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THE 28TH POLISH MALACOLOGICAL SEMINAR

SEMINAR REPORT

It is very difficult to write a Seminar report each year. After five or six seminars, and reports, you start running out of ideas. The location, the weather, the organisers and the number of participants keep changing, as well as some details, for example the length of the opening ceremony, but the general idea and the scheme of things remain the same. I keep trying to change the phrasing at least, but please forgive me if I use the same wording twice. Not that I practice copy and paste, but anyway…

The 2012 Polish Malacological Seminar – the seminar is the annual meeting of Polish malacologists – was held in Boszkowo (the same as the 25th Seminar, but in a different hotel – see Folia Malacologica 18), not far from Poznań, from the 8th till the 11th of May. It was the 28th Seminar, so we shall be thirty soon. Boszkowo is a typical summer-holiday village on a lake, and even during off-season there were quite a lot of non-malacological people populating the nearby pubs and cafes. As many times before, we stayed in one hotel (though some people were in exile in a different part of the same hotel, farther down the street but not very far) which on the whole made our post-session social life much easier. The hotel is located on a lake and has lots of grounds with lawns, flower beds and, for example, swings (used by some participants, not only the youngest ones). The food was very good and plenty. The weather was mostly very good, too – good enough for some people to skip some sessions.

The organising institutions (listed in the same order as on the cover of the Book of Abstracts) were: the Association of Polish Malacologists, the Adam Mickiewicz University in Poznań, the Poznań University of Life Sciences and the Plant Protection Institute in Poznań; the scientific committee included (following the book-of-abstracts order again) ANDRZEJ LESICKI, EWA DANKOWSKA, MONIKA JASKULSKA, TOMASZ KAŁUSKI, JOANNA PIEŃKOWSKA, ELIZA RYBSKA and MARIA URBAŃSKA, all (sensibly) from Poznań. Good job! And great thanks! This year the Seminar was sponsored by the LABSOFT company from Warsaw. LABSOFT sells microscopes, inlcuding the so called low-vacuum or "environmental" SEM, one of which (an almost-portable size!) they showed us (we had to catch creatures to put in the microscope); the company also offers technical service, spare parts and various laboratory accessories.

The oral presentations were successfully squeezed into six sessions (and hardly anybody exceeded the allowed time); there was also a poster session, as usual very good. The chair-persons were (listed in chronological order): ANDRZEJ LESICKI, BEATA M. POKRYSZKO, TOMASZ KAŁUSKI, WITOLD P. ALEXANDROWICZ, JAN KOZŁOWSKI and TOMASZ K. MALTZ.

The list of participants included 36 people, and only two were FTAs [Failed To Appear]. Instead, there were two wives (of two different participants, OF COURSE) and one son. This time the list included no eastern neighbours who on several previous occasions had submitted their abstracts but never materialised. I privately suspect that the Organisers must have done something about it. The maximum population abundance was thus 37 people, and there were no foreign guests. The reason for the small attendance (37 people, compared to 53 last year) may have resulted from the fact that the Seminar (fee + accomodation) was a bit pricy, but things are getting pricier and pricier every year, and – to be fair – we can hardly blame the Organisers. Nowadays, when a hotel owner hears "conference", they automatically assume it is a business conference and proceed to rip you.

Every participant was given a bag, a pen, a marker pen, the Abstract Book (which included the programme), a notebook, and a T-shirt/cap (you could choose). The Abstract Book was edited by TOMASZ KAŁUSKI and MAGDALENA GAWLAK and had a *Helix pomatia* on the cover. Thank you, Editors!

The opening ceremony (Tuesday, 8th) was the shortest we ever had (10 minutes only, compared to the twenty during the 27th Seminar!). It was followed

Fig. 1. Banquet. The new President is easy to identify. Photo: author

by three sessions and the General Assembly. The Assembly elected the new President, TOMASZ KAŁUSKI (our ex-treasurer). Congratulations Tomasz! On the next day there were both oral and poster sessions, and the banquet (Fig. 1). The Seminar excursion (Thursday, 10th), went first to Kórnik with its great old palace and park-cum-botanic garden, with many exotic trees and shrubs, some in flower, and then to Rogalin

Fig. 2. Some participants during the excursion in Rogalin. Photo: ELIZA RYBSKA

Fig. 3. Grill party. Photo: author

with its very impressive old oak trees and the Warta oxbows (Fig. 2), and to lunch in a very nice country inn. After the excursion we had a grill party (Fig. 3) with a great variety of meats, but also vegetarian dishes, plus things to drink (galore!). The last day was another spent in the sessions and then we had to say goodbye.

The programme contained 24 oral presentations and 11 posters. The snail:bivalve ratio was roughly 4:1 (thus higher than 3.47:1 in 2011, 2.33:1 in 2010 and 2.35:1 in 2009, for more ratios from earlier years see earlier volumes of Folia Malacologica), the land:water ratio was 2.8:1 (1.54:1 in 2011, 1.5:1 in 2010 and 0.94:1 in 2009), and thus much higher than ever. The

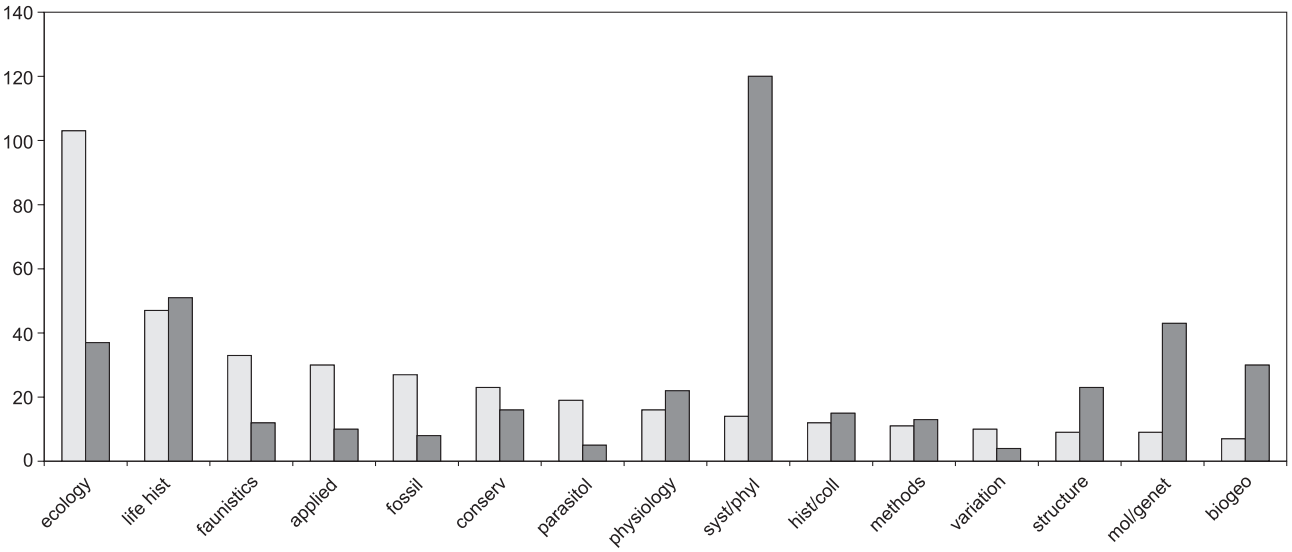

Fig. 4. Graph showing the relative popularity of various disciplines of malacology during the Polish Malacological Seminars 2007–2012 and the 2010 Congress (first bars – Seminars, second bars – 2010 Congress)

No.	Discipline	Number of papers/posters						
		2007	2008	2009	2010	2011	2012	Total 2007–2012
1	Ecology	20	25	18	14	19	7	103
2	Life histories	7	7	8	10	8	7	47
3	Biogeography	0	0	0	0	0	7	7
4	Conservation	2	4	7	4	3	3	23
5	Fossil molluscs	6	4	4	3	6	4	27
6	Applied malacology	2	5	4	8	8	3	30
7	Parasitology	3	6	4	2	3	1	19
8	Faunistics	2	4	5	9	11	2	33
9	Methodology	3	0	2	0	4	2	11
10	Physiology	1	0	1	3	7	4	16
11	Structure (histology, cytology, shell)	0	0	5	1	2	1	9
12	Variation	2	3	1	1	1	2	10
13	Systematics/phylogeny	2	4	3	2	1	2	14
14	Molecular genetics	3	1	3	1	1	0	9
15	Collections	0	3	1	2	2	0	8
16	Others (general, behaviour, archaeology)	3	3	5	2	2	0	15
17	History of malacology	0	0	2	1	1	0	4
18	Education	0	0	0	0	0	1	1

ratio of one-author presentations to presentations with two or more authors was 0.6:1 (higher than 0.37:1 in 2011 but smaller than the 2010 0.85:1), and the ratio of papers/posters presented by girls versus boys was 1.3:1 (1.24:1 in 2011, 1.88:1 in 2010).

