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THE 25TH POLISH MALACOLOGICAL SEMINAR

SEMINAR REPORT

We are now 25 years old! Well, not the Association as such (it was established in 1995), but the tradition of organising Seminars certainly is. The 25th Seminar was held (and thus the anniversary celebrated) from April 21st till Aptril 24th, in Boszkowo near Leszno. We seem to be oscillating between two extremes: last year we went to Gdynia – a big city, this year – to Boszkowo. It is a little village near Leszno (and for those who do not know their geography, Leszno is not far from Poznań), on a lake. Boszkowo (presumably) has some people during the season but when we were there, we seemed to be the only inhabitants, that is apart from the people running our hotel and from participants of some other conference. It was a very good arrangement, we felt as if we owned the place.

The organising institutions included The Association of Polish Malacologists, Adam Mickiewicz University in Poznań, Plant Protection Institute in Poznań and the University of Life Sciences, also in Poznań. It turns out that the last three institutions between them have quite a few malacologists – the organising committee consisted of ANDRZEJ LESICKI, JERZY BŁOSZYK, JAN KOZŁOWSKI, EWA DANKOWSKA, BARTŁOMIEJ GOŁDYN, TOMASZ KAŁUSKI, JOANNA PIEŃKOWSKA, ELIZA RYBSKA, MARIA URBAŃSKA and MONIKA JASKULSKA. They never disclosed who was responsible for which part of the organisation, but everything was absolutely perfect, so there was nobody to blame. Good team! Great thanks!

At the registration desk we were given very good conference packets which contained not only the usual programme, abstract book, badge, notebook and pen, but also a few extra items: a conference mug, a bag, a T-shirt, a three-colour marker pen and a snail-bank (like a piggy-bank, only different), the last item – we suspect – to encourage us to save money for the next Seminar. The opening ceremony (speeches and so on) was very brief and followed by the first session.

In all, those who were diligent spent two whole days in the sessions. The programme contained 33 oral presentations, and most or even all participants were there. It also advertised 27 posters, many of which somehow failed to arrive but instead there were two last-minute posters (thus not in the programme and the Abstract Book). Both the non-materialised posters and the extra posters are included in the abstracts below. A special committee judged presentations of young malacologists. The award for the best poster was won by DOMINIKA MIERZWA (Museum and Institute of Zoology, Polish Academy of Sciences, Warsaw) for her "Malacology and geology. Distribution of *Cepaea vindobonensis* and the geological structure of the substratum". The best oral presentation award went to ALEKSANDRA SKAWINA (Department of Palaeobiology and Evolution, Institute of Zoology, Warsaw University) for the "Experimental decomposition of recent bivalves and mineralisation of gills of Triassic Unionoida". Brave girls! Congratulations! Will there ever be some awards for old malacologists? We liked some other presentations very much. Most posters were beautiful (Fig. 1), and we especially enjoyed the two lectures by our guests from across the border – HEIKE REISE and JOHN HUTCHINSON – both about slug mating behaviour, and both with short porn movies.

The attendance was good (more than 60 malacologists in the list of participants, actually 59 malacological people, plus two children, plus two non-malacological husbands). There was one guest from Germany, one from the United Kingdom (now based in Germany), plus their son, and one guest from the Czech Republic. About one quarter of the participants (14 people) are still at the pre-doctoral stage and thus the so-called young malacologists. On the other hand, some of the last year's young malacologists are now doctors.

Unfortunetaly, some very important people failed to be there: Professors STEFAN W. ALEXANDROWICZ (who had started the sequence of events that ultimately led to the 25th Seminar), ADOLF RIEDEL (honorary member) and ANDRZEJ WIKTOR (another honorary member). We regretted it very much, but they, too, certainly regretted not being there.

The number of presentations in the Abstract Book was 60, with the mean of about one presentation per head, but this was only the mean. The reality was much more complicated: there were 30 single-author presentations, 15 double-barrelled presentations and 15 with three or more authors. People tend to co-operate a lot, and many papers/posters presented were either interdisciplinary or a result of very time-consuming research. There were no participants without presentations (or without at least a part of presentation) to their name, and only one poster without the accompanying author.

Like during the last three seminars, to have a picture of the variety of presented topics, I have attempted assigning papers to disciplines and compared the result with a few previous seminars. Some presentations were difficult to assign to a discipline (some have been assigned to more than one in the Table), and I had to apply more than one division into categories. To show how difficult it is to categorise presentations, the abstracts below have been arbitrarily divided in a slightly different way.

The numbers in the columns do not show any really significant trend, especially since last year; I would rather interpret the changes as reflecting the varying attendance (the random presence/absence of malacologists during consecutive meetings) or the fact that the nature of some disciplines precludes producing a new paper every year. Of things that are not in the table: most applied presentations dealt with pest slugs and attempts at curbing their appetite with various substances; many conservation papers were about species from Annex II of the EU Habitats Directive. Also, there is now a rather strong clausiliid lobby, dealing mostly with various aspects of clausiliid ecology, life histories and conservation – this time there were as many as four clausiliid papers. Again, like last year, we were promised some presentations and the promisers never delivered – our eastern neighbours simply failed to attend, although their presentations were on the Seminar menu (naughty people!).

The division in the table disregards whether the main character in the story was a snail or a bivalve or where it lived (land or water). The snail:bivalve ratio among the presentations was 2.35:1 (compared to 1.54: 1 in 2008, 1.67:1 in 2007, 2.38:1 in 2006), and the land:water ratio was 0.94:1 (0.91:1 in 2008, 0.54:1 in 2007 and 1.13:1 in 2006). Apparently, the trend in the snail:bivalve ratio which for three years kept changing in favour of bivalves is now reversed (are they running out of bivalves?). The same, to a smaller extent, was true of the interest in aquatic malacology already last year, and the increase tendency was maintained.

There were two official social events: the banquet on the second day and the grill party on the third. The banquet was very good, especially that on this occasion we consumed a huge anniversary cake, like a wedding cace only with a snail on top (see Fig. 2). We have a new honorary member now: Professor ANDRZEJ PIECHOCKI (University of Łódź), who is an outstanding specialist in freshwater molluscs, one of the founder-members of the Association and the main organiser of two of our Seminars (Fig. 3). Professor PIECHOCKI was very surprised, he said he did not expect this, and he was telling us the truth – the proof was that he had not brought a tie.

The Seminar excursion went to quite many places. The place most participants liked most was the Experi-

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

Fig. 1. One of the posters, plus two of the participants (Photo B. M. POKRYSZKO)

Fig. 2. The anniversary cake (the snail and the inscription were also eaten in the end; they were made of jelly) (Photo B. M. POKRYSZKO)

Fig. 3. Professor ANDRZEJ PIECHOCKI in the act of becoming honorary member (the absence of tie mercifully invisible; the person with the tie is the President) (Photo B. M. POKRYSZKO)

Fig. 4. Young malacologists performing (Photo B. M. POKRYSZKO)

mental Station of The University of Life Sciences of Poznań where we saw tame wolves (tame but otherwise quite real). Then we went to Obrzycko. Those who remembered the palace in Obrzycko, where we had had our 8th (1992) and 10th (1994) Seminars, could not recognise it and/or believe what they saw. Everybody was equally impressed by the new campus of the Adam Mickiewicz University, and their working conditions. Now these people should be required to produce twice as many publications per year. At least...

The grill party, after the Seminar excursion, was in some respects even better than the banquet. Not only was the food good and plenty, but also our younger participants turned out to be bloody good singers (see Fig. 4). Unofficial social events were many, and it may have had to do with the fact that the Poznań Brewery was one of the sponsors.

The next Seminar will be organised by the Wrocław malacologists (at present four professionally active and one actively retired) who volunteered (well, do you know the expression "to be volunteered?"). We know already when and where it will be: April 20th–23rd 2010, Kudowa-Zdrój in the beautiful Stołowe Mts.

Our Abstract Book was mostly in Polish, with TWO snails on the cover. Brief abstracts in English are presented below; in most cases translated and abbreviated surreptitiously behind the authors' back, by Yours Truly.

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ABSTRACTS OF THE 25TH POLISH MALACOLOGICAL SEMINAR, BOSZKOWO 2009

HISTORY, COLLECTIONS & DATABASES

MOLLUSC FAUNA OF WIELKOPOLSKA – 50 YEARS OF STUDIES

JERZY BŁOSZYK, ELŻBIETA KORALEWSKA-BATURA, BARTŁOMIEJ GOŁDYN, AGNIESZKA NAPIERAŁA

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The knowledge of terrestrial molluscs of Poland varies between regions. The idea of summarizing the information on the malacofauna of Wielkopolska came from the late Prof. Elżbieta Koralewska-Batura. Her doctoral thesis, later published as "Mięczaki Wielkopolski" [Molluscs of Wielkopolska] was the first attempt at such a summary. We decided to prepare an updated estimate of the state of knowledge of the fauna and to assess the mollusc diversity using our own studies and unpublished sources. Fast anthropogenic transformations of the environment make it necessary to monitor changes through time; consequently, faunistic studies gain importance. Properly accumulated and adequately organised information can be used for assessment of the environment quality and provide a basis for protection plans. Data on rare and protected mollusc species, as well as species included in Annex II to the Habitats Directive, are of special significance. All the data on the molluscs of Wielkopolska, verified by us and included in the series of publications now in preparation, are at the same time entered in the computer database of the Collections of the Faculty of Biology and made available on-line to be used for the purposes of nature conservation or studies on mollusc biology, ecology and distribution.

DARWIN AND *CEPAEA* SNAILS. EVOLUTION MEGALAB

MAŁGORZATA OŻGO

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The year 2009 is Charles Darwin's 200th birthday and the 150th anniversary of the publication of his "Origin of species". The Evolution MegaLab invites all who want to see evolution with their own eyes to study one of the favourites of evolutionary research – the *Cepaea* snail. *Cepaea* snails are terrestrial and rather common, with beautifully coloured shells: yellow, pink or brown, unicolour of with banding patterns. These characters are genetically determined and it is possible to tell what genes an individual has without killing it and sending it to a molecular lab. The frequency of various colour morphs depends on environmental factors (climate, microclimate, predators etc.). Can we catch evolution red-handed by comparing populations from various places or from the same place after some time has elapsed? Go to www.evolutionmegalab.org and join the pan-European studies – observe snails in your nearest surroundings. The Polish coordinator of the programme is Dr Małgorzata Ożgo, Instytut Biologii i Ochrony Środowiska, Akademia Pomorska, Arciszewskiego 22B, 76-200 Słupsk (e-mail: ozgo@apsl.edu.pl).

SHELL AS A SYMBOL

ELIZA RYBSKA

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Though representation of mollusc shells in art is not very common, their symbolic meaning is wide, relating to their shape (e.g. resembling moon), complicated form (sophisticated beauty), natural environment (freshwater, sea, land), properties (noise – music), and protective function (protection of life, skeleton as death). The symbolism, often invoking opposite phenomena and experiences (life and death, virginity and licentiousness), stems from the culture which produced the work of art. In the Mediterranean where the culture is based on Greek-Roman mythology and the Bible, there is a similar source of associations. The shell was associated with the motif of birth. Aphrodite (Venus), born of the sea foam, was repeatedly depicted as standing on a shell among waves. The most popular picture with this motif was Botticelli's "Birth of Venus". In the Christian culture a bivalve shell symbolised virginity, immaculate conception, virginal birth. It was an attribute of Virgin Mary, of whom it was said that she carried an invaluable pearl in her womb – Jesus. Art, inspired by mythical motifs, often referred to Amphitrite – a nereid, the most beautiful of Okeanos's daughters, and wife of Poseidon. She was presented as the queen of seas travelling in the company of tritons and nereids. Fortune was imagined as riding a shell charriot. In these contexts shells were attributes of water or lunar deities. The shell motif often appeared in connection with vanitative problematics. Calcareous-organic products of mollusc mantle were to remind the observers of inevitable end which awaits us all. According to primitive tribes conchs ensured immortality of the deceased. On Christian tombstones the shell was an emblem of the body, the corporeal clod abandoned by immortal soul, or the deceased's house. The complicated sculpture of the mollusc shell and its sophisticated form in themselves became symbols of beauty and exquisite artistic tastes. Aesthetic values of shells were successfully used in applied art. The shell motif was used not only as an architectural ornament, but also for ornamenting china objects or jewellery. The universal beauty of shells is confirmed by ancient pictures, intended as faithful copies of definite mollusc species and now regarded as works of arts.

