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THE 30TH POLISH MALACOLOGICAL SEMINAR

SEMINAR REPORT

Only last year I (your on-duty reporter since 1998) complained about how it was "very difficult to write a DIFFERENT seminar report each year, that is unless something unusual happens, but nothing does". Now at last something unusual did happen. It's not usual to celebrate your 30th anniversary, right? You don't celebrate it every year, or even every 30 years, so it's a unique event. Anyway, a few weeks ago we celebrated our thirtieth birthday. Precisely speaking, it was the 30th anniversary of our first Malacological Seminar but, though the Association of Polish Malacologists came into being ten years later, in a sense it was the Association's 30th birthday. We wouldn't have come into existence if not for the Seminars. Let me remind you, we owe the fact that the Seminars started at all to Professor STEFAN W. ALEXANDROWICZ who, thirty years ago, made an inventory of malacologists and invited us all to the First Seminar (and organised the next six, and it was pre-internet and pre-e-mail). Thank you Stefan!

This year the Seminar was held in October (8–10); autumn meetings happen rarely, and when they do, it's mainly because of organisational or financial circumstances. This one was an autumn seminar because we had hoped to get some funds from the Ministry, and such funds are not available in early spring, so we decided to make it October. Alas, the Ministry did not give us a penny (their justification was that it was not "far-reaching enough", meaning that we were not cancer research, or EU economy, or something), so all the waiting and changing of the dates was in vain. We managed nevertheless, as we usually do.

The number of participants from Poland, those who registered, was 61 plus one non-malacological wife and one non-malacological husband. Then there were some FTAs [= failed to appear, though they had registered; but they had good reasons]: ANNA STAŃCZYKOWSKA, BEATA JAKUBIK, JÓZEF DOMAGAŁA, MACIEJ LIGASZEWSKI and BRYGIDA WAWRZYNIAK-WYDROWSKA. So in the end the list of native participants included 57 (Fig. 1), plus one who hadn't registered but nevertheless appeared for half a day. The representatives of the sponsoring companies failed to appear as well, but they sponsored us anyway, so they're forgiven. The neighbours were not very good at attending, though we had sent them special invitations, but that was mainly because our friendly Czech contingent had their own meeting at roughly the same time. As a result, the only participants from abroad were TEREZA KOŘÍNKOVÁ and ROBERT A. D. CAMERON who was also the driver of the Seminar's Vehicle.

Even though most of the neighbours failed us, the attendance was good. As usual, some people complained about the distance (the very south of the country, no very convenient public transport, etc.). But please, look at the map in Fig. 2 – the map shows all the Seminar sites: can you see one which would be equally accessible to everybody? Also, some traditionally arrived late and/or left early. The location was the village of Łopuszna near Nowy Targ, a very long village in a long valley, and our conference centre was very close to the upper end of it. Łopuszna is not far from our birth place – Krościenko on the Dunajec. Even though the cost per person was not exorbitant (cheaper than the previous year), there were still some people who couldn't attend for financial reasons.

The organising institutions were Wrocław University, University of Environmental and Life Sciences in Wrocław and the Association of Polish Malacologists; the organising committee included BEATA M. POKRYSZKO, ELŻBIETA KUŹNIK-KOWALSKA, MAŁGORZATA PROĆKÓW, TOMASZ KAŁUSKI and TOMASZ K. MALTZ, all except the Association's President, TOMASZ KAŁUSKI (Poznań) from Wrocław. Being both one of the Organisers and the author of this report I'm in an embarrassing position (it's unthinkable to thank yourself for organising something), but at least I can wholeheartedly thank all my co-organisers: all the Wrocław people mentioned above

Fig. 1. All of us except those few who arrived later. Photo: A. WITKOWSKI

and the President. Chapeau bas! You were great! The sponsors were the Natural History Museum, Wrocław University, the Faculty of Biology, Wrocław University (here we thank both our Faculty Dean DARIUSZ SKARŻYŃSKI and our Rector Magnificus MAREK BOJARSKI), and the Institute of Biology, University of Environmental and Life Sciences in Wrocław, the Association of Polish Malacologists, Carl Zeiss and a company with mysterious initials KAWA.SKA; we thank them, too.

Fig. 2. Map of all the Seminars (the 30th indicated with the red arrow)

Every participant was given a set of handouts: what we called a "seminar vessel" because we could never decide if it was a glass, a vase, or a salad bowl, with a clausiliid on it, a pen, a notebook (with a snail on it), the Abstract Book, the programme, three gastropod postcards (one with a snail, one with a semislug and one with a slug) and two historic volumes: the old one published for the 15th Seminar, and the new one, published for our 30th anniversary (Fig. 3). The Abstract Book was edited by TOMASZ K. MALTZ, BEATA M. POKRYSZKO, TOMASZ KAŁUSKI and MAŁGORZATA PROĆKÓW, and had two *Cepaea* on the cover. Thank you, Editors! The artists who took the photos and/or designed the things were great: two of the postcards (snail and semislug) and the photo on the front cover of the Abstract Book – ROBERT A. D. CAMERON, Abstract Book cover design and the clausiliid on the Seminar vessel – TOMASZ K. MALTZ, one postcard (slug) – JAROSŁAW PROĆKÓW, photo on the back cover of the Abstract Book – MAŁGORZATA

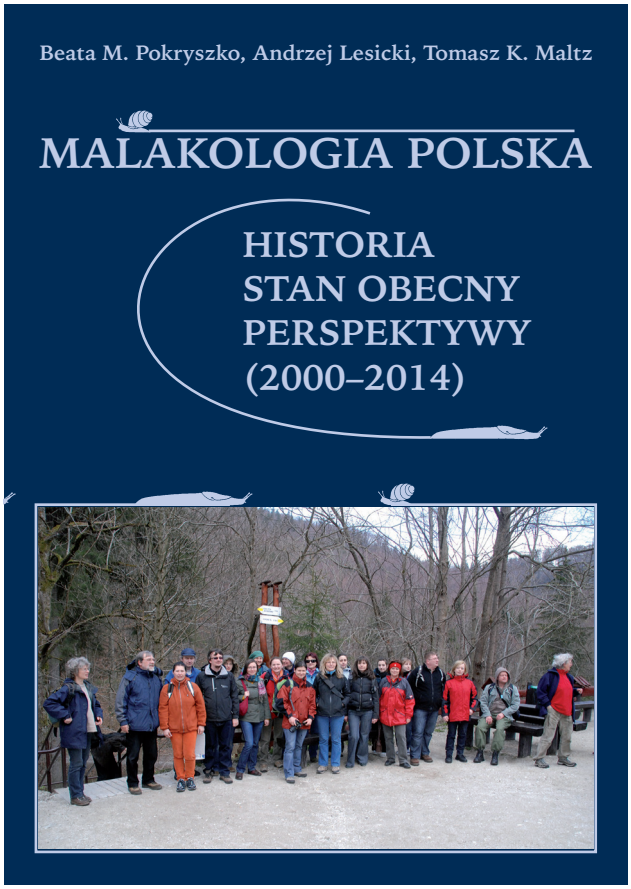

Fig. 3. Abstract volume and the new historic volume

PROĆKÓW. For all the various attributes of the Seminar see Figs 4–9.

Nearly half of the participants, plus all the Organisers, arrived on Tuesday (7th). The Registration Desk worked since Wednesday morning. We placed a welcoming poster with many snails on it near the desk (initially we intended to put it on the door outside, or on the balustrade, but then we thought: well, what if it rains? Which it never did), and the Seminar itself started officially on Wednesday (8th), at 11.45. The opening ceremony was very short, with only the President and one of the Organisers speaking. Because we felt we should celebrate not only during the banquet, but also in a more formal way, and before we started partaking of beer, wine and other beverages, in the first session we had a historic lecture, summarising our activities during the 30 years (by the author of this report), and a general lecture about geological events and placing them in time (by WITEK ALEXANDROWICZ). The oral presentations were fairly many, and they took all the Wednesday afternoon, Thursday afternoon and Friday till lunch. Apart from the two lectures at the opening ceremony, the number of oral presentations in the programme was 35, but three had to be cancelled because their authors failed to materialise. Still, 32 was a lot, especially that we wanted to have time to celebrate and go to the excursion; fortunately about half of the oral presentations were short communications. There were supposed to be 19 posters, but we ended up with 17, again because some people failed to attend. The chairpersons were (in alphabetical order) MAŁGORZATA OŻGO, ANDRZEJ PIECHOCKI, ANDRZEJ SAMEK, MAŁGORZATA STRZELEC, EWA STWORZEWICZ, ANDRZEJ WIKTOR, ELŻBIETA ŻBIKOWSKA. For snapshots of the poster and oral sessions see Figs 10–17.

The real sessions started on Wednesday after lunch – the three sessions were separated by coffee breaks, and followed by the General Assembly of the Association. The dinner was actually a barbecue in a nearby building pretending to be a shepherds' hut, with live fire, grilled meats and quite a lot of beer (Fig. 21). On Thursday morning we went for the excursion – rafting on the Dunajec River. The weather was splendid and warm (+24°C), and, apart from our four rafts, there was nobody on the river (Figs 18–20). The autumn colours were just beginning to show. Most participants said the excursion was fantastic, but maybe they were just being polite… On the way back those who wanted to could visit the fish farm in Łopuszna (Fig. 22). Besides commercial trout, the farm breeds the huchen (also known as Danube salmon, *Hucho hucho*) for reintroduction

purposes. The huchen is the biggest salmonid fish in Europe, it can be up to 1.5 m long, or more. Some didn't go to the excursion but used the time to collect their favourite molluscs instead; some arrived well before the Seminar started, or stayed after the Seminar and went to Mt. Turbacz or to Trzy Korony, and some even to the Tatra Mts. So the Seminar site wasn't all that bad, eh? In the afternoon we had more oral presentations, the poster session and then the banquet. The great attraction of the banquet was the anniversary cake, with snails on it; it was cut by the President. During the banquet our "father", STEFAN W. ALEXANDROWICZ, the initiator of the Seminars, was presented with a big snail (artificial) in recognition of his merit (Figs 23, 24). OK, I know people are given medals, or diplomas, or whatever, but what

Figs 4–9. Various attributes of the Seminar: 4 – Seminar venue, 5 – Seminar welcome poster, 6 – Seminar vehicle, 7 – Seminar cake, 8 – Seminar registration desk, 9 – Seminar vessel. Photos: B. M. POKRYSZKO

Figs 10–17. Poster and oral sessions: 10 – one of the posters with its Author, 11–12 – posters without their authors, 13 – poster session, 14 – table for reprint exchange (doubling as tennis table), 15–17 – oral presentations. Photos: R. A. D. CAMERON (10, 13), B. M. POKRYSZKO (11, 12, 14–17)

Figs 18–24. Excursions and social life: 18–20 – rafting on the Dunajec, 21 – barbecue party, 22 – at the fish farm, 23 – STEFAN W. ALEXANDROWICZ and his snail, 24 – President cutting the cake. Photos: R. A. D. CAMERON (18–20, 22), A. WITKOWSKI (21), B. M. POKRYSZKO (23, 24)

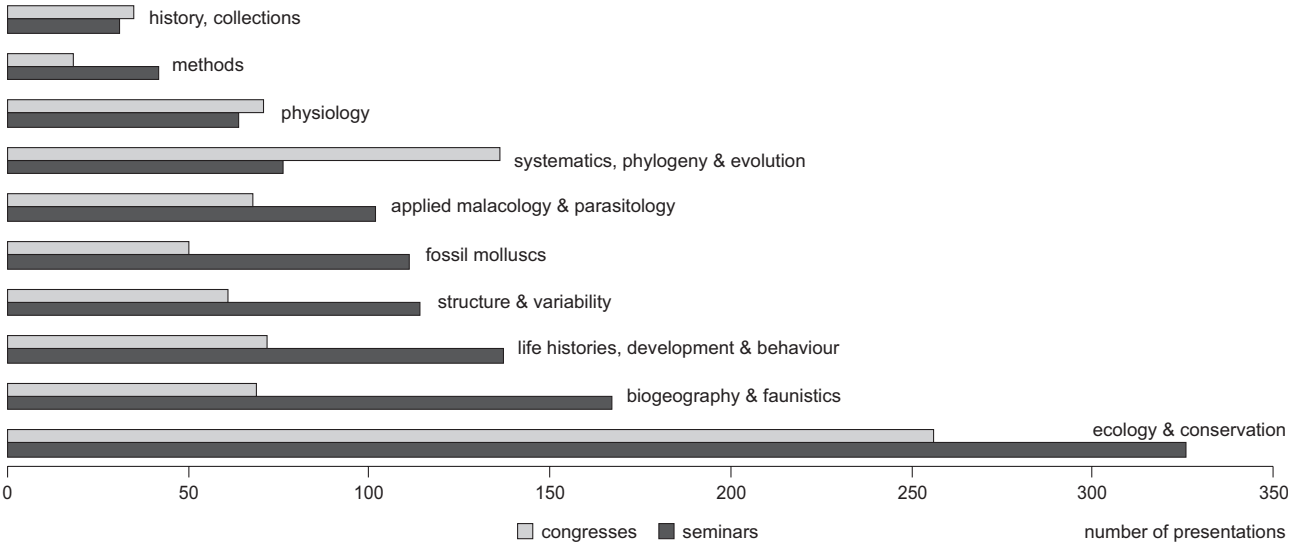

Fig. 25. Graph showing the topical structure of the Seminars compared to the last three World Congresses of Malacology

can you give to a malacologist? Friday morning was without any special attractions: we just got on with the oral presentations (and the computer refused to work on two occasions), then had lunch and said goodbye.

This was the first Seminar with a reprint stall, where you could leave your reprints for the people to take and take other people's reprints. We thought that in the day of the PDF it would be sensible to provide people with an opportunity to get rid of all the paper from their drawers and filing cabinets. Though some of the reprints were left, quite a lot disappeared.

Because of the anniversary, some people brought photos from the previous Seminars, either in old-fashioned albums (GRAŻYNA PYKA was very good about that, she is a true archivist, thanks Grażyna!), or on pinsticks, and those who were interested could look at them in the lecture room during the banquet. Oh, how young we were in those photos! If you decide to join the Association now, you'll be joining an old and respectable association, with lots of very old members.

Both the posters and the presentations were very good. The poster and presentation technologies are getting more and more sophisticated, and also the scientific standard is maintained or – if anything – better than before. Among the presentations, the ones by our few amateurs are noteworthy. One was about the use of molluscs as templates for technical solutions, by ANDRZEJ SAMEK who earlier this year had celebrated his 90th birthday, another about a very unusual church with almost all the ornaments made of mollusc shells (this one by our new amateur, JAREK MAĆKIEWICZ). We always enjoy presentations by our colleague ELIZA RYBSKA who, apart from strict malacology, deals with "snails and teaching". This year she told us about how children imagined the inside of the snail's shell (some kids believed it contained furniture and a TV set); see also Abstracts below. The strictly malacological ones we liked were, for example, the ones about aquapores in snails by JOANNA PIEŃKOWSKA and co-authors, and the one about molecular mechanisms of snail movement by PIOTR KACZOROWSKI.

The programme contained 37 oral presentations and 19 posters. The snail : bivalve ratio was roughly

Table 1. Number of papers and posters in consecutive years

No.	Discipline	2007–2009	2010	2011	2012	2013	2014	Total	Mean
1	Ecology & conservation	76	18	22	10	13	16	155	19.4
2	Applied malacology & parasitology	24	10	11	4	4	8	61	7.6
3	Life histories	22	10	8	7	5	2	54	7.4
4	Miscellaneous: general, behaviour, archaeology, collections, history, education, methodology	21	5	9	3	6	13	53	6.6
5	Biogeography & faunistics	11	9	11	9	8	1	49	6.1
6	Fossil molluscs	16	3	6	4	5	5	37	4.6
7	Structure (histology, cytology, shell) & variation	11	2	3	3	5	6	31	3.9
8	Systematics/phylogeny (including molecular)	16	3	2	2	6	1	30	3.8
9	Physiology	2	3	7	4	2	6	24	3.0
Total		199	63	79	46	54	58	494	61.8

2 : 1 (3.3 : 1 in 2013, 4 : 1 in 2012, 3.5 : 1 in 2011, 2.3 : 1 in 2010, for more ratios from earlier years see earlier volumes of Folia Malacologica), the land : water ratio was 1 : 1 (1.9 : 1 in 2013, 2.8 : 1 in 2012, 1.5 : 1 in 2011 and 2010). The ratio of one-author presentations to presentations with two or more authors was 0.3 : 1 (0.4 : 1 in 2013, 0.6 : 1 in 2012, 0.4 : 1 in 2011, 0.9 : 1 in 2010), and the ratio of papers/posters presented by girls versus boys was 1.3 : 1 (1.6 : 1 in 2013, 1.3 : 1 in 2012, 1.2 : 1 in 2011, 1.9 : 1 in 2010).

