ICIM 4 Program & Abstracts

International Congress on Invertebrate Morphology

ICIM IV

Moscow, 18-23 August 2017

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Ч-52

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Книга представляет собой сборник тезисов докладов 4-го международного конгресса по морфологии беспозвоночных, проходившего 18-23 Августа 2017 года в Московском государственном университете им. М.В. Ломоносова (Москва, Россия). Материалы докладов распределены по 14 симпозиумам, отражающим наиболее актуальные направления современной зоологической науки. Всего в рамках конгресса заслушано 170 устных и 160 стендовых докладов от участников из 25 стран мира. Более трети всех докладов сделаны молодыми учеными – студентами и аспирантами ведущих российских и зарубежных вузов. Пленарные и приглашенные лекции прочитаны ведущими специалистами по сравнительной анатомии, эмбриологии, палеонтологии, геномики и эволюции беспозвоночных.

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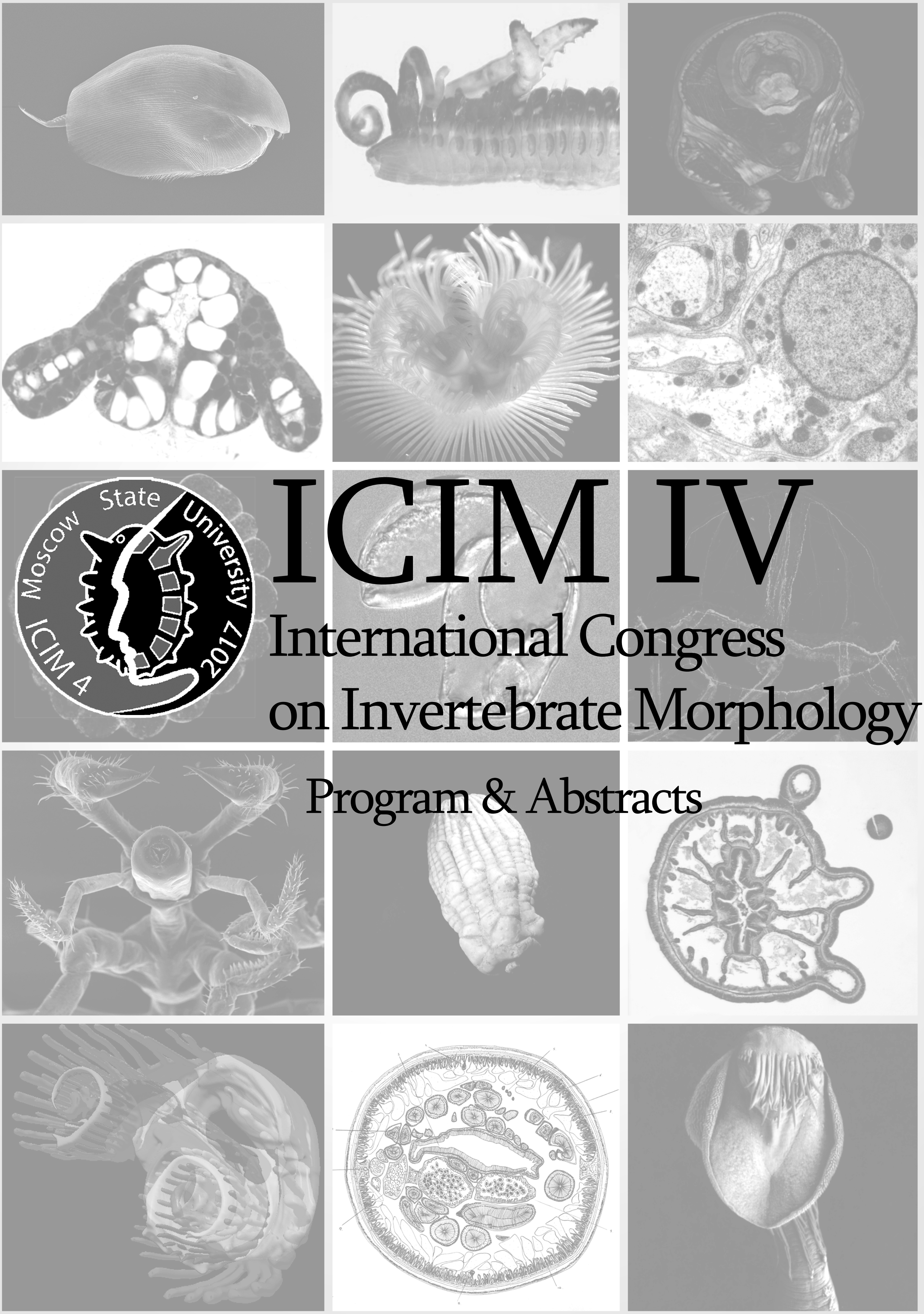


Moscow State University
ICIM 4 2017

ICIM IV

International Congress on Invertebrate Morphology

Program & Abstracts

Dear participants and delegates

Lomonosov Moscow State University and the Paleontological Institute of Russian Academy of Sciences welcome you to the 4th International Congress on Invertebrate Morphology (ICIM4).

The diverse and fascinating world of invertebrate animals always attracted interest of zoologists. However, it was not until just ten years ago when scientists created an international society in the field of Invertebrate Morphology. The society has been a true example of a grassroots movement -- scientists for no other reason than mere interest came together to exchange results, share ideas and technical advances within their studies of this amazing diversity of invertebrates and forms of their adaptation. Until now the Society runs without a large administrative body and relies primarily on the passion of volunteers.

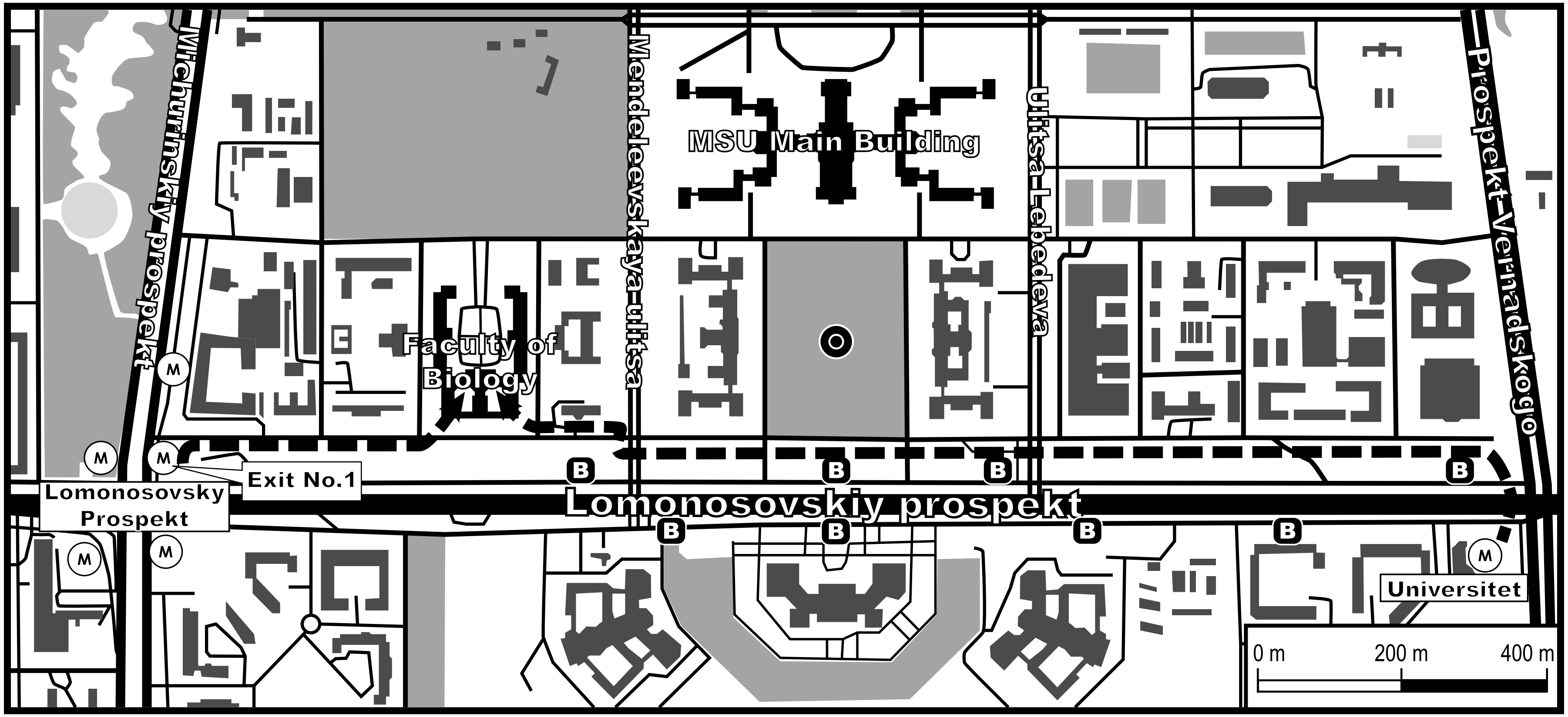
After the inaugural congress in Copenhagen (Denmark) in 2008, Cambridge, (USA, 2011) and Berlin (Germany, 2014) the fourth Congress will be held in Moscow, Russia in August 18 – 23, 2017.
The Moscow Congress will consist of 14 Symposia reflecting actual vectors of invertebrate morphology. The focus of the 4th Congress will be on (i) synthesis of classical morphology with advances in molecular taxonomy and phylogeny; (ii) evolutionary developmental biology; (iii) investigations on structure of different groups of invertebrates, in particular, parasites; (iv) comparative analysis of the system as nervous, circulatory and excretory; (v) the problem of miniaturization and the evolution of larval forms; and (vi) modern achievements in the field of functional morphology and paleontology. Special attention has been paid to modern approaches and methods of morphological and evolutionary studies. One of the main goals of the ICIM4 is to provide a platform for communication and facilitate international collaboration of young researchers. More than 300 participants from 25 countries made their plans to take part in the ICIM4, Moscow.

We thank everyone who contributed presentations on different aspects of invertebrate morphology, especially our keynote speakers and invited lectors! We express our gratitude to sponsors , without their support we wouldn't be able to afford this gathering in Moscow. And let me to express a big 'thank you' to everyone involved behind the scenes!

I extend my best wishes to all of you and hope you have fruitful discussions and memorable time in Moscow.

Natalia M. Biserova
President-elect of the International Society for Invertebrate Morphology

Getting to the Congress Venue

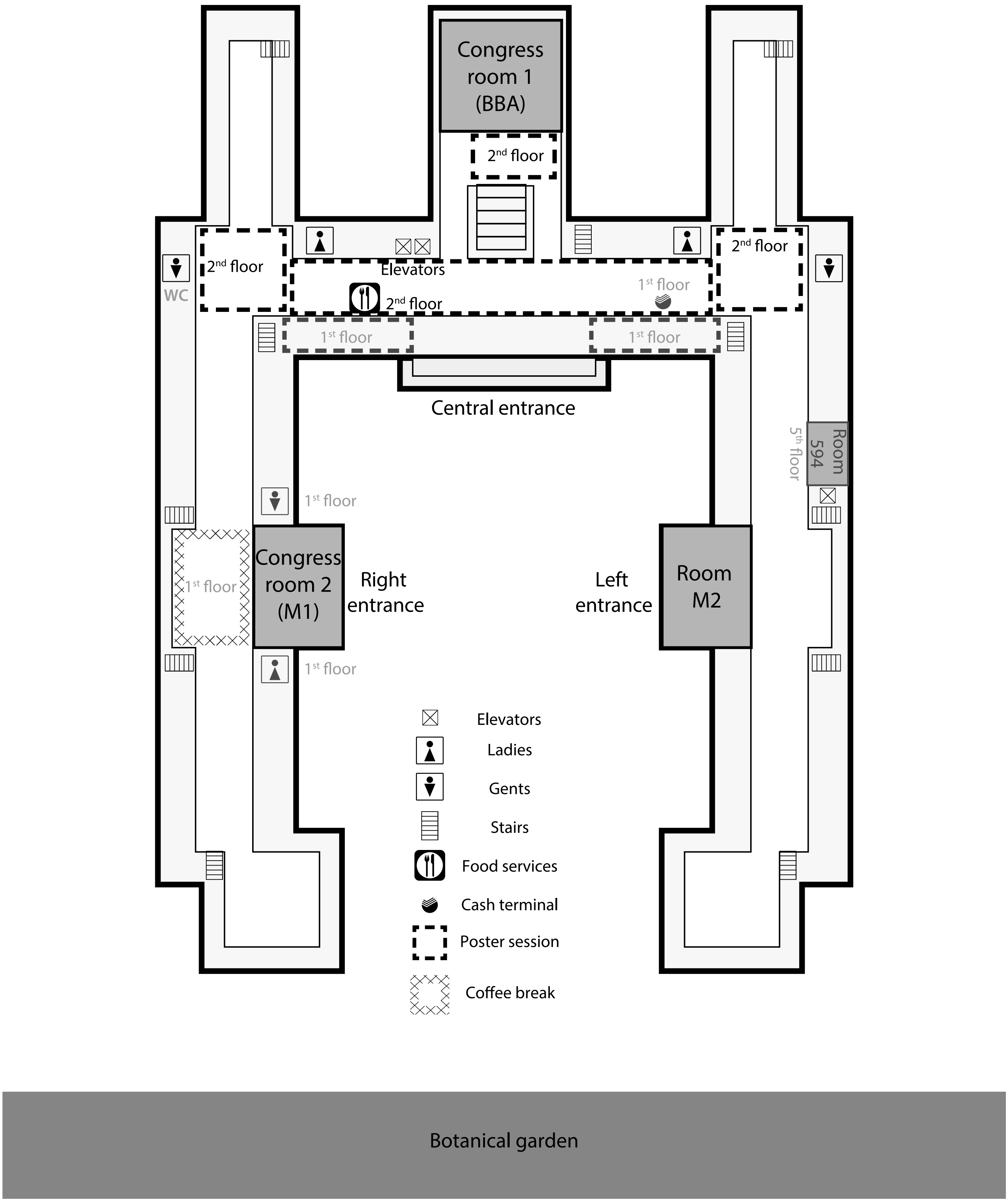


From «Universitet» metro station:
When traveling from the city center board near the back of the train.
When traveling from the outside the city board near the front of the train. At Universitet station take the closest exit. Exit the station and cross Lomonosovsky prospekt which is straight ahead. At the bus stop (B) take trolley No 34 or buses No 47, 67, 103, 113, 130, 260 and get off at Mendeleevskaya Ulitsa stop (the third one). The faculty of biology will be on your right side.

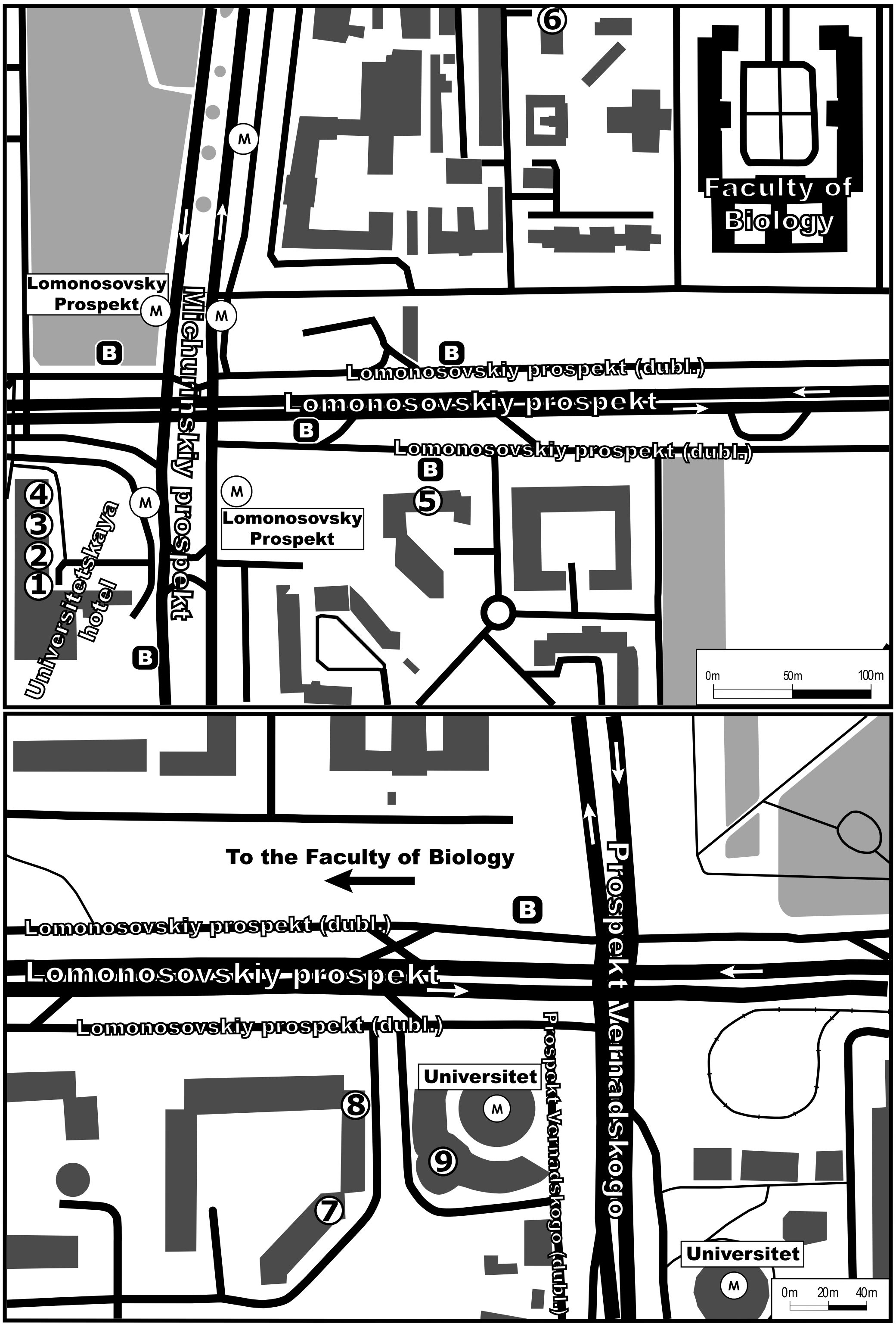
From «Lomonosovsky prospekt» metro station:
Leave the station by exit No 1. Turn right once you are outside and walk about five min. The faculty of biology will be on your left side.

Useful apps during stay in Moscow: «2GIS Offline Maps&Navigator», «Yandex.Metro» apps are available in both Russian and English languages in App Store, Google Play and Microsoft Store.

Faculty of Biology map



Nearby restaurants & cafés



1 — Iv. Durdin restaurant; 12pm —12am
Bar, pub, Russian, European

2 — Beerodrom bar; 12pm — 12am
Bar, pub, European

3 — Bison Steak House; 12pm — 12am
American, European, Latin American

4 — Marea restaurant; 12pm — 12am
Seafood

5 — Chaikhana Gold (ex-Sharabara); 11am — 11 pm
Panasian, Grill, Fusion,Vegetarian (optionally)

6 — Univer Café; 10am — 6pm, on weekdays
Cafeteria

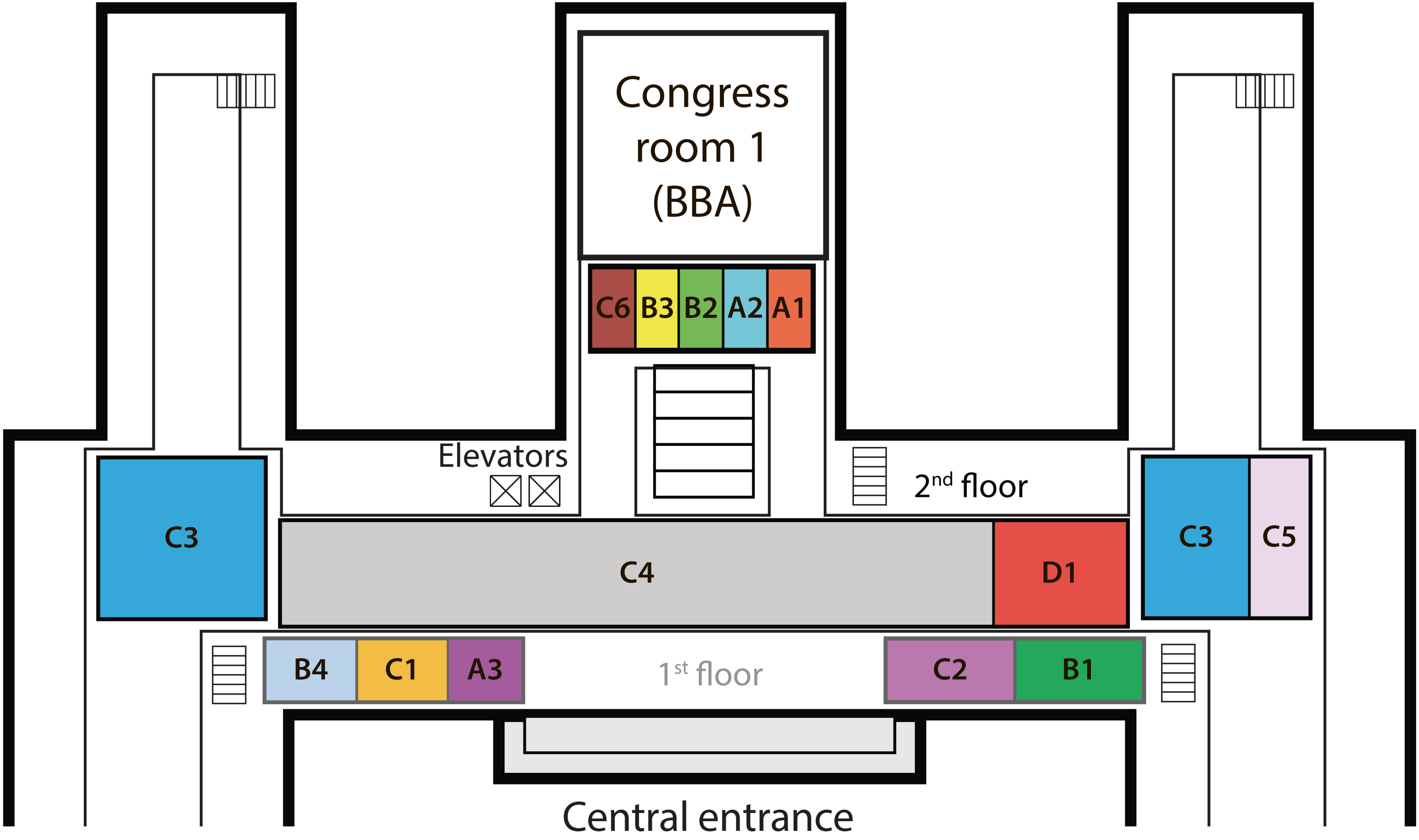
7 — Tapas Marbella Bar&restaurant; 10am — 12am
Spanish, Italian, European

8 — Shockoladnitsa Café; 8am — 11pm
European, coffee, desserts, pastry

9 — Univer-city Shopping Centre; 10am — 9pm

B — Bus stop

Poster Session map



11.08–17.08.2017 pre–congress workshop “Comparative anatomy of invertebrates”	
17.08.2017 (Thu) Faculty of Biology, Lomonosov Moscow State University (MSU)	
17:00 –20:00	REGISTRATION **hall in front of BBA**

18.08.2017 (Fri) Faculty of Biology, MSU		
8:00 – 10:00	REGISTRATION **hall in front of BBA**	
10:00 – 10:20	**Welcome address from Prof. Dr. Gerhard Scholtz and Dr. Natalia M. Biserova**	
10:20 – 11:00	**Prof. Dr. Andrew Ostrovsky "250 years of zoology in Russia: an invertebrate retrospect", BBA**	P. 5
11:00 – 11:20	**Coffee break, hall in front of M1**	

M1			**BBA**		
C6 Morphological diversity of the terrestrial invertebrates **Chair: Elena N. Temereva**			**B1 Functional evolution and morphology of the nervous system** **Chair: Leonid L. Moroz**		
11:20 – 11:50	**Dmitry Shcherbakov** Insects as flying shrimps, myriapods as arthropod snakes—A new synthesis	P. 333	11:20 – 11:50	**Detlev Arendt** From nerve net to nerve cord and brain: the evolution of centralized nervous systems	P.70
11:50 – 12:05	**Roman Rakitov** Piercing stylets of Hemiptera: appendages drawn into setae	P. 332	11:50 – 12:05	**Sabrina Kaul–Strehlow**, Lisa AK Hack, Ulrich Technau Evolution of the neuromuscular junction – insights from the anthozoan *Nematostella vectensis*	P.86
12:05 – 12:20	**Ivo de Sena Oliveira**, Andreas Kumerics, Henry Jahn, Mark Müller, Jörg Hammel, Georg Mayer Using an innovative nanoCT setup to reconstruct the leg musculature in velvet worms (Onychophora)	P. 321	12:05 – 12:20	**Hans–Joachim Pflueger** The tyraminergic/octopaminergic system of insects: an evolutionary conserved system orchestrating neural and physiological behavior	P. 95
12:20 – 12:35	**Mihail Valuyskiy**, Stanislav Melnitsky, Vladimir Ivanov Diversity and distribution patterns of antennal sensilla in genus *Rhyacophila* (Trichoptera: Rhyacophilidae)	P. 334	12:20 – 12:35	**Katharina Jörger**, Franziska Bergmeier, Timea Neusser, Gerhard Haszprunar The enigmatic sensory world of solenogastres (Mollusca)	P. 84
12:35 – 12:50	**Carolin Haug** New insights into body organisation in chelicerates	P. 325	12:35 – 12:50	**Alexandra Kerbl**, Gáspár Jékely Katrine Worsaae Mapping neuropeptide immunoreactivity in the nervous systems of three meiofaunal annelids reveals	P. 87

				unexpected variability	
12:50 – 13:05	**Nesrine Akkari** Novel approaches in morphology pushing boundaries in Myriapod systematics (Arthropoda, Myriapoda)	P. 317	12:50 – 13:05	**Anlaug Furu**, José M. Martin–Duran, Aina Børve, Henrike Semmler Lê, Andreas Hejnol Central nervous system anatomy and expression of mediolateral patterning genes in the rotifer *Epiphanes senta*	P. 80
13:05 – 13:20	**Anne–Sarah Ganske**, Gregory D. Edgecombe, Nesrine Akkari Using traditional and innovative imaging techniques to investigate internal cephalic structures in the highly diverse genus *Lithobius* (Chilopoda, Myriapoda)	P. 322	13:05 – 13:20	**Oleg Tolstenkov**, Irina Podvyaznaya, Natalia Biserova CPG from parasitic flatworm? TEM revealed a simple neural circuit in the tail of freely moving trematode larva	P. 102
13:20 – 14:20	**Lunch** (the workshop of Wiley at room 594 – 5th floor Dept. Invert. Zool.)				
14:20 – 15:00	**Prof. Dr. Vladimir V. Malakhov "Tentacles, ciliary bands, and limbs in metazoan evolution", BBA**				P. 3
M1			**BBA**		
B3 Form and function of invertebrates in extreme environments Chair: Nadezhda N. Rimskaya–Korsakova			**B1 Functional evolution and morphology of the nervous system Chair: Hans–Joachim Pflueger**		
15:10 – 15:40	**Monika Bright** The giant tubeworm evolved to cooperate with its symbiont under extreme conditions at deep–sea hydrothermal vents	P.129	15:10 – 15:40	**Steffen Harzsch** Evolution of crustacean olfactory systems	P. 81
15:40 – 16:10	**Norio Miyamoto** Function and evolution of "root" in bone–eating worm *Osedax*	P. 137	15:40 – 15:55	**Stepan Vodopyanov**, Tim von Palubitzky, Günter Purschke The ultrastructure of the eyes of *Oweniidae* polychaetes	P. 103
			15:55 – 16:10	**Hannah Schmidbaur**, Thomas Schwaha, Gerhard Steiner The nervous system of Syllidae Grube, 1859 (Annelida: Phyllodocida): a comparative study using immunocytochemistry, clsm and light microscopy	P. 97

16:10 – 16:25	**Petr Kuznetsov**, ElenaTemereva, Elizaveta Kiseleva First detailed description of morphology and microscopical anatomy of deep sea echiurid *Protononellia zenkevitchi*	P. 226	16:10 – 16:25	**Elizaveta Fofanova**, Tatiana Mayorova, Elena Voronezhskaya Are dinophilid worms archetypical Polychaete or neotenic trochophore? Insight from early neurogenesis	P. 79
16:25 – 16:40	**Tina Molodtsova**, Dennis Opresko, Dmitry Shvoev Diversity of colony form and functional morphology of the skeleton of black corals (Anthozoa: Antipatharia)	P. 138	16:25 – 16:40	**Jakob Krieger**, Andy Sombke, Steffen Harzsch Three somatotopic maps for one sensorial modality – Brain architecture of the banded cleaner shrimp *Stenopus hispidus* (Olivier, 1811); (Malacostraca, Stenopodidea).	P. 90
16:40 – 17:00	**Coffee break, hall in front of M1**				
M1			**BBA**		
B3 Form and function of invertebrates in extreme environments **Chair: Brett Gonzalez**			**B1 Functional evolution and morphology of the nervous system** **Chair: Hans–Joachim Pflueger**		
17:00 – 17:15	**Sabina Kondrateva** Extreme desiccation resistance in chironomid midges: linking molecular and morphological adaptations	P. 135	17:00 – 17:15	**Jérôme Delroisse**, Esther Ullrich–Lüter, Stefanie Blaue, Patrick Flammang, Jérôme Mallefet Bioluminescence of a brittle star, from luciferase homology to photocyte ultrastructure	P. 76
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17:30 – 17:45	**Elena Voronezhskaya**, Marina Khabarova, Timur Chernov Apical sensory organ and developmental regulation: insight from freshwater gastropod larvae	P. 143	17:30 – 17:45	**Caterina Biffis**, Gerhard Scholtz The development of the medulla terminalis in malacostracan crustaceans: a new look at the “lateral protocerebrum”	P. 73
17:45 – 18:00	**Sandra Franz–Guess**, J. Matthias Starck Microscopic anatomy of sensory organs in *Eukoenenia spelaea* (Chelicerata: Palpigradi)	P. 130	17:45 – 18:00	**Anna Zhadan**, Alexander Tzetlin, Elena Vortsepneva Innervation of unpaired branchial appendages in annelids *Terebellides cf. stroemi* (Trichobranchidae) and *Cossura pygodactylata* (Cossuridae)	P. 105

18:00 – 18:15	**Brett Gonzalez** Troglomorphism in cave scale worms: anophthalmia and elongation of body appendages (Aphroditiformia, Annelida)	P. 132	18:00 – 18:15	**Olga Zaitseva**, Alexander Shumeev Fluorescence imaging of nervous and muscular systems in juvenile *Cadlina laevis* (Nudibranchia) by confocal laser scanning microscopy	P. 104
18:15 – 18:30	**Alejandro Martinez** Do cave animals really look so weird? Unravelling adaptation using comparative methods in several anchialine exclusive lineages, mainly annelids and decapods	P. 136	18:15 – 18:30	**Clemens Döring**, Harald Hausen Phototaxis in bryozoan coronated larvae	P. 77

18:45 – 19:00	**Group Photo at the stairs of the Faculty entrance**
19:00 – 19:10	**Reinhard Rieger Award** at the stairs of the right entrance of Faculty of Biology, MSU
19:10 – 19:20	**Award of Financial Support for young researchers**
19:20 – 19:30	**Memorial words about Rick Harrison**
19:30 – 22:00	**Welcome Party** (hall of the right entrance of Faculty of Biology, MSU)

19.08.2017 (Sat) Faculty of Biology, MSU

09:00 – 09:40	**Prof. Dr. Leonid L. Moroz "Origins and Parallel Evolution of Neural Systems across Metazoa: From Ctenophora to Cephalopoda", BBA**	P. 4

M1			**BBA**		
D Advanced Microscopy and Morphology **Chair: Julia Sigwart**			**C1 Minute metazoans: Little pigeons can carry great messages** **Chair: Vladimir V. Yushin, Alexei V. Tchesunov**		
09:50 – 10:20	**Lauren Sumner–Rooney**, Julia Sigwart Morphological lazarisation: when new technology brings life to historical specimens	P. 342	09:50 – 10:20	**Katrine Worsaae**, Nicolas Bekkouche, Alexandra Kerbl A meiofauna perspective on nervous system evolution	P. 169
10:20 – 10:35	**Julia Sigwart** Ontongeny and form in chiton shell eyes (Mollusca, Polyplacophora)	P. 340	10:20 – 10:35	**Alexey Polilov**, Sergey Farisenkov, Natalia Reshetnikova Morphology of the wing apparatus and flight characteristics of featherwing beetles (Coleoptera: Ptiliidae), the smallest free–living insects	P. 162

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Kleptoplasty in marine meiofaunal flatworms</td><td>P. 167</td></tr>
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<tr><td>11:05 – 11:20</td><td>Kharlampy Tiras, Alexander Deev, Stanislav Klimenko, Leonid Mestetskiy, Valery Novochadov, Alexey Saniev, Anna Pidzhakova, Uliana Vorobeva
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<tr><td>11:50 – 12:10</td><td colspan="5">Coffee break, hall in front of M1</td></tr>
<tr><td colspan="3">M1</td><td colspan="3">BBA</td></tr>
<tr><td colspan="3">A3 The genomic basis for morphological evolution
Chair: Andreas Hejnol</td><td colspan="3">C1 Minute metazoans: Little pigeons can carry great messages
Chair: Alexei V. Tchesunov, Alexei A. Polilov</td></tr>
<tr><td>12:10 – 12:40</td><td>Daniel Chourrout
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			12:25 – 12:40	**Myriam Claeys**, Vladimir Yushin, Jan Leunissen, Jef Claeys, Wim Bert Self–pressurised rapid freezing (sprf): an easy–to–use and low–cost alternative cryo–fixation method for minute metazoans	P. 157
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13:40 – 13:55	**Patricia Álvarez–Campos**, Gonzalo Giribet, Ana Riesgo Stolonazing syllids: ultrastructural and transcriptomic approach	P. 56	13:40 – 13:55	**Nataliya Budaeva**, Conrad Helm An integrative molecular and morphological approach reveals new insights into the evolution of the enigmatic Charlie Chaplin worms (Histriobdellidae, Annelida)	P. 156
13:55 – 14:10	**Sergey Grebelnyi** The significance of acontia for the traditional classification of actiniaria. Conflict of morphological systematics and modern opinions based on the study of molecular markers	P. 61	13:55 – 14:10	**Anna Zofia Urbisz**, Łukasz Chajec, Szymon Gorgoń, Natalia Jarosz, Piotr Świątek Comparison of the ovary micromorphology in clitellate annelids	P. 303

14:10 – 14:25	**Andrei Makashov,** Andrei Kozlov The origin of bilateria is connected with a jump in the origin of orthologs of several functional classes of human genes including those specifically expressed in tumors	P. 62	14:10 – 14:25	**Yoko Matsumura**, Alexander E. Kovalev, Stanislav N. Gorb Bending stiffness gradient and a soft tip of a beetle intromittent organ and their role in the penetration mechanics	P. 330
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M1			**BBA**		
B2 Modular organization in invertebrates: comparative morphological and functional analysis of superorganisms Chair: Igor A. Kosevich			**C2 Structure of Parasitic Invertebrates: Plasticity, Adaptation, Evolution Chair: David Bruce Conn**		
15:30 – 16:00	**Igor Kosevich**, Nicolai Marfenin The concept of modular organisation: questions and problems	P. 113	15:30 – 16:00	**Daniel Mlocicki** Morphological features of tapeworms in relation to host–parasite interactions – from morphology to molecules	P. 189
16:00 – 16:15	**Alexander Ereskovsky** What can sponges tell us about modular and colonial organization?	P. 110	16:00 – 16:15	**David Bruce Conn** Cancer in cestodes (Platyhelminthes, Neodermata): morphology of neoplastic malignant transformation	P. 175
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17:30 – 17:50	**Coffee break, hall in front of M1**				
M1			**BBA**		
B2 Modular organization in invertebrates: comparative morphological and functional analysis of superorganisms **Chair: Igor A. Kosevich**			**C2 Structure of Parasitic Invertebrates: Plasticity, Adaptation, Evolution** **Chair: Natalia M. Biserova**		
17:50 – 18:05	**Natalie Gawin**, Thomas Schwaha, Andreas Wanninger Reconstructing the bryozoan muscular ground pattern on the basis of three phylactolaemate species	P. 112	17:50 – 18:05	**J. Matthias Starck**, Lisa Mehnert, Anja Biging, Juliana Bjarsch, Sandra Franz–Guess, Daniel Kleeberger, Marie Hörnig Morphological responses to feeding in ticks (*Ixodes ricinus*)	P. 197
18:05 – 18:20	**Uliana Nekliudova**, Thomas Schwaha, Daniela Gruber, Norbert Cyran, Andrew Ostrovsky Comparative ultrastructure of placental analogues in Bryozoa	P. 119	18:05 – 18:20	**Darya Krupenko**, Anna Gonchar, Andrei Dobrovolskij Attachment in Digenea: theory and practice	P. 183
18:20 – 18:35	**Thomas Schwaha**, Stephan Handschuh, Andrew Ostrovsky, Andreas Wanninger The neuromuscular system of cyclostome bryozoans shows more similarity to gymnolaemates than phylactolaemates, an example from *Cinctipora elegans*	P. 123	18:20 – 18:35	**Januscha Moll**, Annemariè Avenant–Oldewage Morphology of the digestive system of *Lamproglena clariae* Fryer, 1956 (Crustacea: Copepoda) a gill parasite of African catfish *Clarias gariepinus* (Burchell, 1822)	P. 186
18:35 – 18:50	**Alexander Notov** Pseudocycles concept as a method in the evolutionary morphology of modular invertebrates	P. 120	18:35 – 18:50	**Alexey Miroliubov**, Jens Thorvald Hoeg, Andrej Dobrovolskij Muscular system and some other aspects of internal organization of Rhizocephala.	P. 185

18:50 – 19:05	**Elena Belikova**, Thomas Schwaha, Andrew Ostrovsky Diversity of muscular systems in cheilostome bryozoa	P. 106	18:50 – 19:05	**Elena Kotikova**, Olga Raikova First insight into the nervous and muscular systems of a parasitic turbellarian *Notentera ivanovi* (Platyhelminthes, Fecampiida)	P. 181

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<tr><td colspan="3" align="center">M1</td><td colspan="3" align="center">BBA</td></tr>
<tr><td colspan="3" align="center">C3 Morphological diversity and evolution in freshwater and marine environment
Chair: Alexey Kotov</td><td colspan="3" align="center">C4 Embryonic and larval development of invertebrates: comparative morphology meets new technologies
Chair: Yulia Kraus</td></tr>
<tr><td>09:50 – 10:20</td><td>Diego Fontaneto
Different differentiation and speciation rates between sexual and asexual rotifers</td><td>P. 214</td><td>09:50 – 10:20</td><td>Svetlana Maslakova
Evolution of larval development in ribbon worms (phylum Nemertea)</td><td>P. 293</td></tr>
<tr><td>10:20 – 10:35</td><td>Sergio Stampar, Thais Santos, Maximiliano Maronna, Marcelo Kitahara, Stefany Angelis, Celine Lopes, James Reimer, André Morandini, Alvaro Migotto
Phenotypic plasticity in adults and larvae tricking traditional taxonomy: A case study in Ceriantharia (Cnidaria, Anthozoa)</td><td>P. 246</td><td>10:20 – 10:35</td><td>Timur Magarlamov, Alexey Chernyshev
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<tr><td>10:35 – 10:50</td><td>Andrey Porfiriev, Anastasia Koroleva, Oleg Timoshkin
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<tr><td>10:50 – 11:05</td><td>Nina Aneli, Valeria Vays, Maria Plyushcheva
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11:20 – 11:40	**Coffee break, hall in front of M1**				
M1			**BBA**		
C3 Morphological diversity and evolution in freshwater and marine environment **Chair: Alexey Kotov**			**C4 Embryonic and larval development of invertebrates: comparative morphology meets new technologies** **Chair: Carmen Andrikou**		
11:40 – 11:55	**Yuta Tamberg**, Natalia Shunatova Feeding behavior and tentacle structure in bryozoans: immovable floodlights and flickering flames	P. 251	11:40 – 11:55	**Andrew Ostrovsky**, Thomas Schwaha, Martin Moosbrugger Evolutionary transition from incipient to substantial placentotrophy in a genus of cheilostome bryozoa	P. 300
11:55 – 12:10	**Elena Vortsepneva**, Anna Mikhlina, Yuri Kantor, Alexander Tzetlin Radula of gastropoda: formation and renewal	P. 257	11:55 – 12:10	**Andreas Hejnol**, Bruno Vellutini, Jose Martin–Duran Cleavage patterns, fate maps and cell lineages: What can early developmental similarities tell us about the homology of larval structures?	P. 275
12:10 – 12:25	**Gerhard Steiner** Does mantle cavity morphology reflect the mode of reproduction in trochid gastropods?	P. 249	12:10 – 12:25	**Roman Kostyuchenko**, Darya Nikanorova Cell lineage and fate map of the primary somatoblast: the comparative aspects of annelid development	P. 282
12:25 – 12:40	**Natalia Mikhailova**, Sergei Demin, Andrei Granovitch New cyst type of testis organization in marine gastropods	P. 228	12:25 – 12:40	**Ariel Chipman**, Tzach Auman, Barbara Vreede Analyzing the dynamics of segmentation to understand the evolution of the arthropod body plan	P. 271
12:40 – 12:55	**Anna Mikhlina**, Irina Ekimova, Elena Vortsepneva, Alexander Tzetlin These annoying neighbours: a comparative analysis of feeding apparatus in two drilling nudibranch species	P. 229	12:40 – 12:55	**Franziska Meusel**, Gerhard Scholtz, Carsten Wolff First insights in the formation of ectoteloblasts of the woodlouse *Porcellio scaber*	P. 295
12:55 – 13:10	**Ksenia Shunkina**, Olga Zaitseva Recent data on the nervous system of some Lophophorata	P. 242	12:55 – 13:10	**Viviana Cetrangolo**, Andreas Hejnol Early development and gastrulation in the nematode *Pontonema vulgare*	P. 270
13:10 – 14:10	**Lunch**				

M1			BBA		
C3 Morphological diversity and evolution in freshwater and marine environment **Chair: Viatcheslav N. Ivanenko**			**C4 Embryonic and larval development of invertebrates: comparative morphology meets new technologies** **Chair: Viktor Starunov**		
14:10 – 14:25	**Nikolai Korovchinsky**, Olga Boikova Morphological analysis does not support monophyly of the gymnomera (orders Onychopoda and Haplopoda) (Crustacea: Branchiopoda: Cladocera)	P. 223	14:10 – 14:25	**Carsten Wolff** Light sheet meets water flea – live imaging morphogenesis in *Daphnia*	P. 307
14:25 – 14:40	**Zandra Sigvardt**, D. Christopher Rogers, Jørgen Olesen Clam shrimps (Crustacea, Branchiopoda) – functional morphology of male claspers and systematics of Laevicaudata	P. 243	14:25 – 14:40	**Juliane Vehof**, Gerhard Scholtz, Carola Becker The sperm storage organs of *Paradorippe granulata* (Crustacea; Decapoda; Brachyura; Dorippidae) an eubrachyuran crab with external fertilisation	P. 304
14:40 – 14:55	**Zinaida Starunova**, Andrei Granovitch Shape diversity of littorinid shell morphology by geometric morphometric and micro ct	P. 248	14:40 – 14:55	**Andreas Wanninger** The evolution of mollusks	P. 306
14:55 – 15:10	**Alexey Golikov**, Rushan Sabirov The reproductive system morphology and reproductive strategies of bobtail squids in the arctic (Cephalopoda: Sepiolida)	P. 217	14:55 – 15:10	**Emanuel Redl**, Andreas Wanninger, Hiroshi Saito Development of *Scutopus schanderi* (Mollusca, Caudofoveata)	P. 301
15:10 – 15:25	**Rushan Sabirov**, Alexey Golikov Morpho–functional features of spermatophores as a markers of the reproductive strategies in males of the squid (Cphalopoda: Myopsida, Oegopsida)	P. 241	15:10 – 15:25	**Nami Okubo** Restructuring the traditional suborders in the order Scleractinia based on embryogenetic morphological characteristics	P. 298
15:25 – 15:40	**Carola Becker**, Jaimie T. A. Dick, Julia Sigwart Age Determination of Crustaceans through Annual Growth Rings – Fact or Fiction?	P. 201	15:25 – 15:40	**Yulia Kraus**, Boris Osadchenko, Lucas Leclere Evolutionary changes of complex life cycles dramatically affect embryonic and larval development of cnidarians	P. 287
15:40 – 16:40	**Posters Session**				
16:40 – 17:00	**Coffee break, hall in front of M1**				
17:00 – 20:00	Excursion to the Main building of MSU				group 1
	Excursion to the Zoological Museum				group 2

<table>
<tr><td colspan="6">21.08.2017 (Mon) Faculty of Biology, MSU</td></tr>
<tr><td>9:00 – 9:40</td><td colspan="4">Prof. Dr. Stanislav N. Gorb “Biomimetic adhesive microstructures as an approach to understand functioning of biological systems”, BBA</td><td>P. 1</td></tr>
<tr><td colspan="3">M1</td><td colspan="3">BBA</td></tr>
<tr><td colspan="3">A2 Origin of Bilateria: achievements and contradictions
Chair: Elena N. Temereva</td><td colspan="3">A1 Morphology of recent invertebrates and paleontology: modern synthesis
Chair: Sergei V. Rozhnov</td></tr>
<tr><td>09:50 – 10:20</td><td>Andreas Schmidt–Rhaesa
The transition to Bilateria – a review of thoughts and concepts</td><td>P. 48</td><td>09:50 – 10:20</td><td>Pavel Parkhaev
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Towards a cellular and molecular understanding for the embryonic origins of axial organization in the anthozoan Nematostella vectensis</td><td>P. 44</td><td>10:20 – 10:35</td><td>Mikhail Fedonkin
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Protostomy, deuterostomy or amphistomy: Evolution of bilaterian mouth and anus</td><td>P. 46</td><td>10:35 – 10:50</td><td>Min Xiao, Hua Hong, Cai Yaoping
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<tr><td>10:50 – 11:05</td><td>Jose Martin–Duran, Ralf Janssen, Graham Budd, Yale Passamaneck, Mark Martindale, Andreas Hejnol
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<tr><td colspan="3">M1</td><td colspan="3">BBA</td></tr>
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<tr><td>11:40
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11:55</td><td>Vitaly Kozin, Daria Guk, Roman Kostyuchenko
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11:55</td><td>Yu Wu
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12:10</td><td>José Antonio Gámez Vintaned, Eladio Liñán, Andrey Zhuravlev
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12:40</td><td>Tatyana Kuzmina, Elena Temereva, Vladimir Malakhov
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12:40</td><td>Ekaterina Sidorchuk
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12:55</td><td>Thomas Stach
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12:55</td><td>Igor Barskov
Conch ornamentation in nonammonoid cephalopods: Form and function</td><td>P. 7</td></tr>
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13:10</td><td>Joachim Haug, Matthias Starck
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13:10</td><td>Zhifei Zhang, Lars Erik Holmer
The morphology and diversity of the lophophores in Cambrian (ca. 520 Ma) brachiopods and its phylogenetic implications</td><td>P. 34</td></tr>
<tr><td>13:10 – 14:10</td><td colspan="5">Lunch</td></tr>
<tr><th colspan="3">M1</th><th colspan="3">BBA</th></tr>
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Chair: Andrei Yu. Zhuravlev</th></tr>
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14:10 – 14:25	**Olga Raikova**, Inga Meyer–Wachsmuth, Ulf Jondelius Diversity of nervous system patterns in the earliest bilaterians, nemertodermatida and acoela	P. 47	14:10 – 14:25	**Anna Madison**, Tatyana Kuzmina, Vladimir Malakhov Pedicle sheath of strophomenids (Brachiopoda): True pedicle opening or an anus?	P. 19
14:25 – 14:40	**Pedro Martinez**, Elena Perea–Atienza, Brenda Gavilán The evolution of xenacoelomorph morphologies. A model to understand the origin of brains.	P. 45	14:25 – 14:40	**Jian Han** Meiofaunal deuterostomes from the basal Cambrian of China and their implications for Ur–deuterostomes	P. 13
14:40 – 14:55	**Aina Børve**, Kevin Pang, Anlaug Furu, Joie Cannon, Ulf Jondelius, Andreas Hejnol Neural patterning in xenacoelomorphs	P. 36	14:40 – 14:55	**Sergey Rozhnov** Origin and homology of segmented appendages of carpoid and pelmatozoan echinoderms	P. 24
14:55 – 15:10	**Yaroslav Zabotin** The ultrastructural organization of Acoela and their phylogenetic relationships	P. 54	14:55 – 15:10	**Vladimir Malakhov,** Olga Ezhova Metamerism in the Echinodermata	P. 11
15:10 – 15:40	**Gonzalo Giribet** What the phylogeny of Bilateria may and may not tell us about the bilaterian last common ancestor	P. 38	15:10 – 15:25	**Alexey Smirnov** Origin of the class Holothuroidea (Echinodermata)	P. 29
15:40 – 16:40	**Posters Session**				
16:40 – 17:00	**Coffee break, hall in front of M1**				
17:00 – 20:00	Excursion to the Paleontological museum				

22.08.2017 (Tue) Midcongress Tour and **Congress Dinner**	
Group 1	
9:00–10:30	Transfer to Zvenigorod Biology Station (ZBS)
10:30–11:00	Breakfast at ZBS
11:00–14:00	Field practical course on Fresh water invertebrates
14.00–14.30	Lunch at ZBS
14.30–15.30	Field practical course on Fresh water invertebrates
15.30–16.00	Excursion around ZBS
16.00–20.00	**Congress dinner** at ZBS
Group 2	

10:00–11:00	Transfer to Zvenigorod
11:00–13:30	Excursion around Zvenigorod and Savva Storozhevskiy monastery
13.30–14.00	Free time to buy some souvenirs
14:00–15:30	Lunch, café Pristan'
15.00–15.30	Transfer to Zvenigorod Biology Station (ZBS)
15.30–16.00	Excursion around ZBS
16.00–20.00	**Congress dinner** at ZBS
Group 3	
14.00–15.30	Transfer to Zvenigorod Biology Station (ZBS)
15.30–16.00	Excursion around ZBS
16.00–20.00	**Congress dinner** at ZBS
19.00–20.00; 20.00–21.00	Transfer to metro station

23.08.2017 (Wed) Faculty of Biology, MSU					
M1			**BBA**		
B4 Invertebrate circulatory and excretory systems: comparative morphological and functional aspects **Chair: Tatyana V. Kuzmina**			**C5 Symbiosis between animals: diversity, patterns and inference on processes** **Chair: Temir A. Britayev**		
10:00 – 10:30	**Günter Pass** Evolution of the circulatory system of Arthropoda	P. 149	10:00 – 10:30	**Daniel Martin**, Temir Britayev An overview of the biodiversity and adaptations of symbiotic scale–worms (Annelida, Polynoidae)	P. 312
10:30 – 10:45	**Andrey Shatrov** Coxal glands of the *Parasitengona* – their ultrastructure, functions and evolutionary implication	P. 152	10:30 – 10:45	**Viatcheslav Ivanenko**, Bert Hoeksema, Sofya Mudrova, Mikhail Nikitin, Alejandro Martínez García, Nadezhda Rimskaya–Korsakova, Michael Berumen, Diego Fontaneto Integrative taxonomy and host specificity of copepod	P. 310

				crustaceans living on mushroom corals (Scleractinia: Fungiidae)	
10:45 – 11:00	**Ekaterina Bogomolova** Segmental nephridia in protonymphon larva of *Phoxichilidium femoratum* (Pycnogonida)	P. 145	10:45 – 11:00	**Andrey Vishnyakov**, Nadezhda Karagodina, Olga Kotenko, Thomas Schwaha, Martin Moosbrugger, Andrew Ostrovsky Structural and transport adaptations for symbiosis between bryozoans and bacteria	P. 315
11:00 – 11:15	**Nina Alexeeva**, Natalia Shunatova Pycnogonid body cavity and transport – riddles and answers, answers and riddles	P. 144	11:00 – 11:15	**Rawadee Kumlert**, Tippawan Anantatat, Chamnarn Apiwathnasorn, Suchada Sumruayphol, Piengchan Sonthayanon, Serge Morand, Alexandr Stekolnikov, Anchana Prasartwit, Daniel H. Paris, Sungsit Sungvornyothin Chigger mite species (Acari: Trombiculidae) from Vientiane, Laos	P. 311
11:15 – 11:30	**Nadezhda Rimskaya–Korsakova**, Nadezhda Karaseva Circulatory and excretory system of vestimentiferan siboglinids (Annelida)	P. 150	11:15 – 11:30	**Vladimir Zolotarev** Special morphology of some aquatic protists with emphasis on water quality	P. 316
11:30 – 11:45	**Timea Neusser**, Gerhard Haszprunar, Michael Schrödl, Katharina Jörger Comparative microanatomy and ultrastructure of enigmatic 'dorsal vessel systems' in panpulmonate gastropods	P. 148	11:30 – 11:45	**Tatiana Shcherbakova,** Alexei Ippolitov, Nikolay Neretin, Alexander Tzetlin The fine structure of a palaeozoic polychaete tube helps to identify its systematic position	P. 25
11:45 – 12:00	**Natalia Shunatova**, Yuta Tamberg Bryozoan coeloms: a swim through a spelean river	P. 153	11:45 – 12:00	**Jean–François Flot** Through the looking–glass: the morphological basis for genome evolution	P. 60
12:00 – 12:20	**Coffee break, hall in front of M1**				
12:20 – 13:00	**Prof. Dr. Gerhard Scholtz “Morphology, transformation, and the art of tracking”, BBA**				P. 6
13:00 – 13:30	SPONSORS				
13:30 – 13:50	AWARDS				
13:50	**The ISIM Council election and closing ceremony of the 4th Congress**				

POSTERS

Morphology of Recent invertebrates and paleontology: Modern synthesis (A1)

poster A1.01	Ekaterina Egorova	Axial complex of two echinoderm classes: anatomical studies with 3D–reconstructions
poster A1.02	Natalia Ershova, Olga Ezhova, Vladimir Malakhov	Microscopic anatomy and ultrastructure of the axial complex and associated structures in the sea cucumber *Chiridota laevis* Fabricius, 1780 (Echinodermata, Holothuroidea)
poster A1.03	Joachim Haug, Carolin Haug	Unexpected fossil findings in arthropods
poster A1.04	Andrey Ivantsov	The most probable remains of the Eumetazoa among late Proterozoic macrofossils
poster A1.05	Tatiana Leonova	Evolution of Palaeozoic ammonoid sutures
poster A1.06	Anna Madison, Tatyana Kuzmina	Possible structure of larva of the earliest strophomenids (Brachiopoda)
poster A1.07	Georgy Mirantsev	Morphological diversity of holdfasts in upper Paleozoic crinoids: New data from the carboniferous flexible crinoid *Synerocrinus*
poster A1.08	Tae–Yoon Park, Ji–Hoon Kihm, Sanghee Kim, Jianni Liu, Xingliang Zhang	Morphological comparison of tardigrades and Cambrian lobopodians
poster A1.09	Fedor Plandin, Elena Temereva	Coelomic system in brachiopods: Traditional opinions and novelties
poster A1.10	Yana Shurupova, Ekaterina Tesakova	Evolution of *Palaeocytheridea kalandadzei* (Ostracoda, Crustacea) carapace from Saratov during the terminal Bajocian – early Bathonian (Middle Jurassic)
poster A1.11	Chelaplackal Smitha , T. Raveendran, Philip Rosamma, R. Damodaran	First record of *Cossura aciculata* from Indian waters

Origin of Bilateria: achievements and contradictions (A2)

poster A2.01	Ilya Aronov, Elena Temereva	Absence of tripartite coelom in chaetognath *Parasagitta elegans*: phylogenenic

		implication
poster A2.02	Guzel Gazizova, Yaroslav Zabotin, Anatolii Golubev	Comparative morphology of parenchymal cells in Acoelomorpha and Plathelminthes
poster A2.03	Elena Temereva	Are the lophophorates monophyletic?
poster A2.04	Ekaterina Shafigullina, Yaroslav Zabotin	Main pathways of evolution of spermatozoa of Acoelomorpha and free–living Plathelminthes
poster A2.05	Oleg Zverkov, Kirill Mikhailov, Leonid Rusin, Vassily Lyubetsky, Vladimir Aleoshin	Phylogenomics suggests that Mesozoa are paraphyletic catastrophically reduced Bilateria

The genomic basis for morphological evolution (A3)

poster A3.01	Ilya Borisenko, Marcin Adamski, Sven Leininger, Alexander Ereskovsky, Maja Adamska	Wnt pathway is implicated in axial patterning and regeneration in the demosponge *Halisarca dujardini*
poster A3.02	Yana Mikhaleva, Ragnhild Skinnes, Sara Sumic, Eric M. Thompson, Daniel Chourrout	The role of homeobox genes in the development of oikoplastic epithelium, the evolutionary novelty of larvaceans.
poster A3.03	Andrea Orús–Alcalde, Andreas Hejnol	Comparative study of the expression of candidate genes for hematopoiesis in different animal lineages
poster A3.04	Uliana Vorobeva, Anna Pidzhakova	Mechanism of peptide regulation of morphogenesis of animals and plants

Functional evolution and morphology of the nervous system (B1)

poster B1.01	Nina Aneli, Ksenia Shunkina, Valeria Vays, Maria Plyushcheva	Ultrastructure and morphology of the elytrum of scale–worm *Lepidonotus squamatus* Linnaeus 1767 (Polychaeta, Polynoidae)
poster B1.02	Izabella Battonyai, Zsuzsanna Fekete, Réka Horváth, Károly Elekes	Neurotransmitters in the biofouling zebra mussel byssal system: an immunohistochemical study

poster B1.03	Caterina Biffis, Ekaterina Ponomarenko, Gerhard Scholtz, Carsten Wolff	The first sense of the nauplius
poster B1.04	Bastian Brenzinger, Timea Pamela Neusser, Michael Schrödl, Yasunori Kano	Characterization of a new heterobranch superfamily (Gastropoda)
poster B1.05	Vyacheslav Dyachuk	Neurochemical coding of central and peripheral nervous systems in larvae and adult Pacific oyster *Crassostrea gigas*
poster B1.06	Steffen Harzsch, Andy Sombke, Bill Hansson	Persistent neurogenesis in the adult crustacean brain: the neurogenic niche in *Coenobita clypeatus* and *Birgus latro* (Anomala, Coenobitidae)
poster B1.07	Réka Horváth, Izabella Battonyai, Károly Elekes	Senso–motor interactions in different peripheral organs of the pond snail, *Lymnaea stagnalis*. A chemical–neuroanatomical approach
poster B1.08	Nikolay Kamardin, Boris Sirenko	Ultrastructural study of the osphradia of representatives of the Polyplacophora
poster B1.09	Natalia Kreshchenko, Zakhar Sedelnikov, Angela Mousley, Aaron Maule	Morphological evidence of neuropeptide npf participation in planarians muscle function
poster B1.10	Suman Kumar, Harald Hausen	Evolution, development and function of eyes in a polychaete with a long pelagic larval phase
poster B1.11	Vitaly Kozin, Roman Kostyuchenko	Dynamics of the nervous and muscular system regeneration in the polychaete *Alitta virens*
poster B1.12	Tobias Lehmann, Roland Melzer	The visual system of *Neobisium carcinoides* (Hermann, 1804) (Chelicerata, Arachnida, Pseudoscorpiones)
poster B1.13	Christine Martin, Vladimir Gross, Lars Hering, Henry Jahn, Ivo de Sena Oliveira, Paul A. Stevenson, Georg Mayer	Evolution of the panarthropod nervous and visual system: Learning from onychophorans and tardigrades

poster B1.14	Mikhail Nikitin, Evgeny Ivashkin, Elena Voronezhskaya	Serotonin synthesis and secretion in basal metazoa *Trichoplax adhaerens*
poster B1.15	Irina Severina, I. Isavnina, A. Knyazev	Neuroanatomy of descending brain interneurons in dragonfly *Aechna grandis*
poster B1.16	Irina Severina, I.Isavnina, M.Zhemchuzhnikov, A. Knyazev	Location and structure of intersegmental thoracic interneuron in cockroach periplaneta americana
poster B1.17	Nataliya Shakurova, Aliya Gataullina	A comparative ultrastructural analysis of eyes in leeches (Hirudinea: Rhynchobdellida, Arhynchobdellida)
poster B1.18	George Slyusarev, Viktor Starunov	The Nervous System in Orthonectida

Modular organization in invertebrates: comparative morphological and functional analysis of superorganisms (B2)

poster B2.01	Elena Belikova, Natalia Shunatova	Shared colony–wide musculature – a journey through time
poster B2.02	Fyodor Bolshakov, Igor Kosevich	Different ways of hydranth formation in thecate and athecate hydroids
poster B2.03	Vitaly Dementyev, Vasily Kozhara, Nikolay Marfenin	Functional morphology of stolon in hydroid *Gonothyraea loveni* (Allman, 1859)
poster B2.04	Anny Carolina Forero Mejia, Carina Östman, Giorgio Bavestrello, Timothy Ravasi, Tina Molodtsova	Morphological support to the molecular phylogeny of ceriantharia (Cnidaria, Anthozoa)
poster B2.05	Daria Kupaeva, Yulia Kraus, Stanislav Kremnyov	Folding morphogenesis during anchoring disc formation of *Dynamena pumila* stolon.
poster B2.06	Andrey Lavrov, Igor Kosevich	Stolonial movement of demosponge *Amphilectus lobatus*

poster B2.07	Ekaterina Shevchenko, Daria Matvienko, Andrew Ostrovsky	Comparative ultrastructure of oogenesis in cheilostome Bryozoa with different reproductive patterns
poster B2.08	Celine Lopes da Silva Santos, Sérgio Nascimento Stampar	The genus ceriantheomorphe (Cnidaria; Ceriantharia) in the Western Atlantic: one or two species?
poster B2.09	Thomas Schwaha, Masato Hirose, Andreas Wanninger	Novel insight into the soft–body morphology of the phylactolaemate bryozoan *Stephanella hina*
poster B2.10	Dorian Schoenaers, Jérôme Delroisse, Dong Soo Hwang, Matt Harrington, Patrick Flammang	The smooth and the scaly: tunic morphology of two distant urochordates, *Ciona intestinalis* (ord. Phlebobranchia) and *Halocynthia roretzi* (ord. Stolidobranchia).
poster B2.11	Agniya Sokolova, Igor Pozdnyakov, Sergey Karpov, Alexander Ereskovsky	Transformation of the choanocyte kinetid in evolution of sponges (phylum Porifera) and the observed evolutionary tendencies

Form and function of invertebrates in extreme environments (B3)

poster B3.01	Sandra Franz–Guess, J. Matthias Starck	Microscopic anatomy of *Eukoenenia spelaea* (Chelicerata: Palpigradi)
poster B3.02	Elizaveta Naduvaeva, Elena Vortsepneva	General morphology and ultrastructure of the circulatory and gonopericardial system of *Crystallophrisson nitens* (Mollusca: Aplacophora)
poster B3.03	Alexandra Obukhova, Evgeny Ivashkin, Marina Khabarova, Elena Voronezhskaya	Variable dopamine, stable serotonin: the morphological basis for optimal expansion of sea urchin larvae
poster B3.04	Mina Ramezani	*Artemia urmiana* hatching efficiency, growth and survival after cyclic hydration and dehydration
poster B3.05	Olga Vorobyeva	The morphology of cnidosacs in nudibranch mollusc *Aeolidia papillosa* (Gastropoda: Heterobranchia)

Invertebrate circulatory and excretory systems: comparative morphological and functional aspects (B4)

poster B4.01	Henry Jahn, Jörg Hammel, Georg Mayer	Reconstruction of the blood circulatory system in the velvet worm *Euperipatoides rowelli* (Onychophora, Peripatopsidae)
poster B4.02	Tatyana Kuzmina, Elena Temereva, Vladimir Malakhov	Ultrastructure of the lophophoral coelomic lining in brachiopods *Hemithiris psittacea*
poster B4.03	Elizaveta Savochkina, Alexander Polevschikov	Analysis of the tunic recovery dynamics in ascidia *Halocynthia aurantium* (Pallas, 1787)

Minute metazoans: Little pigeons can carry great messages (C1)

poster C1.01	Polina Avdeeva, Yaroslav Zabotin, Vladimir Evtugin	Light and electron microscopic investigation of morphology of the tardigrade *Macrobiotus hufelandi* (Etardigrada)
poster C1.02	Maria Fedyaeva, Alexei Tchesunov	Alimentary tract structure of two marine nematode species of the order Monhysterida
poster C1.03	Piotr Świątek, Pierre de Wit, Natalia Jarosz, Łukasz Chajec, Anna Z. Urbisz	Ovary structure and oogenesis in *Grania postclitellochaeta* (Clitellata: Enchytraeidae)
poster C1.04	Magdalena Rost–Roszkowska, Marta Jezierska, Kamil Janelt, Anna Ostróżka, Izabela Poprawa	Regenerative cells in Tardigrada digestive epithelia
poster C1.05	Hyunsu Yoo, Ivana Karanovic, Wonchoel Lee	A new species of *Xestoleberis* (Ostracoda: Podocopida: Xestoleberididae) from the east coast in south Korea.

Structure of Parasitic Invertebrates: Plasticity, Adaptation, Evolution (C2)

poster C2.01	Irina Babkina, Georgii Kremnev, Arina Maltseva, Natalia Mikhailova, Andrei Granovitch	How *Microphallus metacercariae* (Trematoda: Microphallidae) from *Littorina* snails react to abrupt temperature rise related to host change.
poster C2.02	Anna Gonchar, Darya Krupenko	Morphological insights linked to behaviour of digenean larvae — cercariae
poster C2.03	Ilya Gordeev	Microscopic anatomy of the *Nybelinia surmenicola* Okada in Dollfus, 1929 (Trypanorhyncha: Lacistorhynchidae) plerocercoid scolex

poster C2.04	Alfia Mustafina	The ultrastructure of the tegument, glands and sensory organs of *Pyramicocephalus phocarum* (Cestoda: Diphyllobothriidea)
poster C2.05	Elena Kornakova	The ultrastructure of the flame bulbs in parasitic turbellarian *Notentera ivanovi* (Pplatyhelminthes, Turbellaria, Fecampiidae) –novel filtration–secretory apparatus
poster C2.06	Janetta Korneva, Irina Yastrebova	Muscle system and frontal glands in proteocephalidean cestodes
poster C2.07	Georgii Kremnev, Sergei Shchenkov, Andrei Dobrovolskij	Morphology and functional dynamics of trematode ovaries: from genital system primordium in cercariae to adults germarium
poster C2.08	Svetlana Kuznetsova	Ultrastructure of the body wall of the cryobiotic leech *Ozobranchus jantseanus* (Annelida; Hirudinea; Rhynchobdellida)
poster C2.09	Alfiia Mustafina	The ultrastructure of the excretory system of *Pyramicocephalus phocarum* (Cestoda: Diphyllobothriidea)
poster C2.10	Maxim Nesterenko, Sergei Shchenkov, Viktor Starunov, Valeriia Khabibulina	Does the blind trematod's larvae see the light?
poster C2.11	Irina Podvyaznaya	On the structure and development of the body cavity in parthenogenetic generations of trematodes
poster C2.12	Natalia Pospekhova	Location of the primary lacuna in the postembryonic development of selected Cyclophyllidea (Cestoda)
poster C2.13	Sergei Shchenkov, Georgii Kremnev, Anastasiya Smirnova, Alexandra Diumina, Andrei Dobrovolskij	Evolution of *Xiphidiocercariae* Luhe, 1909 (Trematoda: Plagiorchida): from where to where?