MALACOLOGICAL COLLECTION OF THE UPPER SILESIAN MUSEUM

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The collection of the Natural History Department of the Upper Silesian Museum (zoological, botanical, geological) includes more than 500,000 specimens. It is the largest such collection in the Polish Upper Silesia, and one of the largest in Poland, after the Museum and Institute of Zoology, PAS, Warsaw, Institute of Evolution and Systematics of Animals, PAS, Cracow and Natural History Museum, Wrocław University. The malacological collection of the Upper Silesian Museum includes more than 28,000 specimens, classified in scientific and educational collection. Of these 26,600 are gastropods, bivalves are fewer; there are single shells of other mollusc taxa. The specimes are dry (shells) or alcohol-preserved. Marine snails from various parts of the world include 667 specimens, representing more than 200 species. The best represented genera are *Conus* (38 species), *Cypraea* (18) and *Strombus* (12). Freshwater snails include 24,300 specimens of 35 species (the most abundantly represented species are *Potamopyrgus antipodarum*, *Planorbis planorbis, Physella acuta*, *Gyraulus albus*, *Gyraulus crista*, *Planorbarius corneus* and *Radix balthica*). Terrestrial gastropods (over 1,600 specimens) are represented by native (85%) and tropical species. Among species of the Polish fauna, 68 terrestrial gastropod species are represented in the collection. The bivalves (1,400 specimens) comprise marine (40%) and freshwater species. The collection is of mixed origin. The oldest part, from the early 20th c., includes over 180 freshwater and terrestrial shells. The collection of marine snail and bivalve shells of Jerzy Jasieński includes more than 200 specimens. Regular scientific expeditions to Turkey by the Natural History Department, started in 2000, and occasional expeditions to other countries (Bulgaria, Greece) yielded also small malacological collections, of more than 200 specimens in total. Roland Dobosz's recent expedition to New Caledonia enriched the collection with over 200 specimens of marine molluscs. Over 8,800 freshwater molluscs were collected by Piotr Cuber in Silesian voivodeship in 2006. More than 15,800 specimens of freshwater molluscs were collected by Katarzyna Skowrońska in 2004–2008 in 26 districts of Silesian voivodeship.

IN COMMEMORATION OF PROFESSOR URBAŃSKI (1909–1981) ON THE HUNDREDTH ANNIVERSARY OF HIS BIRTHDAY

KAZIMIERZ STĘPCZAK, JERZY BŁOSZYK

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Dr hab. Jarosław Urbański, ordinary professor of the Adam Mickiewicz University in Poznań, was, during many years, a member of the Board of Faculty of the Biology and Earth Sciences of the University, head of the Departament of General Zoology, active member of various organisations and scientific societies and a researcher with an unusually wide scope of interests and great knowledge. He is usually said to have written more than 200 scientific papers, but he himself could not list all his publications which were certainly much more numerous. Due to his help 18 researchers got degrees of habilitated doctor and professor. He supervised 15 doctoral dissertations and more than 160 masters' theses. Thousands of students listened to his fascinating lectures. He was the first doctor in Poland promoted after World War II. J. Urbański devoted nearly 70 publications to molluscs alone. His other papers dealt with arthropods, fishes, birds, mammals and nature conservation in broad sense; he also published numerous popular articles. Many nature reserves, nature monuments and two national parks were created due to his initiative or with his help. For many years, till his death, he was active in various institutions and organisations for nature conservation. He was a member of the Zoological Committee of the Polish Academy of Sciense and editor of the series "Przyroda Polski Zachodniej" [Nature of Western Poland]. In recognition of his merits be was awarded an array of distinctions.

THIRTY FIVE YEARS OF RESEARCH ON FRESHWATER MOLLUSCS OF INDUSTRIAL HABITATS IN UPPER SILESIA

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Malacological research, started in early 1970s at the Faculty of Biology and Environment Protection, Silesian University, was mainly aimed at supplementing the earlier information on the freshwater molluscs of Upper Silesia. The common belief at that time was that industrial and urbanized areas were not interesting from hydrobiological point of view. The first stage of research included studies on the effect of various factors, related to mining and heavy industry, on the biology, physiology and morphology of some common freshwater snails, and especially on their life cycles and shell morphology, e.g. *Gyraulus albus, G. rossmaessleri, Planorbis planorbis, Stagnicola corvus*. Later research dealt with malacofauna of water bodies created by man on purpose or accidentally. Development of snail communities was presented on the background of characteristics of degraded habitats; the introduction routes and effect of introduced species on the native malacofauna were analysed. Especially the effect of alien species (*Potamopyrgus antipodarum*, *Physella acuta*, *Ferrissia wautieri*) was studied in great detail. In was found that in conditions of progressing anthropopressure they showed great adaptive abilities and often gained advantage over native species. The studies show that in areas degraded by industry and devoid of natural water bodies, numerous anthropogenic reservoirs play an important part for preserving the mollusc diversity. It appears that wider hydrobiological studies, including other macrobenthos components, in anthropogenic reservoirs are fully justified.

FAUNISTICS & ECOLOGY

THE EFFECT OF ENVIRONMENTAL CONDITIONS ON THE OCCURRENCE OF *THEODOXUS FLUVIATILIS* IN THE NIDA RIVER

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The Nida is a lowland river; is forms the axis of the Nida Landscape Park. Its molluscs are poorly known and the data come from the 1970s. The research was aimed at ascertaining the effect of habitat conditions on the occurrence of *Theodoxus fluviatilis*, and to characterise its habitats on the background of mollusc communities of the river. *T. fluviatilis* lives in fresh and brackish waters, most often in rivers where it attaches to stones and submerged logs. It is regarded as a calciphile of high oxygen requirements, associated with slightly alkaline waters. The study inluded 11 sites (in representative sections of the river) sampled from May till September 2008, with routine methods. Site selection considered the substratum character, flow velocity, depth, and the character of the banks. Physico-chemical analysis of the water revealed no statistically significant differences between the sites which however differed in the substratum character and organic matter content. *T. fluviatilis* occurred only in the site in Nowy Korczyn, where during the whole study period seven snail species were recorded (generally 22 snail species were recorded from the Nida). It was the most abundant in May when its density was 792 indiv./m^2, the least so in September – 440 indiv./m^2. It co-occurred constantly with *Viviparus*

viviparus and *Bithynia tentaculata*. The factor determining its occurrence in Nowy Korczyn was the character of the bottom: submerged boulders and blocks, the so called macrolittoral covered by a thin deposit layer.

PREFERENCES OF CADDISFLY LARVAE (*LIMNEPHILUS FLAVICORNIS*) FOR SNAILS USED FOR CASE BUILDING

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Larvae of limnephilid caddisflies build cases from a variety of materials; they often use mollusc shells. This is especially true of *Limnephilus flavicornis*. It is commonly assumed that the caddisfly shows no species or size preferences when acquiring its building materials. Our study was to test this assumption. We analysed 283 cases of *L. flavicornis* from samples taken from 30 small water bodies and compared their composition with the species composition and size structure of the snails found in the same samples. The most frequent species in the cases was *Anisus leucostomus* (86.6% of the total). The remaining species were *Segmentina nitida* (7.3%), *Planorbis planorbis* (3.9%), *Stagnicola corvus* and *Armiger crista* (0.5% each), *Planorbarius corneus* and *Radix balthica* (0.4%), *Aplexa hypnorum* and *Lymnaea stagnalis* (0.1%). The frequency of shells (irrespective of species) in the caddisfly cases was positively correlated with the abundance of snails in the sample. The frequency of *A. leucostomus* in the cases was greater than in the samples ($p<0.001$; $Z= -5.663$). For the remaining species the dependence was reversed – in the caddisfly cases they were fewer than could be expected based on their abundance in the sample. The cases of *L. flavicornis* contained shells of *A. leucostomus* larger than the mean size in the snail population ($p=0.001$; $Z= -3.22$). The situation was the opposite for *S. nitida* – the caddisfly used smaller shells ($p<0.001$; $Z= -6.263$). The study was partly financed within the grant of MNiSW no. N N304 3400 33.

MOLLUSCS OF THE KRUTYNIA RIVER (MAZURIAN LAKELAND)

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Krutynia, one of the important rivers of the Mazurian Lakeland, was earlier only fragmentarily studied. Our 2008 sudies were aimed at inventorying the malacofauna of the whole river, albeit without the associated lakes. Samples from 10 sites, from the sources to the mouth, revealed 29 species (19 snails, 10 bivalves). The number of species per site ranged from 4 (middle section) to 24 (mouth section). The most common species were *Bithynia tentaculata* and *Viviparus contectus* (frequency 80–90%), the least so – *Planorbis carinatus*, *Anisus vortex*, *Gyraulus albus*, *Stagnicola palustris*, *S. corvus*, *Sphaerium rivicola*, *Pisidium subtruncatum* and *Pseudanodonta complanata* (frequency 10%). *Sphaerium corneum*, *Dreissena polymorpha*, *Anodonta anatina* and *Unio pictorum* were present in the upper, middle and lower sections. The highest density, locally exceeding 100 indiv./m^2, was observed for *Theodoxus fluviatilis*, the greatest biomass, of more than 2.5 kg/m^2, for unionids, especially *Unio tumidus*.

MOLLUSC DIVERSITY IN PERIODIC WATER BODIES: FLOODPLAIN OF THE LOWER BUG RIVER

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The research was to determine the structure, species richness and diversity (Shannon-Weaver index, H') of malacocoenoses in periodic water bodies of the lower Bug River valley (ca. 100 km section). An attempt was also made at identifying environmental factors with the greatest effect on the structure, diversity and abundance of the mollusc faunas. The studies included 49 water bodies within the natural floodplain, the floodplain limited by flood banks and the former floodplain outside the flood banks. Molluscs were sampled in May and June 2007 and 2008. Samples of water and bottom deposits were also taken. Thirty six mollusc species were recorded – 30 snails (including 6 prosobranchs) and 6 bivalves. The number of species in a water body ranged from 2 to 17. The most frequent species (F>50%) were: *Stagnicola palustris*, *Planorbarius corneus*, *Planorbis planorbis*, *Anisus vortex* and *Segmentina nitida*. Mollusc abundance in samples from ca. 1 m^2 ranged from 20 to 1,826 individuals. Species diversity (H') was 0.44–3.12. The dominance structure varied. Species resistant to drying out domi-

nated in most water bodies, but in some, especially those periodically connected with the river or with large permanent water bodies, less resistant species dominated. An array of factors was found to have a significant effect on the structure of the malacocoenoses: age of the water body, depth, vegetation, hydrological connection, position within the floodplain and character of bottom deposits. Among the chemical parameters, the concentration of phosphate, chloride and calcium ions, and the proper conductivity, had a significant effect. The project was financed by grant no. N305 11731/3934.

HOW DID *LITHOGLYPHUS NATIOCOIDES* REACH THE MAZURIAN GREAT LAKES?

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Lithoglyphus natiocoides inhabits large and medium-sized, slow, lowland rivers. It is sporadically found in lakes; in the Mazurian Lakeland it was recorded from Lake Jeziorak and some flow lakes of the Jorka River. At least since 1997 it has occurred, in low numbers and a limited area, in Lake Mikołajskie. According to literature data the snail reached Poland from south-east and was first observed in 1877 in the Bug, and then in the Narew and Vistula Rivers. The only direct connection between these rivers and the Mazurian Great Lakes is the Pisa River. In the summer 2008 bottom deposits (*L. naticoides* is benthic and decidedly avoids aquatic vegetation) were sampled in the Jegliński Canal (connecting Lake Roś, out of which the Pisa flows, with Lake Śniardwy), in 12 sites along the Pisa and in the Narew above its mouth. *L. naticoides* was found neither in the canal nor in the entire, 80 km, Pisa course. The malacofauna of the river was extremely poor qualitatively and quantitatively which may be associated with considerable flow speed, kind of bottom deposits and river bed character (high banks, no riverine habitats). In the Narew numerous specimens of *L. naticoides* were found among the rich and varied malacofauna. The results indicate that the Pisa is, at least to molluscs, a distinct environmental barrier between the Narew basin (or more broadly Vistula basin) and the Mazurian Great Lakes. Penetration of *L. naticoides* into Lake Mikołajskie could have a character of human-mediated "leap invasion" (introduction). The snail could be brought in crevices in yacht hulls; in the spring numerous yachts travel from Warsaw along the Vistula, Narew and Pisa to the Great Lakes. Earlier literature data indicate that there may be another explanation for the insular population of *L. naticoides* in Lake Mikołajskie, namely that Poland is within the natural and not secondary distribution range of the species. The studies are a part of research project 2 P04G 005 28.