Table 1 contains statistics of the 2007–2014 presentations and posters (many, as usual, assigned to more than one category). For technical reasons those of 2007–2009 have been lumped together. This year the number of papers within the "miscellaneous" category was unusually high, mainly because of the special, anniversary character of the Seminar.

Although the numbers of papers within disciplines in consecutive years tend to fluctuate rather than show a trend, we have so many data in the table now that we can say for sure which disciplines are the most popular among the Polish malacologists (look at the columns "total" and "mean" in Table 1). The topical structure of our native malacology compared to the world's trends was shown in a graph in the 28th Seminar Report (see Folia Malacologica 2013, 21: 33–51, http://dx.doi.org/10.12657/folmal.021.005) and in another, slightly different graph, in the historic volume published this year, where the 30th Seminar was not included. This year's new graph (Fig. 25) shows that the situation remains more or less the same, with ecology & conservation as the leading discipline.

The next Seminar will most probably take place in Wieliczka near Cracow, but that was an unofficial promise.

The abstracts below include all the abstracts from the Abstract Book, most of them translated and some tweaked a bit by the author of this report.

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ABSTRACTS OF THE 30TH POLISH MALACOLOGICAL SEMINAR

HOLOCENE MALACOFAUNA OF KAMPINOS FOREST

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Kampinos Forest occupies extensive palaeo-flood terraces on the left bank of the Vistula; its area is predominatly composed of two longitinal dune banks and two marshy depressions. The first information on its Quaternary malacofauna dates from 1961, and detailed studies were undertaken in the 1980s. The assemblage found in 58 samples (total of 12,500 specimens) of carbonate gyttja, lacustrine chalk, calcareous tufa, organic and peat silts, humus and soil, included 51 snail and bivalve species, *Bithynia* opercula and slug shells. In two profiles in the depression along the Olszowiecki Stream, the Holocene series of gyttja with lacustrine chalk intercalations yielded *Valvata cristata*, *V. macrostoma*, *Planorbis planorbis*, *Segmentina nitida*, *Acroloxus lacustris*, *Bathyomphalus contortus* and *Sphaerium corneum*. The higher situated gyttja and marl contained a diverse fauna, among others *Bradybaena fruticum*, *Vallonia pulchella*, *Carychium minimum*, *Succinea oblonga*, *Valvata cristata* and *Anisus leucostoma*. The top part of the profile, with peat silts and silts with humus, contained *Vallonia pulchella*, *Pupilla muscorum*, *Succinea putris*, *Vertigo pygmaea*, *Aplexa hypnorum*, and few *Galba truncatula* and *Segmentina nitida*. In the depression separating the northern and southern dunes, calcareous gyttja and lacustrine chalk below the peat deposits contained numerous shells of *Gyraulus albus*, *G. crista*, *G. rossmaessleri*, *Valvata cristata*, *V. piscinalis* and *Bithynia* opercula, as well as *Pisidium*. The fauna was typical of shallow and permanent water bodies. The mollusc assemblages, characteristic of the Quaternary deposition environment of the area, were radiocarbon dated (mid belt of marshes 9,720 ± 130 years BP, upper limit of age of calcareous deposits 5,950 ± 80 years BP; southern edge of dune banks, peat under lacustrine chalk 10,250 ± 160 years BP, humus intercalation 7,900 ± 120 years BP). The difference between the faunas of the two wetland belts reflects the different character of the Holocene water bodies. In the middle belt, the lacustrine chalk and gyttja, representing the Lower and Middle Holocene, were deposited in the Vistula oxbows. In the southern belt, the fauna indicated periodic water bodies, such as shallow oxbows and flooded areas and, in the case of younger deposits, meadows and marshy meadows as well as periodically flooded areas. The composition of the recent mol-

lusc communities is to a large extent similar to that of the Upper Holocene assemblages.

MOLLUSC ASSEMBLAGES AND DATING OF SLOPE DEPOSITS IN EASTERN PODHALE

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Slope deposits are the most common Quaternary deposits in the Carpathians; they vary in thickness and structure. Their lithological character is mainly bedrock- and climate-determined. They usually undergo slight displacement as a result of surface mass movements, leading to increasing thickness in lower parts of slopes where they interdigitate with fluvial deposits of river valleys. More than ten sites with slope deposit malacofauna have been described from the Polish Carpathians; such profiles are more numerous in the Czech Republic and Slovakia. Malacological sequences in slope deposits usually represent short periods, and their mollusc assemblages most often correspond to one climatic phase; sites with longer periods and several climatic phases are fewer. Their malacofauna can be used not only for palaeoclimatic and palaeoecological reconstructions, but also for dating of the deposits. In eastern Podhale slope deposits with malacofauna were found in 15 profiles representing the last pleniglacial, Late Glacial as well as Early and Middle Holocene. The material included 61 samples with 40 snail species represented by nearly 15,000 specimens. The deposits of the coldest phase of the last glaciation contained typically loess species, among others *Pupilla loessica*, *Succinella oblonga*, *Vallonia tenuilabris*, often accompanied by two cold-loving species of slightly shaded habitats: *Arianta arbustorum* and *Semilimax kotulae*. The late glacial malacofauna, usually representing the younger Dryas, was characterised by very abundant occurrence of cold-loving tundra forms: *Vertigo genesii* and *V. geyeri*, and disappearance of loess species, with admixture of *Columella columella*, and sometimes mesophiles: *Vertigo substriata*, *Euconulus fulvus*, *Perpolita hammonis*. The absence of forest taxa was characteristic. The appearance of forest species was characteristic of Holocene deposits. Initially taiga forms dominated: *Discus ruderatus* which, combined with some other species (*Vertigo substriata*) indicates a cool continental climate. The assemblage was usually supplemented with numerous mesophiles and cold-loving glacial relics (*Vertigo genesii*, *V. geyeri*, *Columella columella*). Such fauna is typical of the Early Holocene. The climate warming and change from continental to oceanic circulation resulted in the Middle Holocene replacement of coniferous forests with mixed deciduous-coniferous communities. The assemblages of that period were rich and dominated by forest species, some of them with narrow ecological requirements (*Discus perspectivus*, *Ruthenica filograna*). The studies of slope deposits provide a basis for palaeogeographic reconstructions and dating of the deposits in the case of which traditional dating methods often fail.

STRATEGIES OF INDUCED DEFENCE IN THE ZEBRA MUSSEL AND OTHER BIVALVES – A REVIEW

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Predation leads to adaptations on the part of both prey and predator. Anti-predator defence is either constitutive, which is present all the time (poisons, body processes, mimicry), or induced – occurring only when the predator is present. Both ways of defence imply energy and evolutionary cost. The constitutive defence requires constant energy expenditure to maintain the defensive mechanisms. The induced defence is more economic but requires precise assessment of danger and implies the risk of erroneous assessment resulting in death. The induced defence often occurs and is studied in aquatic organisms, since transmitting signals of the predator's presence (kairomones) and detecting them is easier in aquatic environment. Induced defence has been observed, among others, in protozoans, copepods, molluscs and fishes. The zebra mussel (*Dreissena polymorpha*), and also marine species *Perna viridis* and *Mytilus edulis*, are often used to study induced defence. All these species attach to the substratum with byssus threads. Bivalve's defensive reactions include, among other things, changes in the strength of attachment to the substratum, number and thickness of byssus threads, speed of movement, degree of aggregation, filtration rate. Signals used in the studies are various predatory species and mechanically damaged bivalves. The bivalve's first reaction to the threat from predator is decreased activity (smaller speed of movement, slower metabolism etc.). This can be explained by an attempt at reducing the metabolite release; the metabolites inform the predator of the prey's presence (this is especially important in the case of predators which use the sense of smell – fishes). With prolonged exposure of bivalves to predator's kairomones, there is an investment in such mechanisms as increase in the number or thickness of byssus threads or increased strength of attachment to the

substratum. The reaction occurs in the presence of the predator. In the presence of mechanically damaged conspecifics the reaction may be different and consist in non-investing in the byssus, but it is not a universal rule. Threatened bivalves generally tend to form aggregations which are more difficult to attack. The state of studies on the bivalve active defence and prospects of further exploration of the problem are discussed.

MORE CITY SNAILS: *CEPAEA NEMORALIS* IN GÖTEBORG, SWEDEN

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Cepaea nemoralis (L.) is a land snail famous for its shell colour and banding polymorphism. While studies of this polymorphism provide some of the most convincing examples of the force of natural selection, sometimes over very short time-spans, there is also evidence that genetic drift and founder effects contribute to the variation seen among populations. It has also proved to be a successful invasive species, especially at the eastern and northern limits of its range. It thrives in the new and often temporary habitat created in cities and it is clearly spread passively by humans. An earlier study of *C. nemoralis* variation in Sheffield (UK) and Wrocław (Poland) showed considerable differences between the two cities, related to the length of time the species had been widespread and the degree of isolation among populations. In neither city, however, were there many earlier records. Göteborg (SW Sweden) is a city of comparable size. *C. nemoralis* is not a native species in Sweden. The first record for Göteborg dates from the mid 19th century. Unlike Sheffield and Wrocław, there are quite many early records and, most importantly, good early surveys where absences can be regarded as reliable. We can show that it has increased in frequency very rapidly in the last two decades, having previously been very uncommon. Early samples show the predominance of yellow-shelled morphs, but in modern populations pink shells predominate. This change goes in the opposite direction to that seen in detailed studies where *C. nemoralis* has been established for centuries or longer. There is great variation in morph frequencies among modern populations with high values of F_{ST}, and with no relationships to habitat. There are, at best, only weak geographical patterns. The overall pattern shown resembles that seen in Sheffield, a city also colonised over a similar time period, but differ from those seen in regions where the species has been established for much longer, for example in Wrocław. The combination of early and recent records suggests not only that founder effects play a large part in determining morph frequencies, but that present populations derive from multiple colonisations from different sources. It is remarkable that so much variation is retained in the face of repeated founder effects.

HOST PLASTICITY OF *VIVIPARUS CONTECTUS* TOWARD DIGENEANS

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Environmental studies on the spread of digeneans in snail populations focus mainly on pulmonates: Lymnaeidae and Planorbidae which participate in transmission of schistosomiasis, fasciolosis or "swimmers' itch". There is little information on the parasite fauna of prosobranchs, which may result from greater difficulties to obtain material (most often small, bottom-dwelling species), and the lack of medical and/or veterinary incentive for such studies. The largest native prosobranch is *Viviparus contectus*. Episodic studies on the species in Poland revealed six species of Digenea. Our aim was to update the list of digeneans occurring in *V. contectus*, with special reference of their prevalence and role of the host snails for the digenean developmental stages. The studies, conducted from May to September of 2008–2011 and in 2014, included selected lakes of the Polish Lowlands. Nine species of Digenea were found in 3,005 examined *V. contectus*. Besides cercariae of *Cercaria pugnax*, *C. vesiculosa*, *Paracoenogonimus ovatus* and *Neoacanthoparyphium echinatoides* known from the literature, we recorded forms which were new to the Polish parasite fauna, preliminarily determined as Furcocercariae sp. B and Xiphidiocercariae sp. D. *Viviparus* also played the role of the second intermediate host for metacercariae of *N. echinatoides*, *Amblosoma exile* and *Leucochloridiomorpha lutea*. Finding a sexually mature stage of *Diplodiscus subclavatus* which probably uses *V. contectus* as the ultimate host in its alternative life cycle was a unique discovery. The total extensity of infection of *V. contectus* with digeneans was 26.7% and varied among the lakes. The infected snails usually played the role of first intermediate hosts (75.6%), less often sec-

ond intermediate hosts (12.1%) or first and second intermediate hosts at the same time (10.0%). Mixed infections (i.e. simultaneous infection with cercariae of two species) and infections where the snail was the ultimate host were rare, of 0.4 and 2.0%, respectively. Our results indicate that the digenean diversity in *V. contectus* is greater than previously believed. The snails, playing the role of the first, second and ultimate hosts to Digenea, show a large plasticity in that they provide appropriate conditions for all these developmental stages. For this reason *V. contectus* is an interesting model in the studies of host-parasite interactions.

PRELIMINARY STUDIES ON THE OCCURRENCE OF DIGENEANS IN UNIONIDAE AND IN DREISSENIDAE WHICH ATTACH TO THEIR SHELLS

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The shell surface of unionids is often inhabited by the zebra mussel (*Dreissena polymorpha*). Such a spatial and temporal relationship between the bivalves of different life strategies is interesting from the point of view of the presence of Digenea in bivalves. Our studies aim at assessing the species richness of digeneans in the Unionidae and the Dreissenidae attached to their shells, as well as estimating their prevalence and role of the hosts of the two families for the digenean larvae. The bivalves were caught in selected lakes of the Polish Lowlands; the data span the period April–July 2014. The numbers of specimens studied were: 204 *A. anatina*, 364 *U. tumidus*, 23 *U. pictorum*, 133 *S. woodiana* and 4,793 *D. polymoprha*. The overall prevalence in Unionidae and Dreissenidae was 2.3% and 2.0%, respectively. The unionids harboured cercariae of *Rhipidocotyle campanula* (proportion among infected bivalves 64.7%) and *Phyllodistomum* sp. (*elongatum?*) (5.9%), pre-patent invasions (i.e. sporocysts and/or rediae; 17.6%) and metacercariae (11.8%). The zebra mussels attached to the unionid shells were mainly infected with echinostoma metacercariae (97.9%); only a few cases of pre-patent infection were recorded (2.1%). The preliminary studies indicate that unionids more often play a part of the first intermediate hosts to Digenea, while *D. polymorpha* is mainly the second intermediate host. Further studies should make it possible to estimate the environmental reasons for the observed differences. Studies financed by an individual grant WBiOŚ UMK (2014) no. 1917-B.

THE EFFECT OF RIVER BED TRANSFORMATIONS ON THE BENTHIC FAUNA WITH SPECIAL REFERENCE TO SNAILS: NIDA RIVER

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The Nida River, a left bank tributary to the Vistula, length 151.2 km, catchment area 3,865.4 km^2, drains the southern part of the Świętokrzyskie Mts and a part of the Nida Basin. For the most part it is unregulated and forms numerous meanders, except the section Stara Wieś-Pińczów, where the river bed was regulated in the 1960s and 1980s. Macrobenthos was sampled in 2007 and 2008 from habitats which were representative of the Nida. Because of the location of the river, its partial or complete regulation, and the mainly agricultural character of the catchment area, most of the sampling sites differed significantly in their mean flow velocity, organic matter content in the bottom deposits, content of O_2, NH_3 and NO_2 in the water, pH and total hardness of the water, which determined the character of the benthic communities. Even a partial regulation had a negative effect on the snail diversity and density. Sites under direct anthropopressure harboured few species which often formed permanent populations (*Bithynia tentaculata*, *Valvata piscinalis*, *Anisus vortex*, *Gyraulus albus*). Some of the species occurred only in the unregulated section of the river (*Theodoxus fluviatilis*, *Viviparus contectus*, *Planorbarius corneus*, *Planorbis planorbis*, *Anisus spirorbis*, *Bathyomphalus contortus*). The absence of six species (*Lymnaea turricula, Anisus septemgyratus*, *A. leucostoma, Segmentina nitida, Aplexa hypnorum, Gyraulus rossmaessleri*), which were recorded in the 1970s during the onset of the regulation work, is most probably a result of anthropogenic influence. At present, because of the planned re-naturisation of the Nida, an increase in the macrobenthos diversity including snails can be expected.

