



THE 26TH POLISH MALACOLOGICAL SEMINAR

SEMINAR REPORT

I have been writing our Seminar reports for 12 years now. Always everything, I mean the Seminar and the writing, goes very well. Now the situation is a bit different – I always praise the Seminar organisers, this Seminar was the work of our team from Wrocław, and it is difficult to praise yourself. Diplomatically, I will try to avoid doing so, and praise my co-organisers instead.

The Polish Malacological Seminar, our annual event always attracting many malacologists from Poland, and – since recently – some foreign guests, this year took place in Kudowa-Zdrój, on April 20th–23rd. It was the 26th Seminar (more than a quarter of a century of annual meetings!). Kudowa is located in the Stołowe Mts, a very beautiful part of the Sudetes. Surprisingly few malacologists had been there before (or so they confessed). We all stayed in a big and nice hotel called Villa Sanssouci [French for “without a care” or “without worries”], which for the occasion became entirely malacological, with no other guests. We also had our meals and held our sessions there.

The organising institution was the Association of Polish Malacologists; the organising committee included (alphabetically) Tomasz Kałuski (Poznań Institute of Plant Protection; the only non-Wrocław organiser), Elżbieta Kowalska, Tomasz K. Maltz, Beata M. Pokryszko and Małgorzata Proćków (all from Wrocław). TK, being the Association treasurer, dealt with registration fees and some bills, and found a cheap printing shop to print the Abstract Book. EK was the Seminar secretary and dealt with correspondence. TKM did most of the editing of the Abstracts and produced the badges, and MP was responsible for the excursions; all the Wrocław team participated in putting together the programme. Thank you all! You were great! I (BMP) only manipulated everybody else into organising the Seminar, and negotiated with the hotel and the glass shop that produced the snail tankards. The Seminar was financially sponsored by the Natural History Museum, Wrocław University (director Tadeusz Stawarczyk), the Faculty of Biological Sci-

ences, Wrocław University (dean Wiesław Fałtynowicz) and the Institute of Biology, Wrocław University of Environmental and Life Sciences (director Joanna Mąkol). The National Park of the Stołowe Mts sponsored us in a different way: they provided National Park folders, pens, poster boards and a very interesting lecture (see below). They also organised a stall where we could buy various National Park publications. Thank you, sponsors! Two people contributed to the organisation unofficially: Andrzej Witkowski, and Lech Witkowski, both born in the Stołowe Mts; they put us in touch with the hotel and the glass shop. A group of people who deserve thanks includes also this year’s chair persons (alphabetically again): Anna Abraszewska, Jerzy Błoszyk, Andrzej Falniowski, Andrzej Lesicki, Krzysztof Lewandowski, Andrzej Samek and Elżbieta Żbikowska.

The organising process was difficult, or maybe we had managed to forget how difficult such things could be... Many participants kept changing their decisions till the very last moment: whether to arrive on Monday or on Tuesday, have a lecture or a poster, etc. We also had to send some special letters threatening people not to include their abstracts in the Abstract Book if they did not submit them before (or not very long after) the deadline. Please, please, every future participant, each time you have difficulties to choose among Monday, Tuesday, lecture, poster, double room, single room, vegetarian or pork diet, remember the last time YOU organised a meeting and do not do to the Organisers what your participants did to you! Anyway, the final list of participants (morning of April 19th) included 53 people. Some of them could not come, though – to be fair – with very few exceptions they either let us know in advance, or could not come for reasons entirely beyond their control. We regretted it because most of them were old friends. Those who usually attend, and who let us know in advance and could not come for health or work reasons were (alphabetically) Stefan W. Alexandrowicz, Andrzej Piechocki, Grażyna Pyka, Adolf Riedel, Anna



Photos – guess which is which: Where we stayed. Banqueting. Snail on the Seminar tankard. Dripstones in the cave. On top of Mt. Szczeliniec. Krzyś telling us about the cave. Cave bear. Cribbing from a poster? President & Secretary during prize-giving ceremony. The tallest participant. The smallest participant. Photos A. SULIKOWSKA-DROZD & B. M. POKRYSZKO



Stańczykowska, Tomasz Umiński and Andrzej Wiktor. A snail card with Seminar greetings was sent to each such person. One person who could not come for very unusual reasons was Robert Cameron whose plain refused to fly because of the volcanic cloud generated by one of the Iceland's volcanoes. Instead, some people came unannounced or as a "last minute offer". Some, as usual, arrived late or left early. In all, at the maximum population abundance there were 56 people (including one non-malacological husband and one possibly malacological child, too early to tell), with eight foreign guests from (alphabetically again) the Czech Republic, Germany and Latvia.

The conference gadgets the participants were given were not as many as during the previous Seminar (see *Folia Malacologica* 17 (2009): 73–99). They included a Seminar folder with the Abstract Book, Programme, snail post card and local map, and a snail tankard (see Figure). Everybody got also another folder, from the National Park of the Stołowe Mts, containing national park information, post cards and a national park pen.

Though officially the Seminar started on the 20th of April at noon, a few participants sensibly arrived on the 19th, afternoon or evening. The opening ceremony, with few people attending (apparently those who had counted on arriving on time, had miscalculated), included a few words from the organisers, and a very interesting lecture on the nature, animated and inanimate, of the Stołowe Mts., by Zbigniew Gołąb. The first session (Tuesday, 20th, afternoon) started just after lunch. All of Wednesday was devoted to sessions, then the Association's general assembly, and everybody was looking forward to the first social event: grill party. The grilled things were fine, alas, the weather was both freezing cold and threatening with rain, so we had to grab our sausages, beers etc. and escape to the dining room. The cold weather, but with no rain, continued on Thursday, with two special events. On Thursday morning the Seminar excursion went to Jakinia Niedźwiedzia [Bear Cave] in Kletno, to see the dripstones, fossil mammal bones and the interesting geology of the valley where the cave is situated. Here again our thanks go to our guides: Krzysztof Stefaniak (palaeontologist), Paweł Socha (palaeontologist) and Jerzy Bieroński (geologist), all from Wrocław University. They offered us a very special trip, really science-oriented, not a standard guided tour around the cave. Chapeau-bas gentlemen!

During the general assembly we discussed many problems, among other things the future of the *Folia*. The situation is better than, say, five years ago but we still do not get enough manuscripts. Promises were made by various members of the Association, it is only to be hoped that they will be as good as their word.

Ironically, the weather started improving during the Thursday afternoon session, followed by the

poster session. This time we had 17 posters on the poster list, but actually there were 20, some simply brought unexpectedly by unexpected participants. This year people were very good about their posters: even our Warsaw colleague Dominika Mierzwa, who could not appear in person, managed to send her two posters to us in Kudowa. As a result, not only were the poster boards full, but also some posters were hanging on the doors to people's rooms.

The committee elected especially for the purpose of fishing out the best lectures and posters by young authors worked all the time.

On Thursday evening during the banquet we were given a real grilled pig with various salads and various kinds of booze. Prizes for the best young malacologists' presentations were given. Their presentations, both lectures and posters, were all good and the prize committee decided not to distinguish between the first, second etc. prize. The prizes went to Magda Marzec (two lectures on life history of *Bulgarica cana*), Roksana Socha & Ola Skawina (one oral presentation by the two of them, one poster by Ola, both about unionids) and to the two youngest participants, Anna Grochowska & Katarzyna Janas. They are students from Warsaw University of Life Sciences, and their poster was about new localities of *Vertigo angustior* (they also disclosed their very recent discoveries – new sites of *Vertigo moulinsiana*). Good girls! The prizes were tiles, like the ones you put on your kitchen or bathroom walls, each with a snail painted on it. The Association is still unable to afford valuable prizes, but after all it is the glory that counts. We also liked some presentations by "old" malacologists, but the poor oldies never get prizes. The good ones were the two by the team Magdalena Szarowska & Andrzej Falniowski, about phylogenies of freshwater snails, two *Dreissena* presentations by Jarosław Kobak (one with co-authors), and two clausiliid presentations by Anna Sulikowska-Drozd & Tomasz K. Maltz, together or separately.

Now to the scientific contents of the Seminar – the problems presented and discussed. First, some simple statistics. There were 30 oral presentations and 20 posters; it is a very good proportion, allowing enough time for discussions, excursions and banqueting. The snail:bivalve ratio was 2.33:1 (2.35:1 in 2009, for more ratios from earlier years see *Folia Malacologica* 2006 to 2009), the land:water ratio 1.5:1 (0.94:1 in 2009), and thus the snails and bivalves have not changed positions very much, but the land is gaining importance. The ratio of one-author presentation to presentations with two or more authors was 0.85:1, and the ratio of papers/posters presented by girls versus boys was 1.88:1.

The table contains more statistics, with the presentations divided into categories corresponding to various branches of malacology. It is always necessary to assign some presentations to more than one category.

No.	Discipline	Number of papers/posters				
		2006	2007	2008	2009	2010
1	Ecology	9	20	25	18	14
2	Life histories	9	7	7	8	10
3	Conservation	7	2	4	7	4
4	Fossil molluscs	5	6	4	4	3
5	Applied malacology	4	2	5	4	8
6	Parasitology	3	3	6	4	2
7	Faunistics	2	2	4	5	9
8	Methodology	2	3	0	2	0
9	Physiology	2	1	0	1	3
10	Structure (histology, cytology, shell)	2	0	0	5	1
11	Variation	0	2	3	1	1
12	Systematics	2	2	4	3	2
13	Molecular genetics	1	3	1	3	1
14	Collections	0	0	3	1	2
15	Others (general, behaviour, archaeology)	2	3	3	5	2
16	History of malacology	0	0	0	2	1

As last year, the numbers do not show any obvious trend. Ecology and various aspects of life histories are still the most popular topics (or maybe the life history lobby is even growing slowly, which would be good). The apparent slight growing tendency for applied malacology and faunistics may be deceiving, we shall have to wait till the next Seminar to see if the trend continues. Many categories (3, 4, 6, 12, 13 in the table) have remained relatively constant for the last five years, whereas collections and history of malacology as topics for papers/posters have appeared only relatively recently.

We still are not sure who will organise the next Seminar and when and where it will take place, but

there are rumours that that the Toruń people have volunteered (or been volunteered) to do it.

The abstract below have, as usual, been translated, abbreviated, and generally tweaked and messed about with behind their authors' back, by the author of this report.

