8th International Crustacean Congress (ICC-8)

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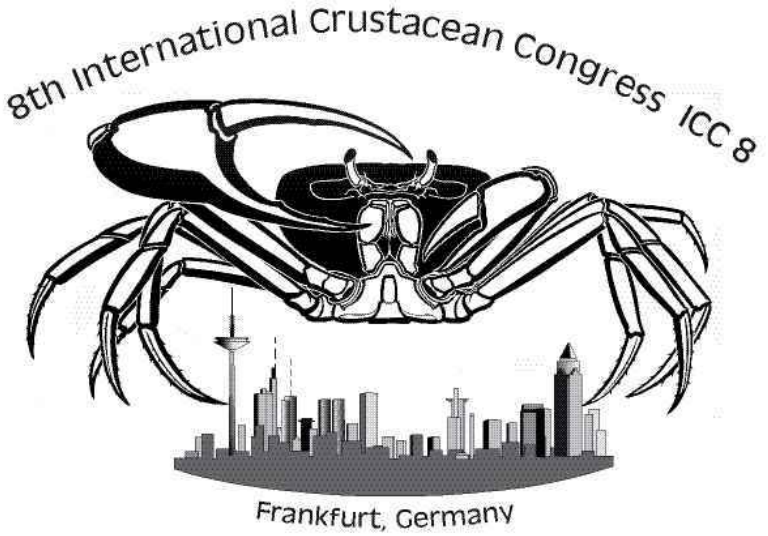

Abstract volume

Abstracts of contributions to ICC-8

The abstracts in this volume are arranged in alphabetic order with reference to the first author irrespective of the kind of presentation or the session in which they are included. In order to be able to distinguish these features a code is introduced between title and author(s).

Poster presentations are marked as “Poster”

Oral presentations bear the code “Oral” with reference to the session/symposium

BEP = Barnacle ecology and phylogeny

BLC = Biogeographic limits in the Crustacea

BR = Branchiopoda

CBF = Conservation and biology of freshwater Decapoda

CTF = Colonisation of terrestrial and freshwater habitats by decapod Crustacea

EMC = An integrative approach to ecology of marine crustaceans

GS = General Session

IC = Invasive Crustacea

MC = Marine Chelicerata

MSI = Molecular species identification

The amphipod (Crustacea: Peracarida) fauna from the South East Asian waters

Oral GS

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A survey of available published literatures, including recent systematic reviews, reveals that 513 known amphipods species have been recorded in the South East Asian waters, including 38 caprelloid species, 16 talitrid species and 459 gammaridean species. These 513 species are classified under 64 different families, among which the Ampeliscidae is the most diverse (55 species), followed by Maeridae (38 species), Aoridae (37 species), Caprellidae (31 species), Lysianassidae (30), Corophiidae (26) and finally the Ampithoidae and Photidae, each with more than 20 species. Forty-five families have fewer than 10 species recorded in each. The total number of species is spread over 7 countries namely China, Indonesia, Vietnam, Thailand, the Philippines, Malaysia and Singapore. In terms of species diversity, the richest areas are the south-eastern coast of China (297 species) followed by Indonesia (137 species), Thailand (77 species), Vietnam (75 species), Malaysia (48 species) and the Philippines (40 species). The lowest numbers of species were recorded in Singapore (14 species) but this may only reflect on the fact that insufficient information is available from this area.

Key words: Amphipods, Senticaudata, South East Asia, checklist.

Potential factors correlated to color polymorphism and genetic variability in *Leptodius exaratus* (H. Milne Edwards, 1834) from the northwest Indian Ocean

Poster

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The common intertidal crab *Leptodius exaratus*, like many other members of the brachyuran family Xanthidae, exhibits conspicuous carapace color polymorphism. This study focuses on the color pattern and genetic variability in relation to habitat, morphological factors and geographic distribution.

20 to 80 crabs were collected from each of eight sampling sites, preserved in alcohol and transported to the laboratory. The substrate from which the crabs were collected was examined. For morphological analysis, 15 characters were measured. These characters corresponded to the dorsal and ventral surfaces of body and the length of first male gonopod. Discriminant analysis shows significant morphometric differences between populations of the Persian Gulf and those of the Gulf of Oman ($P<0.001$) whereas, no positive relationship is seen between color patterns and morphological characters.

A haplotype network based on 800 base pairs of 46 specimens of mitochondrial COI was constructed using TCS. No significant relationship between the color patterns and the genetic marker could be observed. However, there is a small, but relatively consistent, divergence between the specimens form the Persian Gulf and the Gulf of Oman. Carapace color patterns were grouped in six different categories and their relationship to morphological characters, size groups, sex was investigated, none of them being significant. There was also no significant difference in frequency of color patterns except for one site, with mostly red cobbles, while other sites had multicolored cobbles and plates of rock.

In conclusion the proximate reasons for color polymorphism is more likely to be developmental variation or ecological factors influencing phenotypic plasticity, rather than genetic determination. However, variation in genes cannot be excluded, unless further research is done. The ultimate cause might be frequency dependent selection that triggers the co-existence of all different patterns in one environment.

Systematics and Phylogeny of Stomatopoda

Oral GS

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The mantis shrimps (Stomatopoda) are quintessential marine predators. Their powerful raptorial appendages, adapted to 'spearing' or 'smashing' are trademark adaptations. The raptorial strike is one of the fastest known animal movements and the force of the blow from the most powerful 'smashers' approaching that of a small calibre bullet. An equally important adaptation enabling the stomatopod to track prey and engage with its environment is acute vision, which is possibly the most complex of any invertebrate. The combination of powerful raptorial appendages and remarkably developed sensory systems place the stomatopods among the most efficient invertebrate predators. The evolution of such a potent hunting system is of considerable interest. The fossil record suggests that the hoplocarid ancestors diverged from other eumalacostracans during the Devonian, but it was not until the Carboniferous that signs of differentiation of the subchelate maxillipeds first appeared. These proto-mantis shrimp groups essentially form a 'transition series' with increasing differentiation of the second maxilliped as a raptorial claw. The claw reaches maximum development in the Unipeltata, which includes all modern stomatopods, the 'true' mantis shrimp. Phylogenetic analyses of the modern stomatopods, however, have been conducted only in the last decade or so, starting with morphological data, and more recently with molecular data. Here, I review the state of knowledge of the phylogeny and systematics of these remarkable crustaceans.

Composition, Abundance and Seasonality of Caridean shrimp larvae (Crustacea: Decapoda) in the mouth of Bahmanshir and Arvand Rivers (the northern Persian Gulf)

Poster

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The Bahmanshir and Arvand rivers are among the most important breeding sites of the major fishes in the Iranian costal (northern Persian Gulf) waters. The juveniles of these fishes depend on the availability of specific food for their survival, however this has not been studied before. We studied the caridean shrimp larvae composition on a monthly sequence together with some environmental variables on seven stations in the mouth of the rivers Bahmanshir and Arvand from February 2011 to October 2012. Specimens were collected using a plankton net with a 300 μm mesh towed through the station at 2 hour intervals.
Of the larval species identified, *Alpheus lobidens*, *Alpheus estuarensis*, *Latretus anoplonyx*, *Periclimenes brevicarpalis* and *Athanas parvus* are new records for the Iranian waters. The dominant species was *Exopalaemon styliferus*. There was an inverse relationship between species abundance and temperature. Peaks of abundance for caridean larvae occurred in June and September. High diversity occurred in April and June when caridean larval abundance was lowest as compared to June and September. Spatially, highest diversity was recorded at stations located towards the open sea as compared to the stations located in inshore rivers.

Keywords: larval composition, larval abundance, Persian Gulf, Decapoda, Caridea

Naupliar and metanaupliar development of *Thysanoessa raschii* (Malacostraca, Euphausiacea) from Godhåbsfjord, Greenland

Poster

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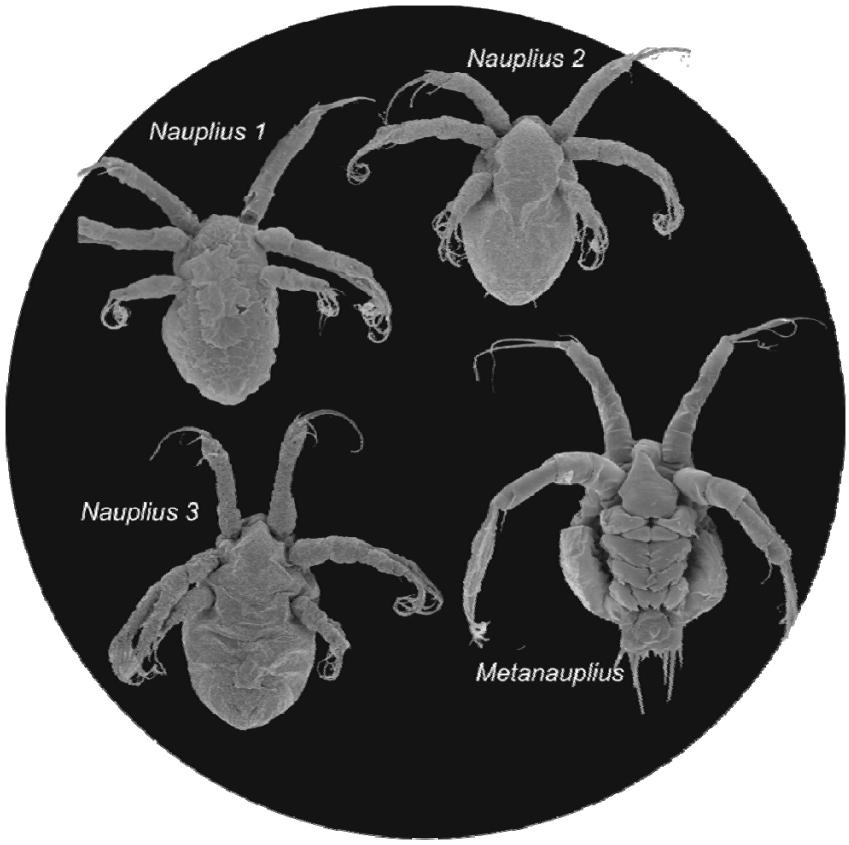
Euphausiaceans, or krill, are one of the dominant animal groups in the plankton of the world oceans, not least their larvae can be very abundant. The development of euphausiaceans is well-known to start with a typical crustacean-type nauplius. Despite this abundance largely no data using scanning electron microscopy (SEM) is available in the literature. Based on material of *Thysanoessa raschii* collected in Godhåbsfjord at Greenland, we describe the external morphology of three naupliar stages and the following metanauplius. Among the new findings are that we establish the presence of three naupliar stages, which is in contrast to some earlier papers where only two such stages have been reported. The most significant differences between the three naupliar stages are found in the number and size of the spines at the hind body. New features described for the metanuplius include the presence of a 'biramous' rudiment of the mandibular palp and two small 'frontal organs' projecting anteriorly between the antennules. Many other structures are known from previous works, but are by this SEM study described in more detail. This may prove important for a wider comparison with larvae of other crustaceans (both recent and fossils) in a phylogenetic context.



Attachment Organ Morphology in Pedunculated and Sessile Barnacles from the upper rocky intertidal: Does it relate to the habitat?