MALACOFAUNA OF THE NATIONAL PARK UJŚCIE WARTY

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The National park Ujście Warty is situated at the northern border of Poland, in the part of Toruń-Eberswalde Palaeovalley which is called Gorzów Basin. The malacofauna was studied since 2011 in order to inventory species in two of the Park's rivers: Warta and Postomia, the latter located in the south-

ern, annually flooded part of the park. Samples were taken manually from the bottom (80×80 cm frame), by diving in nine sites: three in the Warta (7, 14 and 17 km of the river course) and six in the Postomia, in its lower section. Eighteen species of Unionidae, Spheriidae and Dreissenidae were recorded. Four of them are red-listed in Poland. The most rare (status EN – endangered) were *Sphaerium solidum*, *Unio crassus*, *Anodonta cygnea* and *Musculium lacustre*. *Sphaerium rivicola* (status VU – vulnerable) was also recorded. Many rare and protected species showed relatively high abundance in the Park's waters, especially in the Postomia, for example *Sphaerium rivicola*, or *S. solidum*. Also introduced species were recorded in the Park: *Sinanodonta woodiana* is getting increasingly abundant. The species is fairly expansive and its population in the Park has reached a high density and biomass within a short time.

TEMPERATURE-RELATED CHANGES IN BODY AND CELL SIZE OF *HELIX ASPERSA ASPERSA* AND *HELIX ASPERSA MAXIMA*

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According to the TSR (temperature-size rule) ectothermal animals in lower temperatures grow more slowly and are later to reach maturity, but attain a bigger body size compared to those growing at higher temperatures. We tested the TSR predictions for two subspecies of *Helix aspersa* [= *Cornu aspersum*], extending the studies to include cell size (temperature-cell size rule). The snails were kept in climate chambers, at 15°C and 20°C during 13 months with light : dark cycle of 16L : 8D. The body mass was monitored. Between days 136 and 150 we measured the respiration rate, and at the end of the experiment the soft parts were fixed and histological slides made. Snails of both subspecies at 20°C grew faster compared to those kept at 15°C and reached a greater body mass, contrary to the TSR. In both temperatures *H. aspersa aspersa* (HAA) reached smaller body mass than *H. aspersa maxima* (HAM). HAA had significantly larger muscle and epithelium cells compared to HAM, but the size of hepatopancreas cells did not differ between the subspecies. Snails developing at 20°C had smaller muscle and epithelial cells compared to hepatopancreas cells. Production of CO_2 ($\mu L \cdot h^{-1}$) was generally higher at 20°C than at 15°C, but when respiration rate was compared among snails of similar body mass, HAA had a higher rate of CO_2 production than HAM. Studies financed within the projects "Maestro" of the National Science Centre (2011/02A/NZ8/00064) and DS for young scientists and doctoral students, Faculty of Biology and Earth Sciences, Jagiellonian University (K/DSC/000171).

HABITAT-RELATED INTERSPECIFIC DIFFERENCES IN THE UNIONID BIOLOGY

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Among the world's animals, the extinction rate of freshwater bivalves is the greatest; though the percentage of globally endangered species is the highest among unionids compared to other mollusc families, they are among the least studied families. Information on their biology, habitat requirements, spatial distribution and interactions with other species is scarce. Previous studies on populations of *Anodonta anatina*, *A. cygnea*, *Pseudanodonta complanata*, *Unio pictorum* and *U. tumidus* indicate patterns of horizontal and vertical distribution of these species in the Pińczów Reservoir. The bivalves are most abundant 5–8 m from the shore, at the depth of 40–120 cm. No differences in the vertical distribution were observed between the species. Young individuals of *P. complanata* and *A. anatina* were absent; the youngest individuals were four years old. No successful reproduction of either species occurred in the Reservoir during the last four years. Preliminary studies suggest that: a) the bivalves form a guild in terms of habitat use; b) the competition is of "scramble" type – competing for one limited resource but with no possibility of one species limiting the access to the resource by its competitors; c) there is a competition-based character displacement. Further studies within the next two years will focus on monitoring of population dynamics and experimental approach to factors which influence the distribution of bivalves in the Reservoir. The project includes: a) study of fish species composition and distribution, b) experimental assessment of affinity of glochidia to hosts (fishes), c) experimental estimate of effect of habitat conditions on survivorship of young, d) experimental assessment of effect of habitat conditions on growth, e) chemical analysis of water samples. The results should provide the basis for constructing statistical and mathematical models of ecological niches of the bivalves.

MALACOLOGICAL STUDIES OF THE RIVERS OF THE DRAWA CATCHMENT AREA

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The fauna of the rivers of the Drawa catchment area was inventoried in 2009–2014; the studies included also species composition and distribution of bivalves. The whole Drawa, from the sources to the mouth, was monitored. The species composition and distribution of each species were studied. Similar studies were carried out in larger tributaries of the Drawa – Mierzęcka Struga with Koczynka, Korytnica, Płociczna with Cieszynka, and Młynówka. Based on the collected material and the earlier studied fragments of the catchment area, the distribution of selected bivalve species was described in detail. Special attention was paid to *Unio crassus*. Its distribution in the Drawa and its tributaries was mapped. The studies will be continued. Studies partly financed by the EU within the Operation Programme "Balanced development of fishery and coastal fishing areas 2007–2013", no. 00001-61724-OR1600004/10.

ULTRASTRUCTURE OF HEPATOPANCREAS IN *ARION VULGARIS* AND *ARION RUFUS*

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A. vulgaris and *A. rufus* are serious pests of cultivated plants. Gastropod hepatopancreas is anatomically and functionally associated with mid gut; it participates in secretion of digestive enzymes as well as absorption and storage of nutritive substances from the gut. The material was taken from specimens of both species from March till October. Routinely prepared slides were examined in transmission and scanning electron microscopes. The hepatopancreas in the two species is morphologically similar: it is surrounded by a connective tissue sheath with branching nerve fibres. The hepatopancreas parenchyma is composed of tubules, connected by strands of connective tissue which is rich in collagen fibres. The surface of tubule-building cells bears microvilli which face the tubule lumen. The cells represent two ultrastructurally and functionally different types: secretion-absorption cells and calcium cells. In the digestive cells, deep invaginations of cell membrane form among the long and numerous microvilli; they give origin to vesicles, which may suggest endocytosis. The apical parts of these cells are occupied by extensive and irregular vacuoles with electron-translucent contents. The vacuoles result from fusion of smaller vesicles which form with participation of the Golgi apparatus and rough endoplasmic reticulum (RER). The basal parts of the cells contain nucleus, long, well-developed dictyosomes of the Golgi apparatus and well-developed RER cisterns, as well as electron dense glycolipid droplets. The calcium cells contain large vesicles with calcium concretions of concentric structure (calcospherites). These cells have well-developed dictyosomes and RER cisterns which may indicate that proteins are important components of the calcospherites.

HALF A CENTURY OF STUDIES ON VIVIPARIDAE OF POLAND – HISTORY, PRESENT STATE AND PROSPECTS

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In Europe viviparids are represented by the genus *Viviparus* Montfort, with two abundant and common freshwater species found in Poland: *Viviparus viviparus* (Linnaeus, 1758) and *V. contectus* (Millet, 1813). The first studies on viviparids of Poland focused on the distribution and biology (Urbański in the first half of the 20th c., Piechocki and Falniowski in the second half of the 20th c.). *V. viviparus* lives in large rivers, floodplain water bodies, less often in lakes and sometimes in well vegetated ponds; it prefers sandy, loamy, muddy or stony bottom. In Poland it is found in the northern and central lowlands; it is rare in the south. *V. contectus* inhabits muddy, shallow stagnant water bodies: oxbows, flooded meadows, ponds, ditches or wetland pools, as well as small, slow-flowing rivers and lake littoral. It prefers muddy bottom with a thin layer of debris, and vegetated places. It is found in the whole country except the Carpathians and the Sudetes. Both species are ovoviviparous and dioecious which may have an effect on their occurrence in various freshwater habitats. Studies on the population ecology of *V. viviparus* [= *V. fasciatus*] in Poland were started by Stańczykowska in the second half of the 20th c.; they included abundance dynamics, age structure, sex ratio, reproduction and mortality. She observed seasonal tendency of the species to form aggregations. Later studies by other malacologists focused on life history of both species. Jakubik extended the studies to include various types of water bodies. She showed that the ovoviviparity with the associated reproduction control, and

accelerated maturation in unstable conditions, were adaptations of the species to life in variable environments. The work conducted at the end of the 20th c. by FALNIOWSKI, MAZAN, SZAROWSKA and KOZIK contributed considerably to the taxonomy and phylogeny of European viviparids. Based on characters of embryonic shells, soft parts and opercula, they presented cladograms for *V. contectus*, *V. viviparus*, *V. acerosus* and *V. ater*. In view of the studies on preserving biodiversity, the taxonomic status of viviparid forms from various freshwater habitats in Poland should be revised, since some of them may be interspecific hybrids.

ABUNDANCE AND DISTRIBUTION OF POPULATIONS OF *HELIX POMATIA* L., 1758 IN WARMIŃSKO-MAZURSKIE VOIVODESHIP

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The Roman snail was introduced, initially probably for culinary purposes, in northern Poland, including Warmińsko-Mazurskie Voivodeship. The species, having become an export product, attracts increased interest resulting in a danger of decrease in its population abundance. We aimed at assessing the current distribution and abundance of the Roman snail populations in Warmińsko-Mazurskie Voivodeship, compared to the studies of 2005–2006. Here we present the results of abundance assessment. The studies were conducted from May to September 2014. In 67 of the sites selected in 2005 we collected the snails by eye. The snails were counted in the following habitats: meadows, verges, ruderal habitats, railway embankments, margins of water bodies, scrub and forest edges. The sites were classified in three categories, according to the degree of human influence: natural, seminatural and anthropogenic. Snail density per square metre was calculated for each site. As in the previous years, the Roman snail occurred in 64% of the sites. Some (6%) had been permanently transformed and now not available to the snail. In 30% of the sites the density was medium (0.21–3.5 indiv. m^{-2}), in 28% of the sites it was small (0.11–0.2 indiv. m^{-2}), or very small (0.01–0.1 indiv. m^{-2}). No sites with high density were confirmed (>3.5 indiv. m^{-2}). The habitats with the greatest abundance (68%) were anthropogenic (ruderal, railway embankments): the average abundance was 0.33 indiv. m^{-2} (formerly 1.08 indiv. m^{-2}). The species showed low density (0.16 indiv. m^{-2}) in 53% of seminatural habitats (verges, scrub) and was scarce (0.03 indiv. m^{-2}) in 29% of natural habitats (shore and forest edge sites).

DIVERSITY OF AQUATIC MOLLUSC IN A VARIED RIVER LANDSCAPE: FRAGMENT OF THE LOWER LIWIEC RIVER

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The studies were conducted in a ca. 10 km section of the lower Liwiec River and its valley, with a varied set of habitats. The aim was to assess the species composition, diversity, dominance structure and frequency, and to estimate the mollusc density in three kinds of habitats: main river bed, another, smaller bed which is connected to the main bed in its upper and lower part (the so called Bełcząc, length ca. 6.5 km), and the remains of old river bed. An attempt was made to use molluscs to characterise the selected habitats, and to assess the contribution of the three habitat kinds to the diversity of the freshwater malacofauna. Samples were taken in 16 sites in September 2012 and May, June and August 2013. Thirty six mollusc species were recorded (22 snails, including 4 prosobranchs, and 14 bivalves), the noteworthy species being *Anisus vorticulus* (Troschel), *Anodonta cygnea* (L.) and *Unio crassus* Philipsson. The species composition differed among the three habitats. In the Liwiec the main components of the malacocoenoses were bivalves, in the Bełcząc and the old river bed – snails. Only nine species occurred in all three habitats, 10 were found exlusively in the main bed of the Liwiec, four in the Bełcząc and two in the remnants of old river bed. The mean number of species per site (α diversity) and the density were the greatest in the Bełcząc. The total number of species (γ diversity) was also the greatest in the Bełcząc (by ca. 30% greater than in the other two habitats). The proportion of rare species was high (28%); they were represented by one or two specimens each. The number of rare species and the Shannon index were correlated with the total number of species in the whole area and in the main bed of the Liwiec. The proportion of α and β diversity in the studied area, in the Bełcząc and in the old river bed, was similar, but in the Liwiec the diversity between sites (β) was distinctly greater. Only *Sphaerium corneum* was common in the Liwiec (frequency ≥50%); six species were common in the Bełcząc and two in the old river bed. The number of species with frequencies below 10% was the smallest in the old river bed which may have resulted from limited migration possibilities caused by the fragmentation and isolation from the main river bed. The dominance structure differed among the habitats. In the Liwiec bivalves constituted more than 85% of mollusc abundance; the dominant species in the Bełcząc were *Radix balthica*, *Planorbarius corneus*, *Valvata piscinalis* and *Bithynia tentaculata*. The

old river bed was dominated by pulmonates, mainly typical of small water bodies (*Stagnicola palustris, S. corvus, Planorbis planorbis, Segmentina nitida, Anisus vortex*), and some species of *Pisidium* (*P. milium, P. subtruncatum, P. nitidum*). The rather high species richness of the area is due to the varied species composition of the sites and the three habitat types. The varied dominance structure indicates that abundant populations of some species (important for the species' survival) are associated with particular habitats. The mean similarity of species composition (Jaccard coefficient) among the habitats was fairly high (36–40%), similar to those reported from lenitic localities with considerable spatial diversity. The malacocoenoses varied considerably among the sites in the main Liwiec bed, in spite of the possibility of migration. This may result from different outcomes of interactions between dispersal and local competition and/or predation in different river fragments, and the risk of extinction caused by small abundance of an array of species.

THE EFFECT OF SELECTED AGONISTS AND ANTAGONISTS OF ADRENERGIC RECEPTORS ON THE MOTOR ACTIVITY OF EPITHELIUM OF *ACHATINA FULICA*

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During adhesive movement *Achatina fulica* tightly adheres to the substratum. This is ensured by two functional states of the sole epithelium: ca. 80% of the sole surface tightly adhere to the substratum while ca. 20% are raised and moving as progressing waves which are termed epithelium motor activity. The regulation of the phenomenon is complex and little known. Our aim was to check how selected agonists and antagonists of adrenergic receptors, through their effect on nerves, muscles and epithelium, affected the snail movement and the epithelium's motor activity. We used 50 individuals of *A. fulica*, mass 11–68 g and shell length 42–80 mm, from the department's culture. The epithelium's motor activity was recorded during spontaneous, rectilinear movement on a horizontal glass plate, using CCD camera (DFK 41 AV02.AS, The Imagingsource, Germany) coupled with computer; the software used was IC Capture. AS 2.0. We analysed the snail velocity, sole length and width, sole length/width ratio, number of sole waves, sole wave length (lw), length of space between waves, ratio of wave surface to total sole surface, wave frequency, distance covered per one wave (shw) and waving value (shw/lw). The experiments were conducted in control conditions and after injection of two doses (10 and 0.1 mg per 1 g body mass) of octopamine (non-specific agonist of a-adrenergic receptors), clonidine (agonist of a_2-adrenergic receptor), phentolamine (non-specific antagonist of a-adrenergic receptor), isoproterenol (non-specific agonist of b-adrenergic receptors), propranol (non-specific antagonist of b-adrenergic receptors). Statistically significant differences (Wilcoxon test, $p<0.05$). between the control and experimental groups showed that ligands of a-adrenergic receptors in most cases caused increase in the analysed parameters, while ligands of b-adrenergic receptors had an opposite effect. The difference in the effect of agonists and antagonists pertained to the effect on the snail velocity, sole length/width ratio and frequency of sole waves. The dose of 10 mg/g modified a greater number of parameters compared to 0.1 mg/g. The results suggest that cells of ganglia and/or muscle and epithelial cells of *A. fulica* bear receptors which bind the tested adrenergic substances which affect the regulation of the epithelium's and thus the snails's motor activity. Studies financed by the research grant for doctoral students of the Physician Faculty, Collegium Medicum UMK: 2/WF-SD.

ARION LUSITANICUS MABILLE, 1868 AND *ARION VULGARIS* MOQUIN-TANDON, 1855 – ONE OR TWO SPECIES?

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Expansion of a slug of the genus *Arion*, in the literature referred to as *A. lusitanicus*, has been observed in Europe since the 1950s. In recent years an increasing number of publications suggests that the invasive species is *A. vulgaris*, earlier misidentified. *A. lusitanicus* was for the first time described as an invasive species in 1955 by REGTEREN ALTENA in France. The data were repeatedly cited, and the invasion of *A. lusitanicus* in Europe was described on this basis. The slug reached also Poland where it was first identified in the 1990s. In 2002 GERHARD FALKNER stated that the invasive species in Europe was not *A. lusitanicus*, but *A. vulgaris*. The publication caused some nomenclatural confusion. Besides, the recent molecular data show that the species is not invasive, but native to Western Europe. Because of that we have attempt-

ed to clarify the nomenclature and to identify one or possibly two species.