Morphological diversity and evolution in freshwater and marine environment (C3)

poster C3.01	Elmira Alieva, Elena Temereva, Irina Ekimova, Anastassya Maiorova	First record of two *Urechis* species in the Vostok Bay Sea of Japan
poster C3.02	Ilya Aronov, Elena Temereva	Organization of the head musculature in chaetognath *Parasagitta elegans*

poster C3.03	**Polina Belova**, Anna Zhadan, Dimitry Schepetov	Comparative anatomy and phylogeny of Opheliidae and Travisia (Annelida, Sedentaria)
poster C3.04	Ekaterina Bocharova	Species diversity and phylogeny of sea anemones in *Urticina* and *Cribrinopsis* genera
poster C3.05	Anastasia Borisanova, Vladimir Malakhov	Some ultrastructure details of entoproct reproductive system
poster C3.06	Polina Borisova, Nataliya Budaeva	Jaw structure in Lumbrineridae (Annelida) assessed by micro–computed tomography
poster C3.07	Friederike Brand, Gerhard Haszprunar, Francesca Leasi, Katharina Jörger, Timea Neusser	Integrative taxonomy of the first pseudvermis sea slug from the eastern pacific
poster C3.08	Elena Chaban, Alexey Chernyshev	The first experience in the morphological study of male copulatory system of cephalaspids (Gastropoda: Opisthobranchia) by means of CLSM
poster C3.09	Irine Cherneva	Recognizing the unrecognizable: nemertean species of the genus *Lineus* from the White Sea intertidal zone
poster C3.10	Irina Drobysheva	Ultrastructural features of ciliogenesis in the epidermis of *Notoplana humilis* (Polycladida, Plathelminthes)
poster C3.11	Christina Egger, Peter Kohnert, Michael Schrödl	Microanatomy and 3D–reconstruction of cliopsis *Krohnii troschel*, 1854 (Gymnosomata, Pteropoda, Euopisthobranchia)
poster C3.12	Irina Ekimova, Dimitry Schepetov, Anton Chichvarkhin, Ángel Valdés	What do you fancy for your dinner? The morphology of radula and food preferences as the key for unraveling *Dendronotus* (Gastropoda: Nudibranchia) evolutionary history
poster C3.13	Peter Funch, Nicklas Bisbo, Per Andersen	Functional morphology of feeding structures in choanoflagellates and sponges

poster C3.14	Aliya Gataullina	Functional evolution and morphology of the radula of Mollusks with various trophic specialization (Mollusca: Orthogastropoda, Littorinimorpha)
poster C3.15	Alina Ilyasova, Alexey Golikov, Rushan Sabirov	Comparative morphology of catching apparatus, jaws and radula of *R. palpebrosa* Owen, 1834 and *R. megaptera* Verrill, 1881 (Cephalopoda, Sepiolida) in the Barents Sea
poster C3.16	Heidi Jäger, Franziska Bergmeier, Gerhard Haszprunar, Katharina Jörger	The first *Pruvotina* (Mollusca: Solenogastres) from the pacific – a lost loner in the depths of the Sea of Okhotsk?
poster C3.17	Ji–Hoon Kihm, Sanghee Kim, Tae–Yoon S. Park	The preliminary study on the taxonomy of *Dactylobiotus* sp. (Parachela, Eutardigrada) from King George Island, Antarctica
poster C3.18	Jeongho Kim, Ivana Karanovic, Wonchoel Lee	A new species of the genus *Coxicerberus* Wägele, Voelz & McArthur, 1995 (Isopoda: Microcerberidae) from Australia
poster C3.19	Elena Kochanova, Elena Fefilova	Morphological variability and teratology morphology of Palearctic freshwater Harpacticoida (Crustacea: Copepoda)
poster C3.20	Alexey Kotov, Anna Neretina, Nikolai Smirnov	Morphological adaptationd of the Cladocera (Crustacea: Branchiopoda) resting stages to zoochory: analogues with plant seeds
poster C3.21	Petr Kuznetsov, Elena Temereva	Morphology and microscopic anatomy of *Ochetostoma* sp.(Echiura: Thalassematidae)
poster C3.22	Somin Lee, Wonchoel Lee	New records of Recent Benthic Foraminifera from Korean Waters
poster C3.23	Juan Moles, Conxita Avila, Manuel Malaquias	Antarctic newnesidae (Gastropoda: Cephalaspidea): a study of the known species and a new bathyal species
poster C3.24	Piyada Ngernsoungnern, Apichart Ngernsoungnern	Structural study of the gastrointestinal tract of the golden apple snail

poster C3.25	Apichart Ngernsoungnern, Piyada Ngernsoungnern	Structural study of oocyte stages in the golden apple snail
poster C3.26	Ekaterina Nefedova, Alena Sukhoputova	The importance of conditions for the study of marine invertebrates in culture
poster C3.27	Ivan Nekhaev	Investigation of taxonomically significant morphological characters of the eurasian arctic Rissoidae (Gastropoda: Caenogastropoda)
poster C3.28	Boris Neklyudov, Elena Temereva, Anna Zhadan	First record on phoronid species from Persian Gulf
poster C3.29	Anna Neretina, Alexey Kotov, Wondie Zelalem	*Moina belli* Gurney, 1904 (Crustacea: Cladocera), a forgotten rare species from Africa
poster C3.30	Laura Núñez–Pons, Conxita Avila, Thierry Work, Robert Rameye, Juan Moles, Carlos Angulo–Preckler	An emerging disease in the Antarctic sea star *Odontaster validus*
poster C3.31	Nayeon Park, Wonchoel Lee	Distribution and diversity of jellyfish in Korean coastal waters
poster C3.32	Andrey Povetkin, Elena Temereva	New data on ultrasructure of the gonad in holothuria *Chiridota laevis*
poster C3.33	Andrey Povetkin	Peculiarities of the oogenesis in holothuria *Chiridota laevis*
poster C3.34	Zandra M. S. Sigvardt, Katrine Worsaae, Sukonthip Savatenalinton, Alexandra Kerbl, and Jørgen Olesen	Limb musculature of *Cyclestheria hislopi* (Crustacea: Branchiopoda) based on phalloidin staining and confocal microscopy
poster C3.35	Maria Stanovova, Igor Kosevich	Coelomocytes of *Arenicola marina* (Annelida, Polychaeta): morphology and functions
poster C3.36	Sergio Taboada, Juan Junoy, Carlos Leiva, Frances Alexander, Ana Riesgo	Never two without three: a new member of the genus *Antarctonemertes* (Hoplonemertea, Nemertea) from Antarctic waters

poster C3.37	Elena Temereva	First modern data on neuro–muscular system of the lophophore in adult phoronids
poster C3.38	Elena Temereva, Boris Neklyudov	New phoronid species from the South–China Sea and the problem of phoronid taxonomy
poster C3.39	Anna Zofia Urbisz, Łukasz Chajec, Mana Ito, Katsutoshi Ito	Ovary organization in the marine tubificin *Thalassodrilides* sp.
poster C3.40	Maxim Vinarski, Sergei Kramarenko, Arsenia Zharova	Spatial morphological variation in the dwarf pond snail (*Galba truncatula*): scale–dependence and non–linearity
poster C3.41	Stepan Vodopyanov, Robin Wilson, Lynda Avery	The epidermis modifications of different *Travisia species* (Annelida, Travisiidae)
poster C3.42	Philipp Wagner, Joachim T. Haug, Carolin Haug	Morpho–ecospace concept: a comparison between larvae and adults in mantis shrimps
poster C3.43	Thamasak Yeemin, Makamas Sutthacheep, Watchara Samsuvan, Sittiporn Pengsakun	Reexamining morphological characteristics of the scleracinian coral *Pocillopora damicornis* in the gulf of Thailand
poster C3.44	Jisu Yeom, Mikhail A. Nikitin, Viatcheslav N. Ivanenko, Wonchoel Lee	A new laophontid (Copepoda, Harpacticoida) from the sea cucumber, *Eupentacta fraudatrix* collected from Vostok Bay, East Sea (Sea of Japan)
poster C3.45	Jisu Yeom, Wonchoel Lee	A New Miraciid (Copepoda, Harpacticoida) from Baekripo Beach in the West Coast of Korea
poster C3.46	Olga Yurchenko, Alexander Kalachev, Kristina Kolesnikova	Seasonal characters of specific storage cells in the gonadal tissue of the pacific oyster, *Crassostrea gigas*
poster C3.47	Ravil Zeleev	Parametric systematics of sea spiders (Arthropoda: Pycnogonida)

Embryonic and larval development of invertebrates: comparative morphology meets new technologies (C4)

poster C4.01	Sujeephon Athibai, Nattaporn Plangklang, Chaichat Boonyanusit	Ontogenetic development of Thai anostracan nauplius, *Brachinella thailandensis* Sanoamuang, Saengphan and Murugan, 2002 (Crustacea: Branchiopoda: Anostraca)

poster C4.02	Tatiana Bagaeva, Sylvain Couvray, Jean–Luc Bonnefont, Nikoloz Tsikolia, Stanislav Kremnyov	Dynamics of archenteron ciliation during gastrulation of Echinoderms
poster C4.03	Carola Becker, Mathieu G. Lundy, Lawrence Eagling, Jaimie T.A. Dick, Julia Sigwart	Sperm storage and ovarian maturation in the Norway lobster (*Nephrops norvegicus*)
poster C4.04	Nataliya Budaeva, Elena Vortsepneva	Spermatogenesis and sperm ultrastructure in *Mooreonuphis stigmatis* (Onuphidae, Annelida)
poster C4.05	Yuliya Burmistrova, Igor Kosevich	Characteristics of early development of *Ectopleura larynx* (Hydrozoa, Cnidaria).
poster C4.06	Alexander Ereskovsky, Ilya Borisenko, Andey Lavrov, Fedor Bolshakov, Daria Tokina, Maja Adamska	Body plan formation during regeneration in sponges
poster C4.07	Lyudmila Flyachinskaya, Petr Lezin	Embryonic and larval development of the soft–shell clam *Mya arenaria* in the White Sea
poster C4.08	Lyubov Gliznutsa, Alexander Kalachev	Serotonergic apical organ formation in pluteal larvae of echinoids and ophiuroids (Echinodermata).
poster C4.09	Yulia Khramova, Denis Nikishin, Polina Belova, Stanislav Kremnev, Tatyana Bagaeva, Nadezhda Rimskaya–Korsakova	Developmental stages of the white sea burrowing annelid *Ophelia limacina*
poster C4.10	Katja Kienbaum, Gerhard Scholtz, Carola Becker	The male copulatory and female reproductive system of *Percnon gibbesi* (Brachyura: Thoracotremata: Grapsoidea).
poster C4.11	Bo–Mi Kim, Hyun Park, Jae–Sung Rhee	Ecdysone content in developmental stages and effects of environmental fluctuations on the production of ecdysone and related pathway in the mysid crustacean
poster C4.12	Igor Kosevich	Embryonic development and larva nervous system organisation in *Sarsia lovenii* (M. Sars, 1846) (Cnidaria, Hydrozoa)

poster C4.13	Roman Kostyuchenko, Ekaterina Kupriashova	Molecular and cellular events in naidid asexual reproduction
poster C4.14	Ioannis Kourtesis, Harald Hausen	Electron microscopy applications towards the understanding of cell type evolution
poster C4.15	Vasiliki Koutsouveli, Paco Cárdenas, María Conejero, Lindsay Beazley, Ana Riesgo	First insights into the reproduction of deep–sea sponges of the North Atlantic
poster C4.16	Vasiliki Koutsouveli, Sergio Taboada, Juan Moles, Javier Cristobo, Conxita Avila, Andrea Bertran, Joan Solà, Pilar Ríos, Ana Riesgo	Reproductive features of Antarctic demosponges from the orders Dendroceratida, Poecilosclerida and Haplosclerida (Porifera)
poster C4.17	Stanislav Kremnyov, Yulia Kraus	Embryonic development of a marine hydroid using very unusual morphogenetic toolkit
poster C4.18	Natalia Kreshchenko, Nadezhda Terenina	Regeneration of anterior end musculature in planarian monitored by phalloidine fluorescence and laser scanning microscopy
poster C4.19	Alexandre Lobo–da–Cunha, Ângela Alves, Elsa Oliveira, Manuel António Malaquias	Histological investigation of the male copulatory apparatus of *Haminoea navicula* (Gastropoda, Cephalaspidea)
poster C4.20	Anastassya Maiorova	The developmental modes in tentacular apparatus of sipunculans with special reference to the *Phascolosoma* genus
poster C4.21	Tatiana Mayorova, Boris Osadchenko, Yulia Kraus	How does staurozoan embryo with a low number of cells overcome the developmental constraints?
poster C4.22	Polona Mrak, Nada Žnidaršič, Urban Bogataj, Jasna Štrus	Cuticle morphogenesis during intramarsupial development in *Porcellio scaber* (Crustacea: Isopoda) as revealed by microscopy
poster C4.23	Ekaterina Nefedova, Elisaveta Gonobobleva, Ivan Tikhomirov	Ontogenesis of calcareus sponge *Sycon* sp. (Porifera, Calcarea) from aquaculture
poster C4.24	Boris Osadchenko, Yulia Kraus, Igor Kosevich	Development of *Aglantha digitale*, jellyfish without a polyp
poster C4.25	Alena Sukhoputova, Yulia Kraus	Three forms of strobilation in scyphozoan polyps: key stages and morphogenesis

poster C4.26	Andrey Vishnyakov, Tima Altié, Sandrine Chenesseau, Peter Yershov, Alexander Ereskovsky	Ultrastructure of oogenesis in *Paramuricea clavata* (Anthozoa, Octocorallia)
poster C4.27	Olga Yurchenko, Vasily Radashevsky	Fine organization of oocytes in spionid polychaetes (Annelida: Spionidae) with short–headed spermatozoa

Symbiosis between animals: diversity, patterns and inference on processes (C5)

poster C5.01	Polina Dgebuadze, Elena Mekhova	Some features of gastropods morphology and behavior due to their symbiotic lifestyle
poster C5.02	Elena Mekhova, Temir Britayev	Body shape, coloration and location of some myzostomids (Annelida: Myzostomida) from central Vietnam
poster C5.03	Sofya Mudrova, Mikhail Nikitin, Michael Berumen, Viatcheslav Ivanenko	Combined analysis of morphological and molecular diversity of copepods (Crustacea) living in symbiosis with stony corals of the genus *Galaxea* in the Indo–Pacific

Morphological diversity and evolution in terrestrial invertebrates (C6)

poster C6.01	Julia Anne–Sophie Bauder, Harald Wolfgang Krenn	Morphological fine tuning of the feeding apparatus of the Hesperiidae (Lepidoptera)
poster C6.02	Makhosi Buthelezi	Phylogenetic and morphological relationships of the groundnut leaf miner, *Aproaerema modicella* (Deventer) and *Aproaerema simplexella* (Walker) (Lepidoptera: Gelechiidae) occurring in South Africa, Mozambique, India and Australia
poster C6.03	Elena Gorb, Stanislav Gorb	Sexual dimorphism in the attachment ability of *Coccinella septempunctata* beetles to smooth substrates
poster C6.04	Carolin Haug, Alejandro Izquierdo López, Marie Hörnig, Jakob Krieger, Joachim Haug	Convergent evolution of raptorial appendages in arthropods
poster C6.05	Christine Kiesmüller, Carolin Haug	Tagmatisation in camel spiders: how functional constraints shape a complex body organization

poster C6.06	Lisa Mehnert, Yentl Dietze, Carolin Haug, J. Matthias Starck	Microscopic anatomy of pseudoscorpions reveals new insights in segmental body organisation
poster C6.07	Lisa Mehnert, Carolin Haug, J. Matthias Starck	Morphology of the rostrosoma and preoral cavity of pseudoscorpions
poster C6.08	Irena Grześ, Mateusz Okrutniak, Monika Gorzałczany	Morphological diversity of monomorphic ant *Lasius niger* along metal–pollution gradient

Advanced Microscopy and Morphology (D1)

poster D1.01	Valery Novochadov, Uliana Vorobeva, Stanislav Klimenko, Andrey Klimenko, Alexey Terpilovsky, Kharlampy Tiras	High–precision 3D imaging system for biological objects in virtual environment
poster D1.02	Brian Saltin, Carolin Haug, Joachim Haug	Lifting the transparent veil – opportunities for morphological observation using autofluorescence microscopy.
poster D1.03	Julia Sigwart, Lauren Sumner–Rooney, James Dickey, Nicholas Carey	The scaphopod foot is ventral: more evidence from the anatomy of *Rhabdus rectius* (Carpenter, 1864) (Dentaliida: Rhabdidae)
poster D1.04	Vladimir Mordukhovich, Julia Zograf, Nataliya Fadeeva	Potential of confocal laser scanning microscopy (CLSM) as a tool for morphological study of free-living marine nematodes including museum collection material

SYMPOSIA STRUCTURE

AA Evolutionary theories:

A1 Morphology of recent invertebrates and paleontology: modern synthesis

A2 Origin of Bilateria: achievements and contradictions

A3 The genomic basis for morphological evolution

BB Recent advances in functional morphology

B1 Functional evolution and morphology of the nervous system

B2 Modular organisation in invertebrates: comparative morphological and functional analysis of superorganisms

B3 Form and function of invertebrates in extreme environments

B4 Invertebrate circulatory and excretory systems: comparative morphological and functional aspects

CC Special invertebrate morphology

C1 Minute metazoans: Little pigeons can carry great messages

C2 Structure of Parasitic Invertebrates: Plasticity, Adaptation, Evolution

C3 Morphological diversity and evolution in freshwater and marine environment

C4 Embryonic and larval development of invertebrates: comparative morphology meets new technologies

C5 Symbiosis between animals: diversity, patterns and inference on processes

DD Special invertebrate morphology

D Advanced Microscopy and Morphology

BIOMIMETIC ADHESIVE MICROSTRUCTURES AS AN APPROACH TO UNDERSTAND FUNCTIONING OF BIOLOGICAL SYSTEMS

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The biological hairy attachment systems have the robust adhesion and high reliability of contact. The previous comparative experimental studies on biological systems showed the way to development of novel glue-free adhesives. Comparative studies on microstructures with different contact geometries showed that beetle-inspired mushroom-shaped adhesive microstructure (MSAMS) even outperform the gecko-inspired spatula-shaped geometry under certain conditions. The adhesion of MSAMS is reversible and even stronger under the water. MSAMS demonstrated stick-slip free friction and lower impact of contamination by particles. MSAMS can keep its adhesive capability over thousands of attachment cycles. On rough substrates, their performance can be enhanced by the introduction of the fluid into the contact zone. Additionally, the development of MSAMS provides an opportunity for biologists to run experiments, which would be otherwise only hardly possible with real biological system. The present lecture discusses how the knowledge obtained from studies on artificial mimics can be applied to understand functionality of biological adhesive systems of insects.

MORPHOGENESIS OF BRAIN WIRING IN *DROSOPHILA*

Peter Robin Hiesinger
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How can a few thousand genes encode the information to wire up a fly's brain? Complicated morphogenetic processes facilitate the formation of specific synaptic connections between neurons and bring presumptive synaptic partners together. Our lab probes the question: up to what level of synaptic complexity can brain wiring be determined through developmental patterning? We employ an intravital imaging approach that allows to observe the development of the brain in intact, normally developing flies at the spatiotemporal resolution of neuronal contacts. The lecture will feature insight into the morphogenesis of brain anatomy in 4D and the dynamic roles of growth cones and synaptogenesis. These analyses reveal both the beauty and simplicity of how seemingly complex morphology comes to be.

TENTACLES, CILIARY BANDS, AND LIMBS IN METAZOAN EVOLUTION

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The common ancestor of cnidarians and bilaterians is assumed to be bilaterally symmetrical animal with two rings of tentacles (labial and marginal) around the elongated blastopore. The ciliary apparatus of bilaterian larvae forming a closed contour around the elongated blastopore recapitulates the labial ring of ciliary tentacles of common cnidarian/bilaterian ancestor. In adults, the larval adoral ciliary field may give rise to ciliary tentacles, while the neurotroch evolves into the ventral ciliary sole. The metameric parapodia of lophotrochozoan are treated as homologies of the marginal ring tentacles. In chordates (resulted from their upside-down inversion) the dorsal neural folds are the homologies of the labial ring tentacles while the ciliary ependyma of the nerve tube corresponds to the ventral neurotroch. Metameric radials of vertebrate paired fins are treated as homologies of the marginal ring tentacles. As the radials of paired fins evolved into tetrapod digits, so it is possible to trace a long-distance homology between cnidarian tentacles and human fingers. In Cambrian arthropods (Radiodonta, Megaheira, etc.) each segment bore a pair of primary biramous limbs. It was composed of flap-like lateral exopod (possible homologous to the labial ring tentacle) and ventral annulated endopod (possible homologous to the marginal ring tentacle). The lateral flaps evolved into the trilobite gills, chelicerate book-gills and book-lungs, crustacean epipodite gills, and insect wings. The endopods gave rise the arthropodia including the secondarily biramous appendages of crustaceans. The limbless condition of cycloneuralians is interpreted as secondarily loss resulted from the burrowing mode of life.

ORIGINS AND PARALLEL EVOLUTION OF NEURAL SYSTEMS ACROSS METAZOA: FROM CTENOPHORA TO CEPHALOPODA

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Using tools of single-cell genomics, proteomics, metabolomics, microscopy, development and phylogenomics, thousands of individual neurons and hundreds of neural systems have been characterized to decipher early origins and evolution of neural and sensory signaling in basal metazoans, including all major clades of Bilateria. First, the obtained data resulted to (i) unbiased neural classification, and (ii) reconstruction of the genealogy of neurons (and synapses) both at the level of well-defined circuits and at the scale of the entire brains, but with single-cell resolution. Second, a novel, natural classification of neurons (NeuroSystematics) is emerging, with multiple examples of convergent evolution for many neuronal features. Third, real-time genome-scale sequencing aboard of oceanic ships (Ship-Seq) provides access to many fragile and rare species. It opens unique opportunities to marry experimental/cell biology and biodiversity at the planetary scale for both fundamental biomedical and environmental research.

250 YEARS OF ZOOLOGY IN RUSSIA: AN INVERTEBRATE RETROSPECT

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Progressive changes of the expanding Russian Empire in the early 18th century resulted in the establishment of the Russian Academy of Sciences (1724). In the beginning all its members were foreigners (‘invited scientists’ as we would say nowadays). Those of them who studied natural history (Messerschmidt, Gmelin, Steller, Pallas and many others) actively explored the Russian wilderness, writing ‘memoirs’ and making the first collections including fossil and recent invertebrates. These pioneers paved the way for the first generations of Russian natural scientists. Morphological studies of that time were descriptive. It was only in the second half of the 19th century that the evolutionary ideas stimulated the emergence of comparative invertebrate morphology. Kowalewski and Metchnikoff followed by many others (Salensky, Korotnev, Ostroumoff, Ulianin, Shimkevich, Davydoff and Merezhkovsky to name a few) created one of the strongest schools of invertebrate morphology and embryology in Europe.

Russian biology sustained heavy losses after the WWI and the subsequent political upheavals. Many bright researchers died or left the country. Scientists remaining in Russian Federation were in many respects isolated from the international community. On the other hand, the USSR, with its vast territory surrounded by 12 seas, offered almost unlimited opportunities for zoological research. Invertebrate zoology, which was also required for applied purposes in industry, agriculture and medicine, continued to develop in the Soviet universities and the Academy of Sciences. It is associated with the names of such prominent scientists as Dogiel, Zakhvatkin, Beklemishev and later Fedotov, Livanov, Naumov, Ivanov and many others. Beklemishev’s “Principles of Comparative Anatomy of Invertebrates (Promorphology and Organology Volumes)” published in English in 1969 became one of the most influential books on evolutionary zoomorphology of invertebrates of the 20th century.

The collapse of the Soviet Union and the ensuing lack of financing of the universities and the Academy for almost 20 years considerably undermined Russian science in general and zoology in particular. Fortunately, the tide has turned. At present, invertebrate zoology in Russian Federation is a multidisciplinary science incorporated into the international community. With many young people recently coming to this field, we may hope for new discoveries and ideas.

Keynote

MORPHOLOGY, TRANSFORMATION, AND THE ART OF TRACKING

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Morphology has been often considered as a mere descriptive and theory-free approach that is inert with respect to evolutionary methodology and theory. However, the study of morphology is a crucial part of evolutionary biology, because forms and structures are the interface between organisms and their environment and thus essential for evolution and its understanding. Accordingly, modern morphology in the best sense is the narrative of the history of organismic structures, i.e. the reconstruction of the evolutionary transformation of structures and the changes of their functions and biological roles. Nevertheless, the methodology of morphology needs a more elaborated epistemic foundation in order to survive in period of a molecular and experimentally based understanding of science.

Morphology is the oldest biological discipline. This is exemplified by Stone Age cave paintings, which demonstrate a detailed knowledge of animal shapes and anatomy. Furthermore, Stone Age hunters developed the cognitive foundation of morphological methodology by the activity of "tracking". Tracking involves empirical aspects such as pattern recognition and comparison (identification of a track) as well as inductive and deductive approaches (conjecture of a process based on the patterns of the tracks). Thus, tracking has been considered as a methodology characteristic for historical, non-experimental scientific approaches by the art historian Carlo Ginzburg 1983 or as the first form of science by the ethnologist Louis Liebenberg in 1990.

Based on several examples I show in my talk that the morphological method applies the "Art of Tracking" (Liebenberg) to arrive at the narrative of evolutionary transformation. This justifies morphology as an evolutionary discipline.

A1 MORPHOLOGY OF RECENT INVERTEBRATES AND PALEONTOLOGY: MODERN SYNTHESIS

Organizers: Dr. Sergey V. Rozhnov, Dr. Andrey Yu. Zhuravlev

ID: 484

CONCH ORNAMENTATION IN NONAMMONOID CEPHALOPODS: FORM AND FUNCTION

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The initial appearance and the functional significance of external conch ornamentation in main orders nonammonoid cephalopods (Plectronocerida, Ellesmerocerida,Orthocerida, Pseudorthocerida, Actinocerida, Endocerida, Oncocerida, Discosorida, Tarphycerida, Lituitida, Barrandeocerida, Nautilida) is discussed. The strong and elaborate shell surface ornamentation (sculpture): annulations, costae or ridges, nodes, spines, and apertural flanges. which may be reflected on the inner surface of the shell and on the mold, considered in this paper. Growth lines, lirae and ribs — spiral and/or transverse positive structures, which are not reflected on the inner side of the shell, or on the mold don't considered here.

The simplest view on the functional significance of ornamentation in ammonoids: is "that ornamentation is the most economical way to increase the strength of an otherwise thin and fragile conch, i.e., using the least material and adding the least weight" (Ruzhencev, 1962, p. 261). However, this interpretation is insufficient to explain the why and how appeared the ornamentation, and its diversity.

The materials for the discussion are descriptions and pictures in global cephalopod genera handbooks (Ruzhencev, 1962a, b; Moore, 1964) and my experience in studies of these matters.

The first type of ornamentation to appear was the annulated shell of some Early Ordovician Plectronocerida and Ellesmerocerida. The Later Cambrian ellesmerocerids and plectronoicerid were smooth. The primary function of appearance annulation was increase in buoyancy of the phragmocone. A cylindrical shape (phragmocone chamber in smooth shells) has a smaller volume than a barrel shape of the same height.

ID: 479

A1 Poster

FIRST RECORD OF *COSSURA ACICULATA* FROM INDIAN WATERS

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Reporting *Cossura aciculata* (Wu & Chen, 1977) from 100m depth of Arabian Sea, west coast (11. 56. 000 N 74. 37. 000 E) and 32m depth of Bay of Bengal, east coast of India (14.00.080 N 80.20.140 E) during the cruise number 230 onboard, FORV Sagar sampada, January, 2005. The study area extends from the latitude 11o 59"N to 07o 10"N and longitude 75o 05"E to 77o 19"E (7 transects) along the southwest coast of India and latitude 10o 59"N to 14o N and longitude 79o 58"E to 80o 24"E (4 transects) in the SE coast. In each transects, sediment samples were collected from 30, 50, 100 and 200m depth ranges in order to study the depth wise variation of fauna.

In Indian waters *Cossura coasta* is the only one species reported previously under the family cossuridae. All the reports of *Cossura aciculata* are from coastal areas and most of them are reported from a maximum depth of 6m. But in this study *Cossura aciculata* (Wu & Chen, 1977) is reporting from 100m depth of Arabian Sea, and 32m depth of Bay of Bengal. These are comparatively smaller worms of the group polychaete. Almost 28 species were reported from the genus *Cossura* globally. It is the first record of the species *Cossura aciculata* along coastal waters of India. Seven specimens of *C. aciculata* were recorded from Indian waters during the study.

ID: 467

A1 Poster

AXIAL COMPLEX OF TWO ECHINODERM CLASSES: ANATOMICAL STUDY WITH 3D-RECONSTRUCTIONS

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It is known that echinoderms have very peculiar body plan, the fact is that their radial and bilateral structures are mixing. The most characteristic feature of it is axial complex, which have captured our attention for several years. Now we have restudied and compared axial complexes of *Asterias rubens* Linnaeus, 1758 (Asteroidea) and *Strongylocentrotus pallidus* Sars, 1872 (Echinoidea) with the 3D software to illustrate their shape, proportion and interrelation.

Three specimens of *A. rubens* were collected near the Pertsov White Sea Biological Station in 2008, two specimens of *S. pallidus* – near the Seasonal Biological Station Dalnie Zelentsy in 2014. The material was cut into serial sections by the standard histological technique. Two series of sections were used for 3D modelling.

The axial complexes of *A. rubens* and *S. pallidus* consist of the coelomic organs (water-vascular system, axial coelom, pericardial coelom, perihaemal canals and gonad), and haemocoelic organs (axial organ, oral haemal ring, and haemal lacunae of gut and gonad). The water-vascular system communicates with the axial coelom. The pericardial coelom and the gonad coelom are closed. The haemocoelic organs are connected with each other and with entirely haemal system. All these structures have arranged in a very similar way with some minor differences. Unlike *A. rubens*, *S. pallidus* has well-developed perioral coelom and only one perihaemal ring. Organization of echinoderm axial complex is supposed to have considerable phylogenetic significance and needs further analysis.

This work was supported by the grant №16-34-00460-mol_a from the Russian Foundation for Basic Research.

ID: 411

A1 Poster

MICROSCOPIC ANATOMY AND ULTRASTRUCTURE OF THE AXIAL COMPLEX AND ASSOCIATED STRUCTURES IN THE SEA CUCUMBER *CHIRIDOTA LAEVIS* FABRICIUS 1780 (ECHINODERMATA, HOLOTHUROIDEA)

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The absence of axial and pericardial coeloms and the axial organ, presence of a mesocoelomic tentacular apparatus, correspondence of the larval sagittal plane with the madreporic plane of the adult, and some other peculiarities set holothurians apart from all other echinoderms. We studied the holothuroid *Chiridota laevis* with histological methods, transmission electron microscopy and constructed a 3D-model. The bilateral symmetry of the water-vascular system is clear in spite of a peculiar coelomic connection with one of the tentacles in radius D. The somatocoelomic and axocoelomic perihaemal coeloms are absent. There are perioral and water-vascular circumoral coelomic rings. The hyponeural ring is absent. Each radial complex includes a water-vascular canal, a hyponeural canal, two nerve bands (ectoneural and hyponeural), and the non-coelomic epineural canal. The stone canal starts from the water ring on the aboral side in the CD interradius and ends with a madreporic ampulla, from which a few pores open into the perivisceral coelom, and one pore canal opens into the environment. This organization seems to be the intermediate state between most echinoderms, in which the madreporic pores open into the environment, and the typical organization of holothurians, in which the madreporic pores open into the perivisceral coelom. The histological structure of the oral haemal ring resembles the axial organ of other Eleutherozoa. The haemocoel lacunae of the stone canal communicates with the haemal system of the gonad, the oral haemal ring and the gut haemocoel lacunae. There is no genital coelom.

ID: 327

METAMERISM IN ECHINODERMATA

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Metamerism is present in all the main bilaterian groups viz. Lophotrochozoa, Ecdysozoa, and Deuterostomia. Among the latter, metamerism is apparent in chordates and hemichordates. In echinoderms metamerism can be seen in the arrangement of the left somatocoel, which gives rise to several rings along the oral-aboral axis: in echinoids – 5, in holothuroids and ophiuroids – 4, in asteroids – 4 or 3, in crinoids – 2. This allows to hypothesize that the common ambulacralian ancestor had paired preoral coeloms (homologues of the proboscis coeloms), paired circumoral coeloms that gave rise to tentacles (homologues of the collar coeloms) and few metameric trunk coeloms. Echinoderm ancestors lay on the right side of the body and that led to the reduction of tentacles on the right side and the right hydrocoel and to the prevailing development of left trunk coeloms. Carpozoans are considered to be ancient echinoderms that lived lying on their right side, most likely on soft soils. The incomplete radial symmetry developed secondarily as a result of the attachment of pelmatozoans to a substratum and retained after the detaching of eleutherozoan ancestors. Within that hypothesis, echinoderms retain 3-5 coelomic segments in addition to the axocoel and hydrocoel, which means that echinoderms can be considered metameric animals.

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ID: 408

A1 Oral

SYMMETRY OF GLIDING REFLECTION IN THE VENDIAN (EDIACARAN) INVERTEBRATES: A HINT TO THE SPIRAL MODE OF BODY GROWTH, AND PROBABLY, TO THE SPIRAL CLEAVAGE OF AN EGG IN EARLY METAZOAN EVOLUTION?

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Many oldest metazoan body fossils discovered in the Neoproterozoic marine sediments (Vendian Period, Ediacaran, 543-650 Ma ago) demonstrate the modular body structure and the symmetry of gliding reflection: the offset (alternating) position of the identical body parts along the axis or plane of the symmetry. This symmetry is common for attached (or sessile) benthic organisms (*Pteridinium*, *Charnia*, *Charniodiscus*, *Rangea*, *Ventogyrus*, *Bradgatia*, *Fractofusus*, *Beothucus*) and for the bilateral vagile animals (*Vendia, Paravendia*, *Archaraspis*, *Cyanorus*, *Yorgia*, *Dickinsonia*) demonstrating the anterior-posterior polarity and, in some taxa, the locomotion trails associated with the body imprints. The symmetry of gliding reflection is interpreted here as a result of the spiral mode of the body growth. If this interpretation is correct, then one could suggest the phylogenetic connection between the two groups of presumably diploblastic animals mentioned above. The spiral mode of growth might be direct derivative of the spiral cleavage of an egg in the earliest metazoans. The oldest paleontological evidence of the spiral cleavage and growth may be numerous microfossils from the 635-551 Ma old Doushantou Formation in China. These phosphatized microfossils interpreted as the metazoan embryos demonstrate helicospiral structure. This hypothesis can be tested by the synthesis of data from paleontology, comparative embryology and developmental genetics.

ID: 118

MEIOFAUNAL DEUTEROSTOMES FROM THE BASAL CAMBRIAN OF CHINA AND THEIR IMPLICATIONS FOR UR-DEUTEROSTOMES

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The lower Cambrian Kuanchuanpu Formation (ca. 535 Ma) in southern Shaanxi Province, south China has yielded abundant phosphatized microfossils. They are exquisitely preserved in three dimensions and have largely been assigned to microbials, cnidarians and various protostomes, i.e. mollusks, chaetognaths, and scalidophorans. Currently, *Saccorhytus coronarius* extracted from the Xixiang section of this deposit has been proposed to be an earliest-known primitive deuterostome. SEM and MicroCT were used to show the morphology and internal anatomy of the fossils. The millimeter-scale (0.5~2 mm), hemi-ellipsoidal body bears a prominent double-ringed anterior-ventral mouth with associated oral protuberances and two clusters of tentacle-like protrusions, four pairs of prominent conical openings correlated to gill openings, and dorsally many small pores. These features are remarkably reminiscent of both the terminal mouth of vetulicolians and two lateral body cones of vetulicystiids from the Cambrian Chengjiang fauna in south China. The body cones of Saccorhytu might have functioned to expel used water and wasted material, thus most probably related to the respiratory gills. The highly wrinkled body surface with fine chevron patterns resistant to decay indicates an unmineralized or slightly sclerotized integument. The lacking of an anus in Saccorhytus, was thought either to be secondarily lost, or most likely being an original characteristics concerning the background of Cambrian explosion. A mode of direct development is proposed for Saccorhytus. But taken together with the ventral mouth, it is also reminiscent of acolomorphes, further strengthening the hypothesis of independent origin of anus in protostomes and deuterostomes.

ID: 348

A1 Poster

UNEXPECTED FOSSIL FINDINGS IN ARTHROPODS

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Fossils play a major role in reconstructing the evolutionary history of modern-day organisms. Still they are often neglected in studies centered on modern organisms. This is usually coupled to the argument that fossils do not provide the necessary preservation of details, especially of rather small or soft organs. Yet, some fossils stand out and sometimes preserve detailed morphologies to a degree that can be easily compared to their modern-day counterparts. To emphasise this apparently often overlooked fact we present here examples of fossils that could not have been easily predicted. These examples range from fossils in unusual sizes, unusual softness, and unusual environments to unusual preservations of organs or in places where they should not have been able to be preserved.

With these examples we not only point out that more information might be gathered from fossils than usually expected. We also point out that the right method of documentation needs to be employed to extract this kind of information from the fossils. For a reliable comparison also modern counterparts need to be studied in similar ways, i.e. with identical methods, focussed on similar structures. A precise comparison of fossil to modern forms is in fact often not necessarily limited by the preservation of the fossil, but instead by a lack of available comparable information on their extant counterparts. We therefore ask for more exhaustive description of details especially of modern animals to improve the study of fossil organisms.

ID: 216

RAPTORIAL BEHAVIOUR OF EXTINCT MANTIDS – CLUES FROM CRETACEOUS FOSSILS

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Modern praying mantids (Mantodea) are highly specialised for their raptorial lifestyle. One of the most impressive features is a pair of raptorial forelegs. These raptorial legs are equipped with massive spines assisting in catching prey by folding two leg elements against each other. This is one of the features in which praying mantids differ from their close relatives, representatives of Blattodea (cockroaches, with its ingroup Isoptera/termites). Blattodea and Mantodea are the two main lineages of the group Dictyoptera *sensu stricto*. Representatives of the group Dictyoptera *sensu lato* were already abundant in the Carboniferous, about 300 million years ago. These early dictyopteran representatives possess a cockroach-like habitus, in many aspects similar to modern blattodeans. The origin of the group Mantodea in deep time is still under discussion, but it seems most likely that they appear significantly later, possibly during the Jurassic about 200-150 million years ago. Besides the origin of the group, also the evolutionary history of different morphological features such as the raptorial legs is not yet fully understood. The reconstruction of the evolutionary transformation of these characters can also help to elucidate at which point representatives of this group evolved a raptorial lifestyle and how exactly they caught their prey. In this context, we discuss fossil findings of *Santanmantis axelrodi* Grimaldi, 2003, an early mantodean from the Cretaceous (about 108 mya) from the Crato Formation in Brazil.

ID: 192

A1 Poster

THE MOST PROBABLE REMAINS OF EUMETAZOA AMONG LATE PROTEROZOIC MACROFOSSILS

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Biological affinity of "soft-bodied" organisms of Late Proterozoic is difficult to establish. It is technically impossible to perform histological and particular anatomical studies of these fossils, represented mainly by imprints of outer surface of the bodies. Presence of internal systems, even the basic ones, is frequently established by indirect evidences. However, for example, indistinguishability of signs of digestive system on imprints does not directly prove its former absence in studying organisms. To date, assemblages of benthic Proterozoic inhabiting the shallow sea shortly before Cambrian period 560-545 Ma are best studied. Among them, only a few genera can be attributed to Eumetazoa with the greatest possible degree of reliability. The criteria for inclusion are as follows: 1) for radially symmetrical sedentary forms – the presence of compact extensively sculptured external structures (thecas), with shape of conical goblet open at the apical end; 2) for unattached forms – strict bilateral symmetry of body along with traces of intense mobile activity. Thecas of Precambrian Radiata (*Vendoconularia*) in details are similar to those of Paleozoic conulariids (Cnidaria, Scyphozoa) and differ from them only in lack of mineralization. Precambrian Bilateria (*Kimberella*) is the closest to mollusks by complex of revealed signs. Body plan uniqueness of these organisms makes it possible to attribute origin of Eumetazoa to earlier Precambrian. *Keretsa brutoni* is an example of insufficiency of morphological features reduced by fossilization for confident interpretation of fossil remains. It shows close similarity to arthropods, but lacking distinct trunk appendages and, probably, real bilateral symmetry.

ID: 229

EVOLUTION OF PALAEOZOIC AMMONOID SUTURES

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The history of the evolution of the suture can be summarized as follows. In the Emsian, at the end of the Early Devonian, the first ammonoids (Anarcestida, Anetoceratidae) had a two–lobed suture inherited from bactritoids (with ventral and omnilateral lobes, formula VO). At the end of the Emsian a dorsal lobe is occurred in Mimosphinctidae (formula VO:D). At the very end of the Emsian, the omnilateral lobe was replaced by the umbilical (U) in Anarcestina (formula VU:D). In the Middle Devonian Gephuroceratina acquire the inner lateral lobe (I) (formula VU:ID). The external lateral lobe (L) appeared in the Middle Devonian in Tornoceratida (VLU:D). In the Late Devonian (Famennian) five-lobed (VLU:ID) Sporadoceratidae appeared. All subsequent sutural modifications appeared on the basis of these five main lobes. Almost the entire diversity of the septal margins (sutures) of the Palaeozoic ammonoids can be found among Anarcestida (Early Devonian, Emsian–end of the Devonian). Clymeniida (the very end of the Devonian) were strikingly different from all other ammonoids with ventral saddle. Prolecanitida and Goniatitida appeared at the Devonian-Carboniferous boundary. The first Ceratitida appeared at the Early–Middle Permian boundary with the five-lobed (VLU:ID) or a four-lobed primary suture (VL:ID).

The evolution of the Paleozoic ammonoid sutures is evident that changes in the sutural outlines were controlled by a large system of organismal functions and communications, which maintained a certain stability and at the same time were initiated by external factors.

ID: 458

A1 Poster

POSSIBLE STRUCTURE OF LARVA OF THE EARLIEST STROPHOMENIDS (BRACHIOPODA)

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The development of recent brachiopods comprises two main types. Modern Craniiformea and Rhynchonelliformea have lecithotrophic larvae; the larvae of Rhynchonelliformea have pedicle lobe. The ontogeny of Linguliformea includes planktotrophic swimming stage that is in fact a juvenile brachiopod. The larvae of fossil brachiopods may be reconstructed by the relief of first-formed region on the umbo of adult shell. Our collection contains first Ordovician representatives of the order Strophomenida (Rhynchonelliformea). Their first-formed region is asymmetrically conical on ventral valves and flattened on dorsal valves. The ventral cone narrows into tube (pedicle sheath) with 20-30 μm wide aperture on the apex. This aperture is too small for accommodating any peduncular outgrowth. This type of shell may correspond to planktotrophic stage characterized by alimentary canal with anus in the cone apex. Judging by first-formed shells of Permian productids, this type of larva preserved in the class Strophomenata up to the end of Paleozoic. The similarity in the development of strophomenids and their ancestral order Billingsellida is generally accepted. Some billingsellids also have tubular outgrowth on the umbo of ventral valve; however, it is not homologous to pedicle sheath of strophomenids. Our material clearly shows that the tube of billingsellids is formed by accreted deltidial plates of juvenile shell, which already has well-developed structures of inner skeleton. The billingsellids have well-pronounced first-formed region on the dorsal valve and lack it on the ventral valve; their larvae certainly had pedicle lobe as there is a large pedicle opening between the valves.

ID: 457

A1 Oral

PEDICLE SHEATH OF STROPHOMENIDS (BRACHIOPODA): TRUE PEDICLE OPENING OR AN ANUS?

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Brachiopods of the order Strophomenida (Rhynchonelliformea) often have two openings in the posterior part of the shell: between valves in the middle of area and apical foramen or tube (pedicle sheath) on the umbo of ventral valve. The latter is generally supposed to accommodate peduncular outgrowth. We studied first representatives of the order Strophomenida from the Ordovician of Leningrad Region with pedicle sheath located within first-formed region of ventral valve and shaped as thin hollow outgrowth with inner diameter of 20-30 µm at the apex. The gap between the valves, which is used as pedicle opening in articulated brachiopods, is absent at juvenile stages and develops later in the ontogeny, that testifies to the presence of well developed pedicle in strophomenid ancestors. According to C. Nielsen, the ancestor of brachiopods folded on ventral side and their dorsal and ventral valves in fact are both dorsal. Therefore the anus of brachiopods initially should be located on ventral side and the pedicle sheath may be interpreted as tubular outgrowth of the ventral valve accommodating anal papilla. The anus of recent brachiopods is never ventrally located. However, possible homologue of pedicle sheath of fossil strophomenids is the pedicle of recent discinids shaped as outgrowth of soft tissues in the aperture within the ventral valve. Natively this outgrowth was anal papilla, but later anus moved to the right side of the body and ventral outgrowth transformed into anchoring organ. We suppose that discinid pedicle is not homologous to the pedicle of lingulids and Rhynchonelliformea.

ID: 262

A1 Poster

MORPHOLOGICAL DIVERSITY OF HOLDFASTS IN UPPER PALEOZOIC CRINOIDS: NEW DATA FROM THE CARBONIFEROUS FLEXIBLE CRINOID SYNEROCRINUS

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The discoidal holdfasts are discovered and described in crinoid cirri for the first time on the basis of several specimens of *Synerocrinus* distal stems from the Upper Carboniferous deposits of the Moscow and Ryazan regions. These holdfasts on the distal parts of cirri are similar to the attachment discs of the stem. The studied specimens also demonstrate a wide morphofunctional potential of the attachment structures within one species. It is probably an adaptive feature connected with habitat conditions on different types of grounds. Until now, the cases of cementation to the substrate and the formation of the attachment discs have not been observed for crinoid cirri. These holdfasts are represented by heavily increased, overgrown and attached to the substrate discoid-shaped cirrals. The studied specimens allow interpreting isolated discoidal holdfasts form the Upper Carboniferous of the Moscow Region as the radicular cirri attachment structures. Such holdfasts are often form close settlements, sometimes with hardly discernible boundaries of individual discs, covering hard grounds or surfaces of chaetetids and other organisms. The size of facets in one settlement of holdfasts can vary greatly. In addition, individual discoidal holdfast can bear several facets of different diameters. It is interesting that the axial canal of holdfasts in some specimens is trilobite. It is proposed that all these solid discoidal holdfasts belong to the radicular cirri attachment structures of large crinoids (such as *Synerocrinus*). The study was supported by the Russian Foundation of the Basic Research (grant No. 15-04-08315-a).

ID: 266

MORPHOLOGICAL COMPARISON OF TARDIGRADES AND CAMBRIAN LOBOPODIANS

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Tardigrades are minute animals (50 ~1200 μm) with five psuedosegmented body with four pairs of walking legs terminating in claws. The Phylum Tardigrada forms the Superphylum Panarthropoda, together with Onychophora and Arthropoda. Evolutionary origin of this animal group, however, remains unclear; not only the phylogenetic relationships with the Onychophora and the Arthropoda are still hotly-debated, but also how the unique morphology arose is unknown. One of the possible solutions to elucidate this issue is to draw attention to the Cambrian lobopodians from which the panarthropod phyla arose. Among the Cambrian lobopodians, *Onychodictyon* holds special interests, because this extinct animal possessed a specialized proboscis-like mouth and the bulbous phyarynx which are probably reminiscent of those of tardigrades. Here we closely observe the claw morphology of the Cambrian lobopodian *Onychodictyon*, and compare it with that of eutardigrades. Interestingly, in *Onychodictyon*, a double-claw is formed by two heteronomous branches. Such claw structure is not known in other Cambrian lobopodians, such as *Hallucigenia sparsa* Conway Morris, 1977 and Ovatiovermis cribratus Caron and Aria, 2017. Instead, such heteronomous branches within a double claw are known in many species of eutardigrades. This result may indicate a close phylogenetic relationship between tardigrades and the Cambrian lobopodians. Alternatively, there could have been a convergent evolution of claw morphology between tardigrades and *Onychodictyon*.

ID: 212

A1 Oral

PALEONTOOGY ON THE MOLLUSCS ORIGIN AND BASAL RADIATION

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In spite of the presence of hard tissues, i.e. various kinds of carbonaceous armouring – shells and sclerites, and hence very frequent preservation of molluscs as fossils, we still have very obscure knowledge on the origin and early radiation of this enormous group of invertebrates. Consequently, a number of phylogenetic models of molluscs evolution exists up-to-date, and papers with such meaningful titles as “Invertebrate evolution: bringing order to the molluscan chaos” emphasized the problem. However, since the end of the 1990s we witnessed a number of important paleontological and neontological discoveries, that greatly influenced our vision of molluscs early evolution: (1) finds of complete halkieriid scleritome, composed of terminal shells and series of sclerites in between and (2) their subsequent interpretation as polyplacophorans; (3) morpho-functionally based recognition of torted forms (i.e. gastropods) among variable Cambrian univalves and (4) discovery of undoubted muscle scars in Cambrian univalves; (5) discovery of the early Palaeozoic aplacophorans; (6) finds of variable Paleozoic ‘multiplacophorans’; (7) discovery of recent hot-vent ‘scaly-footed’ gastropods; (8) discovery of ‘chitons’ with reduced foot, being morphologically intermediate between polyplacophorans and aplacophorans. As a result, phylogenetic hypotheses with more robust paleontological basement have appeared. We propose slightly different model of the early mollscan evolution, suggesting that classes Polyplacophora, Monoplacophora, Gastropoda and Bivalvia appeared near the Precambrian-Cambrian boundary, i.e. at the very beginning of fossil-documented history of the phylum, whereas their later origin is doubtful. The remaining classes arose later: Cephalopoda – in the Late Cambrian, Scaphopoda – in the Ordovician, Aplacophora – in the Silurian.

ID: 227

A1 Poster

COELOMIC SYSTEM IN BRACHIOPODS: TRADITIONAL OPINIONS AND NOVELTIES

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The Brachiopoda is a phylum of marine sedentary bivalve invertebrates with controversial phylogenetic position: they belong to protostomes, but their morphology and development have a lot in common with deuterostomes. Coelom organization of brachiopods is supposed to be one of the most important morphological features for understanding brachiopods' relationships and their position within other bilaterians. Our work is an attempt to summarize all classical and modern data dedicated to anatomy, ultrastructure and, partially, development of coelomic system in Brachiopoda. We have discussed compartmentalization of the coelom in brachiopods and other lophophorates (bipartite or tripartite); coelom development and ultrastructure of coelomic lining in brachiopods and other bilaterians; the nature of uniqie lateral mesenteries in brachiopods and other lophophorates; origin of unusual brachiopod body plan. Enterocoely and presence of three coelomic compartments contribute to relationship between brachiopods and deuterostomes. On the other hand, brachiopods have some prominent protostome-like features such as the presence of annelid-like setae, specific expression of Hox genes, and protostomian fate of the blastopore in many species. A new information about coelom compartmentalization in *Lingula anatina* Lamarck, 1801 has shown that brachiopods likely retain both archimery resembling coelom organization in echinodermates, and metamery common for both protostome and deuterostome animals. This work accepts possibility to integrate archicoelomate and metameric hypotheses of bilaterian origin. Thus, coelomic organization study is truly one of the most perspective ways to reconstruct and understand brachiopod relations as well as origin and diversification of bilaterians. This work is supported by RFBR (#17-04-00586).

ID: 261

A1 Oral

ORIGIN AND HOMOLOGY OF SEGMENTED APPENDAGES OF CARPOID AND PELMATOZOAN ECHINODERMS

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The origin and homology study of the segmented feeding, attaching and moving appendages among the Pelmatozoa (Crinozoan and Blastozoan) and Carpozoa (Soluta, Cincta, Stylophora) is based firstly on the key moment ontogeny reconstruction of the animals. The presence or absence of some key processes known in the recent crinoid ontogeny can be revealed in the Early Paleozoic pelmatozoan and carpoid echinoderms in the result of the analysis of their adult and aberrant morphology. Similarities in the morphology of crinoid arms, blastozoan brachioles and feeding appendage of solutans can be explained by the similar growth pattern based on the initial organizing role of the radial ambulacral canal. This growth model can be referred to as the model of apical serial enantiomorphic monopodial branching (ASEM-branching model). Differences between crinoid arms and blastozoan brachioles derive from the initiation of the crinoid arms rudiments in the closed vestibular sac. Solutan feeding appendage is really an extension of the pharynx. The hydrocoel was a sac-like and didn’t grow around the pharynx in the solutan ontogeny and the torsion was present. The homoiostele of the solutans is a homolog of the crinoid and blastozoan stem because originated from the larval preoral lobe and right somatocoel. Stylophorans did’t have torsion and the aulacophore originated from the preoral lobe and food-gathering groove. The radial canal was absent in stylophorans. Cinctas had torsion in ontogeny. Homology of cinctas marginals with marginals of *Ctenoimbricata*, *Courtessolea* and Ctenocystoidea is unlikely because these groups have very different internal bodyplan.

ID: 460

A1 Poster

THE FINE STRUCTURE OF A PALAEOZOIC POLYCHAETE TUBE HELPS TO IDENTIFY ITS SYSTEMATIC POSITION

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Body fossils of marine annelids are quite rare, and the fossil record for non-tubicolous families is based on a few uniquely preserved finds scattered in both time and space. Among tubicolous forms, fossilized calcareous tubes are common, agglutinated and organic tubes less so. Because of poor outer morphology of the tubes and its high similarity between different families, annelids with agglutinated and/or organic tubes currently fall into the "blind zone" of paleontology. We studied a unique fossilized organic tube (ca. 1.5 cm wide and 12 cm long) from the Lower Carboniferous (~350 Ma) of Eastern Siberia with SEM. The tube wall comprised several layers of densely packed, differently oriented fibres. In order to compare this fossilized tube with recent ones we studied fine structure of tubes belonging to several of annelid families (Sabellidae, Siboglinidae, Onuphidae, Chaetopteridae) and few tube building amphipod families (Ampithoidae, Corophiidae, Ischyroceridae, Photidae). Such a fabric-like structure with multiple layers of densely packed, parallel cement fibres whose orientation changes from one layer to the next, to provide strength, is characteristic of organic tubes and the inner sheath of calcareous and agglutinated tubes of polychaetes. Silk matrix of amphipod tubes studied by us was more loose and filamentous. The fine structure of the fossil is the most similar to Onuphidae and Chaetopteridae.

ID: 248

A1 Poster

EVOLUTION OF *PALAEOCYTHERIDEA KALANDADZEI* (OSTRACODA, CRUSTACEA) CARAPACE FROM SARATOV DURING THE TERMINAL BAJOCIAN – EARLY BATHONIAN (MIDDLE JURASSIC)

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Studies of the *Palaeocytheridea kalandadzei* ostracod from the *michalskii* and *besnosovi* zones (upper Bajocian – lower Bathonian, Middle Jurassic) of the Saratov region revealed differences in evolutionary plasticity of various carapace elements. The macrosculpture, consisting of three lateral ridges, is the most stable feature: it was appeared in early instars and was inherited during the subsequent moults. On the contrary, the hinge structure was changed during the ontogeny. Drastic developmental changes were observed in the mesosculpture, represented by various pits, – it was not constant either in the ontogeny, or in the phylogeny. The mesosculpture was reduced in the phylogeny but, in the ontogeny, it was changed from smooth, through pitted to reticulate. These unidirectional variations did not occur synchronously over the entire carapace, but embraced area by area of a valve. At first, the reticulation appeared in the posterodorsal, posteroventral, and ventral areas. Simultaneously, the anterodorsal and anteroventral areas became pitted, while the anterior one stayed usually smooth. Over time, the development of the mesosculpture shifted to later instars. The same trend in the mesosculpture reduction is observed in the phylogeny of mature individuals: in the *michalskii* phase, the reticulation covered all the carapace, except for the smooth anterior part. Starting from the following *besnosovi* phase, individuals with pitted anterodorsal and anteroventral areas appeared first, then, those with alike ventral area, and finally all the individuals were turned to be smooth. In due course, this mesosculpture type was becoming the dominant one. In summary, the species is evolved by the neoteny.

ID: 465

DANCING IN THE AMBER FOREST: EVOLUTIONARY STORY OF A MITE FAMILY (ACARI: ORIBATIDA: COLLOHMANNIIDAE)

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Collohmanniidae are unique among Oribatida in having a mating ritual, involving transfer of a male-produced nuptial gift to female. There are five described Collohmannidae species: two – Eocene Baltic amber fossils and three – Recent, together having disjunctive Holarctic distribution.

Objective of my ongoing study is to describe the yet-unknown collohmanniids, fossil and Recent, and try understanding their evolution and biogeography.

There are at least ten undescribed collohmanniid species: five in Baltic amber, five Recent Palearctic species, each from an isolated mountain forest area. 3D micro-preparation of amber and light microscopy of fossil and Recent specimens were used to directly compare their morphology.

All discovered Collohmanniidae are very similar, all belong to *Collohmannia* Sellnick, 1922. Differences involve lengths and shapes of body setae, leg setation, proportions of male leg I tarsus and features of male leg IV. Character states are distributed in a mosaic manner. One fossil female is indistinguishable from *C. johnstoni* Norton et Sidorchuk, 2014 from West Virginia, U.S.A. Each of the character states was found in two or more species, apart from one: shape of the male leg IV and its genual seta v''. These are male body parts coming in a direct contact with female during the nuptial food transfer.

Hypothesis of the speciation by dispersal does not hold for Collohmanniidae. Study of fossils suggests a relatively rapid sympatric speciation of *Collohmannia* in the Baltic amber forest. The driving force of this speciation likely was female choice. This hypothesis calls for behavioral experiments on Recent collohmannias.

ID: 228

A1 Oral

CAMBRIAN BANFFIA – A BASAL DEUTEROSTOMIAN OR AN ABERRANT ECDYSOZOAN?

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Cambrian problematic fossil *Banffia*, which is the only representative of the Banffozoa class-rank group, together with the Vetulicolia is commonly assigned to the Deuterostomia as a sister group of the Tunicata. However, none of over 300 specimens of *Banffia* having been described from the Cambrian Lagerstätten possess either gill slits or endostyle or any other distinct deuterostomian feature. On the contrary, it has an axially twisted vermiform body (10 cm long or less) divided into two equal in length sections, the presumable anterior one with the antero-ventral mouth surrounded by circlets and the posterior one with the terminal anus.

A new *Banffia* specimen from the lower Cambrian Murero Lagerstätte of the Cadenas Ibéricas, Spain, due to its preservation by a clay mineral replacement, demonstrates further features of the body morphology. The posterior section is covered with numerous rhomboidal elements (20-25 µm in width) being organized in multiple ring-like bands. In addition to Si, Al, Fe, Mg, and Ti, which are typical of clay minerals, energy-dispersive X-ray spectroscopy reveals traces of calcium in the rhomboids suggesting their primary rigidity. The anterior section bears rounded elements of the same composition.

Except for the body twist, the overall morphology of *Banffia* does not differ much from cuticles of coeval cephalorhynch worms. In turn, vetulicolians having a rigid anterior carapace, a segmented trunk, and mid-gut diverticulae show more similarity with the Anomalocaridida rather than with any deuterostomian group. Both the Banffozoa and the Vetulicolia are representatives of the early ecdysozoan radiation.

ID: 469

ORIGIN OF THE CLASS HOLOTHUROIDEA (ECHINODERMATA)

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The author adheres to the hypotheses of paedomorphic origin of holothurians. Ontogenetic changes at the stage of five first tentacles resulted in interruption at an early stage of the development with the catastrophic metamorphosis, which is typical for other Eleutherozoa. The ontogeny of holothurians acquired the gradual character. The place and developmental pattern of the radial complex changed and the modern body plan of holothurians was formed. The five primary extensions of hydrocoel give rise to five primary tentacles, and five radial canals develop later between them. It is assumed that such structure of ambulacral system arose as result of separation in time and space of initially single program of development of eleutherozoan ambulacra, which consisted of two stages: the development of tentacles and, after this stage transformation of the tentacles into ambulacral canals. The first part of the program again started the formation of five primary tentacles, and the subsequent part of program – development of ambulacral canals was modified. The radial ectoneural nerve cords have begun to grow out from the subcutaneous rudiment of the ectoneural nerve ring, and the epineural canals started to develop by means of the formation of a cavity in the tissue located outward from the radial nerves. Despite the modified development the equifinality leads to formation in holothurians of radial complex of organs homologous to that of sea urchins and other Eleutherozoa. Although radial complex in holothurians is shifted topographically relative to radial complex of the other Eleutherozoa, these complexes are isomorphic nevertheless.

ID: 152

A1 Oral

ANATOMY AND AFFINITIES OF A NEW 535-MILLION-YEAR-OLD MEDUSOZOAN FROM THE KUANCHUANPU FORMATION, SOUTH CHINA

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The early Cambrian Kuanchuanpu Formation from South China (Ningqiang, Shaanxi Province) yields abundant Small Shelly Fossils (SSF) among them embryonic stages of medusozoans. Their exceptional phosphatic preservation allows very detailed reconstructions of their internal anatomy to be worked by using X-ray microtomography. Although these fossils reveal unknown aspects of the early evolution of cnidarians, important issues remain unresolved such as the development cycle of these early medusozoans, their taxonomy and their relation to modern cnidarian groups. Here we describe *Sinaster petalon* gen. et sp. nov., a new species of Medusozoa characterized by a pentamerous symmetry and a smooth periderm which contrasts with the stellate external ornament of co-occurring forms such as *Olivooides*. X-ray microtomography reveals fine details of its internal anatomy such as coronal muscles, perradial and adradial frenula, interradial septa, accessory septa, gonad-lamellae, tentacle buds and perradial pockets. Our results stress the key importance of internal features in the taxonomy of medusozoans from the early Cambrian Kuanchuanpu biota that still remains in a state of flux. The exceptionally well-preserved endodermic and ectodermic features of *Sinaster petalon* gen. et sp. nov. clearly differ from those of co-occurring embryo fossils. The position and overall shape of the reproductive organs of *S. petalon* gen. et sp. nov. can be reconstructed and compared with those of extant cnidarians and other Cambrian medusozoans.

ID: 298

A1 Oral

NEW ANATOMICAL INFORMATION ON *ANOMALOCARIS SARON* AND *AMPLECTOBELUA SYMBRACHIATA* (RADIODONTA; ARTHROPODA) AND NEW POSSIBLE RADIODONTAN APPENDAGES FROM THE CHENGJIANG BIOTA, SOUTH CHINA

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The radiodantans, a group of stem arthropods that were the largest pelagic animals of the Cambrian and Ordovician periods, characterized by radiating mouth part, lateral imbricating body flaps, one pair of large stalked eyes and pre-oral uniramous appendages (‘great’ appendage), such as *Anomalocaris*, *Hurdia*, *Laggania* and *Amplectobelua*. Due to the high preservation potential to these appendages, which are preserved much more often in isolation and attached to the rest of the body, many previous descriptions concentrated on the appendages alone. Here, we reported two new species of *Anomalocaris* on the basis of large amount of frontal appendages material from Yu’anshan member of Helinpu Formation (Cambrian series 2, stage 3) in Yunnan, South China. They are *Anomalocaris sanjieziensis* sp. nov., which is similar to A. sp Hou et al., 1995, but bears two long, six auxiliary spine-bearing, blade-shaped ventral spines on most two proximal podomeres; and *Anomalocaris yunnanensis* sp. nov., has quite straight ventral margin in a larger size, of which ventral spines project from the mid-length of each podomere. These new descriptions demonstrate the higher diversity of radiodontan in the early and middle Cambrian marine fauna.

Some new morphological features of frontal appendages in *Anomalocaris saron* and *Amplectobelua symbrachiata* were revealed, including inter-segmental muscles, tubular structure at the base of ventral spines, the elbow joint, as well as the detail of arthtodial membranes and setae. We also, herein, apply for the first time the geometric morphometrics to the frontal appendages of *A. symbrachiata* and demonstrate a slightly allometric growth pattern.

ID: 395

A1 Oral

THE NEW MATERIAL FOSSILS OF GAOJIASHAN BIOTA OF GAOJIASHAN MEMBER, DENGYING FORMATION, NEOPROTEROZOIC IN THE SOUTH SHAANXI PROVINCE,CHINA

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The research area, Ningqiang county in the south of Shaanxi province, is located at the northern edge of Yangtze Plate. Gaojiashan biota from the upper Gaojiashan member, Dengying formation of Lijiagou section are well preserved through secondary phosphatization and can be extracted from the dolomite rocks by using the concentration of 8%-12% acetic acid to soak the rocks. Gaojiashan biota has the characteristic of the first occurrence of mineralized skeleton fossils and the fossils are three-dimensional preserved. Except the well-known *Cloudina* with the structure of nested funnels,*Sinotubulites*, a number of calcified cyanobacteria and mineralized algae are found here which are firstly reported in the early Cambrian such as *Epiphyton*, *Girvanella*, *Girvanella*. Maybe the finding of the calcareous cyanobacteria and algae and the research of the environment can support us to solve “the Mistery of the Precambrian”. In addition, other kinds of fossils are found here. Spherical fossils which have the similar surface structure with those reported from Wengan like *Megasphaera ornata* and *Megasphaera inornata*; single hollow tubular fossils with closed start; dichotomous tubular fossils which may present the style of production; a large number of problematic fossils. Due to the Gaojiashan biota located in a special place of the life evolution, the further study of the new materials not only can broaden the recognization of the feature of the Precambrian lives’ diversity, but also has a tremendous significance to the study of the Cambrian Explosion and the origin of the metazoan.

ID: 169

ONTOGENETIC DEVELOPMENT OF *DICKINSONIA* (EDIACARAN MACROFOSSIL) AND ITS POSSIBLE IMPLICATIONS FOR PHYLOGENY

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Some of the most famous organisms of Late Precambrian are representatives of the genus *Dickinsonia*. Four species of *Dickinsonia* are found throughout the section on Southeastern White Sea area. However, their distribution is uneven. At the lower levels (Verkhovka Formation) thin-segmented *D. tenuis* is the most frequently encountered. There are few imprints that can be attributed to *D. costata*, and they are all of small size. Numerous remains of *D. costata*, reflecting all available for observation stages of ontogeny, are present only at the upper levels (Zimnie Gory and Erga Formations). The statistical analysis of *Dickinsonia* imprints from Karakhta locality showed existence of two distinct groups. The first group is represented by small-sized specimens with wide head section, and the second group – by larger specimens with narrow head section. The first group lies on the same trendline with specimens of *D. costata* from Zimnie Gory locality, which show similar ratio of body length and number of isomers. The transition from the first to second group occurs spasmodically but without interruption of the sequence. These groups could represent different stages of ontogeny of single species – *D. tenuis*. All characteristics of juvenile *D. tenuis* – a round body, wide head section and small number of trunk isomers - are distinctive features of *D. costata*. These features remain in adult state of *D. costata*. The most likely explanation of this phenomenon is the origin of *D. costata* from *D. tenuis* by neoteny. This is the first case revealing evidences of neoteny in Precambrian organisms.

ID: 151

A1 Oral

THE MORPHOLOGY AND DIVERSITY OF THE LOPHOPHORES IN CAMBRIAN (CA. 520MYA) BRACHIOPODS AND ITS PHYLOGENETIC IMPLICATIONS

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The lophophore is a tentaculate extension of the mesocoelom, recognized as one of the diagnostic characters in the definition of higher brachiopods taxa, and hence play a major role in the phylogenetic analysis of brachiopods. The structural lophophores are, however, very rarely preserved in fossil brachiopods, and most Cambrian records come from the early Cambrian Chengjiang Lagerstätte (Fauna) of eastern Yunnan, China. So far, all the 9 genera of brachiopods from the Chengjiang fauna have imprints of lophophoral arms preserved. Among the imprints of the lophophore, those in *Eoglossa*, *Lingulellotreta*, *Yuganotheca* and *Heliomedusa orienta* are extremely spectacular. Evidently, the lophophore in the former three taxa is composed of two anteriorly-coiled and spiraled brachial arms. Amazingly, the tentacles in *Eoglossa* and *Lingulellotreta* are delicate, strikingly distinguishable from those occurred in the brachiopods stem genus-*Yuganotheca*, where the tentacles appeared to be much thicker in diameter and distinctly lower in number. By contrast, the lophophore of *Heliomedusa orienta* shows a bizarre organization, with paired brachial arms arching posteriorly and encircling the anterolateral body wall. This arrangement and stylized attitude of the lophophore differs from the anteriorly-converging spiral lophophores in other fossil and extant brachiopods, but shows significant similarities with those found recently in the Cambrian hyoliths—an extinct lineage of skeletal lophophorate total group. Attempts to trace the fossil records of lophotrochozoans in Cambrian permit to argue for the view that brachiopods evolved ancestral bivalved group-plan from the deep conical and tubular lophotrochozoan stems.

A2 ORIGIN OF BILATERIA: ACHIEVEMENTS AND CONTRADICTIONS

Organizer Dr. Elena N. Temereva

ID: 448

ABSENCE OF TRIPARTITE COELOM IN CHAETOGNATH *PARASAGITTA ELEGANS*: PHYLOGENENIC IMPLICATION

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Chaetognaths, or arrow worms, are a small and still rather poor investigated group of sea animals. Their phylogeny is still not strictly established. According to the traditional point of view based on some embryological and morphological data, chaetognaths belong to Deuterostomia. The presence of three coelomic compartments is usually regarded as one of deuterostome-like features of these animals. However, the nature of their body cavity is disputable. It had been discussed in the literature since the beginning of the XX century; nevertheless, there is still no microanatomical evidence about its structure in the head segment. In this work, we have examined the head of a common north sea chaetognath *Parasagitta elegans* (Verrill, 1873) with a transmissive electron microscope, revealing the details of body cavity structure. We have found no evident signs of coelomic epithelium in the head. The lining of epithelium and internal organs of the head is represented by a thin (about 0.1-0.15 μм) lay of seemingly unstructured extracellular matrix. Separate flat myoepithelial cells with large amount of mitochondria are scattered on the matrix, but do not form true epithelium: cells do not connect each other via desmosomes. The absence of true coelomic lining evidences the absence of true coelom in the head of *P. elegans.* As a result, the coelom is not tripartite in *P. elegans* and probably in other chaetognaths. The absence of tripartite coelom becomes another fact supporting the hypothesis that Chaetognatha is not related to Deutherostomia. Work is supported by Russian Science Foundation (14-50-00029).

ID: 373

A2 Oral

NEURAL PATTERNING IN XENACOELOMORPHS

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The central nervous system (CNS) of many bilaterally symmetric animals is condensed into nerve cords and brains. The discovery that homologous genes are expressed in the developing CNS of insects and chordates in similar patterns led to the hypothesis that the cords are homologous and thus were present in their last common ancestor. The group Xenacoelomorpha holds a key position as sister group of all remaining Bilateria. By investigating neural pattering genes and pathways involved in neurogenesis in these animals, we can gain important information about their ancestral role. We investigated the molecular patterning in relation to the neural architecture in members of the Xenacoelomorpha. The nemertodermatids *Meara stichopi* and *Nemertoderma westbladi* and the acoel *Isodiametra pulchra* and show very divergent nervous systems architectures with respect to the location of cords in the body and the presence of a subepidermal brain. We investigated a conserved set of transcription factors that are expressed in a staggered pattern along the a-p axis in the developing CNS of bilaterians and the role of the BMP pathway in neural formation. We found that in xenacoelomorphs these genes are expressed in a similar staggered pattern in the (neuro)ectorderm along the whole body axis of the animals irrespectively of location of neural condensations. Furthermore the BMP pathway does not seem to have an antineural function as it has in insects and chordates and is only involved in dorsoventral axis specification. Our data questions the use of these genes for homologizing bilaterian condensed nerve cords.

ID: 174

COMPARATIVE MORPHOLOGY OF PARENCHYMAL CELLS IN ACOELOMORPHA AND PLATHELMINTHES

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Parenchyma is one of the important morphofunctional features of the organization of Acoela and Plathelminthes. It plays a main role in many physiological processes of their organism such as digestion and excretion, regulatory processes, transport as well as their wonderful ability to regeneration. The study of its nature and development is important for understanding of these processes as well as for obtaining data on morphology, phylogenetics and evolution of this significant group of metazoans. According to this aim, we have carried out a comparative morphological research of parenchyma in 1 species of acoel and 10 species of flatworms, including free-living ones, fluke and tapeworm, on ultrastructural level. As a result of analysis of ultrastructural organization of these species' parenchyma the morphofunctional classification of cells is proposed. We distinguish seven cell types differing by the structure and certain functions. The parenchyma of each species examined is characterized by a unique combination of these cell types. Occurrence of the similar parenchymal cell morphotypes in representatives of Acoela and phylogenetically distant groups of flatworms, to our opinion, allows considering the specialization of this tissue as a parallel evolution.

ID: 476

WHAT THE PHYLOGENY OF BILATERIA MAY AND MAY NOT TELL US ABOUT THE BILATERIAN LAST COMMON ANCESTOR

A2 Invited

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Ancestors have often been proposed as a tool to understand animal evolution, but the scientific value of such constructshas been questioned by others—as the large amount of disagreement about what an ancestor such as HAM may look like shows(Lindberg and Ghiselin 2003). In the particular case of the common ancestor of Bilateria, ithas likewise been proposed to be either segmented or unsegmented, coelomate or acoelomate, with eyes or without vision, etc. However, these questions are difficult to answer using phylogenetics as (a) inferring ancestors is not equivalent to reconstructing ancestral character states, and (b) ancestors could only be tested with a complete fossil record. But even if such ancestors had fossilized, it would be impossible to recognize them as such, as phylogenetically they could be interpreted as either stem groups or as derived members of a clade. Our aim as zoologist should thus focus on reconstructing phylogenies and not ancestors and only in the few cases where paraphylyclearly identifies plesiomorphic features we should emphasize those as character states that may have been present in putative ancestors. Here I use a well-resolved bilaterian phylogeny based on transcriptomics to discuss early bilaterian evolution and possible morphological features of extinct members of the stem group of Bilateria.

Lindberg DR, Ghiselin MT. 2003. Fact, theory and tradition in the study of molluscan origins. Proceedings of the California Academy of Sciences 54:663-86.

ID: 349

MORPHOLOGICAL ANALYSIS OF AMBULACRARIA

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Deuterostomia is a monophyletic group whose representatives exhibit a remarkable variety of morphological organization. Deuterostomia contains fascinating ingroups such as the alien-like echinoderms, non-vertebrate chordates and our own closer relationship, the tetrapod vertebrates. Despite this morphological heterogeneity, basal branchings within Deuterostomia, i.e. the early evolutionary history of the group, had been considered to be resolved, at least roughly. For decades Echinodermata was interpreted as the sistergroup to a monophyletic grouping including Chordata and the hemichordate groups, the latter either as monophyletic or as a paraphyletic assemblage branching off along the lineage towards Chordata. Such a phylogeny led to the reconstruction of a step-wise character acquisition along the lineage towards Chordata. An alternative view, the Ambulacraria-hypothesis places Hemichordata as sistergroup to Echinodermata. The Ambulacraria hypothesis has received morphological and molecular genetic support in more recent years and is largely accepted today. This change in view on phylogeny of Deuterostomia had considerable effects on the reconstruction of character evolution, supposing the presence of numerous chordate-like characters, such as gill slits, in the ground pattern of Deuterostomia. We analyze here the reconstructed character evolution of both phylogenetic hypotheses, based on a detailed morphological analysis and broad comparative approach. This includes different aspects such as the coelomic cavities or the morphology of the larvae. This leads us to conclude that morphological data on modern forms, but also of fossils, are not at all in favour of the Ambulacraria hypothesis, but instead reject it.

ID: 358

MESODERM DEVELOPMENT IN ANNELIDS AS A CLUE FOR UNDERSTANDING ORIGIN OF THE BILATERIAN BODY PLAN

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The mesodermal germ layer has evolved within bilaterians, representing one of the major innovations in animal development. There is strong probability that the mesodermal tissues provided powerful basis for body plan diversification led to the Cambrian explosion. To reveal evolutionary history of the mesoderm formation we analyze its morphological and molecular-genetic aspects in annelids. Using immunostaining techniques, *in situ* hybridization and confocal microscopy we describe cellular dynamics, myogenesis and gene expression patterns in the mesodermal tissues. In most annelids studied the trunk mesoderm originates from the 4d blastomere. This cell gives rise to the bilateral mesoderm bands. Despite the difference in developmental patterns of errant polychaetes and oligochaetes, our comparison of the mesodermal band morphogenesis reveals similarity in cellular composition, early metameric organization and anterio-posterio gradient of maturation. We also characterize several early mesodermal markers in development of nereidid polychaetes – *Twist*, *MyoD*, *Mox*, *Evx* – which are differentially expressed within the mesodermal lineages. Their circum-blastoporal, and later metameric expression is suggested to be ancestral that supports the enterocoelic hypothesis of mesoderm evolution. In trochophores the mRNAs are differentially localized within overlapping domains, reflecting the early heterogeneity of the undifferentiated mesodermal bands. This differential molecular signature leads in more advanced larvae to the segregation of distinct mesodermal lineages, i.e. the parapodial, longitudinal, and oblique muscles. Likewise in embryogenesis, the described marker genes were activated in the postlarval mesoderm, indicating the common developmental program of the mesodermal somite formation. The research was supported by RFBR grant 16-34-00472, RRCMCT and CMM SPbSU.

ID: 451

DATA OF CLASSICAL COMPARATIVE ANATOMY EVIDENCE THE METAMERY IN BRACHIOPODS

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Presence of the metamery in many representatives from three main stems of Bilateria allowed researchers to suggest the presence of metamery in the last common bilaterian ancestor. Adult brachiopods seem to be lack metamery. However, the metamery is described in larvae of craniid brachiopod *Novocrania anomala*, which have three pairs of setae bundles that are repetitively arranged along anterior-posterior axis, unpaired anterior coelom, and three pairs of coelomic sacs. Here, we describe for the first time the metamery in larvae of articulate brachiopod *Coptothyris grayi*, which have three pairs of coelomic sacs arranged along the anterio-posterior axis on the both sides of the archenteron. Metamery was also suggested in adult brachiopods. According to some opinions, the body plan of brachiopods originated due to the folding of the worm-like ancestor on the ventral side. In adult brachiopods, the trunk coelom contains two lateral mesenteries that extend at angle in respect to each other and to anterior-posterior axis. If the anterior-posterior axis of brachiopods is curved, then the lateral mesenteries are located like dissepiments between segments. Each lateral mesentery supports a pair of nephridial funnels and this fact may confirm that lateral mesenteries of brachiopods are true dissepiments. Thus, the brachiopods have preoral and lophophore coeloms and also three trunk segments. These data let us hypothesize that the ancestor of brachiopods was a metameric animal. The segments of brachiopods was possibly reduced due to the extremely shortening of anterior-posterior axis after folding of a brachiopod ancestor.
Study is supported by RFBR (17-04-00586).