BEETLES AS NATURAL ENEMIES OF SNAILS

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Snails are not an easily accessible food source for beetles. Though very abundant and thus potentially available to predators, they have defensive means that make them unattractive to the insects. Their body is covered in mucus, and they can retract into the shell when attacked. Members of several beetle families are specialised snail hunters: Carabidae, Silphidae, Lampyridae and Drilidae. This pertains to both larvae (Carabidae, Lampyridae, Drilidae) and imagines (Carabidae, Silphidae). The specialisation has resulted in far-reaching structural modifications of some beetles (e.g. *Phosphuga atrata*, *Carabus intricatus*, *C. irregularis*, genera *Cychrus* and *Licinus*), especially their mouthparts and head. Members of Drilidae also use the prey shells as shelters for their larvae and pupae. Structural and biological adaptations of beetles to feeding on snails are discussed in detail.

THE EFFECT OF GEOCHEMICAL CHARACTER OF ROCK ON THE OCCURRENCE AND DISTRIBUTION OF *CEPAEA VINDOBONENSIS* IN POLAND

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Localities of *C. vindobonensis* in south-eastern Poland are associated with outcrops of carbonate rocks. The species is also found in different habitats, for example alluvial deposits of large rivers: Vistula, Warta and Odra. The occurrence of *C. vindobonensis* on floodplains of the Vistula and Odra river systems is associated with water dispersal of individuals from areas with carbonate substratum. Along the Vistula valley the species reaches the environs of Świecie. Its distribution range is compatible with the geochemical map of alluvial deposits, showing calcium content in Poland. The continuous part of the range is limited to

carbonate substratum. Its insular parts are associated with alluvial deposits. The presence of the same species in two different habitats has resulted in two forms of different phenotypes. The light form (*pallescens*) is characteristic of carbonate habitats of uplands of south-eastern Poland, while the dark form (*expallescens*) is typical of floodplains. Though a great proportion of phenotypic differences between populations of the species seem to have genetic background, there are also differences distinctly correlated with the geochemical character of the substratum. An example is a weakened shell combined with fading of the characteristic colour pattern in snails from secondary habitats (floodplains), compared to populations from habitats regarded as optimum (limestone substratum).

MALACOLOGY AND GEOLOGY. DISTRIBUTION OF *CEPAEA VINDOBONENSIS* AND THE GEOLOGICAL STRUCTURE OF THE SUBSTRATUM

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In Poland, original (natural) occurrence of *Cepaea vindobonensis* is associated with carbonate rock outcrops of the Lublin Upland, Roztocze, Kielce–Sandomierz Upland, Cracow–Częstochowa Upland and Silesian Upland. *C. vindobonensis* is most often found on sunny slopes with xerothermic vegetation. Rocks of such localities are often dissected by river erosion. High water flow causes faster erosion of rock and alluvial deposits, as well as dispersal of *C. vindobonensis* to lower river sections. Decreasing water level after a flood episode causes deposition of the snails, among other places, on floodplains (secondary localities), even several dozen kilometres away from the original site. Such secondary sites are most often located on right bank terraces of the Vistula (e.g. environs of Puławy, Skurcza, Wilga, Górki, Warsaw, Zakroczym, Płock, Dobrzyń on the Vistula and Włocławek). Besides sedimentation, which directly affects mineral composition of deposits, the possibility of survival of *C. vindobonensis* on the floodplains of the Vistula depends to a large degree on the Ca^{2+} content in the substratum (1–4%). Calcium deficit (probably below 0.5% in deposits), acid pH, poor insolation, high humidity and anthropogenic factors cause decrease in abundance and then disappearance of populations. The snails will persist only if they do not leave the floodplain area. Their abundance drops with migration outside the terrace boundaries, and individuals with deformed shells appear.

OUR MALACOLOGICAL TRIP TO GEORGIA

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In July 2008 we sampled terrestrial gastropods in nine localities with a total of 30 standard forest sampling plots in the Lesser and Greater Caucasus. The plots differed in the character of the forest (some of them relic Tertiary forests), substratum and altitude. The resulting collection includes 88 species, among others 24 pupilloids, 20 zonitoids, 18 clausiliids and 13 helicoids. The paper is in preparation.

DREISSENA POLYMORPHA AS A COMPONENT OF HABITAT OF BENTHIC MEIOFAUNA IN KLEINES HAFF (SZCZECIN LAGOON)

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The zebra mussel *Dreissena polymorpha*, a sessile filtrator, is regarded as a link connecting pelagial and benthal. Many authors point to its crucial role for improvement of living conditions of benthic communities of the deposit surrounding the zebra mussel colonies. In the sumer 2007 we studied the distribution of aggregations of *D. polymorpha* in Kleines Haff (German part of the Szczecin Lagoon) and their effect on the meiobenthos communities. Meiobenthos was sampled in two sites: one with small, loose aggregations of the mussel, another with a dense mussel bed. In the first site samples were taken very close to the mussel aggregations and far from them, in the second – at the mussel bed and 10 m away. The sites differed in the character of their deposits: in the first site it was permeable sand with detritus and shell fragments, in the second – a layer of sand with detritus and shell rubble underlain by a peat layer at the mussel bed and by a layer of permeable sand away from it. The samples from the first site did not differ in the abundance and composition of their meiobenthos. In the second site the meiobenthos was considerably richer quantitatively near the mussel bed (which would confirm earlier observations), the general abundance of benthic meiofauna was smaller at the mussel bed than away from it. The results suggest that parameters of

meiobenthos communities in waters with *D. polymorpha* depend at least partly on those habitat properties that are not affected by the presence of the mussel. The study is a part of the project "Biologische Renaturierungsmethoden für das Oderhaff [Biological Restoration Methods for the Szczecin Lagoon]" financed by the Internationale Büro des Bundesministeriums für Bildung und Forschung (BMBF), Project MOE 07/R58.

THE ROLE OF UNIONID POPULATIONS IN WATER BODIES OF THE EUROPEAN PART OF RUSSIA

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Unionids are food to water fowl and some fishes, hosts to parasites, and play an essential part in aquatic ecosystems' equilibrium. Information on the quantity of organic matter passing through bivalves with filtered water is scanty. The aim of this study was to estimate participation of unionid populations in circulation of organic matter in lakes with different trophic level: Laborzhskoe (hypertrophic) and Krasnoe (mesotrophic), with populations of *Unio tumidus* and *U. pictorum*. The biomass and abunance of the populations from lakes Laborzhskoe and Krasnoe were assessed in the summer of 1982 and 2005, respectively. In Lake Krasnoe the density and biomass were: *U. tumidus* 60 indiv./m^2, 1854.61 g/m^2, *U. pictorum* 24 indiv./m^2, 615.6 g/m^2 and both species combined 84 indiv./m^2, 2470.21 g/m^2. In Lake Laborzhskoe the respective values were 4 indiv./m^2, 106.53 g/m^2; 5 indiv./m^2, 91.85 g/m^2 and 9 indiv./m^2, 198.38 g/m^2. In Lake Laborzhskoe the time required for lake volume filtration is equal to the water exchange period (K_w=5.2 $year^{-1}$). In Lake Krasnoe that time is 4 times shorter than the water exchange period (K_w=1.25 $year^{-1}$). These values indicate a significant water turbulence caused by the bivalves. Its intensity is comparable to that of water exchange in the waterbodies. In Lake Laborzhskoe the bivalves excrete 49.61 gC/m^2 with faeces and pseudofaeces, which nearly equals the food requirements of the macrozoobenthos. The quantity of oxygen needed for mineralisation of the remainder of bivalve-excreted organic matter is equal to BOD_5. In Lake Krasnoe the bivalves excrete 82.16 gC/m^2 which exceeds the zoobenthos food requirements 14 times. The oxygen quantity required to mineralise the remainder exceeds BOD_5 20 times. The bivalves contribute not only to water purification, but also to eutrophication. Organic matter accumulation resulting from mollusc activity may lead to creation of anaerobic conditions in the hypolimnion. This aspect of unionid populations functioning was not considered before.

CAN DIFFERENCES IN CALCIUM CONTENT BETWEEN COLOUR MORPHS OF *CEPAEA NEMORALIS* INFLUENCE PREDATION PRESSURE?

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Calcium is important for snail and bird reproduction. Snail shells are regarded as the main calcium source for passerine birds. There are no data on the dependence between calcium content in shells of various morphs of *Cepaea nemoralis*, and preferences of birds which catch the snails mainly because of calcium. Studies on the effect of predators on the morph frequency in *Cepaea* focused on birds. Information on the role of rodents and their effect on snail populations is scanty, though they can be major *Cepaea* predators. Shell thickness increase may be a possible anti-predatory adaptation; it would increase the time and energy expenditure on the part of the predator. Calcium ensures mechanical resistance of snail shells and thus better protection against mechanical damage (and/or predators). Hence, snails with higher Ca content in their shells should be energetically less profitable for protein- and energy-seeking predators, and thus favoured by such selection. It is possible that predation pressure in *Cepaea* populations exerts selection in two directions at once – for increased calcium concentration in shells (snails with thin shells more often caught by protein- and energy-seeking predators) and for decreased calcium concentration (thick-shelled snails more often selected by calcium-seeking birds). Could such varied selection be a/the factor maintaining polymorphism in *Cepaea*?

GASTROPOD DISTRIBUTION IN REGULAR--SAMPLING PLOTS IN THE NATURE RESERVE DĘBNO NAD WARTĄ

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Four regular-sampling plots were selected in the buffer zone of the nature reserve Dębno nad Wartą (Wielkopolskie voivodeship). Each plot, 15 m^2 in area, was divided into of 1 × 1 m squares. A litter sample was taken from each square four times a year. Besides the malacofauna composition, the propor-

tion of leaves of various tree species was counted for each sample. The degree of coverage with herb layer plants was noted for each square. The distribution of 17 gastropod species in the plots was analysed, as well as their preference to leaves of various trees. The widest distributed species were *Trichia hispida*, *Cochlodina laminata* and *Perforatella incarnata*. Canonical analysis (CCA) showed that *Ruthenica filograna*, *Discus rotundatus* and *Clausilia bidentata* were stenoecious. For their wintering they selected places with little herbaceous vegetation and much litter of elm, ash, and hornbeam. These preferences were observed, but less pronounced, also during the remaining seasons. With progressing vegetation season the distribution of the species became less aggregated. The remaining gastropod species seemed to be euryoecious and wintered over in places with intermediate conditions.

ANODONTA CYGNEA FROM THE MALTAŃSKI RESERVOIR

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The Maltański reservoir is located within the administrative boundaries of the city of Poznań; it was formed as a result of damming of the Cybina River, a right-bank tributary of the Warta. It is a shallow (max 5.5 m) lowland retention reservoir, 64.0 ha in area. It mainly serves sports and recreation. For exploitation reasons it is emptied every 4 years. In October and November 2008, during commercial fishing and emptying, *Anodonta cygnea* and *A. complanata* were observed. Biomass and abundance were estimated for the dominant species, *A. cygnea*. The bivalves were collected from the surface (1 m^2) and from the bottom deposits to the depth of 5 cm. 246 random samples were taken. The total weight of specimens was 37.65 kg, the average biomass was 0.153 kg/m^2 (1,530 kg/ha). In order to assess density, 37 kg of bivalves were randomly divided into 1 kg samples. The mean number of individuals per sample was 49 (74,970 indiv./ha).