CHANGES IN RATE OF BYSSUS PRODUCTION, RESPIRATION AND AGGREGATION OF THE ZEBRA MUSSEL UNDER THE EFFECT OF PREDATOR THREAT

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In the presence of predator, bivalves can change their biology and behaviour in order to decrease the risk of attack. Among other things, bivalves can increase their strength of attachment and form aggregations when in danger. In *Dreissena polymorpha*, some studies showed a poorer byssus production in the presence of a signal from predator. This may be explained by the hypothesis of "metabolic hiding", whereby the bivalve in the presence of direct threat stops filtration and decreases its metabolism, thus making it difficult for the predator to locate it based on chemical signals. The decrease in metabolism implies limiting energy expenditure which would explain the inhibition of costly byssus production. Investment in byssus would be made when the threat is more removed in time. We studied reactions of the zebra mussel to various signals of predator's presence: roach fed with zebra mussel or other food, and squashed zebra mussel tissues. We recorded byssus production, aggregation forming and respiration rate. We tested the hypothesis that predator's (roach) kairomones, especially in the case of roach fed with food different from zebra mussel, signal a threat that is removed in time (predator present but not feeding), while the presence of squashed bivalves, imitating feeding traces, will trigger "metabolic hiding". The bivalves aggregated more readily in the presence of predator signal compared to the control. In both variants with roach, the attachment strength was greater. There were no differences in that parameter between the squashed mussel variant and the control. The respiration rate in all the variants was the smallest at the beginning of measurements (probably effect of stress associated with preparations for the experiment), but in the variants with predators the respiration was smaller than in the control. At the end of the measurements, the differences between the two roach variants and the squashed mussel variant were statistically significant or nearly so (smaller respiration rate in squashed mussel variant). Out studies confirmed some, but not all, hypotheses related to the "metabolic hiding" in the zebra mussel.

ENVIRONMENTAL FACTORS MODIFYING REACTIONS OF *DREISSENA POLYMORPHA* TO ALARM SUBSTANCES

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Injured zebra mussels emit alarm substances which inform other individuals of the danger. We studied changes of the zebra mussel's behaviour under the effect of alarm substances and the environmental factors which may modify the mussel's reactions: locomotion and aggregation forming in mussels of different body size (small: <10 mm, medium-sized: 10–20 mm, large: >20 mm), in different light conditions (dark or ca. 600 lx), on various substrata (sand or glass) with different slope (level or sloping at 6°). Horizontal locomotion was studied in round containers 14 cm in diameter. After 24 h exposure, we measured traces left by mussels moving on the sandy bottom. The effect of alarm substances on horizontal locomotion depended on lighting: in light, distances covered by mussels in the presence of alarm substances were significantly greater than in the control, in the dark the situation was reversed. Larger body size and light decreased the intensity of locomotion. Vertical locomotion was studied by placing 4–5 mussels in aquaria of sloping, glass bottom (12×24 cm). After 24 h we checked the distance covered up and down the slope. Under the effect of alarm substances the mussels more often moved down and less often up the slope. Their general mobility remained unchanged or was greater than in the control. Larger body size and light induced the mussels to move down the slope. Forming aggregations and groups of mussels attached to each other were studied in round containers of 14 cm diameter, on a sandy (no possibility to attach) or glass substratum (attachment possible). The mussels preferred glass substratum to conspecific shells. The intensity of formation of aggregations and druses under the effect of alarm substances was only observed on the sandy substratum; on such substratum the mussels more often formed aggregations in the dark, and larger mussels formed druses more often than the small ones. Earlier studies indicated that the mussels reacted to danger by limiting their activity. Our experiments show that the behaviour under the effect of alarm substances is more complex and depends on many factors. Alarm substances can sometimes increase motor activity. It happens when remaining in one place is associated with the risk of being discovered by the predator, or when movement in a definite direction may increase safety.

ROLE OF AQUAPORINS IN *HELIX POMATIA* L. ENTERING INTO AESTIVATION

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Aquaporins are proteins building aquapores which serve to transport water and small electrically uncharged compounds through the cell membrane. They are classified in two subfamilies: orthodox aquaporins – AQP (transporting water) and aquaglyceroporins – AQGP (additionally glycerol or urea are transported). Aquaporins play an important physiological role in animals, plants, bacteria, fungi and protozoans. One of their functions is adjustment to changing environmental conditions: they participate in alleviating the negative effects of dehydration and freezing. Because of the paucity of GenBank molecular data for *H. pomatia*, it was necessary to identify de novo nucleotide open reading frames (ORF) coding for aquaporins. We sequenced transcriptome of foot and kidney of *H. pomatia*. We identified six different aquaporins. The analysis of aminoacid sequences obtained with in silico translation, showed the presence of motives characteristic of AQP (in three sequences called HpAQP1, HpAQP4 and HpAQP5) and AQGP (in another three sequences called HpAQP2, HpAQP3 and HpAQP6). Then we determined experimentally the role played by these aquaporins when entering into aestivation. Using real-time PCR, we checked the changes in the level of expression of the genes coding for the studied proteins in the foot, kidney and gut in snails which had been deprived of water and food during 1, 3, 7, 15 and 35 days. During the process the expression of aquaporin genes remained constant or even increased. The direction of changes in the expression level was not constant. Quantitative relations between the aquaporins in particular organs changed. Our results offer the first opportunity to analyse processes which take place in the Roman snails preparing to aestivate.
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THREAT TO PLANTS AND ASSESSMENT OF SLUG DAMAGE TO VARIOUS VARIETIES OF LUPIN

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The economic significance of terrestrial gastropods, and especially slugs, has increased within the last 20 years. The main reasons are climate changes, globalisation of trade, intensification and changes in plant production. Warm winters and wet summers favour gastropod reproduction and growth. Intensive trade of plants and other goods favours fast spread of native and alien gastropod species. Changes in cultivations' structure, selection of varieties and minimising agricultural procedures have a decisive effect on the increase in the number of gastropod-inhabited cultivations and abundance of gastropods. Among the gastropods found in cultivations the most serious pest is *Deroceras reticulatum* (O. F. Müller) which occurs in the whole of Poland. Locally much damage is done by *Arion lusitanicus* Mabille (now known as *A. vulgaris* Moquin-Tandon), *A. rufus* (Linnaeus) and *A. distinctus* Mabille. Less often damage is caused by *A. subfuscus* (Draparnaud), *D. laeve* (O. F. Müller), *D. agreste* (Linnaeus), *D. sturanyi* (Simroth), *Limax maximus* Linnaeus and other slugs. Gastropods damage many plants; depending on the region, the most seriously affected are winter rapeseed, winter wheat, potato, cabbage, lettuce, sugar beet, beetroot, carrot and legumes, strawberries and raspberries, as well as an array of ornamental plants. The most common method of slug control is the use of molluscicides which are often unsatisfactory and may affect other organisms. Alternative methods include application of Nemaslug with the parasitic nematode *Phasmarhabditis hermaphrodita*, and various agrotechnical procedures. Great expectations are associated with slug-resistant and slug-tolerant varieties, since the degree of damage by slugs varies among plant species and varieties. In 2013–2014 we exposed germinating seeds of 21 varieties of lupin to feeding of *A. vulgaris*, *A. rufus* and *D. reticulatum*. The experiments were performed in the laboratory, air temperature 16°C, RH 70% ± 3%, day length 12 hours, using young slugs. In consecutive days we estimated the degree of damage to all organs of the germinating seeds according to a five-degree scale. Following the initial intensive feeding on germinal roots, the slugs fed on developing hypocotyles and cotyledons. The data were statistically analysed using variance analysis and Fisher test, significance level $a = 0.05$. The degree of damage varied among the varieties: the most damaged were varieties Bojar and Oskar (*A. vulgaris*), Heros (*A. rufus*) as well as Dalbor and Boros (*D. reticulatum*). The smallest damage was done to the varieties Parys (*A. vulgaris*, *A. rufus*, *D. reticulatum*) and Karo (*A. vulgaris*, *D. reticulatum*). The results allow to specify the lupin varieties which are least sensitive to damage by *A. vulgaris*, *A. rufus* and *D. reticulatum*.

THE EFFECT OF LOCATION OF SUBSIDENCE RESERVOIRS ON THE DIVERSITY OF BENTHOS WITH SPECIAL REFERENCE TO SNAILS

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The studies included two groups of subsidence reservoirs in the Silesian Upland: 7 in forest complexes and 7 along roads; they are of similar age, surface area and depth. They are fed by surface flow, atmospheric precipitation and, those located in forests, also by water from forest ditches. The reservoirs' location affects some of the water properties: those along roads show a higher content of water-soluble substances, electric conductivity, total hardness, calcium and phosphate content, and pH, compared to the forest reservoirs, and the differences are statistically significant. The benthos density in the forest reservoirs is several times higher than in the roadside reservoirs, but the number of taxa is similar. The studies made is possible to specify characteristic taxa of the two kinds of habitats, as well as those which not always find favourable conditions in various types of reservoirs. The proportion of snails in the benthos was greater in the forest reservoirs compared to those situated along roads. No snails were found in two reservoirs, each of a different kind. The total number of recorded snail species was 13. Their communities in different types of location differed in the proportion of particular species, constancy of occurrence and proportion of alien species. In the forest ponds alien species constituted a few per cent of the snail collection, in the roadside ponds the proportion was 32.7%. As many as six species recorded from the forest ponds occurred in single localities while the roadside ponds held only four such species. The above differences were reflected by the values of the Shannon-Wiener, Pielou and Simpson indices. The number of snail species within each group of reservoirs was significantly positively correlated with the density. This in turn, for both kinds of ponds, was affected by the presence of only few species, some of them rare. The studies showed that the communities of subsidence reservoirs, irrespective of their location, included native species from adjacent areas and some alien species which had invaded the newly formed reservoirs where they found adequate conditions to form permanent populations.

RECONSTRUCTION OF DEVELOPMENT STAGES OF LAKES OF SOUTHERN BALTIC IN THE LIGHT OF MALACOLOGICAL STUDIES

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The study area included the Gulf of Pomerania, Gulf of Gdańsk and coastal lakes: Resko, Jamno, Bukowo and Wicko, bar of Lake Jamno, on the section Mielno-Łazy, bar of Lake Kopań and the area of coastal depressions in the region of Darłówek and Modlin. During the Late Glacial and the beginning of the Holocene the whole area was a lakeland. Lakes separated by peat bogs formed in lower places. Bottoms of lakes formed within melt bowls remaining after dead ice were filled by clay-silty and silty-sandy deposits. The lakes had very stable conditions of deposition, they were oligotrophic, fed by rain and ground water as well as tributaries of the rivers which drained the ground moraine. The present-day coastal lakes were within the land south of the Baltic Ice Lake, which existed till ca. 12 thousand years BP. The eustatic subsidence of the Early Holocene Yoldia Sea and the stage of freshwater Ancylus Lake caused no palaeoecological changes of these lakes. Erosion, denudation and accumulation of fluvial material continued. The intensive filling of the lakes resulted in their fast shallowing. Only freshwater molluscs were present. The transgression of the Littorina Sea (Atlantic Period), resulting in the formation of the Baltic, had an especially strong effect on the southern shores of the sea. As a result of southward abrasion shift of the coast line, the lakes transformed into shallow gulfs or isolated water bodies with periodic connection with the sea. The picture of faunal and vegetational succession changed distinctly. The deposits of the studied lakes (Jamno, Bukowo and others) above the peat layer contained a marine mollusc fauna and a fauna of open lagoons of varied intensity of contact with saline water. Following the maximum of the Littorina transgression, the coastal lakes of southern Baltic underwent a gradual freshening, which was reflected in the mollusc species composition. The changing climate conditions resulted also in changes in the forest communities near the then coast. The last and youngest stage of the lakes was associated with the eutrophication of the Baltic, resulting in shrinkage of the euphotic zone. This is mainly indicated by the occurrence of shallow-water mollusc communities of wide ecological tolerance.

MALACOFAUNA OF THE PRZEMKÓW LANDSCAPE PARK

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In June 2013 molluscs were sampled in the Przemków Landscape Park (Lower Silesia) in order to inventory the species, determine their ecological preferences and specify sites of the greatest significance for preserving the mollusc fauna of the region. In each site molluscs were collected visually during a time not shorter than one person-hour (searching all microhabitats) and ca. 15 l of litter were sieved. Freshwater molluscs were collected from aquatic plants and directly from the bottom, using a net. The inventory included the most valuable fragments of the Park, with representative mollusc habitats: beech, oak-hornbeam and riverine forests, sedge beds, ponds and a fragment of the Szprotawa River. Zoogeographically the fauna was dominated by European species sensu lato (24; 49%) and Holarctic species (13; 26.5%), with less numerous Palaearctic (7; 14.3%) and Euro-Siberian species (5; 10.2%). Terrestrial gastropods constituted 73.5% of all molluscs. Forest-dwelling species formed the dominant group (17; 47.2%), followed by euryoecious, hygrophile and open-country (6 species each; 16,6%) as well as synanthropic species (1; 3%). The 13 freshwater species recorded (26.5% of all molluscs) included 9 species of snails and 4 bivalves. Extensive pine forests, small deciduous forests, fish ponds, forest peat bogs and dunes are characteristic features of the Park's landscape. They are mostly calcium-poor and thus not favouring molluscs. The only noteworthy sites are the nature reserves: "Buczyna Piotrowicka", with 19 gastropod species including 3 clausiliids, and "Łęgi Źródliskowe" with 10 species, as well as the pond Albert with 7 species including *Anodonta cygnea* and *Stagnicola corvus*.

THE EFFECT OF SELECTED HABITAT FACTORS ON THE STRUCTURE OF MOLLUSC COMMUNITIES OF LOWLAND RIVERS AND OXBOWS IN AGRICULTURAL AREAS (NORTH-MAZOVIAN LOWLAND)

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In Europe excessive use of fertilizers poses a threat to freshwater ecosystems, hence the EU launched a common strategy including, among other things, control of problems of intensified agricultural production. According to the Directive of the European Parliament and the EU Council, nitrates and phosphates with their eutrophicating effect, are among the most important water pollutants. The problem of agriculture-related degradation of lowland rivers is world-wide. The studies aimed at analysis of malacocoenoses and their changes, with special reference to the EU-protected *Unio crassus*, including the number of species, density, dominance, constancy, diversity in lowland waters of elevated concentration of anthropogenic biogenic compounds; specifying habitat factors which affect the structure of mollusc communities in the rivers of the Wkra catchment area and its selected oxbows; and assessment of the capability of the Wkra population of *U. crassus* to reproduce. The studies included the Wkra from its sources to the mouth (length 249.1 km), its six main tributaries and selected oxbows. The catchment area shows a high concentration of nutrients, mainly nitrates (up to 142.0 mg NO_3^- dm^{-3}; much higher than the threshold value in the Nitrate Directive: 50 mg NO_3^- dm^{-3}). The total number of mollusc species in the Wkra and its tributaries was 44, including rare, endangered or legally protected species, for example *Borysthenia naticina*, *Unio crassus*, *Pseudanodonta complanata*, *Anodonta cygnea*, *Sphaerium rivicola*, and alien species: *Lithoglyphus naticoides* and *Potamopyrgus antipodarum*. The oxbows held a total of 30 species. The highest mean value of the Shannon-Wiener index (H' = 3.20) was recorded in a site in the lower section of the Wkra, above a section which was included in Natura 2000 and the nature reserve "Dolina Wkry". In the rivers most species were recorded from sites with median conductivity of 400–600 μS cm^{-1}, and the median nitrate concentration below 30.0 mg NO_3^- dm^{-3}. *U. crassus*, with the density of 2 to 20 indiv. m^{-2}, was recorded in sites with the median nitrate concentration of 21.26 mg NO_3^- dm^{-3}. Most species tolerate nitrite content below 0.60 mg NO_3^- dm^{-3}, and Unionidae – up to 0.50 mg NO_2^-/dm^3 (median 0.20 mg NO_3^- dm^{-3}). Most species were found in sites with the median phosphate concentration of up to 1.0 mg PO_4^{3-} dm^{-3}, while *Theodoxus fluvia-*

tilis, *Viviparus viviparus*, *Acroloxus lacustris*, *Planorbarius corneus*, *Unio pictorum* and *Musculium lacustre* occurred in sites where that value was exceeded. The structure of the malacocoenoses was determined by several environmental factors. Canonical correspondence analysis (CCA) showed that besides nitrate, nitrite and phosphate concentration, conductivity, hardness, temperature and oxygenation, statistically significant factors included also hydrological conditions, granulation of bottom deposits and macrophytes. High concentrations of anthropogenic nitrates and nitrites had a negative effect on the structure of mollusc communities. The number of species and their density in the Wkra and its tributaries drastically decreased in the last year of studies. The tendency seems to be a direct result of the elevated nutrient content and the regulation procedures in the river beds, or an indirect result of, for example, the absence of fish hosts required by the glochidia.