Poster

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Irrespective of habitat and substratum, all barnacles initiate the sessile part of the life cycle when a cypris larva cements itself upon the substratum. Not surprisingly there have been numerous studies on the settlement biology of the cypris but almost all of these have concerned only a handful of species. This is also true for morphological studies where only a very few have taken a comparative approach and studied species from different habitats.
Here we use SEM to examine cypris antennular morphology in barnacles from the rocky intertidal in search of similarities that may indicate adaptations to this particular habitat. We include both three balanomorphan species and one of the few pedunculated species (*Capitulum mitella*) inhabiting rocky shores. For comparison we include cyprids from both intertidal and subtidal species that are epibiotic: Balanus spongicola and Savignium cretatum, which are balanomoprhans epibiotic with marine sponges and stony corals; Verruca stroemia from the Verrucomorpha, which is the sister group to the Balanomorpha and therefore systematically placed between them and the pedunculated forms and epibiotic on e.g. hydroids and other barnacles; and Scalpellum scalpellum from the subtidal range, which is epibiotic on a range of invertebrates such as hydroids and polychaetes. In all the examined species from the rocky intertidal (both the balanomorphans and C. mitella) the attachment disk is symmetrically bell shaped. This all entails that the attachment disc is near circular in outline and oriented distally relative to the central axis of the segment. In all the epibiotic species the attachment disk is distinctly shoe shaped in lateral view or even (the coral barnacle) extremely elongated and shaped as a spear. This entails that the disc surface is orinted ventrally relative to the long axis of the third segment. In the epibiotic species the disk surface is also elliptically shaped, because it is considerably longer than wide. We conclude from this that there is a clear correlation between attachment organ morphology and the habitat frequented by the species. This morphological difference may again correlate with habitat related differences in surface exploration behaviour of the settling cyprids. Biometrical studies on cyprids from species representing diverse habitats and direct observations of their settlement behaviour are needed to further support this hypothesis.

Description of two thalamitid first stage zoea (Crustacea: Decapoda: Brachyura: Portunidae) from the Red Sea

Poster

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The first zoeal stage of *Thalamita poissonii* AUDOUIN, 1826 and *T. danae* STIMPSON, 1858, collected from the Red Sea are described with illustrations. The characteristic features of zoea I of *T. poisonii* collected here were compared with those of the same species described from the Red Sea in 1963. Variations were found in the aesthetacs, the number of antennules, the exopod setal number of antenna, coxal setal number of maxillule, coxal and basial setal numbers of maxilla, and the basial and endopodal setal patterns of maxilliped I.
Features of *T. danae* compared with those of zoea I of the same species described from the intertidal regions of Penghu Island, Taiwan revealed variations in the setal patterns of antenule, antenna, maxilla and maxilliped I and the number of lateral outer spines of telson. The features of these two species are also compared with that of other congeneric species.

A review of the abdominal parasitic isopods from China

Oral GS

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A review of abdominal bopyrid species including distribution and hosts have presented. Three species are from the subfamily Athelginae parasitizing hermit crabs, and other two species are from the subfamily Hemiarthrinae infesting alpheid shrimp.
Athelges takanoshimensis Ishii, 1914 is recorded from China on *Pagurus pectinatus* (STIMPSON) and Hong Kong on *Pagurus minutus* Hess. *Parathelges enoshimensis* SHIINO, 1950 is recorded outside of Japan and Korea and on a member of the genus *Spiropagurus*. *Pseudostegias setoensis* SHIINO, 1933 is recorded from Hong Kong on *Clibanarius virescens* Hess, from Hainan Province on *Calcinus laevimanus* (RANDALL).
Fourth species is *Eophrixus shoji* SHIINO, 1941 infesting *Alpheus microstylus* (Bate) from Xisha islands of China. Fifth species is *Eophrixus branchialis* n.sp. infesting *Alpheus digitalis* De Haan from Sanya of China. A combination of light and scanning electron microscopy is used to investigate the morphology of these species and data on their prevalence with hosts is provided.

References:

ISHII, S. (1914): On a new epicaridean isopod (*Athelges takanoshimensis* sp. nov.) from *Eupagurus samuelis* Stimpson. Annotationes Zoologicae Japonenses, **8**: 519-530.

SHIINO, S. M. (1933): Bopyrids from Tanabe Bay. Memoirs of the College of Science, Kyoto Imperial University, (B) **8** (3, Article 8): 249-300.

SHIINO, S. M. (1941): Further notes on bopyrids from Kyusyu and Ryukyu. Annotationes Zoologicae Japonenses, **20** (3): 154-158.

SHIINO, S. M. (1950): Notes on some new bopyrids from Japan. Mie Medical Journal, **1** (2): 151-167.

Morphometric characterisation of adult coconut crabs *Birgus latro* (Decapoda: Anomura: Coenobitidae) from Christmas Island in the Indian Ocean

Poster

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Carapace and cheliped morphometry of a population of adult and sexually mature individuals of the coconut crab *Birgus latro* (Decapoda: Anomura: Coenobitidae) from Christmas Island in the Indian Ocean was analysed in order to provide statistical evidence for heterochely and sexual dimorphism with regard to body size, cheliped size and heterochely. The measured carapace and cheliped parameters were: carapace length (CL), cephalic shield length (CSL), thoracic length (TL) and width (TW), cheliped propodus length (CPL) and width (CPW), dactylus length (CDL), and merus length (CML). Additionally, body weight (W) was determined. For analyzing intrasexual heterochely as well as sexual dimorphism with respect to cheliped size and heterochely, standardised values of the measured cheliped parameters corrected for size and allometric shape were used (see LLEONART et al., 2000). For the allometric analyses of W, CPL, CPW, CDL, and CML in relation to TL, two statistical methods were applied and compared in order to identify the least error-prone method: a conventional linear Model II regression and a Model II non-linear analog of Reduced Major Axis Regression (RMA) (see ZAR, 1968 and PACKARD, 2012). The absolute dimensions of W, CL, CSL, TL, and TW were significantly smaller in females than in males, confirming a pronounced sexual dimorphism in body size. Both statistical methods applied to determine allometry resulted in the same pattern of allometry for the analysed parameters. However, the model fitted by the Model II non-linear analog of RMA regression mostly showed a better fit to the data than the model fitted by the conventional linear Model II regression. In both sexes, W followed isometry. The cheliped parameters of females showed shallower allometric slopes than those of males. In both females and males, the dimension of the left cheliped parameters was significantly larger than that of the right (as typical for Coenobitidae), except for CML in females. The degree of heterochely for all cheliped parameters was significantly larger in males than in females, providing evidence for a sexual dimorphism with respect to cheliped size and heterochely.

References:

LLEONART, J., SALAT, J. & TORRES, G. J. (2000): Removing allometric effects of body size in morphological analysis -- Journal of Theoretical Biology, **205**: 85-93.

PACKARD, G. C. (2012): Julian Huxley, *Uca pugnax* and the allometric method -- The Journal of Experimental Biology, **215**: 569-573.

ZAR, J. H. (1968): Calculation and miscalculation of the arithmetic equation as a model in biological data -- Bioscience, **18**: 1118-1120.

Life-history patterns in freshwater Decapoda

Oral CBF

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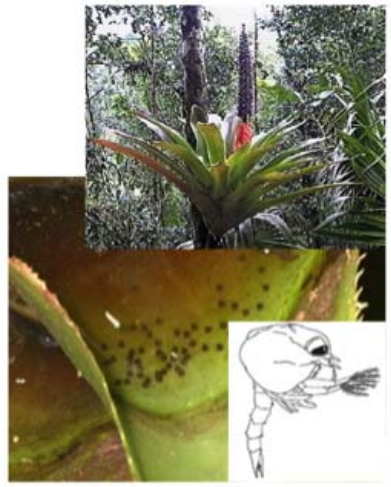
Life-history patterns (modes of reproduction and early postembryonic development) in decapod crustaceans are reviewed in relation to different life styles (marine, freshwater, terrestrial). An extended planktonic (and planktivorous) larval phase is generally considered as ancestral, abbreviated larval and direct modes of development (partially or completely non-feeding) as derived patterns. An extended planktonic development is typical of coastal and fully marine species (reflecting the evolutionary origin of the Decapoda from the sea), whereas an abbreviation or complete elimination of the larval phase occurs mainly in fresh water (e.g., abbreviated development in the bromeliad crab, *Metopaulias depressus*, and other Sesarmidae breeding in fresh water). However, there are many exceptions to this rule, with abbreviated and direct developmental modes found also in the sea (mostly at high latitudes and in commensal species) or, although less frequently, with an extended larval phase in fresh water. The main factors selecting in fresh water against a physiologically and nutritionally vulnerable larval phase are: (1) osmotic stress; osmoregulation is mostly found only in juveniles and adults, but not in larvae; (2) insufficient or unreliable production of planktonic food. Numerous freshwaterinhabiting decapods show amphidromous migrations, in some species over >1.000 km, to release their larvae in estuarine or coastal marine waters, where they pass through an extended planktonic development (e.g., the mitten crab, *Eriocheir sinensis*). Since a part of their life cycle, the early postembryonic phase, depends on marine conditions, amphidromous decapods cannot be considered as true freshwater species. In caridean shrimps, especially in those with abbreviated developments, the classification of life-history patterns is made difficult also by problems of definition, distinguishing late larval from early juvenile stages. Better understanding of relationships between life-history patterns and life styles requires more studies of the ontogeny of functional morphology, e.g. of feeding and locomotory appendages, and of physiological features such as osmoregulatory capacity.



Breeding habitat of the crab *Metopaulias depressus*: rainwater-filled bromeliad leaf axils; Zoea I: GONZÁLEZ-GORDILLO et al. (2010).

References:

BOND-BUCKUP, G. ET AL. (2008); CRANDALL, K.A. & BUHAY, J.E. (2008); DE GRAVE, S. ET AL. (2008); YEO, D.C. ET AL. (2008). IN: BALIAN, E.V., LÉVÊQUE, C., SEGERS, H., MARTENS, K. (Guest Editors): Freshwater Animal Diversity Assessment. -- Hydrobiologia 595.

CIELUCH, U., ANGER, K., CHARMANTIER-DAURES, M., CHARMANTIER, G. (2007). Osmoregulation and immunolocalization of Na+/K+-ATPase during the ontogeny of the mitten crab *Eriocheir sinensis* (Decapoda, Grapsoidea). -- Marine Ecology Progress Series 329: 169-178.

GONZALEZ-GORDILLO, J.I., ANGER, K., SCHUBART, C.D. (2010). Morphology of the larval and first juvenile stages of two Jamaican endemic crab species with abbreviated development, *Sesarma windsor* and *Metopaulias depressus* (Decapoda: Brachyura: Sesarmidae). -- Journal of Crustacean Biology 30: 101-121.

SCHUBART, C. D., WEIL, T., STENDERUP, J. T. CRANDALL, K. A., SANTL, T. (2010). Ongoing phenotypic and genotypic diversification in adaptively radiated freshwater crabs from Jamaica. -- In: GLAUBRECHT, M. (Ed.). evolution in Action. Berlin, Springer-Verlag.

VOGT, G. (2013). Abbreviation of larval development and extension of brood care as key features of the evolution of freshwater Decapoda. -- Biological Reviews 88: 81-116.

Significant fluctuations in the ecdysteroid receptor (*EcR*) gene expression in relation to seasons of molt and reproduction in the grapsid crab, *Metopograpsus messor* (Brachyura: Decapoda), from the Indian peninsula

Oral GS

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Metopograpsus messor, an estuarine brachyuran crab, is a prolific breeder releasing approximately 14 to 16 broods a year. The present work depicts the first time report from a crustacean, the significant fluctuation in the expression of the ecdysteroid receptor gene *(EcR)* in the ovary, cuticle and the hepatopancreas throughout its annual cycle, with special reference to seasons of molt and reproduction. *EcR* expression is found to be at its peak in late premolt crabs during January/May (molt/reproduction season); the expression reaches the lowest profile ($p < 0.05$) during June/July when none of the females would engage either in molt or in reproduction.

Medium levels of expression were found during the breeding season (August/December). Interestingly, this pattern of (gene) expression is in consonance with the fluctuating ecdysteroid levels of the hemolymph and the Y organ secretory activity. The significant levels of fluctuation in the ovarian expression of *MmEcR* strongly suggest the ovary as a potential target for ecdysteroid action. A season-wise comparison of the gene expression reveals that the *MmEcR* expression is more in breeding crabs (August/December) than those of the non-breeding ones (June/July), implicating a possible ecdysteroid role in reproduction in *M. messor*.

References:

LIVAK, K.J. & SCHMITTGEN, T.D. (2001): Analysis of Relative Gene Expression Data Using Real-Time Quantitative PCR and the $2^{-\Delta\Delta CT}$ Method. Methods. **25**: 402–408.