The above table contains statistics of the 2007–2012 presentations (some, as usual, assigned to more than one category). The numbers do not show any obvious trend, except a marked decline in the number of ecological papers.

Having data from 6 years ready in the table creates a good opportunity to compare our native trends with the world's trends in malacology. The graph in Fig. 4 shows a comparison of the topical structure of the last six malacological seminars in Poland with such structure of the last World Congress of Malacology – in 2010 in Phuket (Thailand) (See: Folia Malacologia 19: 107–116, 2011). In general we do: about 10 times less systematics/phylogeny, 5 times less molecular genetics, 4 times less biogeography and 2 times less structure; instead we do 3 times more parasitology, more than 2 times more ecology, faunistics, applied and fossil malacology, and 2 times more variation. Do we really disagree with the world's trends? Hey, remember that our seminars are fairly local (plus a few neighbours from time to time), and when you choose what to present at a local meeting, you act slightly different. Also, Congresses happen once in three years while our (and other countries') Seminars happen every year, so some people perhaps present bits of their research during their seminars and the whole – at a slightly different angle – during the Congresses. There may be other explanations as well, but on the whole our malacology does not seem to be doing badly.

Some topics and presentations are worth mentioning. All were good or very good, but I liked the one by TOMASZ KAŁUSKI & co-authors, about slug pheromones, the one about the effect of amphipods on the behaviour of the zebra mussel (JAROSŁAW KOBAK & co-authors), the one on what happens if we introduce new *Helix pomatia* into an already existing population (MACIEJ LIGASZEWSKI & SŁAWOMIR POL), the one about *Alinda biplicata* and its uniparental reproduction (TOMASZ K. MALTZ & ANNA SULIKOWSKA-DROZD) and finally the one that showed snails from a slightly different perspective – from the point of view of common knowledge and child's perception (ELIZA RYBSKA).

A little bird… sorry, a little snail told me that the next Seminar would be organised by the Szczecin team, somewhere on the seaside.

The abstracts below include all the abstracts from the Abstract Book, most of them translated and some rather brutally reduced in length by the author of this report.

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ABSTRACTS OF THE 28TH POLISH MALACOLOGICAL SEMINAR

ENVIRONMENTAL CHANGES IN THE PODHALE BASIN AS INDICATED BY MOLLUSC ASSEMBLAGES OF FLUVIAL DEPOSITS

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The last few hundred years of environmental history in the Podhale Basin witnessed human-induced transformations: development of agriculture and deforestation. As a result, open habitats expanded at the expense of shaded ones, causing changes in the composition and structure of plant and animal communities. The malacological analysis included 48 samples from 17 localities of Late Glacial fluvial deposits. The number of species per sample ranged from 3 to 21, the number of specimens – from 7 to 173; the total material comprised 2,810 specimens of 46 species (43 terrestrial snails, 1 aquatic snail, 1 bivalve). Besides, the material included vestigial slug shells referred to as Limacidae. The localities represented two main types of river valleys: wide, flat-bottomed valleys and narrow deep valleys of small rivers or gorge sections of larger rivers. The most characteristic species was *Vallonia pulchella* (O. F. Müll.) of high constancy (class C=5) and dominance (D=5); it was present in over 80% of the samples and constituted over 20% of the material. Also *Cochlicopa lubrica* (O. F. Müll.), *Perforatella vicina* (Rossm.), *Vallonia costata* (O. F. Müll.), *Nesovitrea hammonis* (Ström) and Limacidae reached high constancy and dominance. The TDA index indicates a considerable heterogeneity of the composition and structure of the assemblages; it made it possible to distinguish three types of assemblages. The high value of the ADI index (0.824) shows a considerable diversity of the malacofauna. Taxonomic analysis distinguished two essential types of assemblages. One includes assemblages with small proportion of shade-loving species (at most 20% of the assemblage), the other – assemblages with the frequency of open-country species not exceeding 30%. These types include seven subtypes (4 and 3, respectively). Four stages of environmental changes can be distinguished, based on the malacofauna changes: stage I – beginning of Holocene till Middle ages – no visible anthropogenic influence; stage II – 13th–15th c. (Mediaeval Climatic Optimum) – first stage of intensive settlement, deforestation, erosion and fluvial processes, increase in proportion of open-country and mesophile species; stage III – 16th–19th c. (Small Ice Age) – limited human population, smaller anthropopressure, development of forests and increased proportion of shade-loving species; stage IV – 20th c., fast development of settlement, increased anthropopressure, limited proportion of shade-loving species. The shade-loving forms prevailed only in narrow valleys which did not favour agriculture.

MALACOFAUNA OF LOESS DEPOSITS OF THE LAST GLACIATION IN TŁUMACZÓW IN THE KŁODZKO BASIN

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Loesses and loess-like deposits in SW. Poland form an array of isolated patches of different thickness. The patch in Tłumaczów is located in the NW. part of the Kłodzko Basin. The loesses form a vertical cliff 10 m wide and 5.5 m high. The profile is composed of three distinct layers. The material included 17 samples. The malacological analysis was supplemented with lithological studies (granulometric analysis, content of $CaCO_3$). Eight taxa of terrestrial snails were recorded, represented by more than 5,000 specimens. The number of taxa in the samples ranged from 4 to 7, with 53–1,309 specimens. The fauna included only forms which are common in loess profiles. Four assemblages were distinguished: 1. with *Trichia hispida*, 2. with *Pupilla*, 3. with *Arianta arbustorum* and 4. with *Succinea oblonga*. The granulometric composition of the deposit and its high $CaCO_3$ content suggest its eolic origin; the reddish colour and local presence of fragments of Permian sandstones indicate that the loess-forming process periodically included local slope erosion material. In the first period, with cold but rather wet climate, the loess accumulation was of little intensity (fauna with *Trichia hispida*). Upwards, the proportion of *Pupilla loessica* increases gradually, indicating drier and cool conditions with an increasing rate of loess accumulation. Radiocarbon dating of the samples with *T. hispida* places the occurrence of this assemblage between 25 and 21 thousand years BP, directly preceding the phase of intense loess deposition. The loesses above this interval contain a poor assemblage with very numerous shells of the genus *Pupilla* (fauna with *Pupilla*). The impoverishment of the fauna reflects the deteriorating conditions: cooling of the climate and intense loess deposition. Radiocarbon dating in many sites of S. Poland indicates that the *Pupilla* fauna occurred between 21 and 15 thousand years BP. The interval includes intercalations of

the deposits with admixture of coarser fractions (gravel, sand). Their fauna with *Arianta arbustorum* indicates a temporary increase in humidity, while the presence of sand fraction and fragments of Permian sandstones result from solifluction on the slopes. The simultaneous rapid decrease in abundance of *Pupilla loessica* shows a slowing-down of the loess deposition. The changed climatic conditions and slowing down or even stopping of loess deposition resulted in development of the fauna with *Succinea oblonga*. Radiocarbon dating places it between 15 and 14 thousand years BP. The succession of the assemblages is typical of loesses of S. Poland and W. Ukraine. It differs considerably from very many loess faunas from W. and S. Europe, contradicting Ložek's belief in great homogeneity of the European loess faunas. The loesses located south of the Carpathians and the Sudetes usually have much more diverse mollusc assemblages, with numerous xerophile species of higher thermal requirements. Two distinct areas – western and central – can be distinguished in W. Europe. The western area includes the southern part of the British Isles and N. France, and its assemblages show small diversity. The central area, with the Rhine valley and Germany, holds more diverse assemblages. In this context the distinct character of the loess assemblages from W. Ukraine and S. Poland, including Tłumaczów, can be interpreted as a result of combination of a cold, polar but rather dry climate during the last glacial maximum, and a considerable continental influence.

ECOMORPHOLOGY OF UNIONID SHELLS FROM LAKE GARDNO

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Four unionid species were recorded from Lake Gardno: *Unio pictorum*, *U. tumidus*, *Anodonta anatina* and *A. cygnea*. Gardno is a shallow coastal lake with varied chemical composition of water and bottom deposits. Periodic flooding with sea water causes a slight salinity, and the greatest tributary – Łupawa river – brings great quantities of polluted surface runoff. The increased trophic level results in mud accumulation and overgrowing of shores with reed beds. As a result of the specific conditions, the lake's bivalves differ in their shell shape from those of other water bodies. Besides, the shell shape was found to vary depending on the substratum. The eutrophication, muddiness and water pollution constitute threat factors. The negative symptoms in polluted waters include dwarfishness of the bivalves, and decrease in their abundance, followed by extinction. The objective of the study was to determine the length, width and height of the shells and their interdependences. The material was obtained in 2011 and included 326 live animals and 352 shells of *A. anatina*, 188 live individuals and 44 shells of *U. pictorum*, 8 live individuals and 28 shells of *U. tumidus* and 4 live individuals of *A. cygnea*. The empty shells were analysed separately. The results were compared with the earlier data from Lake Gardno (1986). The present bivalve populations are characterised by smaller size of individuals and smaller abundance of some of the species.