ZINC CONCENTRATION IN SHELLS AND TISSUES OF *HELICELLA OBVIA* FROM THE REGION OF BUSKO-ZDRÓJ AND OSOWIEC

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Snails for the study originated from two localities: 1. near Osowiec (53°28'N, 22°40'E), 2. near Busko-Zdrój (50°28'N, 20°43'E). Both are located in "biologically pure" areas with no major industry. Ten adults were randomly selected from each locality. Zinc concentration was analysed in the foot, alimentary tract and shell, with spectrometer BUCK 200 A, using atomic absorption spectrophotometry (AAS). Statistical analysis (ANOVA) revealed statistically significant differences in Zn content, between the organs ($F_{(2,54)}$ =83.91; $p<0.001$), and localities ($F_{(1,54)}$ =24.23; $p<0.001$). For the snails from Busko-Zdrój the greatest concentration was found in the alimentary tract (940.47±353.90), the smallest in the shell (19.10±6.28). The concentration in the foot was 145.96±59.58. The concentration in the alimentary tract was significantly higher ($p<0.001$) than in the shell and foot, while there were no significant differences between the foot and shell. Zn concentration in the snails from Osowiec was less varied between the organs: alimentary tract 295.14±68,02, foot 216.20±63 and shell 16.81±2.58. The concentration in the shell was significantly smaller ($p<0.001$) than in the foot and alimentary tract. *Post hoc* LSD test showed that Zn concentration in the alimentary tracts of the snails from Busko-Zdrój was significantly higher ($p<0.001$), compared to those from Osowiec. The concentration in foot and shell did not differ significantly between the populations. The results suggest that *H. obvia* can be useful in monitoring heavy metal pollution.

CONSERVATION

MONITORING *UNIO CRASSUS* IN THE MID PILICA. IMPLEMENTING THE HABITATS DIRECTIVE IN POLAND

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The population of *Unio crassus* (species from Annex II, Habitats Directive) was studied in the mid Pilica in 2008, in an 80 km section between Maluszyn and Polanka (above the Sulejowski Reservoir) (permission SR.V.6631/257/2008). The 40 km fragment of the river below Przedbórz is a Natura 2000 area. The study was aimed at creating a monitoring system which would meet the Habitats Directive requirements. Twenty five sites (on average every 3.6 km) in the Pilica, mouth sections of two tributaries and in one oxbow were sampled. The resulting 3,395 bivalves represented six native unionid species. The occurrence analysis was based on *U. crassus* – 273 specimens, *U. tumidus* – 1,869, *U. pictorum* – 1,077, *Anodonta cygnea* – 24, *A. anatina* – 137 and *Pseudanodonta complanata* – 15. The distribution was practically continuous except the sections with high level of organic pollution (Gęsiarnia, Przedbórz). A 23 km section below Przedbórz, between Faliszewo and Biała (water

quality class III), was the richest in unionids, including *U. crassus. U. tumidus* and *U. pictorum* were typical for this river section; *U. crassus* was common but not abundant. It was found sporadically in the main current; it stayed mainly in the sandy-muddy littoral, in the reed belt where it accompanied other bivalves. *A. anatina* was much less frequent and less abundant; the remaining two protected species – *A cygnea* and *P. complanata* – were accessory. The unionid density varied from 0.25 to 110.8 N/m^2; the values for *U. crassus* were 0.1–6.6 N/m^2. The largest aggregation of *U. crassus* (66 individuals on a 10 m stretch) was observed near the village Trzy Morgi. The mean shell length of *U. crassus* (n=243) was 60.2±13.5 mm (range 22.6–86.8 mm), the mean age (n=237): 4.99±2.0 (1–11) The values were similar to those obtained for the Pilica population 10 years ago. The character of the mid section of Pilica and the condition of the local population of *U. crassus* suggest that the population should be under constant monitoring.

MALACOFAUNA OF THE SOUTHERN WETLAND BELT OF THE KAMPINOS NATIONAL PARK

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The Kampinos National Park, located within the largest confluence of rivers in Poland (Vistula, Bug, Narew and Bzura), is varied with respect to its topography and habitats. Its southern wetland belt is bordered by dunes and the Błońska Plain and includes extensive oxbows filled by decomposed peat with lacustrine chalk. The high calcium content and alkaline pH favour development of mollusc communities. In 2008 the wetland molluscs were sampled (8 sampling plots) for inventorying purposes. Forty species (38 snails: 23 terrestrial, 15 aquatic, and 2 bivalves) were recorded. The number of species per site ranged from 6 to 15. The largest group included species of small periodic pools. The most abundant species were aquatic *Anisus leucostomus* and *Aplexa hypnorum* as well as hygrophile *Carychium minimum*. Sedge and reed beds harboured species from Annex II of the Habitats Directive: *Vertigo angustior* and *V. moulinsiana.*

RENATURIZATION OF NON-FOREST HABITATS IN THE ŚWIETOKRZYSKI REGION

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Because of its topographic, hydrological and geological character, the Świętokrzyski region (SE. Poland) holds diverse habitats and thus biodiversity. Wetlands form only 0.5–0.6% of the area. Non-forest habitats with species included in the network Natura 2000 – *Vertigo angustior, V. moulinsiana* and *Anisus vorticulus* – are oxbows, molinia meadows, chalk fens and sedge beds. Such habitats, rare in the region, are still insufficiently studied. They were not malacologically inventoried before. The region suffers water deficit and consequent vegetational and faunal changes. The decreasing water level, as well as other anthropogenic changes, have resulted in destruction of bogs near Gnieździska, Czarnca, Żelisławice, Rytwiany and Łyżwy. The area is culturally unique because of archaelogical sites with sequences of prehistoric cultures in the bogs. The 2008 field work yielded localities and areas of occurrence of mollusc species included in Natura 2000 in wetlands and meadows. Fourteen areas of integrated protection of species and habitats were selected. Some show a drying-out tendency, pedogenesis and damage to active bogs. The process can be stopped by renaturization. This requires an urgent monitoring of the state of wetlands and maintaining or improving the water regime in the protected areas.

MOLLUSCS OF THE DĘBNICKO-TYNIECKIE MEADOWS IN CRACOW

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The Dębnicko-Tynieckie meadows are located within the Dębniki district in the SW. part of Cracow. They occupy ca. 1,150 ha and include seven main divisions: Bodzów, Kostrze, Koło Tynieckie, Podgórki Tynieckie, Zakrzówek, Skotniki and Pastwiska. The malacofaunistic inventory was within a larger faunistic project verifying the boundaries of a Natura 2000 area. It was conducted from the end of June till August 2008. Thirty four gastropod species were recorded (3 of them aquatic: *Lymnaea stagnalis, L. turricula, Planorbis planorbis*). The greatest diversity was found in Skotniki, Podgórki Tynieckie and Kostrze. The most important records are those of *Vertigo angustior* Jeffreys, 1830 (Annex II of Habitats Directive). In recent years near Cracow it was reported only from a new locality in Alwernia. In Poland after 1975 it was known only from 20 localities. It has new localities in Pastwiska, Podgórki Tynieckie and Skotniki. Another noteworthy species is *Cepaea vindobonensis,* found in Kostrze. In the environs of Cracow it was previously known from Podgórki Tynieckie, hills between Kostrze and Bodzów, Bielany, Przegorzały and Skałki Twardowskiego. The remaining 32 species are common and abundant in Poland.

NEW LOCALITIES OF *VERTIGO ANGUSTIOR* IN POMERANIAN AND WESTERN-POMERANIAN VOIVODESHIPS

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Seven localities of *Vertigo angustior* were found in 2007 in Pomeranian voivodeship. In September 2008 the search in that region was continued and extended to include the adjacent areas of Western-Pomeranian voivodeship. The field work included mainly places of constant humidity, not drying; only some were periodically under water. The studied habitats were alkaline fens (wetland to a considerable extent covered in sedge-moss plant communities), with sedges. Snails were sought among decomposing leaves of *Carex* sp. During September search a total of 8 localities of *V. angustior* were recorded: 3 in Pomeranian and 5 in Western-Pomeranian voivodeship. Most were located in small river valleys (only two on lakes). One site was periodically under water and the snails stayed on sedge leaves. The remaining localities were not flooded and the snails stayed in the litter. In all, in 2007–2008, 15 new localities of *V. angustior* were found in the studied area (thus at present in Poland 90 localities of the snail are known). The observations suggest that the snail is absent from the northern part of Pomeranian voivodeship (or its localities are very few), while many records are located near Drawsko (as many as 3 sites).

MOLLUSC PROTECTION IN THE NETWORK NATURA 2000 IN THE CARPATHIANS ON THE POLISH-SLOVAK BOUNDARY AREA

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Four mollusc species from Annex II of the Habitats Directive were recorded in the Carpathians on the Polish-Slovak boundary: *Unio crassus, Vertigo geyeri*, *V. angustior* and *V. moulinsiana*. According to the European Union legislation both Poland and Slovakia should desigate a network of areas to protect a representative part of their populations. There are no records of *V. moulinsiana* from the Polish Carpathians; in Poland the species is known to occur only in the lowlands. Slovakia designated 5 such areas for this species, one of them in the Carpathians on the Polish-Slovak boundary. The situation of *V. geyeri* was similar till not long ago. In 2006 an area for this species was designated in Poland at the foot of the Tatra Mts. Slovakia has 5 areas for *V. geyeri* in the area adjoining the Tatra, one of them near the Polish boundary. In Slovakia *V. angustior* is protected in 23 areas, 6 of them in the Carpathians. Till 2008 only 10 areas were designated for the species in Poland, of which one was in the Carpathians. In 2008, 4 Carpathian areas were added to the Polish list. Till 2008 *U. crassus* had 27 areas in Poland, 3 of them in the Carpathians. In Slovakia 22 areas were designated for it, 3 of them in the discussed part of the Carpathians. The information on these species in the Polish Carpathians is still insufficient; the situation is much better in the case of Slovak localities.

DEVELOPMENT, REPRODUCTION & POPULATION DYNAMICS

REMATING AND THE ROLE OF THE PENIAL GLAND IN THE TERRESTRIAL SLUG *DEROCERAS PANORMITANUM*

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In the mating of *Deroceras panormitanum*, after mutual exchange of sperm each partner everts a large penial gland which deposits a secretion over the partner. Here we use latency to remate as an assay to test two hypotheses (amongst several) for the function of this secretion. The first hypothesis is that the secretion identifies the donor and thus allows slugs to avoid remating with the same partner. Slugs collected from the wild were isolated for a week or more and then allowed to mate with a specified partner; partners were then either swapped or kept constant and these pairs were provided with repeated opportunities to remate. Latency to remate did not differ significantly between these treatments, yielding no support for the first hypothesis. The second hypothesis is that the secretion manipulates the recipient to delay remating, to the advantage of the donor in reducing sperm competition and possibly in increasing the recipient's fecundity. Slugs collected from the wild were isolated for at least a week and then allowed to mate. After sperm exchange matings were either disturbed so that the partners separated before gland eversion or were allowed to continue and the slugs similarly prodded only after gland eversion. There was again no significant difference between treatments in latency to remate, yielding no support for the second hypothesis. In both experiments the proportion of pairs mating was lower in the days soon after the last mating than later. In the second experiment it took only three days before over half the pairs had remated; remating rate was similar in one run of the first experiment, but in the second run it took five days before half had remated.

MATING BEHAVIOUR AND TAXONOMY OF THE *DEROCERAS RODNAE* COMPLEX IN THE SÄCHSISCHE SCHWEIZ AND ELSEWHERE

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Collections of *Deroceras* from the uplands south of Dresden (along the Czech-German border) revealed two similar species differing in mating behaviour. The ranges interdigitate, but at no site did the species co-occur, suggesting competitive exclusion. One species has a wide sarcobelum held over the animal's own head, the courtship and copulation are fast (typically 0.5 h and 15 s respectively), and the everted penes are fully visible from above. It resembles *Deroceras praecox*, occurring 100 km further east, whose morphology and courtship behaviour are nevertheless consistenly distinct. Courtship and copulation take longer in the second species (2 h and 40 s) and its sarcobelum has a much enlarged base, but most distinct is that the penes evert downwards, and coil round each other for an additional revolution. At copulation, the hand-like penial gland is often the only part of the penis becoming visible from above. This species is conspecific with Swiss, German and Austrian populations of *D. rodnae*, but distinct from eastern populations, which more closely resemble *D. praecox*. Trees based on allozymes or mDNA sequences support this division. Nevertheless, identifying non-mating animals by their anatomy is often surprisingly difficult. Western populations of *D. rodnae* should now be termed *Deroceras juranum* Wüthrich, 1993. We describe the considerable variation within both species in sarcobelum shape and its disposition during mating.