SUDHA, K. & ANILKUMAR, G. (2007): Elevated ecdysteroid titer and precocious molt and vitellogenesis induced by eyestalk ablation in the estuarine crab, *Metopograpsus messor* (Brachyura: Decapoda). J. Crust. Biol. **27**: 304-308.

SIRINART, T. & CHUNG, J.S. (2013): Ecdysone and retinoid-X receptors of the blue crab, *Callinectes sapidus*: Cloning and their expression patterns in eyestalks and Y-organs during the molt cycle. Gene, **527**: 139-53.

An attempt of the first complete contemporary inventory of decapod (Crustacea: Decapoda) species richness in the seas of the Russian Federation

Oral GS

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A recently accomplished inventory of marine decapods species in the seas of Russia (see reviews in SOKOLOV, PETRYASHOV, VASSILENKO, 2009; ANOSOV, SPIRIDONOV, MARIN, 2012; MARIN, 2013; SPIRIDONOV, PETRYASHOV, MARIN, 2013) makes possible a discussion on Decapoda species richness and diversity patterns of in 13 of 20 marine basins of the Northern Eurasia (see Table). Brackish water faunas of the Baltic, the Azov and the Caspian seas, primary non-diverse, are recently impoverished in addition and influenced by alien species (with the higher shares more than 40% in the Baltic and Caspian seas). Species richness in the Black Sea is similar to the same level as in the Barents and the Chukchi seas but in contrast to the Arctic seas shows higher contribution of Anomura and Brachyura then Caridea with the share of alien species about 18%. Arctic decapod fauna is strongly dominated by Caridea, with the total number of species halves east of the Barents Sea (with an addition of Atlantic species) reaching to minimum in the Laptev Sea. The Chukchi Sea possesses similar species richness to the Barents Sea owing by the presence of Pacific taxa. Fauna of Bering Sea sharing Arctic and Pacific fauna enriched by the number of Commander-Aleutian species additionally. The Russian Pacific side seas house much greater diversity of Decapoda still showing the dominance of Caridea (with the maximum in the Sea of Okhotsk as the NWP center of pandalid and hippolytid shrimps biodiversity) as well as a significant contribution of Anomura and Brachyura (especially in the Sea of Japan owing to temporary warm waters impact). At the same time, this study is not final as new species still can be discovered, especially in deep waters, as well as a revision of a number of scientific names is greatly claimed.

This study is supported by the grant of the President of the Russian Federation MK-4481.2014.4 and Russian Foundation of Basic Research grant 12-04-00540-a, 13-04-01127-a, 14-04-10183-k.

Table. Number of Decapoda species in the seas of Russia. ESS – East Siberian Sea; NWP – North-western Pacific adjacent to Commander, and northern Kuril Islands and East Kamchatka. For the Baltic, Bering seas and the Japan Sea only the waters under Russian jurisdiction are assessed. Number of alien species is given in brackets.

SEA	Carid	Anom.+ Brach.	Others	Total	SEA	Carid	Anom.+ Brach.	Others	Total
Black	14	25	7	46 (8)	Laptev	18	2	0	20 (0)
Azov	3	4	3	10 (2)	ESS	15	5	0	20 (0)
Caspian	2	2	3	7 (4)	Chukchi	28	16	0	44 (0)
Baltic	3	2	0	5 (2)	Bering	52	27	2	81(0)
Barents	29	10	1	40 (2)	NWP	56	37	4	97 (0)
White	13	3	0	16 (1)	Okhotsk	75	55	2	132 (1)
Kara	17	1	1	19 (0)	Japan Sea	71	63	9	143 (0)

ANOSOV S.E., SPIRIDONOV V.A., MARIN I.N. 2012. Revised check-list of the Black Sea Decapoda. -- Abstracts of CSSM – Colloquium Crustacea Mediterranea. 2012. Athens. Electronic publication.

MARIN I.N. 2013. Atlas of Decapod Crustaceans of Russia. M.: KMK Scientific Press. 145 pp.

SOKOLOV V.I., PETRYASHOV V.V., VASSILENKO S.V. 2009. Order Decapoda. -- In: S.V. Vasilenko, V.V. Petryashov (eds). Volume I. Illustrated Keys to Free-living Invertebrates of Eurasian Arctic Seas and Adjacent Deep Waters. Alaska Sea Grant College Program, University of Alaska Fairbanks, pp. 12–178.

SPIRIDONOV V.A., PETRYASHOV V.V., MARIN I.N. 2013. Order Decapoda. -- In: Sirenko B.I. (ed.) Check-list of species of free-living invertebrates of the Russian Far Eastern seas. Explorations of the fauna of the seas. 75(83). St. Petersburg, pp. 116–118.

X-ray irradiation of male crayfish to control invasive populations: encouraging but not predictable results

Poster

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The North American red swamp crayfish *Procambarus clarkii* is a paradigm of freshwater invaders. Several attempts have been made to mitigate the multilevel impact of this species, but none has been successful to date. Preliminary results from the innovative Sterile Male Release Technique (SMRT) are encouraging (AQUILONI et al. 2009) and its field applicability has been recently tested in a small lake of the Friuli Venezia Giulia (Italy). SMRT is based on capturing, sterilizing by X-ray irradiation, and releasing large numbers of males into the wild to mate females, who will then produce non-viable eggs. This technique causes no environmental contamination or non-target impacts, it is species-specific and, differently from traditional trapping, it is efficacious also at low density (GHERARDI et al 2011). Supported by the LIFE RARITY (LIFE 10 NAT/IT/000239) project, here we tested the effects on mating behaviour, reproductive output, and gonad damages induced by different X-ray doses to identify the best dosage to produce sterile males. To this purpose, a control group of males was compared with groups of irradiated males at 20, 40, or 60 Gy (n=30 per group). The damages recorded in the testes (i.e. decreased GSI and shortened seminiferous tubules) increased with irradiation dose, with the exception of the number of pyknosis that in the 60 Gy-males decreased to the control level. The irradiated testis shows spermatogenic germ cells with anomalous meiotic division and supporting cells containing up to 3 micronuclei. In the 60 Gy-testis, the seminal acini contain only cells with large vacuolation and membrane rearrangements. The mean diameter of seminal acini from control is larger than those of the irradiated males. No behavioural alteration occurs, even if a slight shortening of the copula was recorded with 60 Gy. Increasing doses produced a progressive reduction of male fertility (Fig. 1), but the effect obtained is not comparable than those reported in Aquiloni et al. (2009): the damages potentially produced by a X-ray dose are strictly dependent by the biological cycle (i.e. meiotic rate). So, a better identification of the irradiation time is crucial to achieve highest male sterility per dose. Taken together, these results suggest that SMRT could effectively pull down crayfish recruitment, even if the effects of proven dose of X-rays on the male fertility are not easily predictable.

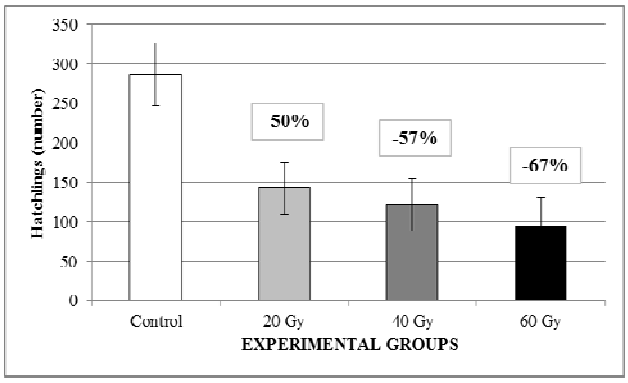

Fig. 1. Mean number (±SE) of hatchlings born from females mated with control and treated

References:

AQUILONI, L., BECCIOLINI, A., BERTI, R., PORCIANI, S., TRUNFIO, C., GHERARDI, F. (2009): Managing invasive crayfish: using X-ray sterilization of males. -- Freshwater Biology, **54**:1510–1519

GHERARDI, F., AQUILONI, L., DIÉGUEZ-URIBEONDO, J., TRICARICO, E. (2011): Managing invasive crayfish: is there any hope? -- Aquatic Sciences, **73**:185–200

Diversity and structure of rich pycnogonid communities off Terre Adélie and George V Land, East Antarctica

Oral MC

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Nymphon australe Hodgson, Antarctic circumpolar species

Pycnogonids are a prevalent and diverse component of the Southern Ocean benthos. Around 20% of the world species are found in Antarctic and subantarctic waters. The benthic diversity from the East Antarctic region is relatively unknown compared to other regions such Antarctic Peninsula and Ross Sea. The Collaborative East Antarctic Marine Census (CEAMARC) was conducted by Australia, Japan, France and Belgium in 2007/08 and aimed to investigate and document the biodiversity of benthic and pelagic communities present in the Dumont d' Urville Sea, between the Mertz Glacier and Dumont d' Urville. Pycnogonids were collected at 67 of 74 benthic trawl stations, in depths between 100 and 2050 m, accounting for more than 2000 individuals in 77 species and 14 genera. The study added fourteen species as first records from East Antarctica and found at least four species new to science. The genus *Nymphon* was the most diverse (20 spp.) and also the most abundant. Almost 60% of all pycnogonids were *Nymphon australe*, this dominant species was found at 70% of the sites. *Colossendeis* was the second most diverse genus with 17 species, followed by *Ammothea* and *Pallenopsis* with 14 and eight species respectively. Multivariate analyses separated *Nymphon*-dominated from Colossendeids-dominated clades while *Pallenopsis*, *Achelia* and *Pycnogonum* were characteristic of the shelf edge sites. Compositional patterns were most strongly related to sediment properties, with depth and other variables of secondary importance. This result differs to those from a Weddell Sea study in which a clear bathymetric pattern in species composition and abundance was found. The analyses of video transect data from a subset of sites provided insights into the relationships between pycnogonid community composition and benthos cover including abundance of corals, sponges and bryozoans. This study has revealed a high species richness of pycnogonids on the East Antarctic region compared to other better sampled Antarctic areas adding enormous conservation value to the largely diverse benthic 'gardens' off Terre Adélie and George V Land in the East Antarctica. This project based on CEAMARC material also aimed at investigating diversity at species level using genetic markers such COI. Traditionally, *Nymphon australe*, the most abundant species all around Antarctica was believed to be a multi-species complex yet to be properly differentiated. In this study, COI has consistently defined *N. australe* as a valid circumpolar species while finding significant geographic differentiation among populations, while other genetic markers including microsatellites were not as successful. Questions arising from these results relate to the factors and mechanisms for dispersal and population divergence, a possible genetic subdivision based on bathymetric structure and how pycnogonid life history traits could predict population structure in *N. australe*.

Deep Sea Shrimps: *Glyphocrangon* (Decapoda: Caridea) From Potiguar Basin, Northeastern Brazil

Poster

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The caridean shrimps of the genus *Glyphocrangon* A. MILNE-EDWARDS, 1881 constitute a monotypic family, Glyphocrangonidae SMITH, 1884. The species of this genus are exclusively inhabitants of deep oceanic regions, with the distribution between 150 and 6,500 m depth. This paper aims to enrich the knowledge of deep sea shrimps of the genus *Glyphocrangon*, reporting their occurrence and bathymetric distribution in the Potiguar Basin, Northeastern Brazil. The Potiguar Basin is located between the states of Rio Grande do Norte and Ceará. Its submerged area comprises approximately 38,500 km² distributed between the continental shelf and slope, to the 2,000 m isobath. The samplings were made with ship Seward Johnson, by bottom trawling at depths of 150, 400, 1,000 and 2,000 m, using otter trawl semi-balloon with a mesh of 50 mm and 18 m of opening. After samplings, individuals were identified and stored in the carcinological collection of the PETRÔNIO ALVES COELHO Oceanography Museum. A total of 810 shrimps were analyzed and five species of the genus *Glyphocrangon* were identified, namely: *G. aculeata*, *G. alispina*, *G. longirostris*, *G. sculpta* and *G. spinicauda*. The species *G. spinicauda* was the most abundant with 334 individuals. All species were recorded for the first time at the study area. It was observed that the cited species occurred in depths from 150 m in the slope, i.e., in waters shallower than previous records. Except for *G. sculpta*, which was located only at the depth of 2,000 m. Probably, that's because in the northeastern region of Brazil, the shelf break is shallower and the slope is steeper, when compared to the southeastern region of Brazil. The Brazilian deep sea fauna is still poorly studied, due to logistical difficulties and the high sampling cost. More incentive for the research of this fauna is necessary, aiming the conservation of the species.