ID: 407

A2 Oral

CLASSICAL CONCEPTIONS OF THE ORIGIN OF BILATERIA IN THE LIGHT OF THE CURRENT IDEAS AND FINDINGS

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Comparative analysis provides evidence that the last common ancestor of cnidarians and triploblastic bilaterians was a bilateral animal. So, the bilateral symmetry is therefore older than triploblastic condition. As ctenophores branched off before the cnidarian/triploblastic bilaterian bifurcation, they keep the axial symmetry. The common cnidarian/triploblastic bilaterian ancestor was presumably a mobile benthic coelenterate with elongated mouth, metameric coelenteron pouches and metameric tentacles. It crawled on the oral surface which evolved into the ventral side of triploblastic bilaterians. Ediacaran metameric bilaterians could be considered to be kin to such common cnidarian/triploblastic bilaterian ancestor. Protobilaterians were comparatively complicated organisms having the through gut, coelom, segmentation and supposedly metameric limbs. New finding let us revive the old ideas of Sedgwick and Van Beneden on the origin of metamery from the cyclomery in new appearance. This hypothesis enables to explain emerging of quite sophisticated forms in Cambrian, i.e. Cambrian explosion phenomenon. Forms with through gut, coelom, segmentation, and metameric limbs occur in all four principal groups of triploblastic bilaterians (Deuterostomia, Ecdysozoa, Lophophorata, and Trochozoa). It seems to be much more likely that the last common ancestor of triploblastic bilaterians had already had all mentioned characters than to imagine that through gut, coelom, segmentation, and metameric limbs appeared in bilaterian evolution three or four times independently.

ID: 238

THE ROLE OF THE BLASTOPORE IN THE EVOLUTION OF BILATERIA

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Generations of students learn that all bilaterally symmetrical animals belong to either Deuterostomia or Protostomia, a fundamental grouping that was originally based on whether the primary embryonic opening, called the blastopore, becomes the mouth or the anus of the adult. This division has prevailed for over 100 years, and has influenced nearly all views on animal evolution. However, gastrulation in Protostomia is vastly variable. To identify the mechanisms underlying the recurrent evolution of these two embryonic patterns, we compared the development of two related species of brachiopods that have similar ecological and reproductive strategies, but surprisingly display deuterostomic and protostomic development respectively. The investigation of the establishment of the axial polarity and fate identity during embryogenesis demonstrated that the protostomic species undergoes an extensive re-patterning of the blastoporal rim that relates to the cooption of the blastoporal orifice into the mouth opening. The differential deployment of Wnt signaling around the vegetal pole, together with the timing and location of mesoderm formation, influence the differential behavior and fate of the blastopore in these two species of brachiopods. Importantly, similar developmental principles may act during gastrulation in protostomic annelids and deuterostomic priapulids. Our findings demonstrate that blastoporal fates are recurrently appeared developmental by-products. Our study thus challenges the long-standing evolutionary emphasis on extant blastoporal behaviors to explain the origin and diversification of bilaterian animals.

ID: 473

TOWARDS A CELLULAR AND MOLECULAR UNDERSTANDING FOR THE EMBRYONIC ORIGINS OF AXIAL ORGANIZATION IN THE ANTHOZOAN *NEMATOSTELLA VECTENSIS*

A2 Oral

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Anthozoan cnidarians are epithelial animals with pronounced oral-aboral axial organization. The oral pole forms at the animal pole as it does in most bilaterians, however the site of gastrulation (endomesoderm formation) also occurs at the animal pole in anthozoans, not the vegetal pole as it does in most bilaterians. Distinct components of gastrulation are controlled by the canonical and the PCR Wnt signaling pathways. The ligand independent canonical wnt pathway located at the animal pole prior to first cleavage activates anterior (NvAx6) in the animal/oral hemisphere and central/posterior Hox genes (NvAx1) in the vegetal/aboral hemisphere prior to gastrulation that pattern the entire oral-aboral axis. Hox genes mutually antagonize each other and regulate canonical Wnt, BMP, and ERG pathways that activate pharyngeal genes including NvBrachyury. NvBrachyury is required for the expression of oral Wnt gene expression that subsequently patterns the entire oral-aboral axis, including genes expressed at the aboral pole. In addition, we show that Par genes are not involved in embryonic polarity (as they are in bilaterians) and that the site of gastrulation is labile and not fixed maternally . We can make endoderm form at any place in the embryo by the ectopic expression of the canonical Wnt signaling pathway. These data are consistent with the idea that the mouth is homologous in all metazoans and forms at the animal pole, and that the site of gastrulation moved from the animal pole (in ctenophores and cnidarians) to the vegetal pole in the common ancestor of the Bilateria.

ID: 108

THE EVOLUTION OF XENACOELOMORPH MORPHOLOGIES. A MODEL TO UNDERSTAND THE ORIGIN OF BRAINS

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The emergence and diversification of bilateral animals are amongst the most important transitions in the history of life on our planet. Our lab's major aim is to provide answers to the questions: How did complex body plans arise in evolutionary time? How are complex body plans are "encoded" in the genome? As the first step, we will focus on the earliest stages in bilaterian evolution, probing the most elusive organisation of the genomes and microscopic anatomy in basally branching taxa, which are currently assembled in a clade named Xenacoelomorpha This enigmatic phylum is composed of three major taxa: acoel flatworms, nemertodermatids, and xenoturbellids. Interestingly, the constituent species of this clade have an enormously varied set of morphologies; not just the obvious external features but also their tissues present a high degree of constructional variation. This interesting diversity of morphologies (a clear example being the nervous system, with animals showing different degrees of compaction) provides a unique system in which to address outstanding questions regarding the parallel evolution of genomes and the many morphological characters encoded by them. A systematic exploration of the anatomy of members of these three taxa, employing immunohistochemistry, in situ hybridisation and high-throughput TEM, will provide us with the reference framework necessary to understand the changing roles of genes and gene networks during the evolution of xenacoelomorph morphologies, with a special focus on the nervous system.

ID: 175

A2 Oral

PROTOSTOMY, DEUTEROSTOMY OR AMPHISTOMY: EVOLUTION OF BILATERIAN MOUTH AND ANUS

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Evolution of the bilaterian tubular gut with mouth and anus from an ancestral cnidarian-like ancestor with a sack-shaped gut is much debated. Four main theories: Protostomy (blastopore became mouth), deuterostomy (blastopore became anus), amphistomy (blastopore split in two by lateral fusion of its lips), and epiboly (blastopore closure by epiboly). We attempt a synthesis, concentrating on five characters: 1) Fate of the blastoporal opening: Highly variable and unsuited for ancestral state reconstructions. 2) Fate of circumblastoporal tissues studied by cell-lineage, especially of spiral-cleaving species; these tissues often surround the mouth and continue posteriorly along a lateral fusion of the blastopore lips. The anus may be the posterior part of the blastopore, but more commonly, it opens secondarily in a posterior group of these cells. This is interpreted as modified amphistomy. 3) Gene expression in circumblastoporal tissues indicates an amphistomy in virtually all bilaterians, with blastoporal marker genes *brachyury* and *foxA* expressed around the mouth, along the ventral midline and around the anus, *goosecoid* expressed around the mouth and cdx and evx around the anus. 4) Ontogeny and morphology of central nervous systems: A main, ventral nervous system with paired longitudinal nerve cords sometimes with loops around mouth and anus, i.e. along the blastoporal lips. 5) Larval ciliary bands: Proto-, meta- and telotroch of the trochophora larvae develop at the cells of the blastoporal edge, and the fate of both these bands and their accompanying ventral nervous system reflect ancestral amphistomy. Together, these five lines of evidence strongly support ancestral amphistomy.

ID: 318

DIVERSITY OF NERVOUS SYSTEM PATTERNS IN THE EARLIEST BILATERIANS, NEMERTODERMATIDA AND ACOELA

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The early steps of nervous system (NS) evolution in Bilateria still remain enigmatic. Nemertodermatida are microscopic marine worms that together with Acoela and Xenoturbellida form the Xenacoelomorpha, sister group of all other bilaterian animals. Nemertodermatid morphology is generally less derived than that of Acoela. The NS patterns in four nemertodermatid species were investigated by confocal microscopy and immunohistochemistry with anti-tubulin, anti-5-HT and anti-FMRFamide antibodies.

The NS of *Flagellophora* is composed of a large neuropile and a loose brain with nerve fibres innervating the frontal broom organ. *Sterreria* shows a concentrated commissural-like brain similar to acoels. *Nemertoderma* has a basiepidermal brain ring and a pair of ventro-lateral neurite bundles. Meara has no brain but only of a pair of basiepidermal lateral neurite bundles. The innervation of the gut in Nemertodermatida is apparently absent similar to the condition in *Xenoturbella*. Thus the hypothetic ancestor of Nemertodermatida likely had an almost cnidarian-grade NS with no brain and no stomatogastric NS.

Within Xenacoelomorpha, *Xenoturbella* has a cnidarian-grade basiepidermal NS with no centralisation. The NS of Nemertodermatida displays considerable plasticity. In acoels, the NS evolution occurs not in the Acoela as a whole, but takes place independently in various smaller monophyletic acoel branches (i.e. species of one genus). There is parallel evolution of a deep-lying concentrated dorsal brain starting from an ancestral loose surface network-like brain.

The study was supported by ZIN RAS (NIOKTR: AAAA-A17-117030110029-3), RFBR 16-04-00593 and 15–29–02650.

ID: 404

A2 Invited

THE TRANSITION TO BILATERIA – A REVIEW OF THOUGHTS AND CONCEPTS

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In my talk I will try to review thoughts and concepts on the origin of Bilateria through time and compare them to “modern” results. Bilateria, the bilaterian ancestor and the transition to bilaterally organized animals has fascinated researchers for a long time. They correspond to the concepts of evolution and evolutionary reconstruction. Especially in the 50s to the 70s, there was a broad range of hypotheses and scenarios for the transition to Bilateria. With the change to phylogenetic systematics, the reconstruction of ancestors came stronger into focus. With the strengthened investigation of model species, conclusions about ancestors were often derived from comparison of model species only. With the recent availability of growing datasets including genetic, genomic and developmental evidence there is the chance to test hypotheses on the transition to Bilateria. Finally the contribution of paleontology is integrated.

ID: 145

MAIN PATHWAYS OF EVOLUTION OF SPERMATOZOA OF ACOELOMORPHA AND FREE-LIVING PLATHELMINTHES

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On the basis of original and literary data on ultrastructure of spermatozoa and their formation the reconstruction of main pathways of evolution of male gametes of Acoelomorpha and free-living Plathelminthes is proposed. Two species of Acoela – *Archaphanostoma agile* and *Convoluta convoluta* – and five species of free-living flatworms from different taxa – *Monocelis fusca*, *M. lineata* (Proseriata), *Uteriporus vulgaris* (Tricladida, Maricola), *Provortex karlingi* (Rhabdocoela, Dalytyphloplanoida) and *Macrorhynchus croceus* (Rhabdocoela, Kalyptorhynchia) – have been investigated. Specimens were collected on the littoral zone of various islands of Keretskii Archipelago (White Sea), fixed in the 1% glutaraldehyde and studied with transmission electron microscope JEM 100 CX by the standard methodics. During the evolution of Acoela the axoneme formula of spermatozoa is modified and the position of free microtubules is reorganized. Evolutionary changes of spermatozoa of Plathelminthes are represented firstly by the locomotory apparatus (incorporation of flagellae, change of an axoneme formula and configurations of free microtubules), then by organization of nuclear material. And finally in specialized groups the oligomerization of mitochondria and additional inclusions occurs. In the spermiogenesis of Acoela and the advanced flatworms the specific peculiarities of ancestral forms, representing the examples of recapitulation on the cellular level, are described. The similarities and the differences of the sperm ultrastructure and spermiogenesis in Acoelomorpha and Plathelminthes are discussed in evolutionary-morphological aspect.

ID: 382

A2 Oral

THERE AND BACK AGAIN (AND AGAIN) - EVOLUTION OF BILATERALITY IN DEUTEROSTOMES

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Zoology textbooks explain the evolutionary origin of bilaterality in animals with the acquisition of a vagile and benthic mode of life and the subsequent concentration of sensory receptors at the anterior end. In this scenario, the evolution of the concentration of sensory cells at the anterior end is followed by the evolution of a close-by brain, the increase in complexity of the sensory structures, and the evolution of more complex behaviors. One corollary of this textbook explanation is its implied contrast of vagility with sessility or a planktonic life style as corresponding to radial symmetry or asymmetry and simplicity in anatomy. Within deuterostomes the switch between benthic, planktonic, and sessile life-cycles occurred repeatedly and independently in the phylogeny of separate clades. Analyzing several examples on different organismal levels, I argue that none of the anatomical consequences of the evolution of new life-history traits is necessarily coupled as had been suggested in the aforementioned textbook explanation. After discussing comparative analyses of 4D-microscopic data, of ultrastructural morphological analyses, and of neuroanatomical studies, I emphasize the need to inspect each individual evolutionary transformation separately in order to be compliant with an evidence-based phylogenetic hypothesis, an inferred probable sequence of ground patterns, and the deduced evolutionary pressures.

ID: 307

A2 Oral

IS THE ANNELID PYGIDIUM A SEGMENT?

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According to a classical point of view, the annelid pygidium is an unsegmented part of the body. However recent studies on Nereidid polychaetes revealed that in this group the pygidium has some characters that are strikingly similar to the trunk segments. The aim of this work is to provide a comparative research of the pygidium morphology in different polychaete groups using CLSM, immunohistochemistry as well as series of semithin and histological sections to analyze the distribution of this unusual organization among other annelids. The obtained data suggest that the annelid pygidium is far more complicated than usually mentioned. We found a well-developed musculature and nervous system in this part of the body. Despite the high level of morphological variability, we followed some trends in pygidial evolution and reconstructed the hypothetical basic plan of the pygidial nervous and muscular systems. The pygidial coelomic cavity, that was found in Nereidids, was not found in the majority of other polychaete families examined. Our results show that annelid pygidium possesses several segment-like characters, however, it is still unclear whether these similarities represent homologies or convergences. The obtained results may contribute to concepts of the evolution of annelid segmentation.

The work was performed at the Research park of St.Petersburg State University Centers for Molecular and Cell Technologies, Culturing Collection of Microorganisms, and “Chromas”. The research was supported by RFBR grant № 16-34-60134.

ID: 396

A2 Oral

ARE THE LOPHOPHORATES MONOPHYLETIC?

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The status of the Lophophorates is one of the central problems of current zoology. There is a contradiction between the molecular results, which mainly indicate the polyphyly of the lophophorates, and morphological results, which indicate the monophyly of the lophophorates. An understanding of lophophore innervation in adult lophophorates can help answer question about the status of the lophophorates. Data on the lophophore innervation, which were obtained by methods of immunocytochemistry, transmission electron microscopy, and laser confocal scanning microscopy in species from all three groups of the lophophorates, are summarized in this report. According to morphological results, the lophophore has several main nerves that are homologous among different lophophorates. The main brachial nerve of brachiopods is homologous to the dorsal ganglion of phoronids and to the cerebral ganglion of ectoprocts. The accessory brachial nerve of brachiopods is homologous to the minor nerve ring of juvenile phoronids and to the circum oral nerve of ectoprocts. The lower brachial nerve of brachiopods is homologous to the tentacular nerve ring of phoronids and to the outer nerve of ctenostome ectoprocts. Morphological data on the lophophore innervation indicate that the Lophophorata is monophyletic group including three phyla: Phoronida, Brachiopoda, and Bryozoa. Contradiction between morphological and molecular results might be explained by of bryozoans, whose evolution was associated with great morphological and, apparently, molecular changes. To reject the lophophorates monophyly we should suggest the independent origin of the lophophore – specific tentacular structure having specific innervation – in both Bryozoa and Brachiozoa. Project is supported by RFBR (17-04-00586).

ID: 322

ARE BRACHIOPODS SEGMENTED? IMPLICATIONS FOR THE EVOLUTION OF THE BILATERIAN HEAD/TRUNK BOUNDARY

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Adult brachiopods do not have a segmented trunk. However, the body of larval brachiopods show putative segmented structures in the ectoderm and mesoderm, such as epithelial boundaries and coelomic sacs. To better understand the development and evolution of these intriguing larval traits, we analyzed the embryonic development and the expression of typical "segmentation genes" in the brachiopods *Terebratalia transversa* and *Novocrania anomala*. Our morphological and molecular data indicate the ectodermal boundaries are not repeated, but unique structures along the anteroposterior axis. Both species exhibit an anterior ectodermal furrow, demarcated by the complementary domains of pax6 and pax2/5/8, and by a stripe of *engrailed* expression, which corresponds to the embryonic head/trunk boundary. Even though *wnt1* is expressed adjacent to *engrailed* in *T. transversa* – a pattern similar to the parasegmental boundaries of arthropods – the expression of *hedgehog* does not support a segment polarity role in brachiopods. Instead, the molecular profile of the embryonic head/trunk boundary of brachiopods resembles that of other non-segmental anterior boundaries of bilaterians, such as the collar/trunk boundary of hemichordates. In particular, several bilaterians express *engrailed* in the anterior-most portion of the trunk early in development, suggesting that a non-segmental *engrailed* domain might be an ancestral trait, potentially involved in the establishment of the embryonic head/trunk boundary – an ancient and perhaps defining feature of bilaterians.

ID: 131

THE ULTRASTRUCTURAL ORGANIZATION OF ACOELA AND THEIR PHYLOGENETIC RELATIONSHIPS

A2 Oral

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Acoela represent one of the most spectacular taxa in animal kingdom. Their phylogenetic position as well as a taxonomic rank widely varies in zoological literature from the order of flatworms to the separate phylum within the deuterostomes or the sister taxon of all other bilaterians. One of the reasons of the absence of consensus among morphologists and molecular biologists is the insufficient amount of fine structural data on Acoela. In the present work the new ultrastructural features of four species of Acoela (*Archaphanostoma agile*, *Otocelis rubropunctata*, *Symsagittifera japonica* and *Amphiscolops sp.*) from different families are described. Along with the archaic characteristics the new apomorphic morphological features of epidermis, body wall musculature and central syncytial parenchyma of species studied were found. The cellular organization of acoels is characterized by the wide morphological diversity, however no significance of the secondarily simplification was found. The alternative views on phylogenetic affinities of Acoela are discussed, and the conclusion of progressive but not regressive evolution of this invertebrate group is proposed.

PHYLOGENOMIC EVIDENCE DISENTANGLES AFFINITIES OF THE MESOZOA

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Orthonectida and Dicyemida are enigmatic animal groups that witnessed long years of hot disputes among evolutionists and comparative morphologists regarding their true affinities in the animal world. These minute parasitic forms possess aberrant metagenetic life cycles and intriguing body plans that always provoked contradictory hypotheses. Historically, they were coined together as the Mesozoa to represent the relict link between protists and multicellular animal life. This view was challenged recently by studies of morphology and molecular phylogenetic analyses. We report results of phylogenomic studies based on originally obtained genomic and proteomic data on the orthonectid *Intoshia linei* and a dicyemid *Dicyema* sp. We constructed and analyzed multigene datasets that largely encompass available genetic diversity of lophotrochozoan animals. The results evidently suggest that orthonectids are members of crown Spiralia, while dicyemids occupy a basal position to the Lophotrochozoa. We report that the Orthonectida and Dicyemida are lineages of bilaterian animals that evolved independently by dramatic morphological reduction most likely associated with unique parasitic lifestyles. Adaptations in I. linei are associated with considerable reduction of metazoan developmental genes to a limit that might be considered a "survival gene kit" for a bilaterian animal form.

Research was supported by the Russian Science Foundation (project 14-50-00150).

A3 THE GENOMIC BASIS FOR MORPHOLOGICAL EVOLUTION

Organizers: Dr. Andreas Hejnol, Dr. José M. Martín-Durán

ID: 401

A3 Oral

STOLONAZING SYLLIDS: ULTRASTRUCTURAL AND TRANSCRIPTOMIC APPROACH

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Syllids are well-known for their remarkable reproduction, that involves the formation of a peculiar reproductive structure, called stolon, usually resembling the adult but containing only gametes. The stolon is formed in the posterior end of the adult (stock) and, when mature, it is released into the water column where spawning occurs. To further understand the reproductive biology of syllids, we have developed a study during the stolonization process, using two different approaches: 1) the study of the ultrastructure of female and male stolons (and the gametes) during their development, and 2) the analyses of the molecular toolkit underlying the cellular processes that occur during stolons formation. Transmission electron microscopy was used to describe female and male stolons of five species and Illumina RNA-seq was used in one species to characterized the gene expression of the final part of the stock and the female and male stolons. Different states of developmental gametes were found among species, but overall, our results showed that the gamete formation starts in the stock but finalizes in the stolon. The differential expression analyses also showed that the genes involved in the onset of oocyte and sperm formation are expressed in the final part of the stock, whereas others related with the maturation of gametes were overexpressed in the stolons. Our study sheds light into the stolon formation process by providing insight into the morphology of the structures in several syllid species and also improves the knowledge of gametogenesis/germ line-related genes that regulate stolonization.

ID: 371

WNT PATHWAY IS IMPLICATED IN AXIAL PATTERNING AND REGENERATION IN THE DEMOSPONGE *HALISARCA DUJARDINI*

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A3 Poster

In Eumetazoans, the Wnt pathway is involved in multiple processes during development and regeneration, including symmetry breaking, body and organ patterning, morphogenesis, cell fate determination, proliferation, polarity and migration. All key components of the Wnt pathway are present in sponges, and the pathway is implicated in patterning of body axis during embryonic development and adulthood. Intriguingly, complexity of the Wnt pathway differs dramatically between previously studied representatives of demosponges (*Amphimedon queenslandica*) and calcisponges (*Sycon ciliatum*), as exemplified by presence of only three Wnt ligands in *Amphimedon* versus 21 in *Sycon*.

Halisarca dujardini is a demosponge very distantly related to *Amphimedon*, and its development and regeneration are well studied at morphological level. We have used Illumina technology to sequence transcriptome and generate preliminary draft assembly of the genome of this species. Multiple Wnt pathway components were identified, including ten Wnt and five *frizzled* genes, in addition to single *disheveled* and *beta-catenin* genes. Thus, the complexity of the pathway is intermediate between the previously studied sponges, and appears to be derived from independent gene loss and expansion events.

We are now investigating expression of the Wnt pathway components in intact and regenerating adult *Halisarca*. So far we have found that transcripts of at least four Wnt genes are differentially expressed along the body axis, and one is expressed in cells at the edge of wound during regeneration.

Financial support by Russian Foundation for Basic Research №16-04-00084 and the Russian Science Foundation №17-14-01089 is gratefully acknowledged.

A3 Invited

AN ALTERNATIVE FATE OF CHORDATE GENOMES EXEMPLIFIED BY THE RAPIDLY EVOLVING LARVACEANS

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Tunicates have for long been considered as proxys of the ancestral chordates, due to their low complexity and divergence from cephalochordates and vertebrates. This view was severely questioned when at last robust phylogenetic trees of chordates placed tunicates as the sister group of vertebrates. Tunicates may well represent the outcome of an anatomical regression from a more complex ancestor. One of the two genomes used in these trees was from the larvacean *Oikopleura dioica*, a pelagic species that keeps its tail throughout a very short life cycle. We will say a word about the development of *Oikopleura* and about its house, a spectacular innovation of larvaceans.

The evolution in larvaceans has been unusually rapid. The genome of *Oikopleura* lost the majority of old introns and virtually all ancient syntenic associations. In examining its numerous new introns, we found support for classical but weakly documented mechanisms of spliceosomal intron gain. To reconstruct the history of genome changes, we built and compared genome datasets from multiple larvacean species. While some specific features have been conserved among these genomes (e.g. the gene complement), others have considerably diverged such as coding sequences, genome sizes, or introns. We have focused on a novel type of non canonical introns that has invaded the genome in another larvacean family and will discuss their possible origin. Strikingly, all these species seem to have lost NHEJ, a major pathway for the repair of double strand breaks (DSBs). With two approaches, we could observe that *Oikopleura* instead repairs DSBs with a mechanism that exploits microhomologies near the break, as does the MMEJ pathway. Why larvaceans can have lost NHEJ is puzzling, but this loss may have to do with their very rapid evolution.

ID: 474

PHYLOGENETIC COMPARATIVE METHODS ARE CRITICAL TO THE INTEGRATED STUDY OF MORPHOLOGICAL AND GENOMIC EVOLUTION

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A3 Oral

Studies of morphological and genomic evolution are still isolated in many respects. Methods for the analysis of morphological evolution are more mature since they have had a head start of more than a century over genome evolution. Past decades of work on morphological evolution have driven the refinement of phylogenetic comparative methods, including independent contrasts, phylogenetic least squares, and related statistical tools. These phylogenetic methods test explicit historical hypotheses of trait change and have clear evolutionary interpretations. While there has been great progress in the phylogenetic analysis of molecular sequence evolution, comparative studies of genome function (including gene expression) have largely neglected advances in phylogenetic comparative methods and instead often rely on pairwise comparisons between species. Recent work has shown that these pairwise comparisons, which do not take species relationships into account, can be misleading and are a missed opportunity to test explicit evolutionary hypotheses. The application of phylogenetic comparative methods that were first developed to study morphology to the study of genome structure and function can advance the study of genome evolution and provide a single integrated perspective on the evolution of both morphology and genomes.

THROUGH THE LOOKING-GLASS:
THE MORPHOLOGICAL BASIS FOR GENOME EVOLUTION

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A3 Oral

1. Objectives

Although the triangular relationship between genomics, morphology and evolution is usually envisioned under the angle of genomic influencing morphological evolution, I would like here to turn the problem around and consider the opposite direction: does the morphology of organisms influence the evolution of their genome, and if so, is it possible to infer some of the morphological traits of an organisms by looking solely at its complete or partial genome sequence?

2. Material and methods

Draft genome sequences were obtained using a variety of approaches depending on the genome size and heterozygosity level of the particular organism under study. In each case presented here, I looked at whether signatures of one particularly strong morphological feature (differentiated sexes, or the lack thereof) could be detected in the genome of the organisms under consideration.

3. Results

In each case, some reasonably strong signature of differentiated sexes vs. ameiotic evolution could be inferred that was congruent with the known sexual phenotype of the species under consideration. Unexpectedly, the more useful source of information was chromosome-scale genome structure, whereas gene-scale features were comparatively less informative.

4. Short discussion and conclusions

These preliminary findings suggest that morphology of organisms imprints genomic sequences signatures strong enough for one to be able to detect them and decipher them. This raises hope for inferring the morphology of organisms solely from genomic data, which could be particularly useful when trying to make sense of environmental DNA sequences.

ID: 466

THE SIGNIFICANCE OF ACONTIA FOR THE TRADITIONAL CLASSIFICATION OF ACTINIARIA. CONFLICT OF MORPHOLOGICAL SYSTEMATICS AND MODERN OPINIONS BASED ON THE STUDY OF MOLECULAR MARKERS

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In the order Actiniaria one of the largest group of sea anemones Acontiaria was defined by Carlgren on the basis of the presence of special stinging organs — acontia. Inside it, the division into families was carried out according to a set of stinging capsules, which equip acontia. With the improvement of optical and electron microscopy, further study of stinging capsules led to a change in their formal classification, which violated the strictness of family diagnoses.

Published in recent years attempts to improve the system undertaken with the help of molecular-genetic methods led to paradoxical results. On the branches of phylogenetic trees, many closely related genera were isolated, and on schemes constructed using different markers (12S, 16S, 18S, 26S) they occupied very different positions. To clarify the reasons for the inconsistency of molecular data with traditional morphological classification, I conducted a pairwise comparison of the same sections of mtDNA. Pairwise comparison of the nucleotide sequences of mitochondrial genes showed the accumulation of multiple substitutions in some parts, indicative of a long independent evolution, and complete identity in other parts. These results, it seems to me, can be explained by the presence of recombination between the divergent regions of mtDNA and the unchanged regions, preserved in the nuclear genome of the cell in the form of *numts* — nuclear copies of mitochondrial DNA.

ID: 414

THE ORIGIN OF BILATERIA IS CONNECTED WITH A JUMP IN THE ORIGIN OF ORTHOLOGS OF SEVERAL FUNCTIONAL CLASSES OF HUMAN GENES INCLUDING THOSE SPECIFICALLY EXPRESSED IN TUMORS

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Objectives.

Human genome contains many genes with tumor-specific expression that are evolutionary novel (TSEEN genes) (Kozlov, 2014). In this paper we performed the study of the phylogenetic distribution of orthologs of different classes of human genes.

Material and methods.

The orthologs of human housekeeping genes, oncogenes, differentiation genes, tumor suppressor genes, homeobox genes, apoptose genes, BMC globally subtracted tumor-specific sequences, cancer-testis (CT) antigen genes and all annotated protein coding genes were studied by ProteinHistorian and HMMER tools in 26 completely sequenced eukaryotic and prokaryotic genomes, including 5 genomes of invertebrates.

Results.

The curves of phylogenetic distribution of orthologs form three clusters. Oncogenes, tumor suppressor genes and differentiation genes form the evolutionarily oldest cluster. Homeobox, apoptotic, CT-autosomal and BMC globally subtracted protein-coding genes form the intermediate cluster. The third cluster is formed by TSEEN genes (CT-X-antigen genes and BMC globally subtracted tumor-specific non-coding RNAs). The slope of all curves of the first and second clusters increases sharply during the period between the origin of multicellular organisms and Bilateria.

Short discussion and conclusion.

Differentiation genes coevolve with oncogenes and tumor-suppressor genes. There is a jump in the origin of evolutionarily novel genes associated with the origin of Bilateria.

The results will be discussed in the light of the hypothesis of the possible evolutionary role of heritable tumors (Kozlov, 2014). The spread of tumors in invertebrate multicellular organisms will be discussed.

A.P.Kozlov, “Evolution by Tumor Neofunctionalization”, Elsevier/Academic Press, 2014.

ID: 337

THE ROLE OF HOMEOBOX GENES IN THE DEVELOPMENT OF OIKOPLASTIC EPITHELIUM, THE EVOLUTIONARY NOVELTY OF LARVACEANS

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A3 Poster

Oikopleura dioica is a pelagic tunicate that produces the complex filter-feeding house by a monolayer of the trunk epithelium cells. The house and oikoplastic epithelium of Larvaceans are evolutionary novelties, the structures that display no clear homology with more ancient tissues or organs. We wondered what kind of genes may play a role as upstream regulators of oikoplastic epithelium development. Using the candidate gene approach and *in situ* screening, we found that multiple homeodomain transcription factors have been recruited in gene pathways governing the development of the oikoplastic epithelium. To confirm the role of homeobox genes in the epithelium development we investigated the function of two prop duplicated genes using RNAi knockdown. This alteration leads to morphological malformation on and around the dorsal midline of the trunk epithelium and specific down-regulation of one oikosin gene (oik41a) that start its expression later in the same region where the prop genes are expressed.

Our study revealed that quite a few homeobox genes are involved in the development of the oikoplastic epithelium most of those have duplicates and what is more both duplicates are expressed in a similar region of the epithelium. This suggests that the epithelial expression preceded the gene duplication events, which were not crucial for the genesis of the house via the oikoplastic epithelium emergence.

If the functional divergence of duplicated homeobox genes represents more than a simple division of work (subfunctionalization), they may have played a role in the complexification of the oikoplastic epithelium and of the house architecture.

ID: 392

A3 Poster

COMPARATIVE STUDY OF THE EXPRESSION OF CANDIDATE GENES FOR HEMATOPOIESIS IN DIFFERENT ANIMAL LINEAGES

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Circulatory systems in animals are very variable and are mainly classified in open and closed systems. However, although the majority of metazoan groups have a circulatory system, it is absent in some clades. Furthermore, there are also few taxa that do not possess blood. In these groups, blood functions are performed by other means (eg. gas diffusion or nutrient transport by the digestive system). Blood forms in specialized proliferative domains in the mesothelium or in a compact hematopoietic organ. In some invertebrates, as *Drosophila*, this organ is called lymph gland and is attached to the coelomic cavity or to blood vessels. Although blood and hematopoiesis have been widely described in *Drosophila*, mice and humans, they are poorly understood in other groups. As a consequence, the homology of blood is unsolved. Thus, in order to understand the evolution of blood it is important to study hematopoiesis in animals at key positions in the evolutionary tree. In order to clarify the molecular background of hematopoiesis we studied the expression pattern of candidate genes in animals with a closed circulatory system (nemerteans), with an open circulatory system (brachiopods and rotifers) and in animals that do not have blood (acoels). Currently, we are in the process of identifying hematopoietic specific genes that are shared between lineages. Here, I present the gene expression patterns of several hematopoietic candidate genes (eg. GATA123/Srp, AML1/Lz, Gcm, Fog1/Ush, Collier). We complement this study with Single-cell sequencing analyses in order to discover new hematopoietic candidate genes.

ID: 246

EVOLUTION OF HOMEOBOX GENES AND THE ANIMAL KINGDOM

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A3 Oral

Homeobox genes comprise more than 100 families of transcription factors with an iconic role in the study of animal development. Some are among the best studied genes in evodevo, such as the Hox genes, but the evolution of the whole homeobox complement across metazoans has been only possible thanks to recent developments in the field of genomics. Here we combine the findings of three different studies that mined large datasets of animal genomes and used molecular analyses to understand the evolution of these transcription factors.

We will show the origin of novel homebox gene families in different lineages of the superclade Lophotrochozoa and their expression patterns using 36 developmental transcriptomes from a species of mollusc. A second case will explore a major simplification of the homeobox complement in the lineage leading to parasitic flatworms. Finally, the relationship between different groups of homeobox genes and the origins of animal will be discussed. Overall, these results illustrate that the homeobox complement is more dynamic than previously thought, and prove the tight association between changes in the number of these genes and major morphological transitions.

ID: 390

A3 Oral

THE GENOMIC BASES OF REGENERATION, DEVELOPMENT, GROWTH AND REPRODUCTION IN SPONGES

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Sponges, being one of the first branching phyla from the metazoan stem lineage, contain essential clues to understand the origin of multicellular animals and the evolution of organ systems. They have long been regarded as simple, even metaindividual animals, but the publication of several genomic resources have helped us to understand that they are in fact molecularly complex animals whose body plan and structures are not yet fully understood. In the recent years, we have focused on several basic processes of sponge biology, including reproduction, embryogenesis, development of their body plan, and regeneration, using morphological and molecular techniques.

Using genomics and transcriptomics, we have been able to characterize the molecular toolkits for germ cell specification, sex determination and development. We have examined also genes involved in the formation of the aquiferous system and the regeneration pathways involved in wound repair in several species of the four classes of sponges, including both marine and freshwater demosponges. In addition, we have been able to describe the cellular and histological features that are at the center of those processes, using light and electron microscopy. Here we discuss the evolutionary implications of our recent discoveries of shared genetic pathways with more complex metazoans, and how that changes our understanding of sponge morphology and biology.

ID: 369

UNDERSTANDING DIFFERENCES IN HYDROZOAN MORPHOLOGIES THROUGH THE LENS OF GENOMICS

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Diversity in morphology and life cycle is a hallmark of hydrozoan cnidarians. Hydrozoans are a group in which the polyp is often the dominant life cycle phase, e.g. in *Hydra* and *Hydractinia*, while other hydrozoan genera alternate between polyp and medusa phases (e.g. *Clytia*, *Podocoryna*), and still others have a greatly reduced or absent polyp phase. Many hydrozoans are colonial (e.g. *Hydractinia*, *Podocoryna*) while others are solitary (e.g. *Hydra*). Most hydrozoans use diverse reproductive strategies and can undergo both sexual and asexual reproduction. We have sequenced and assembled the genomes of two species of *Hydractinia* (*H. echinata* and *H. symbiolongicarpus*) with PacBio single molecule long-read sequencing and Dovetail scaffolding technologies and are comparing these assemblies to a recently improved genome assembly of *Hydractinia*. Using synteny analyses, orthology inference, and comparisons of taxon-specific genes, we are gaining insight into the similarities and differences in their genomes with the ultimate goal of shedding light on their morphological differences. The addition of more hydrozoan genomes, such as *Clytia hemisphaerica* will help further detail the genomic underpinnings within the group. As more cnidarian genomes become available, additional comparisons with members of other cnidarian groups (scyphozoans, cubozoans, staurozoans, myxozoans, anthozoans) will highlight the unique and conserved features within this fascinating and varied phylum.

ID: 325

MECHANISM OF PEPTIDE REGULATION OF MORPHOGENESIS OF ANIMALS AND PLANTS

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Molecular mechanisms of biological processes are unified for all living systems. Universal processes of cell proliferation and differentiation underlie the growth and morphogenesis of both plants and animals. General mechanisms for the regulation of the morphogenesis of animals and plants at the epigenetic level have so far been little studied. This also applies to the mechanisms of peptide regulation of cell proliferation and differentiation. The purpose of this work is to study the regeneration of planaria *Girardia tigrina* under the action of a biologically active peptide in ultra-low concentrations.

Regeneration of the planaria is regulated by various biologically active peptides of animals and humans, being morphogenesis.

The peptide pCLV3 is expressed in the stem part of the *Arabidopsis thaliana*, affecting the growth and development of the terrestrial part and roots of the plant. In this thesis, the effect of a plant-derived peptide pCLV3 from the CLV3 protein, at concentrations of 10-9 M, 10-12 M for the regeneration of planaria, was first studiedation. The area of planarians and their blastems were carried out with the help of the Plana 5.0 software package, and the analysis of the shape of the blastema, i.e. Morphogenesis - with the help of the program Wormeter.

Morphometric control showed that the growth and morphogenesis in the experimental groups was faster than in the control groups. The peptide CLV3 accelerates the regeneration of the planaria by 1.46 times, being a catalyst for the regeneration process.

B1 FUNCTIONAL EVOLUTION AND MORPHOLOGY OF THE NERVOUS SYSTEM

Organizers: Dr. Hans-Joachim Pflueger, Dr. Pavel M. Balaban, Dr. Guenter Purschke

ID: 455

B1 Poster

ULTRASTRUCTURE AND MORPHOLOGY OF THE ELYTRUM OF SCALE-WORM *LEPIDONOTUS SQUAMATUS* LINNAEUS 1767 (POLYCHAETA, POLYNOIDAE)

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The prey defensive strategy of the scale-worms can be divided to 3 different strategies. First one is symbiosis, the second defense strategy is to autotomize scales, and the third defense strategy is to curl into the ring and to protect the body by thick scales with big and sharp tubercles. The aim of this paper is to present the morphological, ultrastructural, and immunohistochemical studies of the scale of *Lepidonotus squamatus*. Elytrum of *L. squamatus* is composed from a dorsal and ventral single-layered epithelium covered with cuticle. The middle compartment is crossed by the ramifications of a nervous plexus. Dorsal cuticle is thicker than ventral and bears numerical macrotubercles of irregular shape. Elytrum is innervated by a single ganglion, situated in the base of elytrophor. Both FMRFamide- and 5HT-positive elements are presented in the ganglion. Laterally thick nerve bundles emerge from the elytrum ganglion to the thickness of elytrum. In the proximal part some fine neural processes protrude between the lower lateral margins of the epithelial cells and go inside papillae. In the distal parts nerves are lying in the middle between dorsal and ventral epithelium. We suppose that nerve fibers of neuroglia form a "chanell" inside the tissue, which is filling elytrum.

ID: 477

B1 Invited

FROM NERVE NET TO NERVE CORD AND BRAIN: THE EVOLUTION OF CENTRALIZED NERVOUS SYSTEMS

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Early animals were simple epithelial spheres, composed of cells that resembled their unicellular ancestors. Each cell performed many functions, such as sensing the environment, capturing and digesting small food, and locomotion via beating flagella. Animal evolution then involved repeated folding of the sphere – first into a bi-layered, cup-shaped animal and then into a worm with a bilateral series of gastric pouches. During this process, the various cells lining the outer and inner surfaces diversified into different types involved in sensing, feeding and locomotion that involved both mucociliary creeping and changes of body shape.

Among the diversifying cell types were the first neurons that integrated sensory input and coordinated locomotion in a primordial nerve net.

Subsequent evolution of the nervous system involved the regional specialization of nerve net neurons for local and more demanding coordinative tasks, reflecting the step-wise emergence of the bilaterian morphology with segmental musculature and a head. This triggered the evolution of specialized nervous subsystems that ultimately gave rise to nerve cord, peripheral nervous system and brain.

New comparative studies based on single cell sequencing in different animals now allow tracing this fascinating rise of complexity. I will report new data from sponges, cnidarians, and annelids that elucidate the step-wise diversification of nerve net neurons into the multitude of sensory, motor and interneurons with different slow and fast transmission systems that exist today. The resulting cell type tree sheds new light on the rise of the centralized nervous systems in bilaterian animals.

ID: 250

NEUROTRANSMITTERS IN THE BIOFOULING ZEBRA MUSSEL BYSSAL SYSTEM: AN IMMUNOHISTOCHEMICAL STUDY

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B1 Poster

Zebra mussel (*Dreissena polymorpha*) is a biofouling freshwater bivalve, displaying a high invasion capacity. They attach to surfaces via the byssal threads, originating near the basic part of the foot and which are controlled by the byssus retractor muscle (BRM). Although its morphology and pharmacology have been described in other bivalve species (Satchell 1979, Muneoka, 1991), little is known about the exact pattern of innervation and the functional-morphological background of neuronal regulation, including the chemical neuroanatomy of the neurotransmitter and neuromodulatory systems. Therefore, we have visualized the 5-HT, FMRFamide, MIP, and ChAT containing elements, respectively, in the locomotion (foot) and anchoring (byssus) organs of *Dreissena* by performing fluorescence immunohistochemistry combined with confocal laser microscopy. It was found that the innervation pattern of the BRM was characterized by varicose networks formed by both 5-HT- and FMRFa-IR fibers with branching into thin fibers supplying the finger-like extrusions of the BRM. Scattered ChAT immunoreactive fine processes was also present along the finger-like extrusions, referring to additional cholinergic regulation of muscle function. MIP-IR elements located mainly in the foot and a group of gland cells were also detected. It is assumed that the BRM stands under aminergic and peptidergic influence, modulated by cholinergic transmission. Our results provide a good basis for further physiological and pharmacological characterization of the BRM as a possible target of different environmental cues. In this way a better insight in the successful invasive strategy of *Dreissena*, at least partly related to the proper function of the BRM, can be expected.

ID: 302

B1 Poster

THE FIRST SENSE OF THE NAUPLIUS

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The plesiomorphic developmental mode of the Crustacea is indirect through a free-swimming, planktonic nauplius larva. Characteristic of the nauplius forehead is the presence of apical sensory organs, also known as "frontal filaments". which show a distinct neural connection to a specific part of the brain (i.e. medulla terminalis). In the stem lineage of malacostracan, however, the nauplius stage was replaced by direct development. Only the dendrobranchiate decapods and the euphausiaceans exhibit a nauplius which, as a consequence, is considered to have evolved secondarily.

Here, for the first time, we report the presence of apical sensory organs in the dendrobranchiate shrimp *Penaeus monodon* and in the euphausiid *Meganyctiphanes norvegica* as malacostracan representatives, and we describe in detail their ontogeny and neural connections to the brain. Moreover, we offer an attentive re-examination of the frontal filaments neuro-anatomy in a non-malacostracan representative (i.e. *Elminius modestus*). Our studies are based on the use of SEM, and of nuclear and antibody stainings in combination with CLSM and 3-D reconstruction.

Despite some external morphological differences, all the investigated species show the same neuro-architecture of the apical sensory organs during development: they are among the first neural structures to develop at the apical pole of the animal, their neural connection to the medulla terminalis is identical and, later in development they protrude from the surface of the optic lobe. We discuss the potential homology of these appendages and their role for the question of secondary nauplii in malacostracans.

ID: 244

THE DEVELOPMENT OF THE MEDULLA TERMINALIS IN MALACOSTRACAN CRUSTACEANS: A NEW LOOK AT THE "LATERAL PROTOCEREBRUM"

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B1 Oral

The protocerebrum is the most anterior unit of the tripartite brain of crustaceans and is associated with the compound eyes. Developmental studies on malacostracans have led to the commonly accepted assumption that a 'lateral protocerebrum' has detached from a 'median protocerebrum' during the evolution of this group. In malacostracans, the 'lateral protocerebrum' is connected to the visual neuropils and includes the medulla terminalis and often the hemiellipsoid body.

Here we offer a detailed re-examination of the development of the medulla terminalis in three different malacostracan species by means of antibody staining techniques, CLSM imaging, and 3-D reconstruction, in a consistent and comprehensive developmental sequence. Based on our comparative analyses, we suggest a developmental origin of the medulla terminalis separate from the protocerebrum. Moreover, in the larval stages of anamorphic species, the anlage of the medulla terminalis is closely associated with a pair of frontal sensory organs, which is possibly homologous throughout the major crustacean taxa. These data lead to a new interpretation of the 'lateral protocerebrum' evolution in malacostracans and in crustaceans in general.

ID: 139

PHYLOGENY OF TUNICATA – A MORPHOLOGY BASED ANALYSIS

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B1 Oral

Tunicates are exclusively marine animals and as one of the major chordate taxa possibly closest living relatives to vertebrates. However, tunicate phylogeny remains ambiguous, because molecular phylogenetic studies of the interrelationships of tunicate taxa are contradictory. Furthermore former phylogenetic studies based on morphological characters are limited due to taxon sampling and characters chosen. In order to elucidate chordate evolution we reconstruct the phylogenetic relationships of 19 tunicate families, belonging to all five major tunicate taxa. Our final character matrix includes 70 characters and 45 tunicate and 5 outgroup species. In addition to classical tunicate characters (e.g. structure of branchial basket, body division, colony formation, position of gonads), that traditionally were used in ascidian taxonomy, we focussed on neuroanatomical characters. The latter played a major role in pylogenetic considerations in many other taxa.

Our results show that neuroanatomical characters are quite similar within tunicates in some aspects, but differ considerably in others. The phylogenetic relevance of some characters present in salps such as the absence of the brain-associated neural gland, conspicuous motoneurons, serotonergic neurons, and lateral nerve fiber tracts in the brain is difficult to ascertain, because these characters might be the result of the more active planktonic lifestyle in opposition to a sessile mode of life in ascidians. Our findings help to reconstruct the ground pattern of the last common tunicate ancestor and therefore allow us to draw conclusions on chordate evolution.

ID: 351

CHARACTERIZATION OF A NEW HETEROBRANCH SUPERFAMILY (GASTROPODA)

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Molecular phylogenetic studies proceed in unraveling the phylogeny of heterobranch Gastropoda, one of the largest mollusk clades. Yet especially the root of this tree remains poorly understood because it contains many lineages that are difficult to examine (minute and species-poor) but are also highly interesting (evolutionarily old and distinct).

By using “standard” multigene markers, we found that two hitherto enigmatic genera form a clade equivalent to superfamilial or even supraordinal level, forming the previously unknown sister group to the major crown-clade of Euthyneura. Species of *Tjaernoeia* (formerly “lower Heterobranchia *incertae sedis*”) and *Parvaplustrum* (formerly Cephalaspidea or Acteonacea) both live in deeper-water habitats and are superficially dissimilar, one being a 1 mm-sized snail with a rather flat, globular shell, the other one slightly larger with an egg-shaped “bubble” shell. Microanatomical analysis of histology-based 3D-reconstructions however shows highly similar soft parts, confirming the molecular hypothesis.

We herein show how the headfoot of both genera confirms with most lower Heterobranchia, but that the unusual configuration of head tentacles (bifid) and their nerves (basally bifurcated) may explain how the two pairs of head tentacles in Euthyneura evolved from one pair in lower Heterobranchia. Besides the complexity and novel characters of the reproductive tract, this implicates new scenarios for the evolution of Heterobranchia at the transition between ‘lower’ taxa and derived Euthyneura.

ID: 133

BIOLUMINESCENCE OF A BRITTLE STAR, FROM LUCIFERASE HOMOLOGY TO PHOTOCYTE ULTRASTRUCTURE

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Bioluminescence relies on the oxidation of a luciferin substrate catalysed by a luciferase enzyme. Numerous light emission systems would have co-emerged independently along the tree of life resulting in a plethora of non-homologous luciferases. We used transcriptome and phylogenomic analyses, immunodetections and electron microscopy to identify the luciferase of a luminous echinoderm, the burrowing brittle star *Amphiura filiformis*, and describe its expression pattern as well as the photocyte ultrastructure. The brittle star luciferase is homologous to the luciferase of the sea pansy *Renilla* (Cnidaria), contradicting with the traditional viewpoint according to which luciferases would generally be of convergent origins. Enzymes homologous to the *Renilla* luciferase but unable to trigger light emission were also identified in non-luminous echinoderms and metazoans. Our findings strongly indicate that ancestral non-luciferase enzymes might have been convergently co-opted into luciferases in cnidarians and echinoderms. In these two benthic suspension-feeding species, similar ecological pressures would constitute strong selective forces for the functional shift of these enzymes and the emergence of bioluminescence. In the brittle star, luciferase is specifically localized in the spines that we demonstrated to be the bioluminescent organs *in vivo.* We investigated the ultrastructure of spine tissues in order to identify photocytes and improve our comprehension of the photogenesis phenomenon in brittle stars. All together our study bring new insights on the bioluminescecne of echinoderms and more generally on luciferase evolution.

ID: 434

PHOTOTAXIS IN BRYOZOAN CORONATED LARVAE

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B1 Oral

Rhabdomeric photoreceptors are most commonly found in protostome larvae to facilitate phototaxis. Bryozoan coronated larvae possess simple eyecups and exhibit a strong phototactic response, but only ciliated photoreceptors were described raising questions concerning the evolutionary origin of their eyes as well as well as their phototactic mechanism. Electron microscopic studies in *Tricellaria inopinata* confirmed the ciliary nature of the eye's photoreceptor cells. Gene expression data show that the opsin employed within these photoreceptor cells belongs to the recently identified group of xenopsins and custom made antibodies demonstrate storage of the opsin within the cilia of the photoreceptor cells. While the opsin used to achieve phototaxis is different to other invertebrates, where the mechanism of phototaxis is well understood, co-expression of VAChT with the opsin indicates a similar, acetylcholinergic mode of signal transmission. Consistently, the phototactic response is inhibited by antagonists of nicotinic acetylcholine receptors. Steering is achieved by modifying ciliary beating pattern during the larval typical helical swimming motion. Unilateral ciliary arrest can be observed while spot illuminating a single eyespot, similar to other invertebrate larval phototactic swimming mechanism. Additionally, the opposite side of the body exhibits ciliary arrest right after the illuminated side, suggesting neuronal crosstalk between the lateral sides of the body. 3D EM data are used to analyze the underlying neural circuit. For the first time the involvement of protostome ciliary eyes and the yet enigmatic xenopsin type of visual pigment in phototactic behavior is described in detail and shows interesting similarities to other invertebrate larvae.

ID: 444

B1 Poster

NEUROCHEMICAL CODING OF CENTRAL AND PERIPHERAL NERVOUS SYSTEMS IN LARVAE AND ADULT PACIFIC OYSTER *CRASSOSTREA GIGAS*

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Bivalvia is a large class-level taxon. While our understanding of neuronal development in other molluscan groups has progressed substantially in recent years, reliable data on bivalve neurogenesis are scarce. We described larval neurogenesis in the Pacific oyster Crassostrea gigas (*Bivalvia*) and reinvestivated the morphology of nervous system of adult mollusc. This study encompasses the larval stages from swimming blastula to D-hinge veliger and umbo stages, with detailed descriptions of neuronal differentiation and axonal pathways using neuronal markers (VAChT-, FMRFa-, 5-HT-antibodies). We found the appearance pioneers neurons having different locality at the early trochophore stage and described their role in development of *C. gigas* larval nervous system. We detect peripheral innervation of developing visceral organs by 5-HT-immunopositive (ip), FMRFa-ip and VAChT-ip neurites emerging from central ganglia as well as local FMRFa-ir network within the digestive system at pediveliger. We reinvestigated the morphology of nervous system of adult mollusc and determined neurotransmitter nature of main ganglia and peripheral nervous system.

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ID: 324

ARE DINOPHILID WORMS ARCHETYPICAL POLYCHAETE OR NEOTENIC TROCHOPHORE? INSIGHT FROM EARLY NEUROGENESIS

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B1 Oral

Dinophilidae is a unique group of Polychaeta the representatives of which combine morphological features of different Lophotrochozoan taxa. Moreover, adult dinophilids demonstrate morphological properties of trochophore larva. Such peculiarities may be associated with either archaic origin of this group or neoteny trait. We investigated the early events in the neurogenesis of two dinophilid species: *Dinophilus taeniatus* and *Dinophilus gyrociliatus* using immunocytochemical staining and LCSM. External ciliation was used for embryo staging. In both species the first neural elements revealed by anti alpha-acetylated tubulin antibodies are solitary neurons located in hyposphere at early trochophore stage. Neurites of these early neurons surround the stomadeum and constitute anlagen of paired ventro-lateral longitudinal bundles. During the development the number of neurites increases and they form compact head neuropil, paired ventro-lateral and lateral longitudinal bundles, unpaired medial longitudinal bundle and transverse commissures in ventral hyposphere. Serotonin- and FMRFamide-immunoreactive neurons differentiate adjacent to ventro-lateral bundles and head neuropil, respectively, after the establishment of main structures of the nervous system at middle and late trochophore stages. Tyrosine hydroxylase immunopositive neurons differentiate at periphery at late trochophore stage. Processes of serotonin-, FMRFamide- and tyrosine hydroxylase immunopositive neurons constitute the small portion of tubulin immunopositive neuropil at all described stages. No elements constituting structures like apical organ, aboral organ, or specific pioneer neurons were found. Our results demonstrate that early neurogenesis is similar in two Dinophilus species but different significantly from that of other investigated lophotrochozoans. Based on the described scenario of early neurogenesis we speculated that Dinophilidae represents...

ID: 379

CENTRAL NERVOUS SYSTEM ANATOMY AND EXPRESSION OF MEDIOLATERAL PATTERNING GENES IN THE ROTIFER *EPIPHANES SENTA*

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It has been argued for a shared ancestry of a central nervous system in Bilateria due to a conserved mediolateral patterning system (MPS) in the ventral nerve cord of flies and annelids, and in the dorsal neural tube of vertebrates. By describing the nervous system and locating genes related to the MPS of the rotifer *Epiphanes senta* we test whether the MPS is evolutionarily conserved and congruent with its CNS patterning.

The CNS were visualized by immunohistochemical staining. Genes related to the MPS were expressed using in situ hybridization.

A cerebral ganglion forms the brain dorsally to mastax. A pair of ventrolateral nerve cords forms the CNS with a pair of nerves towards the lateral sense organs and dorsolateral regions. The ventral nerve cords meet posteriorly at the vesicular and caudal ganglia. Two NK2.1 and two NK2.2 paralogs were identified, all expressed in distinct brain domains. The gene NK6 is detected in two posterior cells, likely the vesicular ganglion, and pax6 is expressed in lateral domains of the brain. No consistent expression for pax3/7 and msx were detected. Therefore, most of the analysed MPS genes are expressed in the brain and posterior ganglia of the rotifer *E. senta*, not along the trunk ectoderm and CNS.

If the similarities in mediolateral CNS patterning between vertebrates, flies and annelids reflect the ancestral bilaterian state, then the MPS got independently lost/modified a number of times. Alternatively, the similar patterning role of the MPS in these three bilaterian lineages evolved convergently.

ID: 163

B1 Invited

EVOLUTION OF CRUSTACEAN OLFACTORY SYSTEMS

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Aquatic crustaceans live in a chemosensory world full of chemicals, chemical cues and signals from conspecifics, prey and predators and from the environment. Many malacostracan crustaceans therefore have evolved sophisticated chemosensory systems both for contact chemoreception and distance olfaction. In olfaction, chemicals in the surrounding fluid are detected by specialized sensilla, the aesthetascs, located on the first pair of antennae. Sensory neurons associated with these sensilla transmit signals towards the brain where their input targets primary chemosensory centers. These are connected to secondary olfactory processing centers by interneurons. This contribution will review our current knowledge of the peripheral and central olfactory pathway in crustaceans from receptor molecules to the processing areas in the brain, including terrestrial representatives of the Malacostraca. Evolutionary trends in the architecture of the primary chemosensory centers and numerical aspects of the involved neuronal populations will be discussed. The structure of the crustacean olfactory brain centers and the wiring logic from receptor to output neurons will be compared to that in insects and possible homologies will be highlited. Such comparison stimulates new hypotheses on how crustacean olfactory systems may function. Acknowledgement: some of the research presented in this contribution was supported by DFG grant Ha 2540/13-1.

ID: 164

PERSISTENT NEUROGENESIS IN THE ADULT CRUSTACEAN BRAIN: THE NEUROGENIC NICHE IN *COENOBITA CLYPEATUS* AND *BIRGUS LATRO* (ANOMALA, COENOBITIDAE)

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B1 Poster

For almost 20 years it is known that neurogenesis persists in the central olfactory pathways of adult decapod crustaceans. In the brains of e.g. crayfish, clawed lobsters, and spiny lobsters it has been shown that distinct proliferation zones generate new olfactory interneurons associated with the primary olfactory centers and that the newly born neurons in fact survive and are integrated into the existing circuitry of the central olfactory pathway. Furthermore, in crayfish adult neurogenesis is driven by a neurogenic niche associated superficially with the brain. The niche is a spherical cluster of cells with glial characteristics and a core of extracellular matrix (cadherins), and dextran injections into the crayfish circulatory system showed that the niche is associated with the vascular system. In these animals, fibrous migratory streams from the neurogenic niche serve as pathways from which neuronal precursors from the niche travel towards the two proliferation zones associated with the clusters of olfactory interneurons, collectively called the "deutocerebral proliferative system". We wanted to know if persistent neurogenesis also characterizes the central olfactory pathway of terrestrial crustaceans. To that end, we analyzed terrestrial hermit crabs of the Coenobitidae with S-phase specific proliferation markers and immunohistochemistry against tubulin, synaptic proteins and actin. Our results suggest that in these animals all components of the deutocerebral proliferative system are present so that persistent neurogenesis characterizes not only the olfactory systems of crustaceans living in aquatic but also in terrestrial environments.
Acknowledgement: supported by DFG grant Ha 2540/16-1 and the Max Planck Society.

ID: 249

SENSO-MOTOR INTERACTIONS IN DIFFERENT PERIPHERAL ORGANS OF THE POND SNAIL, *LYMNAEA STAGNALIS*. A CHEMICAL-NEUROANATOMICAL APPROACH

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B1 Poster

The peripheral nervous system plays an important role in the control of behavior in the pond snail (*Lymnaea stagnalis*), nevertheless we have yet incomplete knowledge about the organization and function of the peripheral senso-efferent systems. Therefore, our aim was to examine the functional morphology of different peripheral organs (lip, tentacle, foot) of adult *L. stagnalis*, using antibodies raised against serotonin (5-HT), histamine (HA), tyrosine hydroxylase (TH), glutamate (Glu), FMRFamide (Fa) and Mytilus inhibitory peptide (MIP), all key members of the signaling system of gastropods. A dense network of extrinsic 5-HT-immunoreactive (IR) varicose fibers was found in the sub-epithelial layer of the three regions. HA-, TH-, Fa- and MIP-IR sensory cells were present under the epithelium in the lip and tentacles, and Glu- and MIP-IR and less HA- and Fa-IR bipolar cells occurred in the foot. In addition, a TH-, Fa- and MIP-IR sub-epithelial networks, respectively, could be observed in the peripheral organs. Double labeling experiments revealed mostly a distinct intracellular localization of the signal molecules, with a minimum of co-localization of 5-HT with Fa and MIP, respectively, in the lip and foot, and 5-HT with HA in the foot. Based on it, both interaction between and parallel action of the neuronal elements containing the studied signal molecules, involved in processing sensory stimuli, are suggested in the Lymnaea periphery. Our results provide also a firm basis for further investigations on the synaptic organization and role of the peripheral senso-efferent systems, using correlative light- and electron microscopy and behavioral assays, respectively.

ID: 384

THE ENIGMATIC SENSORY WORLD OF SOLENOGASTRES (MOLLUSCA)

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B1 Oral

Solenogastres bear a typical tetraneurous nervous system and a series of unique and poorly explored sensory structures (e.g., vestibule or atrial sensory organ, pedal commissural sac and dorsoterminal sense organ(s)). Ultrastructural data is limited to few species and comparative analyses spanning the diversity of the clade are lacking, hampering homology assumptions and evolutionary hypotheses. Here, we provide insights from comparative histology based on serial semithin sections, visualizing the general setting of the nervous system and sensory structures via computer-based 3D-reconstructions and review available literature data covering the four main clades of Solenogastres. We further present results from transmission and scanning electron microscopy on the main sensory structures of Solenogastres to evaluate their variability in ultrastructure. All main clades are characterized by intra- and interspecifically variable groups of so called 'precerebral' or 'frontal ganglia' associated with the innervation of the vestibular sensory organ; histology and ultrastructure however clearly reject their former definition as ganglia. Vestibular papillae show different arrangements and present a unique ultrastructure. The dorsoterminal sensory organ shows great variation within the clades according to absence/ presence, number and structure and likely serves as chemoreceptor. The pedal commissural sac is a complex sensory organ in some Pholidoskepia and cavibelonid *Scheltemaia* with similarity to statocyst organs of other molluscs. We discuss the evolution of these unique sensory structures in the different clades of Solenogastres based on initial phylogenetic hypotheses and reevaluate homology assumptions of the dorsoterminal sense organ with the osphradia in other molluscs.

ID: 178

ULTRASTRUCTURAL STUDY OF THE OSPHRADIA OF REPRESENTATIVES OF THE POLYPLACOPHORA

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B1 Poster

A osphradia ultrastructural study of the representatives of the Acanthochitonina, Chitonina и Ischnochitonida revealed a number of similar, primitive, in terms of sensory physiology, features of the structure. In these animals, osphradium resemble a more or less isolated roller or fold of specialized single-layered epithelium located in the mantle cavity immediately behind the last pair of gills. The receptor surface of the osphradium is formed by ciliated, microvilliferous and secretory supporting cells, as well as peripheral processes of receptor cells with several cilia. On the osphradial surface, there is no division into zones, which is characteristic of the Gastropods. It is undoubtedly the organ of the chemical sense, performing the initial role of the interoceptor and reacting to a change in the physico-chemical characteristics of the fluid in the mantle cavity. However, due to the large plasticity of the mollusks, it is possible to form other sensory structures, which, especially in primitive groups (for example: Lepidopleurida), can partially perform the osphrasdial functions. If we take into account the absence of osphradia and the presence of numerous parts of sensory epithelium in the mantle cavity of the most primitive forms of chitons belonging to the order of Lepidopleurida (Sigwart et al., 2014), then probably osphradia in the more advanced chitons, the Chitonida order, as an independently developed organ, possibly not homologous to the osphradia of other molluscs (Gastropoda, Bivalvia and some Cephalopoda).

ID: 243

EVOLUTION OF THE NEUROMUSCULAR JUNCTION – INSIGHTS FROM THE ANTHOZOAN *NEMATOSTELLA VECTENSIS*

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B1 Oral

The ability to control movements requires the interaction of contractible muscle cells and neurons capable of muscle innervation. Communication between the neuron and muscle cell is accomplished by a specialized synapse, the neuromuscular junction (NMJ). The majority of known animals belong to the Bilateria, which comprises the sister groups Protostomia and Deuterostomia. Within deuterostomes, the NMJ is best studied in vertebrates where acetylcholine (ACh) functions as excitatory neurotransmitter that binds to nicotinic ACh receptors on the sarcolemma of the muscle cell. Surprisingly, muscle innervation in arthropods like *Drosophila* and crayfish works completely different. Unlike in vertebrates, glutamate (Glu) rather than ACh is released from the presynaptic terminal in *Drosophila* and binds to postsynaptic ionotrophic Glu receptors (AMPA/Kainate). So far, it remains unclear what kind of NMJ was present in the bilaterian ancestor. In order to unravel the evolution of the neuromuscular system in Bilateria, the condition in non-bilaterian outgroups is of paramount importance. In this respect, Cnidaria, which comprise the sister group to Bilateria, is of special interest. The anthozoan *Nematostella vectensis* is an ideal candidate, because it is supposed to have retained a number of ancestral features. Like bilaterians, *Nematostella* possesses a nervous system and muscles. However, the structure and function of the NMJ in *Nematostella* is still completely unknown.

By applying a combined methodological approach (transgenetics, genomics, gene expression, immunolabelling and correlative microscopy) we will provide a comprehensive morphological and functional analysis of the NMJ in *Nematostella*. First insights are presented here and evolutionary implications are discussed.

ID: 367

MAPPING NEUROPEPTIDE IMMUNOREACTIVITY IN THE NERVOUS SYSTEMS OF THREE MEIOFAUNAL ANNELIDS REVEALS UNEXPECTED VARIABILITY

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B1 Oral

Neuropeptides are conserved metazoan signaling molecules, which are either widely or narrowly distributed in the nervous system, and may inform on neural function. Since little is known about their variation among closely related species, we assessed the immunoreactivity patterns of 14 neuropeptides in the nervous systems of three dinophilid annelids (*Dinophilus gyrociliatus*, *D. taeniatus* and *Trilobodrilus axi*) using immunohistochemistry, CLSM, and 3D-reconstruction.

We mapped the specific and common neuropeptides, partly found in the transcriptomes of all three species, onto detailed anatomical reconstructions of their microscopic brains and nervous systems. *Dinophilus gyrociliatus* was immunoreactive for the highest number of neuropeptides (13/14), and has most immunoreactive cells in the brain (210 compared to 98 and 101, respectively). The small size of the brains (650-750 cells) made it possible to map each immunoreactive cell onto a DAPI template, suggesting no overlap in the specific peptides tested for. This indicates that a neuron can be specific to one neuropeptide and possibly one function – even in a system consisting of few cells. Ongoing studies of the 68 neurons of the *D. gyrociliatus* dwarf male will further elaborate on this finding. The distribution of labelled cells within the brain expressed high interspecific variation, which was consolidated by intraspecific consistency.

We show that the specific immunoreactive cells are mostly scattered throughout the brain, thereby not demarcating compartments or functional regions in the brain. Furthermore, the apparent variation in the immunoreactivity patterns among the three closely related species indicates a dynamic evolution of the neuromodulatory landscape.

ID: 363

DYNAMICS OF THE NERVOUS AND MUSCULAR SYSTEM REGENERATION IN THE POLYCHAETE *ALITTA VIRENS*

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Polychaetes are among the most highly organized animals capable of restoring almost all tissues and organs. Aiming to develop convenient standardized model, we described recovery of the major anatomical structures and created a staging system for the caudal regeneration in *Alitta virens*. Detection of the neuropil and muscle fibers were performed using tissue-specific fluorescent markers. In average normal organization of posterior body end is restored within 10 days after amputation. The whole process was divided into 5 stages: (1) wound healing, (2) blastema formation, (3) patterning and growth of the blastema, (4) differentiation of the first regenerated segment, (5) formation and differentiation of the subsequent 5–6 segments. The regeneration is carried out mainly by epimorphosis, although the elements of intercalary growth as well as the morphallactic transformation of the stump have been noted. Terminal structures of the pygidium appear first, followed by the formation of new metameres in front of the pygidium. Neural elements of the regenerative bud are developing faster than the surrounding muscles. The neurites extending from the CNS and PNS come to the surface of the wound epithelium within one day after amputation. Later, longitudinal nerve fibers lengthen, thicken, and interconnect via the circumpygidial nerve ring and pygidial commissure. Longitudinal muscles regenerate in anterior to posterior progression, being constantly in contact with the corresponding fibers of the old tissues. All other muscles differentiate from blastemal cells in isolation from the old musculature of the stump. The research was supported by RFBR grant 16-04-00991-a and RRC MCT SPbSU.

ID: 148

MORPHOLOGICAL EVIDENCE OF NEUROPEPTIDE *NPF* PARTICIPATION IN PLANARIANS MUSCLE FUNCTION

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B1 Poster

Free-living planarians are usually used as a biological model to study the processes of morphogenesis, regeneration and development. In the present study the spatial relationship between the musculature and the nervous system was investigated by confocal laser scanning microscopy using histohemical staining of filametous actin with fluorescently-labelled phalloidin and immunocytochemical staining of the nerve system elements with primary antibody to neuropeptide NPF in planarian *Girardia tigrina* (Turbellaria, Platyhelminthes). The results show that the musculature of planarian body is richly supplied by NPF-immunopositive(-IP) nerve elements. The body wall musculature in planarian contains three layers: outer circular, inner longitudinal and diagonal muscle fibrils situated in between. Staining with phalloidin was found in muscle fibres connecting dorsal and ventral body sides and in transversal muscle filaments running from one to another lateral edge of the body. Somatic musculature in *G. tigrina* includes musculature of the pharynx, musculature of the blind gut, and the pharyngeal anchoring muscles which connect the cylindrical pharynx to the body musculature. NPF-IP nerve fibres were identified in submuscular nerve net and in the pharyngeal tube. The study revealed a close spatial relationship of NPFergic nerves with pharynx musculature, anchoring muscles, body wall musculature, and tail region musculature. Such identification of the NPF-IP neurons and its endings close to the muscle fibres of body wall and somatic muscles indicates an important role of NPF-like neuropeptides in planarian muscle function. (The study was supported by RFBR grants № 15-04-05948a).

ID: 149

THREE SOMATOTOPIC MAPS FOR ONE SENSORIAL MODALITY – BRAIN ARCHITECTURE OF THE BANDED CLEANER SHRIMP *STENOPUS HISPIDUS* (OLIVIER, 1811); (MALACOSTRACA, STENOPODIDEA)

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B1 Oral

The pan-tropic cleaner shrimp *Stenopus hispidus* (Crustacea, Stenopodidea) is famous for its specific cleaning behavior as well as an exclusively monogamous life-style. The most prominent head appendages are the two very long and slender pairs of antennae (first and second antennae), which are used in attracting fish as well as for intraspecific communication. Additionally, the first antenna possesses two flagella. Thus, *S. hispidus* features a broad communicative repertoire which is considered to depend on superb motor skills and the underlying mechanosensory circuits in combination with sensory structures. We investigated both pairs of antennae using fluorescence- and scanning electron microscopy. Furthermore, we studied brain anatomy of several specimens of *S. hispidus* using histological sections, immunohistochemical labelings as well as X-ray microtomography in combination with three-dimensional reconstructions. Our analyses show that especially mechanosensory neuropils associated with the first (deutocerebrum) and second (tritocerebrum) pair of antennae are markedly pronounced in comparison to all other neuropils of the central brain and indicate the presence of three topographic maps of its corresponding sensory appendage by sharing structural similarities, such as size and characteristic striated and perpendicular layering to a unique extent in decapods. These structures are known from tritocerebral mechanosensory neuropils in a variety of crustacean species and from deutocerebral mechanosensory neuropils in myriapods and basal hexapods, but were never reported in both neuromeres within one species. Hence, from an evolutionary perspective, *Stenopus hispidus* is an excellent example of how sensory capacity and functional demands shape the architecture of mechanosensory processing areas.

ID: 413

B1 Poster

EVOLUTION, DEVELOPMENT AND FUNCTION OF EYES IN A POLYCHAETE WITH A LONG PELAGIC LARVAL PHASE

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Many marine larva use simple cerebral eyespots for phototactic steering, but not much is known about their actual sensory capabilities and about evolutionary changes and new inventions in the mechanism of steering. Annelids are a diverse group of animals suited for studies of recent and long term evolutionary adaptations. We investigate the larvae of a sedentary polychaete, Malacoceros fuliginosus, which has a long pelagic larval phase and has well adapted larval sensory capabilities. Notably, and in difference to the well studied annelid model Platynereis dumerilii, already 24 hours post fertilization a single pair of simple microvillar eyespots makes from the beginning use of the full neuronal scaffold and impacts ciliary beating in both the proto- and the teletroch of the larva. Within the next 24 hours two additional microvillar eyes develop. Gene expression and immunohistochemical studies show that all microvillar eyes now possess two different cell types expressing different annelid specific subtypes of rhabdomeric opsin. This may point towards subfunctionalization of microvillar photoreceptor cells and a basic mode of color vision within these animals. The set of cerebral eyes is completed by one pair of purely ciliary epidermal eyes, which are not known from any other annelid group. The compact head allows to analyze by 3D EM the neural circuitry of all the different eye photoreceptor cells and how they contribute to different aspects of photactic behavior.

ID: 276

THE VISUAL SYSTEM OF *NEOBISIUM CARCINOIDES* (HERMANN, 1804) (CHELICERATA, ARACHNIDA, PSEUDOSCORPIONES)

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B1 Poster

Since the studies of Hanström – an important arthropod neuroanatomist in the early 20th century – the visual system of pseudoscorpions was ignored by scientists. However, several other chelicerate taxa – Pycnogonida, Xiphosura, Scorpiones, Opiliones, and Araneae – were studied in more detail since then. To fill this knowledge gap we analyse in this study the neuroanatomy of the visual system of the pseudoscorpion *Neobisium carcinoides* with different techniques: The visual neuropils of the eyes are identified with Cobalt backfills and the basic structure of the visual neuropils as well as the protocerebrum generally is described by means of osmium-ethyl gallate procedure and TEM. *N. carcinoides* has two pairs of lateral eyes. The R-cells of the two eyes of each hemisphere are linked to a visual neuropil complex, consisting of a subunit for each eye. The visual neuropil complexes are located in the dorsolateral protocerebrum. Furthermore, the arcuate body is found in the midline of the protocerebrum in a dorsoposterior position. The findings allow a detailed comparison of the pseudoscorpion visual system with that of other previously studied chelicerate taxa and contribute important characters in reconstructing chelicerate ground pattern and phylogeny.