FECUNDITY AS AN ADJUSTABLE LIFE HISTORY PARAMETER IN *VIVIPARUS CONTECTUS*

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Long-term observations on *Viviparus viviparus* made it possible to distinguish some characters of life history which are constant and independent from the type of environment (tendency to form aggregations in the same places at certain times, age and sex structure, percentage of fertile females in the population). Such characters ensure maintaining a balanced abundance of the species. The number of embryos per female varies with environmental conditions. The same life history parameters were analysed in another viviparid – *Viviparus contectus* – in order to check if in this species the expected strategy functioned in its unchanged form in various types of habitats. Density, sex and age structure and fecundity were studied in *V. contectus* from oxbows to various extent connected with the Bug River (flow oxbows, cut-off oxbows). *V. contectus* did not form as dense aggregations as *V. viviparus*. The mean density ranged from 12 indiv./m^2 in the autumn to 25 indiv./m^2 in the summer. The sex ratio was 1:1, sometimes with a slight predominance of males. The populations differed in their fecundity: in flow oxbows in the summer the mean number of embryos per female was 13, and in the cut-off oxbow – 6.4. The fecundity was more or less average for the species. In flow oxbows the females, irrespective of the size class, produced numerous embryos. The fecundity in size class II was greater than in larger females in the flow oxbow. Early maturation of *V. contectus* is an adaptation to unstable environmental conditions.

CHANGES IN SIZE STRUCTURE OF SNAIL POPULATIONS IN THREE ASTATIC WATER BODIES

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The study was to check to which extent aquatic snails adjust their life cycle to periodic drying of astatic field ponds. Three ponds of different hydroperiod (period of filling with water) were selected. They were inhabitaed by *Anisus leucostomus*, *Segmentina nitida*, *Lymnaea stagnalis* and *Planorbarius corneus*. Qualitaive samples were taken every fortnight, from February till October 2008. Live snails were measured based on photographs. Species typical of the most astatic water bodies (*A. leucostomus* and *S. nitida*) reproduced several times a year, resulting in many overlapping generations. Less resistant species (*L. stagnalis, P. corneus*), from ponds of longer hydroperiod (more permanent), reproduced only once a year. Juveniles of such species hatched only at the beginning of June. The study is partly financed by the grant of MNiSW no. N N304 3400 33.

HISTOLOGICAL ANALYSIS OF THE GONAD OF *SINANODONTA WOODIANA* FROM HEATED KONIN LAKES

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The aim of the study was to trace the histological structure of the gonad of *Sinanodonta woodiana* in annual cycle, considering hydrological characters of the lakes and canals of the system. Bivalves were caught from May 2005 till June 2006 (except December-February), every month, on each occasion from three, four or five sites including the warmest reservoir of initial cooling, the cool supply canal of the power plant Konin, the warm discharge canal of the power plant Konin and two lakes: Ślesińskie (cool) and Licheńskie (warm). The total of 142 specimens included 71 females, 62 males, 5 hermaphrodites and 4 specimens of unidentified sex. Gonads were preserved in the Bouin fixative or buffered formalin; sections 7 µm thick were stained with hematoxilin and eosin. The sex ratio in all sites was 1:1. The four specimens of unknown sex came from the cool canal; their gonads contained only connective tissue and empty, undeveloped follicles. In the spring-summer-autumn period the bivalves from both warm and cool reservoirs contained mature male and female gamets. Already in March their ovaries contained follicles filled with vitellogenic oocytes, and their testes contained spermatozoa. In the summer (June, July) in some specimens we observed a decreased number of oocytes contained in small follicles, and almost empty male follicles with remains of spermatozoa in the centre. This indicates gonads emptied during reproduction. Within the whole study period the gonads of specimens from the coolest site (supply canal) showed a different structure. Their gonads contained fewer gametes, often degenerating oocytes, some of the follicles were empty, surrounded by large quantities of connective tissue. This indicates that in colder reservoirs reproductive abilities of *S. woodiana* distinctly decrease.

LIFE HISTORY OF *PERFORATELLA BIDENTATA*

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Laboratory and field observations made it possible to ascertain the following life cycle parameters of *Perforatella bidentata*: mating includes four phases, the longest being courtship; sperm is transferred in spermatophores. Eggs are laid in the winter (November-February) and summer (May-September), in batches of 2–20. They are calcified, slightly oval, ca. 1.5 × 1.8 mm. Incubation takes 8–34 days, hatching is asynchronous. Growth from hatching to maturity lasts from ca. 3 to 9 months. In the wild the youngest age class appears in July. The maximum life span is 3 years. Activity is the greatest in the spring and autumn; in all seasons it is greater in the night and early morning; juveniles are more active than adults. Individual mobility is up to 5 m/month.

HISTOLOGICAL STRUCTURE OF THE OVARY OF *SINANODONTA WOODIANA*

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The objective of the study was to describe the histological structure of the ovary of *Sinanodonta woodiana* (Lea, 1834) and to measure its component structures. The bivalves were caught in the discharge canal of the power plant in Nowy Czarnów. They were preserved in 6% formaldehyde. A fragment of 10 × 5 mm was cut out from each ovary. The tissue was dehydrated, cleared and embedded in paraffin. Serial sections were made of 269 ovaries. Slides stained with the Ehrlich hematoxilin and Y eosin were examined in light microscope Nikon Eclipse 80i. Measurements of follicles and oocytes during proto- and trophoplasmic growth were taken with the programme NIS Elements. *S. woodiana* is dioecious, with 2% of hermaphroditic individuals. Its ovary has a follicular structure. The gonad is in places overgrown with muscular tissue, and interfollicular spaces are filled by haemocoel. The gonad parenchyma is formed by follicles. Nurse cells are situated on the basal membrane of the follicle. The oocytes grow out of the follicle wall. At the end of vitellogenic growth the oocyte contacts with somatic cells only with its basal part, by means of a peduncle. Ovulated oocytes of *S. woodiana* are polarised, the nucleus is located on the animal pole. The cells are surrounded by vitelline membrane of gelatinous character. The study was financed by grant no. N303 068 32/2367 (2007–2009).

WHEN DO *VESTIA GULO* AND *V. TURGIDA* BECOME FULLY MATURE?

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Development of the reproductive system in *Vestia gulo* and *V. turgida* was studied based on specimens at development stages: JVI (6.0–6.9 whorl), JVII (7.0–7.9), JVIII (8.0–8.9), JIX (9.0 till closing apparatus completion), SA (closing apparatus and lip), AM1 (one month after lip completion), AM3 (adults of 3 months) and AM6 (adults of 6 months). Maturation of the reproductive system is very similar in *V. gulo* and *V. turgida*. Stage JVI is the earliest when gonad primordia can be identified, as small lump-like structures not divided into lobules. Histologically, only numerous intensely dividing cells can be seen (prophase of the first meiotic division, mitoses); they fill the whole organ. Stage JVII is very similar to JVI, though the gonad is slightly larger. At stage JVIII the gonad lobes occupy an even greater space; the lobules begin to form. Besides the intensely dividing cells, the first, single small oocytes are observed. At stage JIX the lobules are clearly visible; besides the dividing cells they contain the first spermatocyte rosettes and few small oocytes. At stage AS the lobules are filled by numerous dividing cells, the number of rosette-forming spermatocytes increases, the first spermatids appear, as well as spermatozoa at various development stages. One month after lip completion (AM1) the dividing cells are still visible, the number of mature sperm packets and the number of growing previtellogenic oocytes increase. At stage AM3 the lobules are mainly filled by numerous sperm packets, cells in meiotic prophase being less numerous. Also the first vitellogenic oocytes appear, while at AM6 the gonad is histologically identical with that of adults of one year, two years and older. The remaining organs at stages JVI-IX are small ducts (thin, translucent threads) – primordial hermaphroditic duct, spermoviduct, epiphallus, penis, oviduct and vagina; at stage AS the hermaphrodite duct becomes visible as a somewhat folded structure, primordium of spermatheca with a round widening at the end as well as mucus gland primordium form, and primordia of penis (distinct thickening), oviduct, vagina and albumen gland become visible. Three months after growth completion all the organs are well developed, and six months after growth completion developing embryos can be retained in the oviduct.

MACROGASTRA BADIA IN ZIELENIEC (BYSTRZYCKIE MTS, CENTRAL SUDETES). ECOLOGY, CONSERVATION STATUS AND LIFE HISTORY – PRELIMINARY DATA

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Information on the distribution of the Alpine *M. badia* in Poland dates from the 1960s and was not verified subsequently. A new locality was discovered in 2003 (Bystrzyckie Mts, Zieleniec near Duszniki-Zdrój); it forms a part of a group of isolated, Polish and Czech localities on the border of the species' distribution range. In the discussed part of the range the species is threatened by habitat destruction and climatic changes. It is legally protected in Poland but preserving its populations requires protection of its habitats. The preferred habitat is herb-rich beech forest, and cool and humid climate is crucial for the species' survival. The composition of the accompanying malacofauna varies between the sites which is probably associated with their origin. *M. badia* is oviparous; it reproduces in May and June producing batches of 1–3 eggs. The eggs are partly calcified, 1.39–1.61 in major and 1.32–1.45 mm in minor diameter. The incubation period is 16–19 days; the hatching is asynchronous; the juveniles reach adult size in 7–8 months. Some data on shell variation are provided; the number of apertural folds varies more widely than formerly believed.

THE OCCURRENCE AND VARIATION OF *HIPPEUTIS COMPLANATUS* IN FOREST SUBSIDENCE PONDS

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Hippeutis complanaus (L.) is rare in anthropogenic reservoirs of southern Poland, except fish ponds. In the Red List of Upper Silesia it is endangered by environmental transformations. It usually reaches small densities and occurs in scattered localities. The research was aimed at determining its habitat requirements and presenting its shell size structure in annual cycle. Samples were taken thoughout the year from two forest subsidence ponds in Upper Silesia. The ponds formed as a result of deep coal mining; pond 1 is 22.3 ha, and pond 2 – 66.7 ha in area; their maximum depth does not exceed 3 m. Fallen leaves accumulate near their shores. During the study period 20 samples were taken in each pond. The snails were collected from plants (mainly their remains) and fallen tree leaves, using metal frame 0.25 m^2 in area; the snail density was then converted to 100 g dry

plant weight. Shell height and width were measured and whorls were counted. Five width classes were adopted – class 1: 0–1 mm, 2: 1.1–2 mm, 3: 2.1–3 mm, 4: 3.1–4 mm and 5: 4.1–5 mm. Physico-chemical analysis of water considered parameters which affect snail occurrence. A total of 837 live *H. complanatus* were collected. It was present in the samples from April till November. Its peak abundance differed between the ponds (September for pond 1, June for pond 2). Most individuals were found in the thick layer of leaves fallen from the shore trees (84.5% in pond 1; 97% in pond 2), only single snails were collected from aquatic plant remains. In both ponds class 2 formed the majority, while the largest and the smallest individuals were relatively few. According to literature data the shells reach 5 mm width and 1.2 mm height, and have a maximum of 4–4.5 whorls. In the studied ponds the largest shells were 4.3 mm wide and 1.1 mm high. The size structure in the two ponds was similar. The smallest snails in both appeared in June and August. In pond 1 juveniles were present also in July. In August they were most numerous in both ponds. This may indicate two reproductive periods: May and July. In the spring only snails of class 4 were found, indicating that they had appeared in the previous year. Starting with the spring the largest (last year) specimens began to die out and a distinct growth of juveniles was observed.

DEVELOPMENT OF CLAUSILIAR APPARATUS IN *VESTIA GULO*

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Clausiliid shell growth is uneven: the greatest shell height increments are observed during the body whorl formation. In the laboratory (18–25°C) this stage takes ca. two weeks. It is during this last stage that the clausiliar apparatus is built. It is composed of a complicated system of plicae and lamellae and the so called clausilium. The clausiliar apparatus provides important taxonomic characters. The shell growth terminates with lip formation. The formation of clausiliar apparatus in *Vestia gulo* was analysed and illustrated with SEM photography. The sequence of lamellae and folds formation was as follows: 1) inferior and spiral lamella, 2) superior lamella, subcolumellar lamella, clausilium, principal palatal plica 3) lunella and other palatal folds. Under laboratory conditions the closing apparatus developed during two weeks. The shell development in *Vestia gulo* was compared with literature data on another clausiliid *Herilla bosniensis*. The possible adaptive significance of the rapid development of apertural barriers is discussed in relation to the reproductive biology of Clausiliidae.