References:

HOLTHUIS, L.B., 1971. The Atlantic shrimps of the deep-sea genus *Glyphocrangon* A. Milne Edwards, 1881. Bulletin of Marine Science, Miami, 21(1): 267-373.

KOMAI, T., 2004. Deep-sea shrimps of the genus *Glyphocrangon* A. Milne-Edwards (Crustacea, Decapoda, Caridea, Glyphocrangonidae) from off Southeastern coast of Brazil collected during the Revizee program. Arquivos do Museu Nacional, Rio de Janeiro, 62(1): 31-44.

RAMOS-PORTO, M.; SILVA, K.C.A.; VIANA, G.F.S.; CINTRA, I.H.A ., 2000. Camarões de profundidade coletados no Norte do Brasil (Crustacea: Penaeidea e Caridea). Trabalhos Oceanográficos da Universidade Federal de Pernambuco, 28(1): 71-85.

Deep-Sea Tanaidacea (Peracarida) the Hole in the Phylogeny. A Combined Molecular and Morphological Approach

Poster

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In the deep-sea environment, the order Tanaidacea is one of the dominant invertebrate groups and it is here the diversity is the highest. It is also from the deep-sea that we lack the most critical genetic information, due to the logistic problems of getting fresh deep-sea material for genetic studies. Furthermore, typical deep-sea sampling yields multiple singletons but only a few samples (maybe 1 in 100) will contain several specimens of one species. In the current systematics of the Tanaidacea there are more than 25 deep-sea genera which currently are considered 'incertae sedis'. This is a testimony of the confused state of the current phylogeny caused by conservative or convergent morphology and a gigantic level of homoplasy. Our study focus is on specimens collected from the Mid-Pacific Ocean (NODBIO cruise) and Antarctica (ANDEEP cruises). Several new genera and species of Tanaidacea were found. Our preliminary molecular studies have allowed for confirmations of con-specificity of specimens with dimorphic males. To date we have identified and sequenced 30 deep-sea taxa belonging to a nice 'spread' of families as well as many 'incertae sedis' (Table 1). The DNA extraction and amplification followed the protocols developed by Larsen & Froufe (2010). The target genes were fragments of cytochrome oxidase 1 (COI), ribosomal 28S, and nuclear histone 3 (H3). It is important to emphasize the difficulty in extracting DNA from tanaids. Although the material had been correctly fixed and was relatively fresh it was difficult to get sequences from all three target genes in many specimens. Therefore, while we are not 'there' yet, we hope to solve many of the systematical problems by discovering and adding new characters, both morphological and molecular.

Table 1. Taxa and genes already sequenced from deep-sea Mid-Pacific Ocean.

Number of taxa sequenced	28S	COI	H3
30	21	16	13

References:

ANDERSON, G. (2013): Tanaidacea Taxa and Literature. Available from: http://peracarida.usm.edu/ (accessed 19 April 2014)

BIRD, G.J. & LARSEN, K. (2009): Tanaidacean Phylogeny: The second step. The basal Paratanaoidean families. Arthropod Systematics & Phylogeny, **67** (2), 137–158.

DRUMM, D.T. (2010): Phylogenetic relationships of Tanaidacea (Eumalacostraca: Peracarida) inferred from three molecular loci. Journal of Crustacean Biology **30** (4): 692-698.

LARSEN & FROUFE (2010): Identification of polymorphic species within groups of morphologically conservative taxa: combining morphological and molecular techniques. *In*: NIMIS P.L. & VIGNES-LEBBE R. (eds) Tools for identifying biodiversity: progress and problems. Trieste: Edizioni Universita` di Trieste, pp. 301–305.

The exotic crab *Charybdis hellerii* in Paranaguá bay, southern Brazil

Poster

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Charybdis hellerii (A. MILNE-EDWARDS, 1867) is a Portunidae crab, native of western Indo-Pacific Ocean. Their geographical distribution has expanded as a result of current human activities. The introduction on the American continent was assigned to the problem of ship ballast water or by hull vessels (LOPES, 2006). In Brazil, the first records occurred since the 1990s (TAVARES JR & MENDONCA, 1996). The estuarine complex of Paranaguá bay (CEP) is an intricate system of continental drainage. The rich biota justifies the several protected areas and supports important extractive activities, like crab capture. In this way, this work aims to generate a first description of population stage of this exotic crab in the CEP region and also estimate their invasive potential. In CEP, the first record of *C. hellerii* was an ovigerous female collected in 2010 next to the port of Paranaguá (BAPTISTA-METRI & METRI, 2011). Recently, significant concentrations of the species were found in two other localities: Ponta do Poço (MELPORT, 2013) and Banana Island. On these occasions several individuals were collected, measured, weighed, and had their maturation stage determined. Most individuals were collected manually under rocks of the intertidal zone to 2m deep, but few were collected by trawl in the sandy bottom. By the time, 65 individuals were collected, 43 males and 22 females. Over 90% were adults. Among females, 11 were ovigerous. The carapace width of males ranged from 32.9 to 85.2 mm, with mean of 59.2 mm. The weight ranged from 6.1 to 85.2 g with mean of 58.9 g. Females showed greater variation of size (from 12.6 to 92.5 mm with mean of 46.8 mm) and weight (0.8 to 111.3 g with a mean of 27.5). The size of the ovigerous females ranged from 20.4 to 92.5 mm with a mean of 37.6 mm, indicating a reproductive activity even in small individuals. Ovigerous females occurred in all seasons. Data obtained indicate that the species is established in the region occupying shallow rocky habitats. There are indications that the introduced species is influencing the occupation of habitat for native species, notably *Mennippe nodifrons* Stimpson, 1859 (MELPORT, 2013) that lives at the same habitats. This suggests that *C. hellerii* is invasive. Since in the CEP is located one of the largest Brazilian ports - the Port of Paranaguá - with intense ship traffic, it can be inferred the ballast water or ship hulls as the introduction via. However, as reported for other areas, the high dispersal capacity may be the main mechanism. This hypothesis is supported by the presence of the species in the Guaratuba bay (FRIGOTTO *et al*, 2007), about 40 km away, where no ship traffic is observed; and by the observation of the high reproductive capacity of the species. In this sense, is imperative a greater sampling effort and monitoring the occurrence environments of this species.

References

BAPTISTA-METRI, C.; METRI, R. 2011. Ocorrência de uma fêmea ovígera do siri invasor *Charybdis hellerii* em Paranaguá, sul do Brasil. In: XIV Anais do XIV Congresso Latino Americano de Ciências do Mar, n°368.

FRIGOTO, S. F., SERAFIM JR, M. 2007. Primeiro Registro de *Charybdis hellerii* (Milne Edwards, 1867) (Crustacea) no litoral do Estado do Paraná. Estud. Biol: n. 29, v. 67: p. 227-230.

LOPES, R. M. 2009. Informes sobre espécies marinhas no Brasil. Brasília: MMA/SBF, 440pp.

MELPORT. EIA/RIMA 'Projeto Litoral II'- MEGAFAUNA. Melport Terminais Marítimos LTDA. 2013.

TAVARES, M.; MENDONÇA JR., J.B. 1996. *Charybdis hellerii* (A. MILNE-EDWARDS, 1867) (Brachyura, Portunidae), eighth nonindigenous marine decapod recorded from Brazil. Crust. Res., n. 25: p. 151-157.

Phylogenetic relationships within the shrimp genus *Plesionika* (Decapoda: Pandalidae) in the Atlantic Ocean and Mediterranean Sea based on mtDNA

Poster

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The caridean shrimp genus *Plesionika* BATE, 1888, consists mainly of deepwater representatives and is one of the most speciose genera among the Decapoda, with 92 extant species, of which twenty-two are distributed in the Atlantic Ocean and Mediterranean Sea. Most previous studies of this genus only considered morphology, but a recent paper revealed high genetic divergences and apparent paraphyly within the genus, highlighting the need to continue reviewing the phylogeny with molecular tools. The present work aims to study the diversity patterns of *Plesionika* in the Atlantic and the Mediterranean using partial fragments of the mitochondrial genes Cox1 and 16S. Preliminary results reveal discrepancies from the current taxonomy, confirming the previously suggested paraphyly of the genus *Plesionika*, which seems to embark representatives of *Chlorotocus*, *Pandalina*, and *Stylopandalus*. A lack of genetic differentiation between *Stylopandalus richardi* and *Plesionika narval* was noticed, which may reflect incomplete lineage sorting (recent speciation), hybridization, or phenotypic plasticity (ecomorphs of the same species). The genetic distances between the amphi-Atlantic populations of the presumed circumtropical species *Plesionika edwardsii* question the existence of a single species: two distinct clades are discernible, a western population including the Brazilian specimens and an eastern one with the European (Portugal and Italy) specimens. The results suggest lack of gene flow across the Atlantic Ocean and possibly cryptic speciation.

Reproductive morphology of carrier crabs – A phylogenetic account of copulatory systems and sperm storage organs (Decapoda: Brachyura: Homoloidea)

Oral GS

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The brachyuran group Homoloidea is mainly constituted by carrier crabs (Homolidae) and the spidery-looking Latreillidae. The last pair of walking legs is oriented subdorsally in both taxa and typically used for carrying camouflage. As in all podotreme brachyurans, the sperm storage structures of female homolids are cuticular and situated at the boundary between thoracic segment 7 and 8. These spermathecae are assumed to have no internal connection with oviducts wherefore fertilization is external: spermathecal openings are situated onto the sternum while gonopores open separately on the coxae of walking legs (P3). Due to the cuticle lining of podotreme spermathecae, male sperm is shed when moulting. When mating, the male transfers the sperm directly into the female spermathecae by their two pairs of copulatory appendages (gonopods). We investigate the male copulatory organs and the female spermathecae among homolids by light microscopy, scanning electron microscopy and micro computer-tomography. Our results show, that male copulatory systems are very consistent in homolids and latreillids but strikingly different from other podotreme groups as dromiids. In Homoloidea, the tubular first gonopods are the actual sperm transmitters and specifically correspond to female spermathecal openings. Second gonopods are reduced in size and strongly resemble many eubrachyuran second gonopods, apparently a convergency in the evolution of brachyuran gonopods. However, the mechanism of sperm transfer is supposed to function similarly: while the first gonopod is inserted into the female spermathecal opening, the second gonopod is supposed to work like a piston inside the ejaculatory canal of the first and therefore pushes sperm upwards and into the female spermatheca. In the present study, histological data on the internal morphology of spermathecae is provided for the first time and reveals a surprisingly complex organization and an arrangement of musculature attached to it. We compare our results on the reproductive morphology of Homoloidea with other podotremes and eubrachyuran groups in terms of phylogenetic relationships and the evolution of reproductive traits, particularly with regard to sperm storage, among the Brachyura.

Flexible microhabitat partitioning in marine congeneric amphipods

Oral EMC

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Microhabitat partitioning is a widespread mechanism which reduces competition and thus facilitates the coexistence of species. The extent to which microhabitat partitioning occurs, depends on a variety of environmental parameters and biotic interactions. In the present study, we manipulated factors which potentially influence the differential use of microhabitats by two hemi-sessile congeners that coexist on small spatial scales at very high densities: the amphipod crustaceans *Jassa marmorata* and *Jassa herdmani*. In both species, the presence of heterospecifics had a clear effect on which part of an offered macroalga was preferably colonized, suggesting that the extent of microhabitat partitioning depends on the presence/absence of heterospecifics. Furthermore, 'fish cues' in the seawater induced a predator avoidance behaviour which reduces the extent of habitat partitioning and thus inevitably increases competition between the species. The results clearly show some flexibility of habitat selection in, and thus habitat segregation between, the studied species allowing for a trade-off between interspecific competition and predation pressure.