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ID: 468

EVOLUTION OF THE PANARTHROPOD NERVOUS AND VISUAL SYSTEM: LEARNING FROM ONYCHOPHORANS AND TARDIGRADES

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B1 Poster

Understanding the origin and evolution of arthropods requires examining not only arthropods themselves but also their closest outgroups, the tardigrades (water bears) and onychophorans (velvet worms). Despite the recent rise of molecular techniques, the phylogenetic positions of tardigrades and onychophorans in the panarthropod tree (onychophorans + tardigrades + arthropods) still remain unresolved. Hence, these methods alone are currently insufficient for clarifying the panarthropod topology. Therefore, the evolution of different morphological traits, such as one of the most intriguing features of panarthropods — their nervous system — as well as systems associated with it, become essential for shedding light on the origin and evolution of arthropods and their relatives within the Panarthropoda. Herein we present our recent findings on the nervous and visual systems in onychophorans and tardigrades as well as summarise current knowledge of the evolution of the nervous systems in panarthropods. In particular, our comparative studies specially focus on the evolution of segmental ganglia, the segmental identity of brain regions, and the vision from both morphological and developmental perspectives. We applied a range of different neuroanatomical and morphological techniques to address some of the many controversies surrounding these topics, such as the homology of the onychophoran eyes as well as the segmentation of the tardigrade brain. Finally, we attempt to reconstruct the most likely scenario for these systems in last common ancestors of arthropods and panarthropods based on what is currently known about tardigrades and onychophorans.

ID: 423

B1 Poster

SEROTONIN SYNTHESIS AND SECRETION IN BASAL METAZOA *TRICHOPLAX ADHAERENS*

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Origin of nervous system is important and long-standing issue in evolutionary biology. Among three phyla of most basal metazoans: Ctenophora, Porifera, Placozoa, only Ctenophora have well developed neurons, although their unusual neurotransmitters content raises suspicions of independent origin of ctenophoran neurons. Sponges are sessile filtrators lacking neurons and complicated behavior. *Trichoplax* (Placozoa) do not have morphologically defined neurons, but its genome encodes most molecular components of nervous system, including neurotransmitter receptors and synthesis enzymes, ion channels, synaptic scaffold proteins and neuronal development regulators. However, functions of these genes in placozoans are unknown.

We utilized immunohistochemical staining and confocal microscopy to identify the cells capable to serotonin (5-HT) synthesis, secretion and uptake. Our results show that *Trichoplax* synthesize 5-HT via traditional metazoan pathway from tryptophan through 5-hydroxytryptophan. 5-HT synthesis localized in a subpopulation of flask-shaped gland cells of ventral digestive epithelium. 5-HT is secreted in the mucus layer and distributed across the body surface by ciliary beatings . 5-HT-positive granules are concentrated in the ring-like zone on the dorsal surface ~50 µm centrally from the body margin. Similar mucociliar epithelia with 5-HT secreting gland cells are known in human trachea, snail pedal sole and frog tadpole epithelia. 5-HT in these systems participates in paracrine regulation of ciliary activity. Our results demonstrate the ancestral type of this regulation among Metazoa and shed light on the pre-neural functions of serotonin signaling.

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ID: 478

THE TYRAMINERGIC/OCTOPAMINERGIC SYSTEM OF INSECTS: AN EVOLUTIONARY CONSERVED SYSTEM ORCHESTRATING NEURAL AND PHYSIOLOGICAL BEHAVIOR

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B1 Oral

This talk will focus on aminergic signaling via tyramine and octopamine in insects and emphasize the neuromodulatory roles of these transmitters for behavioral functions. These neuromodulators are not only acting within the central and peripheral nervous systems where they are delivered to specific targets by a small population of neurons but they are also released into the haemolymph with a whole set of physiological actions which seem to be in line with the respective behavior. The talk will focus on the neurons which release octopamine and tyramine and how they are involved in "orchestrating" behavior and physiology. In addition, these systems of insects will be compared with those of other invertebrates.

ID: 196

ULTRASTRUCTURE OF THE CEREBRAL GANGLION OF THE ACANTHOCEPHALAN *CORYNOSOMA STRUMOSUM*

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B1 Poster

A fine study of the cerebral ganglion of the acanthocephalan Corynosoma strumosum, at the stage of the late acanthella, from the paratenic (reservoir) host of the White Sea cod, *Gadus morhua*, which differs from the sexually mature form only by the proboscis inverted into the sheath, is conducted. Ganglion of Acanthocephala is located in the posterior third of the sheath cavity of the proboscis between the fibers of the retractor muscles, being separated from them only by a thin layer of fibrillar matrix. Ganglion consists of a cortex and a neuropile. The cortex is formed by three types of neurons, which, according to their position in the ganglion, can be divided into the peripheral neurons - located on the periphery; central ones - located around the neuropile, and the intermediate - concentrated between the first two cell types. The integrity of the ganglion is ensured both by numerous and different by the complexity invaginated contacts of the surface membranes of neurons with extracellular material and external fibrillar matrix, and due to a large number of soma-somatic connections. Among the latter ones there are synaptic contacts. According to the structure and nature of the introduction into the soma and into the processes of neighboring neurons, the outgrowths of the partner cells can be single, finger-like curved or branched.

ID: 194

THE NERVOUS SYSTEM OF SYLLIDAE GRUBE, 1859 (ANNELIDA: PHYLLODOCIDA): A COMPARATIVE STUDY USING IMMUNOCYTOCHEMISTRY, CLSM AND LIGHT MICROSCOPY

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Immunocytochemical stainings and CLSM are frequently applied methods in the study of the nervous system in Annelida. While more data becomes available, little is known about the wide spread, species-rich family Syllidae. The relationship of the family to other Phyllodocida remains ambiguous. A detailed description of the nervous system of members of the different subfamilies within Syllidae and a comparison to other Phyllodocida could help to resolve phylogenetic relationships. The study aims to identify a neuronal ground pattern for Syllidae as well as variations between subfamilies and species. Immunocytochemistry, CLSM and histological serial sections are employed to reconstruct the nervous system of five species within the two subfamilies Exogoninae and Syllinae. The general structure of the brain with its posterior nerves, the trineuralian ventral nerve cord, the stomatogastric nervous system consisting of initially five neurite bundles and two stomatogastric ring nerves, a pair of ventral, lateral and dorsal longitudinal nerves in anterior segments, four segmental ring nerves and the innervation of the parapodia are possible conserved structures which may be part of the ground pattern in Syllidae. The results also show variability in the nervous system architecture among species of different subfamilies of the Syllidae, regarding clusters of somata in the anterior nervous system, numbers of connectives of the ventral nerve cord, and number of segmental nerves. A first step is taken towards the homologisation of nervous structures to other Phyllodocida, but currently too little data is available to draw conclusions on the phylogenetic implications of the results.

ID: 280

NEUROANATOMY OF DESCENDING BRAIN INTERNEURONS IN DRAGONFLY *AECHNA GRANDIS*

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B1 Poster

Dragonflies are agile predators that spend a lot of time in the air catching prey during the flight with legs. Inputs of different sensory modality converge to the supraesophageal ganglion. Signal transduction to the thoracic centers of locomotion is accomplished with the descending neurons (DN) which bodies and dendrites are located in the supraesophageal ganglion and axons descend to the thoracic ganglia where control of the flight and other motor acts take place. In experiments, imagoes were used on the second day after moulting. Neuron bodies and dendrites were retrograde stained with nickel chloride through one or both neck connectives. Individual neurons, their axons and dendrites were examined and pictured in the whole brain using light microscopy. In the supraesophageal ganglion, we found groups of DNs which were located generally at the dorsal side of the protocerebrum. We've shown DNs which dendrites send branches directly to lateral and middle ocelli. On the ventral side of protocerebrum, a group of cells was stained probably matching visual neurons which detect movements. In DNs of dragonflies in meso- and methathoracic ganglia, typical ramification is when collaterals are directed both to ipsi- and contralateral sides of the ganglion. The obtained data allow to conclude that anatomy characteristics of DNs mainly reflect complex control of locomotion: a necessity of prompt convey of information from eyes, continuous correction of the flight, independent activity of each wing, interaction of wings and legs, and to lesser extent they are associated with the evolutionary age and taxonomic level.

ID: 282

LOCATION AND STRUCTURE OF INTERSEGMENTAL THORACIC INTERNEURON IN COCKROACH *PERIPLANETA AMERICANA*

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A cockroach demonstrates highly maneuverable stable walking pattern. During walking fore and hind leg of the cockroach move simultaneously and in antiphase to the appropriate contralateral legs. Three thoracic ganglia of the insect , pro-, meso- and methathoracic, contain neuronal systems which control movements of the matching pair of legs. During locomotion, interneurons connecting adjacent thoracic ganglia, as well as pro- and metathoracic, are important. In the study, we focused on morphological characterization of interneurons in connection with their possible physiological role. Interneurons were stained with nickel chloride infused into connectives. Location of each neuron was defined as ipsi- or contralateral to the axon directing to the adjacent ganglion. We've found out that neurons which bodies lay at the ipsilateral side send main dendrites also to the ipsilateral side. These neurons receive information from mechanoreceptors of legs and wings directly or through local interneurons and send signals to adjacent ganglia. Contralateral neurons play major role in the interaction of pro- and methaganglion, their dendrites ramifying in several ganglion regions. Some of them are ramifying at the ventral side of the ganglion where signal is transmitted from ventral giant neurons. These neurons could perform a complex integrative function receiving signals from different sensory inputs and contacting with intraganlionic neurons involved in generation of the locomotion pattern. The described architecture of interganglionic neurons could contribute to understanding of mechanisms of locomotion control in cockroaches.

ID: 285

A COMPARATIVE ULTRASTRUCTURAL ANALYSIS OF EYES IN LEECHES (HIRUDINEA: RHYNCHOBDELLIDA, ARHYNCHOBDELLIDA)

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B1 Poster

The hirudineas seem to be unique among the Clitellata because of presence of a complete phaosomal organs – pigmented eyes – that are widespread only in leeches. The last works on the ultrastructure of leech eyes were done in the 60's. The ultrastructure of eyes of the rhynchobdellids, *Glossiphonia complanata* L., 1758; *Helobdella stagnalis* L., 1758 at two developmental stages (larva / adult), and the arhynchobdellids, *Erpobdella octoculata* L., 1758; *E. nigricollis* Brandes, 1900, was investigated. The differences between the two orders of leeches are revealed in the ultrastructure of the rhabdom, the rhabdomeres, periphaosomal zone, and pigmented granules. The rhynchobdellid eyes are characterized by a compact rhabdom, ovoid-spherical phaosomal rhadbomeres, relatively short microvilli, and one type pigment granules in supported pigmented cells of eyes. The unique characteristic of the Rhynchobdellida is the apical centrioles in the phaosomal photoreceptoral cells. For the Arhynchobdellida the features are the less compact rhabdom which separated by an extracellular matrix, ovoid-flattened rhabdomeres, and two types of pigment granules. The unique characteristics of the Arhynchobdellida are distinct zones in the periphaosomal cytoplasm: inner, reticular and outer, mitochondrial layers. The successive events of development of eyes after hatching are as follows: formed clusters of phaosomal photoreceptor cells, associated with pigmented cells or not, move, gradually, rhabdom constitutes compact and becomes surrounded by the pigmented cells of the eye cup. Meanwhile, the phaosomal rhabdomers become rounded up, microvilli elongate, and a stalk appears. Pigmental cells undergo structural changes as well.

ID: 252

THE NERVOUS SYSTEM IN ORTHONECTIDA

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B1 Poster

Orthonectida is a small group parasitizing in various marine invertebrates. The life cycle of orthonectids comprises a parasitic plasmodium and free living males and females with complex behavior. The males and females develop in the plasmodium, egress from the host and copulate upon their release into the environment. After copulation, larvae develop inside the female, egress from it, find a new host and infect the latter. Traditionally, orthonectids have been placed at the same level of organization as sponges and Placozoa due to the absence of nervous and muscular systems. We demonstrated the presence of nervous and muscular systems in Orthonectids. On the basis of sequencing data it was concluded that Orthonectida belong to Spiralia.

Using antobody staining against serotonin we studied the nervous system in males and females of two orthonectid species *Intoshia variabily* and *I. linei*. As the body of adult orthonectids comprises only epithelial, muscular, nerve cells and gametes and the total cell number can be easily counted, DAPI staining combined with the confocal laser scanning microscopy permits to calculate the precise number of nerve cells in the orthonectids. The nervous system of the male *I. variabily* comprises only 2 serotoninergic cells,while the female possesses 4. In *I. linei* the numbers were 4 and 6, correspondingly. In both species, all nerve cells are multipolar and are located in the anterior part of the body in-between the epithelial and muscle cells. Orthonectid plasmodium lacks nervous system. Supported by the RFBR grant № 16-04-00782 and the SPbU grant 1.40.496.2017

ID: 364

CPG FROM PARASITIC FLATWORM? TEM REVEALED A SIMPLE NEURAL CIRCUIT IN THE TAIL OF FREELY MOVING TREMATODE LARVA

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B1 Oral

OBJECTIVES. Free-living trematode (Digenea) larvae, cercariae, are non-feeding minute organisms whose only role is to find and infect the next host, a step which is crucial for the survival of the parasite species. Cercariae often demonstrate fast sensory-motor reactions to different stimuli and have provisory organ for locomotion – the tail. The data on morphology of the nervous system in the tail of cercaria is incomplete and often contradictory.

MATERIAL AND METHODS. Samples of marine cercariae *Cryptocotyle lingua* from periwinkles *Littorina littorea* were collected in the littoral zone of Chupa Bay, White Sea at the Marine Biological Station of the Zoological Institute, Russian Academy of Science, Russian Federation. Series of ultrathin longitudinal and cross sections were studied by transmission electron microscopy.

RESULTS. For the first time we depicted the morphology of the nervous system in the tail of cercaria in cellular resolution. We characterized one unpaired and ten pairs of the neurons organized in the simple circuit. Details of neurons morphology, neuron to muscles and neuron to neuron connections could suggest different functional roles of the cells in the network. The data is discussed in the contest of CPG and limited data on electrophysiology and immunocytochemistry of the species studied.

ID: 431

THE ULTRASTRUCTURE OF THE EYES OF OWENIIDAE POLYCHAETES

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B1 Oral

Oweniidae is among families which seem to be the nearest to the basal root of annelid tree – to the last common annelid ancestor. Detailed morphological investigation are necessary to support this phylogenetical statements. To evolve the annelid eyes ultrastrucutre comparison we decided to start first of all with Oweniidae eyes study. Amphinomidae derived later on than Oweniidae, and Amphinomidae possesses well developed 2 pairs of normal converse adult cerebral eyes. The data about Oweniidae eyes structure can help to reconstruct ground pattern of annelid adult eyes.

The eyes of *Galatowenia oculata* and *Owenia fusiformis* were studied with light microscopy and TEM. Both species bear one pair of pigmented eyes on the lateral sides of prostomium, some specimens of *G. oculata* have additional pigmented strips running to the dorsal side. In both species pigmented cells form a spot, some area within epidermis, not a cup, they are distributed loosely. In *G. oculata* presumable photoreceptor cells bear one cilia and most of their cytoplasm is filled with large elongated mitochondria and a lot of vacuoles with electron-lucent content and invaginations, similar cells occur within the pigmented strips also. The apical parts of pigmented and unpigmented supportive cells posses large vacuoles with homogenous contents of moderate electron density protruding towards cuticle and forming lens-like structure. The data assume that the eyes of oweniids are not typical adult annelids eyes.

The work was financially supported by DAAD “Ostpartnerschaftsprogramm“ and Lomonosov Moscow State University and DAAD “Vladimir Vernadskij” Programm in 2016.

ID: 393

B1 Oral

FLUORESCENCE IMAGING OF NERVOUS AND MUSCULAR SYSTEMS IN JUVENILE *CADLINA LAEVIS* (NUDIBRANCHIA) BY CONFOCAL LASER SCANNING MICROSCOPY

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Many species of Gastropoda are widely used as model objects for neurobiological investigations. However, the body size of most gastropod mollusks exceeds the capabilities of confocal laser scanning microscopy (CLSM). This is why it is often impossible to study the structure of the molluscan nervous system and neuro-muscular interrelations on whole mounts by CLSM. In our research we used CLSM, histochemical and immunohistochemical methods on whole mounts to study the general structure of major organs, nervous and muscular systems in juvenile *Cadlina laevis* (L., 1767). The research has been carried out on 2-4 month old juveniles, 400-800 µm length, hatched in the laboratory from the egg masses that had been collected in the White Sea (Cape Kartesh). We present integrated data on the distribution of monoamines, GABA, neuropeptides FMRFamide, neurotensin and SP, in the central and peripheral nervous systems of the mollusks, together with the structure of their muscular system as revealed by phalloidin staining. We explored peculiarities in the general structure of the central and peripheral nervous systems, receptor cells in sensory organs, body wall, notum, foot and in the wall of the digestive tract. The general architectonics of the body musculature and spatial neuro-muscular interrelations are described.

Our results provide an opportunity to understand the three-dimensional architecture of nervous and muscular systems of gastropods and show peculiarities of distribution and interrelation of their nerve nets containing different neurotransmitters.

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ID: 256

INNERVATION OF UNPAIRED BRANCHIAL APPENDAGES IN ANNELIDS *TEREBELLIDES* CF. *STROEMI* (TRICHOBRANCHIDAE) AND *COSSURA PYGODACTYLATA* (COSSURIDAE)

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Innervation of unpaired branchial appendages was studied using confocal laser scanning microscopy in two annelid species: *Terebellides* cf. *stroemi* (Trichobranchidae) and *Cossura pygodactylata* (Cossuridae). It was shown that the branchial filament is innervated by one unpaired segmental nerve coming from the ventral nerve cord on the level of the chaetiger 2 in *C. pygodactylata*. This nerve goes transversally along the body wall and come to the base of the branchial filament from the side. This fact allowed us to conclude that 1) the branchial filament is unpaired structure, not representing merged paired branchiae and not connected with prostomial and peristomial appendages in origin; and 2) the branchial filament is a result of a shift of one of paired segmental branchiae with parallel reduction of the second branchia from this pair. The branchial organ of *T. cf. stroemi* is innervated by paired segmental nerves from the first and the second chaetigers. The segmental nerves are connected by longitudinal nerves going on lateral sides of the body closer to the dorsum. One nerve from each side proceeds to anterior part of the branchial stalk and one nerve to posterior. All these nerves are linked by transversal connections. Anterior stalk nerves come into anterior branchial lobes and posterior nerves to posterior lobes. In the branchial lobes, main nerves give rise to thinner ones, going to each of branchial lamellae. The present study confirmed a paired nature of the branchial organ of *Terebellides* and its origin from two pairs of segmental branchiae.

B2 MODULAR ORGANISATION IN INVERTEBRATES: COMPARATIVE MORPHOLOGICAL AND FUNCTIONAL ANALYSIS OF SUPERORGANISMS

Organizers: Dr. Igor A. Kosevich, Dr. Alexander Ereskovsky, Dr. Nikolay N. Marfenin

ID: 326

DIVERSITY OF MUSCULAR SYSTEMS IN CHEILOSTOME BRYOZOA

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B2 Oral

Order Cheilostomata is the largest bryozoan taxon with highly diverse zooidal morphology and widespread polymorphism. Their muscular system remains understudied, with only a few species examined with light and transmission electron microscopy. Besides, reconstruction of the muscular system with these methods is a difficult task because of its complexity and small size of the zooids.

To address this issue we used confocal laser scanning microscopy to examine 11 species of cheilostome bryozoans from three major suborders: Malacostegina, Scrupariina, Flustrina (superfamilies Calloporoidea, Flustroidea, Buguloidea, Cribrilinoidea, Lepralloidea and Smittinoidea) possessing different cystid morphologies. In all species studied we identified five main muscle groups: apertural (including those of the operculum, vestibule and the diaphragm), parietal muscles, lophophoral muscles, retractors of the polypide and muscles of the digestive tract. The muscular system of the digestive tract, tentacles and operculum is relatively uniform in the studied species. Three other muscle groups (apertural, parietal and retractors) are highly variable: we found differences in the number of muscle fibers, length and width of individual bundles, their position and attachment sites. Such differences most likely correspond to the differences in the cystid structure, first of all, in the frontal wall/shield.

We found examples of the (pseudo)striated musculature in all examined taxa, in the tentacle and pharyngeal muscles as well as the adductors of the polymorphic zooids (avicularia). There are also indications of striated patterns in the retractor muscles. Although there is no consensus about the ubiquity of striated muscles in bryozoans, we believe they are very common.

ID: 328

SHARED COLONY-WIDE MUSCULATURE – A JOURNEY THROUGH TIME

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Kamptozoa – small taxon including solitary and colonial species. Its phylogenetic position remains controversial, in a greater part because of poor understanding of their anatomy and development. At the moment there is only one description of the musculature of adult zooids of colonial kamptozoans. We traced the development of the muscular system from the bud to the adult zooid in two colonial species *Pedicellina cernua* and *Barentsia gracilis* using CLSM. At the first stage bud lacks contractile elements and consists of undifferentiated cells. At the second stage a single muscle bundle from stolon enters the bud, and the first hemisphere of star-cell complex appears. Then, a few calyx (atrial and tentacle) muscles develop, as well as several flattened cells of the star-cell complex. The number of stalk muscular elements increases and they form a continuous peripheral layer. At this stage, some of them are separated from stolon musculature, but are still attached to its basal part, the rest of the stalk musculature continues to be a part of a single muscular complex of the growth zone. At the fourth stage, the calyx musculature is completely formed, and finally, all stalk muscles detach from a single muscular complex of the growth zone.

From the presence of the musculature in the growth zone of a stolon we may infer the presence of associated nerves. Probably, the growth zone is the area, where we can observe the prerequisites for the transition from low-integrated kamptozoan colonies to a higher level of colony integration.

ID: 185

B2 Poster

DIFFERENT WAYS OF HYDRANTH FORMATION IN THECATE AND ATHECATE HYDROIDS

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Colonial hydrozoans (Cnidaria, Hydrozoa) are good model objects for evolutionary morphology investigation. These animals have modular organization. Most of hydrozoans from subclass Hydroidolina belong to the two main groups – athecate and thecate hydroids. These groups differ in certain features of hydranth morphology and hydranth development.

In present work we analysed the process of hydranth development (from hydranth rudiment to tentacles formation) in typical thecate species *Gonothyraea loveni* (Allman, 1859), typical athecate *Sarsia tubulosa* (M. Sars, 1835) and atypical thecate *Halecium halecinum* (Linnaeus, 1758). The latter species is characterised by reduced hydrotheca, so the hydranth can't retract into it. This morphological feature makes it similar to athecate species. The development of *Halecium* tentacles during hydranth formation display some differences from other thecate species.

Obtained data showed, that the hydranth formation of thecate and athecate hydrozoans has similar features, regardless of the hydrotheca presence or absence. But, in *Halecium* hydranth development differs from that in both groups, and these differences are greater than differences between typical thecates and typical athecates.

ID: 154

FUNCTIONAL MORPHOLOGY OF STOLON IN HYDROID *GONOTHYRAEA LOVENI* (ALLMAN, 1859)

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B2 Poster

The functional morphology of the various stolon sections in the colonial hydroid *Gonothyraea loveni* was studied on serial semi-thin cross-sections and by the method of time-lapse video microscopy. Six morphofunctional zones are identified in stolon that together provide growth and the hydroplasmic movement.

Zone 1: apical part of the growing tip (GT). Distinctive features: thickened epidermis, thin perisark, growth pulsations (GP). GP have regular period and order of intermediate phases of growth cycle.

Zone 2: subapical part of the GT with thickened gastrodermis, small lumen of coenosarc, its permanent contact with perisark. The transverse pulsations of coenosarc (TP) generate stolonic growth: significant longitudinal pulsations (LP) and elongation of GT.

Zone 3: proximal part of GT. Features: the constant contact of coenosarc with perisark remains; normal thickness of gastroderm; the enlarged lumen of gastric cavity serves for accumulation of food particles.

Zone 4: subapical part of coenosarc. Features: the largest amplitude of TP; weaker LP; the smallest concentration of non-epithelial cells in epidermis. The incoming hydroplasmic flows (HFs) are rhythmic, but weak. This site is the main driver of hydroplasm.

Zone 5: coenosarc of the first and second internodes of stolon provides accumulation and migration of specialized cells. The TP amplitude decreases, but is still high. LP weaken and lose clear rhythm. As distance from the GT increases, the speed and periodicity of HF grow.

Zone 6: areas of coenosarc removed from the GT stolon are characterized by the maximum thickness of perisarc and concentration of non-epithelial cells. Stolon branching occur here.

ID: 231

WHAT CAN SPONGES TELL US ABOUT MODULAR AND COLONIAL ORGANIZATION?

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B2 Oral

In populations of the solitary animals individuals are separated physically and different genetically. In contrast, colonial animals consist of units (zooids) that are physically and physiologically interconnected, and have the same genotype. Colonial organization is often considered as modular since colonial animals are comprised of iterated functional units (modules).

Few animals have inspired more debate among biologists concerning the problem of individuality than sponges. Comparative analysis of the structure, functions and development during growth and asexual reproduction in Porifera demonstrate terms "colony" and "zooid" cannot be applied to the sponges. Growth and development of new modules are accompanied by restructuring and rearrangement of tissues in the elements of aquiferous system. Migration of polypotent and secretory cells into the nidus of a new developing bud is the main mechanism of budding in sponges. Formation of new aquiferous units (poriferan modules) is not an asexual reproduction. Any sponge regardless of its structure and number of oscula should be recognized as an individual. Mono-oscular sponge is the solitary and multi-oscular one is modular (but not colonial) individual.

So, among modular animals only some are colonial. The difference between colonial and non-colonial modular metazoans is the mechanism of their development: in the former zooids are formed by non-completed asexual reproduction, whereas in the latter modules are developed via tissue remodeling.

ID: 134

MORPHOLOGICAL SUPPORT TO THE MOLECULAR PHYLOGENY OF CERIANTHARIA (CNIDARIA, ANTHOZOA)

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B2 Poster

Ceriantharia is a group of anthozoan usually neglected from phylogenetic analysis because of its uncertain position within Anthozoa. Recently, we reported a very comprehensive molecular phylogeny for Ceriantharia. Here, using morphological determination and cnidae assessment we support such phylogenetic reconstruction. We sustain that Ceriantharia is an independent clade due to the presence of two different types of tentacles, mesenteries coupled but not paired, a single mesentery in the ventral part of the body and the presence of a unique type of cnidocysts, the ptychocysts). The presence of spirocysts in Ceriantharia is an evidence of their close relationship with Hexacorallia that is supported also by our molecular phylogeny, whilst we cannot find any morphological support of the clade Ceriantharia + Octocorallia. Our observations reported here, shown that it is likely that ancient cerianthid displays an MBmb mesenterial arrangement in quartettes, protomesenteries 2 fertile (P2), a directive labial tentacle (dlt) and, microbasic b-mastigophores, isorhizas and spirocysts in their cnidomes. The four clades of Ceriantharia were supported by differences in the length of P2 and M, P2 sterile of fertile, mesenterial arrangement, presence/absence of dlt, acontioids, isorhizas, striation in ptychocysts capsule-wall and the "faltstyck" form of the microbasic b-mastigophore's shaft. No p-mastigophores were observed at all in cerianthids studied here. Therefore, we strongly suggest a revision of the pinicilli as described in the Hartog's classification.

ID: 197

RECONSTRUCTING THE BRYOZOAN MUSCULAR GROUND PATTERN ON THE BASIS OF THREE PHYLACTOLAEMATE SPECIES

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B2 Oral

Phylactolaemata are commonly regarded as the earliest branch within Bryozoa and thus the sister group to the other bryozoan taxa, Cyclostomata and Gymnolaemata. Therefore, they are important for the reconstruction of the bryozoan morphological ground pattern. In this study the myoanatomy of *Pectinatella magnifica*, *Cristatella mucedo* and *Hyalinella punctata* was analysed by means of histology, f-actin staining and confocal laserscanning microscopy in order to fill gaps in knowledge concerning the myoanatomy of Phylactolaemata. The muscles of the aperture, gut, bodywall, tentacle sheath, lophophore and the retractor muscles constitute the most prominent muscular subsets in these species. The lophophore shows longitudinal muscle bands in the tentacles, lophophoral arm muscles, epistome musculature and hitherto undescribed musculature of the ring canal. In general the muscular system of the three species is very similar with differences mainly in the bodywall, tentacle sheath and epistome. The bodywall contains a regular grid of musculature. The epistome exhibits either a muscular meshwork in the epistomal wall or muscle fibers traversing the epistomal cavity. The whole tentacle sheath possesses a regular mesh of musculature in *Pectinatella* and *Cristatella*, whereas circular musculature is limited to the tentacle sheath base in *Hyalinella*. This study is the first to describe a musculature of the ring canal and contributes to reconstructing muscular features for the last common ancestor of all bryozoans. The data available suggest that two longitudinal muscle bands in the tentacles, retractor muscles and longitudinal and circular musculature in the tentacle sheath were present in the last common bryozoan ancestor.

ID: 403

THE CONCEPT OF MODULAR ORGANISATION: QUESTIONS AND PROBLEMS

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Even though the concept of modular organisation (modularity) was proposed a long time ago, a lot of unresolved questions remain. This concept is still not generally accepted or widely used. The term “modular organisation” is applied to various phenomena, from individual organisation to genome (genetic program) organisation and functioning. We discuss the problems of using the concept of modular organisation in the context of individual organisation using invertebrates as an example.

The notions of “colonial” and “modular” organisms are still frequently used as synonyms. At the same time there are clear (precise) criteria for distinguishing between colonies of individuals and ‘super-individuals’ with modular organisation. One is physical continuity between organism parts either via permanent cytoplasm bridges between cells, or via specialised intercellular contacts integrating cells into tissues.

One of the most problematic points is the definition of modules, the structural units (blocks) of modular organisms. The problem is the existence of different levels and different approaches to defining a ‘module’: morphological, structural, physiological, morphogenetic, *etc.* We propose that the most attractive and useful approach is the morphogenetic one: a ‘module’ is the result of a certain developmental process, i.e. morphogenetic programme.

In most cases a modular individual is constructed with a different number of modules. However, the morphogenetic approach does not always make it easy to compare the organisation of even closely related species, as different ‘primary’ modules can merge into ‘secondary’ modules. Modular polymorphism raises more questions about how to define modules.

ID: 323

OSCULUM DYNAMICS AND FILTRATION ACTIVITY OF SINGLE- AND MULTI-OSCULUM EXPLANTS OF THE DEMOSPONGE *HALICHONDRIA PANICEA*

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B2 Oral

Subdividing their aquiferous system into functional units (modules) enables sponges to pump and filter large amounts of seawater. Contractile behavior, especially of the exhalant opening (osculum), is common among sponges and may affect food uptake. We investigated the interplay between osculum dynamics and filtration activity in single- and multi-osculum explants of the demosponge *Halichondria panicea*. Time-lapse video recordings of the osculum cross-sectional area (OSA) were made simultaneously with measurements of the filtration rate using the clearance method. Osculum dynamics, as expressed in temporal variation in OSA, including osculum contraction and expansion, correlated with variability in explant filtration rate. The mean volume-specific filtration rate of single-osculum explants was 15 mL min-1 (cm3 sponge)-1, which is 2 to 3 times higher than determined in larger *H. panicea* sponges with multiple exhalant openings. A linear relationship between filtration rate and OSA revealed a constant exhalant jet velocity. Our findings indicate that reduction of osculum area must be associated with contraction of the water canal system and suggest that the maximum size of a sponge module may be determined by the frictional resistance to flow.

ID: 415

FOLDING MORPHOGENESIS DURING ANCHORING DISC FORMATION OF *DYNAMENA PUMILA* STOLON

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B2 Poster

Hydrozoa is the most evolutionary advanced group of the phylum Cnidaria. All colonial hydrozoans grow continuously, changing the shape of their colonies and spreading over the substrate with the help of elongating stolons. Exhibiting high diversity of the colony architecture, they represent ideal objects for comparative and evolutionary morphology. The hydrozoan *Dynamena pumila* (Linnaeus, 1758) demonstrates higher complexity of the colony structure. The growth of Dynamena colony is accompanied by a variety of morphogenetic processes. Our work is focused on the formation of the anchoring disk (AD) of the stolon. Successive stages of the AD development were described with LM, CLSM and TEM. The AD is formed in the point of the stolon and stem branching, where stolon expands dividing into the several lobes by deepening folds. We have shown that formation of these folds is associated with accumulation of F-actin in the apical domains of the bottle cells located at the bottom of the emerging fold. This may indicate active invagination, although this process has never been described in the development of hydrozoans. We also found the cells with constricted basal domains situated on the sides of the fold. These cells may help to deepen the fold by creating the inverse curvature. Stabilization of the curvature can be provided by the secretion of the chitinous perisarc into the forming fold. Apparently, development of the AD can be viewed as a reliable and versatile model system for studying the cell-shape-change-driven epithelial sheet morphogenesis, which can be easily observed and analyzed.

ID: 119

BEHAVIOR AND FATE OF MAIN CELL TYPES DURING *HALISARCA DUJARDINII* CELL REAGGREGATION

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B2 Oral

Sponges – the most ancient group of metazoans. They have unique features of organization which not found in other animals. Impressive plasticity of sponge body is one of such features. The most outstanding manifestation of this plasticity is sponge cell reaggregation. Different multicellular aggregates form during reaggregation ending in the reconstruction of intact sponge. So, it is a unique model system to study the cells potencies and behavior in sponges.

We studied cell reaggregation in demosponge *Halisarca dujardinii*, which cells are able to reconstruct intact sponge organization during this process. Using histological, ultrastructural and immunohistochemical methods we described the fate and some aspects of the behavior of main cell types during different stages of cell reaggregation.

At the beginning of reaggregation, the mass cell differentiation takes place – the most of the cells lose their characteristic features and become indistinguishable from maternal amoebocytes, forming the heterogeneous pool of amoebocytes. Only choanocytes and cells with inclusions can also be found in primary aggregates. Formation of primmorphs (aggregates with exopinacoderm) is accompanied by surface amoebocytes and choanocytes differentiation to the exopinacocytes. Finally, during the reconstruction of intact sponge organization new endopinacocytes, choanocytes and lophocytes differentiate both from the heterogeneous pool of amoebocytes and dedifferentiated choanocytes. Cells with inclusions do not change their initial differentiation during the whole process of reaggregation. The intensity of cell proliferation in intact sponge tissues and during reaggregation was studied using EdU staining.

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ID: 160

STOLONIAL MOVEMENT OF DEMOSPONGE *AMPHILECTUS LOBATUS*

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B2 Poster

Sponges (phylum Porifera) traditionally are represented as inactive sessile filter-feeding animals which devoid of any behavior except filtering activity. However, different time-lapse techniques show that sponges are able to wide range of coordinated but slow whole-organism behavior. The present study concerns peculiar type of such behavior in the demosponge *Amphilectus lobatus* (Montagu, 1814) – stolonial movement. During stolonial movement sponge produces outgrowths (stolons) which crawl along substrate and branch thus forming complex net covering considerable area of substrate. This net is used by sponge for searching new spots with appropriate environmental conditions for individual relocation. Branching stolons allow sponge exploring the wide substrate areas, while the ability to retract some stolons minimizes the cost of such exploring. After such spots are found all cells of maternal sponge migrate through stolons leaving naked maternal skeleton forming one or several daughter sponges in the new location. Thus, stolonial movement combines traits of crawling along substrate and asexual reproduction. This behavior relies on the massive cell dedifferentiation followed by coordinated cell migrations to the spot of new sponge body formation and their subsequent differentiation into the specialized cell types.

ID: 389

TRANSPORT SYSTEM PREDETERMINES SOME PARAMETERS OF THE MODULAR ORGANISMS PATTERN (COLONIAL HYDROIDS *GONOTHYRAEA LOVENI* AND *DYNAMENA PUMILA*)

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B2 Oral

The distance of food transport in the colony of the studied species of hydroids depends on the size of hydranths and hydrotheca, and the length and diameter of the modules (internodes) of shoots and stolons. The movement of food inside the tube-shaped coenosarc is determined by: a) the swept volumes of terminal pulsators (hydranths and distal parts of the coenosarc); b) the size of the coenosarc lumen; c) the length of the module, i.e. distance between adjacent branches.

The swept volume is the difference between the volumes of a fully expanded and fully contracted pulsator. The swept volume must exceed the volume of the module, which is determined by its length and diameter. In this case, food particles in the hydroplasm filling the coenosarc can reach from one pulsator to the next during in the period of contraction, for example, from one hydranth to another. Expansion of the hydranth due to the influx of hydroplasm or food also stimulates it to contract.

The outgoing flow of hydroplasm is directed to the next hydranth or shoot. It is along this chain that food moves through the colony. The mutual synchronization of pulsator compressions leads to an increase in cumulative swept volume and, correspondingly, to an increase in the distance that a stream with particles can travel. In this case, the size of modules could be greater than with the minimum swept volume of an individual pulsator.

ID: 132

COMPARATIVE ULTRASTRUCTURE OF PLACENTAL ANALOGUES IN BRYOZOA

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B2 Oral

Matrotrophy (or extraembryonic nutrition) is widespread across Animalia, but our knowledge about its structural and functional diversity is very incomplete. Within the phylum Bryozoa matrotrophy has evolved independently many times making this group a unique example for comparative studies. Our research is focused on bryozoan placentotrophy, one of the most effective and structurally complex modes of parental care.

In our study we compare placental embryonic incubation in two largest bryozoan groups – order Cyclostomata (class Stenolaemata) and order Cheilostomata (class Gymnolaemata) – using light and transmission electron microscopy. While cyclostome bryozoans are characterized by unique reproductive mode combining viviparity, placentotrophy and polyembryony, cheilostomes brood their progeny outside the body cavity, some using placentas.

Placental analogues develop during embryonic incubation and disintegrate after larval release. In Cheilostomata epidermis and peritoneum together with the cells of funicular strands are involved in the placental formation, whereas in Cyclostomata complex syncytial structure of peritoneal origin is formed. In both cases "placental" cells display high synthetic activity. Nutrients are transported to the embryos via exo- and endocytosis, diffusion and active transport are suggested too, thus both bryozoan groups demonstrate a combination of histotrophy and placentotrophy. Ultrastructural mechanisms of the nutrient transport from the gut to the placenta are currently under study.

Our microanatomical and ultrastructural research found that pacental analogues in the representatives of the distant bryozoan lineages evolved from different tissues and display various position and structure. Feeding mechanisms are similar, however, showing interesting example of functional convergence.

ID: 247

PSEUDOCYCLES CONCEPT AS A METHOD IN THE EVOLUTIONARY MORPHOLOGY OF MODULAR INVERTEBRATES

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B2 Oral

The modular organization is found in different groups of colonial invertebrates. Analysis of general patterns of structural evolution of modular animals is important. The purpose of this study is to draw the attention of zoologists to the pseudocycles (P) concept.

Scientific papers discussing pseudocyclical similarities (PS) and P-integration in plants and animals, examples of application of P concept in evolutionary morphology, are analysed.

The P concept was used first in the analysis of morphological series of flowers and inflorescences, which contain repeated structures with a similar habitus related to one another as entirety and its part. The P-integration in modular organisms is determined by specifics in their morphogenesis, ontogeny and systemic features. P-transformations played an important role in evolution of vascular plants. Modular invertebrates are still insufficiently understood in this respect. They have examples of PS, which are found in different groups of invertebrates. PS in animals are usually associated with structural elements. The colonial level is studied clearly insufficiently. The types of architecture in plants have certain analogues in animals. For instance, corals show certain architectural models described for tropical trees.

The probability of discovering of other examples of P-integration increases owing to the hierarchical differentiation of the colony body and network character of structural evolution in different taxa of modular invertebrates. Further frontal analysis of the structural diversity is important from the position of P concept. The results obtained in the analysis of vascular plants are useful in detailed examination of the P-integration of modular invertebrates.

ID: 222

THE GENUS *CERIANTHEOMORPHE* (CNIDARIA; CERIANTHARIA) IN THE WESTERN ATLANTIC: ONE OR TWO SPECIES?

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This study was focused on discuss the taxonomic consistency of *Ceriantheomorphe brasiliensis* Carlgren, 1931 in the Western Atlantic. For this species, a disjoint distribution was attributed, Gulf of Mexico and South America. As a result of this inconsistent distribution, a series of doubts about the taxonomy is established. Based on that, specimens from the two areas (Gulf of Mexico – Mexico/USA; South America – Brazil/Uruguay) were compared in relation to anatomical and micrometrical (cnidome) data. In the anatomical observations, it was possible to distinguish specimens in relation to the maximum number of mesentery pairs connected to the siphonoglyph; two pairs in southern specimens and three in the specimens from the North. Another character that we observe a consistent variation is the proportion in the size of the mesenteries types (m vs M) and (B vs b).In this case, an evident distinction between the specimens from the North in relation to the South was found. In the micrometric approach, it is not possible to recognize any definitely pattern. This was already expected by some published studies that challenge the use of this data. In contrast, the evident distinction in the relative sizes of the mesenteries seems to be a great option of morphological approach. At the moment, many authors indicate that only molecular data can differentiate close species, but we argue that some different approaches can also be useful. Based only on morphological data we can infer that the specimens of the genus *Ceriantheomorphe* from the Western Atlantic are two distinct species.

ID: 418

THE SMOOTH AND THE SCALY: TUNIC MORPHOLOGY OF TWO DISTANT UROCHORDATES, *CIONA INTESTINALIS* (ORD. PHLEBOBRANCHIA) AND *HALOCYNTHIA RORETZI* (ORD. STOLIDOBRANCHIA)

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Ascidians are deuterostome invertebrates known for their remarkable filtering abilities. Their integument is composed of an epidermis covered by a tunic made up of cellulose nanofibers and secondarily colonized by multiple specific cell types. Using various light and electron microscopy methods, tunic morphology and composition were investigated in two species, *Ciona intestinalis* and *Halocynthia roretzi*.

While the tunic of *C. intestinalis* appear translucent and smooth, the one of *H. rorezti* is opaque, thicker and covered by scale-like structures. In the latter species, the basal part of the individuals is characterized by a root-like system also covered by scales which, however, tend to disappear at the root extremities. The histochemical approach showed the presence of polysaccharides and sulfated proteoglycans in the tunic of both species, except in the scales of H. roretzi. EDX analyses confirmed the presence of sulphur in tunic areas comprising sulphated proteoglycans. They also revealed the presence of vanadium in the tunic of *C. intestinalis* and aluminum in the scales of H. roretzi. TEM observations highlighted differences in the cellulose fibre arrangement in the two species. Various cell types, e.g. granulocytes, phagocytes and morula cells, were identified in both investigated species. In H. roretzi, cells containing catechol and redox active groups were hightlighted in the tunic of the roots. They could be involved in tunic sclerification or in the production of adhesive secretions for attachment to the substrate.

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ID: 310

THE NEUROMUSCULAR SYSTEM OF CYCLOSTOME BRYOZOANS SHOWS MORE SIMILARITY TO GYMNOLAEMATES THAN PHYLACTOLAEMATES, AN EXAMPLE FROM CINCTIPORA ELEGANS

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Among the Bryozoa, cyclostomes are a group of approximately 700 species that are the only extant members of the Stenolaemata. The latter are the commonly regarded as sister-group to the Gymnolaemata, both together being sister-group of the Phylactolaemata. In the past decade, the organization of the neuro-muscular system was investigated in several bilaterian phyla with modern immunocytochemical techniques and confocal laser scanning microscopy for gaining detailed knowledge into character evolution in order to infer phylogeny. Among bryozoans, these were only applied for the Phylactolaemata and Gymnolaemata whereas stenolaemates have so far not been studied. In order to fill this gap in our knowledge, we studied the neuromuscular system of the cyclostome *Cinctipora elegans* by immunocytochemical techniques and confocal microscopy, serial sectioning as well as µCT techniques. In accordance to their similar general polypide morphology, the muscular and nervous system of *C. elegans* show more resemblances to the gymnolaemate rather than the phylactolaemate condition: the main neurite bundles of the nervous system run in distinct bundles rather than a diffuse plexus as in phylactolaemates. With the exception of the pharynx, the muscle system of the digestive tract is a sparse network of few longitudinal and circular muscles rather than a complete lining of circular musculature as in phylactolaemates. Also, the lophophoral base shows a series of lophophoral base muscles reminiscent of Gymnolaemata. In sum, the newly gained data support the sister-group relationship of the Stenolaemata and Gymnolaemata.

ID: 311

NOVEL INSIGHT INTO THE SOFT-BODY MORPHOLOGY OF THE PHYLACTOLAEMATE BRYOZOAN *STEPHANELLA HINA*

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B2 Poster

Phylactolaemates are a small group of bryozoans exclusively in freshwater. They constitute the sister-group to all other bryozoans. They represent an important taxon for reconstructing the bryozoan ground-pattern and thus possibly relationships to other taxa. Among Phylactolaemata, the Stephanellidae with the sole representative *Stephanella hina* is commonly considered to represent the sister-group of all remaining taxa. Our recent observations have shown that this species differs from all remaining phylactolaemates in general colony morphology as well as in cystid structure. Still, detailed investigations concerning its soft-body morphology are missing. In this study we present the first observations of the soft-body morphology of S. hina using immunocytochemical techniques and confocal microscopy as well as serial sectioning and 3D-reconstructions. The general morphology of the polypide appears similar to other phylactolaemates. Also, the neuro-muscular system shows only marginal differences to other analysed phylactolaemate species. However, we found crucial differences in the organisation of the lophophoral base and the epistome. The inner row of tentacles above the ganglion is not medially connected and likewise a forked canal typical for all other Phylactolaemata is missing. Topologically, the epistome is similar to other species. It constitutes a protrusion over the ganglion towards the mouth opening with opening connection to the remaining visceral coelom. However, the epistome is much more massive than in other phylactolaemates and forms a large globular bulb rather than a slim, tongue-like organ. This undermines the unique status of *Stephanella hina* and reveals more variation in soft-body morphology of the taxon than previously assumed.

ID: 157

NEUROANATOMY OF POLYMORPHIC ZOOIDS IN CHEILOSTOME BRYOZOA: EXAMPLE OF AVICULARIA

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Zooidal polymorphism is widespread among cheilostomes having the most integrated colonies among Bryozoa. The most abundant and structurally diverse polymorphs are avicularia that act as defensive and cleaning devises. Comparative analysis shows that evolutionary transition from feeding module (autozooid) to avicularium occurred several times in this clade, and was accompanied by modification of the cystid (receptacle of internal organs) and the operculum, reduction of the polypide (feeding apparatus) and the transformation of the tentacle crown to receptory organ. Either hypertrophy or reduction of various elements of parietal musculature with corresponding changes in the nervous system occurred too.

Confocal laser scanning microscopy was applied to study the neuroanatomy of the contrast avicularian types in seven bryozoan species (*Dendrobeania fruticosa*, *Arctonula arctica*, *Tegella armifera*, *Terminoflustra membranaceotruncata*, *Smittoidea propinqua*, *Caberea ellisi*, *Aquiloniella scabra*) from the White Sea. Using α-tubulin we identified: cerebral ganglion and its neuropile, sensory cells in the rudimentary tentacle (bearing cilia), in the vestibular area and under frontal membrane, nerves going from the ganglion to abductor and adductor muscles, retractor and diaphragmatic muscles. Serotoninergic signal was seen in the ganglion neuropile, sensory cells of rudimentary tentacle and of the frontal area (including their processes). Distribution of FMRF-amide mirrors the distribution of α-tubulin (studied in *A. arctica*). Thus, despite the strong dissimilarity in the shape and size of avicularia and the mandibles, their nervous system is basically the same. The differences mainly concern the number of the sensory cells and the length and branching pattern of some nerves.

ID: 224

THE EVOLUTION AND DIVERSIFICATION SIPHONOPHORE (CNIDARIA:HYDROZOA) TENTILLA

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B2 Oral

Siphonophores have the most complex and regularly organized nematocyst batteries of all Cnidaria. These structures are held on the tentacles' side branches called tentilla. Tentilla serve as the principal organs for prey capture, making siphonophores an ideal system for the study of trophic specialization from an evolutionary approach. Modern comparative methods have been applied to study the evolution of siphonophore zooid types, but not yet to the exuberant morphological diversity of siphonophore tentilla. The primary objectives of this work are to describe the morphology and morphometrics of siphonophore tentilla and nematocysts and identify patterns in the evolutionary history of siphonophore cnidoband and nematocyst morphologies. Specimens were collected by SCUBA divers and ROVs. Morphological data was obtained from 1) the primary literature, and 2) transmission microscopy, and 3) confocal microscopy performed on fixed tentacle specimens. Nematocyst complement (cnidome) traits exhibit low phylogenetic signal and higher rate of evolution is higher than tentillum shape. The tentillum morphospace has low effective dimensionality as revealed by phylogenetic PCA, indicating that the evolution of morphological traits of these structures is highly correlated. Tentillum size and nematocyst length are the main drivers of the morphospace. Results suggest that while tentillum shape is slowly evolves, nematocyst characters evolve quickly and independently in different lineages, possibly in response to dietary changes. Results support the idea that siphonophore nematocysts in tentacle batteries evolve as an integrated unit. Understanding the evolution of the prey capture apparatus of siphonophores can help us test hypotheses about the evolution of their predatory habits.

ID: 162

COMPARATIVE ULTRASTRUCTURE OF OOGENESIS IN CHEILOSTOME BRYOZOA WITH DIFFERENT REPRODUCTIVE PATTERNS

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B2 Poster

Cheilostome bryozoans demonstrate a number of reproductive patterns representing a transitional series from broadcasting to incubating strategy with either planktotrophic or lecithotrophic larval types correspondingly. These patterns and production of different larval types involve various modes of oocytic production. Planktotrophic non-brooding strategy implies simultaneous production of cohorts of small (less than 100 mkm in diameter) oligolecithal oocytes that are spawned and activated after an internal post-ovulatory fertilization. Lecithotrophic strategy involves a sequential production of the larger (normally 120 mkm and more) macrolecithal oocytes that are fertilized early in the ovary and which growth is accompanied by the activiry of a nurse-cell. Mature oocyte is oviposed to the brood chamber where larval development occurs. Few bryozoans possess a pattern intermediate between these two, producing numerous small oocytes that are brooded and develop to lecithotrophic larvae. Except one non-published PhD-Thesis, no comparative ultrastructural studies were undertaken on cheilostome oogenesis till now.

Here we present the results of the microanatomical and ultrastructural research of the ovary and oogenesis in three cheilostome bryozoans with different reproductive patterns: *Electra pilosa* with planktotrophic development, *Terminoflustra membranaceotruncata* and *Tendra zostericola* with lecithotrophic development. The latter species represents the intermediate pattern producing yolky (while small) oocytes without nurse-cells. Depending on the oocytic mode, the ovarian anatomy and ultrastructure of the ovarian cells markedly differ in all three species although transport of the yolk precursors is due to the similar mechanism accompanied by the formation of microvilli and endocytosis.

ID: 316

TRANSFORMATION OF THE CHOANOCYTE KINETID IN EVOLUTION OF SPONGES (PHYLUM PORIFERA) AND THE OBSERVED EVOLUTIONARY TENDENCIES

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B2 Poster

Study of evolutionary transformations in the phylum Porifera is traditionally considered to be difficult. Structure of the flagellar apparatus in eukaryotes is a phylogenetic marker for the analysis of macroevolutionary changes. Using transmission microscopy we have obtained original data on the kinetid structure in choanocytes of different sponges. Analysing the kinetid structure we have reconstructed the ancestral types of the choanocyte kinetid in three classes of Porifera. Kinetids of Demospongiae differ from each other by the presence/absence of the additional centriole and the kinetosome-nucleus link, and by the arrangement of MTOCs associated with the kinetosome. Calcarea choanocyte kinetids of the subclasses Calcinea and Calcaronea differ by the presence/absence of link between the kinetosome and nucleus; the occurrence of this link corresponds with the nucleus position in choanocyte. In the class Homoscleromorpha all representatives of the family Plakinidae and several species of the family Oscarellidae (genus *Oscarella*) have apical nucleus associated with the kinetosome. In other species of *Oscarella* the nucleus is basal and having no connection with the kinetosome. Some evolutionary tendencies of evolutionary changes in this organelle were revealed: break of the kinetosome-nucleus link, displacement of the nucleus in basal position, reduction of the centriole, rearrangement of MTOCs. The comparison of kinetid in choanocytes and single-cell representatives of Opistokonta is discussed.

The research was supported by the Russian Foundation for Basic Research (projects No 16-34-50010 and 15-04-03324) at Research Resource Center for Molecular and Cell Technologies of Saint Petersburg State University.

B3 FORM AND FUNCTION OF INVERTEBRATES IN EXTREME ENVIRONMENTS

Organizers: Dr. Nadezhda N. Rimskaya-Korsakova, Dr. Brett C. Gonzalez

ID: 125

THE GIANT TUBEWORM EVOLVED TO COOPERATE WITH ITS SYMBIONT UNDER EXTREME CONDITIONS AT DEEP-SEA HYDROTHERMAL VENTS

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B3 Invited

Symbiotic mutualism, the beneficial cooperation between partners, is ubiquitous. The vast majority of animals and plants house many different microbial species. The giant vestimentiferans tubeworm *Riftia pachyptila* from deep-sea hydrothermal vents is one of rare exceptions with a single, sulfur-oxidizing chemoautotrophic microbial partner Cand. *Endoriftia persephone*. We have been investigating in this mutualism from a notoriously unstable marine environment, which mechanisms of evolved that manage the persistence over ecological and evolutionary time scales. We characterized cycles of symbiont uptake from the environment into the host larvae during horizontal transmission each host generation anew and escape from the host upon host death. Upon symbiont infection through the skin, a single, symbiont-housing organ, the trophosome develops. Nourishment of the host is then taken over by the symbiont, which allowed the host to reduce the entire digestive tract during development. The host, in turn, provides all inorganic nutrients necessary for carbon fixation to the symbiont. Ultimately the system, however, relies on the availability of chemicals in the environment. Volcanic eruptions are in the range of a decade and waxing and waning of vent flow is in the range of years. Thus, colonization of a vent site is rapid, tubeworm growth is fast, and host deaths occur quickly. The symbiont, however, escapes the dead host and colonizes other vents as well as non-vent environments with ambient deep-sea conditions. This release might enable adaptations in the symbiont to spread within host populations and therefore contributes to the stability of this mutualism.

ID: 190

MICROSCOPIC ANATOMY OF SENSORY ORGANS IN *EUKOENENIA SPELAEA* (CHELICERATA: PALPIGRADI)

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B3 Oral

Eukoenenia spelaea Peyerimhoff (1902; Chelicerata: Palpigradi) are cave dwellers and can be found in the Karst regions of the Alps. Living in the permanent darkness of caves, palpigrades have no eyes, but different sets of sensory organs that allow for orientation and possibly communication. Our goal was to analyze the structure of the sensory organs of palpigrades. We studied specimens of *E. spelaea* using semithin serial sectioning for light microscopy, transmission as well as scanning electron microscopy. We describe the shape and cellular arrangement of the trichobothria with details on the dendritic segments. Here, we found a 9x2 + 2 ciliary configuration. We could also show, that the unpaired frontal organ is a bimodial hygro-/thermoreceptor with a complex dendritic outer segment with membrane infoldings. The lateral organ is a unimodal sensor with a cylindrical and branched dendritic outer segment. In addition, we found a yet undescribed area of specialized epidermal cells located anteriorly in the center of the deuto-tritosternum. These cells are enlarged compared to the neighboring epidermal cells and are of a secretory, possibly sensory character. The cells' apical pole displays a multitude of microvilli, the basal pole is rich in glycogen granules. Sensory components of the flagellum are currently under study and will be presented at the meeting. The results are interpreted as morphological features in relation to troglobitic life of *E. spelaea*.

ID: 191

MICROSCOPIC ANATOMY OF *EUKOENENIA SPELAEA* (CHELICERATA: PALPIGRADI)

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Eukoenenia spelaea Peyerimhoff (1902; Chelicerata: Palpigradi) is a troglobitic species which can be found in the European Karst region. Studies of their internal morphology were last conducted many decades ago (Börner, 1901; Rucker, 1901, 1903; Kästner, 1931) but with a lack of detail and resolution as would be appropriate for modern microscopic anatomy. Our goal was to reinvestigate the internal morphology of these enigmatic animals with the example of *E. spelaea* using semithin serial sectioning for light microscopy, transmission as well as scanning electron microscopy. A complete description of the internal and external morphology is presented. Novel, morphological features are: the supra-/ and subesophageal ganglion do not possess a closed layer of pericarya, but show areas where the neuropil is in direct contact with the prosoma musculature. We found a more complex morphology of the coxal glands than previously described. We discovered a yet undescribed area of specialized epidermal cells in the prosoma which are of a secretory, possibly sensory character. In males, we found, that the anterior accessory gland is the place of origin for the paired fusules of the first pair of genital lobes. We were also able to show that *E. spelaea* have a rectal sac with high prismatic epithelial cells, which terminates just shortly before the anal opening, showing no real evidence of a hindgut. Most morphological features can be interpreted in the context of miniaturization. Our results also provide comparative morphological data for the analysis of phylogenetic relationship among chelicerate.

ID: 445

TROGLOMORPHISM IN CAVE SCALE WORMS: ANOPHTHALMIA AND ELONGATION OF BODY APPENDAGES (APHRODITIFORMIA, ANNELIDA)

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B3 Oral

‘Scale worms’, Aphroditiformia, arean extremelydiverse group ofannelids, found throughout marine habitats, displaying complex and vast morphological features and adaptations. Among this diversity, two cave genera from the family Polynoidae, *Gesiella* and *Pelagomacellicephala*,are known from opposing sides of the Atlantic in caves born of significantly different age and geology. Together, these cavepolynoids are of putative deep-sea ancestry, classified withinthe subfamily Macellicephalinae, known only from abyssal depths. We addresses whether cave dwelling scale worms exhibit similar reductive and constructive traits equally as strong as those caveinhabiting arthropods and vertebrates. Known as troglomorphism, these adaptations bring about striking morphologies across both aquatic and terrestrial cave organisms, including varying degrees of eye and pigmentation loss, and hypertrophy of body appendages and sensorial structures. Representing the first model-based phylogeny showcasing these rare cave genera,our phylogenetic results recovered them nested in a strictly deep-sea clade, illustrating a single colonization into marine subterranean environments from the deep-sea before the final opening of the Atlantic. We further employed phylogenetic comparative methods and ancestral character reconstructions, investigating the behavioral and morphological traits of species living in marine caves in comparison to those of species living outside of caves. Our work demonstrated that cave scale worms respond similarly to arthropods and vertebrates in cave environments, showing significant elongation of parapodialsensory cirri and lacking eyes and pigmentation. However, whereas elongation of sensory appendages likely occurred in correlation to cave colonization, eyes were plausibly lost in correlation with the specialization to deep-sea habitats.

ID: 186

EVOLUTION OF ADAPTATIONS TO CHRONIC HYPOXIA IN INVERTEBRATES FROM DEEP-SEA HYDROTHERMAL VENTS

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Deep-sea hydrothermal vents host very a high biomass compared to non-vent influenced areas at similar depths. Such an abundance is made possible through the bacterial primary production that uses the oxidation of reduced chemicals as an energy source (chemosynthesis) instead of the energy of light (photosynthesis). Despite this high biomass, the environmental conditions are very challenging: highly variable temperature, hypercapnia, hypoxia, presence of heavy metals and toxic compounds such as sulfide. As a consequence, the biodiversity is small, and the vast majority of the species encountered there are endemic. Hypoxia is probably the most basic challenge to overcome to reap the benefits of the locally produced biomass. Adaptations can be studied at the morphological, physiological, and biochemical/functional levels.

In decapod crustaceans, the endemic crab family Bythograeidae and shrimp family Alvinocaridae have been studied. The display no significant increase of gill surface area or decrease of diffusion distance through the gills. They do however exhibit an increased ventilation capacity. In annelids, there is an increased gill surface area and the numerous cilia covering the gills that allow an efficient renewal of water at their surface. In the polychaete family Polynoidae, gills are usually absent but are present in about half of the hydrothermal vent species. These are mere expansions of the body wall and are only perfused by coelomic fluid (no blood vessels). Phylogenetic work indicates that all endemic vent polynoidae form a monophyletic group that evolved about 65 million years ago and that gills evovled twice in this lineage.

ID: 480

SEDENTARY POLYCHAETES: HYGIENE OF THE TUBE

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B3 Oral

Sessile invertebrates, obligately living in tubes, face the problem of removing of feces. Such a lifestyle causes the funny body plan with the anterior anus placed dorsally near the head, for example, as in Phoronids or Kamptozoa. Sabelliform polychaetes (Sabellidae, Fabriciidae, Serpulidae) have ciliary fecal groove using for washing feces away. The groove runs from the anus anteriorly along the ventral side of the abdomen, turns to the dorsal side of the thorax and ends close to the base of the branchial crown. The position of ciliary groove is associated with the chaetal inversion - a very conservative feature of serpulomorph polychaetes, where dorsal thoracic chaetae and ventral uncini reverse these positions in the abdomen. The fecal groove associates with capillary chaetae to allow space for the passage of feces between it and the tube wall. In some Sabellidae (*Caobangia*) the fecal groove is modified to the anal trunk, which switches from the dorsal position in the thorax to ventral in the abdomen, across the right side on the thoracic-abdominal boundary. In Sabellariidae the anal trunk is short and free, and it incurves under the abdomen. Previously, it was considered that chaetal inversion is also present in Sabellariidae, but this view is debated now. Here we discuss our data on Sabellidae larval development and regeneration and compare them with existing similar data on Serpulidae and Sabellariidae larval development.

ID: 312

EXTREME DESICCATION RESISTANCE IN CHIRONOMID MIDGES: LINKING MOLECULAR AND MORPHOLOGICAL ADAPTATIONS

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A larva of African chironomid, *Polypedilum vanderplanki*., is the largest multicellular animal which can induce an ametabolic state of anhydrobiosis, when organism is desiccated but still viable. Similarly to the whole organism, *P. vanderplanki*-derived cell line Pv11 is able to enter anhydrobiosis, providing convenient model for morphological and ultrastructural studies.

We induced anhydrobiosis in Pv11 cells by treatment with 0.6 M trehalose and drying [1], processing cells for transmission electron microscopy at different stages.

Trehalose treatment causes cell shrinking by 35% without significant decrease of nuclei size. Most of cells form blebs inside similarly to the processes of programmed cell death. However, a subpopulation of cells with increased density do not form blebs. Probably, this indicates correct induction of anhydrobiosis and subsequent survival, because we expect cell survival to be dependent on the water substitution in cell interior by trehalose. This sugar is well known to protect components of desiccated cells due to formation of biological glass. We hypothesize also that splitting of cells into two subpopulations is related to the different stages of cell division. After dehydration for 6h we observe formation of multilamellar bodies in the cells of surviving population. After rehydration, viability of cells allows them to restore initial population within 10-12 days.

[1] Nakahara Y. Cells from an anhydrobiotic chironomid survive almost complete desiccation / Y. Nakahara, et al // Cryobiology. – 2010. – V. 60. – №. 2.

ID: 412

DO CAVE ANIMALS REALLY LOOK SO WEIRD? UNRAVELLING ADAPTATION USING COMPARATIVE METHODS IN SEVERAL ANCHIALINE EXCLUSIVE LINEAGES, MAINLY ANNELIDS AND DECAPODS

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Anchialine habitats (land-locked water bodies with marine connection) are quite similar to those in the open ocean, but with four striking differences: (1) they harbor a high percentage of endemic species, (2) their communities are disharmonic, with typical marine groups substituted by groups that are never found in the ocean, (3) they host species with a set of shared features, collectively characterized as "troglomorphism", absent in their oceanic relatives, (4) and they harbor animals that are often regarded as primitives and referred to as living fossils. This talk will focus on troglomorphism, commonly involving loss or reduction of eyes and pigmentation, as well as elongation of feeding and sensory appendages. Our goal is to test, using comparative methods, if shared morphological traits in unrelated anchialine species of annelids and crustaceans evolved correlated to cave colonization or rather to different ecological factors present elsewhere in the ocean. First, using phylogenetic general least square analyses, we test if target traits are significantly different in anchialine species than in their marine relatives. Afterwards, the origin of these potential troglomorphic features is traced on different phylogenies, and investigated for correlation with changes in extrinsic geological and ecological parameters. The combination of all these analyses provides robust information on evolutionary processes favoring the morphological similarities in anchialine lineages, as well as morphological convergence at longer time scales, highlighting whether anchialine habitats act as cradles for morphological evolutionary change, or just favor the presence of species with certain traits previously evolved in other environments.

ID: 263

FUNCTION AND EVOLUTION OF "ROOT" IN BONE-EATING WORM *OSEDAX*

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Bone-eating worms of the genus *Osedax* (Annelida, Siboglinidae) exclusively inhabit sunken vertebrate bone. The worms lack a digestive tract and mouth opening. Instead, they have a novel organ for digestion and nutrient uptake called the root. The root is a branching organ at the posterior end of the body, which penetrates into vertebrate bones. It has been suggested that *Osedax* degrade vertebrate bones and uptake nutrients through acidification and secretion of enzymes from the root. Symbiotic bacteria in the root tissue may have a crucial role in the metabolism of *Osedax*. However, the molecular mechanisms and cells responsible for bone digestion and nutrient uptake are still unclear. And also, ontogenic and evolutionary origin of the root is poorly understood. To unveil the function and evolution of the unique organ of the root, we first established a long-term stable culture system of *Osedax* japonicus, and artificial settlement and symbiont infection methods. We also compared transcriptome from three different tissues and examined expression pattern of genes, which might be related to bone digestion and nutrient absorption. We found that the root of *Osedax* has evolved through the combination of molecular evolution of protease genes and co-option of the nutrient uptake mechanism in the posterior epidermal cells.

ID: 135

B3 Oral

DIVERSITY OF COLONY FORM AND FUNCTIONAL MORPHOLOGY OF THE SKELETON OF BLACK CORALS (ANTHOZOA: ANTIPATHARIA)

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Black corals (Antipatharia) are colonial anthozoans characterized by a protein/chitin skeletal axis covered to a varying degree with small spines. Antipatharians are known from pre-Linnean times, and have been reported from all marine environments having normal oceanic salinity levels . They are found from 72°N to 68°S, and from depths as shallow as 2-3 m down to 8.600 m. From an analysis of the diversity of growth forms, it is possible to see that similar types of antipatharian colonies (bottlebrush, monopodial pinnate, flabellate, bushy etc.) have evolved independently in different families. Some colony forms are very complex and originate from an extremely deterministic growth pattern. At the same time deviations in normal branching or pinnulation, due to injury, ecological conditions or the presence of symbionts, may result in growth forms that have mistakenly been considered diagnostic for completely different species or even genera. We discuss here evolutionary trends in formation of monopodial colonies of black corals found at depths below 3000 m. Black corals in the abyss have developed adaptations to deal with the two main problems facing sessile colonial animals in the deep-sea: scarce food input and a deficiency of hard substrate. The first challenge can be met by having a colony form more suitable for passive suspension feeding. An unusual morphological adaptation for colonies living on soft substrates is the formation of the hook-like anchor at the base of the stem, which is found exclusively in the genus *Schizopathes*.

ID: 417

GENERAL MORPHOLOGY AND ULTRASTRUCTURE OF THE CIRCULATORY AND GONOPERICARDIAL SYSTEM OF *CRYSTALLOPHRISSON NITENS* (MOLLUSCA: APLACOPHORA)

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B3 Poster

Aplacophora is an aberrant group of mollusks with a vermiform body devoid of a shell and covered with a thick cuticle with calcareous spicules. Their coelom is reduced to small sizes and is represented by the pericardium and the gonad cavity, thus the hemocoels take on the supporting function. Circulatory system organized into the system of sinuses by diaphragms. The similar organization represents in chitons (Polyplacophora). Thus, the question of the homology of the diaphragms in these groups remains open.

The general morphology and ultrastructure of the circulatory and gonopericardial system of *Crystallophrisson nitens* (Chaetodermatida) were studied by light and electronic microscopy and three-dimensional computer reconstruction.

The gonopericardial system consist of gonad, paired gonopericardial ducts, pericardium, paired gonoducts 1 and gonoducts 2. A distinctive feature of the organization of the body cavity of the aculifera is the presence of the main sinuses (cerebral, visceral and ventral), dorso-ventral septum in the anterior part of the body, the horizontal diaphragm and the dorsal aorta. On the basis of these data, a general circulation scheme for aculifera: the ventral sinus carries blood from the cerebral sinus to the gills, the blood enters and oxygenated in the system of gill sinuses and then blood returns through the visceral sinus to the head. However, the heart of Aplacofora has several distinctive features: the atrium has a connection with the dorsal sinus, and the ventricle is completely closed.

This work was supported by grants of Russian Foundation for Basic Research, projects No.15-29-02447; No.15-04-02850 and No.16-34-00955.

ID: 402

VARIABLE DOPAMINE, STABLE SEROTONIN: THE MORPHOLOGICAL BASIS FOR OPTIMAL EXPANSION OF SEA URCHIN LARVAE

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B3 Poster

Monamine-dependent regulation of swimming is characteristic for sea urchin larva. We used *Paracentrotus lividus* at gastrula, prism and pluteus stages, and analyzed effects of 5-HT and DA application (both 10-7 M) to larval distribution in the water column (1 m length, 4 cm diameter). After pharmacological experiments presence of 5-HT and DA neurons were analyzed using immunochemical detection of 5-HT and FaGlu method for DA visualization.

Gastrula and prism stage larvae concentrated at the top of water column, while pluteus distributed throughout the whole water column and can sink to the bottom. 5-HT application resulted in concentration all stages larvae at the top of the water. DA application induced downward swimming in gastrula and prism, and sinking to the bottom in pluteus. The number and distribution of 5-HT cells were similar in the larvae of one and the same developmental stage independently of their position along the water column. To the contrary, number of DA cells vary greatly at the larvae of one and the same age but collected from the top and bottom of the water column. Interestingly, the larvae sinking to the bottom have the most developed DA system.

We suggested that gradual DA appearance during *P. lividus* development regulates larvae downward swimming. Our pharmacological experiments confirm our hypothesis that stable 5-HT system together with variable DA system contributes to the 3D distribution and thus for most efficient expansion of the larvae.

The work was supported by RFBR grants № 16-34-01381 and № 15-04-07573.

ID: 138

ARTEMIA URMIANA HATCHING EFFICIENCY, GROWTH AND SURVIVAL AFTER CYCLIC HYDRATION AND DEHYDRATION

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Objectives- The aim of this research is study the effects of cyclic hydration and dehydration of *Artemia urmiana* cysts on the hatching, survival percentage and growth.

Materials and Methods- Experiments were carried out in three treatments (1-3 hydration and dehydration cycles) with three replicates for each treatment. Hatching percentage of each treatment was determined according to standard method. Survival and growth were measured on days 8, 11, 15, 20 and 25 of growth.

Results- Data indicated significantly decrease of cyst hatching percentage and survival with repeated hydration/dehydration cycles in comparison by control. As minimum hatching percentage (63.4%) was observed in third treatment. But growth of *Artemia urmiana* is not affected by cyclic hydration/dehydration.

Conclusions- Therefore, against some other species, cyclic hydration/dehydration is not necessary in *Artemia urmiana* and performing it decreases cyst quality.

ID: 437

THE MORPHOLOGY OF CNIDOSACS IN NUDIBRANCH MOLLUSC *AEOLIDIA PAPILLOSA* (GASTROPODA: HETEROBRANCHIA)

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One of the unique features of Nudibranch molluscs (Gastropoda: Heterobranchia) is an ability to sequester, store and use nematocysts from their cnidarian prey. This process was originally described in XIX century, however to date the sequestration process has been studied further in only a few species; data on the general morphology and ultrastructure were also sporadic.

The aim of this research was to study the morphology of cnidosac of *Aeolidia papillosa* (Linnaeus, 1761) and to suggest the presumable mechanism of nematocysts release.

The morphology of cnidosac in A. papillosa differs significantly from the previously studied species of the suborder Aeolidiida. Cnidosac is represented by a muscle sac, located at the end of the dorsal appendages (cerata). The inner lining of the cnidosac is a single-layer specialized epithelium of the digestive gland. We identified three morphological zones: the sphincter zone, the cnidophages zone, the apical zone. Through the muscular sphincter nematocysts move from the digestive gland into the lumen of the cnidosac. Cnidophages are lying in the lumen of the cnidosac and phagocytizing selected nematocysts. Apical zone is located at the distal end of the cnidosac. Its inner surface is covered by a cubic endodermal epithelium with long microvilli which are completely filling the lumen in this zone. In the terminal portion of the apical zone, the endodermal epithelium is partially disintegrated. The comparison of the morphology of intact and exploded cnidosacs is allow us to suggest the presumable mechanism of nematocysts releasing.

ID: 424

APICAL SENSORY ORGAN AND DEVELOPMENTAL REGULATION: INSIGHT FROM FRESHWATER GASTROPOD LARVAE

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Apical sensory organ (AO) is a major part of larval nervous system for most Lophotrochozoan species. This so called “larval brain” is known for more than a century, has a long story of morphological, physiological and recent molecular investigations. AO is believed to detect settlement cues and induce metamorphosis as well as regulate swimming at late larval stages. On the other hand, AO may play a role in the induction of the adult brain formation in Lophotrochozoa (Richter et al., 2010; Nielsen, 2012, 2015; Schmidt-Rhaesa, Harzsch, Purschke, 2016). Despite numerous detailed descriptions, the set of AO possible functions during larval life is far to be complete.