DEVELOPMENT OF A NATURALISED POPULATION OF *HELIX POMATIA* L. DURING FOUR YEARS OF STUDIES (2011–2014)

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A naturalised Roman snail population was established in a fenced, unused plot of 1.5 ha, between Zabierzów near Cracow and the Będkowska Valley, in an area where no live individuals had been found in 2010 and in the spring of 2011. The situation may be explained by unfavourable habitat and trophic conditions, and the absence of shelters in the area which is exposed to drought and frequent hail storms. On the turn of 2010, four rows, each of 10 piles of limestone rubble, were constructed in an area of 1,000 m^2, and trunks of fallen trees were placed there. The area between the piles was ploughed and sown with crucifers and legumes. In May 2011, 3,000 farm-raised Roman snails were released into the plot; they came from the experimental snail farm in Balice (Institute of Animal Husbandry); they were aged 1+, i.e. after their first hibernation in a glass house. The procedure was repeated next year, using 1,000 individuals. In the first two years of studies the intensity of introduction was 4 snails per square metre. The snails had been marked with wood paint in order to make them distinguishable from the possible immigrants from adjacent areas. The first samples for the assessment of growth rate, condition coefficient, shell shape and population density were taken after two months. Seven seasonal samples were taken from 2011 to 2014, and no immigrants were found. On each occasion snails were collected after heavy rainfall by one person during one hour. In 2011 the plot held only farm-raised snails aged 1+; in 2012 also snails aged 2+ were collected; in 2013 individuals of age classes 0+ i 1+ were present, indicating reproduction of snails aged 2+ and 3+ in natural conditions. In 2014, in two seasonal samples, snails born in the wild formed 55.1–58.7% of the whole population. The coefficients of condition and shell shape largely depended on the age class and date of sampling. Based on farm-raised snails aged 1+ and wild-born snails of the same age, the shell shape became adjusted to the different habitat conditions: the farm-raised snails had more flattened shells than those born in the wild. In 2014 snails aged 3+ and 4+ reached the shell diameter of 31.7–32.3 mm.

EXTREME HABITAT DISTURBANCE AND ITS EFFECT ON SURVIVAL OF *VERTIGO MOULINSIANA*

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Vertigo moulinsiana is a small, poorly known and very rare terrestrial snail; it inhabits wetlands of high pH and high calcium content. Here we present the results of studies on its hibernation and response to extreme habitat disturbances such as fire or mowing. Wintering: the winter survivorship rate varied considerably between the years. A significantly higher survivorship was observed for *Carex elata* compared to *Glyceria maxima*; no hibernation in the soil was observed. The winter survivorship was not dependent on the abundance and was within 60–70%. Fire: the depth of fire, litter thickness, tussock height and percentage of burnt area had a significant effect on the number of live individuals; the kind of vegetation and groundwater level had no effect; the groundwater level had a significant effect on the percentage of burnt area, depth of fire penetration and kind of vegetation; the tussock height had no significant effect on the depth of fire penetration, but the tussock height and kind of vegetation had a significant effect on the percentage of burnt area. Mowing: the snail abundance differed significantly among the habitats: it was the greatest in unmowed habitat, smaller in the swath, and no snails were found in the stubble; the air temperature in the mowed habitat was higher than in the unmowed places; also the temperature in the litter was higher in the mowed habitat. The described events are unfavourable for *V. moulinsiana* and, depending on the scale, have a negative effect on its abundance. Despite this, the population can survive such catastrophes and, after some time, regain its abundance.

MOLLUSCS IN DECORATIONS OF THE HOLY SPIRIT CHURCH IN ŁASK (ŁÓDZKIE VOIVODESHIP)

Jarosław Maćkiewicz
Łask

Mollusc shells are often used as a motif in various religions of the world, mainly as symbols or in church architecture. Baroque, and especially Rococo, based on much transformed shell shapes, are examples of using conchological motives in architecture. Mollusc shells are associated with vanitative motives, are attributes of saints (St. Jacob the Apostle, St. Augustine from Carthage), and the sign of pilgrims to Santiago de Compostela. The are included in furnishings of Christian temples, playing the part of chalices (the so called nautilus), stoups or fonts (especially shells of *Tridacna*). They also provide decorative material in jeweller's and other crafts. The church, built in 1666, is made of larch wood and is one of the old and valuable monuments of wooden architecture of Łódzkie Voivodeship; in 1967 it was entered in the register of historic monuments. Its history was complex, hence despite the Baroque style of the church it is difficult to point to any Baroque elements of its furnishings. The furnishings are examples of the use of shells as decorative material for the altar, mensa, predella, stipes, pulpit, sconces, crucifix, font and paschal candlestick. The decorations, funded in the 1920s by the owner of the nearby Karszewo, Zofia Wehr, cover the altar's surface, forming geometric patterns and christograms. Even a cursory examination suggests certain conclusions: 1. the ornaments are composed of non-uniform shell assemblages; 2. the shell assemblages and stylization indicate two different periods of origin of the decorations; 3. common marine molluscs dominate, both those occurring in the Baltic (Cardiidae, Mytilidae), and in other regions (Mediterranean, Atlantic, Pacific); 3. dominant snail species are *Aporrhais pespelecani*, *Littorina littorea*, *Turritella communis*, *Cypraea moneta*, *C. annulus*, *Euspira poliana*, *Strombus urceus*, *Hexaplex trunculus*, *Bolinus brandaris*, *Nassarius reticulatus*; 4. dominant bivalves are *Pecten* sp., *Anadara* sp., *Cerastoderma edule*, *Ensis siliqua*, *Mytilus edulis*, *Macoma* sp.; 5. also freshwater *Viviparus vivparus*, and land snails were used; 6. in the 1990s some decorations of the pulpit, font and paschal candlestick were added, and these differ in the artistic level and in the shells used; 7. the way the shells are mounted does not allow precise species identification (e.g. snail apertures or bivalve hinges embedded in glue); 8. the composition arrangement does not suggest any particular significance attributed to any species which may suggest that the artist treated the shells purely as decorative material; 9. it is impossible to tell if the selection of material was dictated by the founder's liking for shells, or if it had nothing to do with her zoological knowledge; 10. the shell decorations are not signed with a name or firm of the author, suggesting that the artist may have not been a professional. The shell decorations of the Holy Spirit Church in Łask constitute a little known and interesting tourist attraction of the region and should be more widely advertised.

HISTOLOGY OF THE REPRODUCTIVE SYSTEM IN THE CONTEXT OF DIFFERENT REPRODUCTION STRATEGIES IN BALEINAE

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The anatomical structure of the reproductive system of most Baleinae is well known. Species with different reproductive strategies: *Laciniaria plicata* (oviparity), *Vestia gulo* (egg retention) and *Alinda biplicata* (lecitotrophic viviparity) differ in the spermoviduct/free oviduct (place of egg retention) length ratio. In *L. plicata* the free oviduct length is ca. 40% of spermoviduct length, in *V. gulo* – ca. 71%, and in *A. biplicata* – ca. 83%. The elongation of this organ has probably made it possible to retain eggs and to switch to viviparity. Analysis of haematoxylin-stained paraffin sections (7 μm) shows that the reproductive system in all the studied Baleinae is semitriaulic. The spermoviduct has three canals: oviduct, autospermiduct and allospermiduct; the free oviduct, having separated from the autospermiduct which then forms vas deferens, is composed of allospermiduct and oviduct canals. Analysis of epon sections in LM and ultrathin sections in TEM shows that the epithelium lining all three spermoviduct canals is pseudostratifed. It includes cuboid cells with numerous microvilli and ciliae on their apical surfaces; their intercellular connections are of adhesion type; they have slightly elongated nuclei and apico-basally arranged organelles among which endoplasmic reticulum and mitochondria prevail. Aggregations of glycogen granules and single lipid droplets are also visible. The cell membrane in the basal parts forms numerous folds. Their structure suggests participation in ion transport (especially Ca^{2+}) for egg envelope formation or osmoregulation. The epithelium is underlain by a thin layer of connective tissue and single muscle cells. The next layer is formed by secretory cells (ob-

served in oviduct, allo- and autospermiduct canals). Their nuclei are basally located, their apical parts contain secretory vesicles. The secretory cells of the oviduct and autospermiduct canals contain vesicles with mucous secretion (typical mucus cells). Their cytoplasm contains aggregations of glycogen granules, well-developed rough endoplasmic reticulum and dictyosomes. The secretion cells of the allospermiduct canal (like those of prostate) contain vesicles with opalescent granules (LM), and in TEM – electron dense secretion, well-developed RER and dictyosomes. The secretion of secretory cells of all three canals gets to the duct lumen. The external layer of the spermoviduct wall is formed of longitudinal and circular muscle cells. In the free oviduct, the lining epithelium of the oviduct and allospermiduct canals is also pseudostratified, built of cuboid cells provided with ciliae and microvilli; their structure is very similar to that of the spermoviduct epithelial cells and suggests ionic transport. The next layer of the wall of the two canals is built of secretory cells; in the allospermiduct their structure is identical to that of the prostate cells in the spermoviduct; the secretory cells in the oviduct canal are typical mucous cells. In the oviparous snails the mucous cells in the oviduct canal of the free oviduct are fewer than in that canal in the spermoviduct, whereas in the egg retaining and viviparous species their number in the oviduct canal in the spermoviduct and free oviduct is similar. The external layer of the free oviduct is formed by circular and longitudinal muscle cells which are distinctly more numerous than in the spermoviduct. On histochemical histocryl slides examined in optical and fluorescence microscope (PAS, bromophenol blue, DAPI and propidium iodide) the secretory cells in the walls of the three canals of the spermoviduct and the two free oviduct canals differ in their cytoplasm contents: the cells of the oviduct and autospermiduct canals contain mainly mucus vesicles and small glycogen concretions. The cytoplasm of the cylindrical cells of the allospermiduct canal and of the prostate secretory cells stains for the presence of sugars and proteins, in both cases with greater intensity in the prostate cells. On DAPI-stained sections and sections stained with phalloidin conjugated with fluorochrome the circular and longitudinal muscle cells are fewer in the spermoviduct than in the free oviduct. Studies financed by research grant no. NN 303 796740

NATIVE AND ALIEN UNIONID SPECIES AS HOSTS FOR DIGENEANS

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Unionidae include freshwater bivalve species which occur in flowing and stagnant waters of Europe, North America, Asia and Africa. In Poland they are represented by four genera: 1) *Unio* with native *U. crassus*, *U. pictorum*, *U. tumidus*; 2) *Anodonta* with *A. anatina* and *A. cygnea*; 3) *Pseudanodonta* with *P. complanata* and 4) *Sinanodonta* with the introduced *S. woodiana*, recorded since the 1980s. Unionids are the first and second intermediate hosts of digeneans; they provide the parasites with space to multiply and food source. In Europe, studies on the infection of unionids with digenean larvae showed a small species diversity, with mainly representatives of Bucephalidae and Gorgoderidae. Among the former family, *Rhipidocotyle fennica* parasitises *A. anatina*, and *R. kampanula* was recorded both in the native *A. anatina* and *U. pictorum*, and in the alien *S. woodiana*. Gorgoderidae include species of varied host spectrum (Unionidae, Sphaeridae, Dreissenidae), morphology and behaviour of larval stages (cercariae), location in the host and ways of completing the life cycle. Because of this, systematics of the family is difficult, and the taxa are often identified only to the generic level. Among the European unionids, *Phyllodistmum* sp. was recorded in *A. anatina*, and *P. elongatum* in *A. cygnea*. Experimental studies should answer the question if the above-mentioned *Phyllodistomum* sp. and *P. elongatum* are conspecific. Combining traditional methods of morphological identification with new molecular techniques may throw a new light on the actual species richness of *Digenea* in molluscs.

TERRESTRIAL GASTROPODS OF BURNT AREAS IN THE BIEBRZA MARSHES (E. POLAND)

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The studies were conducted in 2008–2009 in the Biebrza National Park, in the peat bog Biele Suchowolskie, where 800 out of the 1,030 hectares of the area had been burnt in 2001. The objectives were to determine if: 1) the remaining unburnt fragments held animal populations which could constitute the source of colonisers for the burnt patches; 2) a few years after the fire the burnt areas were re-colonised by species which were characteristic of the unburnt

patches and/or by species of other plant communities. Nine sampling plots were selected, each of 1 ha: unburnt (4 plots) and burnt (5 plots). Quantitative samples (sieving of plants and topsoil from an area of 0.5 m^2) were taken in June and September during two consecutive years. Fifteen species of terrestrial gastropods were recorded: *Carychium minimum, Succinea oblonga, S. putris, Oxyloma elegans, Cochlicopa lubrica, Vertigo angustior, V. pygmaea, Pupilla pratensis, Vallonia pulchella, V. costata, Punctum pygmaeum, Vitrina pellucida, Nesovitrea hammonis, Euconulus alderi, Bradybaena fruticum*. Individual plots held 4 to 10 species. The unburnt plots were richer in species (mean 7.5 species per plot) compared to the burnt plots (mean 5.2 species per plot). The plots varied in their species composition, but no great differences were found between burnt and unburnt plots. The only species found in all the plots was *V. pulchella*. Conclusions: 1) a period of a few years after a fire is sufficient for burnt areas to be re-colonised by terrestrial gastropods; 2) the malacofauna of Biele Suchowolskie is poor, and the differences between the burnt and unburnt patches of the peat bog are small; 3) the fire may have had a negative effect on the unburnt patches; 4) re-colonisation of burnt areas is mainly small-scale, i.e. from directly adjoining patches.

GENETIC STUDIES ON *CEPAEA VINDOBONENSIS*

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The few previous genetic studies on *Cepaea vindobonensis* dealt mainly with karyology and randomly amplified DNA (RAPD). Our project aimed at devising methods of genetic studies on *C. vindobonensis* and testing the usefulness of microsatellite markers used for the related *C. nemoralis*. In the first stage we used the method of snail preservation described by WIKTOR (2004), sampled ca. 5 mg of tissue (foot fragment), and minced it; the samples were then subject to extraction with NucleoSpin®Soil kit and semiautomatic DNA isolation system produced by FujiFilm. The extract served as a matrix for the polymerase chain reaction. Five markers decribed for *C. nemoralis* were amplified: Cne1, Cne6, Cne10, Cne11, Cne15 (the so called cross-amplification of microsatellite markers), using the method of SCHWEIGER et al. (2004): the reagent mixture contained 2 μl DNA extract, 12.5 μl RedTaq Ready MIX (Sigma-Aldrich), 1 μl of each of the pair of primers and 8.5 μl water (PCR grade water, Sigma-Aldrich). The temperature of primer binding used was 57°C. Amplification success (presence of PCR product) was estimated using electrophoresis on agarose gel. Since the temperature applied did not lead to amplification of the microsatellite markers in *C. vindobonensis*, we conducted a series of reactions, decreasing the temperature from 55°C to 48°C. The decrease in the temperature made it possible to amplify two (Cne10 and Cne11) out of the five microsatellite sequences. Though confirming the presence of PCR products requires analysis with automatic sequencer, it appears that the success of cross-amplification in the case of *C. vindobonensis* is about 40%, i.e. smaller than in the case of microsatellite markers in its congeners. In this case additional molecular markers should be sought for studies at the population level.