Reproductive success and importance in trophic webs of alien amphipods in continental waters of North-Western Russia

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The total list of alien species of European Russia includes 32 species. The all recorded alien species present five complexes differed by origin (Ponto-Caspian, Mediterranean, Circum-tropical, North-American, Baikalian and local immigrants). The greatest number of species (24) is represented by the Ponto-Caspian complex. This paper aims to review current distribution of recent amphipod invaders in the Neva River basin (281,000 km^2 of north-western Russia territory including large lakes Ladoga, Onega, Neva estuary) and to study comparatively life cycle variables and trophic position of the newcomers in aquatic communities. Three species *Pontogammarus robustoides*, *Gmelinoides fasciatus* and *Gammarus tigrinus* are widely spread among amphipods in the Neva River basin and continue to expand actively in different directions. Studying the dynamics of their populations in different parts of basin confirmed polivoltine life cycles with 2 or 3 generations per year (depending on the temperature conditions of the year). Individual fecundity of females studied the reproductive potential of populations obtained for Ponto-Caspian *P. robustoides* below than in native southern habitats (basin of Don, Dnieper Rivers) and for Baikalian *G. fasciatus* and North-American *G. tigrinus* higher than in native habitats. These species can modify trophic relations in benthic-pelagic chain, alter micro-habitats and food base for fish in the localities where they established successfully and comprise above 40% to the total benthic biomass. Analyses of Stable Isotope in the body issues and microscopic gut content in the amphipods found distinct size-dependent differentiations in position in food chain. For example, 5–7 mm specimens of *Pontogammarus robustoides* from the Neva River estuary prefer detritus (80% in the diet) while the filamentous algae, macrophytes and small invertebrates are in the diet of 8–12 mm specimens and mainly animal food (oligochaetes, isopods, planktonic crustaceans, aquatic insects) in the diet of larder 13 mm specimens. The predation index, the difference between losses in number of prey due to predation and the physiological requirements of a predator, increased with an increasing density of prey reaching maximum 50%. Invasive amphipods determine structure of benthic community; outnumbering or even completely replacing native species and/or earlier established invaders. Our analysis (in Lake Ladoga) showed that energy flow to zoobenthivorous fish also can be modified by invaders such as *P. robustoides* and *G. fasciatus*. They influence negatively on abundance of native crustaceans, a formerly important prey item for fish. At the same time the invaders use food sources that would otherwise not be available to fish, at the same time they are important food items of some littoral fish (ruffe, burbot, and perch). Therefore, a greater share of the benthic production became available for fish, increasing the overall fish production in the lake. Research was supported by grants from the President's Program (RSH-5142.2014.4) and from the Russian Foundation of Basic Research (13-04-00962).

Phylogenetic pattern in ornamental crayfish *Cherax* sp. from Papua New Guinea, Indonesia

Poster

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Recently, several new crayfish species belonging to the genus *Cherax* ERICHSON, 1846 have been described, namely *C. boesemani*, *C. holthuisi* and *C. peknyi*. Although these species naturally occur in Papua New Guinea, they are collected there and transported to European, Asian or USA pet market. As no further species-specific information on these crayfish is available, we decided to obtain their reference sequences for considering their phylogenetic relationships within the genus. Two mitochondrial gene regions (12S rRNA and 16S rRNA) were analysed. The pairwise distance among three analysed species ranged from 0.08 to 0.09 (16S rRNA) and from 0.05 to 0.07 (12S rRNA). Analyses of both gene fragments revealed trees with congruent topology. The group of three newly described species (*C. boesemani*, *C. holthuisi* and *C. peknyi*) was clustered together with *C. quadricarinatus* and *C. rhynchotus* composing lineage corresponding to "Northern group" of *Cherax* species according to MUNASINGHE et al. (2004). The rest of available sequences of *Cherax* species used in analyses corresponded to clustering pattern described by MUNASINGHE et al. (2004) composing "Southwestern" and "Eastern" group. Pairwise distance among these three phylogeographic groups ranged from 0.16 to 0.17 (16S rRNA) and from 0.14 to 0.16 (12S rRNA). With increasing number of *Cherax* species (some of them distributed under simple scientific name *Cherax* sp. or common names e.g., "Blue moon", "Ajamaru", and "Hoa Creek") and their elevated occurrence in pet shops, there is a strong need to have the way how to identify them unambiguously. Easy and cheap method of molecular identification could prevent misidentifications and confusions in the pet market as assessment based on habitus might be complicated due to variety of colour strains in some cases. Obtained sequences might also provide molecular evidence elevating further crayfish to species ranks. Aforementioned species of crayfish inhabit very small native ranges and are faced considerable pressure due to intensive field catching for ornamental purposes. Therefore our analysis improves knowledge about these species and also might support their conservation as native stocks.

Reference:

MUNASINGHE, D. H. N., BURRIDGE, C. P., AUSTIN, C. M. (2004): molecular phylogeny and zoogeography of the freshwater genus *Cherax* ERICHSON (Decapoda, Parastacidae) in Australia. Biological Journal of the Linnean Society, **81**: 553-563.

When a male meets a female: discovery of 'swimming' males of Paratanaoidea (Tanaidacea)

Poster

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Identification of males of Tanaidomorpha is particularly troublesome due to a high sexual dimorphism. Males of some Paratanaoidea families that are morphologically so different from females and have not been discovered for most genera so far. Not finding males has led to the assumption that some tanaidaceans might have parthenogenetic reproduction or simply have undeveloped secondary sex traits. During the IceAGE project (Icelandic marine Animals: Genetics and Ecology), with the support of molecular methods, the first evidence for the existence of highly dimorphic ('swimming') males in four families of the superfamily Paratanaoidea (Agathotanaidae, Cryptocopidae, Akanthophoreidae, and Typhlotanaidae) is presented. This study suggests that these males might be the next instars after 'juvenile' or 'preparatory' males, which are morphologically similar to females. It has been assumed that 'juvenile' males with restricted ability for swimming (e.g., undeveloped pleopods) have matured testes and are capable of reproduction and they mate with females nearby, while swimming males can mate with distant females. Our rationale explanation of the dimorphism in Tanaidomorpha lies in the fact that males of some species (e.g. *Nototanais*) have retained the same lifestyle or niche as the females, so secondary traits improve their ability to guard females and successfully mate. Males of other species (e.g. *Typhlotanais*) that have moved into a regime (niche) different to that of the female have demanded morphological changes.

A step-by-step guide to the digital stippling method

Poster

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Vector-based software has revolutionised scientific illustrating and is well established in crustacean taxonomy. However, simple line drawings lack depth information. This can be overcome by shading techniques, such as stippling – the application of dots to generate shade. Here we present a step-by-step guide for digital stippling. It comprises two approaches: Manual stippling offers great flexibility to achieve highly realistic results. A round brush is applied to the line art by tapping. Second, to speed up the process and generate homogeneous shades, a semi-automation is shown: the smallest units of symmetric stippling patterns are stored in a brush library. Using macroinstructions, such stored raw patterns are converted into symmetric repetitive patterns. Accordingly, even stippling patterns can be applied quickly across large areas of the underlying template. These methods come with all the advantages of vector illustrations, such as high scalability, reproducibility and easy correction of strokes that have turned out imperfect. The semi-automated stippling was developed during the description of a new deep-sea isopod species from the Kurile-Kamchatka abyssal plain in the northeast pacific which is used here as an example.

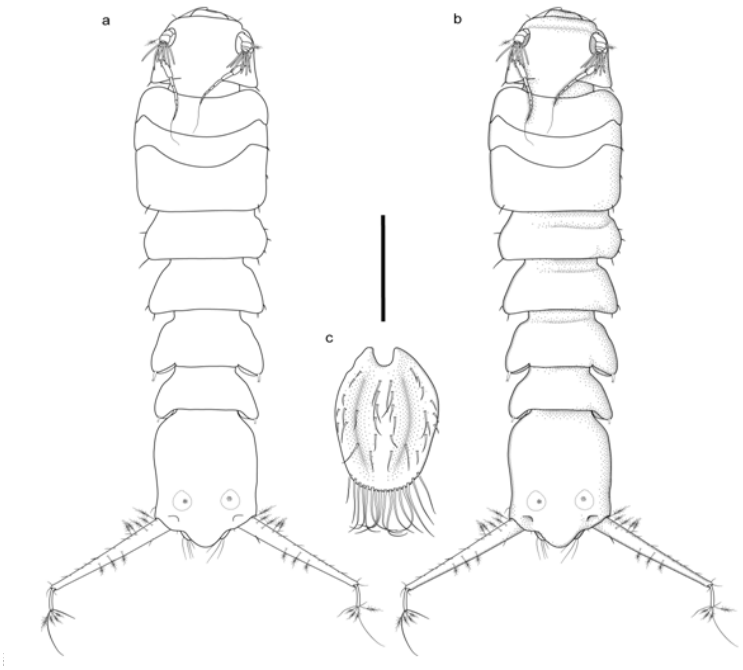

Figure 1: Plain versus stippled vector illustrations exemplified by the isopod (Crustacea) species *Macrostylis scotti* Riehl & Brandt, 2013. a Plain illustration without any shading. b Same illustration as a but with stippling added. Various types of brushed stipplings as well as manual stippling were applied. c The second female pleopods (operculum) with concavities (stippling pattern no. 7) on the surface.

Larval development of Pycnogonida: new data on the larvae of Nymhonidae and interpretation

Oral MC

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The most significant features which characterize diverse variants of postembryoinc development of Pycnogonida are: 1) the first postembryonic stage; 2) order of development of the walking legs; 3) mode of feeding during larval period (lecitotrophic or active feeding as ecto- or endoparasites) which correlates with the egg size. Lecitotrophic development may start with a protonymphon stage but a strong tendency towards the embryonization of the early larval stages has been traced in Ammotheidae, Callipallenidae and Nymphonidae and is especially characteristic for Arctic and Antarctic pycnogonids. In callipallenids protonymphon larvae are absent and larvae hatch at more advanced stage with two or even three pairs of the walking legs anlagen (BRENNIES et al., 2011). Ammotheidae demonstrate a broad spectrum of modes of postembryonic development. Recent studies revealed that in many Antarctic ammotheids lecitotrophic larvae hatch as very large protonymphons, lack spinning apparatus and show sequential pattern of development of the walking legs (Cano, LOPEZ-GONZALEZ, 2013). So, ammotheids do not show embryonization and their lecitotrophic development and larvae differ from that of callipallenids. For Nymphonidae protonymphon larva is common as the first stage of non-lecitotrophic and lecitotrophic larval development. New original data include description or re-description of larvae of four *Nymphon* species. The development of Arctic *N. helleri* BOHM, 1879 starts with protonymphon of the size and external morphology typical of the ectoparasitic actively feeding larvae. Other three species have lecitotrophic larvae. Development of Arctic *N. sluiteri* HOEK, 1901 is characterized by the sequential development of the walking legs and the presence of typical larval apendages II and III which implies existence of protonymphon larva. Arctic *N. hirtipes* BELL, 1853 shows signs of embryonization of the protonymphon stage; the earliest of instars found has larval limbs II, III and anlagen of walking legs I. The most interesting is development of Antarctic *N. australe* HODGSON, 1902. Protonymphon stage absent and the larvae hatch having three pairs of the walking legs anlagen. This pattern of development is a unique example of embryonized larvae in a nymphonid species reported for the first time since 19th century. Adding this to the previous data it is possible to make a sequence of embryonization of early larval stages within Nymphonidae similar to that for Callipallenidae which conforms to current concept of pycnogonid phylogeny. In ammotheids lecitotrophic development might have evolved convergently. An approach to developing terminology for postembryonic stages, types of larvae and patterns of development is suggested.