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ABSTRACTS OF THE 26TH POLISH MALACOLOGICAL SEMINAR, KUDOWA-ZDRÓJ 2010

POPULATION STRUCTURE OF UNIONIDS IN THE MIDDLE PILICA RIVER AFTER 10 YEARS

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The 1998 data and results of 2008 field studies were used for the analysis. The material included 1,059 bivalves of 1998 (15 sites) and 2,944 of 2008 (21 sites). All six unionid species were present in both periods. *Unio tumidus* and *U. pictorum* were common and abundant. The density of *U. pictorum* was maintained at 18 N/m²; its mean biomass increased seven times

and in 2008 it was 4,417.6 g/m². The density of *U. tumidus* decreased twice, to 34 N/m², at the same mean biomass of 2,200g/m². *Anodonta anatina* remained common but not abundant; its mean density decreased from 4.5 N/m² to 0.8 N/m², and the mean biomass from 207.1 g/m² to 28.1 g/m². The condition of *U. crassus* improved; in 2008 the species was transferred from the category of rare and recedent to common though unabanadant. Its mean density increased from 0.5 N/m² to 1.4 N/m² and the biomass from 28.8 g/m² to 49.5 g/m². The abundance and frequency of the rare and protected *Pseudanodonta complanata* and *A. cygnea* decreased. Size structure of unionids after 10 years was compared for the site

Maluszyn. ANOVA showed statistically significant changes ($p < 0.0001$) in the mean shell length of the analysed species. The mean length increased for *U. pictorum* and *U. tumidus* (e.g. *U. pictorum* from $72.8 \pm \text{SD} 7.8$ mm to $81.3 \pm \text{SD} 13.7$ mm), and decreased for *U. crassus* and *A. anatina* (for *U. crassus* from $65.5 \pm \text{SD} 7.8$ to $52.8 \pm \text{SD} 12.0$ mm). Condition of four common species was compared based on the weight regression on shell length. For samples of *U. tumidus* and *U. pictorum* of 1998 and 2008 the growth curves of exponential character were very similar, indicating a good condition. The condition of *Unio crassus* improved compared to 1998. The rectilinear course of growth curves for *Anodonta anatina* in both periods indicates a poor condition of the Pilica population, expressed as smaller body mass in relation to potential shell length.

MALACOFAUNA OF CARBONATE OUTCROPS OF THE MIECHÓW UPLAND

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The Miechów Upland is a part of the Małopolska Upland macroregion. The area is located between the Mesozoic edge of the Świętokrzyskie Mts and the Upper Carboniferous Upper Silesian Basin. The bedrock is of Mesozoic origin, composed of chalk, chalk marls and limestones, and covered by a layer of loess, and in places by loams and loamy sands. Cretaceous formations crop out in many places. The soils and climate favour agriculture. The geological structure, soils and mild climate have contributed to the development of a rich geocosystem. Terrestrial gastropods of the Miechów Upland are little known. Gastropods were sampled in the nature reserves Wały, Dąbie and Złota Góra. The floristic reserve Wały and steppe reserve Dąbie are covered by *Inuletum ensifoliae* and sparse scrubs. The reserve Złota Góra holds thick *Peucedano-Cervariae-Coryletum* and *Tilio-Carpinetum*. The first two nature reserves are special protection areas within Natura 2000; they are under active protection. In Złota Góra, where active protection of xerothermic swards has been abandoned, plant and gastropod succession is rapid. Twenty five gastropod species were recorded in 2008; no dominance structure has developed in the malacoenosis from Złota Góra yet. Numerous natural localities of *Cecilioides acicula* and *Chondrula tridens* were found. The species composition, structure, ecological and zoogeographical composition of the malacoenoses justify further studies on the malacofauna of the area which a part of species migration route.

NEW RECORDS OF *EUCONULUS ALDERI* (GRAY, 1840) IN THE ŚWIĘTOKRZYSKIE MTS

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The distribution of *Euconulus alderi* (Gray, 1840) is poorly known. The species is regarded as Holarctic and has been recorded from the Czech Republic, Slovakia, Scandinavia and United Kingdom. In Poland it is known to occur in the Pomeranian Lakeland, Mazurian Lakeland, Wielkopolsko-Kujawska Lowland and Lower Silesia. *E. alderi* lives in marshes, swamps, fens and wet meadows. In the Świętokrzyskie Mts it was first discovered in 2009 on the south-eastern Mesozoic edge, on Jurassic and Triassic limestones. Single specimens were found in the special protection areas of Natura 2000, Ostoja Żyznów and Dolina Kamiennej. In Ostoja Żyznów *E. alderi* inhabits a wet sedge bed in a depression, where it co-occurs with *Vertigo angustior*. Dolina Kamiennej holds two areas with *E. alderi*: in Wólka Bodzechowska and Kunów. The two fens harbour rare plants, such as *Epipactis palustris*, *Glyceria* and *Carex*; the habitat is favourable for *V. angustior* which is abundant there.

COMPUTER-BASED ASSESSMENT OF POPULATION ABUNDANCE OF *HELIX POMATIA*

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The paper presents computer-based ways of estimating the abundance of *Helix pomatia* and assessing the proportion of the most favourable habitats in communes, counties and voivodeships. The population size and abundance, as well as size and age structure, were estimated based on field studies, and then actual population parameters were determined using orthophotomaps. The population around a lake near Mogilno (Kujawsko-Pomorskie voivodeship) was used as an example. The length of the lake's shoreline is 9,968 m; width of tree row on the scarp around the lake 30–180 m. The resulting area potentially inhabited by the Roman snail is 56.5 ha. The snails were present in all 50 control sites. The mean population density based on the number of specimens collected from 10 monitoring plots was 35.6 indiv./are, with 14 adults exceeding 30 mm per are. Assuming an even distribution in the area of potential occurrence (which is unfortunately a rare situation) the total

population abundance can be estimated as ca. 201,140 individuals, commercial-sized specimens constituting about 20% (ca. 40,228 individuals). The total biomass of commercial-sized adults can be estimated as ca. 1,006 kg. Harvesting 200 kg of Roman snail per year (20% of the population) would not have a deleterious effect on the population. We also describe procedures of locating and estimating the proportion of preferred Roman snail's habitats using GIS system.

FOREST SNAIL FAUNAS FROM GEORGIA: DIVERSITY IN A PLEISTOCENE REFUGIUM

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Together with N.E. Turkey, Georgian Transcaucasia was the only part of the western Palaearctic region to hold large areas of moist temperate forests throughout the Pleistocene. Its forest snail faunas have therefore had millions rather than thousands of years to develop *in situ*, in contrast to most of Europe or the semi-arid Mediterranean region. We sampled in 30 forest sites from the Black Sea coast near Batumi to Lagodekhi on the border with Azerbaijan. We found 90 species of snail overall. In general, species richness at individual sites was low, significantly lower than in similar forests in C. Europe. Turnover among sites was higher, but related only weakly to distance. There are spectacular local radiations especially among Clausiliidae and *Leiostylax*. Species distributions are patchy. There is not much allopatric replacement as seen in Mediterranean conditions, and up to five *Leiostylax* species can be found in the same site. Rare species often occur in a few widely separated sites. Nearly two-thirds of the species found also occur in Turkey, and around a quarter of them are known from Europe. The pattern is rather like that seen in wet subtropical regions. As with some other "refugia" rather few species seem to have spread elsewhere since the last glaciation, and small species (except *Leiostylax*) have spread more widely than large ones.

STRUCTURE OF DIGENETIC TREMATODE ASSEMBLAGES IN POPULATIONS OF *LYMNAEA* *STAGNALIS* FROM SELECTED LAKES OF THE BRODNICKIE LAKELAND

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Heterogeneous environments offer diverse biotic and abiotic conditions, determining the distribution of organisms and resulting in disjunct populations. Such fragmentation in the case of free-living animals is effected only through external environment; in the case of parasites it is also determined by an array of intermediate and ultimate hosts. For obvious reasons studies on the structure of parasite populations are limited to analysis of mono- or multi-species assemblages within environments of the first or second order. Our aim was a qualitative analysis of xenocommunities of digenetic trematodes in populations of *Lymnaea stagnalis*, considering seasonal dynamics of infection. From May till September 2008/2009 936 snails were collected in lakes Bachotek, Strażym and Zbiczno. Infection extensity ranged from 27.0 to 42.9%, depending on the lake. The highest prevalence was noted in August and September 2008 and in May and June 2009 (except lake Zbiczno, where the maximum infection was observed in September again). The dominant trematode species was *Diplostomum pseudospathaceum* (frequency in 30 samples – 93.3%). Its proportion in the xenocommunities was 44.1 (Strażym), 50.0 (Zbiczno) and 62.9% (Bachotek). Faunistic similarity (Sørensen) ranged from 66.6% to 76.9%. Among the 17 trematode species recorded, the following were common to the studied xenocommunities: *D. pseudospathaceum*, *E. aconiatum*, *H. conoideum*, *O. ranae*, *P. elegans*, *S. inermis* and *T. szidati*. The Shannon-Wiener (H') species diversity index for the xenocommunities was 1.28 (Zbiczno), 1.22 (Bachotek) and 1.67 (Strażym).

CONDITION OF POPULATIONS OF THE SNAILS OF THE GENUS *PARTULA* AND PROBLEMS OF THEIR EX SITU PROTECTION

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Partulidae are endemic to the Pacific Islands. The family comprises the genera *Eua*, *Partula* and *Samoana*. The most speciose genus *Partula* includes about



100 species. They inhabit the islands of southern Pacific, often living at high altitudes in volcanic regions, or in lower-situated forested areas. All require high humidity and feed on decaying vegetation. Because of introduction of *Achatina fulica*, followed by introduction of a predator which was supposed to reduce its numbers, *Euglandina rosea*, populations of *Partula* decreased rapidly. Transformation of natural habitats, especially deforestation, leading to physico-chemical changes, is a serious threat. Because of small distribution areas, as many as ten members of the genus are red-listed worldwide as "extinct in the wild". At present their populations are preserved only in zoological gardens and university laboratories, with the aim of reinstating them in the wild. The Poznań Zoo has been keeping *Partula* since 1994. The stock material comes from the culture of the Zoological Society of London. Now the Poznań Zoo keeps *Partula mirabilis*, *P. suturalis strigosa* and *P. hebe bella* (70% of the world's population). The high mortality, especially of juveniles, made it necessary to investigate the reasons for this situation. Comparative studies on the snails kept in different institutions were started; the diets and microclimatic conditions, as well as maintenance procedures were compared. The previously underestimated role of microorganisms associated with the snails' alimentary tract was brought to attention. The studies in Poznań include analysis of faeces, assessing the total abundance of bacteria with special reference to Enterobacteriaceae, *Salmonella* and Lactobacillaceae. An attempt will be made at detecting pathogenic protozoans and a profile of Volatile Fatty Acids will be made.