HISTORIC COLLECTIONS OF SHELLS OF *CEPAEA VINDOBONENSIS* IN WARSAW AND LVOV

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Historic collections of shells of *Cepaea vindobonensis* developed since the 19th c. by numerous Polish and foreign naturalists are part of the collection kept at the Museum and Institute of Zoology (MIZ), PAS, Warsaw, and the Dzieduszycki Natural History Museum in Lvov. The MIZ collection of *C. vindobonensis* includes more than 850 specimens acquired mainly by A. WAGNER (shells from Austria, the Czech Republic, Romania, Bosnia and Hercegovina, Serbia, Macedonia and Croatia, of 1886–1926), W. POLIŃSKI (Austria, Romania, Hungary, Ukraine, 1913–1929), A. RIEDEL, A. GOLJAN and M. MROCZKOWSKI (Bulgaria, 1950). There are also single shells collected, among others, by O. RETOWSKI in Croatia, W. ZABORSKI and J. GROCHMALICKI in Ukraine in 1916–1918, S. WEIGNER in Albania in 1918, A. JANKOWSKI in Romania in 1930 and H. JAWŁOWSKI in Bulgaria in 1932. The materials of *C. vindobonensis* from Poland have been described by D. MIERZWA (2009). The Lvov Museum holds more than 380 shells of *C. vindobonensis*. The earliest materials were collected by J. BĄKOWSKI (Poland and Ukraine, 1876–1881), A. KRASUCKI and W. POLIŃSKI (Ukraine, 1919–1925). The collection contains also shells from Ukraine, donated to the Museum by such collectors as S. S. KRAMARENKO (samples of 1995), L. M. KHLUS (2003) and A. SICH (no date). The voucher and comparative materials in the form of museum collections provide a valuable source of information on *C. vindobonensis*, which at present is threatened with extinction.

FACTORS AFFECTING DIGENEAN INFECTION IN *ANODONTA ANATINA*

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Freshwater bivalves are intermediate hosts to digeneans; factors determining the infection are not well known. Based on samples of *Anodonta anatina* from 18 lakes in north-eastern Poland we checked in what way the sex and age of the bivalves, the degree of overgrowing with the zebra mussel (*Dreissena polymorpha*) and habitat conditions affected the parasitic infection. We estimated location preferences of the parasites (gonad and/or hepatopancreas) and the effect of parasites on the females' fecundity. The bivalves were infected with *Rhipidocotyle campanula* and *Phyllodistomum* sp. The infection rate was higher in older specimens and in females, but was not associated with the biomass of the overgrowing zebra mussels, trophic level of the lake, thermal conditions and calcium availability. The parasites occurred more frequently in the gonad than in the hepatopancreas. Infected females incubated glochidia less frequently, and the glochidia were fewer than in uninfected females. We suspect that the rate of digenean infection increases with the volume of water filtered by the bivalve during its lifetime and/or with the quantity of reproductive reserves of the host which are available to the parasite. The mechanism would explain why the parasites were more frequent in older individuals, in females and in the gonads. Future studies on the interaction between freshwater bivalves and digeneans should consider the biological context of the complicated digenean life cycles, including the presence of fishes – the next hosts. Studied financed by MNiSW, 2007–2011, project no. NN304 1176 33.

RAPID INCREASE IN MORTALITY OF *ANODONTA ANATINA* AND *UNIO PICTORUM* IN A POND IN HAMRZYSKO

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In 2005 three unionid species were found in a pond remaining after peat excavation in Hamrzysko (Noteć Valley): *Anodonta cygnea*, *A. anatina* and *Unio pictorum*, and detailed monitoring of their populations was started. Since 2010 the proportion of live and dead specimens was estimated in samples taken in selected parts of the pond. The total number of individuals in the 2010 and 2014 samples was 2,716 and 2,398, respectively, in the remaining years it ranged from 547 to 676. In the case of *A. cygnea* the proportion of dead specimens remained at a constant level of ca. 2–6%, in *U. pictorum* in 2010–2013 it ranged from 3% to 11%, but in 2014 it was as high as 46%. The increase was even more drastic in the case of *A. anatina*: in 2010–2013 the mortality ranged from 17% to 30% (2010 – 30%, 2011 – 17%, 2012 – 29%, 2013 – 24%), and in 2014 it reached 82%. As a result, during five years the proportion of *A. cygnea* among live individuals increased from 33% to 62%, that of *U. pictorum* dropped from 46% to 33%, and that of *A. anatina* – from 21% to only 5%. The increase in mortality of *U. pictorum* may be associated with the increasingly muddy character of the pond. Such increase in the case of *A. anatina* is difficult to explain. One possibility is a spread of an unknown disease factor. The source of infection may have been the specimen of *Sinanodonta woodiana*, found in the pond in 2014, probably thrown into the pond by a passerby.

A DATABASE FOR *CEPAEA* VARIATION IN POLAND

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As a result of numerous studies on the shell colour and banding polymorphism of *Cepaea nemoralis* (L.) in Poland, we have accumulated a large number of records that are widely distributed across the

country. Including unpublished records, and those contributed by MAŁGORZATA OŻGO's students, we have ca. 830 records of this variation complete with accurate locations and habitat categorisation. We also have many fewer and unpublished records of variation in *C. hortensis* (Müller). We know that others have also got unpublished records, and there are some others entered in the Evolution Megalab database covering the whole range. The latter are limited, because some variants were combined for simplicity when briefing amateur recorders. The data we have show some interesting trends, and they also act as a baseline for monitoring changes over time. The coverage is far from even or complete, and because *C. nemoralis* is spreading, it provides an excellent opportunity to study evolution in action. Equally, the native *C. hortensis* has been ignored for too long and we know that there are "hotspots" where the variation is unusually great. We would like to make this database "live", with new contributors joining us in any analyses or publications that arise from it. We invite those interested to give us contact details. If there is enough interest, we will produce standard recording templates and instructions. It should be easy to accumulate 2,000 or more records, which would give a good basis for countrywide analyses, and with greater precision than that achieved in the Megalab.

COMPARISON OF THE LEVEL OF EXPRESSION IN AQUAPORIN ENCODING GENES IN A TERRESTRIAL (*HELIX POMATIA* L.) AND A FRESHWATER (*LYMNAEA STAGNALIS* (L.)) SNAIL

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Selective transport of substances across the cell mebrane guarantees optimum conditions inside the cell. The existence of aquapores, built of aquaporins, not only ensures fast water transport across the membrane, but also makes it possible to regulate the process, thus guaranteeing water homeostasis of both single cells and the whole organism. Studies on insects revealed the existence of many different aquaporins in the same organism. Their number is especially great in organs or tissues which are involved in very active water transport. Gastropod habitats vary extremely widely in water availability, but gastropods are still poorly studied with respect to proteins which are responsible for water transport across biological membranes. In order to check in what way the habitat affects the number of aquaporins and the level of expression of their genes, we selected two pulmonate species: the freshwater *Lymnaea stagnalis* (L.) and the terrestrial *Helix pomatia* L. Sequences of transcriptomes of foot and kidney of the two species made it possible to identify 12 different aquaporins: five in *L. stagnalis* and seven in *H. pomatia*. Analysis of their aminoacid sequences, and more precisely their regions responsible for the transport specificity, made it possible to classify seven of them as classical aquaporins (3 in *L. stagnalis* and 4 in *H. pomatia*), which transport mainly water, and five as aquagliceroporins (2 in *L. stagnalis* and 3 in *H. pomatia*), which, besides water, transport glycerol. Based on the similarity of their aminoacid sequences, six of them were joined in corresponding pairs. The level of expression of the genes coding for the aquaporins of each pair differs between the two species. The result suggests a dependence between the organ-specific level of aquaporin gene expression and the habitat. Studies financed by the National Science Centre, grant no. DEC-2011/01/B/NZ4/00630

POLISH MALACOLOGY – PAST, PRESENT AND FUTURE 2000–2014

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The Association of Polish Malacologists was established in 1995, but the Polish Malacological Seminars were held annualy since 1985. Our booklet presents the Association's activities, with special reference to the period 2000–2014; the earlier history was described in the booklet published on the 15th Polish Malacological Seminar. At present the Association has 63 members and 6 honorary members. Since the 15th Seminar the Association organised our annual Seminars and published consecutive volumes of the Folia Malacologica. The Association, the Seminars and the Folia Malacologica contributed to the development of the Polish malacology and the conservation of endangered mollusc species. The Folia Malacologica, established in 1987, has an international character; till now 243 original and review papers, 18 book reviews, 27 conference and congress reports and 6 historic articles were published in the journal. The total number of publications in volumes 1–21 was 294; of these 55 by foreign authors, and 23 – by foreign authors in co-authorship with Polish malacologists. Till issue 21(4) inclusive, 157 Polish and 83 foreign authors from 21 countries published their papers in the journal. The best rep-

resented disciplines in the Folia were: 1. palaeomalacology, 2. systematics, evolution and phylogeny, 3. ecology and conservation, 4. life cycles, development and behaviour, and 5. faunistic studies. The thirty Polish Malacological Seminars were held in various locations in the country, and organised by different institutions, often with participation of foreign guests. Many Polish malacologists participated in various European conferences and also in the World Congresses of Malacology. The number of presentations and participants of the Seminars increased in consecutive years. The observed trends were: increasing number of ecology & conservation presentations in 1985–2004, and overall increase in the number of presentations dealing with various aspects of applied malacology, life cycles, development and behaviour. Another tendency was a growing number of papers based partly or wholly on molecular results. An important trend was the increase in the proportion of multi-author studies as opposed to single-author papers. In respect of the represented disciplines, the Polish malacology did not depart from the world's tendencies. The number of institutions which employ malacologists in Poland is 14; in most more than one discipline of malacology is represented. The following disciplines are practiced by the most numerous persons and develop very well: life histories of freshwater and terrestrial molluscs, ecology and conservation of freshwater molluscs, studies from the boundary of ecology, biogeography and conservation of terrestrial species and/or malacocoenoses, palaeomalacology, studies in systematics, phylogeny and evolution, applied malacology and physiology. A number of books, both popular and specialist, authored by our malacologists appeared during the last few years.

THE EFFECT OF LIGHT COLOUR ON THE REPRODUCTION PARAMETERS AND GROWTH RATE OF *HELIX ASPERSA ASPERSA*

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Heliculture specialists in Poland have recently begun to consider supplementing the mixed system of snail production with a closed system. The concept is associated with the increasing variation in our climate, especially the long-persisting spring frosts and short, hot summers, resulting in decreased yield in commercial field farming. The possibility of whole-year production of *Helix aspersa aspersa* in controlled conditions requires, among other things, designing and testing of an adequate lighting system. The knowledge of the problem is limited, and the literature on the effect of light colour on the growth rate, fecundity and survivorship is virtually nonexistent. Studying the effect of physical characteristics of lighting on these parameters in a closed system is scientifically justified and may be of great practical significance. The problem of optimisation of lighting quality in snail farm buildings is becoming increasingly important. Despite the lack of literature data, practical observations of snail farmers suggest a favourable effect of red light. Our working hypothesis was that some light colours might have a positive effect on the reproduction efficiency of *H. aspersa* and its growth rate. The experiment included two stages, with the use of visible light spectrum within wave length ranges perceived as different colours: 400 nm violet; 440 nm blue; 480 nm cyan; 520 nm green; 560 nm yellow; 600 nm orange; 640 nm red; 495–780 nm light for control series. The experimental part was run at the Institute of Animal Husbandry, State Research Institute in Balice. In the first stage which lasted 35 days we studied the effect of light colour on the number of produced eggs, in the second – on the growth rate (shell diameter and body mass) till the fifth week of life. The number of eggs per individual was greatest with lighting with cyan, orange and red light (by 8%, 14% and 14% greater than in the control group, respectively); the fastest increase in shell diameter and body mass was observed in groups which were subject to green, orange and red light. Cyan and yellow light had a negative effect on the survivorship of hatchlings. Diode lighting did not increase the temperature in the experimental container above the optimum value, due to which the snails were not subject to desiccation.

PERMANENT ADAPTATION OR PHENOTYPIC PLASTICITY?

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Trochulus striolatus is a terrestrial snail of north-western Europe; it displays a great variation in its shell size, both within and between populations. In order to determine the effect of climatic factors on the shell size and shape we measured shells from four biotic zones: lowlands, foothills, mountains and subalpine zone. The shell size was significantly negatively correlated with the altitude above sea level, and the sum of summer and annual precipitation, but positively correlated with the mean an-

nual, summer and winter temperature. The decrease in size with increasing altitude may be explained by the shorter growth period in response to the shorter vegetation season in mountain regions of continental Europe (ca. 180 days) compared to lowlands of oceanic climate, with their longer vegetation season (252 days), smaller annual temperature amplitude and more evenly distributed precipitation. Besides, the absence of drought periods and frosty winters in such regions makes it possible for the snails to continue their growth without the necessity to aestivate and hibernate, the consequence being larger mean shell size. Our results correspond to the reversed Bergmann rule and suggest that in the temperate climate variation in body size depends on seasonality and combined effect of temperature and humidity. The ultimate shell size in *T. striolatus* is probably a response to local habitat and/or climate factors.

THE EFFECT OF PREDATION, (MICRO)HABITAT AND LANDSCAPE STRUCTURE ON THE FREQUENCY OF COLOUR MORPHS IN LOCAL POPULATIONS OF *CEPAEA NEMORALIS* (L.)

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Most hypotheses which aim at explaining the evolution of polymorphism in animals are based on selection by predators or on habitat heterogeneity. However, the effect of such factors can be modified by spatially varied landscape structure which was not previously taken into account. We studied the effect of (micro)habitat structure, predation and landscape structure on the presence and density of populations of *Cepaea nemoralis* (L.) and the frequency of colour morphs in the populations. The studies included three areas in Poland: the environs of Gdańsk, Poznań and Ostrów Wielkopolski, and were carried out from May to October 2012. The data collected during three controls in 76 colonies of *C. nemoralis* and in randomly selected control points were analysed using the generalised mixed model (GLMM) and redundance analysis (RDA). The effect of the studied factors depended on the spatial scale. On the microhabitat scale the presence, population density and morph frequency were significantly dependent on the structure of vegetation and on predation. On the habitat and landscape scale the presence and density were significantly positively correlated with the proportion of human habitations in the area, density of roads, presence of garbage and density of bird predators. The abundance of snails was negatively correlated with the abundance of song thrush. Rodent predation pressure was positively dependent on the surfce area of the colony. The proportion of colour morphs was dependent on the rodent predation pressure (positive), density of roads (positive) and percentage of forested areas (negative). The morphs of *C. nemoralis* significantly differed in their response to the studied selection factors, indicating that the variation in environmental factors and their mutual relationships at various levels of spatial scale may contribute to maintaining of polymorphism in the populations of the species. Studies financed by the National Science Centre, grant no. 2011/01/N/NZ8/02015.

JÓZEF BĄKOWSKI'S MALACOLOGICAL COLLECTION IN THE DZIEDUSZYCKI NATURAL HISTORY MUSEUM IN LVOV

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Józef Bąkowski who lived in the second half of the 19th c., an outstanding student of the molluscs of Galicia, was the greatest contributor to the malacological collection of the Dzieduszycki Natural History Museum in Lvov. J. Bąkowski (1848–1887) – zoologist, natural history teacher – studied faunistics and zoogeography of terrestrial and freshwater gastropods. His studies focused on Podole and the areas along the rivers Dniester, Zbrucz and Seret. He was a member of the Physiographic Commission of the Academy of Arts and Sciences and the Mikołaj Kopernik Polish Society of Naturalists, and a council member of the Pedagogical Society. He published his results mainly in two journals: Sprawozdanie Komisyi Fizyograficznej AU (among others *Mięczaki z okolic Bóbrki i Przemyślan*, 1879; *Mięczaki zbierane na Podolu w r. 1879 z tabl. litogr.*, 1880) and Kosmos (among others *Mięczaki tatrzańskie*, 1883; *Mięczaki galicyjskie*, 1884). Despite his short life he contributed considerably to the studies of terrestrial and freshwater molluscs of Poland and Ukraine. J. Bąkowski's main publication: *Mięczaki*, was published in Lvov in 1892, posthumously. The paper was based on his manuscript which contained the description of molluscs of Poland, and on his notes and collections left at the Lvov museum. It was completed by M. A. Łomnicki, curator of the Dzieduszycki Museum in

Lvov. In 1885–87, J. BĄKOWSKI organised the malacological department in the Dzieduszycki Museum, and donated his collection to it. The collection included 107 species of terrestrial gastropods representing 18 families. The material of more than 11.5 thousand shells was collected mainly in Ukraine (among other places in the environs of Ivano-Frankovsk, Lvov, Tarnopol) and in Poland (regions of Rzeszów, Strzyżów, Przemyśl, Cracow, Zakopane, Krynica). The merits of J. BĄKOWSKI were commemorated in malacological names: names of such taxa as *Lymnaea peregra* var. *bakowskyana* Clessin, 1879 and *Helicella instabilis* var. *bakowskyana* Clessin, 1879 were coinded from his surname.