QUANTITATIVE METHODS OF ESTIMATING LAKE LITTORAL MALACOFAUNA AND THE DOMINANCE STRUCTURE OF GASTROPODA AND DIGENEA

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Analysis of the so called malacological background is important for the studies on the spread of digenetic trematodes, since one parasite species uses several snail host species, including the main host and auxiliary hosts. The diversity of habitats preferred by littoral snails renders it difficult to select an adequate quantitative method. We tested three methods of quantitative malacofauna assessment for their usefulness in malaco-parasitological studies. The snails were sampled from May till September 2008–2010, in connected lakes Bachotek, Strażym and Zbiczno (Brodnica Lakeland). In the first year molluscs were collected by eye, in two subsequent years – with a frame. In 2009, a 20 × 100 cm frame was used to collect five samples each from the bottom and from macrophytes. In the last year a frame of 25 × 25 cm was used to take 16 random samples without differentiating between the bottom and the plants. The method used affected the assessment of the dominance structure and diversity. The "by eye" method yielded mainly large pulmonates; the frame method increased the proportion of small snails and prosobranchs. Irrespective of the method, the occurrence of Digenea was found to depend directly on the dominance structure of the snails. In most cases the small proportion of trematodes from a given mollusc species was related to its small proportion in the quantitative samples. The best method of quantitative assessment of malacological background was the version of the frame method which distinguished between bottom and macrophyte samples.

FURTHER STUDIES ON THE USE OF PLANTS TO LIMIT GASTROPOD FEEDING

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At adequate air humidity and availability of plant food some gastropods can reproduce to reach great numbers and become serious pests. They feed on all parts of plants, sometimes damaging them to a large extent or destroying them completely. They are especially dangerous to seedlings and young plants. Attempts at limiting the losses caused by mass feeding employ all available methods of gastropod control; among these, special attention should be paid to non-chemical methods. Commercial molluscicides are not always effective, especially at high air humidity; they can also be harmful to other organisms, and thus alternative methods are constantly sought. The studies focus on feeding deterrents which affect gastropod chemoreceptors. Such deterrents could be used as alternative methods of plant protection in the integrated programme of plant protection which will be in force in Poland, starting January 1st 2014. The aim of the studies was to determine the palatability index and deterrent index for infusions and extracts from *Digitalis* sp., *Stachys* sp., *Hosta* sp., *Mentha* sp. and *Geranium* sp. for the Roman snail *Helix pomatia* in laboratory conditions. Only the *Stachys* infusion and the *Geranium* extract showed weak deterrent properties.

STANDARD AND ENVIRONMENTAL SCANNING MICROSCOPY IN BIOLOGICAL STUDIES

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Scanning electron microscope (SEM) is used to examine the surface of solids. The image, obtained due to a stream of electrones directed on the sample, is constructed based on the signals emitted by the sample. Depending on the type of detector which "catches" the signal, the image can reflect either the exact topography of the sample or its elemental composition. Due to high resolution it is possible to use magnifications of several tens thousand, which makes it possible to obtain images of detailed morphology and microstructures of animals' body covers (e.g. insects, nematodes, snails) and plants, or analyse damage, anomalies etc. Modern SEMs make it possible to view samples at high vacuum (standard type) and low vacuum (natural or environmental SEM), where the vacuum in the chamber can be adjusted. The low vacuum mode is useful when observing non-conducing samples with delicate structure, or much hydrated samples, like most biological samples. The use of environmental SEM with simultaneous use of freezing stage can in some cases replace the time-consuming and costly preparation of biological samples and provide a fast view of freshly-collected material. The poster presents examples of possibilities and limitations of the standard and environmental SEM when examining biological samples.

MALACOFAUNA OF KARST FORM DEPOSITS OF OBŁAZOWA SKAŁA IN PODHALE

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Mollusc assemblages of the deposits of small karst forms in Podhale made it possible to characterise the environments in which such deposits were formed. Isolated limestone rocks of the Pieniny Rock Belt created favourable conditions for gastropods, as shown by numerous snail shells found in the deposits. Samples were taken from small forms of surface karst, such as niches, rock shelters, small caves or crevices. Eighteen samples were taken in six localities. The material included 8,258 specimens representing 50 species. The shells were accompanied by numerous bones and teeth of small vertebrates which were subject to separate analysis. Malacological analysis made it possible to distinguish several mollusc assemblages. The species and assemblages of different sections of the profiles indicated significant environmental changes during the deposition. Two types of assemblages were distinguished in the profiles: assemblage with *Pyramidula rupestris* and *Chondrina clienta*, and assemblage with *Discus ruderatus* and *Arianta arbustorum*. The profiles from southern slopes held assemblages with *P. rupestris* and *C. clienta*. The assemblage was characterised by a considerable proportion of xerophiles and numerous forms of open, dry habitats. The lower parts of the profiles showed a slightly greater proportion of shade-loving species. The succession indicates a gradual disappearance of scrub and an increasing proportion of grassy habitats as well as uncovering of limestone rocks. A distinctly different fauna was found in the western part of Obłazowa Skała. Shade-loving species of the assemblage with *D. ruderatus* and *A. arbustorum* were dominant. Another characteristic feature of the fauna was the presence of cold-loving *Vertigo genesii, V. geyeri* and *Columella columella*. They were accompanied by bones of

cold-loving rodents (*Dicrostonyx gulielmi, Microtus gregalis*). The differences between the assemblages may indicate different age of the deposits of the karst forms. The presence of cold-loving species in the profiles of the western side suggests a late glacial or Lower Holocene age of the deposits. The profile of the southern side may be associated with the Upper Holocene. Verification of the stratigraphic interpretation requires radiocarbon dating and identification of the vertebrate remains.

MOLLUSCS OF THE RIVER-LAKE SYSTEM OF KRUTYNIA (MAZURIAN LAKELAND)

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The Krutynia is one of the main rivers of the Mazurian Lakeland. It is 100 km long and flows through 19 lakes, forming a river-lake system which is typical of the lakeland landscape of northern Poland. Earlier malacological studies of the Krutynia, mostly qualitative, were either performed at the beginning of the 20th c., or limited to some river sections or some selected species. Comprehensive malacological studies of the Krutynia and its lakes were carried out in 2008–2011. In all, 42 mollusc species were recorded in the whole system: 25 snails and 17 bivalves; 39 species in the river, 26 species in the lakes. Twenty three species were common to the lake and river zones. Fifteen species occurred exclusively in the river, three – only in the lakes. The species richness was greater in the river where the number of species per site ranged from 13 to 26; the number of species per lake was 6–15. The most common species, occurring in both the lakes and the river, were *Bithynia tentaculata*, *Viviparus contectus*, *Unio tumidus*, *Anodonta anatina* and *Dreissena polymorpha*. *D. polymorpha* reached the greatest density, locally 11.5 thousand ind./m^2 (Lake Lampasz) while *U. tumidus* attained the greatest biomass, up to 3 kg/m^2 (Lake Zyzdrój Mały).

CONTRIBUTION TO THE KNOWLEDGE OF DEVELOPMENT AND GROWTH OF *ARION LUSITANICUS* MABILLE, 1868 AND *A. RUFUS* (LINNAEUS, 1758)

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Slugs of the family Arionidae, for example *Arion lusitanicus* and *A. rufus*, are commonly known pests occurring in Poland. *A. rufus* is native and its eastern distribution border crosses Poland. The slug occurs in the western part of the country; the patches of its occurrence in the west result from introduction. Originally, it occurred mainly in forests and scrub, but recently it is increasingly often found in cultivations. The invasive *A. lusitanicus* appeared in Poland at the end of the 1980s, near Rzeszów. Initially it spread over the south-eastern part of the country; at present it is found in various regions of ten voivodeships. Both species feed on cereal, oil, papilionaceous and root plants, orchard crops and herbs. They consume seeds, tubers, bulbs, roots, leaves, shoots and flowers, most often damaging young seedlings of 2–6 leaves, but also causing considerable losses in cultivations of adult plants. They occur in gardens where they damage vegetables, flowers and fruits and in agricultural crops where they damage sprouting plants on the margins of fields. Both species have annual life cycles and produce ca. 500 eggs. Hatching occurs in spring and autumn. The eggs produced in the autumn and a great part of juveniles, as well as few adults, winter over. As a result, individuals of different development stages, size and body mass, may coexist in the population. The knowledge of life cycles is essential for devising control strategies. The observations were done on two populations of *A. lusitanicus* in Poznań and Puszczykowo, and two populations of *A. rufus* in Poznań and Kórnik. They started at the end of March 2011 when the slugs began to leave their winter shelters. Eggs and ca. 50 slugs were collected randomly in the selected areas twice a month; dates of copulation and hatching were recorded. In the laboratory the collected slugs were identified, and their body mass, size and approximate age were registered every fortnight. The objective of the studies was to determine and compare the population dynamics and growth rate of *A. lusitanicus* and *A. rufus* in natural conditions.