GASTROPOD SPECIES COMPOSITION AND ATTRACTIVENESS OF GASTROPOD BAITS IN ALLOTMENT GARDENS

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Owners of allotment gardens often have to face the gastropod problem. During humid and warm summers gastropods reproduce fast and feed on practically all plants, damaging leaves, flowers and fruits and detracting from their value. Too great numbers of gastropods may amount to a plague and destroy many plant species, much to despair of the garden owners. One of the ways of decreasing the gastropod numbers is the use of various baits and traps. The aim of the studies was to ascertain the gastropod species list for private allotment gardens and to compare the effectiveness of traditional molluscicides, beer traps and cat food.

RADIATION AND PHYLOGEOGRAPHY OF *BYTHINELLA* FROM CENTRAL EUROPE TO THE BALKANS

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Pleistocene glaciations have shaped the species composition and genetic structure of the fauna of Northern and Central Europe. Till recently it was understood that the fauna had survived in a few large south European refugia, the largest of them being the Balkan area, while only extremely cold-loving species never left the northern areas during the Ice Ages. The genetic structure of northern areas, shaped by the recent migrations from the southern refugia, is considered in opposition to that of south European populations, which are supposed to be old and stable. *Bythinella* inhabits springs; its range extends from southern Poland to the very south of the Balkans, and from the Pyrenees to the Caucasus. We compared radiation and phylogeography of the genus in Romania, Greece, Poland and Slovakia. The greatest species diversity was observed in the Balkans but it decreased in southern Greece. Interspecific differences were greater in Romania (with its probably numerous local refugia during the last maximum glaciation, and speciation-favouring habitat fragmentation), than in Greece where the whole history of *Bythinella* was probably 2–3 million years. During the whole of Pleistocene Greece was probably inhabitable for the snails, but also there the climatic conditions varied greatly. At the same time the genetic structure of *Bythinella* populations, from Poland to the south of Greece, is similar everywhere; despite the low gene flow (though cases of remote passive transport have been reported) the inter-population differences match the model of distance isolation, while consecutive populations are characterised by instability, frequent local extinctions and recolonisation.

MOLLUSCS OF FLOODPLAINS OF THE WARTA RIVER NEAR KRAJKOWO

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Aquatic and terrestrial mollusc communities of patches of high sedges in the Warta River, its oxbows and other water bodies in the habitat protection area of Natura 2000 – Rogalińska Dolina Warty (PLH300012) – were studied from April to Septem-

ber 2008, in 30 terrestrial sites (tall sedge patches) and 33 aquatic sites (30 stagnant water bodies and 3 sites in the Warta River). Sixty three species were recorded: 31 species of aquatic snails, 21 terrestrial gastropods and 11 bivalves. Two of the species are included in Annex II, EU Habitats Directive (*Anisus vorticulus* and *Vertigo moulinsiana*), four are protected in Poland and 14 (including protected and "Natura 2000" species) are red-listed. The terrestrial malacocoenoses are not very rich (1–11 species), compared to the aquatic ones (1–18 species). Aquatic habitats of the area are malacologically valuable on the regional scale, especially because of the occurrence of *Anisus vorticulus* and the relatively high number of species. Except for two sites, there are no malacologically valuable terrestrial habitats. The main threats to the valuable aquatic and terrestrial malacocoenoses are intensive mowing of floodplains and decreased level of surface waters. The studies were financed by Aquanet SA and partly within the grant MNiSW no. N N304 3400 33.

NEW LOCALITIES OF *VERTIGO ANGUSTIOR* IN THE SOUTHERN PART OF MAZOVIAN VOIVODESHIP

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Vertigo angustior, a member of Vertiginidae, is one of the most valuable snail species in Europe. It is included in Annex II, EU Habitats Directive of the programme NATURA 2000 and is red-listed in Poland (EN category). In Poland it is relatively rare, sporadically found in the entire country. *V. angustior* is stenocious. Drainage, eutrophication, intensive grazing and other kinds of anthropogenic ingerence cause a decrease in the number of its localities in entire Europe. The knowledge of its occurrence in Mazovian voivodeship is insufficient; when this study started only one site was known, located in the Kampinos Forest, as well as a few historic sites. Field studies were conducted in 2007–2009 in selected areas in the southern part of Mazovian voivodeship. The material was collected from August till November. The snails were collected directly from plants; samples of substratum including plants were also taken and snails were extracted in the laboratory. The snails were most often found on the sedges, reed and decaying leaves of e.g. alder. The study revealed three new localities of *V. angustior* near the village of Molendy in the central part of Kozienice Forest, in Podeblocie between Maciejowice and Trojanów, and near Solec on the Vistula River. All the localities were damp and exten-

sively used. Finding *V. angustior* indicates a high value and stability of the sites.

REPETITION AND REPEATABILITY OF MATING BEHAVIOUR IN THE SLUG *DEROCERAS PANORMITANUM*

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In *Deroceras panormitanum*, we know that one mating can suffice to fertilise eggs in multiple clutches, but that animals will remate again a few days after their first mating, and on average gain fecundity as well as paternity from doing so. Here we investigate whether animals will continue to remate multiple times. Laboratory-bred virgins were allocated a partner (always an albino with a wildtype, so as to facilitate individual recognition) and given the opportunity to mate with this partner every three days until one partner died. We noted down precourtship behaviour and the timing of the sarcobelum eversions, and video-recorded the copulation. Out of 20 pairs, 14 mated successfully. In these 14 pairs, the mean number of matings was 9, with a maximum of 17. We have attempted to relate mating behaviour and the probability of remating to the number of previous matings, the interval since the previous mating, and egg production. One conspicuous difference from our earlier experiments was the much longer durations of the copulations. We have also analysed the repeatability of mating behaviour, examining both whether the individuals of a pair differ consistently in their roles, and in what respects pairs differ consistently in their behaviour.

EVOLUTION OF LIFE STRATEGIES OF FRESHWATER SNAILS

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Life histories show an array of physiological, morphological and behavioural adaptive features. The main life history characters are body size, maximum life span, growth rate, age at maturity, size and number of offspring, parental care or its absence, semelparity versus iteroparity. Organisms which stop growing having reached ultimate body size, and start reproducing, are usually annual. Organisms of indeterminate growth, with growth rate decreasing with age, are long-lived and their fecundity is correlated with the body size. This strategy matches seasonal changes in the environment. Life cycles of freshwater snails show differences in three main points:

semelparity versus iteroparity, few large eggs versus many small eggs and hermaphroditism versus separate sexes. Most freshwater snails of temperate zone are annual and semelparous. Most marine and terrestrial species are iteroparous and perennial. Freshwater species must have evolved from first marine and then terrestrial ancestors and produced an array of freshwater adaptations. One is a switch from semelparity to iteroparity and ovoviviparity. This strategy provides protection for the offspring; its success depends on survival of the adult through the reproductive period. Once snails invaded freshwaters, they started producing larger and fewer eggs, though the size and number of eggs vary widely. The variation may result from phylogenetic constraints. For example non-ovoviviparous prosobranchs produce small eggs. This might suggest inability to produce larger eggs and explain adopting ovoviviparity by many freshwater prosobranchs.

MALACOFAUNA OF THE KRĄPIEL RIVER

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The survey included the lower section of the Krąpiel River, between the village Pężino and the Ina River mouth; the Ina is the right-bank tributary of the Odra River. The length of the river is ca. 70 km, the studied section is ca. 18 km long. The lower section of the Krąpiel has a montane character, with swift current and mostly sandy or sandy-muddy bottom. Because of its natural values the lower section of the Krąpiel River is protected as an area of special habitat protection within Natura 2000. Five sites were selected, and molluscs were sampled in three subsamples for each. A total of 30 mollusc species were recorded: 18 snails and 12 bivalves. *Theodoxus fluviatilis* dominated among the snails, constituting 28.4% of all snails. Subdominants were *Bithynia tentaculata* and *Lymnaea peregra*, constituting 15.3% and 11.7%, respectively. *Sphaerium corneum* (38.1% of all bivalves) dominated among the bivalves. Subdominants were *Pisidium amnicum* – 20.5% and *P. casertanum* – 11.4%. The occurrence of the red-booked and legally protected *Unio crassus* was confirmed.

THE EFFECT OF TEMPERATURE ON FEEDING ACTIVITY OF THE INVASIVE SLUG *ARION LUSITANICUS*

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Arion lusitanicus comes from the Iberian Peninsula and is a pest of cultivated plants. Because of its fast spread and being a pest, in Poland it is regarded as invasive. Our studies aimed at estimating the effect of air temperature on feeding of *A. lusitanicus* and on the size of damage it does to rapeseed plants. The tests were conducted in the laboratory, in different conditions of air temperature (1, 4, 8, 12, 16 and 20°C) and soil humidity (11%, 33% and 50%). Eight seedlings of Kana rapeseed planted in separate vials were placed in each container half filled with soil. Two slugs of mean weight 1.89 g, starved for the previous 48 hours, were placed in each container. During subsequent 12 days plant damage was assessed according to a five-degree scale (0, 25, 50, 75 and 100% damaged plant surface). Five replicates were made for each combination. The results were statistically analysed with variance analysis and Tukey's procedure at significance level $\alpha=0.05$. The feeding activity as well as the degree of plant damage decreased with air temperature. Soil humidity had no significant effect. Significant differences in plant damage were observed already on the first day of feeding. During the whole observation period plants were the most damaged at 20°C and 16°C. After nine days of feeding the plants at such temperatures were 100% eaten. The smallest damage to the plants was observed at 4°C and 1°C. At the lowest temperature the feeding activity of *A. lusitanicus* was very small, as indicated by the limited plant damage. On the 12th day the damage at 1°C, and soil humidity of 50%, 33% and 11% was: 16.25%, 11.25% and 10%, respectively. This indicates that even at low temperatures the slugs can still feed on the plants, though their feeding activity and plant damage are much smaller.

THE ROLE OF INTEGUMENT IN STICKY LOCOMOTION OF TERRESTRIAL GASTROPODS

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Sticky locomotion, used by terrestrial gastropods, is characterised by tight adherence to the substratum. It is thought that a series of muscle contractions, passing along the sole which adheres to the substratum, makes it possible to accomplish a paradox: simultaneous adhesion and movement. The role of mucus is to increase the adhesion (glue effect) but also to act as a lubricant. We attempted to explain the behaviour of epithelial tissue in sticky locomotion of *Achatina achatina*. We registered the image of the snail's sole during spontaneous movement on a horizontal glass plate with a CCD camera coupled with a computer. We analysed the movement parameters (distance, time, velocity), parameters of sole contractions (frequency, wave length) and changes in the diameter of small air bubbles experimentally introduced under the snail's sole. Based on calculations of dependence between the contraction wave movement on the snail's sole and the locomotion, the factor determining progressive movement is the ability of integument to simultaneously adhere and move. The ability is due to two functional states of the sole epithelium: ca. 70% of the sole adheres tightly to the substratum, and ca. 30% is remote from the substratum and moves as contraction waves. The epithelial surface of the contraction wave is greater than the projection of such surface on the glass plate, and the difference between the two is the "folding", enabling the snail to move forward when the contraction wave has reached the anterior margin of the sole. The progressive movement of the contraction wave is effected through raising a point on the epithelium, moving it, and lowering it onto the substratum in a place which is one "folding value" away from the original point.