B3 Oral

We investigated freshwater Gastropod larvae for more than twenty years with the aim to understand the role of AO neurons in early larval development. We have found that AO reacts to the chemical signals from adult specimens (Voronezhskaya et al., 2004) and alternative expression of serotonin receptors underlay stage-dependent modulation of larval developmental tempo (Glebov et al., 2014). Recently we demonstrated seasonal variations in the larval developmental tempo in response to the chemical signal from adults and respective changes in larval serotonin receptors expression. Experimental modulation of serotonin level in the female reproductive system resulted in “seasonal shift” of developmental pattern. Finally, we concentrated the active substance from the water conditioned by adults and demonstrated it effect on a variety of freshwater and marine Gastropod larvae.

Morphological work was supported by RFBR grant № 15-04-07573 and experimental work by RSF № 17-14-01353.

B4 INVERTEBRATE CIRCULATORY AND EXCRETORY SYSTEMS: COMPARATIVE MORPHOLOGICAL AND FUNCTIONAL ASPECTS

Organizer Dr. Tatiana V. Kuzmina

ID: 301

PYCNOGONID BODY CAVITY AND TRANSPORT – RIDDLES AND ANSWERS, ANSWERS AND RIDDLES

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B4 Oral

Euarthropoda is a well-defined group including branches: Chelicerata and Mandibulata. According to a long-held view, the body cavity of these animals is a mixocoel, which functions as hemocoel. However, this was disproved in a recent study on *Artemia salina* (Crustacea, Branchiopoda). Moreover, similar results were found in pycnogonids' larvae *Nymphon gracile* and *Achelia vulgaris*. Using standard TEM techniques, we examined the body cavity of *Nymphon brevirostre* (Chelicerata, Pycnogonida) through its postembryonic development. This species has free-living oligomeric larvae and ten development stages. Large ECM-lined body cavity was already present in the hatching protonymphons and retained the same organization until adulthood; at no point coelomic cavity was present. As the new segments became initiated and grew, they, too, acquired body cavity lined with ECM. The primary body cavity itself undergoes differentiation, as a horizontal sept and later the heart walls appear. Both structures develop similarly, starting with the sheath cells of the midgut that form outgrowths towards body wall. The lumen of the heart, in particular, inherits the ECM lining of the original hemocoel, just like in *Artemia salina*. Such organisation of the transport system is quite unlike a typical annelid plan, where vessels develop within the ECM of an already present coelomic lining. We believe that these results present a strong argument against a hypothesis of common origin of all invertebrate circulatory systems and the remaining tenets of the Articulata hypothesis.

ID: 436

SEGMENTAL NEPHRIDIA IN PROTONYMPHON LARVA OF *PHOXICHILIDIUM FEMORATUM* (PYCNOGONIDA)

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Little is known about the excretory system of Pycnogonida which is of particular interest due to the phylogenetic position of pycnogonids as the sister group to Euchelicerata or to all other arthropods. TEM and SEM were used to search excretory organs in the protonymphon larva of *Phoxichilidium femoratum* (Rathke, 1799). The complex of three structures in the basal articles of the larval limbs 2 and 3 aroused most interest: 1) epidermal gland common for the integument of pycnogonids; 2) spine typical for protonymphon larvae; ultrustructure of the spine implies that it functions as a sensory seta; 3) a minute sac covered with the ECM, it has proximal wall composed of podocytic pedicels, narrow lumen and exit duct. The same organs were found in the larvae of different pycnogonids (Meisenheimer, 1902; Dogiel, 1913) and were initially interpreted as glands homologous with the spinning apparatus in the larval limbs 1 which secretes a silk thread. However, the ultrastructure of the sacs in the larval limbs 2-3 suggests ultrafiltration and reabsorption rather than secretion. Moreover, the organ in the larval limbs 2-3 has a separate opening not on the spine but next to its base. We consider the sacs in the limbs 2-3 of the protonymphon larvae as filtration nephridia. The only known example of nephridia in the limbs 1 of pycnogonids were found in adult *Nymphopsis spinosissima* (Fahrenbach, Arango, 2007). In all, in pycnogonids paired nephridia are found in three anterior limbs, and they resemble other segmental excretory organs of panarthropods.

ID: 265

RECONSTRUCTION OF THE BLOOD CIRCULATORY SYSTEM IN THE VELVET WORM *EUPERIPATOIDES ROWELLI* (ONYCHOPHORA, PERIPATOPSIDAE)

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B4 Poster

The organization of the blood circulatory system in Onychophora – one of the closest arthropod relatives – has hardly been studied. Hence, the composition of the circulatory system in the last common ancestor of Onychophora and Arthropoda is unknown. We therefore performed 3D imaging and reconstruction based on serial semi-thin sectioning and synchrotron radiation-based X-ray micro-computer tomography (SR-μCT), in conjunction with scanning electron microscopy, to reconstruct the circulatory system in the onychophoran *Euperipatoides rowelli*. Our study revealed two segmentally repeated channel systems that direct the hemolymph into the pericardial sinus surrounding the ostiated heart. The segmental ostia of the heart are located dorso-laterally and orientated diagonally. The heart opens into the anterior supracerebral sinus, the organization of which proved to be more complex than previously thought, as it shows additional medial and anteroventral extensions. Our findings suggest that the last common ancestor of Onychophora and Arthropoda possessed an elaborate, segmentally organized blood circulatory system, which was modified in different arthropod lineages. Nevertheless, comparative studies of additional species are still required in order to identify homologous elements between representatives of the major panarthropod groups.

ID: 456

ULTRASTRUCTURE OF THE LOPHOPHORAL COELOMIC LINING IN BRACHIOPOD *HEMITHIRIS PSITTACEA*

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Concerning brachiopods, detailed ultrastructural data of the lophophore are restricted to the studies of the tentacles. We studied the ultrastructure of lophophoral coelomic lining in articulate brachiopod *Hemithiris psittacea*. The coelomic system of the lophophore consists of large and small canals; both extend along each brachium and end blindly at its tip. Small canal gives rise to blind branches into each tentacle. The lophophoral coelothelium consists of two types of cells, epithelial-muscle and peritoneal cells, and exhibits different types of organization that are known in Bilateria: from primitive epithelium consisting only of epithelial-muscle cells to pseudostratified myoepithelium. Lophophoral coelothelium forms musculature and blood vessel wall of the brachia and tentacles. The lophophoral blood vessel runs in the extracellular matrix of the septum that separates the large and small canals. In the lophophoral vessel, the upper wall consists of epithelial-muscle cells, whereas the lower wall is formed by peritoneal cells. Inner lining of the vessel consists of amoebocytes that do not form a true endothelium. Lophophoral vessel gives rise to blind branches into each tentacle. The wall of lophophore is highly muscular and contains both longitudinal and transverse muscles. As the spirolophe lophophore of *H. psittacea* is supported only by short crura, we assume that coelomic system of lophophore participates in retention of lophophore by regulation of hydrostatic pressure of the coelomic liquid. This study is supported by RFBR (17-04-00586).

B4 Poster

ID: 177

COMPARATIVE MICROANATOMY AND ULTRASTRUCTURE OF ENIGMATIC 'DORSAL VESSEL SYSTEMS' IN PANPULMONATE GASTROPODS

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B4 Oral

'Dorsal vessel systems' are poorly described network-like structures situated dorsally under the epidermis and associated with the circulatory and excretory systems in various groups of panpulmonate gastropods. Current knowledge is limited to gross-morphological dissections, and the microanatomy and ultrastructure of 'dorsal vessel systems' is largely unknown. Accordingly, homology assumptions are problematic and functional assumptions remain highly speculative.

In the present study we provide the first comparative microanatomical and ultrastructural data on 'dorsal vessel systems' from representatives of freshwater, terrestrial and marine habitats of the panpulmonate slug clades Sacoglossa and Acochlidia. The term 'vessel' is misleading and does not apply for the sacoglossan *Elysia viridis*, in which the 'dorsal vessels' are in fact channelled hemolymph sinuses lacking an endothelium. In contrast, there are two different types of 'dorsal vessel systems' in Acochlidia. In freshwater species of the genus Acochlidium the system is connected to the pericardial complex and represents the extended pericardium with podocytes. The enlarged site of ultrafiltration probably is an adaptation to the freshwater environment. In (semi)terrestrial Aitengidae and deep-sea Bathyhedylidae the 'dorsal vessels' are linked to the kidney. The ultrastructure of the 'dorsal vessel system' of the terrestrial *Aiteng marefugitus* resembles that of the kidney and might enhance the resorption of water and prevent the animal from desiccation on land.

Thus, at present stage of knowledge, the 'dorsal vessels' likely present independent developments to cope with different environmental stress factors and adapt to various life strategies.

ID: 472

EVOLUTIONARY MORPHOLOGY OF THE ARTHROPOD CIRCULATORY SYSTEM

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In arthropods, the ground pattern of the cardiovascular system is based on metameric modules which lead to the formation of longitudinal vessels and lateral segmental vessels. Comparative investigations have revealed that during evolution particularly two factors shaped the cardiovascular system reciprocally: changes in body size and changes in respiratory modes. Larger ancestral arthropods, such as xiphosurans and certain crustaceans, exhibit complex vascular systems which are functionally linked to their locally concentrated respiratory organs, the gills. Moreover, their hemolymph transports oxygen by means of respiratory proteins. In conjunction with terrestrialization, the circulatory system was significantly altered in arthropod clades which developed tracheal systems. In these arthropods the cardiovascular system was no longer needed for oxygen transport and underwent reductions in both extent and performance. In insects, only the dorsal vessel remained. However, this organ effects hemolymph circulation exclusively in the central body cavity. To supply body appendages with hemolymph, auxiliary pumping organs evolved that represent evolutionary novelties. Another key event in insects that entailed significant consequences for the circulatory system was the evolution of wings and powered flight. To reduce body weight, hemolymph volume was drastically reduced and replaced by voluminous tracheal sacs. In some insects the latter are alternatingly compressed by heart beat reversals which shifts the bulk of hemolymph between the various body compartments thereby ventilating the tracheal spacer. In advanced flyers thermoregulation emerged as an additional task for the circulatory system, namely to ensure stable temperature conditions for increased performance of the highly specialized flight muscles.

ID: 432

CIRCULATORY AND EXCRETORY SYSTEM OF VESTIMENTIFERAN SIBOGLINIDS (ANNELIDA)

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B4 Oral

Vestimentifera – a group of gutless tubeworms Siboglinidae – inhabits reduced environments and relies their nutrition on bacterial endosymbionts. Here we arise a question if organizations of their excretory and circulatory systems share common features with sedentary annelids, or is a result of adaptations to peculiar mode of life. The organ systems were studied based on *Ridgeia piscesae*, *Oasisia alvinae*, *Riftia pachyptila* with histology, 3D modeling, and electron microscopy. Tubeworms' vascular system comprises two main vessels (dorsal and ventral) and resembles the one of typical annelids. Unlike other annelids, vestimentiferans have *sinus valvatus* and abundant vascular net of blood supply of trophosome inhabited by endosymbionts. Non-obvious organization of coelomes arises questions on segmentation pattern to compare with annelids. In vestimentum there are separate coelomic cavities with undefined connection with each other: obturacular, tentacular, enteral coeloms and one around the dorsal vessel. Spacious coelomic cavities are visible in extended trunk and in each segment of opisthosome. Excretory and genital systems serve as coelomic ducts in vestimentum and trunk, correspondingly. Excretory system is unusual for annelids. This is an excretory tree comprising numerous blind tubules formed by ciliated terminal cells. Cells and tubules are coated by ECM and considered as a site of ultrafiltration. Tubules enter excretory ducts which proximal parts lined by absorptive epithelium. The distal part of the ducts opens by two pores on the dorsal side. Our results represent an important basis to unveil the evolution of the Vestimentifera and could place them into the annelid radiation.

ID: 331

ANALYSIS OF THE TUNIC RECOVERY DYNAMICS IN ASCIDIA *HALOCYNTHIA AURANTIUM* (PALLAS, 1787)

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B4 Poster

Ascidians are marine filter feeders, that lead an attached lifestyle. Damage of an ascidian body wall is a convenient object for investigation of the evolution of innate immunity responses and repair processes. In protective and reparative reactions an important role is played by circulating blood cells of ascidians – hemocytes.

Therefore, the purpose of this work was to study the dynamics of changes in hemocytes populations during the restoration of *Halocynthia aurantium* tunic after tissue damage.

Animals were subjected to the damage of the small part of their body wall and then, during 8 days after the injury, the analysis of the morphological pattern of tunic repair and the assessment of different hemocytes populations dynamics in hemolymph circulation were performed.

After the damage of *Halocynthia aurantium* tunic we could observe the migration of circulating hemocytes into the tunic and their accumulation at the wound region. Four types of hemocytes, that infiltrate the tunic, were identified: hemoblasts, morula cells, phagocytes and granulocytes. The maximum number of hemoblasts at the wound site was observed on the first three days after injury, and maximum number of morula cells – on the third day. Accumulation of hemoblasts in the wound site correlates with their dynamics in hemolymph. New tunic fibers started to appear on the third or fourth day after the damage occurred, though the thrombus material was still preserved on the injured surface. By the eighth day the area of fibers increased, but the wound was not completely closed.

ID: 130

COXAL GLANDS OF THE *PARASITENGONA* – THEIR ULTRASTRUCTURE, FUNCTIONS AND EVOLUTIONARY IMPLICATION

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B4 Oral

Coxal glands of *Parasitengona*, comprising terrestrial and water mites, function in osmoregulation but were not studied ultrastructurally previously.

Material and Methods

Both parasitic larvae and free-living adults of different groups of *Parasitengona* were studied by TEM methods.

Results

Coxal glands are of mesodermal origin and derived from excretory coelomoducts of ancestral forms. They are represented by a pair of long tubes extending from the mouthparts to the frontal midgut wall and composed of prismatic cells arranged around a central lumen. The cells are provided with a basal labyrinth in the distal tubule and with an apical microvilli in the proximal tubule, which turns forward, tightly embraces the distal tubule and ends blindly. The proximal sacculus is characteristically absent. In contrast to terrestrial mites, coxal glands of water mites possess a distal bladder for accumulation of excretory fluids. The ectodermal excretory duct taking up ducts of the salivary glands forms the common podocephalic duct opening into the subcheliceral space.

Conclusion

Coxal glands function in excretion the excess of water and solutions. This process is more intensive in water mites and less intensive in terrestrial mites that is reflected in particular gland structure. Nevertheless, organization of coxal glands in the *Parasitengona* generally corresponds to that of other Acariformes. This study is supported by a grant N 15-04-01203-a from the RFBR.

ID: 314

BRYOZOAN COELOMS: A SWIM THROUGH A SPELEAN RIVER

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In coelomic animals lacking specialized circulatory system body cavity provides transport function. Bryozoan autozooids have tripartite (Phylactolaemata) or bipartite (Gymnolaemata and Stenolaemata), though incompletely separated, coelomic cavity. It was considered that lophophore and trunk coeloms are connected by a forked canal. We studied ultrastructure of body cavities of three phylactolaemate species, five gymnolaemates and three stenolaemates. In phylactolaemates, we found that lophophore and trunk coeloms are confluent at the base of lophophore arms while they are completely separated at the anal side of polypide and forked canal is absent. Cavities of two anal tentacles are confluent with each other and those of neighboring tentacles, and, further, with cavity of the lophophore arm. In studied gymnolaemate species, lophophore and trunk coeloms are connected through paired ciliated duct on either side of ganglion; ciliation density of ring coelom lining positively correlates with polypide size. Stenolaemates lack such ciliated ducts, and lophophore and trunk coeloms are completely separated by the septum with two special sites on either side of the ganglion where podocyte-like cells cover a layer of ECM. Thus, in phylactolaemates and gymnolaemates transport function is supplied by circulation of coelomic fluid between compartments while in stenolaemates transport between lophophore and trunk coeloms is probably based on ultrafiltration which is similar to nemerteans and sipunculids. Coelom in bryozoans also serves as a hydroskeleton, thus differences in connection between lophophore and trunk coeloms in the bryozoan groups are probably due dissimilarities of body wall structure, polypide protruding mechanisms and lophophore size and shape.

C1 MINUTE METAZOANS: LITTLE PIGEONS CAN CARRY GREAT MESSAGES

Organizers: Dr. Vladimir V. Yushin, Dr. Alexei V. Tchesunov, Dr. Alexei A. Polilov

ID: 166

LIGHT AND ELECTRON MICROSCOPIC INVESTIGATION OF MORPHOLOGY OF THE TARDIGRADE *MACROBIOTUS HUFELANDI* (EUTARDIGRADA)

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C1 Poster

Tardigrades (Tardigrada), commonly known as "water bears", are widely distributed in terrestrial, freshwater and marine ecosystems and well-known for their extreme abilities for cryptobiosis. The difficulties of faunal and morphological investigations of these spectacular invertebrates are caused by their minute size and the problematic specific diagnostics. In the present work the morphological data on the terrestrial tardigrade *Macrobiotus hufelandi* (Eutardigrada: Macrobiotidae) with the special emphasis on the diagnostic and taxonomic characters is presented. The tardigrade specimens were extracted from *Sphagnum* moss in the environs of Kazan during the summer field season of 2016, observed alive under the light microscope in laboratory conditions, fixed in 0.1% glutaraldehyde and prepared for scanning electronic microscopy (SEM) using the standard methodic. The SEM investigation revealed the diagnostic features for the genus *Macrobiotus* including the 10 lamellae surrounding the mouth opening and the claws of so-called "*hufelandi*-type". Within the genus the problematic "*hufelandi* species complex" is recognized, characterized by the presence of two macroplacoids and one microplacoid in the pharyngeal apparatus (observed with the light microscopy) and the serrate claw lunulae on the hind legs (observed by SEM). Finally, the certain species *M. hufelandi* was identified by the presence of the small spikes in the buccal cavity, revealed by SEM and not seen under the light microscope. The role of various diagnostic features for tardigrade specific identification using different microscopic techniques is discussed.

ID: 356

NEW ANATOMICAL TRAITS IN GASTROTRICHA AND POTENTIAL IMPACT ON THEIR PHYLOGENY

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Gastrotricha is a cosmopolitan group of meiofaunal animals, which diversity, evolution, and morphology are still only partially known. Their long debated relationships with other Metazoa seem to be finally resolved by phylogenomic studies placing them as sister group to Platyhelminthes. Still, many aspects of their phylogeny and inner anatomy are far from well understood, leading sometimes to confusing relationships between gastrotrichs. Here we present results on the morphology of the nervous system and ciliation studied with confocal laser scanning microscopy of a variety of gastrotrichs showing a higher diversity of structures than previously described. For instance different arrangements of ciliation are found in the pharynx and on the ventral surface. Moreover additional longitudinal nerves extending along subparts of the animal or the entire body length have been found in several species, contrary to the single pair described so far in the majority of gastrotrichs. More precise structures such as specific nerves of the brain or perikarya are also found, showing different states of characters. These different new characters may be of importance for resolving the phylogeny of Gastrotricha and will moreover help to reconstruct the evolution of their anatomy and nervous system. In a context where meiofauna seem to occupy a crucial place in the metazoan phylogeny these results may in the future aid to the understanding of their relation with Platyhelminthes.

ID: 381

AN INTEGRATIVE MOLECULAR AND MORPHOLOGICAL APPROACH REVEALS NEW INSIGHTS INTO THE EVOLUTION OF THE ENIGMATIC CHARLIE CHAPLIN WORMS (HISTRIOBDELLIDAE, ANNELIDA)

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Histriobdellidae – the so-called Charlie Chaplin worms – are an enigmatic group of minute commensal annelids associated with marine and freshwater decapods. They, lack external segmentation and bear a complex jaw apparatus in the ventral muscular pharynx. Although histriobdellids were always thought to be a part of the jaw-bearing Eunicida, an ultimate placement within the annelid tree is still pending due to their highly derived external morphology and lack of comparative molecular and morphological investigations. In order to gain new insights into phylogeny and evolution of Histriobdellidae, we studied adults and different developmental stages of *Histriobdella homari* Beneden, 1858, a commensal of the European lobster. Using an integrative approach including molecular analyses of nuclear and mitochondrial genes immunohistochemistry with standard neuronal and muscular markers, subsequent confocal laser scanning microscopy (clsm), and scanning electron microscopic (SEM) examinations of the jaw apparatus and external body features, we provide important details to comment on the phylogenetic position of histriobdellids. Our study reveals the presence of prionognath-like maxillae and neuronal and muscular features highly comparable to other well-investigated families within Eunicida. Consequently, our results represent an important basis to unveil the evolution of the Charlie Chaplin worms and to finally place them into the annelid radiation.

ID: 272

SELF-PRESSURISED RAPID FREEZING (SPRF): AN EASY-TO-USE AND LOW-COST ALTERNATIVE CRYO-FIXATION METHOD FOR MINUTE METAZOANS

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Self-pressurised rapid freezing (SPRF) has been tested on two species of free-living nematodes, *Acrobeles complexus* and *Caenorhabditis elegans*. The method employs plunge freezing of nematodes (densely packed in water in a sealed capillary copper tube) into the cryogen, a mixture of solid and liquid nitrogen (nitrogen slush). Part of the water inside the tube, expands upon cooling (due to hexagonal ice formation) thereby generating pressure intrinsically supporting vitrification of the samples. The preservation of these unprotected specimens is comparable to that achieved with high pressure freezing (HPF) in the in the presence of a cryoprotectant. The quality of preservation of both nematodes is illustrated by the study of structure of spermatozoa where clear details in mitochondria, membranous organelles and microfibers in the pseudopods have been well documented by transmission electron microscopy. SPRF fixation preserves antigenicity as demonstrated by immuno gold localization of cytoskeletal proteins such as the nematode-unique major sperm protein (MSP). SPRF as an EM preparation method is limited by the inner diameter of the capillary copper tubes (0.35 mm), so the method is suitable for minute metazoans which may be collected in sufficient amounts.

ID: 338

FINE STRUCTURE OF THE INTESTINE OF SOME MARINE NEMATODES – DOES IT REFLECT SYSTEMATIC POSITION OR DIET OF SPECIES?

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C1 Poster

Nematode midgut is a straight tube made up of monolayer of epithelium. Marine free-living nematode species differ from one another in diet and ways of food ingestion that could be reflected in fine structures of the midgut cells, we expect; another possible expectation is the structure of the midgut cell is linked with taxonomic position of species. We studied ten species of White Sea nematodes from five orders: *Bathylaimus arcticus* (Enoplida, Tripyloididae), *Oxystomina* sp. (Enoplida, Oxystominidae), *Paracanthonchus caecus* (Chromadorida, Cyatholaimidae), *Halichoanolaimus robustus* (Chromadorida, Selachinematidae), *Desmodora communis* (Desmodorida, Desmodoridae), *Draconema ophicephalum* (Desmodorida, Draconematidae), *Paramonhystera filamentosa* (Monhysterida, Xyalidae), *Sphaerolaimus balticus* (Monhysterida, Sphaerolaimidae) *Odontophora deconinki* (Araeolaimida, Axonoilaimidae) and *Sabatieria ornata* (Araeolaimida, Comesomatidae). Intestine structures such as glycocalyx, apical microvilli, features of digestive vacuoles and lipid drops, development of endoplasmic reticulum, distribution of mitochondria and even number of cells on a cross-section varies significantly among species. There is a rather weak correlation between glycocalyx structure and diet: species igesting coarse items but having no buccal armament for precursory treatment of food tend to have thick and complicated glycocalyx while those sucking out soft luquid content of injured hard-shelled items mostly haver thinner amorphous glycocalyx, Ciliate- and bacteria feeders have an intermediate or peculiar glycocalyx type. Link of the diet with internal cell structures is less evident and probably determined biochemical traits of food item. The study is supported by Russian Foundation for Basic Research, grant No. 15-04-02597.

ID: 339

ALIMENTARY TRACT STRUCTURE OF TWO MARINE NEMATODE SPECIES OF THE ORDER MONHYSTERIDA

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Paramonhystera filamentosa (Ditlevsen, 1928) (Xyalidae) and *Sphaerolaimus balticus* Schneider, 1906 (Sphaerolaimidae) both belonging to Monhysterida are common in the White Sea intertidal zone. According to own observations and literature data, *P. filamentosa* feeds on coarse particles including diatom algae which are ingested intact while *S. balticus* is a predator swallowing entire prey nematodes. Both species possess no evident armaments in the buccal cavity. Stoma of *P. filamentosa* is rather small and consists of hemispherical cheilostoma and funnel-shaped pharyngostoma. Stoma of *S. balticus* is very large and made up largely of elaborate cheilostoma. Intestine cells of both species are featured by well-developed microvilli and robust glycocalyx. Microvilli are long and densely arranged while glycocalyx is thick and multilayered (with alternating amorphous, dense and lamellar layers). In both species, the glycocalyx can protect the delicate microvillar layer from damage by coarse particles such as sand grains and diatom frustules in *P. filamentosa* or large prey nematodes in *S. balticus*. On the contrary, internal cell content shows differences in both species. In *P. filamentosa* cells mitochondria are concentrated in apical zone while digestive vacuoles are more numerous in basal zone. In *S. balticus*, mitochondria and digestive vacuoles are not stratified in the cytoplasm; vacuoles vary widely in size and inner content; lipid drops are more numerous than those in *P. filamentosa*. Differences in the internal cell structure could be associated with digestion particularities of different food items in two species. The study is supported by Russian Foundation for Basic Research, grant No. 15-04-02597.

C1 Poster

ID: 332

BRAIN STRUCTURE OF TINY DIPTERANS (INSECTA: DIPTERA): COMPARATIVE ANALYSES TO OTHER MICROINSECTS

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The study of the morphology of microinsects is among of the leading directions of comparative morphological studies. Despite the fact that Diptera are a well-established model system for studying the structural organization of the nervous system, until now, data on the structure of the brain of micro-representatives of this taxon are insufficient. To expand the knowledge about the peculiarities of the insect brain organization we have been studied the structural organization of the brain of micro-dipterans from two suborders of Brachycera-Leptocera sp. (Sphaeroceridae), *Hydrellia albolabris* (Ephydridae), and Nematocera-Mayetiola (Cecidomyiidae), *Corynoneura* (Chironomidae). Using the methods of scanning, transmission, light microscopy and 3D reconstructions, the structure of the brain and its individual structures and changes in their relative volumes were analyzed. On the basis of 3D reconstructions the structural organization of the brain and its individual centers was described. The results are discussed in a comparative aspect of Diptera and other microinsects. It was shown that the relative volume of the brain increased significantly with decreasing body size, and the size and number of neurons were significantly reduced. In spite of the small size, the brain of tiny dipterans demonstrates the highest degree of conservatism among other microinsects. In fact, the structure and ultrastructural organization of brain centres are the same as in the most of the related groups. In contrast to other microinsects, the studied dipterans have the highest number of neurons in the brain.

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C1 Oral

ID: 459

MALES OF THE TANTULOCARIDA: WHAT IS IN THEIR HEADS?

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Tantulocarida is a group of minute parasitic crustaceans with complex life cycle and unique metamorphosis. A keystone stage of the life cycle – a tantulus larva - is one of the smallest arthropods on Earth (70 -150 µm long). However, not all the stages are parasitic: males of the Tantulocarida are free living and non feeding. Their body is comprised of cephalotorax incorporating first two thoracic segments, four free thoracic somites and two-segmented abdomen. Internal anatomy of the male Tantulocarida has been studied for the first time using TEM and CLSM.

Cuticle of cephalothorax infolds inside forming two ventrolateral zones which are separated from the central part and possibly serve for storing nutrients. Anterior half of the cephalotorax is occupied by the so-called honey comb like structure (HSC) — a group of tightly packed small cells of unknown origin and function. Each cell of the HCS with large central vacuole filled with homogeneous substance and cap-shaped nucleus with highly condensed chromatin. No evident mitochondria or any other organelles have been observed inside these cells. We suggest that HCS represents male gonad — packed spermatozoa without flagella. Brain closely oppressed to the posterior margin of the honey comb like structure is not divided into proto-, deuto- and tritocerebrum. It is composed of spacious neuropil with thick cortex layer and neurofibers lacking any glial sheathing. Fusion of the cerebral segments and general simplification of brain structures is a result of significant miniaturization as well as lack of any cephalic sensory organs except aesthetascs and pores.

ID: 123

MORPHOLOGY OF THE WING APPARATUS AND FLIGHT CHARACTERISTICS OF FEATHERWING BEETLES (COLEOPTERA: PTILIIDAE), THE SMALLEST FREE-LIVING INSECTS

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Miniaturization leads to considerable reorganizations in the morphology of many insects, but the majority of minute insects retain astonishing complexity of organization. Beetles of the family Ptiliidae are the most vivid example of such complexity. The smallest of them are only 325 μm long and thus comparable in size to many unicellular organisms; at the same time, they are capable of flight. The morphology of their flight apparatus has never been studied in detail. Their flight has never been studied either. We have performed a comprehensive study of the shape and microsculpture of wings and morphology of the apparatus used to fold and protect them and of the flight musculature in Ptiliidae using light and electron microscopy and 3D computer modeling. Comparative analysis of the results of this study and data on the morphology of larger representatives of related coleopteran taxa has revealed miniaturization-related features of the morphology and evolution of flight apparatus. The flight of ptiliid beetles has been recorded for the first time on video using a high-speed camera. Analysis of the video records has shown that functional parameters of the wings of Ptiliidae (frequency, amplitude, trajectory, and others) considerably differ from those of larger beetles. Many publications voiced the opinion that microinsects are capable only of passive soaring, but the results of this study show that the flight of ptiliids is active and very maneuverable and has high relative speed.

This study was supported by the Russian Science Foundation (14-14-00208).

C1 Oral

ID: 253

THE OOGENESIS OF *THULINIUS RUFFOI* (TARDIGRADA, EUTARDIGRADA)

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Tardigrades are microscopic, cosmopolitan ecdysozoans closely related to Arthropoda and Onychophora. Our knowledge about their body organisation and process of gametogenesis is still poor. Three types of reproduction can be distinguished in this phylum of animals: gonochoristic, partenogenetic and hermaphroditic.

The specimens *Thulinius ruffoi* (Bertolani, 1982) were analysed using transmission electron microscopy and confocal microscopy. Histochemical analyses were also conducted.

Thulinius ruffoi is parthenogenetic species. Its reproductive system is composed of: single ovary and single oviduct that opens into the cloaca. The ovary is polarized. The anterior part contains small germarium filled with oogonia. The biggest part of ovary is called vitellarium and is filled with clusters of the germ cells. The cells in the cluster are interconnected by cytoplasmatic bridges. Three phases can be distinguished in this process: previtellogenesis, vitellogenesis and postvitellogenesis (choriogenesis). During process of oogenesis one cell in each cluster develops into oocyte. Remaining cells differentiate into trophocytes (nurse cells). The mix type of vitellogenesis takes place in analysed species. The egg capsule is composed of two shells: vitelline envelope and chorion. The surface of the egg capsule is smooth.

C1 Oral

The ovary found resemble ovary of other eutardigrades analysed (*Dactylobiotus dispar*, *Dactylobiotus parthenogeneticus*, *Paramacrobiotus richtersi*, *Macrobiotus polonicus*). Similar to other analysed species oogenesis is of the meroistic type. The mixed type of vitellogenesis and the eggcapsule composed of two shells are observed.

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ID: 305

COMPARATIVE MORPHOLOGY AND MOLECULAR BIOLOGY OF *MICROARCHICOTYLUS* (PLATHELMINTHES, TRICLADIDA, PALUDICOLA), A NEW GENUS OF DWARF PLANARIANS FROM LAKE BAIKAL

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Endemic dwarf tricladids of the genus *Microarchicotylus* Timoshkin et Porfiriev, 2015 are new to the planarian fauna of Lake Baikal. *Microarchicotylus* representatives were singled out from the genus Archicotylus Korotneff, 1912 of Baikalian tricladids, i.e., a combined genus of planarians.

The morphological characteristics of planarians belonging to the genus *Microarchicotylus* were described based on the histological sections made by the standard methods. DNA was isolated from the tissues of Baikalian planarians using phenol–chloroform extraction. Amplification and sequence analysis were performed by the standard methods. Phylogenetic analysis was carried out with the help of MrBayes (3.1.2) software.

C1 Oral

To date, the genus *Microarchicotylus* comprises five species: M. *stringulatus* (Korotneff, 1912), *M. elegans* (Porfiriev et Timoshkin, 2009), *M. ochroleucus* (Timoshkin et Porfiriev, 2015), and *Microarchicotylus* sp. n.

Microarchicotylus planarians are distinguished by small size (4-5 mm), as well as a white transverse collar behind the pair of eyes on the dorsal body side. The latter is dark colored, except M. ochroleucus having light beige color. The genitals of *Microarchicotylus* planarians do not significantly differ in their structure from the standard scheme of copulative organs in other tricladids. In particular, the copulative organ of *Microarchicotylus* is compact in all its parts. The common atriums are asymmetrically located relative to the gonopore.

The analysis of 18S rRNA gene sequences demonstrated that the nucleotide sequences of *Archicotylus* and *Microarchicotylus* representatives differed by 0.1-3%. Furthermore, the obtained data show polyphyly of the genus *Microarchicotylus*.

ID: 214

REGENERATIVE CELLS IN TARDIGRADA DIGESTIVE EPITHELIA

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The middle region of the digestive system of Tardigrada is formed by the simple epithelium composed of the digestive cells. Being responsible for the secretion, absorption, excretion and the accumulation of the reserve material, the digestive cells degenerate in a continuous manner. Therefore, the degenerated cells must be replaced by the newly formed cells. The new digestive cells are formed from the regenerative ones. These cells are grouped in regenerative nests, which might be located only at the anterior region of the midgut or at both, the anterior and posterior regions of the midgut. Among cells that form the regenerative nest we could distinguished: cells during interphase and progenitor cells. Because of the fact that the regenerative cells of the midgut epithelium have the abilities to proliferate and differentiate into the digestive cells, we can state that they play a role of the midgut stem cells. The progenitor cells show the features of both, midgut stem cells and the digestive cells During the differentiation they gradually achieve features of the digestive cells. The processes of regenerative cells mitotic divisions and their differentiation have been detected using transmission electron microscopy and fluorescence methods.

C1 Poster

ID: 213

ULTRASTRUCTURE OF THE MIDGUT EPITHELIUM OF *PARACHELA* (TARDIGRADA) WITH THE EMPHASIS ON ITS DEGENERATION

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The digestive system of Tardigrada is composed of three distinct regions: the fore-, mid- and hindgut. The midgut is the region that is responsible not only for all processes connected with digestion (secretion, absorption, accumulation of the reserve material, etc.), but it is also one of the first lines of defense against external factors (e.g., xenobiotics, pathogens, starvation, etc.). The digestive cells according to different stressors could be damaged and eventually degenerate in the way of cell death. Therefore, we decided to describe the course of apoptosis and autophagy at the ultrastructural level and to state when these processes are activated in the midgut epithelium of species which belong to *Parachela*. While apoptosis is the type of cell death which leads to the complete cell destruction, the autophagy can fulfil the different roles in the midgut epithelium. Depending of the type and strength of stressors it enables cells to survive or let them to die. As the material for studies we chose some tardigrades e.g., *Isohypsibius granulifer granulifer*, *Xerobiotus pseudohufelandi*, *Hypsibius dujardinii* or *Macrobiotus polonicus* which live in a different environments, so they can be exposed to different external stressors. The analysis was performed using light and transmission electron microscopes.

ID: 161

KLEPTOPLASTY IN MARINE MEIOFAUNAL FLATWORMS

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Kleptoplasty, the phenomenon by which one organism steals plastids from another, has only been reported in one group of metazoans: the sacoglossan sea slugs. Here we find evidence for kleptoplasty in a second animal group. *Baicalellia solaris* and *Pogaina paranygulgus* (Platyhelminthes, Rhabdocoela) are meiofaunal marine flatworms inhabiting intertidal zones of British Columbia, Canada. To investigate the relationship between these animals and their photosymbionts, we used a combination of light and electron microscopy techniques, DNA barcoding, starvation experiments and oxygen production analyses. Our results found that plastids are isolated from pennate diatom prey and sequestered in the cytoplasm of mesenchyme cells. Survival experiments and oxygen measurements gave evidence for functional kleptoplasty, meaning the plastids remain photosynthetically active after being isolated from the diatom cell. Based on the results, we predict that the plastids supply photosynthetically-fixed carbon to the worm in the short term, and act as a nutritious food store in the long term, providing sustenance when seasonal diatom blooms collapse. This study provides a compelling example of convergent evolution of kleptoplasty, which gives animals a competitive advantage in oligotrophic environments.

ID: 195

OVARY STRUCTURE AND OOGENESIS IN *GRANIA POSTCLITELLOCHAETA* (CLITELLATA: ENCHYTRAEIDAE)

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Our knowledge about the internal body organization in numerous small invertebrates is still not satisfactory. The genus *Grania* houses over 70 species of marine benthic microinvertebrates belonging to the family Enchytraeidae. To date, nothing is known about the gonad structure and gametogenesis in *Grania*.

Each of the collected *Grania* specimens was divided into two parts – the anterior part of the body (with gonads) was fixed for ultrastructural studies, whereas the rest of the body was fixed for DNA sequencing for proper species identification.

Grania postclitellochaeta (Knöllner, 1935) has paired ovaries, that resembles a bunch of grapes, and are located in the XII segment. The ovaries are polarized. Oogonia occurred within their anterior parts followed by cells in meiotic prophase I and previtellogenic oocytes. Vitellogenic oocytes were located outside the ovary, within the body cavity. We observed that the germ cells formed syncytial cysts equipped with the cytophore. As oogenesis progressed, two morphologically distinct cell categories could be recognized within a given cyst – one oocyte and 15 nurse cells.

C1 Poster

The ovaries found resemble ovaries of *Enchytraeus albidus* Henle, 1837 and E. *buchholzi Vejdovský*, 1878. Both the ovarian morphology (bunch of grapes) and the organization of germ-line cysts (one oocyte and 15 nurse cells) are the same in all three species. Although we currently only have information about ovary organization and oogenesis in these three enchytraeid species, it appears that gonad organization and the course of oogenesis may be a conservative aspect of gametogenesis in this family.

ID: 368

A MEIOFAUNA PERSPECTIVE ON NERVOUS SYSTEM EVOLUTION

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The evolution of the nervous and its diversification within Bilateria is still highly debated, and to a large extend influenced by the detailed studies of a few model animals. These cannot alone bridge the very diverging body forms and sizes of Bilateria, why additional studies representing this diversity are needed to reconstruct the evolution of the Bilaterian nervous system.

Recent phylogenomic studies have found meiofauna lineages to not just occupy terminal positions in the tree of life, but constitute sister clades to the major Bilaterian groups: Xenacoelomorpha as sister to remaining Bilateria, Scalidophora as sister to remaining Ecdysozoans, and Gnathifera as sister to the remaining Spiralia. However, the nervous system is only studied in details for a few species of these meiofauna clades.

Our broadly sampled, comparative neuroanatomical studies within the spiralian lineages, Gnathostomulida, Micrognathozoa, Gastrotricha and Annelida revealed numerous neural apomorphies of systematic importance, some of which could also help resolve homology of diverging body regions. Our more detailed studies of brain gene expression and neuropeptide patterns in meiofaunal Dinophilidae (Annelida) showed significant variation, even among closely related species. The small size of the males will now allow for further investigations of neural plasticity. It all underlines the necessity for a comparative approach and careful reconstruction of ancestry using phylogenetic tools. With both morphological and molecular methods fast developing, the establishment of multiple new meiofaunal model animals may be within reach, and furthermore essential to finally reconstruct the ancestral configuration and underlying patterning of the bilaterian nervous system.

ID: 283

A CHALLENGE IN INSECT ANATOMY – THE SMALLEST BEETLES AND SUITABLE METHODS TO STUDY THEM

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Ptiliidae (feather-winged beetles) include the smallest known non-parasitic insects. The head morphology of species with different body size (0,3mm – 1,1mm) and feeding preferences (saprophagous and sporophagous) was examined and described in detail, focusing on features affected by miniaturization and food substrates. The observed characters were evaluated with respect to their phylogenetic implications and function, and also their correlation with extreme size reduction.

Detailed examination of extremely small structural elements can be a great challenge. A combination of several techniques turned out as efficient and yielded very good results. Scanning electron microscopy (SEM) is optimal for the documentation of fine surface structures. Digital confocal laser microscopy (CLSM) and microtome sections combined with 3D reconstruction are very well-suited for visualizing internal structures.

C1 Oral

As a result of this study head structures including brain, muscles and glands of one saprophagous (*Acrotrichis sericans*) and two sporophagous species (Nanosellini, *Nanosella russica* and *Porophilla mystacea*) were reconstructed. Several other species including *Scydosella musawasensis*, the smallest non-parasitic insect, were also studied using SEM and CLSM. Extreme body size reduction is a presumptive autapomorphy of Ptiliidae that resulted in the following modifications: loss of cephalic sutures and ridges, simplified tentorium, and brain modified in shape and very large in relation to the head. The ptiliid species with saprophagous and sporophagous feeding habits show only subtle differences in their cephalic structures, notably details of the epipharynx and galeae, and also in the configuration of maxillary muscles.

ID: 181

A NEW SPECIES OF *XESTOLEBERIS* (OSTRACODA: PODOCOPIDA: XESTOLEBERIDIDAE) FROM THE EAST COAST IN SOUTH KOREA

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Xestoleberis Sars, 1866 has a worldwide distribution in marine ecosystems, with 203 species reported so far. In this study we describe one new species *Xestoleberis hujungensis* n. sp., and redescribe *X. setouchiensis* Okubo, 1979, *X. ishizakii* Schornikov, 1975 collected from the Hujung beach on the East Coast of South Korea. The two redescribed species were originally described from Japan (Seto Inland Sea and Uranouchi Bay) and the only difference between Korean and Japanese populations is in their size. So far, sixteen species of the genus *Xestoleberis* were recorded from the East Coast of Korea, but only *X*. cf. *depressa* Sars, 1866, *X. hanaii* Ishizaki, 1968, *X. iturupica* Schornikov, 1974, *X.* cf. *opalescenta* Schornikov, 1974, *X. sagamiensis* Kajiyama, 1913, *X*. cf. *sagamiensis* Kajiyama, 1913, *X. setouchiensis* Okubo, 1979, and *X*. cf. setouchiensis Okubo, 1979 are named.

Xestoleberis hujungensis n. sp. is closely related to *Xestoleberis hanaii* Ishizaki, 1968 originally described from Uranouchi Bay in Japan. The main differences are a wart-like ornament on the anterior end of male carapace, size of carapace, and lobe of the hemipenus. The latter is longer and more slender than in *X. hanaii* Ishizaki, 1968.

ID: 251

MALE GAMETES AND EVOLUTION IN NEMATODES: THE CASE OF THE ORDER RHABDITIDA (NEMATODA)

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Data on the sperm structure and spermatogenesis are used widely for the analyses of the phylogenetic relationships inside many classes of metazoans. However, this has not been done for nematodes because of the lack of comprehensive information of several key taxa. Nevertheless, the order Rhabditida, which includes many plant and animal parasites, is studied relatively well. New observations on sperm development in this group from four superfamilies together with data available on many other key taxa of this order facilitated the comparative analysis of male gametes. The rhabditid spermatozoa represent a highly modified (aberrant) type of male gametes; they are characterized by the absence of an axoneme and acrosome. The spermatozoon is an amoeboid cell with anterior pseudopod and posterior main cell body which includes nucleus, mitochondria and 'membranous organelles' (MO). In the rhabditid spermatozoa two forms of unique organelles, MO and fibrous bodies (FB), develop as FB-MO complexes. Each complex contains a MO, and a paracrystalline FB accumulating cytoskeletal proteins. Dissociation of the FB-MO complexes terminates in mature spermatozoa where FB proteins acquire filamentous form and became the cytoskeleton of the pseudopod. Synchronized formation of the specific FB-MO complexes is one of the most characteristic features of the rhabditid spermatozoa. However, several clades in the order Rhabditida have spermatozoa that are drastically different from the common rhabditid pattern. Dimorphism of spermatozoa found in some species indicates high plasticity of sperm development and structure in the order Rhabditida. (Support: TEM by RFBR 17-04-00719; lecture by RSF for the FEFU 14-50-00034).

C1 Oral

C2 STRUCTURE OF PARASITIC INVERTEBRATES: PLASTICITY, ADAPTATION, EVOLUTION

Organizers: Dr. Natalia M. Biserova, Dr. David Bruce Conn

ID: 353

HOW MICROPHALLUS METACERCARIAE (TREMATODA: MICROPHALLIDAE) FROM *LITTORINA* SNAILS REACT TO ABRUPT TEMPERATURE RISE RELATED TO HOST CHANGE

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We compared metacercaria from different temperature exposition. Our results imply that rapid significant physiological shift occurs in metacercaria of microphallids as a response to temperature raise. This involves metabolic processes and gametes production activation.

C2 Poster

ID: 386

CELLULAR SOURCES OF NEURO- AND IMMUNOMODULATORY MOLECULES OF THE CESTODES REGULATING FISH-HOST IMMUNITY

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Several substances presented in the tapeworms larvae can modulate the host immunity: PG E2; PG D2; GABA, as well as serotonin (Biserova et al, 2011; 2014; Biserova, Kutyrev, 2014 a, b; Kutyrev et al, 2017; Kutyrev, 2017). Analysis of excretory-secretory products of metacestodes reveals potential suppressors of dendritic cell functions (Vendelova et al, 2016).

The aim of our research was detect cellular sources of immunomodulatory molecules in two cestodes species *Diphyllobothrium dendriticum* and *Ligula interrupta*.

For the first time in *L. interrupta* plerocercoids we identified immunoreactions (IR) to prostaglandins E2 and D2 in different types of cells and neuroactive substances as GABA, serotonin and FMRF-amide in the neurons. In *D. dendriticum* plerocercoids we found the PGE2 IR in small neurons belonging to the main cords and commissures. In both species the PGE2-IR partly coincided with α-tubulin-IR and it was found in the apical terminals of the frontal glands and free nerve endings. PGD2-IR occurred in the muscle fibers and coincided with phalloidin TRITC staining of the F-actin in the muscles. Both PGE2 and PGD2 were found in the flame cells of the excretory system of these tapeworms. We proved that parasites excrete the prostaglandins E2 and D2 in response to the host blood serum. By ultrastructural investigations, we found number of cell sources of excretory-secretory products: neurons and free nerve endings, frontal glands and tegument.

This work was supported by the RFBR(15-04-02645; 16-04-01213)

ID: 429

CANCER IN CESTODES (PLATYHELMINTHES, NEODERMATA): MORPHOLOGY OF NEOPLASTIC MALIGNANT TRANSFORMATION

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Cancer is widespread among diverse animal phyla. Studies suggest that this disease state involves universal mechanisms of dysplasia among perhaps all or most metazoans. For most, including humans and other vertebrates, this causes severe dysfunction and ultimately death. Over the past century, reports of anomalous juvenile cestodes (metacestodes) infecting diverse hosts have demonstrated morphological aberrancies leading to massive incessant asexual proliferation of the metacestodes, which usually lose the ability to mature into adults. For several decades we have documented many new cases from around the world and have performed morphological and histological analyses on these and historic cases from museum collections using brightfield and differential interference light microscopy and scanning and transmission electron microscopy. Most of these cestodes have been identified as *Mesocestoides* (Cyclophyllidea) or *Spirometra* (Diphyllobothriidea), though abnormal morphology, inability to mature, and lack of genomic data leave uncertainty. Analysis of data compiled from our studies and published reports of others have shown that structural anomalies of these parasites are similar to specific forms of malignant transformation common to other taxa. Uniquely in cestodes, the neoplastic morphogenesis involves altered association among the tegumental and excretory epithelia, accommodated apparently by altered epitheliomesenchymal interactions with the parenchyma. Except for cases of experimental euthanasia, all cases have resulted in death of the host. Experimental infections have shown that the propagules can be transplanted serially to new hosts, where proliferation continues indefinitely. Thus, the cancer of these cestodes, though interrupting normal development of the parasite, leaves them otherwise viable while killing the host.

ID: 365

MORPHOLOGICAL INSIGHTS LINKED TO BEHAVIOUR OF DIGENEAN LARVAE – CERCARIAE

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C2 Poster

Digeneans are parasitic flatworms whose common life cycle includes not only parasitic but also free-living phases. Notocotylidae is one of the digenean families with a primary two-host life cycle. Their cercariae, free-living larvae of the hermaphroditic generation, encyst in the open rather than inside the second intermediate host. Cercariae of two closely related notocotylid species have recently been differentiated in *Ecrobia* (=*Hydrobia*) *ventrosa* at the White Sea. Both have appearance typical for Notocotylidae (no ventral sucker, presence of dorsal adhesive pockets). Cercariae were shown to unevenly distribute among the potential encystment substrata. In current research we study musculature arrangement in these cercariae by means of fluorescent-phalloidin staining and confocal microscopy, describe their basic behavioural patterns and try to link these two aspects. Results were consistent for the two species. Main behaviour elements are swimming and substratum testing. During swimming cercaria moves, tail forward, and takes a saucer-shape, with a prominent ventral concavity. During substratum testing it performs twisting movements. Involvement of particular muscular elements (well-developed dorsoventral muscle fibres and formation of annular arrangement of longitudinal muscle fibres on the ventral side; and additional body-wall and internal muscle bundles in the anterior region) can explain these two locomotory patterns. Moreover, we try to find an insight of what is behind the differences between the two cercariae in substratum choice by looking at the distribution of sensillae. It appears that thorough morphological examination of musculature and sensory structures can be supported by functional explanations arising from careful behaviour documentation.

ID: 461

MICROSCOPIC ANATOMY OF THE *NYBELINIA SURMENICOLA* OKADA IN DOLLFUS, 1929 (TRYPANORHYNCHA: LACISTORHYNCHIDAE) PLEROCERCOID SCOLEX

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Morphology of Nybelinia surmenicola plerocercoid scolex collected from *Pleurogrammus azonus* Jordan & Metz, 1913 at Japan Sea was studied using light and electronic microscopy. One of the main found features of *N. surmenicola* scolex are complicated organization of the brain, presence of a muscular capsule around the brain and tentacles sheалds. Inside of the scolex there is a cavity that is seemingly filled with transparent intercellular liquid. The cavity has no cellular lining but is limited by a muscular capsule that separates both the inner part of scolex and the tentacle shealds from the outer part of parenchyma and cortical layer. Nervous system of the *N. surmenicola* is formed by a brain (or head ganglion) and outgoing/ingoing nerves and the main nerve cords. The brain is located in the upper third of the scolex and lasts approximately until the end of bothria. The brain`s build is complex. It is formed by a few unpaired and paired lobes and commissures. The feature of the *N. surmenicola*`s brain is presence of the central unpaired lobe that forms a central nerve cord that lasts approximately until the end of *pars bulbosa*. Also *N. surmenicola* is characterized by presence of two main later cords that begin from the lateral parts of the brain. The central nerve cord locates directly in the body core and in strobili is connected with the main lateral cords by periodic connectives oriented in the latero-lateral plane.

ID: 180

THE APICAL CELL – A PECULIAR COMPONENT OF LEECH OVARIES, ITS MORPHOLOGY AND ULTRASTRUCTURE

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In arhynchobdellid leeches, a huge somatic cell occurs at the apical part of the ovary cords. This cell is known as an apical cell (AC). To shed light on the structure and function of this cell, we compared its organization in several leech species belonging to Arhynchobdellida. Moreover, we created 3D reconstructions of the ACs that were found in the ovaries of a leeches – *Haemopis sanguisuga* (Linnaeus, 1758) and *Hirudo verbana* Carena, 1820.

Whole ovisacs were fixed and embedded in an epoxy resin and then the material was cut into semi- and ultra-thin sections for microscopy analysis. The 3D reconstructions of the apical portions of the ovary cords from *H. sanguisuga* and *H. verbana* were created.

In all of the leeches studied, we found one, huge AC at the apical tip of the ovary cord. The AC formed cytoplasmic protrusions that penetrated the spaces between the neighboring germ and somatic cells. Its cytoplasm was loaded with a large amount of mitochondria, Golgi complexes and cytoskeleton. The nuclear envelope was lined with a thick layer of nuclear lamina.

ACs were only found in Arhynchobdellida and their occurrence appears to be an apomorphy of this leeches. The localization and morphology of the AC is similar to the distal tip cell that is known from the gonads of *C. elegans*. Although it is well known that the distal tip cell forms a niche for stem cells, without molecular studies, we will not be able to elucidate the role of the AC in leech ovaries.

ID: 385

THE ULTRASTRUCTURE OF THE FLAME BULBS IN PARASITIC TURBELLARIAN *NOTENTERA IVANOVI* (PLATYHELMINTHES, TURBELLARIA, FECAMPIIDAE) – NOVEL FILTRATION-SECRETORY APPARATUS

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The ultrastructure of flame bulbs in Turbellaria is important phylogenetic character. The gut-less parasitic turbellarians *Notentera ivanovi* (Turbellaria, Fecampiidae) were collected in White Sea from the gut of host polychaete *Nephthys ciliata*. Each flame bulb is prominently large and consists of three cells – the terminal cell and two proximal canal cell. The nucleus- containing portion of terminal cell is very voluminous and lies basally to the bundle of cilia. The bundle of cilia consists of more than 300 axonemes supplied with a single rootlet. Cilia originate from all internal surface of the wall of flame bulb. Internal leptotriches are abundant. The wall of flame bulb has irregular structure. In basal part of terminal cell the wall is constituted of adjacent processes or voluminous cytoplasmic extensions, in some parts the wall is a rather thin cytoplasmic layer with a change of processes and extensions. Extracellular lacunae are formed between the projections of the wall. The cytoplasm contains abundant secretory vesicles of various size and content. The secret is ejected into the extracellular lacunae which open to the flame bulb lumen through the small fissures. Secret discharges into the lumen throw these fissures. The first proximal canal cell surrounds the distal part of the terminal cell, the second one joints to the first. The proximal canal cells bear two desmosomes. The ultrastructure of flame bulbs in *N. ivanovi* is not similar to any ones described in Platyhelminthes thus far.Acknolegedments. The study was supported by ZIN RAS (NIOKTR: AAAA-A17-117030110029-3) and RFBR 16-04-00593-A.

C2 Poster

ID: 170

MUSCLE SYSTEM AND FRONTAL GLANDS IN PROTEOCEPHALIDEAN CESTODES

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A thorough study of morphology of the apical part of the body, including scolex, neck and initial parts of the strobila was carried out for the first time for proteocephalidean cestodes. The methods of light, transmission, scanning electron microscopy and laser confocal microscopy were used to study the fine structure of the scolex of *Proteocephalus cernua* from ruffe, *Gymnocephalus cernuus* (Percidae). Particular attention was focused on the structure of muscle system and frontal glands of the scolex. Aggregations of unicellular frontal glands are situated in the central part of the scolex situated at the base of the suckers and slightly interior them. Secretory cells are synthetically active. Secretory granules are of one type and there are reservoirs where granules merge into a unified mass. Gland openings are concentrated in the region of apical organ and single ducts are observed in the suckers and sides of the scolex. Atypical for cestodes body wall musculature that of *P. cernua* was found to contain circular, longitudinal and diagonal layers. The sucker muscles are radially symmetrical and possess a small variety of fibrils. The lack of muscles is compensated by diverse parenchymal muscles that perform analogous functions to drive the suckers. The muscle system of the apical organ is uniform. Longitudinal parenchymal muscles serve as retractors of attachment organs if longitudinal axis of these organs coincides with longitudinal axis of the parasite strobila.

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C2 Poster

ID: 294

FIRST INSIGHT INTO THE NERVOUS AND MUSCULAR SYSTEMS OF A PARASITIC TURBELLARIAN *NOTENTERA IVANOVI* (PLATYHELMINTHES, FECAMPIIDA)

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The origin of parasitic flatworms, Neodermata, is one of the key questions of zoology. Fecampiida is a small group of rare commensal or parasitic turbellarians displaying the same mode of spermiogenesis (Revertospermata) as Neodermata and therefore proposed as their sister-group. Here is the first description of the nervous and muscular systems of a fecampiid, *Notentera ivanovi* Joffe, Selivanova, Kornakova, 1997, parasitic in a polychaete gut, studied by means of immunohistochemistry, histochemistry and confocal microscopy.

N. ivanovi entirely lacks digestive system and has a simple reproductive system with posterior opening. Its body wall has three muscle layers: the outer circular one, the previously overlooked middle diagonal one, and the inner longitudinal one with a wide marginal muscle band likely functioning as a ventral sucker.

The brain looks like a 6-rayed star with three pairs of brain roots radiating to the longitudinal nerve cords. The latter are interconnected by 7 ring commissures and plexuses. 5HT- and FMRFamide immunoreactive elements mostly follow the cholinergic ones with some exceptions: only cholinergic and FMRFamide immunoreactive fibers are present in the brain neuropile and in the frontal nerve plexus. In contrast, the fine subepidermal plexus shows only 5HT immunoreactivity.

Notentra's NS pattern belongs to the radial orthogon type, which seems to be more derived than the regular orthogon patterns found in basal Neodermata and their larval stages. Therefore the analysis of NS patterns points against the monophyly of Revertospermata.

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ID: 239

MORPHOLOGY AND FUNCTIONAL DYNAMICS OF TREMATODE OVARIES: FROM GENITAL SYSTEM PRIMORDIUM IN CERCARIAE TO ADULTS GERMARIUM

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Trematodes have a complex life cycle, where hermaphroditic and parthenogenetics generations alternate. Adults of hermaphroditic generation undergo amphimixis. Propagation of sporocysts and rediae is considered to be of either asexual or sexual (apomictic parthenogenesis) nature. In the latter case reproductive organs of parthenitae (germinal masses) and adult's ovaries are regards to be homologous.

To test this statement, ovary organization in Haplometra cylindracea adult and ovary's development in ontogenesis of *Neophasis lageniformis* and *Brachylaima* sp. hermaphroditic generation were studied with routine histological methods.

Early ovary segregation from genital system primordium (GSP) takes place in *N. lageniformis* cercariae. All of oogonial cells mitoses are terminates at the metacercarial stage. In result ovigerous adult's ovary is devoid of gonial cells. Only maturation of oocytes continues in such gonad. In *Brachylaima* sp. ovary's anlage splits off during metacercariagenesis, when differentiation of GSP proceeds. Mitoses are observed both in anlage and ovary of adults (4 days after infection). Similar organization is revealed for ovary of *H. cylindracea* gravid adults. This gonad has extended gonial zone along with the zones of gradual oocyte's maturation.

C2 Poster

Hereby, adults may possess either "complete" ovaries (*H. cylindracea* and *Brachylaima* sp.) or female gonads organized like "gestation chamber" (*N. lageniformis*). Analogous morpho-functional trends are known for germinal masses in parthenitae. Rediae of certain species (Echinostomatidae) complete generative function prematurely, while propagation of some sporocysts (Plagiorchiidae) goes on during almost the whole life of the individuals. Our results provide significant evidence for sexual nature of parthenitae propagation.

ID: 405

ATTACHMENT IN DIGENEA: THEORY AND PRACTICE

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Digenea have complex life-cycles with contrasting morphological features and habits of different stages. Diversity and structure are much better known for maritae (hermaphroditic adult), while studies on behavior were almost exclusively performed on free-living larval stages. That's why locomotion, attachment and other activities of maritae are rather presumed than observed.

We used maritae of ten species to describe structure and functioning of two types of attachment organs: ventral sucker and ventral concavity (whole body takes shape of a spoon and functions like huge sucker). Musculature arrangement was studied by means of f-actin fluorescent staining and confocal microscopy. Locomotion and attachment of the same maritae were recorded with micro-cinematography.

Sustained ventral concavity, seeking movement of the anterior region and lateral contraction waves were observed in maritae of Notocotylidae, Heterophyidae and Microphallidae. All these had very prominent dorsoventral musculature (main driver of suction activity), solid layer of longitudinal muscle fibers supporting the bottom of concavity, and circular musculature arrangement along the concavity ridge.

In ventral suckers different operation modes were found, mostly regarding the phase prior to attachment. Ventral sucker of *Zoogonoides viviparus* opens in a clump-like manner, probably by contraction of dorsal superficial longitudinal muscle fibers. Saucer-shaped ventral suckers (like in *Microphallus piriformes*) before suction become flattened, which is provided by meridional muscle fibers of outer surface. In *Derogenes varicus* the cavity of ventral sucker instead of spreading shuts dorsovenrally with chordal muscle bundles.

Different approaches to attachment in maritae are discussed with regard to their localization within host digestive system.

ID: 155

ULTRASTRUCTURE OF THE BODY WALL OF THE CRYOBIOTIC LEECH *OZOBRANCHUS JANTSEANUS* (ANNELIDA; HIRUDINEA; RHYNCHOBDELLIDA)

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C2 Poster

The leech *Ozobranchus jantseanus* is an ectoparasite of Chinese pond turtle. These leeches are capable to survive instant freezing in liquid nitrogen and long term storage in super low temperatures like −90°C. In order to link morphological features with such a unique ability we studied the body wall ultrastructure using TEM. We compared TEM-derived data from control samples and samples after storage in super low temperatures (−80°C) during 30 months.

The body wall of the leech *Ozobranchus jantseanus* includes the cuticle, epidermis and muscle layer. The cuticle contains orthogonal grid pattern of collagen fibers. The outermost part of the cuticle is a fiber-less zone, the epicuticle. The surface of the epicuticle is covered with epicuticular projections. The epidermis consists of a monolayer of epithelial cells.

We observed changes in cuticle structure between control leeches and leeches which were exposed to super low temperature. The cuticle fibers of the thawed leech lay more compact, without free space. Perhaps it is related to the process of dehydration during quick freezing. However, in inner layers such cryoinjuries-like cell membranes injures and organelle damages were not detected. Moreover, in the leach revived after storage in super low temperatures the Endoplasmic Reticulum proliferation was observed. Our study is the first detailed analysis of the ultrastructure of *Ozobranchus jantseanus* in general, and in given tissue in relation to the cryopreservation. The method shows promising potential for implementation in the studies focused on the destiny of cell and organelles under extreme conditions.

ID: 370

MUSCULAR SYSTEM AND SOME OTHER ASPECTS OF INTERNAL ORGANISATION OF RHIZOCEPHALA

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Rhizocephalans are extremely specialized parasitic crustaceans with high level of adaptations for endoparasitizm and due to this fact their adults lost almost all traits know for free living Crustaceans. Unfortunately despite some few data on anatomy and ultrastructure of interna some crucial aspects of morphology are still unknown. Even the muscular and nervous system in interna are still enigmatic.

In our research we have found some new data about the inner morphology of these animals. In the particular study were used serial histological sectioning, TEM and (CLSM) with antibody labelling for visualisation of inner structures of parasite.

We have observed and described muscular systems of two species that belongs to different families: *Peltogaster paguri* (fam. Peltogastridae) and *Polyascus polygenea* (fam. Sacculinidae). It turned out that muscular system of *Peltogaster paguri* was organized in unidirectional single spiral that braids the lumen of main trunk. We suppose that such kind of muscular system could support circulation of nutrients among interna. At the same time, muscular system of *Polyascus polygenea* was organized in totally different way. Muscular elements were observed in each root and looked like a star with muscular fibers located in different directions.

C2 Oral

We have also noticed that root system lying in the hemocoel of the host is braided by a net of host's neural tissue. Physiological interpretation of this phenomenon is still unknown. At the same time some roots were penetrating host's neural ganglions. Distal parts of these roots are modified to cup-shaped organs.

ID: 463

MORPHOLOGY OF THE DIGESTIVE SYSTEM OF *LAMPROGLENA CLARIAE* FRYER, 1956 (CRUSTACEA: COPEPODA) A GILL PARASITE OF AFRICAN CATFISH *CLARIAS GARIEPINUS* (BURCHELL, 1822)

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L. clariae has a tube-like digestive system, which consists of a foregut, an extensive midgut and a very short hindgut. The oesophagus is connected to the midgut via a funnel-like structure. The midgutcan be divided into three zones equipped for digestion and absorption and haemolysed blood occurred in the digestive tract, confirming that *L. clariae* feeds on the host fish's blood. A peritrophic membrane and faecal pellet formation was reported for the first time in this genus.

C2 Oral

ID: 420

THE ULTRASTRUCTURE OF THE EXCRETORY SYSTEM OF *PYRAMICOCEPHALUS PHOCARUM* (CESTODA: DIPHYLLOBOTHRIIDEA)

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The architecture and ultrastructure of the excretory system of *Pyramicocephalus phocarum* (Cestoda: Diphyllobothriidea) has been studied. It consists of the central system of two longitudinal ducts, a peripheral network of ducts, subtegumental canaliculus, flame cells and a terminal pore in the tail. It was established that the excretory epithelium which forms the wall of longitudinal ducts, peripheral ducts and communicates with the flame cells directly has a different structure in different parts of the excretory system. The excretory epithelium of the pair longitudinal ducts is a submerged polynuclear syncytium, which bears round microvilli on its surface. The cytoplasm is divided into two morphologically distinct layers: apical homogeneous layer and basal layer with rod-shaped bodies. There are thick longitudinal muscles beneath the basal layer of the excretory epithelium. The excretory epithelium of peripheral ducts is also submerged polynuclear syncytium. It bears round microvilli on its surface and is divided into three layers: apical homogenous layer, medial layer with rod-shaped bodies and basal layer with mitochondria and vesicles. The excretory epithelium of canaliculus has a lot of processes where intracellular canaliculus are located. They have electron-dense contacts with microvilli of the flame cells and form an ECM filter. Single flame cells have one (inner) row of microvilli of the filtration apparatus, several rows of thin microvilli and several dozens of cilia.

This work was supported by the Russian Foundation for Basic Research (# 15-04-02645).

ID: 421

THE ULTRASTRUCTURE OF THE TEGUMENT, GLANDS AND SENSORY ORGANS OF *PYRAMICOCEPHALUS PHOCARUM* (CESTODA: DIPHYLLOBOTHRIIDEA)

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The ultrastructure of the tegument, glands and sensory organs of *Pyramicocephalus phocarum* (Cestoda: Diphyllobothriidea) have been studied. Three types of the microthriches were found, which have a specific distribution on the scolex and body. A well-developed basal lamina contained radial anchoring fibrils; they were associated with the microfibrills of the lamina reticularis and form regular cross-links. In the tegument, we have found six types of sensory organs and also terminal pores of the frontal glands. It has been shown that sensory endings and secretory pores are co-localized in the bothria tegument: 30 pores and 50 sensory endings were found in one section. Frontal glands were located in the parenchyma of the scolex and body; glands were well-developed and have an intensive eccrine secretion. Comparative ultrastructural analysis of four diphyllobothriidean species showed similarities in the ultrastructure of microtriches and frontal glands in the plerocercoids of *P. phocarum* and *Diphyllobothrium latum*.

This work was supported by the Russian Foundation for Basic Research (# 15-04-02645).

C2 Poster

ID: 487

MORPHOLOGICAL FEATURES OF TAPEWORMS IN RELATION TO HOST-PARASITE INTERACTIONS — FROM MORPHOLOGY TO MOLECULES

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Despite the current progress in biological studies and important advancesmade in invertebrate morphology and developmental biology, cestodes still remain neglected and enigmatic creatures. Tapeworms are evolutionarily successful animals parasitizing all of the known vertebrate species as adults, and both vertebrates and invertebrates as larvae. One of their characteristic feature is the complex life-cycle involving predominantly two or three hosts, and at least two larval stages (invading intermediate host) and the adult (present in the definitive host intestine). In many cases they must switch between hostsfrom invertebrate to vertebrate; therefore, cestodes evolved numerous morphological and molecular features allowing them to survive and successfully complete the life-cycle. During the millennia of co-evolution with their hosts,all of the cestodedevelopmental stages evolved specific morphology and molecular mechanisms allowing them to invade the host tissues, undergo metamorphosis into the following developmental stage, and finally to survive as an adult in the hostile environment of the definitive host intestine. For example, cestode eggs are very diversified in shapes and morphology, however, all contain hexacanth larvaearmed with hooks and glands used during penetration of the host tissues. The hexacanth is gradually transformed into the metacestode stage, developing in the intermediate host's body. Mature metacestodes are protected from the surrounding environment by producing diverse layers of cyst as well as secreting molecules evading host immunity. This invasive stage must be swallowed by the definitive host to develop into the adult parasite. The adults, living in the host intestinal lumen, are exposed to new factors such as digestive enzymes,

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MICROSCOPIC ANATOMY OF PARASITIC BARNACLES (CIRRIPEDIA: RHIZOCEPHALA: SYLON) INFESTING CARIDEAN SHRIMPS

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Parasites are ubiquitous abundant and play an important role in marine habitats. Among crustaceans, parasitism is frequent. Parasitic barnacles (Rhizocephala), mainly parasitic castrators of other crustaceans, show remarkable morphological adaptations to their lifestyle. The adults have lost virtually all vestiges of their crustacean morphology. The adult female parasite consists of a body that can be differentiated into two distinct regions: a sac-like structure containing the reproductive organs (externa), and a nutrient-absorbing, root like system situated inside the host`s body (interna). The ramifying simplicity of the interna has made it difficult to describe the morphology of the parasite. Using histological cross- and longitudinal sections of *Sylon hippolytes* infesting *Pandalina brevirostris*, we describe new details of the topographic organization of the interna of *S. hippolytes* inside its host. Most of parasites interna is entangled around the host`s gut suggesting a straightforward functional interpretation. Additionally, a comparison of histological sections to micro-CT datasets shows methodological limits of micro-CT for such a fine structure like the interna. By comparing infested with a non-infested shrimp, we reveal new specifics concerning the common rhizocephalan interpretation as parasitic castrators. Although it has been proposed that rhizocephalan parasitism results in the castration of their hosts, achieved by absorbing the entire reproductive energy of the host, we observed fertilized eggs with embryos in the host shrimp. Taken together, we add new and significant information to our global understanding of parasitic barnacles, of the interactions between them and their hosts and morphological adaptations of these parasites for such a lifestyle.

ID: 230

PARASITIC GASTROPODS OF THE GENUS *ENTOCOLAX* (EULIMIDAE) IN THE EURASIAN ARCTIC: HIGH MORPHOLOGICAL DIVERSITY, LOW GENETIC DIFFERENTIATION

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Representatives of the gastropod genus *Entocolax* Voigt, 1888 are known as endoparasites of holothurian families Myriotrochidae and Chiridotidae. Adult females of the mollusk are worm-like with a reduced shell and organs of mantle cavity, and have a siphon, an organ attaching mollusk to the body wall or intestine of a host; also females are parasitized by dwarf males. Three of seven described *Entocolax* species are known from the Arctic. The aim of the present study is to estimate the diversity of the genus *Entocolax* in the Eurasian Arctic by means of both morphological and molecular phylogenetic approaches.

Twelve females of *Entocolax* parasitizing holothurians *Myriotrochus* sp. from the Barents, Kara, and Laptev seas were used for our investigation. Based on the morphology of the intestine walls (muscular/not muscular, smooth/with folds), ovary (compact/ branched) and brood-poach (eggs grouped/not grouped into capsules) the specimens were divided into three groups corresponding to species in a traditional taxonomy. However, all specimens apart of a single young mollusk from the NW Barents Sea had not differed by sequences of mitochondrial COI and nuclear ITS2 regions. Cryptic species are common in the other specific parasitic taxa that have a poor set of morphological characters, while high infraspecific morphological variability had been observed much less often. The separation of a specimen from NW Barents Sea agrees with phylogeographic patterns of other invertebrate and fish taxa with trans-arctic distribution.

ID: 336

DOES THE BLIND TREMATOD'S LARVAE SEE THE LIGHT?

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Trematoda (Rudolphi, 1808) is a group of obligate parasites with the complex life cycle, including endoparasitic stages living in first intermediate (molluscs), second intermediate (various invertebrates and vertebrates) and definitive hosts. Infection of hosts is realized by free-living miracidia and cercariae, which get into the host by a passive or active way. Free-living stages usually possess elaborated sensory structures like chemo- and photoreceptors to be able to find a new host. Nevertheless, little is known about details of this process.

Our research was dedicated to investigation of the psilostomatid trematode *Sphaeridiotrema pseudoglobulus* (Szidat, 1937 nec Rudolphi, 1814) life cycle. We used the complex approach, combining transcriptomics, gene expression studies as well as morphological research. Unlike many other trematodes, cercariae of *S. pseudoglobulus* do not have morphologically distinguishable eyes. However comparative transcriptomic analysis revealed variation in genes expression between different stages and showed the increasing of photoreception genes activity level in cercaria. In particular, homologs of photosensitive protein (opsin) and genes, involved in regulation of photoreceptors development, like eya, Otx and Pax6 transcription factors. Follow on the transcriptomic and morphological data, we discuss the possibilities of the photoreception in blind cercariae.

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C2 Poster

ID: 226

ONE UNIQUE ULTRASTRUCTURAL CHARACTER OF THE UTERINE EPITHELIUM OF CHIMAERICOLID MONOGENEANS SHEDDING LIGHT ON THEIR POSSIBLE ORIGIN

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Chimaericolids (Monogenea) are ectoparasites found on the gills of chimaeras, relict cartilaginous fishes. Monogeneans of the family Chimaericolidae are considered to be close to the base of the polyopisthocotylean lineage and key aspects of the unique organization of the uterus are of evolutionary interest. The proximal portion of the uterine tube is characterized by a so-called ‘single-layered multi-rowed epithelium’ containing two types of cells of different size and shape, each lying on the epithelial basement membrane. The height of the tall epithelial cells is 14-19 µm, which is about twice the size of the short ones (6-9 µm). Septate junctions connect these cells. The tall cells are narrow basally and wide apically, where they almost envelope the shorter cells. The parasitic platyhelminths have diverged from free-living flatworms in terms of the appearance of new special structures, the ootype and uterus. Unusual for neodermatans, the epithelium of the proximal uterus of *C. leptogaster* has only previously been reported for outer epithelial covering of some members of the Porifera, Cnidaria, Nudibranchia, Nemertea and higher ‘Turbellaria’. If homology is involved, how can the presence of this type of the epithelium in a monogenean be explained? If we accept a non-classical, molecular phylogeny of the Bilateria, with Platyzoa (including Plartyhelminthes) nested within the superphylum Lophotrochozoa, then it may be that the single-layered multi-rowed cellular epithelium of the chimaericolid uterus may represent an early step in the formation of the polyopisthocotylean, or even neodermatan, uterus. The present study was supported by RFFR, project no.15-04-02890.