ELECTROPHYSIOLOGICAL REACTIONS TO MECHANICAL STIMULATION IN EPITHELIA OF *ACHATINA ACHATINA*

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The movement of matter (solid, liquid) on the vertebrate epithelium surface is associated with changes in electric field, resulting from ionic transport. It remained unknown if such changes occurred in the gastropod epithelium; their physical significance, neuronal, humoral and cellular mechanisms were not understood. The aim of the studies was to check the course of electrophysiological response of the snail

epithelium to mechanical stimulation. The snails *Achatina achatina* came from the departmental culture. A modified Ussing's method was used, consisting in measuring the difference in transepithelial electric potential for intestinal epithelium (isolated intestine fragments ca. 2 cm long from 10 animals) and sole epithelium (sole fragments 1–2 mm thick from 28 animals). The intestine lumen and sole surface were flushed with liquid during 60 s. The liquid movement constituted the mechanical stimulus. The transepithelial electric potential was measured prior to and following stimulation (PD), during stimulation (dPD) and during delayed response to stimulation (dPD_{max}). Inhibitors: amiloride and bumetanide, were used to block the transport of sodium or chloride ions, respectively. The mean dPD value for the sole was 1.1 mV. Two-grade response was observed in the case of intestine: immediate response (dPD=1.8 mV) and delayed response which reached its maximum after ca. 7.1 min (dPD_{max}=3.1 mV), and ceased in 20.9 min. After that time resting potential was depolarised by 1.3 mV. The epithelia of snail intestine and sole show an electrophysiological response to mechanical stimulation, which is similar to such response of the epithelium of other animals. Based on the results, it is proposed to use snail epithelia as biological models for the analysis of transepithelial ionic transport, motor activity of the epithelium and its adjustment to pharmacological effects.

THE EFFECT OF VOLATILE PHEROMONES OF *ARION LUSITANICUS* AND *A. RUFUS* ON INTERSPECIFIC HYBRIDISATION

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Slug mating is often complex and composed of several phases: finding the partner, moving to the mating place, courtship dance and copulation. Finding a sexually mature, conspecific partner is decisive for the success of copulation. There are many indications that both mucus-contained and volatile pheromones play a crucial role in the process. We checked if and how *Arion lusitanicus* and *A. rufus* reacted to volatile pheromones of both or one species. Slugs of both species, in containers closed with a net, were placed on the ends of shorter arms (one on each end) of a Y-shaped perspex tube. *A. lusitanicus* or *A. rufus* were placed in the long arm of the tube; they could move freely toward the short arms. Adult slugs randomly chose to move toward the representative of their own or the other species. Juveniles did not move toward representatives of any species. The results indicate that volatile pheromones which are secreted only by adult individuals play a significant part in finding mating partners.

EFFECT OF DIFFERENT AMPHIPOD SPECIES ON THE BEHAVIOUR OF *DREISSENA POLYMORPHA*

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Some species of invasive Ponto-Caspian amphipods (Crustacea, Amphipoda) actively prefer habitats provided by the zebra mussel – an immigrant from the same region. The reaction of the mussel to the amphipods remained unknown. We observed the mussel behaviour in the presence of three amphipod species of different habitat preferences: *Dikerogammarus villosus* (Ponto-Caspian, preferring shells as substratum), *Pontogammarus robustoides* (Ponto-Caspian, preferring other substrata) and *Gammarus fossarum* (native, usually not co-occurring with the zebra mussel). We studied the strength of attachment, aggregation-forming and vertical migrations: (1) in the presence of freely moving amphipods, (2) with amphipods separated by a mesh and (3) with no amphipods. The mussels which were directly exposed to *D. villosus* attached to the substratum more strongly and less often migrated upward. The reaction to *P. robustoides* was limited to increased attachment strength. The bivalves did not modify their behaviour in the presence of *G. fossarum* and did not react to amphipods separated by a mesh. The amphipods most probably affected the mussel behaviour through mechanical irritation while swimming. In order to test this hypothesis we replaced the amphipods with *Corydoras paleatus* – a non-predatory, South American fish with which the zebra mussel had never had contact, and thus any possible reactions could only result from mechanical effect. The effect of the fish was similar to that of the amphipods but somewhat stronger. The zebra mussel reacts to mechanical irritation by organisms moving nearby. The reactions are similar to those exhibited by the mussel in the presence of predators. The bivalves which are more strongly attached to the substratum and situated near the bottom are probably better protected from unfavourable environmental effects. The studies were financed by grant MNiSW no. N N304 3930 38.

A NEW MOLLUSCICIDE TO PROTECT PLANTS FROM GASTROPODS

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Plant protection against gastropods is a serious problem in Poland and other European countries. One of the most serious pest species is *Arion lusitanicus* Mabille, 1868. It often occurs in masses and causes serious losses in various agricultural and horticultural crops; it may also pose danger to local biodiversity. The most often recommended method of controlling gastropod numbers and limiting the damage is the use of granulated molluscicides with methaldehyde or methiocarb as active substances. The effectiveness of such chemicals is often unsatisfactory, and they may exert a negative effect on non-pest organisms. Methaldehyde is toxic to vertebrates, methiocarb – to beneficial soil invertebrates such as carabid beetles and earthworms, and to some farm animals. Iron phosphate is one of recently discovered slug control substances. The compound occurs naturally as a mineral, is commonly used in food and fertiliser industry and is non-toxic to mammals. Its granulated form has been used for several years in some European countries to control gastropods, mainly in ecological and organic farms. In Poland it was registered in 2011 as a molluscicide called Ferramol GR, containing 10 g of iron III phosphate per 1 kg. It is produced by Neudorf GmbH KG (Germany). According to its label, as registered in Poland, Ferramol GR is destined to control gastropods in *Hosta* cultivations. Because it is environment-safe, it is advisable to assess its usefulness for protection of various plant species. Our preliminary studies tested its effectiveness to limit damage to Peking cabbage and winter rapeseed by *A. lusitanicus*. The effect of various doses of Anti–Limaces Ferramol (Scotts France SAS) and comparative molluscicides on the viability of the slugs and the extent of plant damage was assessed in controlled conditions. The molluscicide was found to limit the damage caused by *A. lusitanicus* to a great extent. In the future it may become a good alternative to the present-day molluscicides.

REPRODUCTION AND GROWTH OF *BRADYBAENA FRUTICUM* (O. F. MÜLLER, 1774) (GASTROPODA: PULMONATA: BRADYBAENIDAE) IN THE LABORATORY

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Bradybaena fruticum (O. F. Müller, 1774) is the only European bradybaenid. It is an eastern European species; its distribution range extends from the Urals and the Caucasus in the east to France in the west, and from the Balkans in the south to southern Scandinavia (65°) in the north. It is common in Poland, except high mountain altitudes. *B. fruticum* lives mainly in damp places with lush herbaceous vegetation, in forests, scrub, on river banks, in parks and wet meadows. Our aim was to determine the life cycle parameters of *B. fruticum* in laboratory conditions. The initial material (6 adults) was collected in June 2009 in Wrocław (51°07'52.03"N; 16°59'24.70"E). They were kept in containers in a climatic chamber (temperature: day 18°C, night 12°C, humidity: 80%, lighting regime 12:12). Till February 2011 they produced 47 egg batches. Milky-white, calcified, slightly oval eggs (2.34–3.17 × 2.18–2.95 mm) were laid in batches (6–62, mean 23.60 per batch), rarely singly, in the soil or on damp tissue paper, from February till September. Juveniles, with shells of ca. 2 whorls (1.95–2.25) hatched in 27–76 days; hatching within batch was asynchronous. Hatching success for snails kept in pairs or groups was 88.36%, for those reproducing uniparentally it was 56.41%. The snails reached morphological maturity (lip) when their shells had 5.5–6.0 whorls (mean 5.55), 261–420 days from hatching (mean 338.59). The growth rate varied during ontogeny: fast growth from 2.25 to 5.0 whorls (53.8–123.04 days/whorl; mean 79.54); slow growth from 1.9 to 2.25 and >5.00 whorls (155.38–462.2 days/whorl; mean 253.51). The growth rate was slower among individuals kept in a group and faster among the isolated snails.