THE EFFECT OF SELECTED ACTIVE SUBSTANCES ON THE CIRCADIAN ACTIVITY OF *ARION LUSITANICUS*

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Arion lusitanicus is a serious pest of cultivated plants in the whole of Europe. It comes from the Iberian Peninsula, and was first recorded from Poland in the 1990s. Recently it has been observed to expand its range rapidly. Originally observed only in south-eastern Poland, today it can be found everywhere in the country. The results presented here are a continuation of the studies started in 2008 and partly presented during the 24th Polish Malacological Seminar. The studies were conducted in the laboratory, in a climatic chamber, at 16°C and day length of 12 h. Two slugs were placed in each of the three plastic semi-transparent containers with a 10 cm soil layer. The container surface was divided in four parts: one held a slug shelter, the second – soil sprinkled with the tested active substance (except control), the third – four pieces of Pekingese cabbage soaked in the studied substance, the fourth – pure soil. The studied active substances were: methaldehyde + N-acetylo-L-cysteine 1%; copper sulphate 1%; abamectin 0.2% and methaldehyde 1%. A camera with infrared radiator linked to image recorder was placed in each container. The slug behaviour was recorded during the next 48 hours. The recordings were examined, and the time of particular types of behaviour in each hour noted. The results were analysed with Student t-test, significance level $\alpha=0.05$. The time spent by the slugs in the shelter, time of movement and of immobility differed significantly between the active substances and control; the slugs spent the longest time in the shelter when methaldehyde and abamectin were used; their mobility was the greatest in control conditions. The time of feeding also varied considerably; it was significantly longer in control containers compared to those with copper sulphate and methaldehyde.



FACTORS AFFECTING BEHAVIOUR OF SETTLED INDIVIDUALS OF THE ZEBRA MUSSEL *DREISSENA POLYMORPHA*

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Passive movement of planktonic larvae and their differentiated settling on various substrata are the most important factors determining survival and distribution of adult zebra mussels in a water body. The results presented here indicate that behaviour of settled individuals can be also an important factor affecting the zebra mussel distribution. Behaviour of juvenile and adult mussels was traced from their detachment from the substratum, through locomotion and search for a new attachment place, to settling in the new location. It was found that the most important factors determining the zebra mussel behaviour were: (1) light causing negative phototaxy and limiting activity; (2) gravity, causing negative geotaxy of small mussels in the dark and positive geotaxy of large mussels; (3) presence of conspecifics, stimulating attachment, and (4) presence of predators (large roach), limiting activity and decreasing attachment strength. The results indicate that the mussel behaviour to a large extent depends on the direct or indirect signals of danger from predators. In the absence of such danger the mussels are more mobile and tend to move upward (especially small individuals), which enables them to occupy places on the top of the colony. In this way they can avoid oxygen deficits caused by conspecifics, and metabolic products excreted by them, and compete for food more successfully. When in danger (e.g. predator kairomones or light signalling easier access for predators), the mussels become less active and select shaded places, at bases of submerged objects or among conspecifics, as a result becoming less exposed to predator attacks at the expense of staying in somewhat worse conditions.

PREFERENCES OF PONTO-CASPIAN AND NATIVE AMPHIPODS TO ZEBRA MUSSEL *DREISSENA POLYMORPHA*

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A rapid expansion of amphipods in Europe has been observed since the second half of the 20th c. In the newly invaded areas the amphipods meet the ze-

bra mussel, a bivalve also originating from the Ponto-Caspian region, but present in our waters for more than 200 years. The zebra mussel is capable of modifying its environment to a large extent, and it is likely to have a positive effect on other invasive species which are adapted to life in its presence. To test this hypothesis we studied the association between the substratum formed by live zebra mussel or its shells and two Ponto-Caspian amphipods: *Dikergammarus haemobaphes* and *Pontogammarus robustoides*. For comparison, we tested the dependence between the zebra mussel and the European *Gammarus fossarum*, which encountered the mussel only after its westward expansion. *D. haemobaphes* preferred live mussels, compared to empty shells which were selected more often than stones and smooth substratum. The shape of substratum and the properties of its surface affected the species' preferences. The amphipods did not react to the mussel activities, such as secreting chemicals to the water, byssus production or shell movements. Preliminary results of the studies on the preferences of *D. haemobaphes* to shells of other molluscs (*Viviparus viviparus*, *Helix pomatia* and unionids) suggest that the species may also select habitats with shells of other bivalves. The second Ponto-Caspian amphipod, *P. robustoides*, showed no preference to the zebra mussel. Unexpectedly, the native *G. fossarum* also selected habitats with the zebra mussel, but its preferences were limited to empty shells. It reacted only to the shape of the object and the properties of its surface.

ARACHNIDS (ARTHROPODA: ARACHNIDA) AS NATURAL ENEMIES OF GASTROPODS

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Among the native arachnids, only spiders (Araneae), harvestmen (Opiliones) and mites (Acari) tend to feed on gastropods, and only few taxa show special adaptations to this mode of feeding. There are no specialised gastropod-eaters among spiders. They mainly hunt for arthropods, and gastropods constitute a small proportion of their diet. Only big mygalomorphs, especially those building tunnels to catch prey on the soil surface (e.g. *Atypus muralis*), eat a considerable proportion of gastropods. Gastropod hunting is rare among Araneomorphae but it was observed in several families, e.g. Pisauridae (*Dolomedes*), Lycosidae (*Pirata*) or Araneidae (*Araneus* and *Argiope*). Feeding on small slugs

during long-lasting rainy weather was observed in the case of *Argyope brunneichi*. Gastropods can constitute a significant proportion of the diet of *Meta menardi* (Tetragrathidae), which is associated with the specificity of the habitats (dark caves, tunnels, damp cellars). Most harvestmen eat a wide range of prey, including also gastropods. Two families show an advanced gastropod-eating specialisation: Trogludidae (in Poland several species of the genus *Trogulus*) and Ischyropsalididae (in Poland two species of *Ischyropsalis*). Trogludidae are shell intruders (entering the shells), while Ischyropsalididae have powerful chelicerae to crush the shells or make holes in them (shell breakers). Members of both these families hunt also for slugs. Female *Trogulus* use shells of the snails they have eaten as egg-laying places. Some species of mites of the genus *Riccardoella* are parasites of the lung cavity of terrestrial gastropods. They feed on blood which may limit growth and delay reproduction of the host.

BIVALVES THE IN PALAEOONTOLOGICAL
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The malacological section of the Natural History Collections of the Faculty of Biology, Adam Mickiewicz University, includes a rich material of fossil bivalves. It is represented by structural (shells, internal casts, prints) and trace fossils (mainly rock-borer corridors) from various geological periods. One of the most interesting collections is the one from the Middle Miocene (Badenian) of Korytnica near Kielce (several hundred specimens). The specimens from Korytnica include perfectly preserved complete shells (*Venus multilamella*, *Anadara diluvii*, *Chama gryphoides*, *Crassostrea gryphoides*) and fragments of larger shells (*Pelecypora islandicoidea*), internal casts, sometimes with preserved shell fragments (*Amusium cristatum*, *Cultellus papyraceus*, *Panopea menardi*, *Pelecypora islandicoidea*), prints of Veneridae and rock-borer corridors (*Lithophaga* sp.). Numerous shells bear holes bored by predatory snails. Specimens from Pińczów also come from the Miocene; they include very well preserved shells of *Pecten* (*Gigantopecten*) *latisinus nodosiformis* with attached bryozoans and polychaete tubes. Fossilised bivalves from the collection of Jarosław Urbański (several dozen labelled specimens) are also noteworthy. The palaeontological collections are being systematically examined and catalogued (entered into a computer data base and photographically documented); original labels, sometimes of great historic value, are always preserved.

LIFE-HISTORY IN A POPULATION
OF *SPHAERIUM CORNEUM*

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Reproduction biology of the viviparous freshwater bivalves of the family Sphaeriidae has been attracting attention for more than 100 years. The reproduction mode of the population has been shown to depend both on individual breeding strategies and environmental conditions. In the present study, a population of *Sphaerium corneum* from an artificial mill race subject to irregular changes of water level was investigated using quantitative monthly sampling, paraffin histological sections and chromosome preparations. Unlike most of the previously studied populations of the genera *Sphaerium* and *Musculium*, the one presented in this paper exhibits less synchronised life spans. Despite two main birth periods, many specimens release their broods also individually during the season. An adult usually breeds at least twice in a season. The life span is more than one year, more often one and a half year. All age and length classes are able to overwinter. Spermatogenesis and oogenesis apparently proceed simultaneously from spring to autumn and they occur also in fully developed larvae which are still retained inside their parents' gills. The relationship between the observed breeding strategy and the fluctuations of environment is discussed, as well as the intraspecific and interspecific variation in life-history traits within Sphaeriidae.

DAMAGE TO VARIOUS PLANT SPECIES BY *ARION*
LUSITANICUS MABILLE AND *ARION RUFUS*
(O. F. MÜLLER)

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Arion lusitanicus Mabille, 1868 and *Arion rufus* (Linnaeus, 1758) inhabit human-transformed areas and are serious plant pests. *A. lusitanicus* originates from the Iberian Peninsula, from where it spread to many European countries. It appeared in Poland in early 1990s. Initially it occurred only in the environs of Albigowa (Subcarpathian Region); now it can be found in many localities, mainly in the southern and central parts of the country. It lives synanthropically and occurs in masses in gardens and cultivated fields near human habitations, in shrubland, parks, cemeteries and ruderal habitats. *A. rufus* occupies similar

habitats. It is a West European species, and in Poland its natural eastern distribution border runs through Pomerania, Wielkopolska, Lubuskie Region and Lower Silesia. Recently, patches resulting from its introduction in other parts of the country have been observed. Originally it occurred in forests and open habitats, avoiding managed areas and it did not damage cultivated plants. At present it is a member of synanthropic fauna, found in parks, cemeteries, meadows, gardens and margins of cultivated fields where its populations are very abundant. Both slugs are serious pests of all kinds of cultivated plants. They attack plants at all development stages, but seedlings and young plants are the most susceptible to the attacks. The slugs bite holes in all plant organs, cut off their fragments or scrape off the tissues. The damage decreases the assimilation surface of the plants, causes growth inhibition, and sometimes a complete destruction and thus large crop losses. The degree of damage may vary greatly among various species of cultivated plants because of the specific food preferences of the slugs. Plants of the family Brassicaceae are the favourite food of most slugs. However, other vegetables and other crops are also readily eaten. The aim of our studies was to estimate the rate and size of damage to four different plant species by *A. lusitanicus* and *A. rufus*. The tests were performed in controlled conditions on beetroot, Pekingese cabbage, winter rapeseed and maize, at the stage of 2–3 proper leaves. Symptoms of slug feeding were observed and the degree of damage to the plants during consecutive days of feeding was estimated in no-choice tests; the results were subject to statistical analysis. The least susceptible to slug damage were maize plants, the most susceptible – Pekingese cabbage plants.