RUTHENICA FILOGRANA – AN OVOVIVIPAROUS CLAUSILIID

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In laboratory conditions *R. filograna* produces progeny at the earliest one month after lip completion. The interval between consecutive births is on average ca. 1.5 month. *R. filograna* is ovoviviparous. Adults most often produce 2–3 juveniles, at most 4, with complete embryonic shells. Embryonic development takes place within the parent's body, and on birth the juveniles are capable of independent existence. No egg batches were observed in the laboratory. Observations on embryonic development were based on dissection of adult *R. filograna* from the population in the nature reserve Dębno on the Warta in Wielkopolska. The size of the embryos does not change with their number in the uterus. The embryo length is ca. 1/8 of the mean shell height and 2/5 of the mean shell width. The embryo-filled uterus occupies from 2/3 to 1 1/2 whorl of the visceral sac. The embryos in the uterus are always arranged linearly. With few exceptions, the embryos within the uterus are at the same development stage. The proportion of advanced embryos was high in May, July and August, and dropped to zero from September to April. From November till February no adults contained embryos; *R. filograna* does not winter over as pregnant.

POPULATION DYNAMICS OF *LYMNAEA SARIDALENSIS* FROM LAKE CHANY (W. SIBERIA)

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The aim of this study was to trace the population dynamics of *Lymnaea saridalensis*, a common freshwater snail, in the south of Western Siberia. The population was monitored in 2002–2007 in Lake Chany. The density was assessed based on the approximate number of snails collected per square metre of the lake littoral. Data on water level and temperature were obtained daily in the estuary of the Kargat River. The mean water level changed within 0.5 m. During the study period the mean annual snail density decreased from about 16.1 to 4.0 per square metre. There was no significant correlation between the den-

sity and the mean water level (r=0.296, p<0.05), though there was an increase tendency with the increasing water level. The mean annual density was positively correlated with the mean water temperature in the summer (r=0.892, p<0.05). The density was the greatest in June (large number of juveniles). In the autumn the number of molluscs decreased. In years with high water level and high temperature the population densiy tended to increase. The study was financed by the Russian Fund of Basic Research (03-04-48807, 07-04-01416a).

SYSTEMATICS, STRUCTURE & GENETICS

GENETIC DIFFERENCES AND SIMILARITIES AMONG SLUGS OF THE GENUS *ARION*

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The genus *Arion* includes five subgenera: *Arion, Carinarion, Kobeltia, Mesarion* and *Microarion*. About a dozen species live in Europe; eight of them are found in Poland. Identifying members of *Arion* based on anatomical characters is often problematic. Many species differ only in the structure of their reproductive system. Specimens found in the field are often too young to display all the diagnostic characters of the genitalia. Since the genus includes several plant pests, it is important that even inexperienced people should be able to identify species. We made an attempt at finding the best molecular marker which would enable identification of all species of *Arion*. The studies had other interesting implications. Molecular analyses of various members of *Arion* included nuclear and mitochondrial DNA (genes 16S rRNA and *cox1*) and were based on our own results and the Gene Bank data. Analyses of nuclear DNA involved the region repeated in the genome, including ribosomal genes and non-coding sequences (18S, ITS1, 5,8S, ITS2, 28S) in 27 species of *Arion*. That DNA region was found not to vary in 10 species, in the remaining species the variation was up to 1.5%; it was the greatest in *A. subfuscus* (3%). Variation between species was 0.3–11.7%; it was the greatest (ca. 54%) between *A. subfuscus* and the remaining species. Some species, such as *A. irratti* against *A. lizarrustii* and *A. moline* or *A. nobrei* against A. *flagellus* and *A. flugineus*nie showed no interspecific differences in that DNA region. Misidentifications of some species were detected, based on the analysis of variation for over 100 sequences in each gene available in the Gene Bank for *Arion*.

KARYOTYPES OF SOME PALAEARCTIC SPECIES OF THE GENERA *SPHAERIUM* AND *PISIDIUM*

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Chromosome numbers of sphaeriid species reported so far vary from 30 to more than 200, the higher ones probably resulting from ancient allopolyploidy; in *Sphaerium corneum* intraspecific variability and supernumerary chromosomes have been reported. I examined karyologically 2 species of *Sphaerium* (*S. corneum, S. nucleus*) and 6 species of *Pisidium* (*P. casertanum*, *P. personatum*, *P. obtusale*, *P. supinum*, *P. nitidum* and *P. henslowanum*). The chromosome number in *P. casertanum* (2n=180–190) is well in compliance with earlier findings of other authors. The karyotypes of *P. personatum* (2n~210), *P. obtusale* (2n~210), *P. supinum* (2n~150), *P. nitidum* (2n~180) and *P. henslowanum* (2n=200–210) are reported here for the first time. Within the sibling species complex *S. corneum* and *S. nucleus*, differences in karyotypes are intraspecific rather than interspecific – both taxa have 30 chromosomes plus a varying number of supernumeraries. Supernumerary chromosomes do not form bivalents during meiosis. Interestingly, in contrast to some other organisms with B-chromosomes, in *Sphaerium* the supernumeraries are probably not heterochromatinised, as could be inferred from the results of C-banding.

SHELL DEFECTS IN *CEPAEA VINDOBONENSIS*

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The terrestrial snail shell is one of the structures reflecting the effect of geochemical factors on organisms. Shells show many characters which provide systematic information. Variation in shell morphology under the effect of geochemical characters of the environment may create problems when trying to identify species. Shells of *Cepaea vindobonensis* lose their colour pattern in extreme habitats (e.g. margins of floodplains). The wide variation of the species may cause problems regarding identification, constancy and genetic continuity of features regarded as characteristic of the species. Studies on such problems require an interdisciplinary approach. The interface of malacology, physiology, geology, mineralogy, crystallography and chemistry may explain these problems in *C. vindobonensis*. Preliminary results show that such an approach is useful. Microscope studies and detailed quantitative analysis in micro-areas made it

possible to describe the chemical composition, similarities and differences in the shell structure between *C. vindobonensis* from different habitats.

DNA BARCODING AS A TOOL FOR IDENTIFYING MOLLUSC SPECIES

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DNA barcoding is a means of quick and unambiguous species identification. The main criterion of conspecificity is possessing an almost identical marker DNA sequence. The nucleotide sequence used as "barcode" must be short and come from a specified, always the same place in the genome. At present the standard "barcode" for animals is a fragment of 648 nucleotides from the 5' end of mitochondrial gene of the first subunit of cytochrome oxidase (*COI*). The fragment proved sufficient to identify many bird, fish, fly, butterfly and other animal species. Variation in *COI* sequence among conspecific animals is very small and essentially within 1–2%, while it is much greater among individuals of different, even closely related, species. The *COI* "barcode" turned out to be useless for plants, probably because of the low rate of evolution of their *COI* gene. Experiments are in progress in order to find a different barcode sequence for plant species identification. Consortium for the Barcode of Life (CBOL) was established in order to use DNA barcoding as a global standard in taxonomy; till now it was joined by over 170 institutions from 50 countries. One of its main aims is to create a large public library of barcode sequences assigned to particular species. Such a database would enable researchers to assign their specimens to species of already known barcode sequences. One of the main such databases is the Barcode of Life Database (BOLD). The analysis (March 2009) of data from the BOLD base shows that all the sequences there originate from 772,665 specimens, 553,176 of the sequences meeting the requirements of barcode sequences and representing 75,000 species. Among these, molluscs are represented by 27,462 specimens; 21,665 meet the barcode requirements and represent 4,597 species. Molluscs are represented by six classes in the BOLD base: Aplacophora (6 specimens, 6 species); Bivalvia (5,213 specimens, 808 species); Cephalopoda (2,118 specimens, 252 species); Gastropoda (18,756 specimens, 3,440 species); Polyplacophora (1,168 specimens, 74 species) and Scaphopoda (128 specimens,16 species).

DO *TROCHULUS PLEBEIUS* (DRAPARNAUD, 1805) AND *T. CONCINNUS* (JEFFREYS, 1830) EXIST?

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The genus *Trochulus* Chemnitz, 1786 was earlier known as *Trichia* Hartmann, 1840. As a result of the decision of the ICZN, Opinion 2079 (BZN 61 (3) Sep. 2004), the name was changed to avoid homonymy with *Trichia* de Haan, 1839 (Crustacea: Brachyura). Till now *T. hispidus* (Linnaeus, 1758) was regarded as distinct from *T. plebeius* (Draparnaud, 1805) and *T. concinnus* (Jeffreys, 1830), described from western and central Europe. Distinguishing between the three forms was always problematic, and the studies on interpopulation and individual variation of *T. hispidus* in Poland showed that the variation range was very wide. Populations of *T. hispidus* from Muszkowice and Zieleniec departed in their shell proportions from the remaining Polish populations, and resembles forms described as *T. plebeius*. Biometrical analysis of an extensive material (total of 2,339 specimens from 58 localities) showed that conchological variation ranges of *T. plebeius* and *T. concinnus* were within that range of *T. hispidus* and revealed not a single character that would enable an unambiguous distinction between these forms. Nearly every examined population differed statistically significantly from the remaining populations in at least one character, while intra-population variation ranges of most characters were very wide. Most populations differed in their shell measurements, proportions and the number of whorls. Some pairs of populations differed in all or nearly all analysed characters. Though descriptions of *T. plebeius* (Draparnaud 1805: 105) and *T. concinnus* (Jeffreys 1830: 336) are very laconic, and the original materials have been preserved only for *T. plebeius* (Naturhistorisches Museum Wien), it seems justified to synonymise *T. plebeius, T. concinnus* and *T. hispidus*.

MITOGENOMIC CHARACTERISTICS OF *UNIO PICTORUM*

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As a rule, animal mitochondrial DNA (mtDNA) is inherited from the mother (SMI, Standard Maternal Inheritance). A different system, called doubly uniparental inheritance (DUI) has been described in some marine (Mytilidae, Veneridae, Danacidae, Solenidae) and freshwater bivalves (Unionidae, Margaritiferidae, Hyriidae). In DUI females transfer their mtDNA (F

haplotype) to both daughters and sons, while males transfer their mtDNA (M haplotype) only to their sons, and it is present in male gonads. The occurrence of DUI in phylogenetically remote families suggests that it may be widespread among bivalves. The DUI mechanism is better known in marine bivalves where deviations from it, concerning recombination and masculisation, are often observed. Complete mtDNA sequences including F and M aplotypes have been obtained for *Mytilus edulis, M. galloprovincialis* and *Venerupis philippinarum*. Among more than 300 freshwater bivalves (Unionidae) DUI was detected, based on single genes (*cox1*, *cox2* or cytochrome b), in nearly 40 species. The two complete mitochondrial genomes are known only for *Inversidens japonensis*, while only F type is known in *Lampsilis ornata*. Our study was aimed at obtaining a complete sequence of mitochondrial genome of F type in *Unio pictorum*. Three female genomes were obtained; they were analysed with respect to the size, number and sequence of the genes, and intraspecific variation within F haplotype. The female mitochondrial genome in *U. pictorum* is relatively small and tightly packed. It has 15,760 base pairs and 37 genes: 13 coding proteins, 2 ribosomal genes and 22 tRNA genes. The sequence of the genes is identical with that in *Lampsilis ornata*; the variation level is 30%. The study is financed by the MNiSW, grant no. N 303 3647 33.