THE EFFECT OF INTRODUCTION OF CULTURED *HELIX POMATIA* L. AGED 1+ INTO NATURAL HABITATS IN THE FIRST YEAR OF STUDIES

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In May 2011, 3,000 *Helix pomatia* aged 1+ and born in the previous year in a hot-house were released in each of three natural or seminatural sites of different trophic conditions in the environs of Kraków. Prior to release they were marked with wood varnish. Trophic conditions in the field locality Będkowice were improved with special cultivating procedures, and were the most favourable; the site was devoid of natural Roman snail population. The second site was a park in Balice – the source of original specimens for the hot-house breeding. The forest site in Mydlniki, with no nutritionally valuable herbaceous plants, offered the worst trophic conditions. In July, two months after the introduction, the growth rate of the snails aged 1+ among the introduced snails and in the natural populations was found to decrease with decreasing quality of feeding conditions. The differences (body mass, shell diameter) between the sites in the case of introduced snails were statistically significant ($P<0.01$). The growth rate of the culture-derived snails aged 1+ was smaller, though usually statistically insignificantly, compared to the natural populations. In Balice and Mydlniki the condition coefficient of the introduced snails aged 1+ was statistically significantly smaller ($P<0.05$ and $P<0.01$, respectively).

LIFE CYCLE OF *ALINDA BIPLICATA* (MONTAGU, 1803) (GASTROPODA: PULMONATA: CLAUSILIIDAE) IN THE LABORATORY, WITH SPECIAL REFERENCE TO UNIPARENTAL REPRODUCTION

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Five-year laboratory observations on *Alinda biplicata* showed that it was iteroparous, ovoviviparous and long-lived. The snails were kept in pairs and groups; the initial material came from a population in SW. Poland. In the laboratory *A. biplicata* reproduced throughout the year, with maxima in the spring and autumn. The whole embryonic development took place in the eggs retained in the parent's organism. The snails kept in pairs or small groups gave birth to juveniles (no eggs were observed), and dissected specimens were found to retain 3–15 eggs. The number of juveniles per litter was 1–8; the annual fecundity was 3–20 juveniles in 2–9 litters. The neonate shells had 2.1–2.9 whorls and were 1–1.6 mm high. The time till shell growth completion was 20–56 weeks and increased with increasing density. The snails attained sexual maturity 5–6 months from growth completion and formation of closing apparatus. The juvenile mortality ranged from 16.7% to 60.6% and increased with density. The life span in laboratory was 220–295 weeks (4–6 years). Three-year observations of 30 snails, born in the laboratory and kept in isolation from the stage of 6–7 whorls, showed that they were capable of uniparental reproduction. They took 18–24 weeks to reach ultimate size, and reproduced 26–39 weeks after growth completion. In the first year 63% of such snails reproduced. Besides typical litters (39%), they produced egg batches (38%) and mixed batches of eggs and neonates (23%). The eggs were translucent with visible calcium carbonate concretions (1.43–1.72 x 1.3–1.56 mm). After a few days they became decomposed and in mixed litters were often eaten by the neonates. Dissection of 10 of the 30 initial snails (5 reproducing and 5 which failed to reproduce) revealed that they had fully mature reproductive systems with all stages of gametogenesis. In subsequent year 70% of the remaining 20 snails reproduced (all that had reproduced in the previous season). The proportion of egg batches (12%) and mixed batches (7%) decreased (litters: 81%). The neonate:egg proportions were: in the first year 54% neonates and 46% eggs, in the second year 74% neonates and 26% eggs. The egg-laying, not observed in individuals kept in pairs and groups, should be regarded as anomaly: getting rid of eggs which were probably not fertilised or eggs in which the embryos died at early stages of cleavage.

TERRESTRIAL SNAILS AS POTENTIAL BIOINDICATORS OF ENVIRONMENT POLLUTION

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Wild organisms are exposed to anthropogenic toxic substances which may cause their death or disturb various physiological processes. Molluscs, with their ability to accumulate heavy metals and their limited detoxication abilities, may help understand these processes and estimate the degree of environment pollution with heavy metals. Snails are good model organisms because of their high abundance in various ecosystems, easy collecting and identification, accu-

mulation of heavy metals in their tissues in the degree proportional to the concentration in the environment, and their great tolerance to many kinds of pollution. Studies on heavy metal accumulation pertain mainly to cadmium, lead and zinc, and their effect on the increased synthesis of free radicals which have a negative effect on various cellular processes. Excess of free radicals causes oxidation stress. Using biomarkers in natural conditions is based on assessment of physiological, biochemical and molecular parameters of animals which were exposed to toxic compounds, in order to assess the environmental risk. Using markers of oxidation stress (concentration of non-enzymatic antioxidants and/or antioxidative enzymes) makes it possible to estimate the degree of environment pollution and its effect on the animals. Changes of defence parameters are usually observed already in conditions of moderate pollution, hence the interaction between heavy metals and components of antioxidant defence reflects the organism's reaction to the environment. Biomarkers of oxidation stress should make it possible to determine the effect of pollution on the organism, and measuring the activity of antioxidant enzymes is regarded as a fast method of tracing environmental stress; it facilitates predicting population and ecosystem effects of environmental pollution. The project is partly financed by grant MNiSW no. NN304 393238.

CAN SEA STORMS AID EASTWARD EXPANSION OF *CEPAEA NEMORALIS*?

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Cepaea nemoralis is a western European species. The natural border of its distribution crosses Germany and reaches Estonia along the Baltic Coast. This distribution may reflect climatic conditions which are favourable for the species. At present the snail is also spreading to areas of a more severe, continental climate. This probably results from increased human-associated passive transport. The present distribution range is limited by the poor dispersal powers rather than by the climatic conditions. In February 2011 I observed a kind of passive transport, earlier unrecorded for *C. nemoralis*. In Poddąbie near Ustka, in storm debris on the beach, I found live specimens of the species, most probably washed off its costal habitat in another place. Sea storms occur mainly in winter. The fact that the wave-brought snails were alive suggests that this form of transport may have contributed to the eastward expansion long before the human-mediated dispersal began.

ODRA-SPREWA AND ODRA-HAWELA CANALS AS ROUTES OF MIGRATION OF INVASIVE MOLLUSC SPECIES INTO POLAND

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Malacological materials were collected within the project "Wing dams as a factor shaping anthropogenic habitats in rivers: analysis of benthic, planktonic and periphyton communities in the stagnant water between the wing dams in the middle and lower Odra sections", in 2009–2010 by the team of Dr. Agnieszka Szlauer-Łukaszewska (Szczecin University). The rich benthos collection included 572 mollusc samples, with 23 species of Bivalvia and 32 of Gastropoda. Alien snail and bivalve species formed a considerable part of the fauna (14.5%). They included *Corbicula fluminea* (O. F. Müller), *C. fluminalis* (O. F. Müller), *Dreissena polymorpha* (Pallas), *Potamopyrgus antipodarum* (Gray), *Lithoglyphus naticoides* (C. Pfeiffer), *Menetus dilatatus* (Gould), *Ferrissia wautieri* (Mirolli) (septal form!) and *Physella acuta* (Draparnaud). Some of them were among the commonest species in the Odra. The invasive *Potamopyrgus antipodarum*, represented in 193 samples (33.7%), was the most frequent; *Physella acuta* (87 samples, 15.2%) and species of the genus *Corbicula* (68, 11.8%) were also common. The present composition of the malacofauna indicates an increasing importance of alien species in the river's ecosystem. Interactions between the new arrivals and the representatives of native malacofauna require detailed studies. It seems, for example, that the native *Physa fontinalis* L. (10 localities, 19 samples) is competed out by *Physella* which occurred in the whole middle and lower section of the Odra. The two species co-occurred only in three localities. Also protected species were recorded in the slow current between the wing dams. They included *Sphaerium solidum* (Normand), *S. rivicola* (Lamarck), *Anodonta cygnea* (Linnaeus) and *Borysthenia naticina* Menke. Rare species/forms which are little known in Poland include *Bithynia tentaculata* f. *producta* Menke and *Pisidium crassum* Stelfox. The abundance of alien and invasive species in the river is probably associated with the existence of canals connecting the systems of Sprewa and Hawela with the Odra system. Intensive navigation accelerates and facilitates the faunal exchange.