SELECTED ASPECTS OF REPRODUCTIVE BIOLOGY OF *ZONITOIDES NITIDUS* (O. F. MÜLLER, 1774) (GASTROPODS: PUMONATA: GASTRODONTIDAE)

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Zonitoides nitidus (O. F. Müller, 1774) is a Holarctic species inhabiting nearly all of Europe. In Poland it is common in the lowlands, less so in the mountains, usually occurring below 800 m a.s.l. It lives in damp meadows, on lake shores and river banks, and in alder carrs. Its life cycle was studied in the laboratory. The material for the laboratory culture originated from Muszkowice near Henryków (SW. Poland). The snails were kept in Petri dishes of a size depending on the number of inhabitants, placed in a climatic chamber

at constant temperature (18°C day and 12°C night) and humidity (80%). *Z. nitidus* lays eggs on leaves, in the soil, moss or rotting wood – also adults are associated with these substrata. The eggs, calcified, ca. 1 mm in diameter, are laid both by individuals kept in pairs/groups and those kept singly since early development stages. Their number per batch is 2–30 (mean 8). Most individuals produce one batch per day. The incubation period is 13–31 days (mean 18); the hatching is asynchronous. The hatchlings have shells of 1.4–1.9 whorl (mean 1.57). The snails reach maturity in 3 months. Egg cannibalism by juveniles and adults was observed.

SEASONAL CHANGES IN AGE STRUCTURE OF A POPULATION OF *BRADYBAENA FRUTICUM* (O.F. MÜLLER, 1774)

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Bradybaena fruticum (O.F. Müller, 1774), an Eastern European snail, is euryoecious. It lives mainly in damp places with lush herbs, in sparse deciduous forests, shrubland, on river banks, in parks and on wet meadows. It is usually found crawling on plants or inactive, stuck to the underside of large leaves. Our field observations, conducted from May to November 2009 in the north-western part of Wrocław, aimed at assessing its age structure. Each month individuals caught during 2 hours “by eye” from a forest plot of about 20 m² were marked. The number of snails caught on each occasion varied from 40 to 131 (total of 581). Whorls were counted and each snail was marked with nail varnish in a way allowing for increment reading on recapture, and released. Eight age classes were distinguished: 7 immature and 1 adult. The smallest snails, representing the two youngest classes, occurred from July till November, suggesting that in the wild *B. fruticum* laid eggs throughout the vegetation season. The earliest hatched snails reached four whorls in the same season; most juveniles wintered over when their shells had 2.6–3.5 whorls. The mean time required to form one whorl in juveniles (first growth stage) was 20–30 days (1–1.5 whorls per month). Adult size was reached in the next season. Snails of the oldest age class were present during the whole season, but were the most numerous in July and August.

UNIONIDS OF THE KRUTYNIA RIVER (MAZURIAN LAKELAND)

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Krutynia is among the main rivers of the Mazurian Lakeland; it flows through about a dozen lakes and after ca. 100 km falls into Lake Będany. It is an important canoeing trail running through protected areas: three nature reserves and the Mazurian Landscape Park. The bivalves were surveyed in 2008–2009. Samples were taken three times from 10 constant plots distributed roughly evenly from the source section to the mouth. The bivalves were identified in the field; their age and size were assessed and they were released into the river. A total of 764 unionids were collected, representing six species. *Unio tumidus*, constituting 65.6% of all bivalves was the most abundant species. *Anodonta anatina* (16.5%) and *U. pictorum* (10.3%) were less abundant. The least frequent were *A. cygnea* (5.2%), *U. crassus* (1.6%) and *Pseudanodonta complanata* (0.8%). The maximum unionid density in the Krutynia was 80–120 indiv./m², the maximum biomass locally exceeded 2.5 kg/m². Literature data from 50 and 100 years ago indicate the presence of the same unionid species in the Krutynia, testifying to stable environmental conditions in the river.

CURRENT PROBLEMS OF SNAIL FARMING IN POLAND

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The Polish heliciculture has been developing for 20 years, but it still remains a new branch of alternative production. The alternative production (EU nomenclature) pertains to animal breeds and species which in some countries and regions are real alternatives to the previous models of agricultural economy dominated by standard breeds, crosses and lineages of pigs, cattle and poultry. Products derived from rabbits, water fowl, carp, rainbow trout, sheep or snails represent a negligible proportion in the country's animal production. Since industrial production of the standard animals, constituting the food basis of European nations, has long exceeded the upper limit of demand, many European countries are beginning to support attempts at increasing variety and improving culinary quality of animal products. The most recent example is the EU help programme for supporting production of poikilothermic animals, such as fishes and snails. A part of the public opinion in Poland, journalists included, reacted in a satirical way which

had a positive effect, namely that snail production became the focus of attention for at least a moment. Not all realise that large farms of *Helix aspersa* already function or are being established in Poland, with annual production size of 100–170 tons. The snail production technology is obscured by the information noise in electronic media. The number of seriously interested farmers, with the associated range of fodder producers and manufacturers of farming equipment, is gradually increasing. The following problems constitute obstacles: absence of state interest in alternative production, conservative attitude of opinion-forming agricultural circles, which makes financing of studies difficult, lack of branch consolidation, small domestic market. The Animal Husbandry Institute in Cracow is among the few scientific institutions which appreciate the prospects of heliciculture. There is still no unequivocal and updated knowledge of the value and market assessment of the native, farmed populations of *Helix aspersa* in Poland, and no farmer-oriented veterinary, climatological or soil-science studies. The only developed aspects of knowledge are snail keeping technology and feed production. An interdisciplinary help from scientists could contribute to the development of this little appreciated branch of animal production.

HABITAT SELECTION BY *VERTIGO MOULINSIANA* IN THE MARSHES OF THE NIDA RIVER VALLEY: VEGETATION, HUMIDITY AND TEMPERATURE

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Studies on population dynamics and habitat preferences of *Vertigo moulinsiana* have been conducted on the Nida River since 2008 (project MNiSW no. N N304 2367 33 "Occurrence and habitat protection of the snails of the genus *Vertigo* included in the Habitats Directive"). Temporal and spatial changes in the population abundance are monitored; data on the number of individuals and kind of preferred vegetation are collected, with exact mapping and registering of temperature and humidity. Preliminary results indicate that the abundance peak in the discussed area occurs in the summer: June, July, August, with a rapid decline in September. The largest density was observed in damp places with *Glyceria* sp. and *Carex* sp. The snails seem to spend winter on the plants (all specimens found in the litter were dead), mainly on *Glyceria* sp. and *Carex* sp., and the survival rate through winter mainly results from the number of wintering individuals. The distribution of the species in the Nida River Valley (area from Motkowice to Nowy Korczyn; 40 km section) was also studied based on a network of transects. In spite of abundance of potentially adequate habitats, only one new locality was found.



ANNUAL ACTIVITY OF MATURE GONAD IN TWO MEMBERS OF THE GENUS *VESTIA* P. HESSE (GASTROPODA: PULMONATA: CLAUSILIIDAE)

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Vestia gulo and *V. turgida* are iteroparous and simultaneously hermaphroditic. In the wild they are active from April till October, reproducing in the spring and summer (egg retention from May till August); hibernation lasts from November to March. Studies on the histological changes in the gonad and gamete production in annual cycle were conducted from September 2006 to October 2008. Sexually mature snails of both species were used (maturity criteria: completed shell with developed closing apparatus, developed reproductive system, gonad overgrowing hepatopancreas, black-pigmented and divided into lobes and lobules). Each month gonads were fixed in Bouin solution, paraffin-embedded and cut into serial sections 7 μm thick, stained with haematoxylin and eosin and examined in light microscope. Gonads of both species are the most active in the spring and summer (oocyte maturation – intensive vitellogenesis: March-May, numerous mature oocytes: May-August, spermatozoa production and maturation: March-May, numerous packets of mature spermatozoa: May-October), which coincides with the reproductive period. The onset of reproduction is determined by the adequate pool of vitellogenic oocytes which start to form in the summer of the previous season and mature in the spring of the next season. Mature spermatozoa are present in the gonad from spring till autumn, indicating the ability to copulate throughout the active period. During hibernation the gonads contain no spermatids, mature spermatozoa or advanced vitellogenic oocytes.

FECUNDITY OF *BULGARICA CANA*

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Bulgarica cana was kept in the laboratory from October 2004 till January 2010. Its fecundity was estimated in the laboratory, based on observations of 34 couples of snails. An individual lays the mean number of 23.5 eggs per year. The numbers of eggs produced by the individual in consecutive years do not differ. The eggs are laid in batches (98% eggs; 2% are laid singly); the mean number of eggs per batch is 8.4 (2–29), large batches being rare; 75% of batches contain up to 10 eggs. No uniparental reproduction was observed. The snails are capable of long-term sperm

storage. Snails initially kept in pairs, after the death of their partner retained their ability to lay viable eggs for up to 829 days. *B. cana* is capable of producing eggs throughout the year, but some seasonality can be observed. Individuals which in the laboratory were active throughout the year, showed peaks of egg-laying in February and June. Hibernated snails showed one very distinct peak in April i.e. the first months after hibernation. No differences were observed in the number of eggs produced per year by hibernated and non-hibernated individuals. The hatching success is 86.4%. Egg cannibalism within batches is the reason for mortality of 35.7% of unhatched eggs (4.9% of all eggs). The remaining mortality is attributed to random events (e.g. desiccation), but could result from the maintenance procedures (all eggs were removed from parents' containers and transferred to separate containers). Other factors, such as unfertilised eggs or embryos failing to develop, can not be excluded.