SECRETS OF BIVALVE MITOCHONDRIAL GENOME

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Inheritance of mitochondrial DNA is among the important problems of contemporary genetics. The system of inheritance of mtDNA, different from the maternal one (SMI, Standard Maternal Inheritance) and called doubly uniparental inheritance (DUI), was observed in seven bivalve families (Mytilidae, Veneridae, Hyriidae, Margaritiferidae, Unionidae and recently Danacidae and Solenidae). DUI was detected in relatively few species, based on female and male sequences for single genes (*cox1, cox2* or cytochrome b). Complete sequences of both mitochondrial genomes are known only for a few species, of mainly marine bivalves. Among freshwater bivalves they are known for *Inversidens japonensis* while in *Lampsilis ornata* only the female genome is known. The greatest problem in comprehensive studies on mtDNA, which includes ca. 16 thousand base pairs, is the scanty knowledge pertaining only to single genes of different species (on average ca. 10% per species). This precludes simple PCR reactions. In order to obtain sequences of the whole mitochondrial DNA molecules, amplification with long range PCR is necessary (LR-PCR) using properly selected starters, and then sequencing of PCR product with "primer walking". Processing and assembling of raw sequencing results is done with computer programmes Phred, Staden, FitchTV or DNAMAN. Annotation of the resulting genomes is semiautomatic, with a package of programmes (critica, glimmer3, wise2 and cove) implementing several different gene-identifying algorhitms. Analysis of polymorphism of the resulting mitochondrial genome sequences is performed with programmes DnaSP, Mega4, DNAMAN and PHYLIP.

FOSSIL

USE OF ISOTOPE RECORD ($\Delta^{13}C$ AND $\Delta^{18}O$) IN MOLLUSC SHELLS IN PALAEOLIMNOLOGY

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The analysis of composition of stable isotopes of carbon and oxygen ($\delta^{13}C$ and $\delta^{18}O$) in autochthonous lacustrine carbonates has been a part of palaeolimnological studies for thirty years. Interpretation of carbon isotope record enables conclusions about productivity and time of water retention in the lake. Oxygen isotopes make it possible to reconstruct changes in water temperature. $\delta^{18}O$ record conveys information on the water exchange rate and evaporation intensity. In most palaeolimnological studies fine carbonate fraction is the one subject to isotope analysis (e.g. $\delta^{13}C$ and $\delta^{18}O$ in ostracod carapaces). Though molluscs are often well represented in deposits, their shells are rarely subject to isotope analyses. The most often studied shells are those of *Pisidium*. Use of isotope content in mollusc shells in palaeolimnological studies has its advantages and limitations. Some physiological factors affect the isotope composition of shells. Food-derived carbon and breathing with atmospheric air may have an effect on $\delta^{13}C$ in shells. Mollusc fossil record often lacks continuity. Freshwater snail and bivalve shells are usually built of aragonite which then recrystallises to calcite; this may be accompanied by changes in their isotope composition. One of the davantages is the absence of any doubts as to the origin of shells, as opposed to the fine carbonate fraction of deposits which may contain allochthonous debris. It is believed that mollusc shells are formed in isotope balance with DIC (dissolved inorganic carbon) and water; consequently they provide information on isotope conditions in which they arise. Selection of species which inhabit different microhabitats in the lake makes it possible to com-

pare isotope composition of DIC and water in various parts of the lake. Isotope composition of consecutive shell increments reflects seasonal changes in $\delta^{13}C_{dic}$ and $\delta^{18}O_{water}$ and in long-lived species even long-term changes. There is no published information on the dependence between isotope composition of shells of particular mollusc taxa and $\delta^{13}C_{dic}$ and $\delta^{18}O_{water.}$ Such studies could verify the shell formation in isotope balance with DIC and water, postulated on the basis of analyses of isotope composition of single species.

MOLLUSCS AND RECONSTRUCTION OF THE NEOLITHIC ENVIRONMENT AND HUMAN ECONOMY

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Human economy in the Sandomierz Upland dates back to the beginning of the Neolithic; it involved deforestation, grazing, mining of iron ore and flint. Archaelogical exploration makes it possible to reconstruct spatial organisation of local communities, but the anthropogenic effects on the natural environment are still obscure. Such changes are sudden and trigger irreversible successional and biogeographical processes. Studies on Quaternary natural environment in the Kamienna river catchment area provide information on its development; fossil soils and molluscs document the climate and vegetation. Archaeological site No 63 in Krzczonowice, on a loess hill, was excavated in 2006–2008. Besides archaeological artifacts, mollusc remains were found. The material included 12 shells, 8 of them *Cepaea vindobonensis*. A shell of *Bradybaena fruticum* was found in one object, and shells of *Unio crassus* in two. Snail immigration to areas deforested by humans resulted in establishing populations of Pontic and Mediterraean species. At present *C. vindobonensis* lives in xerothermic swards on limestone. Its presence in the discussed site indicates that during ca. 1,500 years the habitat on the loess hill in Krzczonowice had a steppe character. Appearance of *B. fruticum* – a typical species of shaded habitats – means cessation of grazing on the hill and development of vegetation. Appearance of *C. vindobonensis* in the Sandomierz Upland and the Świętokrzyskie Mts was usually associated with the beginning of the 19th c., but the archaeological studies in Krzczonowice place it much earlier. Besides floristic data which are used in archaeology, molluscs can contribute information on the type of land use.

MOLLUSC-BEARING DEPOSITS IN WILDNO, DOBRZYŃSKIE LAKELAND

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Mollusc-bearing deposits were found during geological research in Wildno, ca. 10 km N of Lipno (Dobrzyńskie Lakeland), at the depth of 3.0–6.5 m. The deposits in the form of silt, sandy mud and fine-grained sands are covered by loams of the Vistula glaciation (upper stadial), and overlay dark grey silt without mlacofauna. The shells are poorly preserved. The dominant taxa are *Viviparus* sp. and *Valvata* sp. (probably *V. piscinalis*), shells with upper whorls preserved (to 2.5) being the most numerous. One complete and several damaged opercula of *Bithynia tentaculata* were also found, as well as shell fragments of that species and *Theodoxus* cf. *fluviatilis*, shell debris of *Pisidium* cf. *amnicum* and *Sphaerium* sp. All the molluscs are freshwater forms, of both stagnant and flowing waters, and it is difficult to precisely determine the character of the water body in Wildno. Palynological analysis of the underlying silts indicates their accumulation in a small, shallow oligotrophic water body in a cool climate (presence of *Pediastrum kawraiskii*), in an open environment. The malacofauna-bearing deposits are practically devoid of pollen, but the composition of the mollusc assemblage (i.a. presence of *Viviparus* sp.) indicates more favourable temperature conditions. Radiocarbon dating of mollusc remains determines them as older than the maximum of the last glaciation. It can be conjectured that the deposits may represent an interstadial within the Vistula glaciation, which is rare in Poland. Further studies will explain the stratigraphic position and the origin of the deposits.

FRESHWATER AND BRACKISH BIVALVE ASSEMBLAGES FROM LOWER JURASSIC DEPOSITS OF POLAND

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The studied fossil bivalve assemblages come from silicoclastic Upper Jurassic (Liassic) deposits of the northern boundary of the Świętokrzyskie Mts. The collection includes several hundred specimens collected from nine localities, stratigraphically including the Hettangian, Pliensbachian and Toarcian. The geological profile of the Early Jurassic in the Świętokrzyskie region includes a few sedimentation episodes associated with the development of brackish and marine environments within the epicontinental basin of

fluvial accumulation. Preliminary results of palaeoecological analysis of the deposits indicate significant succession-associated changes in the malacofauna. The lowest Hettangian is represented by river deposits, and their bivalve fauna consists of unionoids. Estuarine deposits, situated above them, are associated with the marine influence and development of brackish habitats; they bear a rich assemblage with *Cardinia follini*, *C. inglensis*, *C.* cf. *kullensis* Troedsson, '*Modiola*' *ruuthi* Troedsson, *Taeniodon nathorsti* (Lundgren), '*Pholadomya*' *cuticulate* (Lundgren), '*Eotrapezium*' sp. A similar assemblage from brackish deposits of the Hettangian in Skåne (Sweden) is associated with the initial transgression of the lowest Jurassic in Europe. Another succession is observed in the late Hettangian deposits, during the maximum of Hettangian transgression in the early Jurassic epicontinental basin of Poland. Besides marine bivalves of the genus *Cardinia*, the deposits bear remains and traces of marine arthropods (Limulidae, Malacostraca). The maximum of the Liassic transgression corresponds to silty-sandy sedimentation; the deposits contain numerous fossils of marine bivalves and arthropod traces. The Liassic sequence ends with deposits associated with fluvial accumulation and the appearance of Unionoida. The freshwater environments show a smaller species diversity (1–3 species) compared to the brackish-marine and lagoon habitats (3–7 species). Six assemblages of different age can be distinguished in the Świętokrzyski region: two associated with freshwater habitats, two – with brackish conditions (estuary-lagoon) and two – with brackish-marine environments.

EXPERIMENTAL DECOMPOSITION OF RECENT BIVALVES AND MINERALISATION OF GILLS OF TRIASSIC UNIONOIDA

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Fossil bivalves of the order Unionoida with mineralised gills were found in late Triassic deposits of Lower Silesia. Preservation of such tissues requires mineralisation early enough to prevent their further decomposition. The expeiment was to indentify the stage at which gill decomposition in the Triassic bivalves stopped, and to explain the mechanism of mineralisation. In involved decomposition of recent *Unio tumidus*; the results were then compared with the state of preservation of the mineralised fossil gills. SEM observations of recent gills (known time of bivalve's death, pH, O_2 concentration, electric conductivity, temperature) made it possible to identify stages of gill decomposition. EDS analysis showed that the fossil gills were preserved as calcium phosphate (contrary to the surrounding deposit which contained mainly aluminosilicates). The Triassic gills contained aggregations of 1–2 μm long mineralised bacteria, suggesting – in the absence of calcium phosphate crystals – bacterial mineralisation. Bacteria of a similar morphology and density were found in the experimental gills at pH ca. 6.5 (bacteria of such morphology were present only in samples at pH=6.9), which may be associated with a greater stability of calcium phosphate, compared to calcium acrbonate, in acid conditions. Comparison of the state of preservation of the fossil gill filaments and the morphology of bacteria, and also adductor muscles (non-functional) with the experimental data made it possible to estimate the time of mineralisation as between 64th and 92nd hour after death.

PARASITOLOGY

TREMATODE INFECTION IN *VIVIPARUS VIVIPARUS* IN SELECTED OXBOWS OF THE BUG RIVER

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Viviparus viviparus is known to adjust its fecundity to unstable environmental conditions. Long-term studies on its populations in oxbows connected with the river showed a high fecundity irrespective of the size class. The aim of the research was to explain this high fecundity. The reason may be the so called compensation fecundity, associated with earlier sexual maturation of young, infected snails. The extensity of infecion with larvae of digenetic trematodes was estimated in populations of *V. viviparus* from two oxbows of the Bug River. In both water bodies most snails were infected with larvae of *Amblosoma exile*, *Neocanthoparyphium echinatoides* and *Leucochloridiomorpha lutea*. The extensity in both sexes exceeded 80%. The trematodes were found only in the largest snails – size classes III and IV. The invasion intensity increased with the shell size. No decrese in fecundity was observed in snails with larvae of digenetic trematodes.

SNAILS OF THE BRODNICKIE LAKELAND AS HOSTS TO DIGENETIC TREMATODES

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The study was aimed at ascertaining the species composition and degree of infection of the most

abundant pulmonates and prosobranchs with partenites of digenetic trematodes. The 2008 collecting, from May to September, included selected water bodies of the Brodnickie Lakeland and yielded 5,548 snail individuals representing 6 families and 16 species. The most abundant species were *Lymnaea stagnalis* (1,386 specimens), *Planorbarius corneus* (1,009) and *Viviparus contectus* (1,229). Twenty two trematode species were detected in *L. stagnalis*, 12 in *P. corneus* and only 6 in *V. contectus*. The prevalence of infection among the two pulmonate species was identical (mean annual prevalence 31%); only about one quarter of the prosobranchs (24.9%) carried parasitic larvae. The difference may have external reasons (access of ultimate hosts to snail habitats, survival of dispersion forms of the parasite and their ability to find host snails), but may also be related to the structure and behaviour of potential hosts. Pulmonates, exploiting more varied microhabitats and devoid of protective operculum, are more susceptible to parasite infection.