ID: 182

ON THE STRUCTURE AND DEVELOPMENT OF THE BODY CAVITY IN PARTHENOGENETIC GENERATIONS OF TREMATODES

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Flatworms are, in general, acelomate animals. Body cavity is present only in some Neodermata at some life cycle stages. For example, trematode parthenitae usually have a well-developed body cavity, which functions as a brood chamber for developing embryos. In the absence of special studies, this body cavity is assumed to be a pseudocoel. Our ultrastructural study of sporocysts and rediae from various trematode groups revealed different variants of structure and development of their body cavity. In echinostomatid and notocotylid rediae, which retain many archaic features, the body cavity has no epithelial lining, as befits the pseudocoel. In echinostomatids, it develops in young rediae just starting reproduction by divergence of cells located near the germinal mass. In notocotylids, it is formed in mature rediae after resorption of the apical part of the germinal mass. In highly specialized parthenitae of hemiurids and bucephalids, the body cavity has a distinct epithelium-like lining. In hemiurid parthenitae, lining cells bear lamellae on the luminal surface. In bucephalid sporocysts, the basal surface of the lining rests on the basal lamina, in some bucephalids, the body cavity lining is a syncytium. Development of a body cavity with its own lining was studied in hemiurid rediae. It appears in embryonic rediae inside the germinal mass anlage and its lining cells derive from the supporting tissue of the developing germinal mass. Thus, our study indicates that in parthenitae of some trematodes the body cavity may share common features with the coelom, which is apparently an instance of convergent evolution.

ID: 296

LOCATION OF THE PRIMARY LACUNA IN THE POSTEMBRYONIC DEVELOPMENT OF SELECTED CYCLOPHYLLIDEA (CESTODA)

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The postembryonic development of most cyclophyllids within the intermediate host includes one invagination. This positions the remnants of the primary lacuna between the walls of the dense cyst. Some diplocysts, floricerci and ascocerci undergo two invaginations. In a fully formed larvocyst belonging to these types, the remnants of the primary cavity are located between the walls of the additional outer envelope (exocyst). The presence or absence of a primary lacuna is the key characteristic used for metacestode classification. Nonetheless, the position of the primary lacuna during post-embryogenesis may also be important for understanding the evolution of the cestode lifecycle and phylogenetic relations among cyclophyllids.

ID: 295

EVOLUTION OF XIPHIDIOCERCARIAE LUHE, 1909 (TREMATODA: PLAGIORCHIDA): FROM WHERE TO WHERE?

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Stylet cercariae (Xiphidiocercariae Luhe, 1909) is an enormous group of trematodes larvae. Its main character is the presence of stylet in modified oral sucker. These larvaes are widespread in marine and freshwater ecosystems (it belongs to the Plagiorchiida s. str.).But its biodiversity is poorly investigated and almost nothing is known about its evolution trends.

Based on the results of long-term studies (since 2012), the morphology and taxonomic affiliation of a large number of species of stylet cercariae have been studied using a wide range of methods, such as vital microscopy, routine histology and histochemistry, confocal, fluorescence and electron microscopy, molecular phylogenetic methods. Detailed analysis of the obtained data made it possible to identify the main trends in the evolution of these diverse animals. We discuss the ways of transformation of the penetration apparatus, mucoid apparatus, the appearance and modification of virgula organ and caudal pockets. Significant changes affect the nervous system of cercariae – this concerns the number and topology of the neurons and the main parts of the nervous system, as well as surface sensilla. It is shown that the organization of its protonephridial excretory system can vary too. All hypothesis on the evolution of larvae agree with data on its molecular phylogeny. The study was performed atResearch Resource Center for molecular and cell technologies of Saint Petersburg State University.

ID: 254

MORPHOLOGICAL RESPONSES TO FEEDING IN TICKS (*IXODES RICINUS*)

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We study morphological adaptations of *Ixodes ricinus* to volume changes of their opisthosoma during feeding. By comparing histological and ultrastructural differences of the cuticle and epidermis of the alloscutum, the epithelium of the midgut diverticula, and the tracheae of adult female ticks during fasting, during the slow feeding period, and when fully engorged, we aim to understand the functional morphological features that accommodate the enormous volume changes. Our results support previous findings that the area of the soft alloscutal cuticle expands by growth, unfolding and expansion. The area of the epidermis increases by cellular differentiation, cellular hypertrophy and shape changes of the epithelial cells, i.e., from pseudostratified to single layered prismatic in semi-engorged ticks, and thin squamous, epithelium in fully engorged ticks. We did not find evidence for cell proliferation. – The midgut diverticula accommodate the volume increase by cellular hypertrophy and changes of cell shape. – Tracheae also follow the volume changes of the opisthosoma in feeding ticks to secure oxygen supply to the inner organs. We provide evidence that the tracheae of castor bean ticks have telescoping properties, i.e., they expand when the volume increases and the distance between the respiratory spiracle and the oxygen demanding tissue enlarges.

C3 MORPHOLOGICAL DIVERSITY AND EVOLUTION IN FRESHWATER AND MARINE ENVIRONMENT

Organizers: Dr. Alexey A. Kotov, Dr. Anna N. Neretina

ID: 433

FIRST RECORD OF TWO *URECHIS* SPECIES IN THE VOSTOK BAY SEA OF JAPAN

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Although recent echiurid fauna includes about 230 species, new records of deep sea water echiurids evidence more huge taxonomic diversity of this group. In the Vostok Bay Sea of Japan, the only echiurid species, *Urechis unicuntus*, has been described. Some morphological differences were mentioned in different specimens of *Urechis unicuntus* living in the Vostok Bay. The most prominent difference is the color: some specimens have red color, whereas others are white and thirds are brown. In this report, *Urechis* specimens of three different colors were studied by morphological and molecular methods. Morphology of main organ systems was studied in dissected animals; the structure of epithelium was investigated by scanning electron microscopy and histology. Investigation of gross morphology does not reveal prominent differences in organization of organ system in all studied specimens. The structure of integuments differs in thickness and in abundance of gland cells. Obtained sequences of mitochondrial (COI and 16S) and nuclear (H3) genes were compared with data from GenBank and with each other. Our results suggest that there are minimum two species in Vostok Bay – *Urechis unicuntus* and another one. Sequences of brown and red colored specimens are conspecific to *Urechis unicuntus* from GB. According to preliminary molecular data, white colored specimens are significantly different from both *Urechis caupo* and *Urechis unicuntus* and therefore seem to be a new species. Further morphological and molecular studies are required to clarify the taxonomic status of these organisms. This work is supported by Russian Science Foundation (14-50-00029).

ID: 454

MORPHOLOGICAL DIFFERENCES OF BIOLUMINESCENT AND NON-BIOLUMINESCENT SPECIMENS OF SCALE-WORMS, WHICH STRUCTURAL LOOSE ARRIVED TO FUNCTIONAL LOOSE

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Since the last quarter of XIX century it has been known that some of scale-worms (Polychetae, Polynoidae) are bioluminescent and some are not. It has been described, that bioluminescent species are characterized by the rapidity of movements and scale autotomy. In 2009 it has been shown that homogenated scales of "non-bioluminescent" scale-worms produce high luminescence in presence of superoxide donor system. Further comparisons of scale worm morphology with the epithelium structure of two more bioluminescent annelids and bioluminescent organs of deep-sea arrow worms it have been concluded that the role of photosytes corresponding to secretory epithelial cells, filled with special granules. In case of bioluminescent scale worms this type of cells are located in dorsal epithelium inside the special cuticle structures, called tubercles.

In our work we decided to look at scale growing process of non-bioluminescent specie *Lepidonotus squamatus* with special attention to dorsal cuticle structures that are in charge of bioluminescent reaction of bioluminescent species of scale-worms.

Based on morphological and ultrastructure studies we can separate 4 stages in tubercle development: (1) active growing of cuticle structures with epithelial secretory cells sublying the tubercle, (2) separating of epithelial secretory sells from the cuticle, (3) closure cuticle basement with apoptosis of epithelial cells and (4) formation of tubercle getting the structure of empty barrel.

According to our opinion this is the direct demonstration of structural lose causing the functional lose.

ID: 449

ORGANIZATION OF THE HEAD MUSCULATURE IN CHAETOGNATH *PARASAGITTA ELEGANS*

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Chaetognaths (arrow worms) remain one of the most enigmatic groups in an animal kingdom. Many aspects of their anatomy and biology are still unknown. The situation is exacerbated by the lack of modern morphological works. Thus, the last complex researches of locomotory system date from the first half of the XX century. This paper is the attempt to investigate the muscular system of the head of *Parasagitta elegans* (Verrill, 1873) with modern methods: semithin sectioning, transmission electron microscopy, laser confocal scanning microscopy, and 3D reconstructions. The use of new methods allowed to make detailed description of muscle system in head of *P. elegans*. According to new results, the main head muscles are musculus obliquus capitis brevis, musculus expansus superior, musculus constrictor oris alter, musculus constrictor oris primus, musculus obliquus capitis longis, musculus dilator vestibuli externus, musculus complexus lateralis, musculus dilator vestibuli internus, musculus obliquus superficialis, musculus bicornis, spines adductors. The lateral muscle complex consisting not only of musculus complexus lateralis, but of musculus dilator vestibuli externus, dilator vestibuli internus and other minor muscle bundles is described here for the first time. New functions are proposed for some muscles. For example, musculus bicornis could expand the foregut during swallowing the prey. New data contribute into our knowledge on biology of enigmatic chaetognaths. Thus, the presence of separate muscle passing to each grasping spine allows them to move independently of one another. This independence provides virtuosic work of spine apparatus during hunting. Work is supported by Russian Science Foundation (14-50-00029).

ID: 375

AGE DETERMINATION OF CRUSTACEANS THROUGH ANNUAL GROWTH RINGS – FACT OR FICTION?

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Growth rings can be used to determine the age of fish and invertebrates if cyclic variation in environmental conditions (e.g. seasons) are reflected in accretionary growth of skeletal elements. For crustaceans, it has been assumed that growth rings do not exist, because calcified structures are lost when moulting. Since 2011, however, a new approach using eyestalks and gastric mill ossicles of decapods has been increasingly applied. In this method, endocuticle rings are interpreted as annual growth increments, since their number increases with body size and correlates to size-based age estimates. Additionally, live staining with calcein supports the idea that age structures are retained through moulting and therefore provides a record of chronological age. Since its first publication, the new aging method has become widely used and sparks a hope that studies on population structure could have dramatically improved resolution. The study presented herein tests the validity of this method in an un-biased approach from an anatomical perspective. We investigated the endocuticle bands of commercially important decapod species in UK waters through petrological and histological sections as well as micro-computed-tomography. We further explored the fate of the structures used for aging during the moult. Our results confirm the presence of cuticle bands through different morphological methods and that band counts are approximately correlated to size-based age estimates. However, the discontinuous growth of crustaceans, together with our observations on cuticle structure dynamics during moulting, shed doubt on the interpretation of cuticle bands as annual growth rings and their usability for age determination.

ID: 328

SHARED COLONY-WIDE MUSCULATURE – A JOURNEY THROUGH TIME

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Kamptozoa – small taxon including solitary and colonial species. Its phylogenetic position remains controversial, in a greater part because of poor understanding of their anatomy and development. At the moment there is only one description of the musculature of adult zooids of colonial kamptozoans. We traced the development of the muscular system from the bud to the adult zooid in two colonial species *Pedicellina cernua* and *Barentsia gracilis* using CLSM. At the first stage bud lacks contractile elements and consists of undifferentiated cells. At the second stage a single muscle bundle from stolon enters the bud, and the first hemisphere of star-cell complex appears. Then, a few calyx (atrial and tentacle) muscles develop, as well as several flattened cells of the star-cell complex. The number of stalk muscular elements increases and they form a continuous peripheral layer. At this stage, some of them are separated from stolon musculature, but are still attached to its basal part, the rest of the stalk musculature continues to be a part of a single muscular complex of the growth zone. At the fourth stage, the calyx musculature is completely formed, and finally, all stalk muscles detach from a single muscular complex of the growth zone.

From the presence of the musculature in the growth zone of a stolon we may infer the presence of associated nerves. Probably, the growth zone is the area, where we can observe the prerequisites for the transition from low-integrated kamptozoan colonies to a higher level of colony integration.

ID: 453

COMPARATIVE ANATOMY AND PHYLOGENY OF OPHELIIDAE AND *TRAVISIA* (ANNELIDA, SEDENTARIA)

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Traditionally Opheliidae-Scalibregmatiidae formed the order Ophelida with Opheliidae including genus *Travisia*. However, molecular data do not confirm this grouping.

According to recent molecular phylogenic data, genus *Travisia* forms sister-group to the Scalibregmatidae. Study of morphology, anatomy and ultrastructure of the species *Ophelia limacina* (Rathke 1843), *Ophelina acuminata* (Öersted 1843), *Euzonus (=Thoracophelia) arcticus* (Grube 1866) and *Travisia forbesii* (Rathke 1843) has been done using light microscopy, scanning and transmission electron microscopy, micro-CT scanning, and laser scanning confocal microscopy to reveal phylogenetic relationships of these groups. Cladistic analysis based on morphological criteria has been performed.

New morphological features suitable for phylogenetic analysis of Opheliidae and Scalibregmatidae have been revealed based on our anatomy studies of four representatives of the family. A partial body septae reduction and secondary annulation have been found for both groups - Opheliidae and Scalibregmatidae but these characters seem to be homoplasies.

A mid-ventral groove, which consists of multilayered pattern of fibres and epithelial junction; anal tube, two septae, typhlosol, a common structure of branchia, and probably ventral cord lacking ganglia - all these characters have been identified as new synapomorphies for Opheliidae as monotypic taxon. Synapomorphies confirming monophyly have been found for subfamilies within Opheliinae (a heart, an injector organ), and Ophelininae (the reduction of secondary annulation, celothelium, lateral grooves). All studied genera of Opheliidae appeared to be monophyletic. *Travisia forbesii* forms a well-supported clade related to Scalibregmatidae. The clade Travisia-Scalibregmatidae is supported by presence of four septae and salivary glands. This study is supported by RFBR 17-04-00586a

C3 Oral

ID: 366

SPECIES DIVERSITY AND PHYLOGENY OF SEA ANEMONES IN *URTICINA* AND *CRIBRINOPSIS* GENERA

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Representatives of Urticina and Cribrinopsis genera are very similar to each other by their morphology. We compared *U. felina, U. eques, U. crassicornis* and *C. similis* from the Barents Sea with *U. grebelnyi, U. crassicornis, C. albopunctata, C. olegi* and *Urticina* spp. from the Pacific Ocean (Kamchatka), and with *C. fernaldi* and *Cribrinopsis* spp. from the Pacific Ocean (British Columbia, Canada). Only three species were known to brood offspring in gastrovascular cavities (*U. crassicornis, C. albopunctata, C. olegi*), the rest used external fertilization and swimming larvae. Sanger sequencing of three mitohondrial genes (12S rRNA, 16S rRNA, cytochrome oxidase III) and two nuclear genes (18S rRNA, 28S rRNA) was conducted to reveal genetic differences between these species. All the samples were identical by their mitochondrial fragments except *U. crassicornis* from the Barents Sea (one substitution in 16S rRNA sequence) and *C. olegi* from the Pacific Ocean (one substitution in COIII sequence). This fact can be an evidence of low rate of mitochondrial DNA evolution in *Urticina/Cribrinopsis* group. Phylogeny based on the nuclear gene sequences and concatenated nuclear and mitochondrial fragments showed separate clades of each species with the bootstrap support, which was not low than 89% and 91%, respectively. Evolutionary divergence over sequence pairs between species varied from 0.002±0.001 to 0.006±0.001. The Barents and the Pacific populations of U. crassicornis were found in two different clades that can be an additional proof for dividing this species into two ones (brooder and non-brooder). This work is supported by RFBR Grant №16-04-01685.

C3 Poster

ID: 321

SOME ULTRASTRUCTURE DETAILS OF ENTOPROCT REPRODUCTIVE SYSTEM

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Here we described microscopic anatomy and ultrastructure of gonads of colonial species *Barentsia discreta*. Gonads of *B. discreta* are separated from body cavity by thick layer of extracellular matrix of complicated structure - basal lamina. Adjoining cells of body cavity fit to basal lamina and form partial envelope around gonads. Ovary is lined by germinative epithelium. In proximal part of ovary epithelium is presented by undifferentiated gametocytes, which give rise to oocytes and accessory cells. In distal part of ovary large oocytes aren't connected with basal lamina. Protuberances of basal part of accessory cells lie between oocytes and basal lamina. Wall of testes is formed by one-layered flattened epithelium. Cells at various stages of spermatogenesis can be found in testis. These cells creating four types of clusters with cells at one stage of differentiation. In process of differentiation the structure of nucleus changes and the volume of cytoplasm decreases. Mature spermatozoid represents elongated cells with extended nucleus which occupies front half of head, and zone of electronic dense material in back half of head. Horseshoe mitochondrion settles down around zone of dense material. Cilium of typical structure departs from the back end of cell. Spermatozoa of Entoprocta belong to "modified" type which is characteristic for animals with external-internal fertilization. Wall of both male and female gonads consists of external layer of basal lamina and inside layer of germinative epithelium which is directly lining gonad cavity. It is possible to assume that gonads of Entoprocta represent only derivatives of coelom.

ID: 313

JAW STRUCTURE IN LUMBRINERIDAE (ANNELIDA) ASSESSED BY MICRO-COMPUTED TOMOGRAPHY

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Lumbrineridae is a family of marine bristle worms with relatively poor external morphology but complex jaw apparatus located in the ventral muscular pharynx. Lumbrinerid jaws consist of four to six pairs of dorsal maxillae with maxillary carriers and ventral partly fused mandibles. Traditionally details of structure of maxillae were used in generic diagnoses in Lumbrineridae. Investigation of jaws require dissections and often leads to damage or compete loss of the jaw apparatus. Micro-computed tomography (micro-CT) is a non-destructive three-dimensional imaging technique. The use of this method allows describing the spatial arrangement of jaws without preparation of specimens. The aim of the study was to investigate, using micro-computed tomography, structure and spatial arrangement of jaw apparatuses in different lumbrinerid genera. Animals were scanned with a micro-CT SkyScan 1172 in polypropylene pipette tips, either in ethanol or in air after critical point drying. Different parts of the jaws in all samples had various densities. Mandibles, maxillae I and II had the highest density. Other elements of jaws had density similar to the surrounding muscular tissue. The jaws were less contrast in the dry specimens than in the specimens scanned in ethanol. Three-dimensional images of jaws were obtained for all studied genera and used for detailed description of the shape and arrangement of all elements.

C3 Poster

ID: 200

INTEGRATIVE TAXONOMY OF THE FIRST *PSEUDOVERMIS* SEA SLUG FROM THE EASTERN PACIFIC

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With minute body sizes and mesopsammic lifestyle Pseudovermidae present a unique evolutionary history among the otherwise mainly epibenthic nudibranch sea slugs. Progenesis was identified as key factor in their evolution, but comparative microanatomical data is still limited and the morphological diversity and phylogenetic position of pseudovermids remains poorly understood. Only 16 species are described worldwide from tropical and temperate waters. Here, we present the first lineage of Pseudovermidae discovered in the Eastern Pacific. Specimens collected from subtidal sands in tropical Panama were investigated via an integrative taxonomic approach. We combined 3D-microanatomy based on histological section series with scanning electron microscopy of radula and jaws and molecular barcoding to ensure conspecifity of the collected material and for preliminary molecular species delineation. The barcodes of this lineage form one haplotype network with comparably high genetic distances to other *Pseudovermis* in the Pacific and Western Atlantic. Digestive system including radula and jaws correspond to the typical pseudovermid bauplan and bear few distinguishing characters. Encountered differences in the nervous system still require more comparative analyses to evaluate intra- vs interspecific variability in the setting of cerebral nerves. The diaul hermaphroditic genital system with uncuticularized penis is unique among *Pseudovermis*. Excretory and circulatory systems are highly reduced which likely presents and adaptation to minute body size. Our integrative data supports the hypothesis that the characterized *Pseudovermis* presents a species new to science, ready for formal description. In the future, barcoding data will support species identification of these sea slugs which are in parts externally cryptic.

ID: 289

THE FIRST EXPERIENCE IN THE MORPHOLOGICAL STUDY OF MALE COPULATORY SYSTEM OF CEPHALASPIDS (GASTROPODA: OPISTHOBRANCHIA) BY MEANS OF CLSM

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The morphology of the cephalic copulatory apparatus of the gastropods from the order Cephalaspidea has been used in systematics for over a century. Until now, the copulatory organs have been investigated mainly using light and sometimes scanning electron microscopies. We represent the results of the first attempt of investigation of the copulatory apparatus of five species of Cephalaspidea using confocal laser scanning microscopy (CLSM) with phalloidin and DAPI labeling.

Material for this investigation (*Cylichnatys angusta* from the fam. Haminoeidae), *Retusa minima* from the fam. Retusidae, *Philine scalpta*, *Ph. argentata*, and *Yokoyamaia ornatissima* from fam. Philinidae) was collected in the Vostok Bay (Sea of Japan).

The penial sacs of *Cylichnatys angusta* and *Retusa minima*, and hammer-shaped penises of the philinids consist of the longitudinal muscles; in addition, the penial sacs of the philinids have numerous diagonal muscles. Contrary to published data, our investigations demonstrate that penises of *Cylichnatys angusta* and *Retusa minima* are conical structures consisting mainly circular muscles; the penis of *Yokoyamaia ornatissima* is typical (hammer-shaped) for philinids.

C3 Poster

Confocal microscopy in combination with phalloidin and DAPI labeling proves to be an effective method for studies of the gastropod copulatory apparatus. This method is particularly advantageous in comparison with traditional histology, particularly when dealing with thin muscle layers, isolated fibers, and very narrow ducts. Results of this study revealed several new characters potentially useful in cephalaspid systematics.

ID: 452

RECOGNIZING THE UNRECOGNIZABLE: NEMERTEAN SPECIES OF THE GENUS *LINEUS* FROM THE WHITE SEA INTERTIDAL ZONE

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Nemertea is a taxon of unsegmented soft-bodied worms which inhabit marine biotopes all over the world. The heteronemertean species *Lineus ruber* (Müller, 1774) and *Lineus viridis* (Müller, 1774) are the most abundant nemerteans at European and north European coasts. These worms were described in XVIII century as two separate species, but further were considered as two color variations of *Lineus gesserensis* (Müller, 1774). The differences in reproductive biology, embryonic development and larva type advocate two species according to Schmidt (1930). Different molecular researches show the presence of one to three species within the Lineus ruber/viridis species complex. We studied nemertean's species composition of the White sea. Our research of COI gene sequences shows that there are tree species in the White sea intertidal zone: *Lineus ruber*, *Lineus viridis* and *Lineus clandestinus* (Krämer, 2017) recently described from north-west coasts of France and the German North Sea coast. However morphological description of *Lineus clandestinus* doesn't match with our observations absolutely. Among our material species believed to be *L. clandestinus* by molecular data shows morphological features different to described holotype. Furtherer investigations are required for solving phylogenetical relationships within Lineus ruber/viridis species complex.

ID: 267

RECENT PROGRESS IN UNDERSTANDING OF MORPHOLOGY AND EVOLUTION OF THE NEMERTEAN PROBOSCIS

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All nemertean worms (except *Arhynchonemertes axi*) possess a proboscis. In the present report, we summarize our ten-year study of the proboscis morphology and its evolutionary transformation. The proboscis apparatus of about 80 nemertean species was examined by electron (TEM and SEM) and confocal laser-scanning (CLSM) microscopy. Using CLSM and antibody and phalloidin labeling, we obtained new data on the morphology of the proboscis musculature, nerves, and sensory structures.

Proboscis of most palaeonemerteans has two intraepithelial or subepithelial unconnected longitudinal nerves and four muscle layers, which is probably a primary state for nemerteans. In heteronemertean and hoplonemertean proboscis, nerves form an irregular or regular grid-like plexus; the proboscis musculature forms different bilateral or radial patterns. The proboscis glandular epithelium lacks typical ciliated cells, except monociliar or multiciliar sensory cells; some gland cells have numerous tubulin-containing long microvilli. All gland cells can be grouped into five types: mucoid, granular, bacillary, rhabdoid-containing, and pseudocnidae-containing cells. The shape and morphology of pseudocnidae (a nematocyst-like structure in anoplan nemerteans) can be used in the nemertean taxonomy. The stylet-like structures ('armature'), described from four orders of Nemertea, have a different functional morphology.

C3 Oral

Proboscis of some palaeonemerteans is closest to the ancestral state of this organ and 'reflects' the arrangement of the muscle layer and longitudinal nerves in the body wall. The subsequent evolutionary transformations of the proboscis proceeded in two directions: (1) increasing bilateral symmetry in the arrangement of the musculature, nerves, and gland epithelium; (2) increasing radial symmetry and loss of the dorso-ventral differentiation of the gland epithelium.

ID: 218

ULTRASTRUCTURAL FEATURES OF CILIOGENESIS IN THE EPIDERMIS OF *NOTOPLANA HUMILIS* (POLYCLADIDA, PLATHELMINTHES)

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Ultrastructure and morphogenesis of the turbellarian epidermis is characterized by high variability. This study aims to investigate the epidermal cells of adult and juvenile *Notoplana humilis* (Stimpson, 1857) using transmission electron microscopy in order to contribute to a comparative study of centriologenesis in Plathelminthes. The epidermis of *N. humilis* is a monolayered cellular, ciliated epithelium with a strongly developed basement membrane. It consists of two cell types: the actual epidermal cells bearing locomotor cilia, and unicellular glands forming lamellar rhabdites. The rhabditogen cells bear no cilia; they are located at the base of epidermis near the basement membrane and approach the body surface only to release the mature rhabdites. The structures typical for continuous ciliogenesis are observed in ciliated cells of both juvenile and adult specimens. Single centrioles and small centriole groups are scattered throughout the ciliated cell cytoplasm, while free basal bodies (centrioles+rootlets) occur more rarely and only in the apical zone of cells. Rootlets are formed during migration of centrioles to the epidermal surface. New centrioles appear to be generated mainly "de novo" and by the centriolar pathway. Formation of intermediary structures – centriolar precursors – is uncommon for the polyclad *N. humilis*. In contrast, acentriolar centriologenesis with prominent centriolar precursors has been observed in more evolutionary advanced neoophoran taxa. All presently available data suggest that the centriolar pathway could represent the initial pattern of centriole multiplication in ancestral Plathelminthes. The study was supported by ZIN RAS (NIOKTR: AAAA-A17-117030110029-3) and RFBR grant 16-04-00593 A.

ID: 300

MICROANATOMY AND 3D-RECONSTRUCTION OF *CLIOPSIS KROHNII* TROSCHEL, 1854 (GYMNOSOMATA, PTEROPODA, EUOPISTHOBRANCHIA)

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Gymnosomes are a shell-less clade of holoplanktonic Pteropoda (Gastropoda), comprising 6 families with approximately 42 species. They feed exclusively on their shell bearing sister group, the thecosomes which play an important ecological role in the seas and which are model organisms for ocean acidification. Information on the morphology of gymnosomes usually dates back to the 19th century with very little data added afterwards.

Herein we re-evaluated *Cliopsis krohnii* Troschel, 1854 (Cliopsidae) in microanatomic detail. Using serial semi-thin histological sectioning and virtual 3D reconstruction, this study focuses on the presence, shape and functions of feeding structures and inner organ systems.

Our investigated specimen shows the typical features of the Cliopsidae: a bulbous body with small wings, in contrast to the other gymnosomes. The proboscis is extremely long (3 times the body size) and possesses two hook sacs, specialized for extracting their prey *Creseis* (Thecosomata) out of their elongated tube-like shells. The stomach shows a ciliated band and connects to an appendix of so far unknown function. The hermaphrodite reproductive system shows a huge gonad, and we found a widely extending third female gland. Noticeable within the nervous system are the long and torn cerebrobuccal connectives and ganglionic structures extending along some of the bigger nerves. Our first microanatomical study thus confirms and supplements the original description of *Cliopsis krohnii*.

Thecosomes are in scientific focus because they are threatened by oceanic changes. Their gymnosome predators, on the other hand, although they share this fate, appear to merit better representation in modern science.

C3 Poster

ID: 427

WHAT DO YOU FANCY FOR YOUR DINNER? THE MORPHOLOGY OF RADULA AND FOOD PREFERENCES AS THE KEY FOR UNRAVELING *DENDRONOTUS* (GASTROPODA: NUDIBRANCHIA) EVOLUTIONARY HISTORY

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Nudibranch molluscs represent a diverse and successful group of marine gastropods. They are distributed worldwide and can be found in the most marine ecosystems with the highest diversity in the Indo-Pacific region. Since nudibranchs are shell-less molluscs, the study of their evolution and speciation process were problematic due to absence in the fossil record. In this study, we focused on the phylogenetic relationships of species of the genus *Dendronotus* (Nudibranchia: Dendronotida). These molluscs demonstrate a high variability in morphological characters and represent the highest diversity in boreal and Arctic waters instead of tropics, which is uncommon distribution pattern within Nudibranchia.

Methods and approaches included a detailed study of morphology and anatomy, molecular phylogenetic analysis of four markers, an analysis of radular ontogenetic variations and ecological studies.

Phylogenetic hypothesis based on molecular markers reveals six major clades; each clade represents by species with Atlantic and Pacific distribution and possessing similar radula morphology. The ontogenetic changes of radula through the late ontogenesis are species-specific feature and stand in close interdependence with the feeding modes and the specialization on different feeding objects. A model of morphological evolution of the radula strongly corresponds with molecular phylogenetic hypothesis. Our data indicate the North Pacific origin of boreal *Dendronotus* species with fast radiation by the adaptation to different feeding objects. Further speciation relates with a migration and allopatric speciation during periodical opening and closing of Beringia during Miocene-Pliocene and early Pleistocene.

This study was supported by Russian Foundation for Basic Research (grants #16-34-00955 and #15-04-02580).

ID: 462

DIFFERENT DIFFERENTIATION AND SPECIATION RATES BETWEEN SEXUAL AND ASEXUAL ROTIFERS

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The question of why organisms diversify into discrete species instead of showing a continuum of genotypic and phenotypic forms is important to answer yet difficult to study. The problem is that often asexuals are recent and potentially originate from evolution of their ancestors under gene flow. One peculiar group of organisms, the Rotifera, has two main groups, the strictly asexual parthenogenetic Bdelloidea, and the cyclical parthenogenetic Monogononta. Using population-level approaches on several organisms of different species to compare the degree of diversification between the two groups could allow us to disentangle whether species discreteness come from adaptation to fill discrete niches or from interspecific gaps generated by reproductive isolation. We investigate the importance of reproductive isolation by comparing genetic discreteness, intra- and interspecific genetic variation, various metrics from population genetics, and applied a quantitative description of the shape of their jaws using Procrustes-based geometric morphometrics. We find that monogonont species are more discrete than bdelloid species both in genetic parameters and in morphological parameters, but exhibit similar levels of intraspecific variation. This pattern could arise because bdelloids have potentially diversified into discrete genetic clusters at a faster net rate than monogononts.

ID: 485

FUNCTIONAL MORPHOLOGY OF FEEDING STRUCTURES IN CHOANOFLAGELLATES AND SPONGES

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Our objective is to investigate and compare the fine structure and functional morphology of filter feeding structures in choanoflagellates and sponges to get an insight into the early evolution of filter feeding.

Two choanoflagellates *Salpingoeca rosetta* and *Diaphanoeca grandis* and one demosponge *Halichondria panicea* were studied using light-, epifluorescence- and electron microscopy.

Cells of *S. rosetta* colonies had a 14 µm long flagellum, while *D. grandis* had a 9 µm long flagellum, a collar of 50 microvilli around 6 µm in length. External wing-like structures or vanes were absent on the flagella of both choanoflagellates. A lorica partly covered by a membrane was present in *D. grandis*. SEM studies on cryofractured choanocyte chambers of *H. panicea* showed predominantly flattened choanocytes with 9 µm long flagella without flagellar vanes surrounded by a collar of 35 microvilli around 5 µm in length. The prosopyle inner diameter varied between 3 and 5.3 µm while the apopyle had an inner diameter around 5 µm.

Flagellar external structures have been demonstrated in both choanoflagellates and sponges, but seem to be absent in the species studied here. It cannot be ruled out that fixation artefacts could ruin such delicate structures, but we find it most likely that these structures are indeed absent, since different methods failed to show them. We consider the partly membrane-covered lorica in *D. grandis* as a hydrodynamic adaptation to optimise food capture.

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ID: 344

FUNCTIONAL EVOLUTION AND MORPHOLOGY OF THE RADULA OF MOLLUSKS WITH VARIOUS TROPHIC SPECIALIZATION (MOLLUSCA: ORTHOGASTROPODA, LITTORINIMORPHA)

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Evolution of gastropoda inseparably connected with evolution of a radula. Among a large number of researches about functional evolution and morphology of the Mollusks radula the research about structure of a radula Litorinimorpha was conducted for the first time. As a result, species in clade Litorinimorpha have the wide artrogloss teniogloss radula, which composed of kampilodont teeth, and was described the dental formula. In the course the change of trophic specialization of species within the clade Littorinimorpha from microfuge to macrophage and predatory some types of radula's structure changes, namely: increasing surface of central teeth, the transformation from structure with bearing padding sections to falciformly pointed edges of marginal teeth, increases a size in a radula's segments. A facultative predator's radula gets in structure some changes like another predatory. This radula equipped with central teeth bearing several parts of the cutting bend and a falciform marginal teeth without bear padding sections.

ID: 374

THE REPRODUCTIVE SYSTEM MORPHOLOGY AND REPRODUCTIVE STRATEGIES OF BOBTAIL SQUIDS IN THE ARCTIC (CEPHALOPODA: SEPIOLIDA)

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Morphology of the reproductive system and reproductive strategies are crucial for understanding the life history and reproductive output of the organisms. Are they always under impact of the environment (being ecologically conditional) or does the phylogenetic conditioning also take place? Arctic-boreal bobtail squid *Rossia palpebrosa* (326 specimens) and high-arctic *R. moelleri* (30 specimens) were studied to understand that. Females have unpaired ovary, left oviduct with oviducal gland, paired nidamental glands and accessory ones. Fecundity in females is 191±8.84 oocytes in *R. palpebrosa* and 396±48.32 oocytes in *R. moelleri* with diameter 8.7±0.9 mm (21.97±3.18 % of mantle length) and 11.1±1.1 mm (16.24±1.23 %) accordingly. Early stages of oocytes development are absent earlier during ontogenesis in comparison to tropical and temperate cephalopods. Males have unpaired testis occupying asymmetric position and spermatophoric complex with loop-like coiled basal part of the spermatophoric sac. Spermatophore numbers are 13 – 62 (31±2) with length 13.5±0.08 mm (41.50±0.26 %) in *R. palpebrosa* and 84 – 141 (109±6) with length 19.7±0.07 mm (44.56±0.18 %) in *R. moelleri*. Sizes of reproductive products in both species are bigger than in tropical/temperate Rossiinae, but their number is lower. *Rossia* thus shows tendency to increase reproductive K-strategy features while moving northward to the Arctic with secondary increase of already enlarged oocytes and spermatophores in *R. moelleri*. The same time morphology of the reproductive system clearly bear ancestral features of all Sepiolida. So the conclusion is that morphology of the reproductive system is phylogenetically explained the same time its functioning being adaptation to the critical environmental conditions of the Arctic.

C3 Oral

ID: 309

COMPARATIVE MORPHOLOGY OF CATCHING APPARATUS, JAWS AND RADULA OF *R. PALPEBROSA* OWEN, 1834 AND *R. MEGAPTERA* VERRILL, 1881 (CEPHALOPODA, SEPIOLIDA) IN THE BARENTS SEA

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Arctic cephalopods are important component of the ecosystems while their biology remains unsufficiently known. There are 2 species of *Rossia* with doubtful identification in the Barents Sea. We have compared them and found some significant differences. We have studied 120 specimens of *R. palpebrosa* and 19 specimens of *R. megaptera*. *R. palpebrosa* has 2-4 rows of arm suckers, *R. megaptera* always has 2 rows. Catching apparatus is similar to other Sepiolida: each arm sucker contents chitinous ring consisting of infundibulum and papillated inner ring. The last one consists of 6 – 7 rows of polygonal structures in *R. palpebrosa* and 5 – 6 rows in *R. megaptera*. Pattern of sucker growth is different: wideness of chitinous ring in *R. palpebrosa* is gained by increasing of infundibulum while in *R. megaptera*' it is gained by papillated inner ring increasing. Beaks in both species are of typical shape. According to the rostrum shape, *R. palpebrosa* has 3 forms of beaks: straight, interjacent and claw-like. Some specimens have extra corner in the basal part of the rostrum. *R. megaptera* always lacks additional corner, and the rostrums are never of claw-like shape. Radula in both species has 7 teeth per row, its formula is 2:1:1:1:2. *R. palpebrosa* has flat wide triangular teeth while *R. megaptera*'s radula consisted of sharp and thin triangular teeth with wide bases. So, many additional morphological differences were found between this 2 species of bobtail squids in relation to their morphology of catching apparatus, beak and radula.

ID: 383

THE FIRST *PRUVOTINA* (MOLLUSCA, SOLENOGASTRES) FROM THE PACIFIC – A LOST LONER IN THE DEPTHS OF THE SEA OF OKHOTSK?

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Solenogastres (or Neomeniomorpha) have been collected in the oceans worldwide in all depth zones from the shallow subtidal to the abyssal. But the species diversity, distribution and biogeographic patters of the different clades of these enigmatic worm-molluscs still remain poorly explored. The Pruvotinidae (Cavibelonia) form a well-known family which comprises thirty-four species in fifteen genera, with the most species rich genus *Pruvotina* currently only known from the North Atlantic and (Sub-)Antarctic waters. Here we present the first species of *Pruvotina* collected in the lower bathyal (3371-3377 meters) of the Pacific Ocean during a deep-sea benthos expedition to the Sea of Okhotsk, a marginal sea of the Northwest Pacific. The species was investigated via an integrative taxonomic approach combining molecular barcoding with a detailed morphological description based on 3D-reconstructions from histological serial sections and scanning electron microscopy. This unique lineage from the Pacific shows the typical taxonomic characters of the genus (i.e. scleritome with hollow needles and hooks, epidermal papillae, distichous radula, ventrolateral foregut glands type A and dorsal foregut glands) with minor variations in scleritome and the setting of the vestibule in relation to the buccal opening. Molecular barcodes ensure conspecificity among the multiple collected individuals and preliminary molecular analyses cluster the characterized lineage among several distinct clades with morphological affinities to Pruvotinidae collected in the same region. Therein, our data indicates that *Pruvotina* does not present a "lost loner" but might resemble a common member of the still understudied bathyal and abyssal malacofauna of the Far Eastern Seas.

C3 Poster

ID: 297

THE PRELIMINARY STUDY ON THE TAXONOMY OF *DACTYLOBIOTUS* SP. (PARACHELA, EUTARDIGRADA) FROM KING GEORGE ISLAND, ANTARCTICA

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Tardigrades are hydrophilous micrometazoans with a five segmented body which consists of a head and four trunk segments. The limno-terrestrial tardigrades are one of the most dominant groups in the scanty terrestrial ecosystem of Antarctica. However, due to their limited key morphological characters and restricted access to the habitats, taxonomic study on Antarctic tardigrades largely remains to be challenged. KOPRI ecology team collected several species of tardigrades near the King Sejong Station, King George Island, Antarctica during 2014-2015 season expedition. Among the collected species, one species shows a bucco-pharyngeal apparatus reminiscent of *Macrobiotus*-type and typical *Dactylobiotus*-type 2-1-1-2 claws. According to these characters, this species could belong to the genus *Dactylobiotus*. This species is quite large in size (600-700 µm) with prominent eyespots and smooth cuticle. The 18S rDNA and cytochrome c oxidase subunit 1 (COI) sequences do not correspond to any previously-reported sequences as only limited molecular data of tardigrades have been reported so far. At present, key morphological characters of bucco-pharyngeal apparatus and claws are being measured, and pt ratio (the ratio of the length of a given structure to the length of the buccal tube) will be compared to that of other *Dactylobiotus* species. Comparing pt ratio is expected to be helpful to see whether the species is a previously reported *Dactylobiotus* species documented in other regions around the world, or a new species.

ID: 320

A NEW SPECIES OF THE GENUS *COXICERBERUS* WÄGELE, VOELZ & MCARTHUR, 1995 (ISOPODA: MICROCERBERIDAE) FROM AUSTRALIA

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A new species of *Coxicerberus* Wägele, Voelz & McArthur, 1995 collected from Manly beach, Sydney, Australia was described. The new species was assigned to the genus *Coxicerberus* on the basis of the tiny, elongate body, tergite of the pereonites 2-4 with distally pointed coxae, male pleopod 2 with elongate rectangular sympod, tiny rounded exopod and uropod with tiny, exopod. *Coxicerberus* sp. nov. resembled to *Coxicerberus boninensis* Ito, 1975, sharing the same armature formula of the antennula and the antenna, similar morphology of male pleopod 2 and uropods. However, the new species can be distinguished from other congeners primarily by the presence of the pleopod 1 like character. In contrast to the other congeners, the ventral part of the pleonite of *Coxicerberus* sp. nov. exhibited a bifurcate protrusion which is similar to the pleopod 1 observed in the evolutionarily old groups, *Mexicerberus* Schultz, 1974 and the *Bulgarocerberus* Baldari & Argano, 1984. Based on the morphology of the pleopod 1 like character, the evolutionary relationship between the *Coxicerberus* and other genera, *Protocerberus* Wägele, 1983, *Afrocerberus* Wägele, 1983, *Microcerbrus* Karaman, 1933 and *Isoyvesia* Özdikmen, 2009 was re-examined and an updated identification key to species is presented.

ID: 447

MORPHOLOGICAL VARIABILITY AND TERATOLOGY MORPHOLOGY OF PALEARCTIC FRESHWATER HARPACTICOIDA (CRUSTACEA: COPEPODA)

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The analysis of the phenotypic variability allows to determine the structure of taxa, boundaries and the genesis of intraspecific forms, and to distinguish the norm from the pathology of development of a specific species. Harpacticoids (Crustacea, Copepoda) are important components of the freshwater and marine ecosystems. The rich abundance and high level of diversity of forms and life strategies of the species allow them to inhabit various biotops—from water inside leaf bases to lakes and seas.

The variability of morphological characteristics of ten populations of the freshwater harpacticoid *Canthocamptus staphylinus* are described. The most variable morphometric indices, body size, ratios of lengths of caudal rami and spines on the fifth leg exopod, and important quantitative morphological characters, e. g. the number of spinules on the anal operculum, have been assessed. Morphological diversity of other harpacticoid species like *Bryocamptus* (*Arcticocamptus*) *cuspidatus* (Schmeil), *Moraria insularis*, and *M. mrazeki* Scott were studied. Data on teratology like body asymmetry, deformations of morphological structures and transsexual mutations have been summarized for: *Atthyella* (*Neomrazekiella*) *nordenskjoldi* (Lilljeborg), *Atthyella* (*Neomrazekiella*) *northumbrica trisetosa* Chappuis, *Pesceus schmeili* (Mrazek) and *C. staphylinus*. These variations and abnormalities in the studied specimens are assumed to be caused by geographical isolation of populations and differing environmental conditions.

C3 Poster

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ID: 147

MORPHOLOGICAL ANALYSIS DOES NOT SUPPORT MONOPHYLY OF THE GYMNOMERA (ORDERS ONYCHOPODA AND HAPLOPODA) (CRUSTACEA: BRANCHIOPODA: CLADOCERA)

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For a long time since Sars (1865) researches discussed a question about the systematic proximity and monophyletic origin of Onychopoda and Haplopoda, united in the group Gymnomera. In the recent years, more strong support of monophyly of Gymnomera were postulated again by research works, based both on morphology and molecular analysis (e.g. Schwenk et al. 1998; Richter et al. 2001, 2007; Olesen 2009; Kotov 2013). But a closer look at synapomorphies of the discussed taxon leads to the conclusion of their formality because all of them concern features connected with the carnivorous mode of life. However, there are numerous morphological and anatomical structures which display substantial differentiation: general body plan, head shape, eye size and structure, position and armament of antennules and swimming antennae, presence or absence of head pore, structure of mouth parts, structure of carapace, structure of thorax, number and structure of thoracic limbs and their appendages, structure of abdomen and postabdomen, presence or absence of the huge caudal process and position of postabdominal (caudal) setae etc. In addition, the representatives of two orders possess many other structural differences, e.g. alimentary canal, ovaries, testes, and spermatozoa of different structure, and position as well as modes of brooding and embryonic development. The difference in evolutionary age should be also taken into consideration. Judging from the numerous morphological and other peculiarities of Onychopoda and Haplopoda, it seems most probable that their features were acquired independently in different evolution lineages and developed in parallel.

ID: 242

MORPHOLOGICAL ADAPTATIOND OF THE CLADOCERA (CRUSTACEA: BRANCHIOPODA) RESTING STAGES TO ZOOCHORY: ANALOGUES WITH PLANT SEEDS

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Cladocera (Crustacea: Branchiopoda) is a group of microscopic crustaceans inhabited continental water bodies of different types. They have resting eggs well-protected from an unfavorable environment influence. In three recent orders (Ctenopoda, Onychopoda, Haplopoda) the resting eggs are covered by a strong drought-resistant shell, while in the fourth order (Anomopoda) the resting egg(s) are enclosed by so-called ephippium - a modified moulting exuvium of female. It is well-known that just transportation of the resting eggs and ephippia by water birds through the gut and on the feathers is the main vector of the cladoceran dispersion. Previously several authors already declared that functionally, ephippia are very similar to plant seeds, and the same dispersal mechanisms may operate (Altermatt and Ebert, 2008; Figuerola and Green, 2002; Van Damme and Sinev, 2013). We pay a special attention to the analogues between the cladocera resting eggs and ephphippia and the plant seeds in their morphological adaptations to zoochory. The study is supported by the Russian Foundation for Basic Research (grant 15-04-08552-a).

C3 Poster

ID: 400

MORPHOLOGY AND MICROSCOPIC ANATOMY OF *OCHETOSTOMA* SP. (ECHIURA: THALASSEMATIDAE)

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Echiurida is a small group of marine benthic invertebrates, living in burrows and having hidden life style. Investigation of the morphology and microscopic anatomy of all organ systems can help to understand of echiuran biology. Morphology and microscopic anatomy of *Ochetostoma* sp. are studied by methods of light microscopy, histology, scanning electron microscopy, and 3D reconstruction by series of sections. Proboscis is characterized by strong development of the longitudinal muscles and lacks of the coelomic ventral plexus. The epidermis of trunk forms numerous large papillae, which consist of glandular cells. The connective tissue of the posterior part of the trunk is very thick and occupied by numerous glandular cells. The coeloms of proboscis and trunk are not separated from each other. In the trunk thara are numerous radial mesenteries, with anchor the intestine to the body wall. Coelomocytes are numerous and form large aggregations in the trunk coelom. The neurointestinal blood vessel is very looped and long; the ring vessel is spacious. In the anterior part of the trunk, the nerve tube extends between dorsal and ventral sides of the body and subdivides the trunk coelom on the left and right chambers. New results evidence the presence of unique morphological features in organization of some organ systems in *Ochetostoma* sp. Detailed investigations of many specimens from different taxa will help in future to make complete comparative analysis, to reveal the echiuran biology, and to reconstruct their evolutionary way from segmented ancestor to recent forms. Russian Science Foundation (14-50-00029) supports this study.

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ID: 341

FIRST DETAILED DESCRIPTION OF MORPHOLOGY AND MICROSCOPICAL ANATOMY OF DEEP SEA ECHIURID *PROTONONELLIA ZENKEVITCHI*

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Echiurida is a group of marine benthic invertebrates, living in burrows and have hidden life style. Investigation of morphology and anatomy of all organ systems will help to understand the biology of echiurids, many of which are deep sea species. Morphology and microscopical anatomy of deep sea *Protobonellia zenkevitchi* Murina, 1976 were studied by methods of light microscopy and histology. The presence of ciliary grooves and vacuolated cells in connective tissue of the distal part of the proboscis allowed to suggest the specific position of the proboscis on the substratum and mechanism of sort of food particles. It was shown for the first time that the coelom is not subdivided into compartments: the united coelom occupies the proboscis and trunk. New segment of digestive tract, which probably functions for storage of food and for thorough digestion, was described for the first time. This portion of the digestive tract is important in oligotrophic conditions of deep sea. The circulatory system of *P. zenkevitchi* lacks of neuro-intestinal and ring blood vessels. The oocyte storage chamber of the gonoduct has a pore, which opens into the trunk coelom. Comparative analysis revealed that many organ systems in *P. zenkevitchi* have simpler organization in comparison with other echiurids. This simplicity may correlate with small body size of *P. zenkevitchi* and may be caused by living in deep sea. At the same time, *P. zenkevitchi* has some unique anatomical characteristics, which correlate with specific biology of this species. Work is supported by Russian Science Foundation (14-50-00029).

C3 Oral

ID: 304

NEW RECORDS OF RECENT BENTHIC FORAMINIFERA FROM KOREAN WATERS

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As a part of the survey of indigenous biological resources of Korea, 30 unrecorded benthic Foraminifera species were taxonomically identified. The samples were collected from the east, and the west coast of South Korea, in April 2015, and May 2016 respectively. Sediment samples from eight stations (four from the east and four from the west) were qualitatively analyzed by using stereo microscope, and SEM. As a result, 30 unrecorded benthic Foraminifera species belonging to 25 genera in 7 orders (Astrorhizida, Lagenida, Lituolida, Miliolida, Robertinida, Rotaliida, and Textulariida) were identified. From the west coast, 10 species belonging to 9 genera in 5 orders (Lagenida, Lituolida, Robertinida, Rotaliida, Textulariida) were identified. Among them, Order Rotaliida was found to be the most dominant by including 4 species (*Evolvocassidulina tenuis* (Phleger & Parker, 1951), *Cibicides mabahethi* Said, 1949, *Cibicides pseudolabatulus* Perelis & Reiss, 1975, *Cibicidoides barnetti* (Bermudez, 1949)). From the east coast, 20 species belonging to 16 genera belonging to 5 orders (Astrorhizida, Lagenida, Lituolida, Miliolida, and Rotaliida) were identified and Order Lagenida was the most dominant by including 11 species (*Lagena strumosa Reuss*, 1858, *Lagena nebulosa* (Cushman, 1923), *Reussoolina laevis* (Montagu, 1803), *Procerolagena cylindrocostata* Albani & Yassini, 1989, *Fissurina subchasteri* McCulloch, 1977, *Oolina laevigata* d'Orbigny, 1839, *Polymorphina amplissima* McCulloch, 1977, *Polymorphina subelliptica* McCulloch, 1977, *Guttulina succincta* McCulloch, 1977, *Guttulina neoproblema* McCulloch, 1977, and *Lagenosolenia obtecta* McCulloch, 1977). Present finding increases the number of Korean foraminiferal species to about 1066, which will contribute to understanding diversity of Foraminifera in Korean waters.

ID: 122

NEW CYST TYPE OF TESTIS ORGANIZATION IN MARINE GASTROPODS

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Within marine gastropods, *Littorina saxatilis* is one of the model objects for ecological and population genetics studies including of whole genome sequencing. Data on gamete development are still missing, although highly demanded due to existence of three sibling species in "saxatilis" species-complex and unknown mechanisms of their reproductive isolation.

Detailed description of *L. saxatilis* mature testes was made using live material (DIC microscopy) and fixed tissues (high pressure squashing technique). Different staining techniques and fluorescent microscopy were applied for identification of cell types and nuclei.

L. saxatilis unpaired testis is located along the hepatopancreas ducts and has a lobed structure. A large number of cysts containing differentiated sperm fill the lobules of mature gonad and arranged randomly. Cyst development begins with the formation of the blastocyst comprising a cystic cell of somatic origin and a primary spermatogonium. Multicellular spermatogonial, spermatocytic and spermatide cysts are formed in which a multistage process of spermatogenesis is carried out. We described endoreduplicated nuclei and a minimum of six cycles of chromatin condensation during sperm development. Final stages of sperm maturation are completed in the gonad cavity and genital ducts. Apoptotic cysts get into the gonad cavity and can play essential role in sperm maturation.

"Cyst" type of testis organization was not previously shown in Prosobranchia. Cysts in the testes of *L. saxatilis* are arranged randomly, in contrast to the tubular type of gonad organization in bivalves and other gastropods. *L. saxatilis* cyst organization and development is similar to those occurring in *Drosophila melanogaster* spermatogenesis.

ID: 101

THESE ANNOYING NEIGHBOURS: A COMPARATIVE ANALYSIS OF FEEDING APPARATUS IN TWO DRILLING NUDIBRANCH SPECIES

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The drilling feeding type is presented in both main nudibranch clades: Doridacea and Cladobranchia. We compared the morphology of the feeding apparatuses in two drilling nudibranch species: *Vayssierea elegans* (Baba, 1930) (Doridacea) and *Eubranchus rupium* (Møller, 1842) (Cladobranchia) in order to find out, whether morphology of the feeding apparatus correlates to the feeding mechanism or to the taxonomical position.

The general and fine morphology of the feeding apparatus of these two species were studied using light microscopy, cLSM, SEM and TEM; the 3D-reconstructions of the buccal complex were made as well.

The adaptations to drilling feeding type in both species are reflected in the morphology of the odontophore: it lacks the supportive structures, such as cartilages or bolsters, and operates together with the radula as a muscular drilling instrument. Nevertheless, the general plan of the buccal complex in these two species is different. The buccal complex of *V. elegans* includes numerous thin muscle bundles and lacks jaws, while the buccal complex of *E. rupium* consists of several large muscle bundles and has paired jaws with masticatory processes.

The morphology of the feeding apparatuses in examined nudibranch species corresponds to the general plans of doridacean and cladobranch buccal complexes respectively. That means, the buccal complex's morphology of nudibranch is related more to the taxonomical position, than to the feeding mechanism.

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ID: 271

ANTARCTIC NEWNESIDAE (GASTROPODA: CEPHALASPIDEA): A STUDY OF THE KNOWN SPECIES AND A NEW BATHYAL SPECIES

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The study of Antarctic heterobranch diversity, as in other marine invertebrates, has been hampered until very recently by the lack of detailed morphological and anatomical studies, as well as comparative molecular studies. However, Antarctic species are crucial for disentangling the phylogenetic conundrums in many clades. Recently, in fact, a new family of cephalaspidean molluscs, Newnesiidae, was proposed to include *Newnesia antarctica* and the newly discovered *N. joani*. In these studies, the family Newnesiidae was recovered as a sister group to all other Cephalaspidea, and thus the Antarctic origin of Cephalaspidea was proposed. In light of cryptic speciation observed for several Antarctic invertebrates, we further analyzed several *Newnesia* specimens collected from the Ross Sea, the Weddell Sea, and the Drake Passage. A detailed morphological and anatomical description of the type species *N. antarctica* is included here, and a new species from bathyal depths in the Drake Passage is described. The results of our molecular phylogeny, together with the morphological synapomorphies of *N. joani*, support the introduction of a new genus to accommodate the latter species. This study further reinforces the fact that thorough sampling and taxonomic efforts are still needed in the Southern Ocean.

C3 Poster

ID: 361

THE IMPORTANCE OF CONDITIONS FOR THE STUDY OF MARINE INVERTEBRATES IN CULTURE

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Maintaining of invertebrates in culture allows to carry out many types of research that appear unavailable in natural conditions.

Cultures of *Aurelia* sp. (Cnidaria, Scyphozoa) polyps exhibit the dependence between long-term temperature conditions and the sensitivity to the temperature shift inducing strobilation. Polyps, which were kept at unstable temperatures above 20°C, require specific conditions for a long time or chemical agents for the induction of strobilation. The maintenance at the constant temperatures below 20°C for a year or more leads to the ability of polyps to strobilate in response to small short-term temperature drop.

A sharp increase of salinity induces abnormal strobilation in *Cassiopea* sp. (Cnidaria, Scyphozoa) polyps. Duration of strobilation in Scyphozoa is inversely related to the temperature of strobilation and independent of the temperature of the induction of strobilation.

The culture of *Sycon* sp. (Porifera, Calcarea) have been maintained in an aquarium with other invertebrates in natural sea water for many years. It allows to find out some factors effecting growth and development of *Sycon* sp. Sponge growth rate depends not only on organic nutrients, but also on regular administration of depleted inorganic salts. Change of the sodium chloride relative concentration in seawater initiates gametes production in adult sponges. In lack of organic compounds (milk or carbonic acid diamide and sodium phosphate in different trials) sponge formes asconoid structure only, but not syconoid structures. Change of the sponge body position in relation to the water current leads to additional osculum formation.

ID: 275

INVESTIGATION OF TAXONOMICALLY SIGNIFICANT MORPHOLOGICAL CHARACTERS OF THE EURASIAN ARCTIC RISSOIDAE (GASTROPODA: CAENOGASTROPODA)

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Rissoidae is a family of minute marine mollusks distributed all over the world. Only the most important anatomical characters, used for reconstruction of the general evolution of the family had been studied and described so far. However, the taxonomical system of the family on species level is still based mainly on conchological characters whereas anatomy remains unknown for the majority of species. The goal of this study is to build morphology-based taxonomical system for the rissoid taxa distributed in the Eurasian Arctic seas. External shell morphology and internal anatomy (reproductive system and radula) had been investigated for two tens of valid species known from the Arctic.

High infraspecific variability of shell sculpture was discovered for many species. All species distributed exclusively in the Arctic have an embryonic shell indicated a direct type of larval development but, the sculpture of protoconch is usually unique for a species. All studied species have a same general type of radula, but numerous differences in proportions and shape of teeth had been observed. The radula with the rectangular median cusp of a central tooth was discovered for the first time in the family. Male and female reproductive system were the most diverse, however, their characters are usually correlated with a sculpture of embryonic shell. Three undescribed species, distributed in the Arctic and Northern Pacific had been revealed.

The study was supported by the Russian Foundation for Basic Research (Grant No. 16-34-00372 mol_a)

ID: 406

FIRST RECORD ON PHORONID SPECIES FROM PERSIAN GULF

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Phoronida is a small phylum, which includes brackish and marine worm-like invertebrates with biphasic life cycle. Currently, the phoronid world fauna includes about fourteen recognized species, known from adults; however, at least 40 larval forms have been described or documented. Although most of phoronids have worldwide distribution, adults and larvae of phoronids are still unknown from many areas of the World Ocean. One of these areas is the Persian Gulf. In adjacent area — the Gulf of Oman, only one phoronid species — *Phoronis australis*, which usually lives as commensal in tubes of cerianthares, is detected. In this study, we report for the first time about two records of adult phoronids, which have been collected in the terminal area of the Persian Gulf near Kuwait. About fifty specimens were gathered from soft substratum (mud with sand) and two specimens were found in shell rock. The total length of body with tentacles is about 10 mm in phoronids from soft substratum; in phoronids from the rock, the length of anterior body part with tentacles is about 2 mm. According to preliminary morphological data, phoronids from soft substratum apparently belong to genus *Phoronopsis* because of presence of the collar – an epidermal fold situated at the base of the lophophore. The spiral-shaped lophophore forms one coil and bears about 100 tentacles. Detailed morphological and molecular analysis will be done to establish the species of phoronids from both findings. This work is supported by RFBR (#17-04-00586).

C3 Poster

ID: 260

MOINA BELLI GURNEY, 1904 (CRUSTACEA: CLADOCERA), A FORGOTTEN RARE SPECIES FROM AFRICA

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Species of the genus *Moina* Baird, 1850 (Cladocera: Moinidae) are abundant in the tropical regions, but to date many of them are scarcely studied. The aim of our work is to redescribe morphology of *M. belli* Gurney, 1904, a forgotten rare species, firstly found in the Republic of South Africa and later known only from several localities.

For this study we used several samples with *M. belli* from the Republic of South Africa and Ethiopia. Parthenogenetic, gamogenetic females and males were investigated under light and scanning electron microscopes using common techniques.

We conducted a full redescription of *M. belli* corresponded to current morphological standards. At this moment, while reliable diagnostic characteristics for moinids are only under development, morphology of stiff seta 1 of limb I is the best feature for identification of *M. belli*. Stiff seta 1 of *M. belli* is covered by fine setules, in contrast to *M. macrocopa* (Straus, 1820) with prominent widely spaced setules. Postabdomen dorsal side of *M. belli* bears bunches of hairs. Also, head, valves and external appendages of *M. belli* are covered by hairs. Hairs or setules on the body were found in some other moinids. They provide purity of body in the conditions of temporary muddy water bodies. In Africa, *M. belli* may be considered as exclusively rare, but widespread species; due to peculiar morphology there is no chance to misidentify this taxon with other moinids.

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ID: 128

STRUCTURAL STUDY OF OOCYTE STAGES IN THE GOLDEN APPLE SNAIL

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The golden apple snail (*Pomacea canaliculata*) has become a cause of major problems in agriculture in Thailand for decades. One of the reasons is that the snail has a short reproductive cycle. The present study attempted to examine structures of the developing oocytes of this species. The snail's ovarian tubules were studied under light and transmission electron microscopes. Results revealed that oocytes in the ovarian tubules were divided into five stages; oogonia, previtellogenic oocyte, early vitellogenic oocyte, late vitellogenic oocyte and mature oocyte. Oogonia were low columnar or cuboid in shape. They were arranged in a single row attaching to the basement membrane. Previtellogenic oocytes contained spherical nuclei with prominent nucleoli. Chromatins were scattered within the nuclei, and some of them were clumped and attached to the nuclear membrane. Early vitellogenic oocytes contained nuclei that became partially lobulated. Heterochromatins were scattered close to the nuclear membrane. Yolk granules were accumulated in the ooplasm. Late vitellogenic oocytes contained complete lobular nuclei. Electron dense chromatins were attached to the inner nuclear membrane making the clock-face pattern of the nuclei. Parts of the plasma membrane were invaginated into the ooplasm forming vesicles. The vesicles fused together and developed into yolk granules. Mature oocytes had small, eccentric nuclei. In the ooplasm, numbers of the yolk granules were found more than those of the late vitellogenic oocytes. Knowledge on reproduction of this invasive snail could be important for effective management strategies which are going to be developed in the near future.

ID: 129

STRUCTURAL STUDY OF THE GASTROINTESTINAL TRACT OF THE GOLDEN APPLE SNAIL

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The golden apple snail (*Pomacea canaliculata*) is an agricultural wetland pest in Thailand. The snail has a high growth rate which related to its high food consumption. Until now, knowledge on the snail's biology is still limited. The present study intended to examine the structure of the gastrointestinal (GI) tract of this species. The snail's GI tracts were separated into esophagus, stomach, small intestine, and large intestine. They were examined under light and transmission electron microscopes. Heights of the epithelial cells were measured under a light microscope using an image analysis program. Results revealed that all parts of the GI tract were lined with simple columnar epithelium. Numerous microvilli were identified in the apical region of the epithelial cells. Mucous-secreting cells were scattered among the epithelial cells, except those of the stomach. The small intestine had the highest height of the epithelial cells, whereas the esophagus had the shortest height of the cells. In all parts of the GI tract, transmission electron micrographs revealed that euchromatins were observed in the nuclei of the epithelial cells. The nuclei of the stomach and large intestine contained prominent nucleoli. In the small intestine, Golgi apparatus, rough endoplasmic reticulum and mitochondria were prominent in the cytoplasm. Tight junctions and desmosomes were identified between the adjacent epithelial cells of the stomach and large intestine. Results of the present study could provide basic knowledge on the digestive function of the snail species.

ID: 270

AN EMERGING DISEASE IN THE ANTARCTIC SEA STAR *ODONTASTER VALIDUS*

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An increasing interest has been growing recently for devastating syndromes that have annihilated sea stars populations along the American Pacific coasts, producing unusual mortality events in echinoderms. Echinoderms are key components in benthic communities, and therefore, any affection on their populations may have important consequences on the whole ecosystems. During our Antarctic cruises ACTIQUIM-3 (Dec 2011-Feb 2012) and ACTIQUIM-4 (Jan-Mar 2013) at Deception Island (South Shetland Islands), we found sea stars of the species *Odontaster validus* Koehler, 1906 with clinical signs of multifocal ulceration. The affectation was ~10 % of the population of this keystone predator within Port Foster Bay. Histological analyses on healthy and affected specimens showed ulceration of the epidermis, associated with inflammation and tissue necrosis in diseased animals. To characterize homeostatic disorders in the microbiome of Bacteria/Archaea and Fungi (ITS-1) associated with the disease, we compared the microbial communities in healthy and diseased specimens, using MISeq technology to barcode 16S V3–V4 and ITS-1 regions. The analysis of several divisions within the microbiota provides information about interactions and compositions related to healthy and diseased stages. This will assist to disentangle the roles different microbial compositions play in marine ecosystems, in particular in the much less understood Southern Antarctic Ocean. We present here the preliminary study of a deeper exploration into this emerging disease affecting a species of the Antarctic benthos. Future efforts will be directed to perform additional analyses at the microscopic and ultrastructural level with microbial and molecular studies.

C3 Poster

ID: 235

DISTRIBUTION AND DIVERSITY OF JELLYFISH IN KOREAN COASTAL WATERS

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Jellyfish continue to bloom at larger scale each year on the coastal waters of South Korea. Despite its many negative effects endangering other marine species and wellbeing of ecosystem, there is still much lack of understanding of jellyfish in Korea. Classification and ecological investigations are still lacking compared to other regions of the world and existing data are fragmented, making it difficult to understand jellyfish of Korea in more integrated manner. This study aims at gathering existing materials, organizing the diversity and distribution of jellyfish that have been recorded in coastal region of Korea. Total of 55 species of jellyfish and comb jellies belonging to two phyla, five classes, 15 orders, 35 families and 53 species have been recorded in coastal region of Korea. Two species remain unclassified due to difficulties classifying its taxonomic status. Of the classified species, most commonly occurring species are *Aurelia* sp.1 and *Nemopilema nomurai* with species like *Carybdea rastonii*, *Physalia physalis utriculus* and *Spirocodon saltatrix* also recorded frequently. Distribution varied greatly depending on the species. Overall, the southern coastal regions such as Gyeong-nam and Jeon-nam showed relatively high distribution rates and species diversity compared to other regions. The problem remains that distribution of jellyfish is constantly growing with new exotic tropical/subtropical jellyfish being introduced to Korean coastal regions. Therefore, an ongoing investigation of jellyfish of Korea will be critical in order to conserve and manage our costal ecosystem.

ID: 278

NEW DATA ON ULTRASRUCTURE OF THE GONAD IN HOLOTHURIA *CHIRIDOTA LAEVIS*

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Holothuroidea is a class of echinoderms, whose body plan is different from all other Echinodermata. The amount of information about holothurians reflects their economic significance. Commercially important species have been studied in great detail, however little is known about structure and ecology of many other holothurians. The anatomy and ultrastructure of gonad of holothuria *Chiridota laevis* are studied using light microscopy, cLSM, SEM, and TEM. The gonad is a single organ consisting of elongated and ramified tubules of variable length and diameter. Proximally gonad tubules unite into a basal sac, which connects the gonoduct that opens by gonopore. The most distal sac-like parts of tubules are called acini. According to our new results, the wall of different gonad parts has different ultrastructure. In all parts, the wall consists outer visceral epithelium, inner germinative epithelium, and the genital haemal sinus cavity between two cellular layers. In acini and basal sac, the wall contains muscle cells, which are located under the visceral epithelium and form longitudinal, circular, and diagonal musculature. In gonoduct, the visceral epithelium is formed by typical podocytes. The hemal sinuses is strongly developed in gonoduct, whereas is represented by thin layer in acini and basal sac. The inner epithelium of the gonoduct exhibits ultrastructural features of apocrine secretion. Many specific features of the gonad organization, which are described for the first time in this report, correlate with specific type of gametogenesis that is still poor studied in sequential hermaphroditic holothurians. Work is supported by Russian Science Foundation (14-50-00029).

ID: 279

PECULIARITIES OF THE OOGENESIS IN HOLOTHURIA *CHIRIDOTA LAEVIS*

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Gametogenesis is usually used not only for understanding of reproductive biology, but for phylogenetic analysis as well. Holothuroidea is a class of echinoderms, whose oogenesis was described briefly for several commercially important species, most of which are dioecious. At the same time, oogenesis of other holothurians, especially in sequential hermaphroditic species, is still poor studied. The oogenesis of holothuria *Chiridota laevis* is studied using light microscopy, SEM, and TEM. Oogenesis occurs in the most distal parts of the gonad, in acini. The inner layer of acini is represented by germinative epithelium, which gives rise to primordial germ cells and accessory cells. The accessory cells form a follicle around developed oocytes. In *C. laevis*, each follicle can contain more than one oocyte that is unusual feature, which has never been described in holothurians before. Between follicle cells and oocytes there are no any specialized contacts, which may provide the transport of nutriments and which are described in many other holothurians. The surface of vitellogenic oocyte forms thin rare microvilly exposed into narrow peryocyte space. In mature oocyte, the cytoplasm adjacent to the voluminous space of haemal sinuses differs significantly in its absence of yolk and presence of numerous transparent vesicles of different sizes. Along oolemma the endocytotic vesicles are numerous. The presence of endocytosis evidences the heterosynthesis, which is typical for holothurians. On the other hand, the absence of specialized contacts between oocytes and follicle cells seems to be unusual feature of oogenesis of *C. laevis*.

ID: 442

MORPHO-FUNCTIONAL FEATURES OF SPERMATOPHORES AS A MARKERS OF THE REPRODUCTIVE STRATEGIES IN MALES OF THE SQUID (CEPHALOPODA: MYOPSIDA, OEGOPSIDA)

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Phenomenonof spermatophores is widely distributed among animals,and it reaches the most complicated level in cephalopods. The process of spermatophorogenesis determines the originality of functional maturation and reproductive strategy in males of different cephalopod groups. Big amounts of original and literature data were analyzed in here, giving the information on spermatophores production in 14 families and subfamilies of squids. The analysis of spermatophores quantity in sac, length of spermatophores, length and volume of seminal reservoirs wasperformed. Epi- and mesopelagic squids are mostly «competitors»(C-strategy), forming from 200-300 up to 1800spermatophores. Their length and seminal reservoir volumes increase insignificantly during ontogenesis, usually not more than up to 1.5 times (Loliginidae; Gonatidae:*Berryteuthis*; “muscular” Onychoteuthidae; Ommastrephidae:Illicinae, Todarodinae, large-size Ommastrephinae). «Ruderals» (R-strategy) in epipelagial form from the first decades up to 200 spermatophores, they are listed as follows – Ommastrephidae:Todaropsinae, small-sizeOmmastrephinae; Thysanoteuthidae. «Patients» (P-strategy) prevail in meso- and bathypelagic layers, producing relatively small number of spermatophores, but their length and seminal reservoir volumes increase significantly, from 1.5 to 12 times, and from 1.6 to 18 and much more times, accordingly(Ancistrocheiridae; Architeuthidae; Gonatidae: except *Berryteuthis*; Lycoteuthidae, “ammonial” Onychoteuthidae). InvertedP-strategyisdistinc tiveforHistioteuthidae, formingupto 3000spermatophores in which length and volume of seminal reservoir decrease up to 1.5 times during ontogenesis. Different mechanics of effective sperm investment (total volume of sperm invested in all spermatophores) allow cephalopods to productively realize the promiscuity (exceptThysanoteuthidae leading paired lifestyle) with different types of male reproductive strategy.

ID: 241

RECENT DATA ON THE NERVOUS SYSTEM OF SOME LOPHOPHORATA

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Bryozoans, phoronids and brachiopods are marine and freshwater filter-feeding sessile animals widely spread all over the world. For a long time all three groups were placed in a single type – Lophophorata. They were united by the morphological features of lophophore – special feeding apparatus, and some specialties of embryological development. Nevertheless, a lot of investigators were confused by the dissimilarity of these groups. Furthermore, some molecular data allowed to suppose that Lophophorata – is an artificial taxa. In this investigation we made an attempt to compare these taxa in terms of nervous system structure and different neuromediators localisation character.

Nervous system is known to be unique from two points of view. From one hand, nervous system has a high plasticity, being able to responce to the environmental changes. From the other hand, nervous system is highly conservative, being one of the main regulatory and integrative systems in an organism. It allows to use the data concerning nervous system structure as a key data for comparing different groups and understanding their phylogenetic position.

Using data from our own investigations of freshwater bryozoan nervous system and literature data, concerning the nervous system of marine bryozoans, phoronids and brachiopods, we have compared the localisation of common neuromediators and the general structure of the lophophore nervous system (which is investigated mostly). We discuss different ideas concerning the relationship between these groups.

This study was performed as part of budget project AAAA-A17-117030110029-3 (ZIN RAS) and supported by the RFBR (project 15-29-02650).