GROWTH RATE OF *BULGARICA CANA* IN THE LABORATORY AND IN THE WILD

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The growth of *Bulgarica cana* in the laboratory was assessed based on 358 individuals hatched in the laboratory. Among them 212 (59.2%) reached ultimate size and typical shell appearance, 31 (8.7%) showed various shell deformations, and 115 (32.1%) died as juveniles. The time required to reach ultimate shell size varied from 4 to 14 months. Juvenile shells upon hatching have the mean number of 2.63 whorls (1.5–3.2), those of adults – 12.42 whorls (11.2–14.0). The mean time required to reach the ultimate size is 6.8 months, and 75% of individuals terminate growth when 8 months old at the latest. There is a significant dependence between the growth time and the ultimate size (expressed as the number of whorls). The time of growth of ultimately larger snails is longer ($r_s = 0.30$ $p < 0.0001$). The correlation is fairly weak and does not explain all the individual variation in the growth duration. Longer growth period is mainly associated with smaller growth rate. The mean growth rate ranges from 2.28 whorls/month for snails completing growth within 4 months to 0.65 whorl/month for those completing growth in 13 or 14 months. Periods of growth arrest occur in 32.9% of individuals. These periods are not responsible for the individual differences in growth periods. The growth rate varies in the course of individual growth. The maximum growth rate ranges from 1.4 to 4.0 whorls/month, the minimum rate from 0.1 to 2.2 whorls/month. The growth assessment in the wild was based on 100 individually marked juveniles (6.8–11.3 whorls at first marking), with 47 recaptures; the time between con-

secutive captures ranged from one week to 22 months. The mean growth rate in the field in the summer (June-September) was 0.67 whorl/month (minimum 0.2 and maximum 1.8 whorl/month). In the winter, between October and May (8 months) the snails did not grow (n=12 snails, i.e. all snails recaptured in that period).

CEPAEA VINDOBONENSIS IN THE NIDA RIVER VALLEY

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In 2002 *Cepaea vindobonensis* was found in the nature reserve Skorocice by Anna Sulikowska-Drozd; the record was then confirmed by Dominika Mierzwa and Andrzej Szymkowiak in 2009. The nature reserve Skorocice (commune Wiślica) is located in the macroregion of the Nida Basin in the Nida Valley. It was established as a steppe reserve in 1960. The morphology of the area is karst-related; the reserve holds erosion-transformed horizontal beds of Miocene gypsum. Besides various petrographic varieties of gypsum, numerous sink holes, rock outcrops and bridges can be observed. The landscape value is enhanced by the Skorotnicki Stream running along the bottom of the valley. The stream is the reason for the live karst relief, with currently forming swallets and vaucluses. Four plant communities exist in the reserve: *Festuco-Brometea* (xerothermic swards), *Molinio-Arrhenatheretea* (meadows), *Phragmitetea* (reed beds), *Rudereto-Secalinetea* (nitrophilous vegetation). Many rare plants occur there: *Adonis vernalis* L., *Stipa capillata* L., *Stipa joannis* Čelak. and *Anemone silvestris* L. D. Mierzwa and A. Szymkowiak observed also *C. vindobonensis* in 2009 in Gacki (commune Pińczów). Gacki are located in the macroregion of the Nida Basin, in the Solec Basin. The landscape of the planned geological reserve results from gypsum exploitation in the 20th c. After the exploitation ceased, the pit was filled with water and is now protected. Like in Skorocice, the species abundance here is low. Other localities in the Nida Basin, reported by earlier authors, include: Pińczów, Skowronno, Łagiewniki – Pińczów Hump; Busko-Zdrój – Solec Basin mesoregion; Maszków, Rzeżunia – Miechów Upland mesoregion.

MALACOLOGISTS IN THE 190-YEAR HISTORY OF THE MUSEUM AND INSTITUTE OF ZOOLOGY, POLISH ACADEMY OF SCIENCES

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The history of the Museum and Institute of Zoology [MIZ], Polish Academy of Sciences dates back to the beginning of the 19th c. when the Zoological Cabinet was established at Warsaw University. During its 190-year existence many outstanding malacologists were associated with the MIZ, contributing to the establishment and development of the institution. Some were Museum directors, others donated their valuable collections and libraries to the MIZ. In 1921–1928 Antoni Wagner was the Museum's director. He donated to the Museum about eight thousand mollusc species from all over the world, and his zoological library. He published numerous taxonomic and zoogeographical papers. Władysław Poliński became curator of the Invertebrate Department in the State Zoological Museum (as the institution was then called); in 1928–1929 he was head of the whole institution. His malacological studies were mainly physiological, faunistic and zoogeographical in scope. He was succeeded by Waław Roszkowski (director in 1929–1935). Roszkowski was interested in terrestrial snails to which he devoted numerous publications. In 1929 Leon Retowski included the malacological collection of his father, Otto von Retowski, in the Museum's collection. After World War II, in 1947–1953 the position of Museum's head was entrusted to the malacologist Stanisław Feliksiak, who already in 1929 was associated with the Museum. In 1929–1945 he worked as assistant in the Molluscan Section, and then was head of the Invertebrate Department. Adolf Riedel became employed as assistant at the Museum in 1949; for the whole of his professional life he was associated with the MIZ. Adolf Riedel was dealing with terrestrial snails, mainly of the family Zonitidae. He was author of numerous valuable anatomical-systematic and zoogeographical papers.

ANTIOXIDATION DEFENCE IN TWO SNAIL SPECIES: *HELIX ASPERSA* AND *HELIX POMATIA*

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Data on mollusc antioxidation defence do not allow for an unambiguous explanation of the antioxidation mechanism in terrestrial snails. Our data on



the Roman snail contribute much new information but depart considerably from such data on *H. aspersa*. We attempted to compare the two species which made it possible to generalise about the biology of terrestrial snails. We studied the mechanism of antioxidation defense in the two species in laboratory conditions during aestivation, just after the aestivation and 24 hours after resuming activity, and in two control groups: snails active in the field and snails active in the laboratory. We could thus answer the question whether the two species showed different defense reactions and whether the differences could possibly result from the experimental conditions. Both species showed the greatest catalase activity when active in the field. The activity of glutathione reductase was higher in the Roman snail, but the transferase activity was higher in *H. aspersa*. The catalase and transferase activity was the highest in the hepatopancreas and the lowest in the foot. The concentration of dimalone aldehyde shows that in both species aestivation and resumption of activity do not cause lipid damage. It can be supposed that the system of antioxidation defense prevents free-radical damage and the level of enzyme activity shows interspecific differences. The two species are characterised by an endogenous regulation of the antioxidation mechanism, but environmental changes can modulate the rhythm. Learning mollusc physiology may help understand the effect of environment and climatic changes on the survival of native species. The studies were partly sponsored by the MNiSW, grant no. N N304 393238. We thank Prof. Maciej Ligaszewski, Institute of Animal Husbandry, for the individuals of *Helix aspersa*.

SINANODONTA WOODIANA IN A NATURAL WATER BODY IN THE BUFFER ZONE OF THE SŁOWIŃSKI NATIONAL PARK

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Sinanodonta woodiana is an alien member of the Polish fauna. It comes from Eastern Asia, and was introduced in Europe in the 1960s with fish species imported from China. Its development requires high temperatures and in Poland it occurs mainly in heated waters, though it has also been observed in water bodies of natural thermal regime. In this presentation we describe a locality of the giant clam in Czarny Młyn, in the buffer zone of the Słowiński National Park, found by us in October 2009. It is one of the northernmost localities of the species. The water body where it occurs is a remnant of a large fish pond complex. It resulted from the damming of a left-bank tributary to the Łupawa River, and later ac-

quired a largely natural character. It has a natural thermal regime, but because of its small depth and dark muddy bottom it heats in the summer. The clam was most probably introduced with fish stocking material. Locally, the population reaches high densities. Shells of many individuals bear ca. 10 annual increment lines, and the mean shell length is 172 mm (n=14). The sample measured by us was collected non-randomly, to acquire large specimens. However, abundance of such specimens indicates that it is a stable population inhabiting the water body for many years. We plan further studies on the population and a search for other populations in similar water bodies of Central Pomerania.

BIOINFORMATIC IDENTIFICATION OF AQUAPORES IN MOLLUSCS

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Water transport across the cell membrane proceeds according to two modes: 1 – free diffusion; 2 – fast transport through aquapores. The results of the last decade studies show that aquapores occur in all kingdoms. They have been very well characterised in mammals, mainly man and mouse. However, till now there are no literature data on their occurrence in molluscs. All hitherto identified aquapores share a common structure. In the cell membrane they function in the form of tetrameres. Their subunits, called aquaporines, are integral proteins of the membrane built of six transmembrane helices and five loops. The amine and carboxylic ends of the polypeptide are located on the cytoplasmic side of the membrane. Each aquaporine contains two – pore-lining – conservative motives, each with aminoacid sequence Asn-Pro-Ala (or Asn-Pro-Val). Two groups are distinguished among the proteins building aquapores, depending on the specificity with respect to transported substances: 1 – aquaporines *sensu stricto*, which transport water molecules and 2 – aquaglyceroporines, which additionally transport glycerol and probably other uncharged molecules, e.g. urea. To identify aquapores in molluscs, we conducted a bioinformatic analysis of available databases with nucleotide and aminoacid sequences of various mollusc species. The search revealed only three sequences corresponding to aquaporines, present in three gastropod species: *Aplysia californica* (J. G. Cooper, 1863) (Aplysiidae, Opisthobranchia), *Lottia gigantea* (Sowerby, 1864) (Lottiidae, Patellogastropoda) and *Lymnaea stagnalis* (Linnaeus, 1758) (Lymnaeidae, Pulmonata). The sequences from *L. gigantea* and *L. stagnalis* were the closest to the human and murine AQP4, while the se-

quence from *A. californica* – to AQP8. Though the aminoacid sequences indicate that the bioinformatically identified proteins are aquaporines, it can be fully confirmed only with laboratory studies. Such studies will also make it possible to understand how the aquapores function and what is their role in the mollusc cell membrane.