A SECOND *MONACHA* SPECIES (PULMONATA: HYGROMIIDAE) FROM POLAND

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Only one species of the genus *Monacha* Fitzinger, 1833 – *M.* (*Monacha*) *cartusiana* (O. F. Müller, 1774) – has been reported from Poland. This species, assumed to have a native range including western, southern and south-eastern parts of Europe, was consequently considered to be expanding northward in the east. However, detailed anatomical analysis showed that at least some Polish populations of *M. cartusiana* had been misidentified and actually belonged to a different *Monacha* species, similar to Müller's species in shell structure, but distinct from it anatomically and molecularly. This species had never been recognised as distinct before, partly because of its non-diagnostic shell but possibly also because specimens with similar anatomical features had been assigned to *M. cartusiana* by Schileyko. A literature survey suggests a correspondence between the misinterpreted Polish *Monacha* sp. and *Monacha dissimulans*, a species from Bulgaria described as new by Pinter. Similar features (differentiating the two from *M. cartusiana*) include: (1) long vagina (the section between the outlets of the appendicula and mucous glands); (2) vagina without sac-like diverticulum; (3) rather long penial flagellum; (4) rather short and thick bursa copulatrix duct; (5) evenly tapered, cone-shaped appendicula with proximal part (that entering the base of the genital atrium) longer than distal part. Definitive attribution of the Polish *Monacha* to Pinter's species was nevertheless impossible because there are older available names for the same species: *Helix claustralis* Menke, 1828 from Greece and *Helix subobstructa* Bourguignat, 1855 from Turkey (possibly a junior synonym of the former). Since Hausdorf stated that it was necessary to check whether or not all populations assigned to *M. claustralis* were conspecific, we isolated and sequenced DNA from specimens of eight Polish and five foreign (Czech and Hungarian) populations, considering *COI* and *rRNA* (*16S, 28S, ITS2*) gene fragments. Preliminary results confirm that *M. cartusiana* and *M. "claustralis/dissimulans"* are distinct, and that the current subgeneric division of the genus *Monacha* needs to be revised.

A SHORT HISTORY OF THE GENUS *LEIOSTYLA*

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Extant species (46), included in the genus *Leiostyla* or in the genera *Leiostyla* and *Euxinolauria*, inhabit the Caucasus with adjacent areas (14 species) and the Macaronesian islands (Madeira: 28 species, Azores: 2 species, Canary Islands: 1 species). The two areas are refuges where relic Tertiary forests have been preserved. One species is found on the western fringes of Europe and northern fringes of Africa. The fossil record from central-western Europe includes four species from deposits dated as Upper Miocene to very early Pleistocene which would suggest a once continuous range, with subsequent extinction of most European species. Anatomical studies made it possible to distinguish a few phylogenetic lineages; each inhabits both areas, and each area holds representatives of more than one lineage. This indicates radiation and dispersal preceding the extinction in the intervening area. Our phylogenetic analysis used COI and 18S sequences of 24 species of *Leiostyla* (52% of all extant species) and *Lauria* as out-group. Biogeographical and anatomical information as well as fossil record, combined with sequence analysis, revealed the following history of *Leiostyla*. The genus came into existence in the Early Tertiary or even earlier, in central-western Europe. Its subsequent radiation and differentiation into several phylogenetic lineages was accompanied by dispersal, the Macaronesian islands being colonised repeatedly, starting ca. 15 million years ago. During the Pleistocene glaciations the European members of the genus, except *Leiostyla anglica*, became extinct.

FOREST MALACOCOENOSES OF THE CRIMEAN MOUNTAINS

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Forest malacocoenoses of the Crimean Mountains were studied in May 2011 in 26 sites (a few open sites were studied for comparison) located within a small

area (44.465–44.868°N and 33.911–34.469°E), at altitudes of 220–1,147 m a.s.l. and on various substrata. Discounting slugs, 40 species were recorded, 12–23 per site (mean 17.6). The collection met the completeness criteria (Chao index 3 for the whole set, <1 for individual sites; number of specimens per site 248–1,274, mean: 686.5). The main taxa of the area were Pupilloidea sensu lato (18 species) and Zonitoidea (11). The remaining were Clausiliidae (3), Helicidae (3), Endodontidae (2) and other families (3 species). Out of the 40 species, only six were endemic to the Crimea (including one known from the type locality only), 26 were widely distributed, the ranges of eight were narrow but not limited to the Crimea. Only one species was common with the Caucasus and not found anywhere else. Forest or shade-loving species (10) constituted 25%, eight species in other parts of their range inhabited open, dry and sunny habitats, and 22 were euryoecious. Small species (<5 mm) constituted more than 60% of the fauna. Similarities (Nei) among the communities were 0.27-0.87 (mean: 0.62), the mean similarity between the forest and the open habitats was 0.41. The Whittaker index for the whole set of localities was 2.27. The most frequent species were *Punctum pygmaeum*, *Monacha fruticola* (100% each), *Euconulus fulvus* (96.1%), *Acanthinula aculeata* (88.5%), *Cochlicopa lubricella, Vallonia costata* (84.6% each), *Vitrina pellucida, Vitrea contracta* (80.8% each), *Lauria cylindracea, Oxychilus deilus, O. diaphanellus, Mentissa canalifera* (76.9% each), *Ena obscura* (69.2%), *Peristoma rupestre, Aegopinella minor* (65.4% each), *Mentissa gracilicosta* (57.7%), *Vitrea pygmaea* (53.8%) and *Truncatellina cylindrica* (38.5%). The distribution of commonality, expressed as the product of frequency and dominance, was similar. In the structure and species composition the malacocoenoses of the Crimean Mountains are closer to the central European fauna than to the Caucasian fauna. They differ from both in their structure: prevalence of Pupilloidea and Zonitoidea as opposed to Helicoidea and Clausiliidae, considerable proportion of xerothermophile species, hierarchy of frequency and dominance, considerable proportion of small forms and great similarity of their species composition to the nearby open sites. The wide range of similarity values between the communities and the high value of the Whittaker index, considering the small study area and the small number of species (4) which are characteristic of groups of closely situated sites, suggest that the individual communities are effects of random survival/colonisation in forest areas separated by open country. The structure of the malacocoenoses results from the Pleistocene history of the Crimean Peninsula: alternate shrinking of forest areas during dry periods and their expansion during wetter periods.

PHYLOGENETIC AND MORPHOLOGICAL ANALYSIS OF *TROCHULUS PHOROCHAETIUS* (BOURGUIGNAT, 1864) AND RELATED TAXA

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Trochulus phorochaetius (Bourguignat, 1864) is a poorly studied endemic species from SE. France. Using molecular, morphological and anatomical data we attempted to ascertain its taxonomic status and phylogenetic relationships with the related *T. plebeius* (Draparnaud, 1805) and *T. hispidus* (Linnaeus, 1758). Conchological and anatomical analysis distinguished three morphotypes which corresponded to the three nominal species. However, multi-method phylogenetic analyses based on COI sequence were not always compatible with the conchological analysis. None of the morphospecies formed a monophyletic clade. The Coiserette population (French Jura) was the most problematic: conchologically it corresponded to both *T. plebeius* and *T. phorochaetius*. The length of hairs, which differs between the species, placed them in *T. plebeius*. Morphometrics of the reproductive system distinguished them from *T. plebeius* – long spermatheca duct. Genetically, the specimens from Coiserette were closest to the population from Échallon (morphotype of *T. plebeius*). Three clades with mitochondrial sequences from two different species, found within the same country, were identified: (1) *T. plebeius* + *T. hispidus* from Great Britain, (2) *T. plebeius* + *T. hispidus* from Poland, (3) *T. hispidus* + *T. phorochaetius* from France. The genetic similarity may indicate an ability to hybridise, as suggested also by the absence of major differences in the structure of the reproductive system. It would be premature to propose nomenclatural changes; gene flow between sympatric populations should be studied.

DOES EVERYBODY KNOW WHAT A SNAIL LOOKS LIKE?

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Sometimes common knowledge results in misinterpretation of natural phenomena. It differs essentially from scientific knowledge. Being based on commonly accepted opinions, it pertains only to external aspects of phenomena, at the same time showing a lack of logics. Ignoring common knowledge by teach-

ers will not lead to better education or to replacing common knowledge with scientific knowledge. The common knowledge should be explored in order to transform it into scientific knowledge in a way which would be acceptable to the student. The analysis of documents included children's drawings as a form of personal notes which reflect and stimulate thinking, attention and expression, and reflect emotions with respect to the object. Most often the analysis of drawings in pedagogical studies focuses on descriptive, psychometric or projection analysis. There is no place for an analysis of drawings which would consider the aspects of intellectual experience of the authors, their cognitive process and reflection of their personal knowledge. I analysed in detail 150 snail drawings, with descriptions of their body parts and observations on the animals. Also questions addressed to the expert – malacologist – provided interesting information. The analysis revealed areas which might be relevant to the teaching process but are most often neglected in curricula.