ID: 355

CLAM SHRIMPS (CRUSTACEA, BRANCHIOPODA) – FUNCTIONAL MORPHOLOGY OF MALE CLASPERS AND SYSTEMATICS OF LAEVICAUDATA

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Clam shrimps consist of the three groups Spinicaudata, Laevicaudata, and Cyclestherida, which belong to the crustacean class Branchiopoda. Here we present results of two related projects on clam shrimp systematics. (1) Male clam shrimps have their first one or two trunk limb pairs modified as 'claspers', which are used to amplex the female during mating and mate guarding. Clasper morphology has traditionally been important for clam shrimp taxonomy and classification, but little is known about how the males use the claspers during amplexus. We studied clasper functionality in one laevicaudatan and four spinicaudatan species using close-up video recordings and scanning electron microscopy (SEM). We mapped clasper morphology and functionality aspects on a branchiopod phylogeny and theorize that the claspers of the three groups were adapted from an original, simpler clasper, each for a 'stronger' grip on the female's carapace margin. (2) The systematics of the understudied Laevicaudata (~40 species) is being addressed based on morphology and molecular data. Clasper morphology especially holds important phylogenetic information. Preliminary results raise the possibility of paraphyly in *Lynceus*, the largest genus, but more data is needed.

ID: 352

COMPARATIVE MORPHOLOGY OF BRANCHIOPOD (CRUSTACEA) LIMBS

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Branchiopoda is a relative small monophyletic taxon of crustaceans mostly found in seasonally astatic freshwater pools. The group consists of around 1200 described species divided into the groups Anostraca (fairy shrimps), Notostraca (tadpole shrimps), Cladocera (water fleas), and the paraphyletic 'Conchostraca' (clam shrimps) consisting of Spinicaudata, Laevicaudata, and Cyclestherida. Branchiopods are ancient-looking crustaceans going back around 500 million years in the fossil record. Most branchiopods have very characteristic foliaceous and lobed trunk limbs, showing serial similarity from anterior to posterior. These trunk limbs show great similarities across the different groups, but differences in limb morphology are found in e.g., some groups of (predatory) cladocerans, with limbs deviating from being foliaceous, flattened structures. We are here presenting a (preliminary) study of branchiopod limb musculature based on confocal laser scanning microscopy. *Cyclestheria hislopi* (Cyclestherida) is in the center of the work, but the goal is to study and compare the branchiopod limb musculature in search for homologies and apomorphic muscular traits. The muscular studies will also be used to re-address proposed limb homologies between major taxa through phylogenetic and evolutionary analyses.

ID: 240

SPERM PACKAGING AND THE FUNCTIONAL ROLE OF THE SEMINAL VESICLES IN THE *HYGROPHILA* (GASTROPODA: PULMONATA)

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Most fixatives, however fast and non-intrusive they might be, cause deformation of tissues and cells, and therefore some morphological information can only be obtained from live or chemically untreated material. This study used chemically untreated sperm (dry mounts) to examine sperm packaging in the seminal vesicles of 5 families (Acroloxidae, Ancylidae, Lymnaeidae, Physidae, and Planorbidae) and 21 species of the *Hygrophila*, with a purpose to determine whether, or not, there are differences in sperm packaging within this group and clarify the functional role of the seminal vesicles. The spermatozoa were examined by LM and SEM. The results show that the spermatozoa in all the families studied are packaged in the same fashion, with cells bundled together and each sperm coiled into a ring. The way the spermatozoon is folded differs throughout its length: the head, neck and anterior midpiece are coiled into a ring, but not folded in any other way; the major part of the midpiece is folded onto itself, twisted in a double helix and then coiled into a ring, and the glycogen region and tail form a separate ring that lies inside the first ring. The total number of coils in the ring does not exceed 8-10. The most prominent differences in sperm packaging were found in Acroloxidae, because their sperm have exceedingly long nuclei. It is likely that the role of the seminal vesicles is not only to store sperm, but also to provide conditions for sperm packaging. This work was supported by RFBR grant 15-04-05278a.

C3 Poster

ID: 399

PHENOTYPIC PLASTICITY IN ADULTS AND LARVAE TRICKING TRADITIONAL TAXONOMY: A CASE STUDY IN CERIANTHARIA (CNIDARIA, ANTHOZOA)

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The taxonomy of the subclass Ceriantharia (tube anemones) has several challenges to be addressed, including the absence of developmental data from several genera. Some species names were assigned for larval forms, which frequently have no consistency or morphological relationship to the adult. Furthermore, the taxonomic backbone patterns of some genera/species have been based on one or few specimens, resulting in dubious/questionable definitions. In this study, we compared morphological and developmental data from five Ceriantharia genera (*Arachnanthus*, *Botruanthus*, *Ceriantheomorphe*, *Ceriantheopsis* and *Pachycerianthus*). Although morphological data were congruent to the traditional definitions of these genera and respective species, developmental data indicated a divergence between larval morphology and adult forms in *Arachnanthus*. In addition, several structures in *Botruanthus*, *Ceriantheomorphe*, *Ceriantheopsis* and *Pachycerianthus* change depending on the age of the adult specimen and/or environmental factors (depth, sediments). These results included not only morphological variation of some structures, but also presence or absence of some structures. However, within species, phylogenetic data (COI, ITS, 16S) did not show variation between different ontogenetic stages or morphologies, indicating considerable phenotypic plasticity. Until now, intraspecific variation has not been a concern for ceriantharian taxonomists. Thus, delineation of species and genera in the subclass is obviously imperfect due to such issues. Based on these results, we argue that integrative studies (molecular and morphological data) are essential for a better understanding of the real taxonomy of Ceriantharia.

C3 Oral

ID: 435

COELOMOCYTES OF *ARENICOLA MARINA* (ANNELIDA, POLYCHAETA): MORPHOLOGY AND FUNCTIONS

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Annelids (or “polychaetes”) compose significant part of marine bottom ecosystems. Annelids are characterized by metameric body structure, presence of coelomic cavity and a well-developed circulatory system. Combination of these features provides high level of adaptive plasticity and enables development of an effective immune (defensive) system. Organization and functioning of immune system remains one of the least studied problems in invertebrate physiology. Free cell elements of the coelomic fluid, coelomocytes, constitute the main component of immune system in annelids. Coelomocytes offer recognition of foreign material and its subsequent elimination or isolation. Moreover these cells release humoral factors which are involved in immune response providing. Only several species of annelids were described from this point of view, therefore there is no possibility to combine an unified classification of annelids coelomocytes. Nevertheless there actually is high variability in morphology, origin and functions of coelomocytes among the representatives of different families.

Arenicola marina, the marine lugworm, is a common annelid species of cold-watered seas tidal zone. We studied morphology of *A. marina* coelomocytes, their ability to perform phagocytosis and encapsulation of different foreign bodies using light, transmission, scanning and confocal microscopy. Coelomocytes of this species represent a heterogeneous population with at least five cell morphotypes. All of them are able to perform phagocytosis in varying degree. Encapsulation seems to be more specific defensive reaction and involves only certain cell types. Our results create the basis for further experiments on this species.

ID: 308

SHAPE DIVERSITY OF LITTORINID SHELL MORPHOLOGY BY GEOMETRIC MORPHOMETRIC AND MICRO CT

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Populations of different *Littorina* species along of the North Atlantic coast have wide variety of different habitats within the intertidal zone, and variable types of shores. Littorinas appear an important and the most frequent component of intertidal communities of the White and Barents Seas in Russian Federation. The shell shape of *Littorina* mollusks has high plasticity level, and that is one of the reasons of differentiation into the morphometrically and genetically distinct ecotypes, as a result of natural selection in a specific site on the shore.

Landmark-based geometric morphometric techniques were applied to analyze the morphological variation of *Littorina* species from ecologically different habitats, geographical locations and parasite invasion. To make visible shape and form changes transformation grids and Micro-CT were used.

We found prominent interpopulation shell shape differences, which correspond to the zonal position on the shore, the degree of the wave action, salinity, parasite invasion and geographical region. Shape analysis show that *L. saxatilis* has the highest level of morphological plasticity among other Littorinid species examined. All these morphological traits appear to have adaptive significance and can evolve independently in different sites by different *Littorina* species.

C3 Oral

The scientific research was performed at the Research park of Saint Petersburg State University Center for Geo-Environmental Research and Modeling (GEOMODEL).

ID: 284

DOES MANTLE CAVITY MORPHOLOGY REFLECT THE MODE OF REPRODUCTION IN TROCHID GASTROPODS?

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Mediterranean trochid snail species of the clade comprised of the genera *Gibbula*, *Steromphala*, and *Phorcus* are common inhabitants of shallow water rocky habitats. Surprisingly little is known about the variability in their reproductive biology. Information is available on only two of the about 25 European species: *St. cineraria* is known as a free-spawner releasing eggs to the water column developing into lecithotrophic swimming larvae, whereas *St. adriatica* produces egg clutches from which juvenile snails hatch. Molecular data show some species genetically homogeneous throughout the Mediterranean (e.g. *Ph. turbinatus*) but others clearly geographically differentiated. These differences in gene flow may be due to different dispersal potential mediated by the presence/absence of swimming larvae. Direct observation of egg release is temporally limited and difficult. However, the ability to produce gelatinous egg clutches requires glands in the female pallial cavity. Therefore, clutch-laying species are expected to show hypertrophied hypobranchial glands or additional glandular tissues. Preliminary histological data and 3D-reconstructions of the pallial cavity architecture of several gibbulid species are presented and used to test the hypotheses derived from population genetic data.

ID: 391

NEVER TWO WITHOUT THREE: A NEW MEMBER OF THE GENUS *ANTARCTONEMERTES* (HOPLONEMERTEA, NEMERTEA) FROM ANTARCTIC WATERS

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Although scarcely documented, Nemertea represents an important component in the Southern Ocean. Few well-known species commonly occur in the shallow Antarctic waters, and among them we found the congeneric *Antarctonemertes valida* (Bürger, 1893) and *A. riesgoae* Taboada *et al.*, 2013, two relatively small brooding hoplonemerteans whose females lay eggs inside cocoons. Here we document the existence of a third Antarctic *Antarctonemertes*, originally described as Tetrastemma unilineatum Joubin, 1910. Phylogenetic analysis using three genetic markers (COI, 16S and 28S) place the new *Antarctonemertes* in a robustly supported clade as sister to the other two congeneric Antarctic species (*A. valida* and *A. riesgoae*). Pairwise COI molecular distances between the three species ranged from 5.2–6.2 % (p-distance), falling within the range of the barcode gap for Nemertea. The new *Antarctonemertes* is similar in shape to its Antarctic congenerics although slightly smaller. Its most prominent morphological character is the dorsal mid-longitudinal band present along the body, retained even after preservation. As in *A. riesgoae*, the new *Antarctonemertes* also has a cephalic V-shaped white band with the apex pointing backwards. We also report here the presence of a cocoon built by females of the new *Antarctonemertes*, a character shared with its congeneric. Although the three species overlap their distribution, *A. riesgoae* and *A. valida* generally appear in sympatry in the West Antarctica shores while the new *Antarctonemertes* is more frequent in the East Antarctica shores and SubAntarctic Islands. However, further studies are still needed in unexplored areas to confirm this.

ID: 299

FEEDING BEHAVIOR AND TENTACLE STRUCTURE IN BRYOZOANS: IMMOVABLE FLOODLIGHTS AND FLICKERING FLAMES

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Tentacles are the main food-gathering organs in bryozoans: they bear cilia that generate currents, and take part in capturing or rejecting particles. Representatives of three classes are dissimilar in their use of tentacles: Gymnolaemata display high variability and speed of behavioral reactions, Stenolaemata have a limited repertoire of fast reactions, and Phylactolaemata perform them 2-10 times slower and at a low frequency. We examined the tentacle ultrastructure of 12 species to find morphological underpinnings of these behavioral capabilities. Properties of the musculature gave controversial results: in phylactolaemates widely spaced striations occur in a small area at the base of the tentacle, otherwise tentacle muscles are smooth. Gymnolaemate species possess either striated or smooth muscles along the whole tentacle, and only striated muscles occur in Stenolaemata. There was, however, a correspondence between speed of reactions and tentacle measurements. In phylactolaemates the area enclosed by ECM was related to the area of the contractile elements as 7-20:1, while in marine groups – only as 2-5:1 ($p = 0.008$, Wilcoxon test). Tentacle and lophophore coeloms were large (~67 µm2 and ~2000-60000 µm2) and confluent in freshawater bryozoans, but in Gymnolaemata and Stenolaemata measured ~10 µm2 and ~200 µm2 respectively. It is known that a single liquid-filled vessel best provides uniform pressure, maintaining a stable shape, while small compartments allow to localize pressure and change it independently. We speculate that Phylactolaemata benefit more from cheap posture while feeding, while in Gymnolaemata and Stenolaemata tentacle are optimized for fast, frequent and variable movements.

ID: 397

FIRST MODERN DATA ON NEURO-MUSCULAR SYSTEM OF THE LOPHOPHORE IN ADULT PHORONIDS

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Organization of the lophophore is an important point in frame of the problem of the lophophorates monophyly. Although the lophophorates monophyly was supported by anatomical and embryological data and by few results of molecular phylogeny, most of molecular data reject the unity of the lophophorates because of specific phylogenetic position of bryozoans. The detailed investigation of the lophophore, which is the morphological peculiarity of the lophophorates, may help to clarify question of the lophophorates monophyly. Neuro-muscular system of the lophophore was investigated in four phoronid species with different types of the lophophore organization: *Phoronis ovalis*, *Phoronis ijimai*, *Phoronis australis*, *Phoronopsis harmeri*. Comparative analysis of new data revealed that the simplest lophophore of tiny *P. ovalis* is innervated by more numerous nerves than complex lophophores of other studied phoronid species. Nervous system of *P. ovalis* lophophore consists of the dorsal ganglion, the tentacular nerve ring, the inner nerve center, and the inner nerve ring, which gives rise to the frontal and laterofrontal tentacular nerves. Serotonin-like immunoreactive flask-like cells are located on inner nerve ring between tentacles at their base. The presence of these cells, peculiarities of innervation of tentacles, and the presence of the inner nerve ring make the nervous system of the lophophore of *P. ovalis* different from the nervous system of the lophophore of other adult phoronids and similar to the nervous system of the lophophore of bryozoans. This similarity allows to regard *P. ovalis* as a connecting link between phoronids and bryozoans. Project is supported by RFBR (17-04-00586).

C3 Poster

ID: 317

NEW PHORONID SPECIES FROM THE SOUTH-CHINA SEA AND THE PROBLEM OF PHORONID TAXONOMY

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Phoronida is a small phylum of marine invertebrates with worldwide distribution. In the present research morphology and microanatomy of new phoronid species – *Phoronis savinkini* sp. nov. – from South China Sea is studied. Phoronids of new species form settlements with a high density on rocky ground at a depth of 2 meters. The epidermal collar at the base of tentacles is absent. The lophophore has spiral shape with one coil. Special reproductive glands in lophophoral cavity are absent. Longitudinal muscle bundles are of bushy type. The maximal number of bundles is 49. Metanephridium has strongly curved excretory canal, small anal and large oral funnels. There are two giant nerves of 2-5 micrometers in diameter. Comparative analysis of morphology has shown that the new phoronid species is the most similar to *Phoronis hippocrepia*. However, there are significant morphological differences between two species: a fundamentally different type of the lophophore, a different organization of the excretory organs and the absence of reproductive glands in crone of tentacles in the new species. Cladistics analysis of phoronid taxonomic diversity shows that ecological division of phoronids into two groups (burrowing and living in soft substratum) has the taxonomic sense. Muscle type and number of branches of nephridial canal can be considered as main differences between two groups. The monophyly of genus Phoronopsis and paraphyly of genus Phoronis are shown. The assumption on secondary simplification of *Phoronis ovalis* has made. An idea about presence of separated clade including *Phoronis pallida* and *Phoronis embryolabi* is supposed.

ID: 188

OVARY ORGANIZATION IN THE MARINE LIMNODRILOIDIN *THALASSODRILIDES* CF. *BRIANI*

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Thalassodrilides cf. *briani* Erséus, 1992 is a marine oligochaete belonging to the subfamily Limnodriloidinae (Naididae). To date, the ovary organization and the process of egg formation has only been described in freshwater Naididae. Due to its high potential to reduce the concentration of pollutants in marine sediment *T.* cf. *briani* is also a suitable candidate for bioremediation and therefore its sexual reproduction should be analyzed.

Mature specimens were prepared according to the standard procedure for ultrastructural and histochemical studies. A 3D reconstruction of the gonad based was also created.

Paired, inconspicuous ovaries are attached to the intersegmental septum. The ovaries are polarized and germ cells in subsequent stages of oogenesis are localized along their long axis. The germ cells are represented by oogonia, meiotic cells in prophase I and cells that are morphologically differentiated into oocytes and nurse cells. Each germ cell is united into a syncytial cyst. Within the cyst, each germ cell is connected to a common cytoplasmic mass, a cytophore, via one stable cytoplasmic bridge. During oogenesis, the oocytes grow and gather cell organelles and nutritive material. Mature oocytes detach form the ovaries and float freely in the coelom.

C3 Poster

The organization of the ovaries in *T.* cf. *briani* is similar to the other tubificin species studied to date. Moreover, the ovaries of *T.* cf. *briani* share common features with the other clitellate annelids that have been studied to date, i.e. the formation of germ-line cysts with a cytophore.

ID: 225

SPATIAL MORPHOLOGICAL VARIATION IN THE DWARF POND SNAIL (GALBA TRUNCATULA): SCALE-DEPENDENCE AND NON-LINEARITY

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The reality of spatial clinal variarion in morphological traits of freshwater pulmonate snails (Gastropoda: Pulmonata) has repeatedly been questioned or totally disclaimed. The lack of sound statistical evidence in the articles hitherto published on this subject supported these claims. Here, by means of different analytical methods (analysis of spatial autocorrelation, trend surface analysis, canonical analysis and geometric morphometry), we demonstrate that shell variation in the dwarf pond snail, *Galba truncatula* (O.F. Müller), is patterned in space throughout northern and central Palearctic, with latitudinally oriented clines in body size and (partially) in shell proportions. Shell size in *G. truncatula* decreases with latitutude and temperature representing a special case of converse Begmann cline. However, the temperature itself is hardly the main driver of shell size variation. It is argued that the shorter growing seasons at high latitudes may represent a better explanation for the observed trend. Shell proportions in the dwarf pond snails weakly vary at the macrogeographic scale being spatially patterned at lower (mesogeographic) scales around 1200–1500 km. The spatial clines in shell shape in the dwarf pond snail are non-linear (U-shaped) clines as it has been revealed by means of the geometric morphometry approach. The northern and southern populations of this species are characterized by similar shell proportions, whereas the 'intermediate' ones are more or less distinct phenotypically.

In general, the spatial variation in *G. truncatula* shell size is decoupled from variation in shell shape demonstrating clear scale-dependence similar to that found in different species of terrestrial (non-aquatic) pulmonate snails.

ID: 439

THE EPIDERMIS MODIFICATIONS OF DIFFERENT *TRAVISIA* SPECIES (ANNELIDA, TRAVISIIDAE)

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6 undescribed species of *Travisia* from Australia were investigated with semithin sections and scanning electron microscopy. The pedunculated epidermal papillae of all of them have similar structure, but differ in size and shape.

C3 Poster

ID: 446

RADULA OF GASTROPODA: FORMATION AND RENEWAL

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The radula is a apomorphic character of Mollusca. It is a cuticle structure consisting of teeth and radular membrane. New teeth of radula are formed in the terminal end of the radula sheath by specialized cells – odontoblasts. Radula membrane is synthesized by membranoblasts. Despite of the numerous studies of general morphology of the radula there are practically no data on fine morphology and mechanism of radula formation. The fine morphology of radula sheath is described for different groups of gastropods,including Patellogastropoda(*Testudinalia testudinalis*), Neogastropoda (*Conus pulicarius*) and Nudibranchia (*Flabellina verrucosa*) by light, electron microscopy and cLSM. All studied species have different patterns of radula formation. The differences between renewal mechanisms of the radula in studied molluscs are resulting in: 1) number of odontoblasts that form one tooth (from one to thousands); 2) size and shape of odontoblasts (big cuboidal, small elongated and square); 3) type of secretion (by microvilli orcytoplasmatic protrusions orapocrine secretions); 4) location of the membranoblasts (directly in front of the odontoblasts orat a distance from the odontoblasts or absent) and mechanism of attachment to the radula membrane; 5) fine morphology of the youngest teeth (it consist of vesicles or homogeny structure); 6) mechanism of maturation.The high morphology diversity of the radula shows that mechanism of the renewal is unique for the studied groups and combinations of morphology features do not repeat in different molluscs.

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C3 Oral

ID: 258

MORPHO-ECOSPACE CONCEPT: A COMPARISON BETWEEN LARVAE AND ADULTS IN MANTIS SHRIMPS

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Ecological indices, such as the Shannon- or Simpson-index aim at measuring biodiversity. They are based on the number of species in a respective area and the abundance of these species, i.e., how individual-rich the different species are. One shortcoming of such indices is that they exclude non-adult ontogenetic stages. Adult individuals of one species are identified as that species. Larvae can often not be identified to their respective adult form and therefore are completely neglected. Yet, these ontogenetic stages can represent large parts of different faunas.

Here we compare morphological structures of mantis shrimps (Stomatopoda), using a morpho-ecospace concept, which incorporates non-adult ontogenetic stages. Stomatopods are marine predators, forming an ingroup of Malacostraca with about 500 known species, inhabiting a broad range of habitats, ranging from coral reefs to habitats in 1500 m depth. Their ontogeny features several free-living larval stages, living in pelagic habitats in contrast to the benthic adults.

The morpho-ecospace concept aims at estimating the ecospace of an organism based on its morphospace. Ecospace describes the ecological features of organisms, which are difficult to quantify, while morphospace characterizes the shape of organisms which can be easily quantified.

Measurements on larvae were performed on specimens from a sample collected at the coast of Congo, near Pointe-Noire (Natural History Museum in Paris) and compared to published data of adults, complemented by material from the Zoological State Collection Munich. Differences and similarities between larvae and adults are outlined and the high morphological diversity of larvae is displayed.

ID: 273

REEXAMINING MORPHOLOGICAL CHARACTERISTICS OF THE SCLERACINIAN CORAL *POCILLOPORA DAMICORNIS* IN THE GULF OF THAILAND

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Most scleractinian coral species show high variation of intraspecific morphological characteristics although their taxonomy is largely based on skeleton morphology. The coral *Pocillopora damicornis* is frequently used in ecological and experimental researches. Most previous studies in the Gulf of Thailand identified *Pocillopora* as *P. damicornis*. However, recent studies at some reef sites in the Indo-Pacific reported that *P. acuta* was frequently observed. The aim of this study was to investigate morphological characteristics of *P. damicornis* in the Gulf of Thailand in details. Fifty *P. damicornis* samples were collected from Ko Khang Khao, the Inner Gulf of Thailand, Hin Phoeng, the Eastern Gulf of Thailand and Ko Samui, the Western Gulf of Thailand. Each coral colony was photographed in the field before part or all of it was sampled. All coral samples were examined their morphological characteristics in the laboratory. Most coral samples had braches fine, elongate, slender to bushy branches (high sub-branching), crowded towards terminal end as describe by Schmidt-Roach et al. (2014). However, some coral samples showed branches slender, round to flattened, almost cylindrical, robust branches with swollen ends. We hypothesize that previously reported *P. damicornis* in the Gulf of Thailand were *P. acuta* and *P. damicornis*. Further studies on molecular taxonomy of *Pocillopora* in the Gulf of Thailand are required for better understanding on the existence of cryptic species of the corals. Findings of this study highlight the importance of accurate identification of coral species before conducting ecological and biological studies.

ID: 232

A NEW LAOPHONTID (COPEPODA, HARPACTICOIDA) FROM THE SEA CUCUMBER, *EUPENTACTA FRAUDATRIX* COLLECTED FROM VOSTOK BAY, EAST SEA (JAPAN SEA)

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A new genus and species of a harpacticoid copepod representing Laophontidae living on the sea cucumber *Eupentacta fraudatrix* was collected at the subtidal zone of the Vostok Bay, Peter the Great Bay of the East Sea (Japan Sea). The distinctive character set of the new copepod includes 1) dorso-ventrally compressed body, 2) highly modified mouth parts, 3) well developed maxilliped, and 4) reduced rami of the swimming legs 1-5 (P1-5). Like in other laophontids the male's antennule segmentation has two segments distal to geniculation, the syncoxa of maxilliped has only 1 seta on the first endopodal segment of P1 without inner seta, the second endopodal segment of P2 without outer spine, the endopod P3 of male without proximal inner seta present in the female endopod, The exopod of P5 has separated insertion sites and cephalothorax, genital somite, and caudal rami have no cup-shaped transformed pores on shown for other laophontids. The new genus is close to the genera *Peltidiphonte* Gheerardyn & Fiers, 2006 and *Microchelonia* Brady, 1918 in having dorso-ventrally compressed body form, and to the genera *Afrolaophonte* Chappuis, 1960 and *Aequinoctiella* Cottarelli, Bruno & Berera, 2008 in having reduced legs. Phylogenetic relation of the new genus with other laophontids based on analysis of molecular and morphological data will be discussed.

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ID: 233

A NEW MIRACIID (COPEPODA, HARPACTICOIDA) FROM BAEKRIPO BEACH IN THE WEST COAST OF KOREA

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A new species belonging to Miraciidae Dana, 1846 was collected from interstitial habitat of Baekripo sandy beach in Chungcheongnam-do on the west (Yellow Sea) coast of Korea. We could not place this Miraciid in any extant genus within the family. To accommodate the species, a new genus of the family Miraciidae is proposed and described here. The new species is closely related to the three primitive genera, *Pseudamphiascopsis* Lang, 1944, *Rhyncholagena* Lang, 1944, *Sarsamphiascus* Huys, 2009 by the elongated P1 enp-1, segmentation of P1-P4, the number of outer spines of P1-P4 exp-3 and ovate shape of the female P5. However, there are discrepancies from the species of the three genera in the absence of a seta of antenna basis, the unsegmented exopod of antenna, the inner seta with actiniform ornamentation and proximally swollen outer terminal seta of female caudal ramus. The new species have sexual dimorphism in male A1, P1 basis, P2 endopod, P3 exopod, P5, P6 and setae of caudal rami.

ID: 167

SEASONAL CHARACTERS OF SPECIFIC STORAGE CELLS IN THE GONADAL TISSUE OF THE PACIFIC OYSTER, *CRASSOSTREA GIGAS*

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Development and maturation of gametes in oysters are tightly associated with two types of somatic cells: accessory cells and cells of vesicular connective tissue (VCT-cells) - specific storage cells. The accessory cells located within acini and provide a structural support to developing gametes, while the VCT-cells are outside the acini and function as nutrient-storing cells. This study presents new data on the fine organization of VCT-cells in gonad tissues at various stages of the reproductive cycle using TEM, histochemical and immunofluorescent techniques. In males and females, VCT-cells lie close to each other and form clusters. The cells are about 20–30 µm in length, irregular in shape, and have single nucleus with one large or several small nucleoli in the peripheral position. Ovoid or slightly elongate mitochondria are located in the perinuclear region or adjacent to cytoplasmic membrane. Cytoplasm of VCT-cells contains an enormous amount of glycogen particles and lipid droplets. It should be noted that VCT-cells within an individual differ in their lipid content. Some cells almost completely lack lipid droplets, but glycogen is obvious. Intracellular distribution of glycogen is irregular and densest near the cytoplasmic membrane. Glycogen particles frequently aggregate on stick-like structures which are regularly distributed over the cytoplasm. The cytoplasmic membrane forms thin processes that have presumably tight contacts. The difference in spatial location, size characters and in lipid content in the VCT-cells at various stages of reproductive cycle is evident.

ID: 486

PARAMETRIC SYSTEMATICS OF SEA SPIDERS (ARTHROPODA: PYCNOGONIDA)

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Sea spiders (Pycnogonida) is a class of marine arthropods with unique combination of characteristics. It is impossible to indicate their place within a hierarchical system of arthropods unambiguously and to reflect the relations of taxons between themselves. The analysis of specifics and scope of diversity of 20 significant characteristics allowed to suggest a variant of parametric system with resolution up to families and genera.

The suggested Pycnogonida system is based on a characteristic extracted by V. M. Shimkevich, i. e. the number of segments of the first three pairs of appendages. Their quantities plotted as coordinates on three axes according to their main evolutionary tendency (segments quantity reduction) compose this class taxonomic space which is filled very nonuniformly. Only 2 of 6 potential sides are occupied. The inner parts of the taxonomic space are almost empty, containing only atypical sea spider genera referred to as *incertae sedis*. The closely relative genera are filling adjacent cells as a rule, but nonuniformly as well. Some cells appeared to be particularly popular, the genera, that are found there, are often from different families. We named them bio-isotope genera. This allows to speculate about the possible ways of occupying of the class taxonomic space by representatives of different families.

The extinct genera in the obtained system are occupying the periphery of implemented forms range at both plesiomorphic and apomorphic sides, this points to nonlinear evolution of this taxon.

C4 EMBRYONIC AND LARVAL DEVELOPMENT OF INVERTEBRATES: COMPARATIVE MORPHOLOGY MEETS NEW TECHNOLOGIES

Organizer Dr. Yulia A. Kraus

ID: 450

MOLECULAR CHARACTERIZATION OF PROTONEPHRIDIA DEVELOPMENT IN PRIAPULIDS AND EVOLUTIONARY IMPLICATIONS

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The two main types of excretory organs are the protonephridia and metanephridia. Due to their morphological and developmental differences, and their scattered phylogenetic distribution, the homology of nephridia is not yet solved. Recent molecular comparative studies showed that a suite of orthologous developmental and structural genes are expressed in similar domains of the protonephridia of platyhelminthes and metanephridia of vertebrates suggesting their putative homology. However, we still have a limited view of the molecular diversity of nephridia due to the poor taxon sampling. In this study, we are using comparative transcriptomics to identify protonephridia-specific genes in two species of priapulids (Scalidophora), sister group to Panarthropoda (who have metanephridia or malpighian tubules) and Nematoida (who lack nephridia). The transcriptome analysis of both priapulid species (*Priapulus caudatus* and *Halicryptus spinulosus*) revealed a number of orthologous genes with a conserved role in nephridiogenesis and nephridial formation as well as novel genes. By analyzing the expression of these genes during the development of *P. caudatus* we found that they are mainly expressed in two groups of laterally localized mesodermal cells lining the introvert boundary, thus suggesting that nephridiogenesis occurs in these mesodermal regions. These data show that the molecular pattering of nephridiogenesis is overall conserved independently of the nephridial architecture (protonephridia vs metanephridia) or phylogenetic distribution. We are currently performing a cross-species comparison including a metanephridia-specific transcriptome of Brachiopoda, to help us understand whether this molecular identity existed in the ancestral nephridium and what this could imply for the evolution of protonephridia and metanephridia.

ID: 203

ONTOGENETIC DEVELOPMENT OF THAI ANOSTRACAN NAUPLIUS, *BRACHINELLA THAILANDENSIS* SANOAMUANG, SAENGPHAN AND MURUGAN, 2002 (CRUSTACEA: BRANCHIOPODA: ANOSTRACA)

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Nauplius of the genus *Brachinella* was firstly described from Thai anostracan, *Brachinella thailandensis* Sanoamuang, Saengphan and Murugan, 2002. The hatched nauplii were subsequently collected every hour for a total of 72 hours and preserved with formaldehyde solution. The development was examined under light compound and scanning electron microscopes. The nauplius larva of *B. thailandensis* can be divided into 8 stages based on total length, accretion of number of thoracic and abdominal segments, development of second antenna and number of setae of cercopods. Concomitant change in certain larval stages occurs as size increase and was briefly described hereafter.

C4 Poster

ID: 416

DYNAMICS OF ARCHENTERON CILIATION DURING GASTRULATION OF ECHINODERMS

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Visceral organs of vertebrates positioned in a specific left-right asymmetric way. The most supported theory about mechanisms of body plan symmetry breakage links establishment of left-right asymmetry with directed extracellular fluid flow, generated by mono-ciliated cells in the so-called left-right organizer (LRO). LRO structures were found in various taxa across of vertebrates, which assume cilia-based mechanism of body symmetry breakage is conservative. One major question remained unanswered: where and when in evolution this mechanism was evolved. For our studies, we chose echinoderms, the basal Deuterostome animals and sister group to Chordata. It was shown that cilia in sea urchin archenteron (LRO homolog) during gastrulation play a crucial role in the spatial positioning of Nodal signaling. We use descriptive approaches to characterize differences in the LRO organization during development of three echinoderms: *Paracentrotus lividus*, *Strongylocentrotus pallidus* and *Asterias rubens*. The most striking differences we found between sea urchins and sea stars. We revealed that they have significantly different dynamics of the cilia formation in the archenteron. At the beginning of gastrulation of the *A.rubens*, the vegetal plate does not lose cilia as it happens in sea urchins but starts to invaginate with outer surface cilia. Surprisingly, the length of these cilia exceeds the diameter of archenteron. And apparently, such lengths of the cilia are not able to generate directional fluid flow. Our ultrastructural data let us suggest the absence of dynein arms in the structure of these cilia, and accordingly their motility. The expression patterns of motile cilia markers have been analyzed.

ID: 377

SPERM STORAGE AND OVARIAN MATURATION IN THE NORWAY LOBSTER (NEPHROPS NORVEGICUS)

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The Norway Lobster (*Nephrops norvegicus*) is commercially the most important crustacean species in Europe. Approximately 60 000 tonnes are landed each year, half of which are caught in UK waters with a market value of £111.1 million. Despite the economic importance of *Nephrops norvegicus*, in-depth anatomical studies of the female reproductive system have not previously been reported. Here, we present a histological analysis of the female sperm storage organ (thelycum). Our data reveal that females mate with multiple males during one reproductive cycle and support an interpretation that the mode of fertilization is external. The female reproductive cycle was studied through macroscopic and microscopic observations on ovary maturation stages, which provides crucial information on the size at onset of sexual maturity and the determination of minimum landing sizes. At several trawling locations in the Irish Sea and North Sea, a high proportion of females were observed to resorb mature ovaries instead of spawning after completing their annual ovary maturation cycle. We investigated females with resorbing ovaries in detail by testing mating success through the incidence of spermatophores in their thelyca. We hypothesize that populations with high proportions of females with resorbing ovaries are more vulnerable to high fishing pressure since the reproductive output is reduced compared to populations with annually spawning females. For sustainable stock managment of *Nephrops norvegicus*, the phenomenon of resorbing ovaries in mature females demands attention when calculating reproductive capacity of affected populations.

ID: 422

SPERMATOGENESIS AND SPERM ULTRASTRUCTURE IN *MOOREONUPHIS STIGMATIS* (ONUPHIDAE, ANNELIDA)

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Here we present the first complete description of spermatogenesis in Onuphidae at ultrastructural level. *Mooreonuphis stigmatis* is a tube dwelling worm inhabiting intertidal mud flats in the north-eastern Pacific. It is a dioecious species with gametes developing in the coelomic cavity of the posterior body region in both sexes. Spermatogenesis and sperm ultrastructure in *M. stigmatis* was studied using transmission electron microscopy techniques. In addition, a series of semithin histological sections was used for 3D reconstruction if seminal receptacles in females. Spermatogonia are formed in association with blood vessels and contain large nuclei with irregularly distributed chromatin, scattered mitochondria and extensive endoplasmic reticulum. Spermatocytes form large clusters of cells connected in the center by cytoplasmic bridges. Gametogenic stages undergo synchronous development and remain associated with a cluster until very advanced state. Elongated spermatids contain nuclei with granular chromatin, spherical mitochondria, and flattened acrosome vesicles located posteriorly in association with a Golgi complex. In the following development, the acrosome becomes conical and migrates towards the anterior part of a spermatid. Mature spermatozoa detach from a cluster and float freely in the coelomic fluid. They are about 10 µm long and have extremely long nuclei, bell-shaped acrosomal complex, four elongated mitochondria in midpiece and relatively short flagellum surrounded by a cytoplasmic annulus. The shape of mature spermatozoa and the presence of sperm storage organs in females suggest the existence of sperm transfer mechanism in *M. stigmatis*. Following Rouse and Jamieson (1987) terminology, the sperm can be classified as ent-aquasperm.

ID: 362

CHARACTERISTICS OF EARLY DEVELOPMENT OF *ECTOPLEURA LARYNX* (HYDROZOA, CNIDARIA)

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Studying Cnidaria as sister group of Bilateria is very important for understanding evolutionary processes. Investigation of embryonic development of cnidarian species is necessary for analysis of morphogenesis and conserved developmental mechanisms. Hydroid polyps as widely distributed and available cnidarians are favourite objects of development research.

In present work, we analysed the stages of medusoid development and the early embryonic development of athecate *Ectopleura larynx*. With the help of light and electron microscopy (TEM) and immunocytochemical staining with CLM, we studied development of medusoids starting from early stages of bud formation up to mature medusoids containing developing embryo.

Ectopleura larynx belongs to Aplanulata group lacking a planula stage. Embryos develop within medusoids (reduced medusa stage) to actinula larva stage. Two-four oocytes differentiate sequentially from i-cells that accumulate in spadix (reduced manubrium). As oocyte grows and maturates, it detaches from spadix and migrates into the medusoid cavity, while another oocyte becomes visible within spadix. We observed numerous apoptotic nuclei in developing embryo, which maybe be the nuclei of adjacent i-cells phagocytised by growing oocyte. We studied stages of medusary nodule (entocodon) formation, from which smooth and striated muscles derive. Entocodon is formed by ectodermal i-cells proliferation at apex of the developing bud. Due to expression of mesodermal genes in medusary nodule, it is considered as homologous to the third germ layer specific for Bilateria. Thus, the study of cnidarian developmental processes is important for understanding establishment of developmental mechanisms in common ancestor of Cnidaria and Bilateria.

ID: 378

EARLY DEVELOPMENT AND GASTRULATION IN THE NEMATODE *PONTONEMA VULGARE*

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Pontonema vulgare is a marine, free-living nematode belonging to the Enoplida. Its development is remarkably different from the well-known nematode *C. elegans* in that it seems to lack a stereotypic development. While the cleavage pattern has been described and preliminar fate-mapping experiments have been conducted, little is known about the cell fates of the blastomeres during gastrulation. In this work we aim to better understand the process of gastrulation and cell fate specification with a main focus on mesoderm. We used a 4D-microscope system to record the development of *P. vulgare* and combined this with actin, tubulin and nuclear stainings to describe embryonic morphology. The study of gene expression in blastomeres using in situ hybridization of bilaterian tissue markers (*twist, snail, Nk2.1, FoxA, Wnt* etc.) can be used to determine the early fate specification of early blastomeres. With these tools, we describe the development of *P. vulgare* from two-cell stage to comma stage and the cell internalizations of the blastomeres during gastrulation. As expected, *P. vulgare* shows a highly variable development, followed by a stepwise specification of the blastomeres of the mesoderm and ectoderm. Single embryo RNA-seq of different developmental stages will elucidate the dynamics of gene expression during development. This will lead us to a better comprehension of mesoderm formation and of nematode evolution.

C4 Oral

ID: 234

ANALYZING THE DYNAMICS OF SEGMENTATION TO UNDERSTAND THE EVOLUTION OF THE ARTHROPOD BODY PLAN

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Our understanding of arthropod body plan development stems from work on *Drosophila melanogaster*. In *Drosophila*, there is a relatively detailed model for the network of gene interactions that proceeds in a hierarchical fashion to define the segmented body. However, most arthropods generate segments through a sequential process wherein a dynamic process in the posterior growth zone is used to delineate new segments. Thus, we have focused on the growth zone of the milkweed bug *Oncopeltus fasciatus* as a model for a relatively conserved and typical process of segment generation. We present morphological measurements of the growing germband throughout segmentation, complemented by cell division profiles and expression patterns of key genes. We present morphological and mechanistic changes in the growth zone and in nascent segments throughout segmentation, and examine the relative contribution of newly formed versus existing tissue to segment formation. While segment addition is primarily generated through cell rearrangement of undifferentiated cells, there is nonetheless proliferation in the posterior. By correlating proliferation with gene expression in the growth zone, we propose a model for the dynamics of the segmenting growth zone in which it is functionally subdivided into two separate regions: a posterior region devoted to slow growth among undifferentiated cells and an anterior region in which segmental differentiation is initiated and proliferation inhibited. The growth zone network is ancient and probably plesiomorphic to arthropods. It has undergone a significant amount of systems drift, wherein many of the genes have changed. However, it maintains a conserved underlying logic and function.

ID: 204

BODY PLAN FORMATION DURING REGENERATION IN SPONGES

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The ability to regenerate is widespread in the animal kingdom, but the regenerative capacities and mechanisms vary widely. Sponges are known to possess remarkable regenerative abilities. As an ancient animal lineage, they are important models in studies of the evolution of animal regeneration mechanisms, including relationships between regeneration and development. We have combined several microscopy techniques to study cellular mechanisms of regeneration in four sponge species from different clades: *Oscarella lobularis* (Homoscleromorpha), *Halisarca dujardini* (Demospongiae), *Sycon ciliatum*, Leucosolenia complicata (Calcarea) to understand diversity of developmental mechanisms found among sponges.

Wound healing followed by complete restoration of lost body parts have been observed in all four species, although the cellular mechanisms varied. Epithelial morphogenesis, mainly spreading (flattening) and fusion of epithelial sheets was found to be the key morphogenetic process during regeneration for *O. lobularis*, *S. ciliatum and L. complicata*; while mesenchymal morphogenesis by mesenchymal-epithelial transformations is the main mechanism active during *H. dujardini* regeneration. In addition, formation of blastema was observed in this species. Transdifferentiation of choanocytes to pinacocytes accompanied the regeneration in all investigated sponges.

C4 Poster

Altogether, we demonstrate that regeneration in sponges involves a variety of processes utilized during regeneration in other animals and points to the particular importance of transdifferentiation in this process. While further studies will be needed to uncover the molecular mechanisms governing regeneration in sponges, Wnt and Tgf-beta pathways appear to play important roles in this process as they do in other metazoans.

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ID: 146

EMBRYONIC AND LARVAL DEVELOPMENT OF THE SOFT-SHELL CLAM *MYA ARENARIA* IN THE WHITE SEA

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The present paper examines the development of the soft-shell clam *Mya arenaria* (Linnaeus, 1758) from fertilization to metamorphosis. Early embryonic and larval development of the mollusk was described with a particular attention to the structure of larval shell and larval hinge.

The studies were performed at the White Sea Biological station of Zoological Institute RAS (66° 20.230′ N; 33° 38.972′ E) in 2000-2014. Larvae were obtained from plankton; early stages of development were studied in laboratory conditions.

Mya spawning occurs in summer-autumn period; the oocyte size is 73-76 µm. Cleavage is full, irregular and asynchronous, with formation of the first polar lobe. Blastula can be classified as sterroblastula type. Gastrulation leads to formation of conchostoma, which is characterized by the presence of arhenteron and shell gland. Trochophora is formed after eversion of the shell gland. In the subsequent development, until metamorphosis, the larva passes through the veliger and pediveliger stages.

The shell on the D-stage has a size of 130 µm. For the most part of the development the shell is rounded with a pointed front edge. Posterior shoulder is shorter, the umbos are clearly expressed. The hinge edge is narrow, with tooth-like projection on each valve, the ligament has posterior position. Metamorphosis occurs when the shell size reaches 310 µm.

ID: 430

SEROTONERGIC APICAL ORGAN FORMATION IN PLUTEAL LARVAE OF ECHINOIDS AND OPHIUROIDS (ECHINODERMATA)

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Echinoderm larvae are a classical problem for evolutionary biology; each of the classes has a typical larval form, but larval forms do not correspond well with phylogenies. Asteroids and holothuroids have dipleurula-like larvae and ophiuroids and echinoids have a pluteus larvae. Although last two are not sister groups in phylogeny of Echinoderm. Characters of larval skeleton formation, the patterns of larval neurogenesis and metamorphosis are reflected in favor of convergent similarity of the ophiuroid and echinoid plutei. Recently larval neurogenesis of many species of Echinoderms were investigated, but the dates for ohiuroid larvae are poor. To compare the features of neural development pattern in plutei of ophiuroid *Ophiura sarsi* and echinoid *Scaphechinus mirabilis* anti-serotonin immunohistochemical labelling and laser confocal microscopy investigation were undertaken. During echinoderm larval development the pioneer serotoninergic neurons appear in the animal plate of late gastrula. On prism stage the serotoninergic neurons stay at animal plate of echinoid pluteus and migrate laterally in ophiuroid pluteus. Two symmetrically located non-compact lateral ganglia without commissures represent the apical organ of developed ophiopluteus. In echinopluteus there is rapid increase the number of neurons and the formation of a compact bilateral symmetric apical ganglion in upper part of the larva. In both cases, neurons are not part of the ciliary band. The plutei of echinoids and ophiuroids, as compared to the larvae of other Ambulacraria, are characterized by a time and topology strict pattern of apical organ formation that could be caused by the skeletal rods developing.

ID: 372

CLEAVAGE PATTERNS, FATE MAPS AND CELL LINEAGES: WHAT CAN EARLY DEVELOPMENTAL SIMILARITIES TELL US ABOUT THE HOMOLOGY OF LARVAL STRUCTURES?

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The conserved pattern of spiral cleavage has fascinated embryologists for over 100 years. The concerted pattern of blastomere divisions in which individual blastomeres can be identified and homologized in animals that look very different as adult like molluscs, annelids, nemerteans and flatworms raises important questions about the connection of early and late developmental processes. Several researchers have been intrigued by this conserved pattern and have used the fate of the early blastomeres to deduce the homology of later, mostly larval structures (e.g. apical organs, ciliary bands) between the diverse clades that show this pattern. This approach implies that there is a direct connection between early and late developmental stages during evolution. It has been shown for many cases, however, that the development is not informative for inferring homology of later structures since homologous organs can form with different pathways and homologous early stages can give rise to convergent adult structures. In the light of recent advances in live imaging technologies and the ability to correlate gene expression with blastomere fates, we will discuss this problem in the context of the fate maps of spiralians and their previous use for inferring homologies of apical organs, ciliary bands and the larval nervous system.

ID: 245

SIMPLE VISION SYSTEM DEVELOPMENT IN *AURELIA AURITA* (CNIDARIA: SCYPHOZOA)

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Cnidaria is one of the most curious taxa in studies dedicated to photoreception morphology and development, due to their phylogenetic position as a sister group to all bilaterians. While the developmental pathways of Cubozoan, Anthozoan and Hydrozoan are intensively investigated, Scyphozoa group remains weakly examined.

Our work is focused on molecular basis of photoreception structures development during strobilation of scyphozoan *Aurelia aurita*. In this process, eyeless polyp gives rise to several juvenile jellyfishes or ephyrae bearing both pigment cup and pigment spot eyes in specific organs at the bell margin called rhopalium.

Transcriptome and genome analyses of *A. aurita* revealed the set of opsins (primary photosensitive proteins) and particular development regulating genes, like *eyesabsent* and Six-family transcription factors homologues. With the help of RNA in situ hybridization we identified spatial pattern of opsin expression, including expression in single cells all over the polyp body. Furthemore we showed the change of developmental genes expression pattern from *eyesebsent* and *Six1* labeling encircle zones of future ephyrae in strobila to small areas of Six6 expression precisely in forming rhopalium.

Our results suggest that basic molecular elements of photosensitivity and photoreception structures development in *A. aurita* generally coincide to those in other known cnidarians, specifically to Cubozoans.

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ID: 441

DEVELOPMENTAL STAGES OF THE WHITE SEA BURROWING ANEELID *OPHELIA LIMACINA*

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Ophelia limacina is a common inhabitant of the upper subtidal zone of the White Sea. This object has several advantages of other species for development experiments, like simplicity of obtaining of embryological material and culturing in the laboratory. Reproduction period of *O. limacina* starts in June. Body cavities of adults are usually crammed with gametes. Female gametes make a specimen yellowish, whereas male gametes effect a pinkish or purple color. Fertilization can be performed in vitro after collecting gametes by piercing the body wall. Oocyte activation takes place within half an hour following fertilization. Germinal vesicle breakdown, cytoplasm reorganization (segregation) and formation of a very thin fertilization envelope occur during this process. As a result, the initially flat, lentil-shaped egg gains a spherical shape. Two polar bodies form within a couple of hours following fertilization and homoquadrant dextral spiral cleavage starts. The main quartet of blastomeres is visible as four large cells at the vegetal pole of the 64-cell embryo (11 haf). Gastrulation of *O. limacina* starts at this stage and lasts until 30 haf until a late gastrula starts swimming via beating of prototroch cilia. The cells movements during gastrulation are discussed. Further larval development can be observed during a month following the fertilization.

ID: 199

THE MALE COPULATORY AND FEMALE REPRODUCTIVE SYSTEM OF *PERCNON GIBBESI* (BRACHYURA: THORACOTREMATA: GRAPSOIDEA)

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The classification of Eubrachyura into the two large groups Heterotremata and Thoracotremata is traditionally based on the position of sexual openings (gonopores). The reproductive systems of thoracotremes are regarded as uniform even though only a few groups have been investigated to date. We address this issue by investigating the male and female copulatory and reproductive systems of a representative of the Grapsoidea, *Percnon gibbesi*, with histological methods and 3D reconstructions based on μ-CT scans. The male copulatory system is situated under the ventrally folded pleon. It is formed by paired first and second gonopods and likewise paired penes. The first gonopod is typically long and the second gonopod is short. Both have two muscle strands within the podomeres. The distal tip of the second gonopod bears an apical girdle, a character also present in heterotremes. The penis emerges from the gonopore, as an extension of the ejaculatory duct. These three components transfer sperm into the female ducts during copulation. The female reproductive system of *Percnon gibbesi* differs from other thoracotremes in the ratio of cuticle to secretory lining in the seminal receptacle, an accessory cuticle structure, and the oviduct not entering the seminal receptacle but running directly into the vagina. Further studies will show whether these new remarkable characters can be used for phylogenetic analyses and if *Percnon gibbesi* reflects a greater diversity in the reproductive systems system of thoracotremes than previously believed.

C4 Poster

ID: 335

ECDYSONE CONTENT IN DEVELOPMENTAL STAGES AND EFFECTS OF ENVIRONMENTAL FLUCTUATIONS ON THE PRODUCTION OF ECDYSONE AND RELATED PATHWAY IN THE MYSID CRUSTACEAN

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1. Objectives

The mysid species are relatively small crustaceans. To understand developmental stage-specific ecdysone role, we analyzed ecdysone contents in the developmental stages of the marine mysid *Neomysis awatschensis*. Also, we measured ecdysone levels upon environmental fluctuations for interpreting the effect of environmental conditions on growth and duration of mysid development.

2. Material and methods

The ecdysone levels were measured at different developmental stages of the marine mysid by employing competitive Enzyme Immunoassay (EIA) 20-Hydroxyecdysone EIA kit. The levels were further analyzed after exposure to changes in several environmental conditions (i.e. temperature, salinity, pH). In addition, we annotated genes involved in the ecdysone-related pathway by employing RNA-seq platform and tested their transcriptional modulations with qPCR upon environmental changes.

3. Results

Ecdysone levels were varied by different developmental stages in the mysid. The levels were modulated by changes in normal environmental conditions. Particularly, modulations of three environmental factors, temperature, salinity, and pH clearly affected normal growth duration and reproduction. These results were partially explained by mRNA expression of ecdysone-related genes.

4. Short discussion and conclusions

Our results may contribute to obtain a better understanding of how environmental fluctuations can modulate ecdysone system and physiological homeostasis in the mysid crustacean.

ID: 438

EMBRYONIC DEVELOPMENT AND LARVA NERVOUS SYSTEM ORGANISATION IN *SARSIA LOVENII* (M. SARS, 1846) (CNIDARIA, HYDROZOA)

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Cnidarians and particularly hydroids display a great variety of modes of embryonic development. Details of this process strongly depend on the general mode of reproduction and details of sexual stage development which not always correlate with group phylogeny.

Oocytes of *Sarsia lovenii* develop in slightly reduced but attached medusoid stage. Mature eggs are released in surrounding water. After fertilisation eggs become sticky, adhere to the substrate and further development takes place within the mucous sheath. The cleavage is complete, equal and polyaxial. Blastula with minute blastocoel develops. Gastrulation proceeds at the 128-cells stage in a form of primary delamination and ends with parenchymula development. Further on ectodermal cell differentiation starts and in 24 hours post fertilisation competent planula escapes from the sheath.

First cells of the nervous system were detected soon after. Few tubulin-positive cells form a belt of sensory cells at the level of endodermal core. A bit later some cells arranged in rosette-like structure around the anterior larva pole start displaying anti-RFamide immunoreactivity. Other cells at the apex of anterior pole also display weak and diffuse anti-RFamide immunoreactivity. RFamide-positive cells also look like the sensory cells. No real ganglionic cells were found.

Embryonic development of *S. loveni* has certain peculiarities: (1) the larva consists of relatively few cells; (2) cell proliferation after cleavage quickly slows down, particularly in endoderm; (3) nervous system consists of few cells and precisely organised; (4) competent planula include only about 10 nematocytes; (5) embryonic development ends within 24 hours under 15°C.

ID: 354

MOLECULAR AND CELLULAR EVENTS IN NAIDID ASEXUAL REPRODUCTION

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Asexual reproduction is widespread and has evolved independently in almost all major animal taxa. Knowledge of the fundamental mechanisms of agametic reproduction is important for understanding genetic programs controlling cell differentiation and body plan formation as well as evolutionary origin of different types of post-embryonic development. Using TEM, cell proliferation assays, immunostaining and molecular cloning, we have carried out a comparative study of the fission formation in two naidid oligochaete species, *Nais communis* and *Pristina longiseta*, focusing in particular on the cellular origin of the fission zone and molecular events of asexual reproduction. During fission zone formation, the epidermal cells of this zone become modified and possess the morphological characteristics of undifferentiated cells, which might migrate and redifferentiate not only into epidermal cells. Expression of the stem cell marker suggests important dynamics in molecular profile of the cells that make the fission zone. Since the establishment of multiple anterior-posterior axes and tissue differentiation take place during paratomy, we have also cloned numerous genes encode homeodomain transcription factors significant for axis formation and tissue patterning. Remarkably, all these developmental regulators change their activity in both blastema cells and some differentiated tissues during the fission zone formation, its growth and differentiation. Our results show that asexual and sexual reproduction share common genetic programs and suggest evolutionary conservation of developmental mechanisms used to produce body plan and tissue differentiation during post-embryonic development, e. g. asexual reproduction and regeneration. This work was supported by the RFBR grant 16-04-00991-a, and RRCMCT SPbSU.

ID: 360

CELL LINEAGE AND FATE MAP OF THE PRIMARY SOMATOBLAST: THE COMPARATIVE ASPECTS OF ANNELID DEVELOPMENT

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The annelids are a numerous and widely distributed phylum of segmented worm, with great diversity in morphology and ecology. Like other spiralians they display a high conserved pattern of early development known as “spiral cleavage” and often form a free-swimming larva, metamorphosis of which into adult worm occurs by elongation, larval body segmentation and posterior growth zone formation (PGZ), which produce additional postlarval segments. Various authors have claimed that both ectoderman and mesodermal teloblasts (embryonic lineages-specific stem cells), descended form the first (2d) and second (4d) somatoblasts, reside in this region and give rise to the postlarval body trunk. According to other scenario the PGZ can arises by dedifferentiation of ectodermal cells in front of and on either side the anus. Interestingly that in many species the PGZ can be formed *de novo* during regeneration or asexual reproduction, i.e., without residual teloblasts, while in some other species it is not to be found in juvenile or adult worm. Thus, the PGZ is unique model for studying both processes of cell differentiation and segment formation and specification. In order to clarify some events of morphogenesis resulting in the PGZ formation we have investigated cleavage pattern in several annelid species from Nereididae, Dinophilidae and Enchytraeidae. Using immunostainig and confocal microscopy technique we described cell lineages, focusing in the first somatoblast (2d blastomere) sublineage, and compared the cleavage pattern and generated fate maps for studied objects. This work was supported by the RFBR grant 16-04-00991-a and the RSF grant 17-14-01089, and RRCMCT SPbSU

C4 Oral

ID: 410

STRUCTURAL DIVERSITY OF GYMNOLAEMATE LARVAE (BRYOZOA): NERVOUS AND MUSCULAR SYSTEMS

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Comparative study of the nervous and muscular systems in non-feeding larvae of four gymnolaemate bryozoan species (*Alcyonidium hirsutum, Tegella armifera*, *Rhamphostomella ovata*, *Celleporella hyalina*) was undertaken using light and electron microscopy and fluorescence labelling by confocal microscopy.

The larval neuroanatomy among Gymnolaemata is rather uniform. Just behind the pyriform organ (PO), all larvae have the neuropil that is connected with the apical organ (AO) by two paraxial neurite bundles and gives rise to the pair of lateral neurite bundles branching into anterior and posterior parts of the coronal nerve ring (CNR). At least two serotonergic neurons were seen in AO, and 2-4 neurons near CNR. Many species-specific differences were detected. They concerned the number and position of neurites going from PO to the neuropil, the number and type of sensory cells, and the arrangement of neurites in the posterior part of the larva.

Significant differences were detected in the larval body wall musculature (simple loose network of individual fibers vs complex elaborated meshwork of closely interwoven longitudinal and circular fibers). What is important, the larvae of all four studied species have a transversal muscle bundle which is clearly homologous to the shell adductor of feeding larva (cyphonautes). No similarity for some specific muscles was determined, although their homology could be suggested by their position.

Our data allow reconstruction of the ancestral state of the nervous and muscular systems for gymnolaemate larvae and support the idea that non-feeding larvae originated many times throughout bryozoan evolution.

ID: 398

ELECTRON MICROSCOPY APPLICATIONS TOWARDS THE UNDERSTANDING OF CELL TYPE EVOLUTION

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Molecular and structural characterisation of various cell types across different animal groups provides deep insights on how complexity arose in different evolutionary lineages of the animal kingdom. In order to get insights into the ultrastructural characteristics of cell types of interest we apply modern electron microscopic approaches.

For automated high resolution imaging of very large volumes in 3D we use serial section based STEM-in-SEM. It can easily applied on high-pressure frozen and freeze substituted samples yielding highest structural preservation. The generated data allow us to screen whole larvae for structures of interest, to reconstruct organs in 3D and to analyse neural circuits across whole larval organisms.

In order to identify cells at the ultrastructural level that exhibit specific molecular markers we further employ array tomography as one variant of correlative light and electron microscopy (CLEM). We are using both, chemically fixed LR White embedded as well as HPF fixed Lowicryl embedded samples.

Integration of the data generated so far with molecular studies yields intriguing insights in development and evolution of animal eyes and neuroglia. With help of the mentioned techniques we identified and reconstructed in 3D replicates of head eyes in mid-body and even hind-body regions of a basal mollusc. In addition, for the first time, we were able to identify in protostome invertebrates radial glia cells, which play a very important role in vertebrate nervous system function and development.

C4 Poster

ID: 269

FIRST INSIGHTS INTO THE REPRODUCTION OF DEEP-SEA SPONGES OF THE NORTH ATLANTIC

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The sponge grounds dominated by the genera *Geodia* and *Phakellia* along the Northeastern Atlantic and *Vazella pourtalesi* in the Northwestern Atlantic, are essential ecosystems since they provide a three-dimensional habitat to thousands of species, and they are key components of biogeochemical cycles. However, little is known about their basic biological features, such as their life cycle and their dispersal capabilities. In our study, we surveyed 6 species, *Geodia barretti*, *G. atlantica*, *G. macandrewii* and *G. hentscheli* (Tetractinellida), *Phakellia ventilabrum* (Axinellida) and *Vazella pourtalesi* (Lyssacinosida) collected from the Norwegian (Korsfjord), Swedish (Kosterfjord), Arctic (Schultz Massive Seamount) and Canadian (Flemish Cap) sponge grounds. Samples were preserved for light and transmission electronic microscopy to assess their reproductive cycle.

Low numbers of previtellogenic oocytes were observed in *G. hentscheli*, *Phakellia ventilabrum* and *Vazella pourtalesi*, indicating a k-strategy. Similar vitellogenic oocytes were observed in *G. atlantica* and *G. macandrewii*. Spermatic cysts containing spermatocytes were detected in *V. pourtalesi* samples. No embryos were detected in the samples, underlining the oviparity characteristic of Tetractinellida and Axinellida, but not Lyssacinosida. The lack of male reproductive elements in *Geodia* spp. and *Phakellia ventilabrum* may indicate gonochorism. On the contrary, *V. pourtalesi* was found hermaphroditic, like all hexactinellids studied so far. A remarkable observation was the engulfment of bacteria by oocytes in both *G. atlantica* and *G. macandrewii* suggesting vertical transmission of microsymbiont communities. Although these sponges share the same habitat, they seem to have developed different reproductive strategies that may represent differential survival rates for the species.

C4 Poster

ID: 268

REPRODUCTIVE FEATURES OF ANTARCTIC DEMOSPONGES FROM THE ORDERS DENDROCERATIDA, POECILOSCLERIDA AND HAPLOSCLERIDA (PORIFERA)

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Sponges comprise a dominant element of the Antarctic benthic communities, posing both high species richness (more than 300) and large population densities. Despite that, reproduction events in Antarctic sponges have been rarely reported. In our study, we surveyed the tissue of 6 species of the orders Dendroceratida (*Dendrilla antarctica*), Poecilosclerida (*Phorbas areolatus*, *Kirkpatrickia variolosa*, and *Isodyctia kerguelenensis*) and Haplosclerida (*Hemigellius pilosus* and *Haliclona penicillata*) for reproductive elements. Samples were collected by SCUBA diving on rocky outcrops at 15 m depth in Deception Island (62°59'31.20" S, 60°33'5.07" W, South Shetland Islands, Antarctica) during 2011 and 2013, and they were preserved and processed for light and transmission electron microscopy.

All species were found to contain only female reproductive elements and brooded their embryos within their mesohyl. In general, their reproductive features were similar to those in their counterparts of other latitudes [6], although several features were observed for the first time in some species, such as bifurcate follicle cells in *P. areolatus*, embryonic gigantism in *I. kerguelenensis* and spongin fibers within the embryos of *D. antarctica*. Our study contributes to the scarce knowledge of reproduction in benthic Antarctic invertebrates and provides the grounds for the study of their specific adaptations to the environment to understand their ecological and biological resilience.

ID: 333

EVOLUTIONARY CHANGES OF COMPLEX LIFE CYCLES DRAMATICALLY AFFECT EMBRYONIC AND LARVAL DEVELOPMENT OF CNIDARIANS

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The majority of metazoans possess complex life cycles (CLCs). However, many fundamental questions concerning the evolution of CLC remain unanswered. First of all, if later developmental stages depend on earlier ones, how can an intermediate stage of CLC be lost without deleterious effects? To address this question, we established a model system, which include cnidarian species exhibiting similar evolutionary modifications of CLCs: *Aglantha digitale*, *Solmundella bitentaculata*, *Liriope tetraphylla* (Hydrozoa) and *Pelagia noctiluca* (Scyphozoa).

Many cnidarians have CLC consisting of a juvenile stage (polyp), an adult stage (medusa) and a planula larva. CLC of our model species underwent evolutionary changes: they lost the polyp stage and acquired the holopelagic LC. Since medusa is normally produced from polyp tissues, the loss of the polyp imposes severe developmental constraints. Using histology, immunocytochemistry, CLSM, SEM and TEM we described normal development of our model species. We investigated very peculiar traits of their development, which can be considered as side effects of LC evolution. Comparative analysis of holopelagic medusae versus ‘typical’ ones reveals many dramatic shifts in the timing of the developmental events (heterochronic changes): some features of the medusa stage such as the bell or tentacles appear very early during embryonic/larval development. We characterized morphogenetic basis of these unusual developmental processes, which help holopelagic medusae to overcome the constraints imposed by the loss of the polyp. We consider holopelagic medusae as an exciting novel system, which will help us to clarify the general rules of CLC evolution.

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ID: 419

EMBRYONIC DEVELOPMENT OF A MARINE HYDROID USING VERY UNUSUAL MORPHOGENETIC TOOLKIT

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Comparative study of the basal Metazoa ontogeny helps to shed light on the general patterns and rules of morphogenesis mechanisms evolution. Among all cnidarians studied in the respect of embryonic development, the hydroid *Dynamena pumila* (Linnaeus, 1758) is exceptionally unusual. We described morphogenetic mechanisms of Dynamena early development using LM, CLSM and TEM. The expression pattern of the well known oral pole marker Wnt3 has been characterized at successive developmental stages.

In the course of cleavage, Dynamena embryo becomes a morula, the loose aggregate of cell. In such morulae, gastrulation usually proceeds through the secondary delamination. In *Dynamena*, the gastrula stage is characterized by extremely irregular shape and very high level of morphological and morphogenetic variability. Secondary delamination in this species is based on the epithelization of the outer cells, which begins simultaneously in several regions of the embryonic surface leading to the formation of multiple blastopore-like "holes". The "healing" of these holes provides the formation of a continuous epithelial sheet, and the hole that heals in last turn corresponds to the posterior pole of the planula-larva. Embryonic cells of *Dynamena* demonstrate very high migration activity. During in vitro rearing of embryos, their cells spread on the substrate until monolayer formation, but this does not prevent embryos from forming the normal body plan. We suppose that such a high level of cell migration activity provides massive cell rearrangements, which help *Dynamena* embryo to achieve a regular shape at the late gastrula stage.

ID: 153

REGENERATION OF ANTERIOR END MUSCULATURE IN PLANARIAN MONITORED BY PHALLOIDINE FLUORESCENCE AND LASER SCANNING MICROSCOPY

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Planarians have a remarkable ability to regenerate any part of its body including nervous and muscle systems. These animals possess of a well-developed musculature which in the absence of true skeletal system playing a supportive function and taking part in locomotion.

Restoration of musculature in dissected planarian *Girardia tigrina* has been examined. Observations were carried out on whole-mount preparations by a confocal laser scanning microscopy combined with phalloidin staining for actins. Development of anterior body wall musculature was studied within 7 days of regeneration.

On day 1 the wound area was covered by epithelium and regenerating blastema has formed showing no staining for phalloidin. The border between blastema and old tissue was distinguished by presence of phalloidin-stained muscles in body stump. On day 2 very thin muscle fibres appeared in the proximal part of blastema. On day 3 phalloidin staining was observed in delicate irregularly orientated muscle filaments. Days 4-5 were characterized by increase of regenerating blastema size where phalloidin was observed in thin circular and longitudinal muscles. New muscle fibers were arising between already existing ones. Staining in muscle filaments became stronger. By day 7 staining in circular, diagonal and longitudinal muscle fibres was as strong as in non regenerating part but fibres were still thinner that intact ones.

Muscle cells arisen de novo from undifferentiated stem cells and developed in proximo-distal order. The number of fibers has gradually increased during observation when the new muscle fibers continued to grow and maturate. (Supported by RFBR grant 15-04-05948a and 17-54-18036)

ID: 144

HISTOLOGICAL INVESTIGATION OF THE MALE COPULATORY APPARATUS OF *HAMINOEA NAVICULA* (GASTROPODA, CEPHALASPIDEA)

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Due to its relevance, several studies have been dedicated to the reproductive system of gastropods. In cephalaspideans, the anatomy of the male copulatory apparatus is usually reported in taxonomic descriptions, but few detailed histological studies were performed on this apparatus. To extend the current knowledge, the male copulatory apparatus was extracted from four specimens of *Haminoea navicula* (da Costa, 1778) collected in Portugal, and processed for light and electron microscopy. Histological stains and histochemical techniques for protein and polysaccharide detection were applied to sections of paraffin embedded tissues and to semithin sections of Epon embedded tissues. The male copulatory apparatus of *H. navicula* consists of a muscular penial sheet containing the penis, seminal duct and prostate. The seminal duct linking the penial sheet to the prostate, presented a strong muscular wall. Vacuolated cells with an acidic content were abundant below the ciliated epithelium of this duct. The prostate is divided in two lobes separated by a thin muscular septum with a central opening. Both lobes were formed by numerous tubules. Four types of secretory cells were indentified in the tubules of the proximal lobe, but the tubules of the distal lobe contained just a single type of secretory cells. This study revealed the complexity of the prostate in this species. The functional morphology and histology of the male copulatory apparatus of *H. navicula* differs substantially from the one of *Bulla striata*, a species that belongs to another family of cephalaspideans, highlighting the diversity among the male copulatory apparatus of cephalaspideans.

ID: 388

CAN THE LARVAL APICAL ORGAN STILL BE PRESENT IN AN ADULT ORGANISM? THE CASE OF NEMERTEANS

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The apical organ is the most prominent feature in ciliated larvae of many marine invertebrates. During metamorphosis, the apical organ of the bilaterian larvae is reduced. However, adult hoplonomerteans have frontal organ situated in the place of the apical organ. The aim of the current work was to determine whether the frontal organ of the hoplonemertea *Quasitetrastemma stimpsoni* was a modified apical organ or both organs are independent.

The larvae and adults of *Q. stimpsoni* were examined using transmission electron microscopy and confocal laser scanning microscopy with anti-serotonin and anti-tubulin antibodies.

In the early morphogenesis stages (12-24 hours after fertilization) the apical organ is represented by a small pit with a long broad apical tuft. The apical plate consists of columnar densely packed multiciliary cells. In the 36-hours-old larvae glandular cells appear around the apical plate. In the 50-hours-old larvae the anterior region is occupied by the glandular cells which mark the future cephalic glands. Frontal organ of juvenile worms consists of an epithelial plate, with the cephalic glands duct opening around them. The ciliary tuft is short. The frontal organ of adults shows a small pit; the epithelial plate of the frontal organ consists of columnar multiciliary cells, with the cephalic glands ducts passing between them. The serotonergic neurons form a network underlying the frontal organ epithelium.

Our current research has revealed that larval apical organ is transformed into the frontal organ of the adult hoplonemerteans.

ID: 426

THE DEVELOPMENTAL MODES IN TENTACULAR APPARATUS OF SIPUNCULANS WITH SPECIAL REFERENCE TO THE *PHASCOLOSOMA* GENUS

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The morphology of the tentacular apparatus differs considerably among the taxa Sipuncula. Three main developmental modes may be designated within sipunculans. In Golfingiidae, the tentacular apparatus is composed of two crowns: the nuchal arc enclosing the nuchal organ and a crown of numerous oral tentacles arranged in U-shaped festoons. In Themistiidae, the only one oral crown, but their branched stems may be homologized structurally and functionally to the oral festoons in Golfingiidae. In both groups, the distinct sympodial pattern in the arrangement of tentacles in the tentacular apparatus is well evidenced by the outlines of the ciliary oral grooves. In Phascolosomatidae, the tentacular apparatus is composed of only nuchal crown: the nuchal arc enclosing the nuchal organ. To reveal the developmental details of tentacular apparatus the juveniles of *Phascolosoma* were reared from fertilized eggs to settled juveniles with three pairs of tentacles in lab with control samples from wild. In early juveniles, two dorsal protrusions develop into the first, or primary, pair of tentacles of the nuchal arc. The second pair of tentacles of the nuchal arc develops dorsolaterally on the bases of the primary tentacles. Two ventrolateral lobes of the oral disk grow and become circumoral ciliary field. In opposite to Golfingiidae and Themistiidae sympodial pattern all next pair of tentacles develop in the dorsolateral growth zones lateral to the borders of the nuchal arc.

ID: 179

EVOLUTION OF LARVAL DEVELOPMENT IN RIBBON WORMS (PHYLUM NEMERTEA)

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Nemerteans, a phylum of marine predatory worms characterized by an eversible proboscis, belong to one of the most diverse, and arguably least studied major clades of bilaterians - the Spiralia (Lophotrochozoa). One of the most remarkable aspects of nemertean biology is the long-lived planktotrophic larva, the pilidium, which evolved in one clade of nemerteans, the Pilidiophora, from a more direct development found in the basal members of the phylum. The pilidium larva spends many weeks in the plankton feeding on microscopic algal cells using a unique system of ciliary bands spanning its lobes and lappets. Uniquely, the juvenile nemertean gradually develops inside the pilidium from a series of isolated rudiments, which grow and fuse around the larval gut. Once complete, the juvenile suddenly emerges from and devours the larval body in rapid and catastrophic metamorphosis. While metamorphic life histories are common among benthic marine invertebrates, in most groups indirect development is considered ancestral, and its origin is obscured by time and lack of suitable intraphyletic comparisons. Nemerteans are an especially suitable group for studies of the evolution of development and novel larval body plans, because in their case maximally-indirect development via the pilidium larva clearly evolved within the phylum. Furthermore, as in many other groups of marine invertebrates, planktotrophic pilidium appears to have been lost within the Pilidiophora multiple times giving way to novel lecithotrophic larval forms. I will talk about insights into the evolution of nemertean larval development gained from comparative studies of larval morphology, developmental gene expression, and embryonic cell lineage.

ID: 334

HOW DOES STAUROZOAN EMBRYO WITH A LOW NUMBER OF CELLS OVERCOME THE DEVELOPMENTAL CONSTRAINTS?

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The class Staurozoa comprises enigmatic and understudied cnidarian species. While the anatomy of adult staurozoans has been recently characterized (Miranda et al., 2016), their embryonic and larval development has never been studied using the modern research techniques. It is known that staurozoan embryos and larvae are very small and have a very low number of cells (Wietrzykowski, 1912), that may indicate severe developmental constraints imposed on morphogenetic processes.

Our model species is the White Sea staurozoan *Lucernaria quadricornis* (O. F. Müller, 1776). To characterize *Lucernaria* embryonic development, we used light microscopy, histology, immunocytochemistry, CLSM and TEM. We created a time-table of *Lucernaria* embryogenesis and described morphogenetic processes during gastrulation and elongation of the primary body axis. We have shown that different kinds of cell rearrangement rather than cell-shape-change driven epithelial sheet morphogenesis play major roles in the primary germ layers formation and in the shaping of a *Lucernaria* embryo. Comparative analysis based on our new data demonstrates that phylogenetically unrelated animals, namely nematodes, cnidarians and ascidians, characterized by a low number of cells developed convergently similar morphogenetic trajectories to overcome the developmental constraints.