FOREST MALACOCOENOSSES OF THE ROMANIAN CARPATHIANS

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In 2009 (14 July–7 August) we sampled forest malacoenoses in six chains of the Romanian Carpathians: Lotru, Buçegi, Retezat, Apuseni, Ceahlău and Maramureş Mts, in 43 sites grouped in 10 localities of 2–6 sites each. The sites, each of 400 m², were spread between 45.30 and 47.89°N and 22.72 and 26.00°E, at 341–1,264 m a.s.l.; they differed in the exposure, inclination, substratum, humidity and plant species composition. We used methods commonly accepted in such studies (collecting by eye during two person-hours, sieving 20 l of litter). The total number of snail species found was 82, the number per site ranging from 19 to 40 (mean 26.93). Considering the size of the area, the total number of species and their number per site did not depart from such numbers in the Polish or Ukrainian Carpathians. The Nei similarity between the sites was not correlated with geographical distance and varied widely, from 0.22 to 0.99, being more varied than in the remaining parts of the Carpathians or in the Northern European Lowland. For example, the similarity between the sites in two neighbouring valleys in the Lotru Mts: Capraret and Lotrioara, a few kilometres away, ranged from 0.60 to 0.74, the range being similar to that calculated for the whole of the Bieszczady Mts. The similarity between the localities showed a similar pattern. Whittaker's index for the studied localities was I_w 3.08, I_{max} 2.08, indicating a greater between-site diversity than in the Polish and Ukrainian Carpathians or the Northern European Lowland, for which I_w was only 1.20–1.88 and I_{max} 1.13–1.44 (for comparison: in the Tertiary relic forests of the Caucasus I_w 5.66, I_{max} 4.29). Small area endemics are responsible for only a small part of this differentiation; only 13 out of the 82 species are limited in their distribution to 1–2 mountain ranges. We associate the differences with the glacial history of the discussed areas. The studied malacoenoses include 47 widely distributed species (European to Holarctic) and 35 Carpathian species s. lat. From the point of view of a Central and Western European malacologist, *Acicula perpusilla*, *Spelaeodiscus*

triaris, *Mastus venerabilis*, *Alopiia livida*, *Cochlodina cerata*, *Hygromia transsylvanica* and *Drobacia banatica* are especially noteworthy. Conclusions about the structure and composition of the studied malacoenoses are not facilitated by the still poor knowledge of the Romanian malacofauna, and the presented results are preliminary.

ASSESSMENT OF POPULATION ABUNDANCE AND DISTRIBUTION OF THE ROMAN SNAIL (*HELIX POMATIA*) IN KUJAWSKO-POMORSKIE VOIVODESHIP

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The Roman snail (*Helix pomatia*), the largest native terrestrial snail, is the only commercially exploited mollusc in Poland. Its commercial exploitation started after World War II. In 1961–1974 the annual export to such countries as France and Germany was about 300 tons. The intensive exploitation caused a decrease in its abundance in some regions already in 1960–1963. The still valid regulations pertaining to the shell size and collecting period were introduced in 1963. However, a reliable control of exploitation of the Roman snail resources is still lacking. Likewise, there are no methods of estimating and prognosing the size of harvest which would not be detrimental to the population. The Roman snail resources were assessed in Kujawsko-Pomorskie voivodeship from May 1st till July 7th 2009, on commission of the Regional Inspectorate of Environment Protection in Bydgoszcz; all the component communes were included in the survey. A total of 6,013 individuals from abundant populations were collected, and the presence of 1,200 snails occurring singly was recorded. Five categories of communes were distinguished: 1) communes with commercial Roman snail resources, 2) communes with rich resources, 3) communes with medium-sized resources, 4) communes with small resources 5) communes where no snails were found. Individuals from each studied population were measured and weighted, and the number of empty shells was noted. The age and size structure of the populations were ascertained, with indication of commercially significant populations. The density of commercial-sized individuals per are was also determined. The single large-area survey does not provide a basis for unequivocal conclusions, but may be of use when planning the number of purchase centres and collection limits for individual communes.



TRIDACNA – THE LARGEST BIVALVES

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Tridacna, the huge marine bivalves, belong to the family Tridacnidae, distinguished by J. G. Bruguière in 1797. The family includes two genera: *Tridacna* and *Hippopus*. The largest species is *Tridacna gigas*, reaching up to 1,500 mm length and a mass of 250 kg. Large species include also *T. maxima* and *T. squamosa*, with the shell length of 350–400 mm. *Tridacna* inhabit extensive areas of the Indopacific, Red Sea and eastern coast of Africa to Polynesia, but the distribution differs among species. The 2008 discovery of a new large species *T. costata* in the Red Sea was a real sensation. *T. costata* resembles *T. maxima*; it is very rare but the situation was different in the remote past. An unusual character of *Tridacna* is their symbiosis with zooxanthellae, unicellular dinoflagellate algae which the bivalve keeps in the mantle. They absorb carbon dioxide arising during calcium uptake from sea water, and emit oxygen, thus improving the bivalve's welfare. They also constitute an extra food source. Because of the symbiosis, the evolution of *Tridacna* involved an increase in the mantle surface and changes in the relative position of body and shell. The huge shell size, especially of *T. gigas*, was admired and marvelled at by man. *Tridacna* shells served as fonts, ornaments in artificial grottos in rococo gardens and the pride of collectors – owners of natural history cabinets in the 18th c. In Far East the bivalves were consumed. Large pearls of irregular shape were sometimes found in *T. gigas*. The Lao-Czu pearl, found in 1934, and called also the pearl of Allah, was among the largest: 240 mm long and weighing 6.4 kg. Its history is long and rather mysterious. The pearl of Elias, found in 1977, is almost as large. The threat to populations of large *Tridacna* suggested the idea of their farming. After many attempts, an array of stations and centres were established in the Indopacific islands, where the farmed individuals serve to re-stock the endangered areas. They also serve commercial purposes: consumption and aquaristics. Large farming centres are located in the Marshall Islands, Tonga and Palau, and on the coast of the Philippines and Indonesia.

SHELL SCULPTURE AND LOCOMOTION OF JUVENILE UNIONIDS IN BOTTOM SEDIMENTS

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All recent members of the order Unionoida have a parasitic stage in the development, the host being

usually fish; upon leaving the host they bury themselves in the bottom sediments. Little is known of the period spent in the sediments and the reasons for burying. The role of juvenile shell sculpture – morphologically different from that of adult shell – is unknown. The difference in sculpture has persisted since the late Triassic. Observations on completely buried bivalves require a translucent medium and layers of sediment with different permeability to X-rays (penetration of the sediment by the animal will leave a trace – mixed layers – visible on X-ray photos). The main aim was to ascertain if there were any behavioural differences between juveniles of strongly sculptured *Unio tumidus*, less sculptured *U. pictorum* and delicately sculptured *Anodonta anatina* (velocity and depth of burying, degree of locomotory activity). In the experiments I used materials which give a large contrast in X-ray photos: quartz sand and aragonite sand. *U. tumidus* and *A. anatina* (a total of 3 individuals of shell length 8–13 mm) were placed in thin-walled aquaria filled with laminated quartz-aragonite sediment and photographed with X-ray camera after 1, 3, 6, 25, 72 hours, and after a week. Thin-walled aquaria filled with silica gel (almost translucent when placed in water) contained juvenile *U. tumidus*, *U. pictorum* and *A. anatina* (a total of 5 individuals of shell length 6–14 mm); their behaviour was recorded for 24 hours during 4–5 days. In both variants: 1) all juveniles of shell length of 6 mm or more did not bury for the depth larger than that required to cover all the shell; 2) the behaviour of the more strongly sculptured species did not differ significantly from that of the poorly sculptured species. The project was financed by the Warsaw University grant BW no. 68–183125.

LATE TRIASSIC TRACES OF ATTACKS OF DIPNOAN FISHES ON BIVALVES OF THE ORDER UNIONOIDA

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Fossil bivalves of the order Unionoida were found in late Triassic deposits in three localities in Opole Silesia. The deposits from Krasiejów and Woźniki, probably of the same age, were dated as ca. 225 mln years, those from Lipie Śląskie are probably much younger, ca. 210–200 mln years. In all the localities the bivalves were mainly preserved as prints and internal casts. Some bore traces of original shell damage: fan-like impressions, scratches, wedges and edge fractures. Their character indicates a pathological origin. Remains of dipnoan fishes (cf. *Ceratodus* sp.) were found in the same deposits – among others their characteristic shield-like teeth. The shell damages match

the teeth of *Ceratodus* in their shape and size. They were probably a result of attacks by the fish. The absence of regeneration traces on the bivalve remains indicates that the bivalves were probably killed by the fish and then buried in the deposit (not passing through the fish digestive system). The occurrence of traces of fish attacks on late Triassic fossil bivalves indicates a commonality of trophic relations in the ecosystems from 225–200 mln years ago.

BIODIVERSITY OF SILESIAN VOIVODESHIP AS EXEMPLIFIED BY MOLLUSC DATABASE OF THE UPPER SILESIAN CENTRE FOR NATURAL HERITAGE

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Biodiversity of Silesian voivodeship is still unevenly known despite the several centuries of scientific studies in the area. The knowledge of recent mollusc fauna is complete only in relation to aquatic molluscs of the central part of the region. The Upper Silesian Centre for Natural Heritage was established in 1992; its aim is to study, document, protect and prognose the state of nature. One of the aims is creating computer databases (recent and historic) on the occurrence of species, objects of inanimate nature and forms of nature protection. The data sources are publications, unpublished papers and observations by the staff and other naturalists. At present the database of mollusc occurrence in Silesian voivodeship (Excel) includes more than 6,500 records of 193 species. Spatial visualisation of faunistic data is done using GIS system, MapInfo programme. The data are used when preparing opinions on initiatives that may affect the environment, applications to protect valuable areas, reports on the state of nature and regional red lists of species and habitats. In 2010 the Centre started preparing the Nature Protection Strategy of Silesian Voivodeship for 2011–2030, which is a part of the country-wide State Strategy of Protection and Moderate Exploitation of Biodiversity, and a contribution to the aims of the Biodiversity Year proclaimed by the United Nations. Data on the occurrence of and threats to species of plants, fungi and animals, including molluscs, of Silesian voivodeship, will be updated in cooperation with specialists.

ORGANISATION OF UNIONID MITOCHONDRIAL DNA

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Vertebrate mitochondrial genomes (mtDNA) are very conservative with respect to their size, number and sequence of genes, as well as maternal inheritance (SMI, Strict Maternal Inheritance). In invertebrates, including molluscs, mtDNA varies widely; bivalves are especially noteworthy in this respect. The bivalve mtDNA variation pertains to the size (from 15,712 bp in *Cristaria plicata* to 32,115 bp in *Placopecten magellanicus*), number of genes (no *atp8* gene and extra tRNA gene for methionine in *Mytilus*) and their sequence, as well as inheritance. A departure from maternal mtDNA inheritance has been detected in six bivalve families (Mytilidae, Unionidae, Margaritiferidae, Hyriidae, Veneridae, Donacidae and Solenidae); it is termed doubly uniparental inheritance (DUI). In the case of DUI the same species has female (F) and male (M) mitochondrial genomes characterised by high nucleotide diversity, in unionids reaching 28–34% for single genes and up to 52% for whole mitochondrial genomes. Besides, F and M genomes in unionids differ in the position of the tRNA gene (*trnH*), inversion of *atp8-trnD* region and the presence in male genomes of additional 185 codons (555 bp) on 3' end of *cox2* gene. Male genomes of unionids are longer and have more numerous non-coding sequences compared to female genomes. Two types of organisation of female mtDNA have been distinguished based on gene sequence: frequent – present in seven bivalve species (first described in *Lampsilis ornata*) and another, found in only two species of the subfamily Gonideinae.