COLOUR AND BANDING POLYMORPHISM IN *CEPAEA NEMORALIS* (L.) IN URBAN AREAS IN THE PRZEMSZA VALLEY (SILESIAN UPLAND)

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Cepaea nemoralis, polymorphic with respect to its shell colour and banding, occurs synanthropically in southern Poland. Previous analyses of the occurrence of its morphs did not include the urbanised and industrial Silesian Upland. In 2011 I inventoried the populations of *Cepaea* and studied their polymorphism in anthropogenic areas of the Przemsza River valley. Three kinds of habitats were distinguished: shaded (trees of compact crowns), half-shaded (sparse trees) and open (no trees or shrubs). Each three of the nine sites, of 400 m^2, represented one kind of habitat: environs of allotment gardens, park and cemetery. 120 live adult snails were collected in each site (except one site with too few snails). They were scored for background colour and banding and released into their original habitat. Only *C. nemoralis* was found in the Przemsza valley. The material included 1,015 snails. The most common morphs were pink unbanded (P00000 = 23.0%), yellow unbanded (Y00000 = 19.6%) and yellow five-banded (Y12345 = 17.7%). The proportion of yellow in the whole collection was 63.0%, of brown – 3.3%. Unbanded snails constituted 45.8% of the collection. The proportion of yellow unbanded shells ranged from 5.0% in the shaded sites to 28.3% in the open sites. Brown shells constituted 8.3% in the shaded sites and were not found in the open sites. The morph composition varied among the sites.

ALIEN SNAIL SPECIES IN WOODLAND WATER BODIES

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Small woodland water bodies are constantly enriched with allochthonous plant matter in the form of fallen tree leaves which provide a specific substratum for the benthic fauna. Deposits of such leaves show a temperature higher than the bottom deposits, and the resulting detritus provides food to many invertebrates. Woodland water bodies are usually devoid of large elodeid clumps, as a result of shadiness; helophytes are the main plants. Such water bodies hold a diverse snail fauna (23 species), including the alien *Potamopyrgus antipodarum*, *Physella acuta* and *Ferrissia wautieri*. Three types of woodland water bodies were distinguished: 1. *Physella* type, where, besides *P. acuta, R. balthica* and *G. albus* occurred constantly, and the dominants, besides *P. acuta*, were *B. tentaculata* and *V. piscinalis*. Such reservoirs also held other alien snail species; 2. *Potamopyrgus* type, where among the 16 species (including 10 accessory species) only *P. antipodarum* and *R. balthica* – the dominants – occurred constantly. *P. acuta* occurred in low abundance in single localities; 3. *Ferrissia* type, where the following species occurred constantly: *F. wautieri*, *G. albus*, *H. complanatus, P. corneus*, and the dominant species were *G. crista* and *H complanatus*. *F. wautieri* was abundant in the water bodies with lush aquatic and rush vegetation. The results indicate that small, isolated and shallow woodland water bodies participate in dispersal of alien species.

ROMAN SNAIL (*HELIX POMATIA* L.) RESOURCES AND THEIR PROPER EXPLOITATION

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In Poland protection of the Roman snail populations against overexploitation consists in: 1. collecting only snails of more than 30 mm shell diameter; 2. limiting the collecting period to May; 3. obliging voivodeship nature conservation authorities to set allowable collection limits within the voivodeship. The last condition requires prior assessment of the Roman snail resources. Initially, the allowable collection limit was determined based on average collections in the previous years. It was assumed that, when no distinct decrease in the collection size was observed in the previous years, the same level of exploitation would guarantee maintenance of the population at the same level. This method of assessment is justified in areas with regular exploitation – when the number of pur-

chase points is constant from year to year, and the number of collectors is similar. Such a situation is rare and pertains to small areas. Actually, the number of purchasing and processing firms in the whole of Poland has been increasing for many years. Likewise, the number of collectors has been growing. This precludes a rational assessment of the Roman snail resources based on the obtained and very variable crop. It is relatively easy to assess the resources of individual Roman snail populations through: 1. a series of experimental catches coupled with removal of caught specimens in consecutive catches; 2. repeated catches coupled with marking-release-recapture, followed by calculating the Lincoln index; 3. a series of censuses of snails within areas of 1 m^2 and converting the mean results to the whole area of the locality. The resources of larger areas are the sum of resources of their component populations, but it is impossible to assess resources of all the populations. For this reason, approximate resources are calculated based on the results from selected populations and habitats. The results are biased but sufficient to plan the collecting limits. It should be remembered that, besides the economic exploitation, the population abundance and biological condition are affected by other factors, including the last winter (mild, frosty, snowy or without snow) and the weather (early/late spring, humidity, spring and summer precipitation, drought periods, temperature). Even with a reasonably good assessment of the Roman snail resources, regular census of selected populations and availability of data from purchase points are necessary.

REPRODUCTION OF *VESTIA RANOJEVICI MORAVICA* (BRABENEC, 1952) IN THE LABORATORY, WITH NOTES ON TAXONOMIC VALUE OF LIFE HISTORY CHARACTERS IN BALEINAE (GASTROPODA, PULMONATA, CLAUSILIIDAE)

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Traits of life cycles in the subfamily Baleinae, such as egg size and shape and size of egg batches/litters, show a considerable interspecific and intraspecific variation. The earlier data on *Alinda biplicata, Laciniaria plicata, Vestia gulo, V. turgida, V. elata, Balea* (*Pseudalinda*) *stabilis* and *B.* (*Pseudalinda*) *fallax* were compared with the results obtained in the culture of *Vestia ranojevici moravica* (Brabenec, 1952), which occurs in Moravia in the Czech Republic, in a site isolated from the main, Balkan distribution range of the species. The observations were conducted in the laboratory (hibernation November-February, 3°C) in 2008–2011. The snails reproduced from the end of March till half of September, with a peak in May and the first half of June. *V. r. moravica* is oviparous (mean egg size 1.8 × 1.5 mm); the development of eggs at room temperature lasts 14–18 days. The number of eggs per batch is 1–10 (usually 4–6), the number of batches per pair per season – 1–8 (mean 3.3), and the number of eggs per pair per season – 3–40 (mean 16.2). Newly hatched juveniles have shells of 1.8–2.0 mm and 2.8–3.4 whorls. The shell growth takes 20–29 weeks. The onset of reproduction was observed 32 weeks from hatching (copulation), and the egg-laying after 50 weeks. Adults collected in the field survived more than 4.5 years in the laboratory. Laboratory-hatched individuals reached a larger size (shell height, number of whorls), compared to their parents collected in the field. The egg shape and size and the batch size differed significantly between the field-collected and laboratory-born snails. Such characters are variable and thus of little value for interspecific comparisons.

SPERMOVIDUCT STRUCTURE IN *RUTHENICA FILOGRANA* (ROSSMÄSSLER, 1836) (GASTROPODA, PULMONATA, CLAUSILIIDAE)

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The spermoviduct is common to the male and female parts of the pulmonate hermaphrodite reproductive system. In clausiliids it is poorly known, and not described in the ovoviviparous *R. filograna*. The material included specimens from lowland western Poland (52°05'N, 17°28'E). The spermoviduct is composed of three incompletely separated channels: oviducal channel for transport and storage of embryos, autospermiduct for autosperm, and allospermiduct for allosperm. The autospermiduct is accompanied by prostate gland. The wall of each channel is composed of glandular cells and epithelial cells which show no secretory activity. In its distal part the spermoviduct separates into vas deferens and free oviduct. Initially the free oviduct is still composed of allospermiduct and oviduct, of a structure similar to that observed in the spermoviduct. A blind process – diverticulum – extends along the spermoviduct; in its proximal part it adjoins the allospermiduct, and in its distal part it becomes an independent duct, opening to the spermatheca duct. The reproductive system of *R. filograna* is a semi-triaulic stylommatophoran type.

In contrast to *Helix*, with its semi-triaulic reproductive system, in *R. filograna* allospermiduct occurs both in the distal part of spermoviduct and in the proximal part of free oviduct. In *R. filograna* the oviduct is not a common duct for exogenous sperm and embryos. During the development of the embryos the distal part of oviduct transforms in a brood pouch.

PLEISTOCENE MOLLUSCS FROM ROSKOSZ NEAR BIAŁA PODLASKA

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The locality Roskosz is situated ca. 6 km NE of Biała Podlaska, between the villages Roskosz and Wilczyn, within a narrow W–E basin about a dozen kilometres long and being a trace of a fossil lake (ca. 420–380 thousand years BP). The analysis included six samples of sands and silts with malacofauna, from the depth of 0.6–1.5 m below deluvial deposits. Thirty six taxa were identified (19 snails, 17 bivalves) represented by 32,218 specimens. The number of taxa and specimens in individual samples ranged from 22 to 30 and from 2,686 to 7,274, respectively; they reached their maxima in the middle part of the profile (0.95–1.05 m). All the taxa except *Succinea putris* (single specimens) were freshwater, of both stagnant and flowing waters. *Valvata piscinalis* f. *antiqua* and *Pisidium lilljeborgii* indicate lacustrine environment, *Pisidium henslowanum*, rather numerous in the lower part of the profile, indicates the presence of flow. Taxa of running waters (e.g. *Pisidium nitidum*, *P. subtruncatum*, *Unio* spp.) in places constituted more than 20% of the assemblage, but with respect to the number of specimens they were accessory components (1–5%), which is associated with limited water flow. The flow intensity decreases in the upper part of the succession. The age of the assemblage – Mazovian Interglacial – is confirmed by the presence of *Viviparus diluvianus* and *Lithoglyphus jahni*, which are typical of that period in Poland. Three mollusc assemblages correspond to three phases of the lake development. The first is dominated by *L. jahni* (depth 1.25–1.45 m), the second (0.8–1.2 m) by *Valvata piscinalis* and *Bithynia tentaculata*. Predominance of *Bithynia* opercula indicates development of reed beds which is also reflected by the increased proportion of vegetation-associated forms: *Lymnaea stagnalis*, *Gyraulus albus*, *Acroloxus lacustris*, *Planorbis carinatus*. It is still an open question whether the abundance of *L. jahni* was affected by the vegetation changes, but decrease in its abundance in favour of *V. piscinalis* and *B. tentaculata* was also observed in the nearby interglacial lake near Hrud. The third assemblage (0.65-0.75 m) is characterised by the dominance of *V. piscinalis* and distinct decrease in abundance of *B. tentaculata*. The proportion of species associated with lush vegetation (e.g. *G. albus*, *A. lacustris*, *Valvata cristata*) decreases distinctly. Probably the vegetation development was inhibited by the deepening of the lake.