THE EFFECT OF PROSTHOGONIMID PARTHENITES ON MORPHOMETRIC SHELL CHARACTERS OF *BITHYNIA TROSCHELI*

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The population of *Bithynia troscheli* from the Kargat river (Lake Chany basin, SW. Siberia) was studied with respect to its age (growth lines) and sex (genital system) structure, and morphometrics (shell height and width, spire height, aperture height and width). Snails aged 2+ and 3+ differed signifiantly in all measurements. 4,343 shells of uninfected snails were compared with 202 shells of prosthogonimid-infected snails. All the shell characters assumed greater values in the infected snails: shell height: females 1+ – 110.8% (df=46; p=0.002); females 4+ – 108.4% (df=14; p=0.05), males 2+ – 112.2% (df=36; p<0.002); males 3+ – 114.7% (df=83; p<0.001); shell width: females 1+ – 105.8% (df=29; p<0.04); females 3+ – 105.5% (df=31; p<0.001), males 1+ – 109.8% (df=14; p=0.004); males 2+ – 109.1% (df=33; p=0.003); males 3+ – 111.6% (df=28; p=0.003); spire height: females 1+ – 110.6% (df=29; p<0.006); females 3+ – 108.1% (df=18; p<0.001), males 1+ – 126.9% (df=11; p=0.002); males 2+ – 119.0% (df=28; p<0.001); males 3+ – 122.4% (df=16; p<0.01); aperture height: females 100-103%, males 1+ – 115.5% (df=32; p=0.004); males 2+ – 103.8% (df=28; p<0.03); aperture width: females 1+ – 108.3% (df=29; p<0.05); males 1+ – 115.4% (df=11; p<0.001); males 2+ – 108.4% (df=28; p<0.03).

RESPONSES OF FRESHWATER MOLLUSCS' SYMBIOTIC COMMUNITIES TO ANTHROPOGENIC IMPACT IN FIELD EXPERIMENTS

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Biological indication of water quality with the use of symbiotic (parasitic) organisms is currently developing and being discussed. Infection parameters of widespread ciliates – unionid symbionts – can also be used as biological indicators: samples of unionids (with known parameters of ciliate infection) are placed in habitats under different anthropogenic impact; the ciliate presence and number are recorded after a period of exposure. The method was further developed by using also snails and their trematodes. In field experiments, samples with known parameters of infection were placed in an extremely polluted Lake Opechen-Verkhnje (Kyiv). The results of parasitological dissection after the exposure were compared with infection parameters in the control locality – a flood reservoir of the Desna River (the experimental bivalves came from the same locality). Two experiments, of 14 and 30 days duration, were carried out. At the beginning of the experiments, the molluscs were attached to the bottom in soft net containers. The 14-day exposure seemed to be optimal for detection of changes for the ciliate–clam system (hosts – unionids) and the 30-day exposure – for the trematode–snail system (host – *Viviparus viviparus* L.). The 14-day ciliate-unionid experiment suggests that different ciliate species of the genus *Conchophthirus* react differently to anthropogenic impact. *C. curtus* Eng., 1862 is sensitive to such impact which results in a decrease of infection parameters. A considerable increase in infection intensity (almost 3 times) was observed for *C. unionis* Raabe, 1932. The 30-day trematode-snail experiment indicates that the system *V. viviparus-Cercaria pugnax* La Valette is the most sensitive to pollution.

PARASITIC CASTRATION OF SNAILS – FACTS AND MYTHS

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Digenetic trematodes are parasites of heteroxenic life cycle in which snails play a part of the first intermediate hosts. The parasites reach sexual maturity in many vertebrate species, while their relation to

molluscs is highly specific – usually parthenites of one trematode species can develop only in one or two snail species. The unique character of the trematode-snail interaction results from the fact that, despite the high invasion intensity, the parasite remains in a long-term relationship with its intermediate host, successively releasing dispersion forms. Parasitic larvae developing in snails may affect a variety of aspects of their host's life: mortality, condition, reproduction and behaviour. The effect on the reproduction of host snails is polyvalent and may cause host's earlier maturation, compensation fecundity, inhibition of gonad activity or castration. Parasitic castration may result from disturbed hormonal balance of the host or destruction of the gonad in which the parasite's parthenites develop. Limiting or complete prevention of snail reproduction is regarded by various authors as the reason for the changed shell growth pattern (shape change, forming additional structures), disturbed calcium metabolism, somatic dwarfishness or gigantism, and also changes in the host's behaviour whereby the parasite would manipulate the host to increase its own success.

PHYSIOLOGY

ANTIOXIDATION DEFENSE OF THE ROMAN SNAIL DURING WINTER TORPOR

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Resuming activity after a period of winter torpor implies a risk of oxidation stress: increased metabolic rate and consequent oxygen consumption result in intensified synthesis of free radicals. Our earlier studies showed that the Roman snail was capable of spontaneously resuming activity in the spring, irrespective of environmental conditions. This study was aimed at checking if the increased activity in that period was preceded by enhanced antioxidation defense. Activity of antioxidation enzymes and concentration of a non-enzymatic antioxidant – reduced glutathione (GSH), as well as that of malonic aldehyde (MDA), a natural indicator of lipid peroxidation, were measured in the hepatopancreas, kidney and foot of snails at the beginning (November), in the middle (January) and at the end (April) of winter torpor. The control group included active snails examined in the autumn and spring. The activity of the antioxidation enzymes was the smallest at the beginning of winter torpor and then increased with its progress; these changes suggest a precise regulation of antioxidation defensive mechanisms. The GSH concentration did not change depending on the torpor phase but varied between the organs, being the highest in the hepatopancreas and the smallest in the foot. The MDA concentration increased in the kidney and foot, but remained unchanged in the hepatopancreas during the whole torpor period. GSH seems to play a protective role in the hepatopancreas, since it takes part in detoxication processes. The results suggest that the Roman snail actively regulates its antioxidation defense during the winter torpor, thus preventing damage during resumption of activity.

DO MOLLUSC CELL MEMBRANES HAVE AQUAPORES?

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Aquapores are found in cell membranes of nearly all organisms. They are built of proteins called aquaporines, members of the group of major intrinsic proteins (MIP). All aquaporines characterised till now are homotetrameres. Each of their monomeres contains six transmembrane domains of alpha-helix structure and five connecting loops. As a result of interaction between the aminoacids in the domains and the loops, the polypeptide forms, in the two-layered phospholipids of the cell membrane, an hour-glass shaped structure, with a pore in the centre. Its structure ensures selective transport, letting through only molecules without electric charge, such as water or glycerol. Recently it has been found that some aquaporine pores transport also other substances, such as CO_2, H_2O_2, NO, NO_2 and NH_3. However, the question if the transport of such molecules through aquapores is of physiological significance remains open. Since the discovery of aquaporines, they have been studied in detail in cells of various organs of mammals, especially mice and humans. Little is known of invertebrate aquaporines. There is no information on the presence or kind of aquaporines in molluscs. To demonstrate their presence we performed an array of experiments in order to find their corresponding nucleotide sequences in genetic material isolated from a selected snail species. Based on the known sequences of two conservative aminoacid motifs lining the pore, we designed degenerated oligonucleotides which we then used in PCR reactions. The matrix for the reaction was cDNA reversely transcribed from RNA isolated from a fragment of foot of *Helix pomatia*. The nucleotide sequence of one

of the products obtained by us was to a large degree similar to the known aquaporine sequences. Unfortunately, the obtained fragment was very short and allowed only to conjecture that snail cell membranes probably have aquaporines. We are planning to characterise their component proteins.

APPLIED

LABORATORY TESTING OF SELECTED CHEMICALS AS MEANS OF SLUG CONTROL

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Atmospheric conditions in glasshouse and foil tunnel cultivatins favour development and feeding of slugs throughout the year. Their excessive reproduction, combined with the absence of natural enemies, may create serious problems. As a result of slug feeding the plants lose their decorative and economic value. In such conditions slug control with traditional methods – molluscicides – is difficult and not always satisfactory. New means of control and new chemicals are constantly sought. The aim of the study was to test selected chemicals – non-molluscicides – for their usefulness as means of slug control.

ESSENTIAL OILS – AN ALTERNATIVE TO PLANT PROTECTION MEANS USED FOR SLUG CONTROL

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Arion lusitanicus is among the most serious pest gastropods; it damages wild and cultivated plants everywhere in Europe. At present two active substances are used to control it: methaldehyde and methiocarb. The use of methaldehyde will be banned in 2010 since it is not inluded in Annex I, Directive 91/414 EC. Alternative substances are sought. Our experiments were to test effectivity of selected essential oils in limiting damage caused by *A. lusitanicus*. They were conducted in a climatic chamber, at 16°C, RH 93% and day length 12 h. No-choice tests were performed on Peking cabbage leaves (Optiko F1) treated with the tested oils. Eleven oils, ginger extract and methiocarb at concentrations of 0.01, 0.05, 0.1 and 0.5% were used. Leaf fragments submerged in water were used as control. After 24 hrs the slugs were removed and checked for their condition, the non-consumed leaf fragments were measured and the proportion of consumed surface was calculated. Six replicates were run for each object and 24 replicates for the control. The results were subject to co-variance analysis considering the weight of slugs; Fisher test was used at significance level 0.05. Some of the substances were found to inhibit feeding of *A. lusitanicus* and limit the leaf damage. The most effective substances were: methiocarb at 0.1%, 0.01% and 0.5%, pine oil at 0.05% and melissa oil at 0.5%. Turpentine, bergamot and lemon oils, as well as ginger extract at 0.1% proved to be attractive to the slugs.

EFFECTIVITY OF SELECTED ACTIVE SUBSTANCES AGAINST PLANT DAMAGE BY *ARION LUSITANICUS*

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Slugs are among the most serious pests of cultivated plants in central and northern Europe. The greatest damage, besides *Deroceras reticulatum*, is caused by *Arion lusitanicus*. The slug originates from the Iberian Peninsula and spreads in many European countries including Poland. It most often occurs in masses and damages many cultivated and wild plant species. It destroys almost completely garden plants, especially vegetables and some ornamental, orchard and medicinal plants; it damages field cultivations, mainly germinating winter rapeseed and winter wheat. Protecting plants against pest slugs involves use of granulated molluscicides which contain methiocarb or methaldehyde as active substances. Their effectivity in slug control is often unsatisfactory, and they may have a deleterious effect on other organisms. The Institute of Plant Protection in Poznań conducts research on new active substances which may potentially limit slug feeding on cultivated plants. Within this research we performed no-choice tests for the effectivity of selected molluscicides, insecticides and natural substances in limiting slug damage to plants. The tests were perfomed in controlled conditions, using rape seedlings sprayed with the tested substances and exposed to feeding of *A. lusitanicus*. Among the tested substances the following were the most effective: abamectin (0.2%), methiocarb (0,5%) and methaldehyde (1.0%), the activity of methaldehyde being maintained only during 9 days after application. These three compounds were not phytotoxic to rapeseed plants and none of them, at the concentration used, was lethal to slugs. The reduction of rapeseed plant damage resulted from their deterrent and/or antifeedant effect. Abamectin was found to show a considerable potential usefulness for protec-

tion of winter rapeseed against slugs. The compound is a macrocyclic glycoside derived from a soil bacterium *Streptomyces avermitilis* and is effective against a wide range of pests. It is also effective against herbivorous slugs. The research was financed by the MNiSW, grant no. N31000831/0912.

QUALITATIVE ASSESSMENT OF SHELLS OF FARMED EDIBLE SNAILS *CORNU ASPERSUM* AND *HELIX POMATIA*

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Two subspecies of *Cornu aspersum*: *C. aspersum aspersum* and *C. a. maxima* are farmed and commercially sold. The quality of their shells is important from the point of view of farming, trade and processing. Shells of *Cornu* and *Helix* can be characterised by their width, height and diameter; the width/height ratio depends on the species, subspecies, geographical form, area and habitat conditions. The shell thickness, as the mean of measurements of its numerous fragments, is associated with its mechanical resistance. The resistance is estimated with computerised texture analyser, as the so called piercing force measured with a steel needle and associated with the shell hardness, and as the crushing force, measured with a cylinder and associated with the shell elasticity. The diameter of the cylinder is adjusted so that the kind of resulting damage corresponds to such damage arising as a result of mechanic-chemical cleaning of shells during processing. The shell massiveness is expressed as massiveness coefficient [shell mass (shell width × shell height)$^{-1}$] 100 (g cm^{-2}), which makes it possible to compare shells of different size and mass, as well as shells of different species and populations. Calcium content (mineral microstructure), phosphorus content (organic microstructure) and raw ash content are chemical indicators of the degree of maturity and microstructure.