WHAT'S IN A SHELL? CHILDREN'S CONCEPTS OF SNAIL ANATOMY

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Earlier studies show that children have a kind of biological knowledge termed "naive biology" which is mainly shaped by early childhood experiences. The knowledge is often at variance with biological laws, leading to formation of erroneous mental models of reality; such models are often resistant to changes, and erroneous concepts appear even among students. On the other hand, feelings and knowledge of environment of humans affect their attitude to environment; this also pertains to attitudes to live organisms. Children's drawings may provide information about their concept of the world. Analysis of drawings is useful to gain insight into children's concepts of internal structure of plants and animals. Children's ideas of snails' internal structure were not studied before. We aimed at getting to know these ideas and indicating how they could be used in teaching. Children aged 5, 7 and 10 were asked to draw what in their opinion was inside a snail. Some of the concepts were found not to change with age. The most often drawn structures were heart, muscular system and nervous system. Boys more frequently than girls included mucus and other organisms (flies, bacteria) in their drawings. Often the children placed all the internal structures in the foot, leaving the shell empty. In some drawings the shell was the snail's "home", complete with furniture and a TV set. The knowledge of such concepts may prove useful to teachers in that it makes it possible to plan the lesson in a way that would help the pupils conctruct a correct idea. Another important point is the necessity to draw the pupils' attention to invertebrates as organisms which are not only animals, but also live, feel, can be observed, kept and looked after. This favours not only constructing correct zoological knowledge, but also developing pro-environmental attitudes.

MOLLUSCS AS TEMPLATES IN ART AND SCIENCE

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Wider interest in nature as a source of inspiration for innovative technical solutions dates back to the second half of the 20th c. The complexity of machines designed today, necessity of team work of specialists in many disciplines and cost result in the use of templates which ensure correct solutions. The present-day methods of machine design (intuitive methods, brain storm, methods based on invention theory, etc.) have led to a very general nature-oriented design concept. Templates for innovative technical solutions are increasingly often sought in nature. Two approaches can be distinguished: 1) basic studies aimed at discovering and describing a previously unknown phenomenon in nature; the results can be then used for technical solutions; 2) looking for analogies between a designed technical system and a set of natural systems, in order to find a template. The analogy between the designed technical system and the natural system may involve: 1) mode of locomotion; 2) change of state resulting from the effect of external forces or tensions caused by the system's operation; 3) kind, property and structure of materials of which the system is built; 4) structure of the system, mutual position and interrelationship of its components. Though mollucs are not very popular as templates (arthropods and vertebrates are much more so), an array of interesing solutions has been based on molluscs. This pertains mainly to cephalopod swimming, snail crawling, or materials which build the shell and soft parts. It should be noted that none of the nature-based swimming robots has gone beyond the stage of prototype. Two cephalopod-based robots are the autonomous, octopus-based swimming robot and the squid-based inspection robot. Snail-based (crawling) robots are few. Two robots "Robosnail" have different kinematic systems: one has a rubber elastic sole, in the other the elastic sole has been replaced with five movable segments. Very interesting elastic components of robots which are cephalopod-based have been designed recently. Devices commonly used in robotics are sucker gripping devices, modelled on cephalopod suckers. In connection with studies on

energy-absorbing materials, a recently described deep sea snail *Crysomallon squamiferum* has aroused interest. Its multi-layered foot processes contain molecules of ferrous sulfide which absorbs energy (possible use for bullet-proof vests). The position of molluscs in art is well established. They have always stimulated human artistic activities, starting with parts of Greek columns, through the stairs in the Blois castle, in the form of sinistral, spiral shell, Dutch schools of shell painting of the 17th and 18th c., to the Rococo style with its use of shells as decorative elements. They never stop delighting us with their shapes and colours.

PROBABLE CIRCADIAN RHYTHMS OF SEROTONIN CONCENTRATION IN THE HAEMOLYMPH OF *UNIO TUMIDUS* AND THE TISSUES OF *PISIDIUM CASERTANUM*

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Light is regarded as the main time-giver (Zeitgeber) for animal biological clocks. The shelled bivalve body is usually protected from light; also the bivalve life style – burying in the substratum, makes contact with light difficult. In spite of this bivalves have simple photoreceptors in pallial tentacles or mantle edge, and these transfer the photoperiod information to the nervous system, among others through serotoninergic fibres. Serotonin concentration in the haemolymph of the marine snail *Aplysia* is light-dependent. It was unknown if unionids and pisids could recognise light signals and if the serotonin concentration in their tissues and haemolymph underwent cyclic changes. In order to trace the potential dependence of serotonin concentration on photoperiod or biological clock we ran two preliminary experiments: 1) *Unio tumidus* were kept in lake littoral, in natural photoperiod (LD, 12 : 12); every four hours haemolymph was sampled from hearts of five adult individuals; 2) *Pisidium casertanum* collected in the wild were placed in the laboratory in two groups: in natural photoperiod (LD, 10 : 14) and in permanent darkness; every four hours 10 bivalves of each group were frozen in liquid nitrogen, and their tissues were homogenised. Serotonin concentration was measured with ELISA method. Probable circadian rhythm of serotonin concentration in the haemolymph of *U. tumidus* was demonstrated for the first time. The concentration was smaller during the day and twice greater in the dark. We did not ascertain if the changes were induced by lighting changes or if they resulted from endogenous biological clock. We demonstrated circadian rhythm of serotonin concentration in the tissues of *P. casertanum*. In LD conditions the concentration was the highest at the end of day and small in the night and early in the day. In constant darkness there was a four-hour shift of the peak of serotonin concentration: the highest values were recorded at the beginning of subjective night and during subjective day, low values fell on subjective night and during subjective day. The observations show that the rhythm of serotonin concentration in *P. casertanum* is the effect of endogenous biological clock. Studies financed by the Ministry of Science and Higher Education, funds for development of young researchers and doctoral students within the Faculty of Biology, Warsaw University, DSM 501/86-104946 and the National Science Centre, grant. No. NN303803340 (MAP).

THE FIRST MITOGENOMIC CHARACTERISTICS OF *ANODONTA ANATINA*

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Anodonta anatina is a European freshwater unionid; it has a unique way of inheriting mitochondrial genome, called doubly uniparental inheritance (DUI). Males have two mitochondrial genomes (mtDNA): F – inherited from the mother and present in somatic tissues, and M – inherited from the father and found in gametes. All the female tissues contain only one kind of mtDNA – F. Both mitochondrial genomes are much varied in unionids (ca. 50%), suggesting that DUI has occurred in that family for at least 200 million years. Because studying male mitochondrial genomes is difficult, since they are difficult to obtain and may easily stay undetected in molecular studies, complete male and female mitochondrial genomes have been described in only six unionid species: North American *Pyganodon grandis, Utterbackia penisularis* (Anodontinae), *Venustaconcha ellipsiformis, Quadrula quadrula* (Ambleminae) and Asian *Solenaia carinum* and *Inversidens japanensis* (Gonideinae). In Poland the two genomes have been sequenced in *A. anatina*. It is the first species in Europe to be provided with complete mitogenomic characteristics. Both genomes have 38 genes and both contain an ORF which is new for unionids. Female genomes show length polymorphism of 15,637 to 15,653 base pairs and nucleotide polymorphism of 0.3%. Male genome

is longer by more than 8% (16,906 bp) and its nucleotide variation is 0.1%. Both genomes have a high content of A+T bases which is more than 66%.

THE EFFECT OF SUBSTRATUM ON THE OCCURRENCE OF *FERRISSIA FRAGILIS* (TRYON, 1863): A FOREST POND

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Studies on the occurrence of alien species provide information which is relevant to preserving biodiversity of freshwater habitats. Anthropogenic reservoirs play an important role in dispersal of alien species which more frequently appear in disturbed than in undisturbed water bodies. Our aim was to estimate the effect of substratum on the occurrence of *Ferrissia fragilis*. Four kinds of substratum, representative of the forest pond, were selected: macerated remains of *Phragmites australis* (Cav.) Trin. ex Steud and *Typha latifolia* L., deposits of fallen tree leaves and leaves of *N. lutea* (L.) Sibth. & Sm. Samples were taken from May to October with standard quantitative methods. Because of the legal protection of *N. lutea*, snails were collected from its leaves in situ. Eleven snail species were recorded in the pond, from 9 (helophyte deposits) to 11 (deposits of tree leaves) per substratum. Irrespective of the kind of substratum, *F. fragilis* co-occurred always with *Hippeutis complantaus*, *Planorbarius corneus*, *Gyraulus crista*, *Planobis planorbis* and *Gyraulus albus*. The snail density was the greatest on the remains of *T. latifolia* (mean density – 1,784 indiv. m^{-2}), and the smallest on the leaves of *N. lutea* (631 indiv. m^{-2}). *F. fragilis* was the eudominant on each kind of substratum except the site with *P. australis* (dominant). Its highest mean density was observed on *N. lutea* (271 indiv. m^{-2}), the smallest – on the remains of *P. australis* (60 indiv. m^{-2}). On all kinds of substrata it reached its peak abundance in August, except the site in the belt of *P. australis*. It appeared in June on all kinds of substrata except *N. lutea* (May). CCA analysis specified the kind of substratum (*T. latifolia* and *N. lutea*), calcium and iron content in the water as the factors influencing the occurrence of *F. fragilis*. Water birds and economic use of the pond may contribute to the spread of *F. fragilis*.

SIXTY YEARS OF STUDIES ON *DREISSENA POLYMORPHA* – IS IT POSSIBLE?

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The zebra mussel (*Dreissena polymorpha*) is a commonly known, small bivalve, often abundantly occurring in fresh and brackish waters of Europe and North America. It may play an important part in aquatic ecosystems. On the one hand the role is positive (removing suspension, role in biocoenosis), on the other negative (overgrowing hydrotechnical equipment). We have tried to study this and many other aspects of biology and ecology of *D. polymorpha* for nearly 60 years (studies started by A. STAŃCZYKOWSKA in the 1950s; joined by K. LEWANDOWSKI in the early 1970s). In different periods our interest focused on different problems. Initially we looked for regularities of occurrence of the mussels depending on natural environmental conditions in different lakes and their parts, later we started to consider anthropopressure to an increasing extent. Besides adults, we dealt with early development stages – planktonic larvae and settling postveligers, whose fates (finding adequate substratum, mortality) have a significant effect on the development of the mussel's populations. Important answers to questions about the role of the zebra mussel in freshwater ecosystems were provided by field experiments on filter-feeding. The experiments were conducted in conditions close to natural (natural thermal regime and sestone composition). Among other things, they showed that during the blooming of the dinoflagellate *Ceratium hirundinella* the filtration activity of the mussel became very much limited. Our other studies were associated with ascertaining the role of the zebra mussel in the ecosystems, for example in the accumulation of various elements in bodies and shells, and relation between the mussel and other organisms (invertebrates, fishes, birds). Most of our studies were carried out in the Mazurian Lakeland, not only in the Great Mazurian Lakes but also in dozens of smaller water bodies scattered over the whole lakeland. Many studies were conducted in other regions of Poland (e.g. heated Konin Lakes, rivers and dam reservoirs, Gulf of Vistula) and Europe (Lake Balaton, Geneva and Zurich lakes, and others).

RARE AND LITTLE KNOWN SNAILS (HYDROCENOIDEA AND PUPILLOIDEA) FROM EOCENE BALTIC AMBER

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Among inclusions found in amber, both Baltic which originated in the Eocene, and those coming from other parts of the world and dated as the Trias to the Miocene, snails form only a very small proportion. Though the first information on the subject dates from the 19th c., most of the known specimens were relatively recently described. All the data indicate that members of Pupilloidea constitute the greatest proportion of amber-embedded snails. This may result from the characters which favour shell preservation: small size and reinforcement of aperture by apertural barriers, and the way of life – in litter at the foot of resin-producing trees, as indicated by numerous syninclusions of plant fragments. Fifteen taxa of terrestrial snails have been described from the Baltic amber to date. Five of them represent pupilloids. Besides the earlier recorded *Vertigo*, *Leiostyla*, *Propupa* and *Strobilops*, new materials have yielded a representative of another genus, *Ptychalea*, which is poorly represented in the Tertiary. Previously the earliest known member of the genus was *Ptychalea flexidens* (Reuss, 1861) from the Lower Miocene of Tuchořice and Lipno, and thus by more than 15 million years younger than the presently described species. Another form, previously not found in the Baltic amber, is a representative of Hydrocenidae – terrestrial prosobranchs; previously the earliest known species was described from the Middle Miocene.

VERTIGO ANGUSTIOR AND *V. MOULINSIANA* IN ŁÓDZKIE VOIVODESHIP

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New localities of *Vertigo angustior* Jeffreys, 1830 and *V. moulinsiana* (Dupuy, 1849) were discovered in 2010–2014, in the southern part of Łódzkie Voivodeship. The snails were found in wet sedge beds within the areas of Natura 2000 Lasy Spalskie (*V. moulinsiana*), Ostoja Przedborska (*V. angustior*) and Łąka w Bęczkowicach (both species). Earlier records of *V. angustior* in the voivodeship came from Grabica in the Grabia Valley and Bobrowniki near Załęcze, while *V. moulinsiana* was reported between the wars from Kacperek near Skierniewice.

COMPUTER MICROTOMOGRAPHY IN MALACOLOGICAL STUDIES

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X-ray computer microtomography (*XMT* or *μCT*) is a method of non-invasive imaging with high resolution (1 μm/pixel). Laboratory scanners make it possible to obtain serial transverse secions of rock, shell, bone or composite samples. The X-ray beam emitted by Roentgen lamp is weakened during its passage through the sample to the extent depending on the density of the material. Then the beam falls on the two-dimensional detector where it is registered. Due to the precise rotation of the sample, a whole series of transmission images of the object at various angles is generated. Based on the two-dimensional layered images obtained by scanning, the software produces a three-dimensional reconstruction of the object's internal structure. The data make it possible not only to visualise the actual structure of the sample, but also allow a quantitative analysis, for example, measuring morphometric characters. X-ray microtomography is appreciated especially when it is essential to analyse internal mineralised structures without damaging the specimen. Some researchers postulate establishing collections of virtual type specimens, called cybertypes, to facilitate fast and simultaneous access to the most valuable material. X-ray microtomography is used in studies on fossil and extant molluscs. For example it has been used to follow the course of embryonic shell formation in a tropical snail *Biomphalaria glabrata*. It has made it possible to ascertain fecundity and other life cycle parameters of Pleistocene Viviparidae. Ontogenetic changes in the ammonite chamber volume have been reconstructed based on tomographic data. We have used such data to compare the internal diameter of the shell of oviparous and viviparous clausiliids – the first biometric study on the patency of the closing apparatus. The main advantages of microtomography over traditional methods of shell examination reside in the possibility of: 1) distinguishing between mineralised and soft tissues without dissection; 2) obtaining great numbers of sections of the same spec-

imen and analysing the structures in various planes, and 3) using the data for quantitative analysis.