PHARMACOLOGICAL MODIFICATION OF STICKY LOCOMOTION OF *ACHATINA ACHATINA*

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Terrestrial snails tightly adhere to the substratum while crawling. This is ensured by two functional states of the sole epithelium: ca. 70% of the sole surface adheres to the substratum, ca. 30% is removed from the substratum and moves in the form of waves passing from the posterior end of the foot toward the head. The sole waves result from specific activity of epithelial tissue; analysis of this activity raises the question if other epithelia are capable of similar activity. The objective of our studies is to identify the substances which affect the neural, muscular and/or epithelial components during the snail's movement and modify the epithelium's activity, and to find out if active substances originating from the environment can affect the snail's movement, and if any reactions to pharmacological stimuli are characteristic of epithelia of various organs. Ligands of adrenergic system – adrenalin and noradrenalin, of serotoninergic system – serotonin and serotonin-creatinine complex, CFTR protein activators – IBMX and forskolin as well as a drug – ambroxol were used in the experiments. The experimental animals were *Achatina achatina*, body mass 19–30 g, from the departmental culture. The snail's sole during spontaneous, rectilinear movement on a glass plate was observed and recorded with camera CCD DFK 41 AV02.AS (Imagingsource, Germany) with CCTV 5–50 mm F/1.8 objective (Pentax) and image analysis programme IC Capture.AS 2.0. Changes in velocity under the effect of pharmacological substances were always accompanied by changes in the number of waves or wave length and changes in the wave frequency or distance covered per wave. The results suggest an integrated system which governs the snail's movement and includes neural, muscular and epithelial components. Further studies will aim at identifying substances which can affect these components selectively.

SINANODONTA WOODIANA AND ITS SYMBIONTS

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We tried to check if the alien bivalve – *Sinanodonta woodiana* – could be colonised by invertebrate "symbionts" occurring in the waters of Poland. In 2011 we examined 216 specimens of *S. woodiana* from 11 sites in the Konin lakes, selected fish ponds and in the Danube (environs of Budapest). We searched the mantle and internal organs (gonads, hepatopancreas, gills and heart) for the presence of symbionts. We found cercariae of *Rhipidocotyle* sp. (prevalence 0.7%), in Poland recorded only from *Anodonta anatina*. The examined specimens of *S. woodiana* more frequently bore Hydrachnidia (5.1%), Chironomidae (5.5%) and *Chaetogaster limnaei limnaei* (Oligochaeta: Naididae) – 9.2%, whose relations with the bivalves are still unclear. The results indicate a possibility of forming a relation between the alien bivalve and local parasitofauna. *S. woodiana*, being large and extending its distribution range to waters with natural thermal regime, may provide an attractive habitat for various freshwater invertebrates.

GASTROPOD DISPERSAL AIDED BY GARDENING CENTRES

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Assessment of significance of gardening centres for gastropod spread included inventory of malacofauna and identification of plants and objects which provided the best snail-carrying vectors. The studies were carried out in three gardening centres; we also examined diverse plant material bought from internet shops or directly from producers. We recorded 14 gastropod species of various habitat preferences, ranging from xerothermophiles to hygrophiles. They included typical garden species: *Arion rufus, A. "subfuscus", Deroceras leave, D. reticulatum, Limax maximus, Cepaea hortensis, C. nemoralis* and *Helix pomatia*, as well as species which are rare in gardens: *Helicella obvia, Succinea putris, Perforatella rubiginosa, Vallonia pulchella, V. costata, Trichia hispida* and *Arion silvaticus. Cepaea hortensis* and *C. nemoralis* were the most frequent, while the best plant vectors were maple (*Acer* sp.), beech (*Fagus* sp.) and birch (*Betula* sp.). Conifers can also contribute to gastropod spread, e.g. yew (*Taxus* sp.) and thuja (*Thuja* sp.). Potted plants most often contained gastropods; plants bought from internet shops and seedlings with bare roots created the smallest chances for gastropod dispersal. In all cases the gastropods preferred damp and shaded places; during the day they often hid under pieces of foil, bark, stones or plant material left on the ground. Besides plants, such objects are very good gastropod vectors.

ORIGIN AND DISTRIBUTION OF EUROPEAN SLUGS – WHAT DO WE KNOW

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Slugs constitute ca. 20% of recent gastropods. Sluggishness is a result of parallel evolution and has made it possible for the slugs to compete with snails successfully in specific environmental conditions and to occupy new ecological niches. Slugs are found on all continents except Antarctic and in all kinds of habitats except sandy deserts and salty soils. In the absence of fossil record, the geographical origin of slug families can be only hypothesised based on their present distribution. In Northern and Central Europe, during the Ice Ages, the slugs became extinct or receded to southern refugia. Post-glacial period was too short to allow speciation. The present distribution shows that Papillodermatidae are endemic and originated in the Spanish Asturia. Also Testacellidae probably came into existence somewhere in the Iberian Peninsula, and Boettgerillidae – in the Caucasus. Parmacellidae evolved in Central Asia, Trigonochlamydidae in the Transcaucasia, Milacidae in the Balkans and Asia Minor, and Arionidae – in the Pyrenean Peninsula. The place of origin of the most speciose family – Agriolimacidae – today found in vast areas of Palaearctic and Nearctic, is unknown. It is also difficult to specify the place of origin of Limacidae; they are likely to have evolved in Central Asia from where they expanded to the vast area from the Himalaya to Europe and northern Africa. Alien and often invasive slugs present a separate problem; they started expanding fairly recently, and the expansion is most often human-mediated. Most of them originate from the west and expand eastward; an exception is the Caucasian *Boettgerilla* which at present occurs in most of Europe and a part of Asia. No slug has been introduced in Europe from another part of the world, but

numerous European slugs have been introduced in Asia, North America, Australia, Africa and even some oceanic islands.

FACTORS DETERMINING THERMAL BEHAVIOUR OF SNAILS

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Temperature is an important factor determining the course of many physiological processes. Various ectothermic animals can regulate their body temperature only behaviourally. Though no structurally distinct thermoreceptor organs have been identified in molluscs, their behaviour suggests an ability to perceive thermal stimuli. Thermoreception abilities of molluscs enable them to adopt energetically favourable position in relation to the heat source, and to migrate to various thermal microhabitats. Though the mechanism of transduction of the signals which is crucial to thermobehavioural reactions of molluscs it unknown, it has been found that the reactions can be induced by both endogenous and exogenous factors. The studies on thermobehaviour of *Lymnaea stagnalis* and *Planorbarius corneus* revealed that thermal preferences of snails depended on the species and the phase of annual activity, and varied under the effect of natural parasite infection or experimental injection of bacterial or fungal pyrogens. Depending on the factor, snails can show symptoms of anapyrexia (reversed fever) or behavioural fever. Snail anapyrexia, like that of vertebrates, develops under the effect of high doses of pyrogen (e.g. 4 mg zymosan per 1 kg body weight) or during intensive infection with parasites (e.g. releasing of numerous or large cercariae of digenetic trematodes). Injection of yeast zymosan at the dose of 1 mg/g or lipopolysaccharide (LPS) from *Escherichia coli* at the dose of 10 mg/g into hibernating *P. corneus* caused symptoms of behavioural fever. The presence of cyclooxigenase (COX) and prostaglandines, which in homoiothermic animals take part in the endogenous regulation of set-point, also in molluscs, may suggest a similarity between the mollusc behavioural fever and fever in homoiothermic vertebrates. Further studies will include finding the COX-coding genes in *P. corneus* and, possibly, a COX-dependent mechanism of behavioural fever. The studies are financed by a grant from the National Science Centre, no. 3247/B/P01/2009/36.