References:

BRENNEIS, G., ARANGO, C. P., SCHOLTZ G. (2011): Morphogenesis of Pseudopallene sp. (Pycnogonida, Callipallenidae). II: postembryonic development. - Development Genes and Evolution, **221**: 329–350.

CANO, E., LOPEZ-GONZALEZ, P. J. (2013): New data concerning postembryonic development in Antarctic. - Polar Biology, **36 (8):** 1175-1193.

Ontogeny of osmoregulatory organs in two closely related species of *Macrobrachium* with different life histories.

Poster

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The ontogeny of osmoregulatory organs was compared between two geographically separated species of the South American shrimp *Macrobrachium*: *M. amazonicum*, from the Amazon delta (A), which lives in coastal rivers and estuaries in northern Brazil, and the new species *M. pantanalense* (P), which spends its entire life cycle in freshwater habitats (FW) in south-western Brazil. A previous investigation has shown that all stages of *M. amazonicum* are hyper-osmoregulators at low salinities, and hypo-regulators at higher concentrations. But only zoeae I, juveniles and adults were able to survive and osmoregulate in FW. In *M. pantanalense*, all postembryonic stages were hyper-osmoregulators at salinities below 17 ppt, with a strong osmoregulatory capacity in FW. Unlike in *M. amazonicum*, all stages were osmoconformers at higher salinities, lacking the function of hypo-regulation.

The structural development of the branchial chamber and excretory glands and the presence of Na^+/K^+-ATPase (NKA) were compared at different stages between the two species after exposure to two salinities, FW and 20 ppt. In zoeae I of both species, gills were absent and NKA was localized along the inner epithelium of the branchiostegite. In intermediate (zoea V) and late larval stages (decapodids), significant differences between the two species were observed in gill development and NKA expression. The main osmoregulatory organs were branchiostegites in *M. amazonicum* and gills in *M. pantanalense*. This difference might be related to the different osmoregulatory capacities in the two species. In juveniles, NKA was detected in the gills and the branchiostegites, with no difference between species. The strong hypo-osmoregulatory capacity of the early stages in *M. amazonicum* could partially originate from ion excretion effected by the branchiostegites. The presence of fully functional gills expressing NKA appears essential for efficient hyper-osmoregulation in late developmental stages during successful freshwater adaptation and colonization. At all developmental stages of both species, NKA was present in the antennal glands upon hatching. The involvement of V-H^+-ATPase in freshwater adaptation is under investigation.

In conclusion, the ontogeny of osmoregulatory structures described here is strongly correlated with the ontogeny of the physiological processes of osmoregulation, and both are related to the ecology of each species.

References

ANGER K (2013) Neotropical *Macrobrachium* (Caridea: Palaemonidae): on the biology, origin, and radiation of freshwater-invading shrimp. J Crust Biol 33:151–183

BOUDOUR-BOUCHEKER N, BOULO V, LORIN-NEBEL C, ELGERO C, GROUSSET E, ANGERK, CHARMANTIER-DAURES M, CHARMANTIER G, (2013). Adaptation to freshwater in the palaemonid shrimp *Macrobrachium amazonicum:* comparative ontogeny of osmoregulatory organs. Cell Tissue Res 353:87-98

BOUDOUR-BOUCHEKER N, BOULO V, CHARMANTIER-DAURES M, GROUSSET E, ANGER K, CHARMANTIER G, LORIN-NEBEL C, (2014) Differential distribution of V-type H+-ATPase and Na+/K+-ATPase in the branchial chamber of the palaemonid shrimp *Macrobrachium amazonicum*. Cell Tisue Res In press

CHARMANTIER G, ANGER K (2011) Ontogeny of osmoregulatory patterns in the South American shrimp *Macrobrachium amazonicum*: Loss of hypo-regulation in a land-locked population indicates phylogenetic separation from estuarine ancestors. J Exp Mar Biol Ecol 396:89–98

DOS SANTOS A, HAYD L, ANGER K (2013) A new species of *Macrobrachium* Spence Bate, 1868 (Decapoda, Palaemonidae), *M. pantanalense*, from the Pantanal, Brazil. Zootaxa 3700:534-546

Diversity of Entophilidae (Isopoda: Epicaridea) and recognition of larval morphological characters that support a recent molecular phylogeny of Epicaridea

Poster

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A detailed reexamination of both male and female *Entophilus mirabiledictu* MARKHAM & DWORSCHAK, 2005, resulted in recognition of seven female and six male characters that separate the species from its sole congener, *E. omnitectus* RICHARDSON, 1903. Several characters, including those of the female and male antennae, and the female's oostegites and pleopods are resdescribed based on SEM micrographs. Characters of both males and females indicate that the two species are generically distinct, and that *E. mirabiledictu* warrants its own genus within Entophilidae.

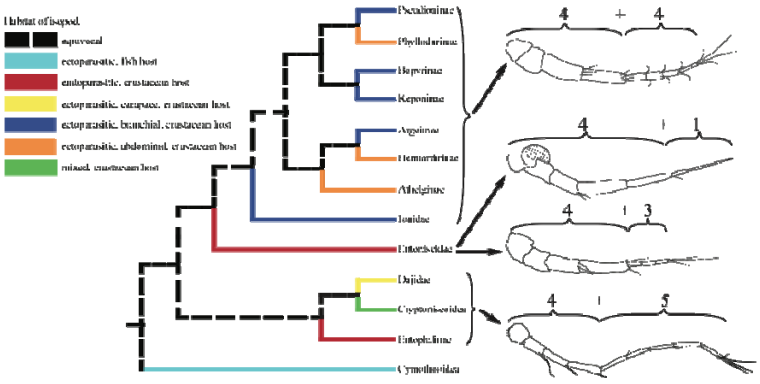

Fig. 1. Habitat of family-level and higher isopod taxa plus antennal segmentation patterns for epicaridean taxa mapped onto a phylogeny derived from 18S rDNA analysis (BOYKO et al., 2013). Mixed = examples of ecto-, endo- and mesoparasitism within the taxon.

Additionally, a review of morphological features of life history stages of entophilid species indicates that the number of flagellar segments on the second antennae (antennule) of cryptoniscus larvae (ADKISON & COLLARD, 1993) offer morphological support to a recent molecular phylogeny of epicaridean taxa (BOYKO et al., 2013) that radically rearranged the component families within the two recognized superfamilies. All taxa in Cryptoniscoidea (including Dajidae and Entophilidae) have cryptoniscus larvae with 9 antennal segments (4 basal + 5 flagellar), while all taxa in Bopyroidea have 8 antennal segments or fewer (4 basal + 4 flagellar for all Bopyridae and Ionidae; 4 basal + 1 or 3 flagellar for Entoniscidae).

References:

ADKISON, D. L. & S. B. COLLARD (1990) Description of the cryptoniscium larva of *Entophilus omnitectus* Richardson, 1903 (Crustacea: Isopoda: Epicaridea) and records from the Gulf of Mexico. —Proceedings of the Biological Society of Washington **103**: 649-654.

BOYKO, C. B., J. MOSS, J. D. WILLIAMS & J. D. SHIELDS (2013) A molecular phylogeny of Bopyroidea and Cryptoniscoidea (Crustacea: Isopoda).—Systematics and Biodiversity **11**: 495-506.

MARKHAM, J. C. & P. C. DWORSCHAK (2005) A new species of *Entophilus* RICHARDSON, 1903 (Isopoda: Bopyridae: Entophilidae) from the Gulf of Aqaba.—Journal of Crustacean Biology **25**: 413–419.

Revision of basal calanoid copepod families and description of new species and genus of Pseudocyclopidae

Poster

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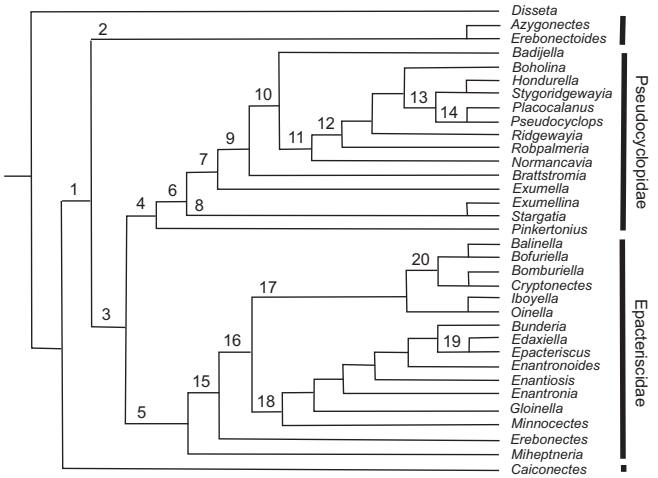


The single strict consensus, morphology-based, tree after one round of successive weighting.

A newly discovered plesiomorphic genus and species of calanoid copepod (*Pinkertonius ambiguus* n. gen. n. sp.), taken with an epibenthic sledge from the flanks of the Chatham Rise east of New Zealand at about 900 m, could not be assigned to any known genus or family based on available diagnoses.

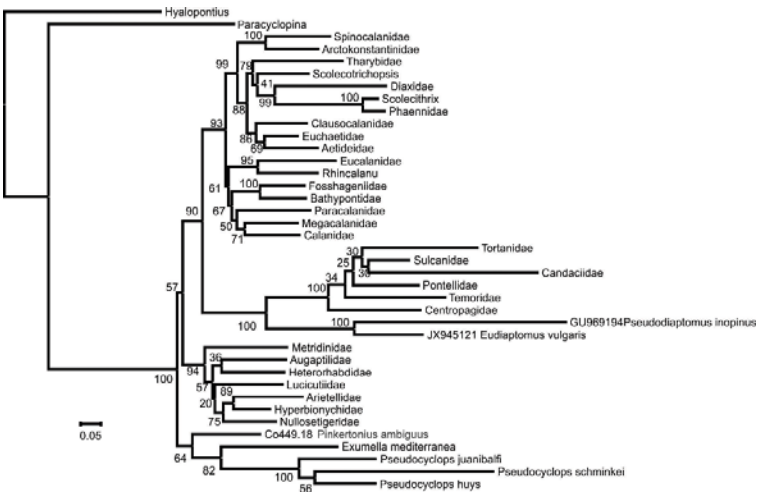
We made a morphology-based cladistic analysis of all genera previously placed in the Epacteriscidae, Pseudocyclopidae, Ridgewayiidae, Boholinidae and the new taxon.

The Pseudocyclopidae and Epacteriscidae are confirmed as monophyletic families but the family names Ridgewayiidae and Boholinidae become synonyms of Pseudocyclopidae. There are no grounds on which more than a single basal superfamily, the Pseudocyclopoidea, can be recognised thus Epacteriscioidea becomes a junior synonym of the Pseudocyclopoidea.

The Pseudocyclopoidea and families Pseudocyclopidae, Epacteriscidae, and the new genus were diagnosed. *Pinkertonius ambiguus* is placed within the Pseudocyclopidae.

Genetic data confirms the basal position of the Pseudocyclopoidea in a revised Calanoida phylogeny. This phylogeny contributes to an improved resolution of the relationships among the Centropagoidea, Megacalanoidea, Bathypontioidea, Eucalanoidea and Clausocalanoidea, as well as providing testable hypotheses for future work.

This paper is in press with the *Zoological Journal of the Linnean Society.*



Phylogram of taxa in copepod Order Calanoida. Topology and branch length correspond with RAxML Maximum Likelihood tree. Numbers of nodes indicate % of bootstrap recovery / Bayesian Posterior Probability.