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C4 Poster

ID: 215

FIRST INSIGHTS IN THE FORMATION OF ECTOTELOBLASTS OF THE WOODLOUSE *PORCELLIO SCABER*

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As representative of malacostracan crustaceans, the woodlouse *Porcellio scaber* (LATREILLE, 1804) exhibits a unique way of germ band extension and segment formation. Ectodermal cells that will eventually form the posterior head and entire trunk are organized into a series of stereotypic rows and columns of cells. The material needed for this ectodermal grid is provided by ectoteloblasts arranged in a transverse row anterior to the center of gastrulation (blastopore). In a stem-cell like mode, the ectoteloblasts divide twelve-times asymmetrically and generate transverse cell rows in an anterior direction. Except for a few data in other malacostracans, it is still largely unclear how ectoteloblasts differentiate and if there is any cell division pattern involved.

To approach these questions, *Porcellio* embryos were labeled *in vivo* with fluorescent dyes and development were followed using different microscopic techniques. Data were analyzed by using the open-source tool Fiji plugin MaMuT for tracing cells from the early germ disc stage until germ band extension.

Our results show a stereotyped cellular behavior of the cells that surround the blastopore. We observe two semicircular cell arrangements. Out of one cell half-ring the ectoteloblasts differentiate and produce offspring in an anterior direction. The second cell half-ring produces offspring only in a posterior direction. These cells participate in closing the blastopore. During these processes, we also observe two cells leaving the cell arrangement of primordial ectoteloblasts that migrate anteriorly, away from the proliferation zone.

This contribution is part of a PhD project, founded by the Einstein Foundation Berlin.

C4 Oral

ID: 277

CUTICLE MORPHOGENESIS DURING INTRAMARSUPIAL DEVELOPMENT IN *PORCELLIO SCABER* (CRUSTACEA: ISOPODA) AS REVEALED BY MICROSCOPY

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Crustacean cuticle, an apical chitinous matrix of ectodermal epithelia, takes an integrative part in performing diverse biological functions of cuticle-lined organs, such as integument and gut. Studying the cuticle morphogenesis provides an insight into structural-functional modifications of cuticles in different organs in relation to whole organism development.

We present the exoskeletal and hindgut cuticle ultrastructure in the selected embryonic and early postembryonic stages (marsupial mancae) of terrestrial isopod *Porcellio scaber* Latreille, 1804, which develop in marsupium, a controlled fluid-filled female brood pouch.

We show that the early apical matrices in mid- and late-stage embryos are similar in the epidermis and hindgut, precuticular matrices consisting of electron lucent material overlaid by a dense ruffled lamina and the first cuticle displaying characteristic cuticular layers. Structural differences between the exoskeletal and hindgut cuticle are more apparent in marsupial mancae, implying the adjustment to their specific functions. In marsupial manca the exoskeletal cuticle consists of multilayered epicuticle and lamellar exo- and endocuticle and is already calcified. Hindgut cuticle displays an electron dense epicuticle and a non-lamellar procuticle. Late marsupial manca is in premolt phase, forming a new cuticle in the epidermis and hindgut.

C4 Poster

Evidently, the cuticle differentiation stages are approximately synchronous with the major development-related events, such as the onset of embryo locomotion, hatching and release from marsupium. This implies that the cuticle modifications during development are important for the integument and gut functional changes in relation to feeding and changing environmental condition during transition from the egg and marsupium to external terrestrial environment.

ID: 359

ONTOGENESIS OF CALCAREUS SPONGE *SYCON SP.* (PORIFERA, CALCAREA) FROM AQUACULTURE

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Early stages of development of calcareous sponges prior to formation of syconoid organization of aquiferous system have been studied last century on several species of genus *Sycon*. Maintaining of *Sycon* sp. aquarium culture by Zoological institute (RAS) allows to study its further ontogenesis.

According to our observations *Sycon* sp. had more than one rearrangement of aquiferous system from asconoid to syconoid during ontogenesis. Also it appeared capable to build new asconoid structure in basal part of the sponge body during ontogenesis. Under unfavorable conditions *Sycon* sp. could stop growing and stay in the same size for more than a half of year or could creating asconoid parts only. After reproduction *Sycon* sp. could destroy a peripheral part of its body with considerable decrease of the length of radial chambers, with the skeleton composition and the set of spicules changing accordingly. *Sycon* sp. formed spicules during the entire ontogenesis and every rearrangement of aquiferous system is associated with reorganization skeleton structure. Environmental conditions (change of nutrients profile, chemical composition of seawater) appeared to trigger aquiferous system rearrangement. However precise evaluation of particular chemicals and their combinations effects should still be done.

ID: 140

RESTRUCTURING THE TRADITIONAL SUBORDERS IN THE ORDER SCLERACTINIA BASED ON EMBRYOGENETIC MORPHOLOGICAL CHARACTERISTICS

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The order Scleractinia includes two distinct groups, which are termed "complex" and "robust" as indicated by the molecular phylogeny of mitochondrial 16S ribosomal gene sequences. Since this discovery, coral taxonomists have been seeking morphological characters for grouping this deep division in the order Scleractinia. Recently, morphological characteristics during embryogenesis that facilitate grouping the two clades as "complex" and "robust" were reported, thus clarifying a deep division in the Scleractinia. In the recent paper, I established two new suborders, Refertina and Vacatina, on the basis of the embryogenetic morphological characteristics, molecular data, and new observations of *Tubastraea coccinea* and *Cyphastrea serailia* embryogenesis. The new suborder Refertina consists of the families that belong to the "complex" clade and have no or little blastocoel. The new suborder Vacatina is composed of the families that fall into the "robust" clade and have an apparent blastocoel.

ID: 440

DEVELOPMENT OF *AGLANTHA DIGITALE*, JELLYFISH WITHOUT A POLYP

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Trachylina, the sister group of all other Hydrozoa, is important for understanding the hydrozoan origin and evolution but is poorly investigated. The characteristic feature of Trachylina is a minute polyp, which is totally absent in Trachymedusae and Narcomedusae. When the polyp stage is lost, the medusa is formed directly from the planula-larva. As medusae develop normally from the polyp tissues, it is interesting to compare this unusual developmental pathway with the formation of medusa buds in the ‘typical’ hydrozoans.

Aglantha digitale (Trachylina, Trachymedusae) is a common White Sea species. Its minute planktonic larva consists of about 100 cells. Multiciliary ectodermal cells cover highly vacuolated cells of the endoderm, which are arranged linearly. The planula-larva transforms to actinula-like larva by forming the gastric cavity, tentacles and manubrium. At this stage we can distinguish a ring-like ectodermal growth zone that is composed of i-cells and surrounds the aboral-most area. The growth zone corresponds to the rim of the forming bell, and the aboral epithelium corresponds to the future exumbrella. The bell surface area increases due to divisions of cells of the growth zone and by the flattening of the aboral cells. Subumbrellar cavity is formed as a circular fold in between the tentacles and manubrium. This fold moves inward squeezing the gastric cavity that results in the formation of eight radial canals. The most part of medusa bell tissues originates from the activity of the growth zone, which moves orally in the course of development.

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C4 Poster

ID: 156

EVOLUTIONARY TRANSITION FROM INCIPIENT TO SUBSTANTIAL PLACENTOTROPHY IN A GENUS OF CHEILOSTOME BRYOZOA

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Acquisition of extraembryonic nutrition (matrotrophy) was shown to strongly influence an energy allocation during sexual reproduction in a number of animal groups. Instead of investing resources to oogenesis and production of large yolky eggs, the energy flow was redirected to incubated embryos. Moreover, a number of vertebrate groups (e.g. some bony fishes, squamate reptiles) show a continuum from the strict lecithotrophy to advanced matrotrophy including a series of intermediate variants combining different degrees of both provisioning modes. Such a continuum could be considered as illustration of the evolutionary transition from an incipient to substantial matrotrophy.

Here we describe a similar example from an invertebrate phylum Bryozoa in which various modes of extraembryonic nutrition evolved multiple times. In particular, we focused our research on the bugulid cheilostomes. Seven species traditionally united in the genus *Bugula* were studied using histological and TEM methods. The studied species showed the large variation in embryonic increase in volume (from 2.2 to about 310-fold) during incubation that was inversely proportional to their oocytic size and mode ranging from small oligolecithal to the small and large macrolecithal. Placental cells grow proportionally larger in case of the bigger embryonic increase. At the moment, it is the best documented example illustrating the evolutionary transition towards substantial placentation in invertebrates.

C4 Oral

ID: 281

DEVELOPMENT OF *SCUTOPUS SCHANDERI* (MOLLUSCA, CAUDOFOVEATA)

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The Mollusca consist of two subphyla, the sclerite-bearing Aculifera and the single-shelled Conchifera. Within Aculifera some data are available on the development of Polyplacophora and one of the worm-shaped, shell-less aplacophoran groups, the Solenogastres (Neomeniomorpha), but the second aplacophoran taxon, the Caudofoveata (Chaetodermomorpha), remains poorly studied. This impedes a well-founded reconstruction of the last common ancestor of Aculifera and subsequently of Mollusca, making it difficult to trace origin and character evolution of this morphologically diverse phylum. Therefore, we investigated the development of a caudofoveate, *Scutopus schanderi* using light, electron, and confocal laser scanning microscopy. *S. schanderi* is a free-spawning species with separate sexes and develops via a free-swimming trochophore-type larva. During development from hatching to metamorphosis the larva changes its shape from more roundish to oval to elongate and its behavior from negatively to positively geotactic. No sclerites were formed during the observation period, i. e., until ten days after metamorphosis. The larval nervous system consists of a simple apical organ with few flask-shaped cells and a single pair of longitudinal nerve cords. Even in metamorphosized juveniles, a mollusk-typical tetraneurous nervous system, i. e., a second pair of nerve cords, was not found. Development of *S. schanderi* closely resembles that of the caudofoveate *Chaetoderma*. However, in the earlier development of sclerites, *Chaetoderma* differs markedly from *S. schanderi*. Neurogenesis bears strong resemblances to Solenogastres, e. g., in the early development of the first pair of nerve cords, despite the different larval type, the pericalymma larva, of the latter.

ID: 291

THREE FORMS OF STROBILATION IN SCYPHOZOAN POLYPS: KEY STAGES AND MORPHOGENESIS

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Strobilation is a process by which scyphozoan polyps produce ephyrae that develop into medusae. We aimed to study the ephyra formation in three cultures of *Aurelia* and three cultures of *Cassiopea* polyps with different geographic origin. To characterize gross-morphology, cell and tissue dynamics in the course of strobilation, we used methods of histology, SEM and CLSM.

We found that our polyps demonstrate three forms of strobilation (SF). Two *Aurelia* cultures (North Sea; Pacific Ocean) possess very typical polydisk strobilation, by which up to 16 stare-shaped ephyrae with 8 long lappets are formed. *Aurelia* polyps from White Sea demonstrate oligodisk strobilation resulting in the formation of 1-5 bell-shaped ephyrae with 8 short lappets and significantly better developed mesoglea and gastric system. All cultures of *Cassiopea* polyps exhibit monodisk strobilation and form roundish ephyra with multiple small lappets, well-developed manubrium, mesoglea and gastric system.

We subdivided the ephyra formation into the following developmental events: demarcation of the ephyra anlage; enlargement of the ephyra disk; differentiation of the disk margin, development of mesoglea, gastric system and manubrium; ephyra detachment. We created a time-table of ephyra formation for all polyp cultures. We found that the SFs differ in the particular pattern of ephyra formation. We revealed that the set of developmental events as well as their morphogenetic mechanisms are independent of SF. However, the relative timing of these events strongly depends on the SF. Thus, evolutionary transformations of SFs can occur on the basis of heterochronic changes.

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C4 Poster

ID: 187

COMPARISON OF THE OVARY MICROMORPHOLOGY IN CLITELLATE ANNELIDS

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The organization of the female gonad in clitellate annelids has been intensively studied in several groups of oligochaetes and true leeches.

The specimens were fixed and analyzed according to light and electron microscopy methods. Histo- and cytochemical methods were also used.

In all of the clitellate annelids studied to date, the ovaries are composed of germ cells that are accompanied by somatic cells. In true leeches and acanthobdellids, the ovaries are enclosed within the ovary sac, while in oligochaetes and branchiobdellids no such a direct envelope is present - the ovaries are connected to the intersegmental septum by a ligament, while the entire gonad is located freely in the body cavity. The ovary morphology shows significant variety between groups and several different types of ovary organization have been distinguished. Despite these differences, all of the germ cells are united into syncytial cysts which architecture has the same pattern - a common cytoplasmic mass (cytophore) in the center and the gem cells connected to it via one stable cytoplasmic bridge. The germ cells within a cyst differentiate into two morphologically distinct categories - oocytes and nurse cells (meroistic oogenesis). The only exception is *Capilloventer australis* Erséus 1993 in which cysts are not formed at all and each germ cell has the potential to develop into an oocyte (panoistic oogenesis). Preliminary ways of ovary evolution in Clitellata are suggested based on the obtained results.

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ID: 176

THE SPERM STORAGE ORGANS OF *PARADORIPPE GRANULATA* (CRUSTACEA; DECAPODA; BRACHYURA; DORIPPIDAE) AN EUBRACHYURAN CRAB WITH EXTERNAL FERTILISATION

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Two fundamentally different types of sperm storage organs occur within crabs (Brachyura). The early diverging lineages (formerly “Podotremata”) possess sternal spermathecae which are separated from the coxal gonopores, and therefore, fertilisation is external. Seminal receptacles of Eubrachyura, on the other hand, have a direct connection with ovaries and fertilisation is internal. This pattern has been interpreted as an apomorphy of Eubrachyura.

The dorippid *Paradorippe granulata* shows a very peculiar female reproductive system, which is fundamentally different from all other eubrachyurans, but also from podotreme crabs. Histological investigations reveal that the female reproductive system of *P. granulata* consists of paired ovaries and four cuticle-lined sperm storage cavities, two on each side of the oviducts. Oviducts and sperm storage cavities have no internal connection and open into the vulva via separated pores. The first contact of spermatozoa and oocytes seems to occur in the vulva opening. Thus, fertilisation is external. The extraordinary morphology of the female reproductive system of *P. granulata* challenges the common concept of eubrachyuran seminal receptacles and their hypothetical evolutionary origin and gives rise to several questions:

1. Is the reproductive system of *P. granulata* the result of a progressive reduction or a plesiomorphic form of the reproductive system in Dorippidae?

2. Is a twin sperm storage structure on each side of the body with external fertilisation the precursor of the seminal receptacles observed in other dorippid species?

3. Is the typical eubrachyuran seminal receptacle with internal fertilisation not a real apomorphy of the Eubrachyura?

ID: 219

ULTRASTRUCTURE OF OOGENESIS IN *PARAMURICEA CLAVATA* (ANTHOZOA, OCTOCORALLIA)

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Reproductive biology of Octocorallia is poorly known even for common species. Mediterranean gorgons *Paramuricea clavata* is dioecious (gonochoric) species. Female germ cells are located and developed in mesenteries and evidently have endodermal origin. We investigated reproductive system of female individuals of *P. clavata* from NW of Mediterranean by using of TEM. At all stages of development the oocytes encircled by a layer of follicular cells that usually have dark phagosomes, up to 1 μm in diameter, located in the basal part of the cells. Fibrous mesoglea occurs between the follicular cells and the developing oocytes. It increases its thickness from 1 up to 4-5 μm during oogenesis. Close to oocyte surface between the collagen-like fibrils the fine granular material occurs. The cytoplasm of young oocytes close to mesogleal layer has numerous invaginations of the plasma membrane, forming endocytic vesicles. Later oocyte surface is strongly bent and generates twisted outgrowths that increase surface contact with mesoglea. Electron-dense phagosomes appear in cytoplasm as a result of endocytic visicles and lysosomes fusion. Later phagosomes are modified and lose their dark content. Numerous Golgi complexes secrete 1 μm spherical bodies, vitellogenous granules, which show complex dynamic of maturation processes. The entire period of oocyte development the nucleus is active and its envelope is elaborated into numerous pores due to it has dots-in-line structure. At the final stage of oogenesis the oocytes are released and their surface acquires a complex set of convoluted surface outgrowths.

ID: 205

THE EVOLUTION OF MOLLUSKS

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Mollusks are morphologically highly diverse invertebrate animals with rich fossil record and divergent life cycles that may involve trochophore- and veliger-type larvae. Key molluscan taxa include the worm-like aplacophorans, shelled groups (polyplacophorans, monoplacophorans, gastropods, scaphopods, bivalves) and the cephalopods with highly elaborated nervous systems. Molluscan origins and evolution of their different phenotypes are still debated, but significant progress has been made over the past years. Recent phylogenomic studies suggest a deep split of the phylum, resulting in Aculifera (shell-less aplacophorans and multi-shelled polyplacophorans) and Conchifera (all other, primarily uni-shelled groups), challenging traditional hypotheses that mollusks gradually evolved complex phenotypes from simple, worm-like animals. Developmental studies support this view by showing that aplacophorans are secondarily simplified. Gene expression data indicate that the Hox and ParaHox genes, that are involved in anterior-posterior patterning in many bilaterians, most likely lost this function in the conchiferans and instead acquired novel functions during ontogeny of taxon-specific morphological features. The deviation of various mollusks from common metazoan developmental pathways may have been an important driving force during evolution of the dramatic phenotypic plasticity and the wide range of morphological novelties exhibited by representatives of various molluscan sublineages.

C4 Oral

ID: 202

LIGHT SHEET MEETS WATER FLEA – LIVE IMAGING MORPHOGENESIS IN *DAPHNIA*

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Light sheet microscopy (LSM) uses a thin plane of light to optically section and view tissues with very high spatiotemporal resolution. Photobleaching and phototoxicity are insignificant compared to established fluorescence imaging techniques such as epifluorescence or confocal microscopy. Labelled with a fluorophore, whole organisms can be imaged in unprecedented resolution over extended periods of time. This makes it an ideal tool for studying dynamic developmental processes and allows studying cellular behaviours that orchestrate tissue and organ morphogenesis.

Daphnia exhibits leaf-like (phyllopodous) thoracic appendages that are specialized for filter feeding. Compared to the more common biramous crustacean appendages these limbs have a different principle of construction and only few and superficial data about their morphogenesis are available. Fluorescently labelled *Daphnia* embryos were imaged with multi-view LSM during entire embryogenesis.

The terabyte-sized LSM datasets with millions of images raise several challenges for data handling. Software solutions based on the platform Fiji help to efficiently address image processing and data analysis. By cell tracking and lineage reconstruction, new insights into the mechanisms underlying the three-dimensional epithelial remodelling during *Daphnia* limb morphogenesis can be provided.

Particular the limb elaboration is a highly dynamic process and happens in a very short time. Different proliferation rates along the dorso-ventral axis of the limb primordium in addition with preferential orientation of cell division of epidermal cells play crucial roles in establishing the final proximo-distal axis of a phyllopodous thoracopod. Surprisingly, these findings reveal that phyllopodous and birmaous thoracic limbs follow a same morphogenetic pattern during limb elaboration.

ID: 168

FINE ORGANIZATION OF OOCYTES IN SPIONID POLYCHAETES (ANNELIDA: SPIONIDAE) WITH SHORT-HEADED SPERMATOZOA

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Spionids demonstrate diversity in gamete organization. Free spawning spionids are unique among polychaetes in having oocytes with sculptured envelopes of different thickness and composition. We examined ultrastructure of the oocyte and short headed spermatozoa of three free spawners: *Aonides oxycephala, Spiophanes uschakowi* and *Prionospio japonica*. The spermatozoa have similar spherical nuclei, spherical mitochondria in midpieces, and long flagella, but differ in the composition of acrosomal complexes: conical multilayered, about 1.4 µm long in *A. oxycephala*, discoid, 0.5 µm long in *S. uschakowi,* and biradially symmetrical, 0.3 µm long in *P. japonica*. The oocyte envelopes of *A. oxycephala* and *S. uschakowi* are sculptured, about 7 and 4 µm, respectively, and composed of unbranched microvilli and homogeneous extracellular matrix. Large invaginations of the envelope into ooplasm in the form of spherical vesicles are regularly arranged in two circles in *A. oxycephala* and in one circle in *S. uschakowi*. In both species, the envelopes inside vesicles are significantly thinner than in other parts. Opposite to the earlier hypothesis about vesicles as buoyancy regulator structures, we suggest that they are used as places for penetration of spermatozoa through thick envelope for the fertilization. This hypothesis is supported by our observations on the artificial fertilization in *A. oxycephala*, when the first signs of the completed penetration were observed near the vesicles. The oocyte envelopes of *P. japonica* are about 0.5 µm thick, with branched microvilli that terminate above heterogenous extracellular matrix which fills the space between microvilli. The fertilization mechanism in this species remains unknown.

C5 SYMBIOSIS BETWEEN ANIMALS: DIVERSITY, PATTERNS AND INFERENCE ON PROCESSES

Organizers: Dr. Temir A. Britaev, Dr. Viatcheslav N. Ivanenko

ID: 236

SOME FEATURES OF GASTROPODS MORPHOLOGY AND BEHAVIOR DUE TO THEIR SYMBIOTIC LIFESTYLE

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Gastropods from the genus *Stilifer* (Eulimidae) are exclusively associated with starfishes. These eulimids form specific thickenings of hosts' body-walls and live inside them. There is a small hole on the gall top from which the shell apex can be seen. Moreover symbiont produces specific pseudopallium to separate from the host.

Most authors do not assume the possibility of eulimids detachment from the echinoderms, however there are no finds of dead shells in the hosts tissues.

During underwater observations in Vietnam gall-forming *Stilifer variabilis* from the starfishes *Culcita novaeguineae* were found detached on the host surface. There were suggested that rise in temperature (up to 29 °C) could provoke the separation of mollusks from the host tissues and such "escape" from the gall.

The main purpose of the research was the experimental observation of symbiotic gastropods behavior and verification of this hypothesis with temperature influence.

Starfishes with symbiotic mollusks were put in different aquaria and observed with increasing of temperature (from 26 to 29 °C) during one week.

As a result unusual behavior of *Stilifer variabilis* was revealed: the apex of the shell began to stick out strongly on the host's body surface. In some experiments, symbionts were rejected by the host's tissues and died. The shells of the dead individuals completely left the host body. At the same time, the pseudopallium, foot and proboscis remained inside the gall. The examined hosts stayed alive during all experiment.

The study was supported by the Russian Foundation for Basic Research, under grant 16-04-00340.

ID: 105

INTEGRATIVE TAXONOMY AND HOST SPECIFICITY OF COPEPOD CRUSTACEANS LIVING ON MUSHROOM CORALS (SCLERACTINIA: FUNGIIDAE)

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Symbiotic copepods living on scleractinian corals are an important component of marine biodiversity. They are poorly investigated, in particular regarding their, zoogeography, host specificity, and the functional relation with their hosts. The sampling of copepods is complicated as it requires special methods and preservation processes. The identification of copepods with body length less than 1.5 mm is difficult as diagnostic characters are hard to distinguish as well as to evaluate. Here, we use an original approach of DNA extraction from a single specimen, preserving its skeleton for morphological studies. The rationale of the study involved collecting of the mushroom corals on different reefs in two distinct areas of the Red Sea, extracting all the associated copepods, morphological screening and identification of described copepod species, using methods of molecular analyses (using COI and ITS markers) to determine the genetic diversity of all specimens, and reconstructing phylogenies to support the morphological identification of copepods and to further delimit previously unknown species, analyzing the ecological drivers of the occurrence and diversity of these copepods. The analysis of fine morphological characters and molecular markers of all copepods found on 13 species and eight genera of host corals revealed seven species of copepods, most of which are undescribed, without any apparent host specificity. All findings are new for the Red Sea and represent new species. The results show the importance of integrative taxonomy and ecological analyses in the examination of species distinction and host specificity of symbiotic copepods living on scleractinians.

ID: 223

CHIGGER MITE SPECIES (ACARI: TROMBICULIDAE) FROM VIENTIANE, LAOS

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Scrub typhus is endemic in rural areas of Asia Pacific, including in Lao PDR. The causal agent, Orientia tsutsugamushi, is a gram-negative bacterium transmitted by Trombiculid mite larvae (chiggers), which live as ectoparasites on vertebrate hosts. For effective disease control, robust vector surveillance is essential, which should include understanding of chigger mite species and host profiles.

In this study, we explored the chigger species and their rodent hosts. We trapped rodents carrying chigger mites in Vientiane province, Lao PDR. A total of 285 mites were collected from 23 rodents of 7 species. Chigger species are classified by their morphological characteristics. The most important feature for identification and classification of chigger mites is the central dorsal shield. Its shape, size and the distribution of attached setae (fine hairs) and sensillae (sensory hairs) allow assignment of mites to the genus level and often to the subgenus level. Additional characteristics are required for identification to the species level; including the shape and arrangement of body setae (chaetotaxy), and features of the gnathosoma, legs and coxae. We found 13 chigger mite species from 7 different genera, including *Ascoschoengastia indica*, *Blankaartia acuscutellaris*, *Gahrliepia elbeli*, *G. marshi*, *G. tylana*, *Walchia alpestris*, *W. ewingi ewingi*, *W. ewingi lupella*, *W. kritochaeta*, *W. aff. micropelta*, *Leptotrombidium deliense*, *Schoengastia kanhaensis and Schoutedenichia centralkwangtunga*. This data also revealed that *L. deliense*, one major vector of scrub typhus, could be found in Laos PDR.

ID: 464

AN OVERVIEW OF THE BIODIVERSITY AND ADAPTATIONS OF SYMBIOTIC SCALE-WORMS (ANNELIDA, POLYNOIDAE)

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The family Polynoidae, known also as polynoids or scale-worms, are certainly the most diverse polychaete family including symbiotic species. Among 879 species of scale-worms recorded as valid in the World Register of Marine Species (WoRMS, www.marinespecies.org/aphia.php?p=taxdetails&id=939 on 2017-03-04) 221 (i.e., 25.1%) are considered to live as symbionts, 217 being commensals (although a few have been recently recognised as mutualistic) and 4 being parasitic. A total of 79 genera among the xxx known to date (WoRMS, ibidem) include symbiotic species. In most cases these genera include one (40), two (23) or three (7) symbiotic species, although *Hololepidella*, *Harmothoe*, *Lepidasthenia* and *Malmgreniella* include 11, 19, 20 and 23 symbiotic species, respectively. Polynoids are involved in 622 symbiotic relationships, 593 (commensalistic/ mutualistic) and 29 parasitic. In most cases, each species is involved in a single relationship (92 species), followed by 2 (40), 3 (20) and 4 (14), while only 4 species are involved in more than 20 relationships. As for the host taxa harbouring polynoids, the most diverse are cnidarians, decapods and polychaetes, while the least diverse are sponges. In addition to this basic information on the biodiversity of the symbiotic scale-worms, our presentation will provide an overview of the most relevant adaptations of this polychaete family, including mimetic colouring and morphological (such as modified eyes, chaetae, elytra or parapodial structures) and behavioural (e.g. host recognition, intraspecific aggressiveness, living in pairs) adaptations.

C5 Invited

ID: 274

BODY SHAPE, COLORATION AND LOCATION OF SOME MYZOSTOMIDS (ANNELIDA: MYZOSTOMIDA) FROM CENTRAL VIETNAM

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Myzostomids are among the most specialized symbionts of echinoderms. According to the mode of life four ecological groups are usually established. They are: free-moving, cysto- and gall-forming and host's cavities inhabiting species. The last three myzostomid groups are protected from the predators and direct environment impact by host tissues, whereas the free-moving species are more vulnerable to these factors. In this report, we are considering the relationships between myzostomids color and body shape and their location on the host's body. The material was collected during Russian-Vietnamese expeditions in 2008, 2014 and 2015 in shallow waters of the Nhatrang, Vietnam. Observations on myzostomid locations were made in situ for large species and in aquaria for small ones. Data on coloration and body shape are based on the observations of living specimens. Free-moving myzostomids are able to move along the host body, however, it is possible to establish for them four preferred areas on the host surface: (1) the calyx and the division series, (2) the aboral surface of the arms, (3) the oral surface of the arms, (4) the pinnules. We demonstrated that different myzostomid species prefer different areas, and that species inhabited different areas differ in coloration and body shape. We are considering these features as adaptations to coexistence on the same host, and as protective coloration and mimicry to the particular host area. The study was supported by the Russian Foundation for Basic Research, under grant 16-04-00340.

C5 Poster

ID: 409

COMBINED ANALYSIS OF MORPHOLOGICAL AND MOLECULAR DIVERSITY OF COPEPODS (CRUSTACEA) LIVING IN SYMBIOSIS WITH STONY CORALS OF THE GENUS GALAXEA IN THE INDO-PACIFIC

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More than 360 species of copepods representing different families and orders are known to be symbionts of scleractinian corals. Despite this, understanding of the diversity and geographical distribution of the coral-associated copepods is based on the fragmentary taxonomic data and lack of data from many parts of the world. Since the overall diversity of coral-host species and their symbiotic copepods cannot be evaluated in a single project, hermatypic corals of the genus *Galaxea* (Scleractinia: Euphylliidae) were selected as a model group of hosts. In frame of our project we collected and analyzed morphological features and molecular markers (COI, ITS, and 18S) of hundreds of copepod specimens from the colonies of *Galaxea* corals in distinct regions of the Indo-Pacific: the Heron and Lizard Islands of the Great Barrier Reef, the Ningaloo Reef on the west coast of Australia, the Hainan Island in China, the south Vietnam, south atolls of Maldives and various reefs along coast of the Saudi Arabian Red Sea. Combined analysis of morphological and molecular data revealed high and unknown diversity as well as particular patterns of geographical distribution of copepods living in symbiosis with corals of the genus *Galaxea*.

C5 Poster

ID: 159

STRUCTURAL AND TRANSPORT ADAPTATIONS FOR SYMBIOSIS BETWEEN BRYOZOANS AND BACTERIA

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Mutualistic associations between prokaryotes and eukaryotes hosts employ adaptations encouraging symbiont transmission symbiont in the host generations. Some cheilostome bryozoans employ vertical transmission of symbiotic bacteria protecting larvae during post-incubation swimming period. The role of the symbionts for adult bryozoans is unknown, however.

The anatomical and ultrastructural investigations of cheilostome bryozoans - placental *Bugula neritina* (western Atlantic) and non-placental *Aquiloniella scabra* (White Sea) revealed the presence of the voluminous reservoirs (‘funicular bodies’) containing numerous bacteria in the feeding modules (autozooids). These bodies were round, oval or elongated being either positioned on the upper surface of the blind part of the stomach (caecum) or suspended in the body cavity. Having an epithelial wall each body is connected with funicular strands that are hollow mesothelial cords connecting the stomach with body wall and providing the nutrient transport within a colony. Presence of bacteria within the central cavity in these cords has been shown earlier thus explaining the route of bacterial migrations inside zooids.

Using some more bugulid cheilostomes possessing symbionts we, for the first time, were able to trace the stages of the cross-placental transition of bacteria to larvae. Close to larval release, the symbionts are accumulated in the small groups close to the brood chamber containing mature larva further moving to the brood cavity between the cells of placental analogue (if present) and through its cuticle. Mechanism of this transition is yet unknown. Next, bacteria penetrate the fertilization envelope surrounding the larva and, moving between its cilia, approach the larval pallial sinus.

ID: 481

SPECIAL MORPHOLOGY OF SOME AQUATIC PROTISTS WITH EMPHASIS ON WATER QUALITY

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The functional diversity of free-living aquatic protozoans is discussed with respect to the feeding ecology, life strategies and water quality. The objective is to show the specific morphological features of indicator groups. Heterotrophic nanoflagellates (HNF) are known as most important grazers of bacteria in many aquatic ecosystems, since HNF generally contain a diverse community of species significantly differing in their feeding behaviour and other ecological properties. Recent studies of flagellate feeding processes indicated that there are significant species-specific differences and individual variability regarding the food uptake and food selection of bacterivorous flagellates. Variability of bacterivory is discussed regarding the prevailing feeding modes and the feeding microhabitat, respectively. The Choanoflagellida is peculiar group interesting in different aspects such as evolutional, ecological, and practical. They have an essential role in microbial food webs contributing to a process of self-purification of water bodies as well as are used in monitoring systems. Multivariate statistics were used to design "the scale of toxicity" across a gradient of toxicant stress and organic compounds. A new index of periphyton flagellates (IPF) as indicator of the trophic status of a water-body and a simplified index for a sublethal toxicity assessment were developed. So, morphological features, diversity and relative abundance of flagellates, ciliates and other protozoans can be used as indicators of trophic status, toxic pollution and acidification of aquatic ecosystems.

C6 MORPHOLOGICAL DIVERSITY AND EVOLUTION IN TERRESTRIAL INVERTEBRATES

Organizers: Dr. Natalia M. Biserova, Dr. Elena N. Temereva, Dr. Elena V. Vortsepneva

ID: 350

NOVEL APPROACHES IN MORPHOLOGY PUSHING BOUNDARIES IN MYRIAPOD SYSTEMATICS (ARTHROPODA, MYRIAPODA)

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Since the earliest taxonomic treatments, species descriptions have nearly always been accompanied by varied kinds of visual representations, which are vital to convey information about the morphology and character states described to distinguish taxa. Recently, we performed a few attempts to enhance morphological descriptions for taxonomy, using non-conventional methods such as rotational SEM images and interactive identification keys. Recently, we also described a new millipede species using high-resolution X-ray microtomography (micro-CT) as a substantive adjunct to traditional morphological examination. 3D models of the male holotype and female paratype were presented to discuss the potential of this non-destructive technique in documenting new species of millipedes and other organisms. The micro-CT data have been uploaded to an open repository to serve as the first actual millipede 'cybertypes' to be published. At present we also use micro-CT to extract morphological characters from a Dominican amber fossil of an undescribed genus of millipede (Diplopoda, Spirobolida).

These examples demonstrate how the practice of morphology-based science need no longer be seen as quaint and old fashioned but as a discipline that reflects the ways knowledge is produced, shared, and used in our modern era. New endeavours and current technologies will certainly continue to play important roles in that, and the spirit of sharing data will make it only go forward.

ID: 221

RESILIN - A RUBBER-LIKE PROTEIN IN INSECT FLIGHT SYSTEMS

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Winged insects propel themselves through the air at high speeds and with great manoeuvrability, thereby being able to evade obstacles, forage and escape predators in air. Some of them are able to fold their wings into smaller wing packages and, thus, are more agile in narrow spaces of dense vegetation, soil, under bark, etc. During flight and wing (un-)folding, insect wings flex at designated regions, thereby allowing the wing to undergo passive deformations adapted to the momentary aerodynamic situation and enabling almost origami-like folding mechanisms. These highly stressed regions would be highly prone to failure without the presence of a rubber-like protein called resilin. Resilin stands out for its almost perfect resilience, low stiffness, large extensibility, high fatigue limit and its ability to store elastic energy and, thus, adds flexibility to ostensibly stiff wings. We present a short overview about the function of resilin in insect flight systems, with special reference to dragonfly wings. The distribution of resilin in wings of *Sympetrum vulgatum* was examined using confocal laser scanning microscopy, scanning and transmission electron microscopy, supplemented with micro-CT data and further analysed with the finite element method. Our results showed that that in contrast to wings of other Pterygota that deform on the basis of flexion and folding lines, flexibility in dragonfly wings is supported by flexible vein joints between cross and longitudinal veins, soft inner cuticle layers in wing veins and a flexible transition between veins and the wing membrane, thereby influencing the wing´s directional stiffness and elastic deformation.

C6 Poster

ID: 471

MORPHOLOGICAL FINE TUNING OF THE FEEDING APPARATUS OF HESPERIIDAE (LEPIDOPTERA)

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The form and function of the mouthparts of Hesperiidae was studied for the first time in detail. These butterflies are of particular interest since the butterfly species possessing the longest ever recorded proboscis is a representative of the Neotropical hesperiid genus Damas. We focused on the functional morphology by comparing flower handling, feeding capacity and proboscis morphology in skippers with extremely long, medium sized and short proboscis that have been shown to be specialized in various flower with matching nectar spur length in a Neotropical habitat. We used state of the art light microscopy, scanning electron microscopy and micro-tomographical methods.

Results revealed that all studied Hesperiidae have the same proboscis micromorphology, proboscis musculature and sensilla endowment regardless of the proboscis length. However, the morphology of basal proboscis organs which are responsible for movements and the composition of the pumping organs for nectar uptake are related to the proboscis lengths and feeding capabilities. The particularly long proboscid skipper butterflies have been found to show remarkably longer manipulation times during flower visits. This disadvantage is interpreted to result from rather poor supply with sensilla at the proboscis tip compared with species possessing a shorter proboscis.

ID: 198

PHYLOGENETIC AND MORPHOLOGICAL RELATIONSHIPS OF THE GROUNDNUT LEAF MINER, *APROAEREMA MODICELLA* (DEVENTER) AND *APROAEREMA SIMPLEXELLA* (WALKER) (LEPIDOPTERA: GELECHIIDAE) OCCURRING IN SOUTH AFRICA, MOZAMBIQUE, INDIA AND AUSTRALIA

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The South African groundnut leaf miner was found to be very closely related to both Australian soya bean moth *Aproaerema simplexella* (Walker) and the Indian groundnut leaf miner *A. modicella* (Deventer) based on the molecular and ecological studies. Therefore, the investigation of the evolutionary relationships of these species was conducted by comparing sequences of five different gene regions of mitochondrial and nuclear DNA (COI, COII, cytb, 28S and EF-1 ALPHA). Sequenced samples included 44 collected from four sites in South Africa, four from Mozambique and three each from India and Australia. Evolutionary history was assessed using Maximum Parsimony (MP) and Neighbour Joining (NJ) analysis. In the phylogenetic tree for region 28S, all sequences, irrespective of the country from where they were sampled, gathered and formed one group. In the phylogenetic trees for regions COI, COII, cytb and EF-1 ALPHA, a similar pattern was observed in the way that the sequences assembled into different groups; i.e. some sequences of *A. simplexella* from Australia were grouped separately from the others, but some Australian sequences grouped with those of the groundnut leaf miner from South Africa, India and Mozambique. Genetic pairwise distances between the experimental sequences ranged from 0.97 to 3.60% (COI), 0.19% to 2.32% (COII), 0.25 to 9.77% (cytb) and 0.48 to 6.99% (EF-1 ALPHA). Results indicated that these species are genetically related and presumably constitute a single species. Morphological studies by examining the genitalia of these species to complement the molecular findings are underway.

ID: 257

USING AN INNOVATIVE NANO-*CT* SETUP TO RECONSTRUCT THE LEG MUSCULATURE IN VELVET WORMS (ONYCHOPHORA)

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X-ray Computed Tomography (CT) is a powerful non-invasive technique for investigating the inner structure of objects and organisms. However, even with the recent surge of CT analyses in many fields of the biological sciences, the resolution of most laboratory-based CT systems remains limited to the micrometre range and still prevents small samples to be imaged with satisfactory level of details. Herein, we used an innovative table-top nanoCT system able to reach 3D resolutions down to 120 nm for investigating the myoanatomy of a ~300 µm long walking appendage of a velvet worm (Onychophora) — an invertebrate group pivotal for understanding animal evolution. The new nanoCT setup proved able to depict simultaneously the external and internal morphology of the leg with resolutions comparable or higher than other popular imaging methods, e.g., scanning electron and confocal laser scanning microscopy. Based on our nanoCT data, we could, for the first time, track individual muscle fibres and three-dimensionally reconstruct in detail hitherto unexplored anatomical aspects of the onychophoran leg musculature. Our findings suggest that previous studies clearly oversimplified the complex muscular system operating the legs of these organisms. We identified 15 distinct sets of muscle fibres, including promotors, remotors, retractors, protractors, depressors, levators, rotators, flexors and constrictors, as well as additional septum-like muscles in the leg cavity and ring muscles in the foot. Our study contributes substantially to understanding the intricate muscular system in Onychophora and demonstrates that it is now possible to generate high-resolution CT data from small samples in a laboratory environment.

ID: 428

USING TRADITIONAL AND INNOVATIVE IMAGING TECHNIQUES TO INVESTIGATE INTERNAL CEPHALIC STRUCTURES IN THE HIGHLY DIVERSE GENUS *LITHOBIUS* (CHILOPODA, MYRIAPODA)

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The large centipede genus *Lithobius* consists of approximately 500 species/subspecies, with a wide geographical distribution pattern. Species descriptions are based on traditional taxonomic characters like number and arrangement of ocelli, number of antennal articles or tergite projections, etc. Previous studies, investigating the microanatomy of the peristomatic structures (epi- and hypopharynx), yielded a great potential in conveying phylogenetically useful characters in the centipede orders Scutigeromorpha, Scolopendromorpha and Geophilomorpha as well as Lithobiomorpha. In this study we explore the same microanatomical structures in the genus *Lithobius*, represented by 29 species of the 'subgenera' *Lithobius* (23 spp.), *Monotarsobius* (3 spp.) and *Sigibius* (3 spp.), using light and scanning electron microscopy (LM, SEM).

As preliminary results, we describe the variation in peristomatic structures between the species, adjust character descriptions based on an existing character matrix and describe new characters. Additionally, we use micro-computed tomography (µCT) to investigate further internal structures of the cephalic capsule that might hold a potential phylogenetic relevance, mainly focusing on the mandibulo-tentorial complex and the associated muscles. These findings pave the way to further phylogenetic analyses and a better understanding of the evolutionary relationships within the genus *Lithobius*.

C6 Oral

ID: 124

SEXUAL DIMORPHISM IN THE ATTACHMENT ABILITY OF *COCCINELLA SEPTEMPUNCTATA* BEETLES TO SMOOTH SUBSTRATES

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This study was carried out in order to test the effect of differences in micromorphology of attachment devices (adhesive pads) in males and females of the seven-spotted ladybird beetle *Coccinella septempunctata* (Linnaeus, 1758) on their attachment. We examined the microstructure of adhesive pads in adult male and female beetles using a scanning electron microscopy and performed centrifugal force measurements with insects on a smooth glass surface.

In *C. septempunctata*, adhesive pads belong to the hairy type of locomotory devices. The ventral side of the two first proximal tarsomeres bears numerous tiny tenent setae. Among the setae, several types are distinguished: (i) with a pointed, usually sharp tip, (ii) with a flattened and widened end plate, called the spatula, (iii) a transitional type, often with a pointed tip and a rather narrow elongated end plate, and (iv) with a flat discoid end plate. There is a distinct sexual dimorphism in the morphology of adhesive pads: males have all four setae types, whereas females have only the first three types.

Males showed significantly higher attachment (friction) forces than females (males: 58.27±20.77 mN; females: 41.07±16.01 mN; t-test: d.f.=28, t=2.541, P=0.017). These differences between males and females were caused by the sexual dimorphism in the terminal elements structure of tenent setae: being adapted for holding on to females strongly and for a long time during pairing, discoid setal tips of males provide reliable adhesive contact and have high ability to resist formation of crack at the interface between the tip and substrate.

ID: 208

MORPHOLOGICAL DIVERSITY OF MONOMORPHIC ANT *LASIUS NIGER* ALONG METAL-POLLUTION GRADIENT

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Ants are common component of invertebrate fauna in metal polluted areas. Metal toxicity may affect variable parameters including morphology such as symmetry in bilateral traits or body size. This study presents preliminary study performed to test if the morphological diversity of body size of the common garden ant *Lasius niger* (Linnaeus, 1758) is correlated with metal pollution level. The study was performed in the vinicity of zinc and lead smelter Bolesław, southern Poland. 30 workers were sampled in the field from 60 mature colonies originated from 6 independent sites of variable pollution level, and measured using digital methods. Body size of workers was approached as head width. The within-colony measurements of diversity i.e. variance, standard deviation and coefficient of variation were relatively low, suggesting low diversity of body size within a colony. The within-colony standard deviations in body size did not correlate with pollution level. On the other hand, when standard deviations in the body size were compared between sites small increasing trend with the pollution level was detected ($p = 0.06$). The results lead to the conclusion that diversity in the body size in *L. niger* is relatively small, independently on the pollution level, but the variation between colonies seems to increase with pollution level. The body size of the investigated ant will be further studied using larger number of sites in order to support or challenge the above conclusion.

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C6 Poster

ID: 346

NEW INSIGHTS INTO BODY ORGANISATION IN CHELICERATES

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The body segments of arthropods are organised into functional units (tagmata). Certain types of body organisation are often thought to represent a key to the evolutionary success of a group, such as the highly conservative organisation in insects. Also in chelicerates the body organisation is generally seen as rather stereo-typic with an anterior prosoma and a posterior opisthosoma, only partly modified further in certain ingroups. Yet, the supposedly distinct prosoma-opisthosoma division seemingly present in xiphosurans (horseshoe "crabs") or araneaens (web spiders) in fact involves different segment compositions of the tagmata. Dorsally the sclerotisations (prosomal shield, tergites) usually indicate the tagma borders. Ventrally mainly the functional aspects of the appendages indicate tagma identity. Additionally, the tagmata can be further subdivided, also in different ways in the different groups. This subdivision as well as tagmatisation in general can even differ between the dorsal and ventral side. A striking example are solifuges (camel spiders) which exhibit a very special subdivision of the prosoma, apparently coupled to their mode of prey capture. The body re-organisation in mites, though in general a very prominent counterexample to the prosoma-opisthosoma division, appears to be indeed far more complex, as the morphology in the different mite groups is rather diverse. However, even in groups with an externally apparently clear prosoma-opisthosoma division, the internal morphology may point to a more complex situation, e.g., in pseudoscorpions. I will present examples emphasising the non stereo-typic nature of body organisation of extant and fossil chelicerates.

ID: 347

CONVERGENT EVOLUTION OF RAPTORIAL APPENDAGES IN ARTHROPODS

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The term "convergent evolution" describes the evolutionary appearance of similar morphologies in only distantly related organisms. A prominent example is the independent evolution of wings in birds, bats and pterosaurs. However, the concept of convergent evolution or convergence is usually not well delineated, but is instead used as a rather gross measure of similarity without strict criteria. In this way, it is only possible to state that certain structures must have evolved convergently, but a distinct measure for evaluating the degree of convergence is lacking. One possibility to quantify convergence are direct morphological length measurements on similarly shaped structures in representatives of different groups. These can (after eliminating the effect of the entire size of the organism) show objectively if these structures are similar also in detail, or if this similarity is only superficial. For testing the applicability of this approach the raptorial appendages of different arthropods have been investigated. Despite their generally similar mode of function the raptorial appendages strongly differ between the arthropod groups, e.g., in their way of folding and their axis of movement. Hence, for comparison groups were chosen whose raptorial appendages are similar in these aspects. An example are the downward-striking subchelate appendages as seen in ghost shrimps (Caprellidae), praying mantises (Mantidae), and armoured harvestmen (Laniatores). Comparison not only reveals general similarities and differences, but also heterogeneity within the compared groups. This tool should improve our general concept of convergence by providing discrete measures replacing only qualitative and often anecdotic comparisons.

C6 Poster

ID: 259

TAGMATISATION IN CAMEL SPIDERS: HOW FUNCTIONAL CONSTRAINTS SHAPE A COMPLEX BODY ORGANISATION

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Body organisation (tagmatisation) of arthropods, especially within Euchelicerata and its in-group Arachnida, is still not well understood. One of these arachnid groups is Solifugae (camel spiders) with a general spider-like appearance, but an apparently specialised tagmatisation, especially of the anterior body part (prosoma). We applied fluorescence-microscopic and computer-tomographic imaging to look at this prosomal tagmatisation.

The huge chelicerae of solifuges and their more dorso-anterior position entail several morphological changes. Solifuges are one of the few euchelicerate in-groups with a prosomal shield subdivided into three parts: the anterior larger propeltidium and two tergite-like parts, meso- and metapeltidium. This subdivision appears to be functionally necessary because of the huge chelicerae and the raptorial lifestyle of solifuges, subsequently requiring a higher mobility in the anterior body than an undivided prosomal shield would allow.

However, it still seems to be not fully resolved which segments contribute to the propeltidium. It is generally assumed that the propeltidium is formed by the first five segments, i.e., ocular plus four appendage-bearing segments. Here we question that the fourth appendage-bearing segment contributes to the propeltidium, based on aspects of endoskeleton, musculature and on morphological changes coupled to the large size of the chelicerae. Also ventrally the conjoined condition of appendage-bearing segments two and three clearly sets off the fourth appendage-bearing segment from the more anterior segments. In conclusion, the tagmatisation of camel spiders appears even more complex than already assumed.

ID: 286

MICROSCOPIC ANATOMY OF PSEUDOSCORPIONS REVEALS NEW INSIGHTS IN SEGMENTAL BODY ORGANISATION

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Studies of body organisation in Chelicerata are primarily based on external morphological features. Pseudoscorpions are divided into a prosoma and opisthosoma. The opisthosoma is characterised by twelve tergites and eleven sternites resulting in a mismatch of dorsal and ventral segment borders, and a transverse border between pro- and opisthosoma. It is generally assumed, that the first opisthosomal sternite is reduced and the enlarged genital operculum forms the second sternite. Here, we used histological sections and μ-CT imaging to analyse the dorso-ventral and intersegmental musculature of the opisthosoma of pseudoscorpions to understand the anatomical underpinnings of the dorso-ventral mismatch of opisthosomal organisation. The serial arrangement of the dorso-ventral musculature of opisthosoma segments provides evidence for the original sequence of segments. We find the musculature of the first and second segment spanning from the tergite to the respective sternite. Specifically, the anterior muscle of the first tergite in the opisthosoma is connected to the endosternite and then attaches to the ventral sternite. The musculature descending from the second opisthosomal tergite is attached to the cuticle covering the internal dorsal part of the genital atrium. The musculature in the third opisthosomal segment is completely reduced. All following segments show a set of dorso-ventral muscles. We conclude, that the first sternite is not reduced but forms the external genital operculum, the second sternite is part of the internal genital atrium and the third sternite forms the posterior part of the genital segment.

C6 Poster

ID: 288

MORPHOLOGY OF THE ROSTROSOMA AND PREORAL CAVITY OF PSEUDOSCORPIONS

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The rostrosoma of pseudoscorpions is a complicated structure providing features important for the analysis of phylogenetic relationship of the group. Similarities of rostrosoma of pseudoscorpions and solifuges have been invoked as evidence for their potential sister group relationship. We used histological longitudinal- and cross-sections for the 3D-reconstruction of the rostrosoma and the preoral cavity of adult pseudoscorpions (*Neobisium carcinoides*). The rostrosoma of pseudoscorpions is unique among chelicerates. It consists of a functional upper lip anteriorly from which lateral lips emerge ventrally. Posteriorly, it bears two independent attachments for sucking and the pharyngeal musculature. The preoral cavity is formed by the rostrosoma and a functional lower lip, which is positioned between the lateral lips of the functional upper lip. The basipodits of the pedipalps close the preoral cavity ventrally resulting in a tube-like atrium. The functional upper and lower lip join in forming the actual mouth opening. The chelicera do not contributed to these functional units, but conceal the rostrosoma dorsally. Muscle contraction for food intake to the pharynx is only performed by the rostrosoma and pedipalp basipodits. The lateral lips are covered with setae filtering food particle, which can be released by lateral locomotion of the basipodits. The detailed morphological analysis of the rostrosoma provided here differs from previously published descriptions, recognizes the rostrosoma of pseudoscorpions as unique character and questions its use as synapomorphic character of pseudoscorpions and solifuges.

BENDING STIFFNESS GRADIENT AND A SOFT TIP OF A BEETLE INTROMITTENT ORGAN AND THEIR ROLE IN THE PENETRATION MECHANICS

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Penetration by thin structures with high aspect ratio without buckling and rupturing is mechanically challenging. This study aimed at understanding penetration mechanics of a hyper-elongated structure of a beetle penis, termed a flagellum, whose good penetration performance during copulation had been previously numerically demonstrated. We applied a three points bending test for the flagellum to measure its bending stiffness along the entire length. In addition, material composition analysis and size measurement were carried out. We demonstrated the presence of the bending stiffness gradient, in which the basal half is relatively stiff and the apical half is softer. The stiffness gradient is the result of the flagellum cross section, which is cylindrical and tapered toward the tip. Moreover, the materials of the curved tip comprise a harder outer curve and a softer inner curve. Considering these data and findings of preceding studies, the flagellum working principle is hypothesized in the following way: 1) the bending stiffness gradient supports the flagellum, easily fitting to a shape of a highly coiled spermathecal duct, 2) the stiffness property of the very tip may make the tip tougher and more resistant to the damage, 3) the curled tip and homogeneously cylindrical shape of the flagellum help the very tip to fit the shape of the spermathecal duct of the female. Our study shows that the apparently simple flagellum penetration is achieved by numerous elaborate mechanical adaptations.

C6 Oral

ID: 209

DOES DIVISION OF LABOUR IS SIZE-DEPENDENT IN MONOMORPHIC WORKERS OF *LASIUS NIGER*?

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Body size can be associated with the division of labour not only in polymorphic ants but also in monomorphic species. The aim of our research was to check if there is an association between body size of workers of monomorphic ant *Lasius niger* (Linnaeus, 1758) foraging outside the nest (extranidal workers) and the size of food particles carried by them. Additionally we asked if there is a difference in body size between the extranidal workers and intranidal workers (non-foraging workers). The extranidal workers were attracted by tuna bait exposed close to the nest in the form of pieces and in pasta. The intranidal workers were sampled from the upper-nest chambers. The sampling covered 30 independent mature colonies located in abundant field. The body size of ants was expressed as the maximum head width above the eyes. The measurement of the head width of each ant was carried out using digital methods. In order to identify the differences in body size between workers GLM model was applied. The analysis displayed no significant difference between the body size of workers foraging for different food particles. The analysis revealed significant difference in size between extra- and intranidal workers. Intranidal workers were 2% larger than extranidal. We demonstrated that relatively small workers rather than big ones prefer foraging outside the nest. To summarize, contrary to expectations bigger extranidal workers do not forage for big-particles food.

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ID: 255

PIERCING STYLETS OF HEMIPTERA: APPENDAGES DRAWN INTO SETAE

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The mandibles and laciniae of the piercing-sucking bundle of Hemiptera are long sclerotized needles, which can be as thin as setae. To combine thinness with mechanical strength, stylets contain along their main length only strain-sensing dendrites, while epidermis is restricted to their short widened bases. Stylets thus cannot molt as regular appendages. The peculiar styletogenesis, first noticed by Mechnikov and studied by Weber, Pesson, and Pinet, resembles the development of imaginal discs. It has caused fragmentation of the original mandible and lacinia: because the replacement stylet's base grows away from the old base, protracting and retracting muscles are attached to a funnel-shaped collar, into which the base of the new stylet snugly slips when it is pulled into the working position during molting, or to levers associated with it. Unlike the collar, the levers are not parts of the mandible or lacinia. Continuity of dendrites during styletogenesis, like in sensory setae, requires the existence of yet undiscovered molting pores at stylet apices. After eclosion and after molting, the maxillary stylets become interlocked together and, basally, with hypopharynx by coordinated pressure from the maxillary plates, labrum, and labium. The salivary canal may have evolved from an interlocking groove. The airtight interlocking acted as a life-threatening constraint canalizing the evolution of mouthparts in terrestrial hemipterans and was lost only in aquatic Corixidae. The main traits of stylets are shared between Hemiptera and Thysanoptera. Besides stylets of other insects and mites, parallels can be drawn between these stylets and piercing ovipositor valvulae.

C6 Oral

ID: 193

INSECTS AS FLYING SHRIMPS, MYRIAPODS AS ARTHROPOD SNAKES—A NEW SYNTHESIS

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Deep similarities of Archaeognatha to Syncarida indicate that insects originated from higher crustaceans. Insects are neotenic in retaining such embryonic syncarid characters as sessile eyes and uniramous 1st antennae and uropods (= cerci). These changes correlate with terrestrialization, as well as the loss of a swimming larva (nauplius), suppression of its natatory limbs (2nd antennae and mandibular telopodites = palps), and acquisition of tracheae.

The escape reaction (backstroke or jump) shared by Malacostraca, Archaeognatha and mayfly nymphs is served by specialized muscles in the abdomen. To jump in terrestrial habitats, a larger volume of these muscles was needed. Probably the first insects were littoral hoppers. I suggest that they were bristletails, which descended from syncarid-like ancestors via neoteny, homeosis and gamoheterotopy: five posterior segments of the malacostracan thorax repatterned after abdominal ones; modified gonopods shifted caudally, and transferred from males to females to form an ovipositor.

Three principal tagmata (head, thorax and abdomen) and sets of homeotic genes underlying them are homologous across Arthropoda, irrelevant of the segment number (the ground-plan segment is thoracic; in abdominal segments limbs are suppressed). In myriapods and Remipedia this genetic mechanism is partially turned off, making their trunk secondarily homonomous and thorax-like in contrast to the highly elaborate head tagma. Likewise in snakes the trunk axial skeleton was homeotically transformed towards thoracic identity, and limbs (absent in the ground-plan vertebrate metamere) were lost. I hypothesize that myriapods evolved as litter creepers from bristletail ancestors via entognathous hexapods.

The study is supported by RFBR (16-04-01498).

C6 Invited

ID: 287

DIVERSITY AND DISTRIBUTION PATTERNS OF ANTENNAL SENSILLA IN GENUS *RHYACOPHILA* (TRICHOPTERA: RHYACOPHILIDAE)

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The genus Rhyacophila is a large complex; it was divided using characters of male genitalia to four main evolutionary branches, which, in their turn, include 72 groups of species. Investigation of antennal sensilla diversity can resolve a various phylogenetic problems of the genus, and determines evolutionary patterns of receptor structures in representatives of this taxon.

We investigated male antennal sensilla of 30 species from all branches of genus Rhyacophila by scanning electron microscopy. SEM photographs of antennal surfaces provided data for exploration of sensilla types, measurements of size and counting of the sensilla numbers.

Totally 13 types of sensilla have been identified. The maximal diversity and number of sensory structures have been found on the basal flagellomeres. Pseudoplacoid sensilla divided into several categories. Antennae typically have 1–2 types of pseudoplacoid sensilla. Forked sensilla form long and short subtypes. Sensory fields in the basal parts of antenna are formed by the curved trichoid sensilla.

A number of studied species has modifications of sensilla not found elsewhere; for example, dissected sensilla of *Rh. stigmatica* are transitive state between mushroom-like and forked sensilla. General features of sensilla distribution vary within genus; for example, in *Rh. tristis* sensory fields found on almost all flagellomeres despite the persistence of reduction sensilla diversity towards the antennal tip. Closely related species have similar structure of sensilla, but can demonstrate differences in their topology. Groups of species more separated in evolution differ in structure of the cuticular parts of sensilla in addition to the sensilla distribution.

C6 Oral

DD ADVANCED MICROSCOPY AND MORPHOLOGY

Organizers: Dr. Julia Sigwart, Dr. Lauren Sumner-Rooney

ID: 488

UNLOCKING MORPHOLOGY IN THE ARTHROPOD FOSSIL RECORD

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Many of the modern imaging and analytical approaches used to study anatomy of extant invertebrates are fruitfully applied to fossils as well, and are proving to be effective for diverse organisms in different styles of fossil preservation. Amber serves as a standard for comparing the ability of different techniques to extract morphological detail, perhaps most striking in a museum context being recovery of diagnostic systematic characters in opaque ambers. The autofluorescence of arthropod cuticle renders it especially favourable forautofluorescence imaging and confocal microscopy (CLSM). CLSM is a useful proxy for scanning electron microscopy with historical type material of groups for which SEM is a standard protocol for documenting details of external morphology, and in fossils CLSM is even effective in such media as chert. Examples from the Lower Devonian RhynieChert demonstrate that even microscopic structures such as sensilla are accessible. Micro-CT andphase contrast enhanced and synchrotron X-ray CT are widely employed to document external and internal anatomy in diverse arthropods in different preservationalmodes, including largely 3-D material (such as moulds in nodules or secondarily phosphatised microfossils) or effectively 2-D Burgess Shale-type compression fossils in shales.

D1 Oral

ID: 330

SEA ANEMONES THROUGH X-RAYS: MICROCOMPUTED TOMOGRAPHY (MCT) OF SOFT BODIED CNIDARIA, ADVANTAGES, LIMITATIONS AND FUTURE PERSPECTIVES FOR THE TAXONOMY AND SYSTEMATICS OF THE CLASS ANTHOZOA

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Microcomputed tomography (μCT) has proven efficient in the delineation of morphological features of many taxa, and a revolution in the way we can share morphological data, to the point we are on the brink of producing a database comparable to molecular databases such as GenBank/EMBL. While most of this technology has been used in vertebrates and specifically on hard tissue such as bone or scales, recent advances have been made in the use of this technology for the study of soft bodied tissues. In the case of small soft-bodied invertebrates, advances have been made on taxa with no chitinous or calcified tissues; such as leeches and earthworms. For the first time, we evaluate the utility of μCT for the identification of morphological characters on sea anemones (Cnidaria, Anthozoa), comparing it to the traditional histological techniques. We discuss the advantages as well as limitations for its use in sea anemone taxonomy and systematics. Furthermore, we explore the potential of using this technology in the study of comparative anatomy of polyps across the Class Anthozoa, a work that has been hindered by the challenges of implementing traditional histological methodologies on most taxa within the group.

ID: 387

HOW IS THE KINORHYNCH HEAD WIRED? A FIB-SEM/CLSM-BASED 3D RECONSTRUCTION

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Scalidophorans (kinorhynchs, priapulids and loriciferans) are unusual ecdysozoans in having bilaterally symmetrical bodies with radially symmetrical heads. The absence of trunk appendages and the presence of a hard cuticle has resulted in the evolution of a sophisticated head consisting of an array of cuticular extensions, called “scalids”, “stylets” and “teeth” that function in locomotion, feeding and sensorial reception. The head of kinorhynchs is composed of a retractable mouth cone and an eversible introvert with seven concentric rings of cuticular scalids. We comprehensively studied the anatomical architecture of the kinorhynch head using different microscopic techniques, including CLSM, TEM, SEM, FIB-SEM and 3D reconstruction. These data show that the mouth cone and the introvert are independently wired with different functions. The introvert works as a complex sensorial and locomotor apparatus with functional regionalization. The first row of scalids is highly innervated playing an important locomotory and sensorial role, sometimes carrying a variable number of eyes, whereas the remaining scalids are less innervated combining secretory and sensorial functions. The mouth cone, also highly innervated, is devoted to feeding and food processing. The organization of the nervous system suggests that separate muscular systems are involved with feeding and locomotion behaviors. These data establish a robust framework for comparisons with other scalidophorans to better understand the evolution of complex heads within the group.

ID: 483

HIGH-PRECISION 3D IMAGING SYSTEM FOR BIOLOGICAL OBJECTS IN VIRTUAL ENVIRONMENT

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The novel technologies of high-precision grinding in the fields of biology and medicine was developed and tentatively probed. The outcome implies 3D virtual replicas of biological objects of any complexity, being devoid of spatial and color distortions.

This approach seems very appropriate for creating 3D models of biological objects with a solid cover, with which the traditional histologic processing is not feasible. These are mollusks, insects and many other groups of invertebrates with a complicated 3D shape. Their quantitative description is commonly not available. The high-precision technology of grinding will be applied in designing such models of objects, which will be maximally approached to the native state of live object. The further study of these models is aimed at acquisition of direct qualitative data on the structure of complex biological species to be used both for the goals of systematics, and in the work with experimental biological models designed with these objects. This approach seems very appropriate for creating 3D models of biological objects with a solid cover, with which the traditional histologic processing is not feasible. These are mollusks, insects and other groups of invertebrates with a complicated 3D shape.

The resultant reconstructions will be employed to produce virtual museum pieces, atlases and virtual trainers attracting the principles of supplemented reality, or in the models with 3D-printing of physical trainers and working models for the needs of medicine, veterinary and adjacent areas, i.e. everywhere, in case if the MRT or histology reconstructions do not provide a valid 3D pattern.

ID: 183

LIFTING THE TRANSPARENT VEIL – OPPORTUNITIES FOR MORPHOLOGICAL OBSERVATION USING AUTOFLUORESCENCE MICROSCOPY

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The aim of this work is two fold: firstly exploring the sutability of autofluorescence microscopy for morphological observation and secondly describing the hitherto unknown internal morphological changes during puppation of *Panorpa communis* (Linnaeus, 1758) and *vulgaris* (Imhoff & Labram, 1836).

Contrary to general assumption, the autofluorescence microscopy study shows that the transformation of the outer morphology is not finished at the final larval moult in scorpionfly (*Panorpa*) pupa (Mecoptera, Panorpidae).

This observation of gradual changes during the puppation, e.g. of the distinct and complex mouth parts of the mecopteran group *Panorpa* as well as that of the holometabolous adult complex eye lead to:

1) questioning the assumption that the mecopteran pupa are morphologically similar to the adult

and the synchronicity of these changes with puppation,

2) highlighting the possibilities presented by laser based investigation of specimens, including autofluorescence microscopy in order to observe transitory morphology between that of the larva and that of the adult within the (pupa's) outer cuticle in the undisturbed organism.

While the results remain preliminary we emphasise that the combination of the appropriate methods and the right organism can provide new insights into seemingly concealed processes such as the metamorphosis of holometabolous insects.

ID: 141

ONTONGENY AND FORM IN CHITON SHELL EYES (MOLLUSCA, POLYPLACOPHORA)

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Building heavily armoured defense may require a sacrifice in sensitivity to the outside world. Polyplacophoran molluscs solve this conundrum with an elaborate sensory system embedded within their shell plates. These "aesthetes" are a chiton's largest sensory system. In some taxa, a subset of these pores is elaborated into lensed eyes, which have been shown to be capable of simple vision. Aesthete pores and shell "eyes" are connected to the main body beneath the shell by a network of tissue-filled channels, meaning the shell comprises a substantial proportion of volume that is not solid. Using synchrotron radiation X-ray tomography, similar to micro-CT scanning, on museum specimens of many species we can create three-dimensional models of chiton valves to trace the internal shell canals. This allows for visualisation of the internal structures hidden within the shell. The models also provide a quantitative framework to test the distribution of weaknesses in the shell armour of chitons. Shell "eyes" provide a dramatic step up in sensory perception for the species that have them, and may not require any loss in defensive strength.

D1 Oral

ID: 143

THE SCAPHOPOD FOOT IS VENTRAL: MORE EVIDENCE FROM THE ANATOMY OF *RHABDUS RECTIUS* (CARPENTER, 1864) (DENTALIIDA: RHABDIDAE)

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Scaphopods comprise about 900 described species of elongate infaunal molluscs, separated into two orders. The phylogenetic position of this class is contentious, having been proposed as a sister-group to bivalves or alternatively cephalopods, all groups that notably represent dramatic modifications of the molluscan body plan and historical confusion over the fundamental body axes. The digging scaphopod foot was previously considered to be anterior. Here we use a three-dimensional tomographic reconstruction of digestive anatomy and partial dorso-ventral musculature, to test the hypothesis that the scaphopod foot is ventral. Similar to cephalopods, the body orientation is confounded by ano-pedal flexion, but rationalising scaphopods is perhaps further undermined by their infaunal lifestyle, which confounds comparison of ecological life position. Some scaphopods are locally abundant, providing good quality material for anatomical study. In our focal species, Rhabdus rectius (Carpenter, 1864), sexes can reliably be differentiated *in vivo* by differential colour of the gonad (yellow in females; white in males). The gut is composed of three complete loops. Based on the orientation of the digestive tract and the dorso-ventral muscles, we find further evidence to support the interpretation that the concave side of the scaphopod shell is anterior (the site of the mouth) and the foot is ventral.

D1 Poster

ID: 142

MORPHOLOGICAL LAZARISATION: WHEN NEW TECHNOLOGY BRINGS LIFE TO HISTORICAL SPECIMENS

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This symposium will showcase the applications of state-of-the-art scientific techniques to historically important specimens and natural history collections. Classical anatomical, histological and palaeontological work established our fundamental understanding of the natural world over centuries of meticulous and dedicated research by our predecessors, much of which remains unparalleled to this day. Thanks to the curation of their work in universities and museums across the world, many of these original specimens are still available to active researchers, and the explosion of new methods over recent decades has opened fresh avenues of research using these invaluable resources. We review the application of novel techniques, primarily new imaging methods, to historic and important specimens, and look forward to the increasing role of existing natural history collections at the frontier of morphological endeavour. The pursuit of ultra-high resolution magnification, three-dimensional digital modelling, non-invasive scanning techniques, and, increasingly, elemental analyses all have enormous implications for the future of morphology. Within invertebrate morphology, the fields of palaeontology, comparative anatomy and development in particular make ideal platforms for the exploitation of these new techniques. These methods are revolutionizing our use of museum collections and reinventing their role in modern morphological research, which comes at a time of increasing threat to collections and museum curation funding. Future innovations in imaging and non-invasive analyses will doubtless accelerate the renewed research efforts dedicated to existing specimens. Most importantly, we celebrate the continued contributions to invertebrate morphology from these invaluable pieces of our scientific heritage.

ID: 482

DIGITAL METHODS FOR THE ANALYSIS OF LIFETIME IMAGES OF REGENERATING PLANARIA

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Preservation and analysis of the lifelong image of animals, such as planar planar worms - not having a rigid outer or inner skeleton, requires special conditions for unifying their condition at the time of imaging. Unified registration of the visual image of the planaria in the norm and regeneration is possible in the course of its rectilinear uniform motion along the surface with the help of cilia and it is the only possibility of creating an intravital planarian image during regeneration.

For the analysis of planar images, three different softwares were used in norm and during regeneration, (Plana 5.0 and Imager.2.0, Wormeter 1.0), which allow to characterize the growth and morphogenesis processes of a growing blastema when regenerating the head end of the body of the *Girardia tigrina* planaria. The size (area, length) of the blastema was determined using two software Plana 5.0 and Imager.2.0. This size directly depends on the number of blastema cells, so that its area can be an indirect indicator of cell proliferation during regeneration. The program Wormeter 1.0 allows to characterize the morphogenesis of the blastema through a change in its shape: from semicircular to triangular. This criterion can be an indirect indicator of cell differentiation. Thus, an integral approach has been created for the quantitative recording of growth processes and morphogenesis in the regeneration of planarians. Planarians are used as an experimental model for the study of regeneration, so that it is possible to register the same animal throughout the entire process of morphogenesis

ID: 217

COLOURFUL SHELLS: INVESTIGATING THE EVOLUTION OF SHELL COLOUR IN MOLLUSCS

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The phylum Mollusca includes some of the most beautiful exemplars of biological pigmentation. In order to better understand the evolution of shell colour we need to know more about how colour is distributed across taxonomic groups, identify shell pigments and link pigments to biochemical pathways. In this talk I discuss several projects that use museum collections to address these issues. The first looks at the distribution of shell colour in bivalves, by recording 24 shell characters for the NHM dry bivalve collection and plotting the results onto a molecular phylogeny. In the second project high performance liquid chromatography was used to identify two porphyrin pigments and eumelanin in the shell and coloured foot tissue of marine snails *Clanculus pharaonius* and *C. margaritarius*. Evidence from confocal microscopy analyses shows that the distribution of porphyrin pigments corresponds to the striking pink-red of *C. pharaonius* shells, as well as pink-red dots and lines on the early whorls of *C. margaritarius* and yellow-brown colour of later whorls. Since the same pigments occur in the shell and coloured foot tissue, the third project hypothesised that the same colour-related genes may be simultaneously expressed in both mantle (which produces the shell) and foot tissue. Transcriptomes of the two *Clanculus* species and a negative control, *Calliostoma zizyphinum*, were sequenced to identify genes associated with the synthesis of porphyrins. As expected, gene expression levels results were consistent with synthesis of porphyrin pigments in mantle and coloured foot tissue only in *Clanculus*.

ID: 264

POTENTIAL OF CONFOCAL LASER SCANNING MICROSCOPY (CLSM) AS A TOOL FOR MORPHOLOGICAL STUDY OF FREE-LIVING MARINE NEMATODES INCLUDING MUSEUM COLLECTION MATERIAL

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Recent technological advances have allowed us significantly expand our knowledge of the morphology, phylogeny and ecology of marine nematodes. Scanning and transmission electron microscopy increased the amount of morphological information. In the last decade some works have demonstrated importance of CLSM in the taxonomic study of free-living nematodes due to their natural auto-fluorescence. The aim of this work was to assess the effect of five fixatives for the preservation of marine nematodes and storage time on auto-fluorescence as well as possibility of using CLSM for different taxonomic groups of nematodes. For investigation specimens of *Enoplus* sp., *Monoposthia* sp. and *Paracanthonchus* sp. were picked up alive from sediments (one hundred individuals of each) and immediately were fixed in five different fixatives as follows: formaldehyde (4%), pure ethanol, DESS, buffered paraformaldehyde (4%) and buffered glutaraldehyde (2,5%). These species were selected because they were easily recognizable under a stereomicroscope and had a high abundance. Five specimens from each species and fixatives were processed in glycerin after 1 day, 1 week, 4 weeks and 6 months after fixation. In addition, we analyzed specimens of a large numbers of families and genera from museum collection. Fluorescence image stacks were registered in the 488-nm (green) channel. Our study shows that CLSM may be very useful and important in the morphological study of nematodes and allows describing of the peculiarities of cuticular structures (cephalic capsule, spicules and gubernaculum, teeth and mandibles etc.) including old specimens. Support: RSF 14-50-00034; RFBR 15-29-02736 ofi-m

D1 Poster