POLISH CONTRIBUTION TO THE STUDIES ON PALAEOZOIC TERRESTRIAL SNAILS

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Though the history of molluscs began more than 550 mln years ago, at the end of the Precambrian, the oldest fossils of terrestrial snails come from as late as Upper Carboniferous and Lower Permian deposits. The first land snails were found in fossil trunks of *Sigillaria* embedded in coal beds in Joggins (Nova Scotia) and in St. John in the region of New Brunswick, in North America. These two localities, and a few other North American formations yielded 12 species of seven genera, three of them being represented also in



Europe. Poland is among the few countries, next to the United States, Canada, United Kingdom, France, Germany, Austria and the Czech Republic, where such fossils were found. The fact that the same forms appeared almost simultaneously in now very remote parts of the world is not surprising, considering that Pangea was formed during the Carboniferous and, as a result of Variscian orogenesis, a large mountain range arose, extending from the Appalachians through southern England, Central Massif, the Ardennes and Harz, to the Świętokrzyskie Mts, and the American and European localities are situated on the same, northern, side of the mountains. In Poland fossils of Palaeozoic snails were discovered in two localities: Upper Carboniferous siderite concretions from the black coal mine Porąbka-Klimontów in Sosnowiec and Lower Permian tufa in Karniowice near Kraków. The sphaerosiderites contained imprints of three shells, but only one was preserved sufficiently well to reconstruct the shell shape. Unfortunately, because of the absence of taxonomic characters the shell could not be assigned to species, genus or even family. In its shell form it is the closest to extant terrestrial prosobranchs Poteriidae or Pupinidae. The studies on the Karniowice tufa started in the 19th c. and already then Zaręczny mentioned the presence of snails in the tufa, though he never examined them. In 1936, based on these materials, Panow described a new species of *Dendropupa* – *D. zarecznyi*. The studies, resumed in recent years within the grant of the MNiSW (E. Stworzewicz, B. M. Pokryszko and J. Szulc – geologist from Jagiellonian University) yielded new materials, with another three species: *Anhtracopupa ohioensis*, *A. britannica* and *Protodiscus priscus*. Due to this discovery the Polish contribution to the studies on Palaeozoic land snails is considerable.

LIFE CYCLE OF *VESTIA TURGIDA* (ROSSMÄSSLER, 1836) – ALTITUDINAL DIFFERENCES

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Vestia turgida (Rossmässler, 1836) is an ovoviviparous clausiliid found in various kinds of habitats in the Carpathians, from the foothills to the alpine zone. The aim of the study was to trace its population dynamics, considering the wide vertical distribution range and the associated climatic differences. The studies included four localities in the Pieniny Mts (Krościenko) and Tatra Mts (Mała Łąka Valley), and used marking-release-recapture method. In each locality snails were collected from an area of ca. 2 m², the shell height was measured, the whorls were counted, the shells were marked with varnish and the

snails were released. Shell increment since the last marking was recorded for each recaptured snail. The observations were conducted from April till October, every 4–5 weeks during two vegetation seasons. A total of more than 3,900 snails were marked; recaptures constituted 12–55% of each sample. *Vestia turgida* has a relatively long reproductive season – juveniles appear from the second half of June till August. During the vegetation season in the Pieniny the juveniles grow on average by 3.3 whorls (maximum increment 6.3 whorl), and in the highest-situated locality in the region of Mała Łąka – by 1.3 whorl (maximum 2.2). In the populations from lower altitudes in the Tatra the mean increment is 2.2–2.7 whorl (maximum 5–5.5). Such growth rate indicates that *Vestia turgida* attains ultimate size in the third (Pieniny, lower altitudes in the Tatra) or fourth/fifth season of life (higher situated localities). The shell growth terminates in late spring and summer. *Vestia turgida* is long-lived – in the Pieniny marked adults live for at least three years.

CAN MORPHOLOGY BE THE BASIS FOR SYSTEMATICS OF RISSOOIDEA?

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Shells of Rissooidea, small snails of world-wide distribution, are characterised by a paucity of systematically useful characters. Useful characters were repeatedly searched for in the soft part anatomy, histology or shell ultrastructure (FALNIOWSKI & SZAROWSKA 1995, WILKE et al. 2001, SZAROWSKA 2006), and not a single character was free of homoplasies. The results of fairly recent molecular studies (WILKE et al. 2001) rendered doubtful morphology-based phylogeny reconstructions. SZAROWSKA (2006) tested an array of morphological characters in the Balkan members of Rissooidea. Mapping morphological characters on molecular tree showed that not a single morphological character provided a basis for credible phylogeny reconstruction. Besides numerous parallelisms and reversals, it was found that the evolution involved several composite structures each of which was a complex of characters in classical sense. In such cases the change (reversible) included the whole structure i.e. all character complex. It seems that all the character states appeared early in phylogeny, to later become lost or re-acquired. This seems to confirm the great significance of regulatory genes in macroevolution, and questions the concept of uniquely derived characters and traditional cladistic coding of characters and their states. The morphology can also be misleading when identifying species: species of Rissooidea may be indistinguishable morphologically, but also

(like in e.g. *Bythinella*) two species may differ or not, depending on the locality.

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VARIATION OF *RUTHENICA FILOGRANA* (ROSSMÄSSLER, 1836) (GASTROPODA: PULMONATA: CLAUSILIIDAE)

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Shell variation in *Ruthenica filograna* was studied based on collections, snails collected from lowland and montane populations and specimens from laboratory culture: in total 1,552 shells from 85 localities (30 populations). Eleven shell parameters were subject to statistical analysis of intra- and inter-population variation (CVA, variance, correlation, dendrogram). The most variable character in natural populations was ribbing (20%). The variation of basic shell measurements was within 5–8%. Most studied populations differed statistically significantly in most shell characters, but the variation ranges overlapped forming a continuum. No population showed variation ranges completely different from those of the remaining populations. High similarity was observed between lowland and montane populations, and populations from different geographical regions. With increasing altitude the number of whorls increased. It seems that the environmental factors enforcing estivation and hibernation, rather than genetic factors, affect the shell size. In all the studied populations the apertural barriers varied, but no apertural barrier pattern was specific to any population or group of populations. Observations of specimens from laboratory and wild populations showed that the apertural barriers in *R. filograna* were phenotypically plastic and could vary under the effect of environmental conditions. Biometrical characters of specimens born and grown in the laboratory were within the variation range of natural populations. No correlation between the growth rate and ultimate size was observed in the laboratory. Fast-growing snails reached ultimately large or small size; the

same was true of slow-growing individuals. The range of *R. filograna* is composed of insular populations with probably very limited gene flow. The snails spend their life in the litter and their mobility is negligible. This may also contribute to large interpopulation differences. In older literature there was an attempt at distinguishing forms withing *R. filograna*: form *transsylvanica* Rossmässler, 1836; form *catarrhactae* Bielz, 1861 and form *polita* M. Kimakowicz, 1883. This study on variation indicates that any such distinction would be groundless.

WHICH FACTORS AFFECT THE ZEBRA MUSSEL SPREAD IN THE MORAVA RIVER BASIN (CZECH REPUBLIC)?

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The zebra mussel (*Dreissena polymorpha*), one of the globally most important invasive species, has recently been observed to massively invade small artificial water reservoirs in the Morava River basin. Many factors, such as temperature, oxygenation, pH, trophic conditions etc. affect the presence, survival and reproduction of the mussel; on the other hand, the mussel, when present in masses, can affect the habitat. In optimum conditions the density of the zebra mussel may reach tens or hundreds thousands individuals per square metre. This usually causes radical changes in the structure of local biocoenoses. The intensive spread of the zebra mussel in the Morava River basin involves mostly the floodplains, and floods favour its dispersal to new localities. We mapped the occurrence of the mussel in small water reservoirs of the Morava and Bečva river basins; we found the species in 15 out of the 44 explored localities, and sampled its sites for the population size structure. The proportion of juveniles was high mainly in disturbed water bodies (sandpits of active mines). Selected water parameters were analysed for all the water bodies. The poster shows the results of monitoring and discusses the flood dispersal as well as the effect of some factors on the populations of the zebra mussel.

THERMAL PREFERENCES OF *PLANORBARIUS CORNEUS* (L.) NATURALLY INFECTED WITH DIGENETIC TREMATODES

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Behavioural observations make it possible to conclude about thermoreception abilities of gastropods.



Thermosensitivity of neurons has been experimentally confirmed in e.g. *Aplysia californica* or *Helix pomatia*. The researchers based their conclusions on differences in reactions to changing temperatures. In the studies on *Planorbarius corneus*, and earlier on *Lymnaea stagnalis*, animals subject to experimental and natural factors which modified their metabolism, could choose among microhabitats of different temperature. The observations aimed at recognising thermal preferences of planorbids which, contrary to lymnaeids, have haemoglobin in their haemolymph, and thus testing the hypothesis of thermoreception abilities of gastropods. Thermal behaviour of snails subject to starvation, pricked with a thin needle or naturally infected with eight different species of digenetic trematodes, at prepatency or patency stage, was observed and compared with preferences of control snails. Uninfected, lettuce-fed control snails selected ambient temperature higher than acclimation temperature (20°C versus more than 27°C). Two week

starvation and delicate damage to integument resulted in selecting temperatures below the acclimation point: 18°C and 12°C, respectively. Thermal preferences of naturally infected snails depended on the trematode species and development stage. Hosts with prepatent invasion selected temperatures above 26°C, hosts spreading cercariae, depending on the kind of invasion – 14–23°C. The results suggest that: 1. *P. corneus* is thermophilous, but starved or wounded shelters in cooler microhabitats; 2. the presence of parasitic larvae of digenetic trematodes does not evoke a fever reaction, but snails with patent invasion of some trematode species shelter in microhabitats with temperatures below the acclimation point; the behavioural reaction to body damage, experimental or by parasite larvae, has symptoms of behavioural anapyrexia. The study was financed by the MNiSW grant no. 3247/B/P01/2009/36.