Comparative magnetic resonance imaging of brachyura from different time periods

Poster

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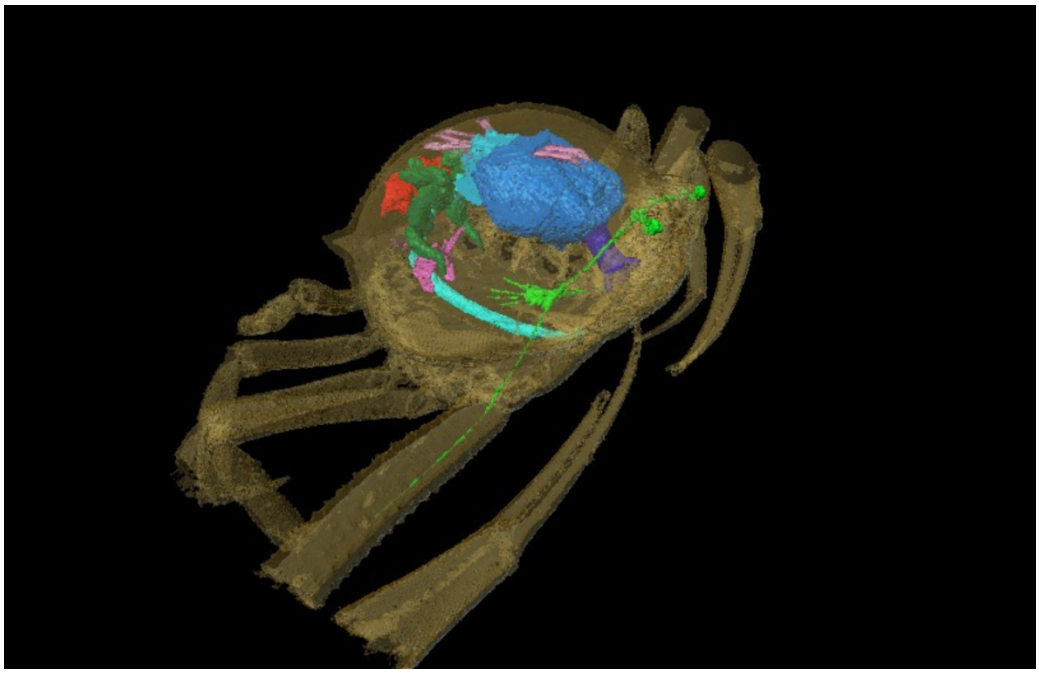
Museum collections are a unique window onto the diversity of species on earth. However, detailed information on anatomical structures is currently difficult to get since that mostly requires the destruction of the object of interest. Magnetic resonance imaging allows for non-invasive three dimensional imaging of soft tissue structures with high spatial resolution even from deep inside of the organism. In combination with micro CT it may further illuminate soft and hard tissue interactions. In contrast to CT, MRI operates on radio waves with the advantage of no further damage to DNA. Here we applied high resolution MRI of different contrast weighting on living, fresh fixed, and historic specimens (up to 200 years old). Based on these MR data 3D reconstructions of different organs including heart, hepatopancreas, and neuronal system were performed in their in-situ position. This morphometric information opens up the analysis of structural changes by environmental adaptations over defined long time periods. Another focus of this study was the reconstruction of parasite-host-interaction in situ. MRI has been extensively and successfully applied in medicine and basic biomedical research. Compared to that, its application in marine zoology is still at the beginning. This study also wants to draw attention to the benefits of the technique for crustacean research.



Legend: 3D-reconstruction of the inner organ systems of a male *Ilia nucleus* specimen based on MRI-data.

Should I stay or should I go? Dispersal in zooplankton.

Oral BR

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The temporal and spatial variability in temporary aquatic systems is expected to favour selection for dispersal which in zooplankton is supposed to be mainly effected by dormant eggs. By means of different case studies on temporary water bodies, we assessed dispersal of dormant eggs by both abiotic (wind, water) and biotic (mammals and amphibians) vectors in the field and via laboratory experiments.

At two rock pool sites in southern Africa we found direct proof of the importance of wind as a dispersal vector, at least at the local scale. We collected dormant propagules near the rocky surface with sticky traps and at a height of 1.5 m with wind traps. The latter fraction mainly consisted of smaller propagules that were probably on their way for long distance transport in contrast to the larger sized propagules that tumble along the substrate and may contribute dominantly to short range dispersal. The propensity of diverse types of dormant zooplankton propagules to be picked up by wind on different substrates was also assessed in a wind tunnel experiment. Here, larger propagules were consistently picked-up at lower wind speeds than smaller propagules. Propagules were furthermore more easily picked-up from fine grained than from coarse grained or smooth surfaces, while the effect of substrate type depended on propagule size and shape.

At both rock pool sites we also collected large numbers of dormant eggs in overflowing water with heavy rains, using overflow traps. In the laboratory we observed that during each experimental inundation about half of the dormant eggs of an anostracan species (*Branchipodopsis wolfi*) floated, which may facilitate such hydrochorous dispersal.

Next to the importance of these abiotic vectors, we also illustrated the importance of animals as vectors of dormant eggs. At the South African rock pool site, invertebrate propagules were isolated from the faeces of African clawed frogs (*Xenopus laevis*). By hatching mud collected at different heights from rubbing trees at variable distances from temporary savannah pools in Zimbabwe, we also disclosed the importance of large mud wallowing mammals (e.g. warthog, buffalo, rhinoceros, and especially elephant) in transporting dormant eggs of a large number (22) of invertebrate taxa. In a Mediterranean wetland area in southern France this role was mainly taken up by wild boar as revealed by analyzing mud from rubbing trees and faeces. We also recovered both propagules and live specimens of 14 freshwater invertebrate taxa from the fur of nutria (*Myocastor coypus*), an aquatic rodent introduced to southern France. For the same wetland area we also collected large numbers of dormant eggs from footwear and cars of conservationists and researchers, with the unintentionally dispersed dormant community reflecting the corresponding research sites.

Although leaving the parental habitat may be a risk, the generation of multi-year egg banks and mixed dispersal strategies allows many zooplankton species to respond to unpredictable habitat availability/suitability in both time and space and contributes to population persistence through metapopulation processes.

Diversification of isopods in the deep South Atlantic and the Icelandic continental slope. Our understanding at a start.

Oral GS

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To date, molecular studies on deep-sea isopods are often incompatible because different DNA fragments were used and only small numbers are available on GenBank (Benson et al. 2008) while a huge amount of unpublished sequences is waiting in the *DNA Barcoding deep-sea Isopoda* project. The asellote family Munnopsidae is by far the most extensively studied group from the molecular perspective, followed by Macrostylidae, Haploniscidae and Desmosomatidae. In order to understand the distribution patterns of isopod species in the deep sea, an integrative approach combining morphological data with genetic data from mitochondrial (COI, 16S) and nuclear (18S) DNA markers was used. Within deep-sea isopod families, such as Macrostylidae (RIEHL & BRANDT 2013), Desmosomatidae (BRIX et al. 2014), Haploniscidae (BRIX et al. 2011), Munnopsidae (OSBORN 2009) or Serolidae (BRANDT et al. in review), relatively fast-evolving markers show intraspecific variation larger than the postulated 3% barcoding gap (HEBERT et al 2003) and especially in asellote species in CO1 often even a variation clearly above 20% uncorrected p-distance (BRIX et al. 2011, 2014, RIEHL & BRANDT 2013). For example, the discovery of distinct gene pools within the well described species *Atlantoserolis vemae* MENZIES, 1962 from the Argentine basin comes as a complete surprise. The results suggest the presence of two reproductively isolated species within the same trawl of an epibenthic sledge, which cannot be discriminated morphologically. The unexpected genetic diversity seems to be a general characteristic of deep-sea isopod populations under study. Also for species of the genus *Chelator* HESSLER, 1970 (BRIX et al. 2014) high intraspecific genetic variability within morphologically similar specimens could be shown. Furthermore, within the eurybathic type species of this genus, *Chelator insignis* (HANSEN, 1916), occurring South of Iceland, four distinct groups could be distinguished showing high between-group divergence contrasted by low intraspecific variability. Thus, there is evidence for cryptic species inside the nominal *C. insignis* with a partitioning of variation related to bathymetry along the south Icelandic continental slope. It seems as if the genus *Chelator* is not fully understood - whether morphologically neither genetically.

BENSON D. A., KARSCH-MIZRACHI I., LIPMAN D. J., OSTELL J. & WHEELER D. L. 2008. GenBank. *Nucleic Acids Research* 36: D25–30.

Brandt A., Brix S., Held C & Kihara T.C. (in review) Enigmated species of Serolidae from DIVA-3. *Journal of the Linnean Society*.

BRIX S., RIEHL T. & LEESE F. 2011. First genetic data for *Haploniscus rostratus* and *Haploniscus unicornis* from neighbouring deep-sea basins in the South Atlantic. *Zootaxa* 2838: 79–84.

BRIX S., LEESE F., RIEHL T. & KIHARA T.-C. 2014. A new genus and new species of Desmosomatidae Sars, 1897 (Isopoda) from the east South-Atlantic abyss described by means of integrative taxonomy. *Marine Biodiversity.* DOI: 10.1007/s12526-014-0218-3.

HEBERT P. D. N., CYWINSKA A., BALL S. L. & DEWAARD J. R. 2003. Biological identifications through DNA barcodes. *Proceedings of the Royal Society of London, Series B: Biological Sciences* 270: 313–321.

RIEHL T. & BRANDT A. 2013. Southern Ocean Macrostylidae reviewed with a key to the species and new descriptions from Maud Rise. *Zootaxa* 3692: 160–203.

OSBORN K. J. 2009. Relationships within the Munnopsidae (Crustacea, Isopoda, Asellota) based on three genes. *Zoologica Scripta* 38: 617–635.

Mating with Multiple Males: A Study of Reproductive Tactics in Horseshoe Crabs (*Limulus polyphemus*)

Oral MC

H. JANE BROCKMANN

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Why do females mate with multiple males? Since females usually acquire all the sperm they need from one male and since mating is often costly, the evolution of multiple mating is puzzling. Multiple mating may result from male-male competition (convenience polyandry) and be costly to females. Alternatively, females may gain from mating multiply through direct benefits (e.g. resources), insuring fertilization, increasing offspring diversity, improving male quality ('good genes') or increasing genetic compatibility. I evaluate these hypotheses in the Atlantic horseshoe crab (*Limulus polyphemus*) where some females mate with one male (monandrous) and some mate with multiple males (polyandrous females). In this species some males locate females offshore, attach to their posterior spines with a specialized pair of claws and together the pair travels to the beach where they nest and spawn during new and full moon high tides. Fertilization is external and occurs in the water underneath the female as she is laying her eggs; the fertilized eggs are left to develop in the sand. Many males do not attach to females; they come ashore without females and join spawning pairs as satellites. Satellite males are attracted to some spawning pairs (polyandrous) by visual and chemical cues while ignoring others (monandrous). Satellites often achieve high paternity, particularly when there are several satellites with one spawning pair. Field manipulations of the number of satellites around polyandrous and monandrous females reveal that satellite males do not increase fertilization success and, in fact, they are costly to females in terms of nesting success. But are there any compensating benefits? *In vitro* fertilization (IVF) experiments demonstrate that eggs from polyandrous females have particularly low developmental success when crossed with sperm from their own attached males. This could be due to low quality among males of polyandrous females and indeed there is some evidence for this. However, another IVF experiment in which each female was crossed with four different males shows that there are both strong maternal effects and significant incompatibility effects on offspring development. Interestingly, these IVF experiments show that monandrous and polyandrous females differ in the benefits they can derive from mating with multiple males: only polyandrous females show improved developmental success. These studies suggest that monandry and polyandry are female reproductive tactics that evolved in response to sexual conflict. These female mating decisions are influenced by condition-dependent differences among females, context-dependent differences among males and interaction effects. As an ancient and independently evolved arthropod, horseshoe crabs provide a unique opportunity to extend our understanding of the evolution of multiple mating.

Foregut structures of freshly molted exuviae of *Maja crispata, Cancer pagurus and Pseudosesarma moeschi* (Crustacea, Decapoda, Brachyura)

Poster

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Periodically molting is vital for the growth of crustaceans. The process is characterized by a complete replacement of the external skeleton, including eyestalks, legs, the pleon as well as the foregut and hindgut.