AN INTERGLACIAL MOLLUSC ASSEMBLAGE FROM KOLONIA CHARLEJÓW NEAR KOCK

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The locality Kolonia Charlejów is located in Wysoczyzna Łukowska, ca. 12 km NW of Kock. When preparing a 1:50,000 geological map of Poland, Dr. M. ŻARSKI from PIG-PIB documented a laustrine series on fluvioglacial sands of the Sanian 2 Glaciation, covered by sandy deposits of the Vistulian Glaciation and Holocene peaty aggradation. The thickness of the lacustrine series, built of carbonate gyttja, silts and sands with mollusc shells, was up to 6 m. Based on geological and palynological characteristics, its age was estimated as the Mazovian Interglacial. Two drillings were done in the site, to the depth of 6 m (KCH 6) and 5 m (KCH 10). Shells occurred in fine-grained, sometimes humus sands (KCH 6) and in calcareous, slightly sandy gyttja (KCH 10). The total number of samples was 15, at 5–15 cm intervals; one sample spanned 70 cm as a result of high hydratation and difficulty to obtain material. The total number of taxa in the profile was 13 (4 snails and 9 bivalves), represented by 2,313 specimens. The number of taxa per sample was 3–12, the number of specimens – 3–980. All the taxa were freshwater, predominantly of stagnant waters; rheophile species were represented by single specimens of *Pisidium nitidum* and *P. subtruncatum*. The assemblage was dominated by *Valvata piscinalis* with the lacustrine form *V. piscinalis* f. *antiqua*, which may indicate a slightly deeper zone of the water body. Only in the upper part of profile KCH 10, the proportion of *Bithynia tentaculata* increased, which was probably associated with shallowing of the lake. The predominance of opercula may suggest development of reed beds, but no forms associated with abundant macrophytes were found in the deposits. The samples contained shell fragments of *Viviparus* and *Lithoglyphus*, but it is difficult to tell if they represented the characteristic species of the Mazovian Interglacial: *V. diluvianus* and *L. jahni*. The deposits document another palaeolake which was part of an extensive fossil lakeland located in eastern Poland during the Mazovian Interglacial. Studies financed by the Faculty of Geology, Warsaw University, project DSM 105 521.

MALACOFAUNA OF CAVE DEPOSITS OF ROCK SHELTER SCHRONISKO NAD BRAMĄ SŁUPSKĄ (KRAKÓW-CZĘSTOCHOWA UPLAND)

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The mollusc assemblage comes from cave deposits of the rock shelter Schronisko nad Bramą Słupską, situated in the central part of the Kraków-Częstochowa Upland, within the range of Skały Kroczyckie, ca. 50 km SE of Częstochowa. Eight strata of total thickness of ca. 2 m were distinguished in the entrance part of the rock shelter. They were mainly fine-grained, slightly loamy sands of varied colour and rubble content. In places they passed into sandy loam (stratum 5) or loess-like deposits (stratum 4). All, except the bottom stratum 8, contained well-preserved mollusc shells. Thirty five large samples (10 cm intervals, mass 3–5 kg) were subject to standard malacological procedures. The assemblage included 46 taxa (40 species) of terrestrial snails represented by 1,226 specimens. They were assigned to three ecological groups: F – shade-loving species (25 species); O – open-country species (6); M – mesophile species (9). Shade-loving species dominated in the lower part of the profile (strata 7–5); they formed 74 to 95% of the assemblage which was dominated by species of cool climate: *Discus ruderatus*, *Semilimax kotulai* and *Vallonia tenuilabris*. Stratum 4 documented development of open habitats, with expansion of *V. tenuilabris*, which then disappeared in the same layer. Stratum 3 indicated another expansion of shaded habitats. *D. ruderatus* was still abundant, but the increase in significance of *Discus rotundatus* might suggest the Holocene climatic optimum. *Chilostoma faustinum* and *Perforatella incarnata* also appeared abundantly. Mesophile species dominated in the upper part (strata 2, 1); they constituted up to 65% of the assemblage and were mainly represented by *Laciniaria plicata* and *Helicigona lapicida*. Four radiocarbon dates were obtined for the profile: two from shells of *D. ruderatus* from strata 7, 6, one from bones from stratum 3 and one from traces of hearth on the boundary of strata 2 and 1. Samples from the upper part of stratum 7 and the lower part of stratum 6 yielded dates 11,170 cal BP and 10,540 cal BP, respectively, corresponding to the Early Holocene – Preboreal. The age obtained for stratum 2 (ca. 7,000 cal BP) assigned its deposition to the Atlantic Period, while the dating for the boundary of strata 1 and 2 was ca. 300 AC. The results are well compatible with the changes in the malacofauna, especially during the Atlantic

Period. The age of strata 7 and 6, which contained *Vallonia tenuilabris*, not found in the Holocene previously, is noteworthy. The snail may have appeared in the Jura in the Early Holocene which is confirmed by the ^{14}C dates obtained from cave deposits from the rock shelter Schronisko w Smoleniu III. Studies financed by the Faculty of Geology, Warsaw University, project DSM 166 901.

A PARASITE-LIKE STRUCTURE IN SLUGS. WILL IT HELP US FIGHT AGAINST THESE PESTS?

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A parasite-like structure (PLS), or more specifically, an organic structure behaving like a parasite, is described. The PLS development takes place inside the slug's haemocoel, and the PLS's size and morphology change radically along the slug's life cycle. Every slug species studied by us has its particular PLS, so that it may be assumed that, in all the studied cases, slug and PLS must have been coevolving for a long time. Growth of the PLS occurs in three different, highly coordinated stages. The onset of development of every stage seems to be linked to particular clues, such as photoperiod and/or to some biochemical characteristics of some somatic tissues of the slug, so that the developing PLS must regularly receive some kind of updated information, probably by means of hormones, about those clues. To meet the PLS's developmental requirements, more and more nutrients are withdrawn from the somatic tissues which, from a functional point of view, become "the host" of the PLS. The exhaustion of the host's resources by the parasite leads to the host's death. The slug dies after the PLS has laid several egg-clutches.

UNIONIDAE OF THE MALTA RESERVOIR IN POZNAŃ

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The Malta Reservoir in the centre of Poznań is a dam lake on the Cybina River. Due to the abundance of fishes it provides ideal conditions for unionid populations; because of its recreational role it requires emptying and cleaning every four years. Our aim was to inventory its unionid fauna and compare it with the fauna of natural water bodies and with the earlier results. The material was collected during maintenance work in 2012, using transect method which made it possible to estimate the density and age structure. All the bivalves were measured in order to compare the shell size with literature data. Three species of unionids were recorded. The most abundant was *Unio tumidus*, followed by *Anodonta anatina*. *Anodonta cygnea* was the least abundant. Comparison of the results of 2008 and 2012 showed: 1) decrease in the density of *A. cygnea* (2012 – 0.05 indiv. m^{-2}, 2008 – 6.6 indiv. m^{-2} and it was then the dominant); 2) changes in the age structure of *A. cygnea*: 2008 – predominance of individuals aged 1+: 56.6%, 575 individuals, and 2+: 29.1%, 296 individuals; older bivalves were fewer: 3+ – 101, 4+ – 39; age classes 5+ and 6+ represented by 3 individuals each; 2012: no bivalves aged 1+ and 2+; only one individual aged 5+; no inviduals older than 5+.; predominance of bivalves aged 3+ (78%, 67 specimens); individuals with age estimated as 4 years constituted 21% of the sample. The absence of *A. cygnea* aged 1+ and 2+ indicates the lack of reproduction in the population. It is difficult to specify the reasons for the situation. The only documented factor that has changed in recent years is the use of phosphorus inactivation method, PIX-113. Literature data do not indicate negative effects of the method, and the problem requires further studies.

ABUNDANCE, SIZE AND AGE STRUCTURE OF *DREISSENA POLYMORPHA* (PALLAS, 1771) IN THE SKOSZEWO BAY (GULF OF SZCZECIN)

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The zebra mussel *Dreissena polymorpha* (Pallas, 1771) plays an important role in aquatic ecosystems (filtration limiting the quantity of suspension, faeces and pseudofaeces contributing to faster decomposition of organic matter, providing food for benthic organisms, when abundant, providing three-dimensional structure with numerous microhabitats). We sampled *D. polymorpha* monthly, from April to November 2010–2011 and from May to November 2012, in the Skoszewo Bay, being part of the Gulf of Szczecin. Bottom sediments' characteristics and basic physical and chemical parameters of water were determined in each site. Macrobenthos samples, three in each site, were taken with Van Veen grab with catching area of 625 cm^2. They were washed on sieves of 1.0 mm mesh, and all individuals of *D. polymorpha* were removed. They were measured and assigned to one-millimetre size classes (24 classes). The density was calculated as the number of individuals per square metre for each study period. The age was assessed based on the number of growth rings, and the mussels were assigned to six age classes (0+ to 5+). *D. polymorpha* was present in all the sampling months, with the mean density: 2010 – 1,387 indiv. m^{-2}, 2011 – 3,826 indiv. m^{-2} and 2012 – 5,839 indiv. m^{-2}. In 2010 the density during consecutive months ranged from 85 to 5,547 indiv. m^{-2}, with the maximum in October and the minimum in May. In 2011 the minimum fell on April (107 indiv. m^{-2}), the maximum on August (17,227 indiv. m^{-2}). In 2012 the minimum occurred in October (725.3 indiv. m^{-2}), the maximum in November (15,493 indiv. m^{-2}). In 2010–2012 the most numerous size class was 9–13 mm; the percentage of individuals in the population decreased with their size. The mean shell length was: 2010 – 10.36 mm, 2011 – 10.39 mm, 2012 – 10.38 mm. In the Skoszewo Bay both juveniles – aged one year, and older, five-year mussels occurred. The age structure varied between the years, for example in 2010 age classes 3+ (38.61%) and 2+ (35.09%) formed the greatest proportion, and in 2011 and 2012 the prevailing age class was 1+ (ca. 50% of all mussels). In all three years classes 4+ and 5+ were the least numerous. The mean age was: 2010 – 2.2, 2011 – 1.1, 2012 – 1.4. The abundance, age and size structure in different periods may reflect the biotic changes associated with the seasonal life cycle of the mussel, as well as the presence of birds for which the species is the basic food source. The fluctuations may also be subject to the influence of natural abiotic factors, for example waves, or undercurrents, since the reservoir is shallow (mean depth ca. 2.0 m), where aggregations of *D. polymorpha* can be easily displaced by currents or waves. Studies financed by the National Science Centre, grant no. N N305 397538

MALACOFAUNA OF THE NATURE RESERVE "GRAPA" (SILESIAN VOIVODESHIP)

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The forest reserve "Grapa" is located in Sporysz, a district of Żywiec, in the Żywiec Basin within the range of the Western Beskidy Mts. It was established in 1996, in order to protect a fragment of deciduous forest with plant species characteristic of the Żywiec Basin. The reserve includes two forest communities: ash riverine forest and subcontinental oak-hornbeam forest which is the dominant community. The hydrological system comprises two streams: Okiel and Młynówka which partly mark the southern boundary of the reserve. The main aim was to provide an up-to-date inventory of the mollusc fauna. Field work was carried out from May to November 2012–2014, in 15 sites representing all the habitat types; sampling was qualitative (visual search) and quantitative (inspection of ca. 10 litres of litter on site for terrestrial gastropods and using 1 mm mesh net for freshwater molluscs). The malacofauna of the nature reserve "Grapa" includes 21 species of five ecological groups, forest and shade-loving species constituting the greatest proportion. The richest habitat is the community with *Impatiens parviflora*. Five of the recorded species are red-listed in Poland; one species is invasive.

RECONSTRUCTION OF A POPULATION OF *UNIO CRASSUS* IN THE BIAŁA TARNOWSKA RIVER

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The Biała Tarnowska is a medium-sized river in southern Poland; it is a right-bank tributary of the Dunajec. Its lower section holds a large population of *Unio crassus*, with the abundance estimated as ca. 200,000 individuals. In its mid section the Biała is

joined by its tributary Zborowianka (also called Bieśninka), which has a smaller population of the species (ca. 4,000 individuals). The populations were separated by a *Unio*-free, previously polluted section of the Biała where the concrete bars had just been modified to facilitate migrations of fishes (unionid hosts). Physico-chemical properties of water, species composition and distribution of fishes and river bed morphology were studied in this section. Based on the obtained data, we selected sites which according to literature information and our earlier observations met the habitat requirements of *U. crassus*. The sites were no further apart than 2.5 km. Twenty to thirty adults caught in the lower section of the Biała were introduced in each site. It was assumed that the bivalves would colonise the mid section of the Biała from these sites, thus restoring the connection between the population from the river and the one from its tributary. In 16 of the sites the species persisted during more than one year: the bivalves survived winter, floods, low water level and started reproducing in the spring. Next year, juveniles obtained from artifical breeding based on individuals from the Biała were introduced into these sites. In order to obtain precise information on the characters of preferred sites in the mid section of the Biała, we traced movements of individually marked bivalves (radiotracking). Groups of marked bivalves were placed in places with different types of river bed; their position was then regularly monitored. In unfavourable conditions the bivalves dispersed. They tended to gather in stright sections of the river bed, with fine-grained bottom deposits, small bays sheltered from the main current, of rather small flow (sometimes with backcurrent). Some of the 16 sites of introduction had characters preferred by the marked individuals. Both the survivorship of adults and the recruitment of juveniles were the greatest in such sites. In conditions of adequate water quality and access to fish hosts, the crucial part in the habitat preferences of *U. crassus* is played by the local morphology of the river bed and the local hydrological processes.

SPECIES RICHNESS OF DIGENEA IN SNAILS – DATA FROM POLAND IN RELATION TO INFORMATION FROM EUROPE

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Studies on the species richness of digeneans in pulmonate and prosobranch gastropods in Europe were started by Lühe in 1909; he created a system of morphological classification of digenean cercariae. Till now the parasite fauna of Lymnaeidae and Planorbidae (especially *Lymnaea stagnalis* and *Planorbarius corneus*) is the best studied, which is the effect of medical and veterinary implications of the presence of Digenea in these species. In recent years there has been an increased interest in prosobranchs, both native (i.a. Viviparidae), and alien. The estimated number of digenean species occurring in *L. stagnalis* in Poland is 17, in the Czech Republic – 19, in Germany – 18, in Finland – 9. In *P. corneus* 8 digenean species have been recorded in Poland, 11 – in the Czech Republic and 7 each in Denmark and Germany. Episodic studies on the infection of *V. contectus* by digeneans have revealed 9 (Poland) and 6 (the Czech Republic) species. *Diplostomum pseudospathaceum, Plagiorchis elegans*, *Echinoparyphium aconiatum* and *Opisthioglyphe ranae* are the most frequent digeneans in *L. stagnalis*, while *P. corneus* most often harbours *Rubenstrema exasperatum/Neoglyphe locellus, Echinostoma spiniferum* and *Tylodelphys excavata*. In the case of *V. contectus* there are no comprehensive data on the predominating digeneans from Europe; in Poland *Cercaria pugnax* and *Neoacanthoparyphium echinatoides* are mentioned. The species richness of digeneans found in *L. stagnalis* and *P. corneus* in Poland is close to the European values, and for *V. contectus* it is greater which may be partly explained by the range of the studies (number of examined localities and specimens). The actual digenean richness in *L. stagnalis, P. conreus* and *V. contectus* may be much greater than suggested by the presented data, since many species of these parasites are part of the so called species complexes (e.g. *Trichobilharzia ocellata*), where species are diagnosed based on molecular information.

SNAILS – MODEL (?) IN STUDIES OF FEVER IN ECTOTHERMAL ANIMALS

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The term fever means increase in body temperature caused by disease or injury. Endothermal animals are provided with an internal system of temperature regulation which is controlled by hypothalamus. Shitfing the set point above the normal temperature results in an increase in body temperature which is maintained during a definite time and then decreases to the normal level, with the return of the set point to its original position. The changes in the set point are preceded by a cascade of biochemical reactions with participation of the so called exogenous pirogens (LPS, poly I:C, LA and others) which stimulate secretion of endogenous pirogens (IL-1b, IL-2, IL-6,

TNFa, interferones and others). Under the effect of the latter substances arachidonic acid (AA) is released from biological membranes; it is the substrate in the synthesis of E series prostaglandines (PGE1, PGE2) which interact with the set point. Ectothermal animals can generate the so called behavioural fever: infected or injured individuals move to microhabitats with higher temperature. The phenomenon was discovered more than 30 years ago in reptiles, then observed in fishes, amphibians and some invertebrates; it was found to have an effect on the survivorship of the diseased animals. Besides, anatomical structures similar to endotherms' hypothalamus were found to participate in generating fever. Experimental use of pirogens, antipyrethics or protaglandines in various ectothermal animals including invertebrates made it possible to find similarities in generating the two types of fever. Recent studies on the defensive thermal behaviour of ectothermal animals develop in the direction of the analysis of changes in the gene expression in the course of fever, and the use of molecular diagnostic methods (PCR) makes it possible to trace phylogeny of animal fever mechanisms. The results of our studies and the data of other authors indicate that gastropods can generate symptoms of behavioural fever. Including them in the group of model organisms in the studies on the phenomenon is very likely.