In the present study a series of freshly molted brachyuran exuviae (*Maja crispata* RISSO, 1827; *Cancer pagurus* LINNAEUS, 1758 und *Pseudosesarma moeschi* (DE MAN, 1888)) were investigated concerning the remaining calcified foregut structures. All investigated exuviae show part or complete degradation of lateral expanded ossicles of the gastric mill (e.g., ossicles II, V and IX). Most of the ossicles of the pyloric filter are unaffected by the degradation processes. Reduction of the calcium content and the increasing flexibility of the foregut ossicles do enable the passage of the bigger "old" foregut through the smaller oesophagus of the newly formed foregut.

The gastric teeth of the examined exuviae are not influenced by the molting process. All teeth structures (lateral, dorso-median and accessory teeth) are completely present in the exuviae and the individuals will lose the calcium components of the gastric teeth (e.g. hydroxylapetite) during every molting cycle.

Hyperbaric limitation of bathymetric distribution; do lineage-specific tolerances contribute to global phylogenetic bottlenecks?

Oral BLC

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Lithodid crabs share preferences for cold-water environments. Their shallow-water latitudinal distribution appears to be constrained by the detrimental effects of temperature extremes, but phylogenetic evidence supports the hypothesis that lineage-specific physiological thresholds may have differentiated lithodid lineages in successful colonisation of the deep sea (Hall and Thatje, 2009). The lithodid subfamily Hapalogastrinae is endemic to the North Pacific and restricted to depths shallower than 200 m despite tolerating temperatures representative of the deep sea; the majority of hapalogastrine species occur in the eastern part of this region. In contrast, genera of the subfamily Lithodinae occur deeper than 200 m and are distributed globally, appearing to result from at least three distinct recent and rapid radiations. However, these genera remain excluded from the abyssal depths (>4000 m). Consequently, the north-eastern Pacific coastline is considered the evolutionary environment of the incipient Lithodidae and the isothermal submergence of the Lithodinae into the deep sea is regarded as the result of ecological adaptation. The evolutionary history and distribution of lithodid crabs is representative of wider bathymetric biodiversity patterns on deep continental margins. These appear to be driven by a hyperbaric and hypothermal physiological bottleneck imposed on shallow-water organisms colonising the deep sea (Brown and Thatje, 2013). King crabs are, therefore, ideal model species for investigating the contribution of lineage-specific tolerances to global phylogenetic bottlenecks. To examine the role of hydrostatic pressure in constraining bathymetric distribution we assessed physiological responses to pressure in the lithodid crab *Lithodes maja*.

References:

BROWN, A., THATJE, S. (2013): Explaining bathymetric diversity patterns in marine benthic invertebrates and demersal fishes: physiological contributions to adaptation of life at depth. Biological Reviews, doi: 10.1111/brv.12061.

HALL, S., THATJE, S. (2009): Global bottlenecks in the distribution of marine Crustacea: temperature constraints in the family Lithodidae. Journal of Biogeography, **36**, 2125-2135.

Krill world-wide – a comparison of Atlantic and Arctic Euphausiids

Poster

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Krill occupy a central role in oceanic food webs as consumers as well as as producers. Squid, fish, birds, seals, and whales depend on krill. A change in a krill population may thus have dramatic impacts on ecosystems. In turn, we use krill species as indicators of environmental changes in a large scale comparison focussing on Euphausiids of the Arctic and the NE- and SE-Atlantic. The central questions are:
How do krill species adjust to hydro-climatic variability, concerning:

- growth and reproduction in relation to seasonal and long term changes
- resource partitioning
- horizontal and vertical distribution
- energy storage strategies
- temperature and low oxygen tolerance?

The AWI – Team „Krill-world-wide“ including DORIS ABELE, NELLY TREMBLAY and THORSTEN WERNER has been comparing krill species from the Pacific and Atlantic oceans which live under contrasting hydro-climatic conditions and are steno- to eurothermally adapted. Some current results are highlighted.
Recent literature documents that Antarctic krill stocks diminish strongly, due to the retreat of sea ice, whereas „Arctic“ krill profits from ocean warming and increases in biomass.
The deep NE-Atlantic shows a clear vertical zonation of species, which are possibly trophic niches avoiding competition. The occurrence of the mid-water *Nematoscelis megalops* indicates a southern influx which now reaches up to Svalbard. The very numerous *Meganyctiphanes norvegica* are expanding to the North as well.
Synchrony in growth and spawning is tuned to the upwelling system in *Euphausia hanseni.* Stocks have remained in a comparable range since 2004.
In the Arctic, the most frequent *Thysanoessa inermis* still appears to exist in a fringe situation, due to polar temperatures. The co-ocurring species, *T. raschii,* seems to cope better with the cold environment, has recently been found spawning, and may profit from a changing food-web due to an increasing “Atlantification” of the warming Svalbard environment.

References:

BUCHHOLZ, F. , WERNER, T. & BUCHHOLZ, C. (2012) First observation of krill spawning in the high Arctic Kongsfjorden, west Spitsbergen, Polar Biology, 35(8): 1273-1279

HUENERLAGE, K. & BUCHHOLZ, F. 2013 Krill of the northern Benguela Current and the Angola-Benguela frontal zone compared: physiological performance and short-term starvation in *Euphausia hanseni. Journal of Plankton Research* 35 (2): 337-351

WERNER, T., HUENERLAGE, K., VERHEYE, H. & BUCHHOLZ, F. (2012) Thermal constraints on the respiration and excretion rates of krill, *Euphausia hanseni* and *Nematoscelis megalops*, in the northern Benguela upwelling system off Namibia, *African Journal of Marine Science* **34**(3): 391-399

Reproduction strategy in epizoic scalpellid barnacles in light of habitat availability

Oral BEP

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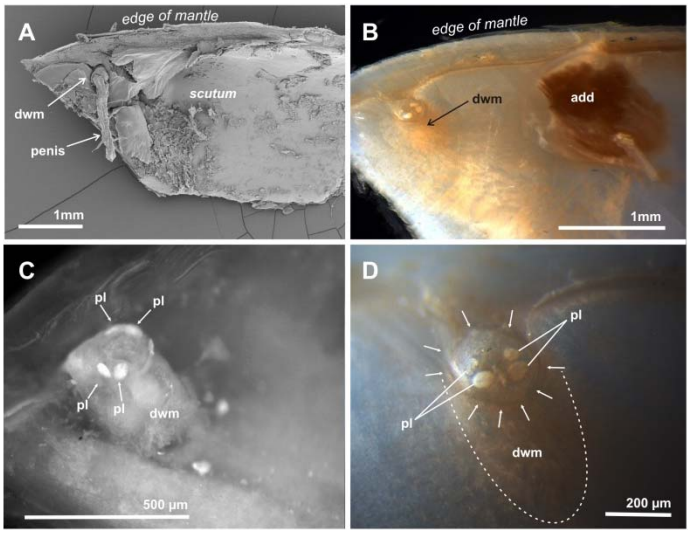
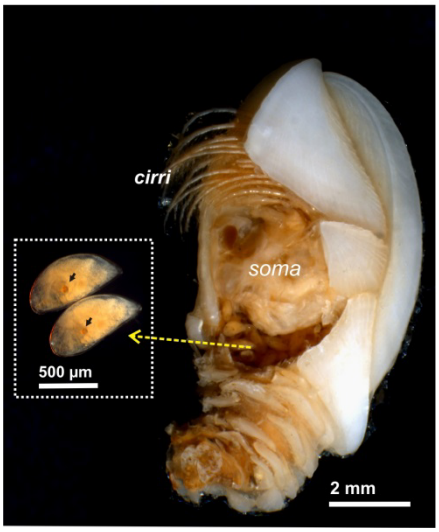
We have studied reproduction strategy in the epizoic pedunculated barnacles *Scalpellum scalpellum, Ornatoscalpellum stroemii*, *Arcoscalpellum michelottianum, Verum brachiumcancri* and *Weltnerium nymphocola* with different hosts and depth distribution. The type of larval development the number and size of eggs, the morphology of the dwarf male and its position in the female receptacle, and number of males in the female/hermaphrodite were recorded. All species have a pair of receptacles each of which can host from one single male and up to 12 males, depending on species. Eggs and larvae differ in size between species as do brood size, and the reproductive data indicate that the species invests very differently in their propagules. For the three deep sea species *O. stroemii*, *V. brachiumcancri* and *W. nymphocola* the development to cypris larva take place inside the female and they have only one single dwarf male that is almost fully embedded in a well defined receptacle inside the female mantle cavity. *S. scalpellum* has up to five males in its open pocket like receptacle whereas *A. michelottianum* has up to 12 males. Both species have nauplii that up to 10 days in the plankton.



Verum brachiumcancri. Dwarf males in situ on the inside of the scutal plate. **A** SEM of dwarf male position with penis extended, apical end broke off during preparation. **B** LM view of dwarf male in receptacle. **C** LM view of dwarf male, with four minute shell plates, buried deep in the receptacle. **D** LM view of dwarf male, dotted line indicates position inside the receptacle, only parts outlined by arrows is exposed. Add adductor muscle; dwm dwarf male; pl shell plate.



Verum brachiumcancri. Female opened showing partially extended cirri and a brood of cypris larvae in the lower part of the mantle cavity (brood chamber). Two cypris larvae extracted to show shape and the presence of compound eyes (arrows).

Our comparison of reproductive strategies among scalpellids suggests a connection between lack of free nauplii, small brood size, and the presence of only a single dwarf male. In addition the dwarf male of *V. brachiumcancri* has a complex penile structure that aid to the fertilization of the few large eggs. The findings indicate that the highly specialized male and females allocating resources to a few offspring represents an adaptation to the scarcity of suitable substratum. This challenge to overcome the huge distances between suitable substratum and conspecifics is something epizoic scalpellids shares with many host specific deep-sea organisms.

Behaviour and habitat of *Neohela monstrosa* (BOECK, 1861) in Norwegian Sea deep water

Poster

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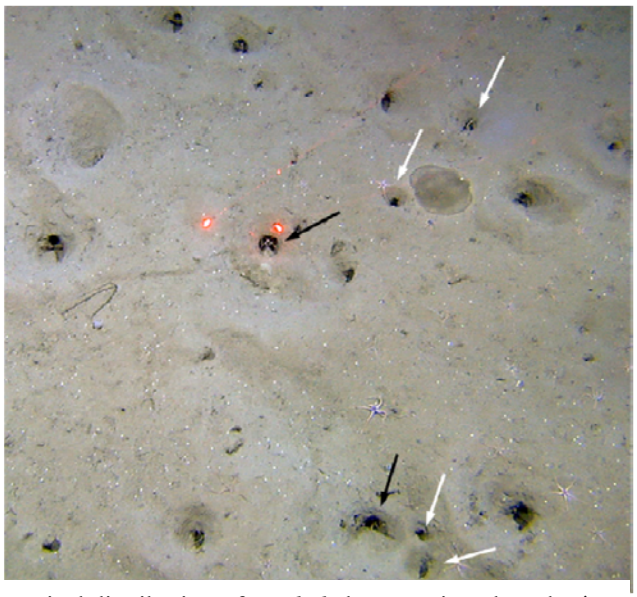
There are few in situ observations of deep-sea macrofauna behaviour, due to the remoteness of this ecosystem. Visual surveys, as part of the MAREANO mapping programme, have offered unique possibilities to do such observations over large areas in the Norwegian Sea. In addition, specimens collected with hyperbenthic sleds have been used for species confirmation. One common species at depths below 700 m is the large amphipod *Neohela monstrosa* (Boeck, 1861). Dense communities of this amphipod are often found in stands of the arctic sea pen *Umbellula encrinus* at more than > 1000 meters depth.

In this study we present its bathymetric distribution and habitat requirements as well as behavioural observations. Mean density observed for larger areas is 4/100 m^2, while local patches sustain a density of >20 specimens/ m^2. *N. monstrosa* digs tunnels in soft muddy bottoms; this is done primarily by using the large shovel-like gnathopods to scoop sediment out of its burrow. This behaviour has also been observed in aquaria (Enequist, 1949), where it was noted that the amphipods were simultaneously reworking the sediments with its mouthparts when pushing out sediment.

We have observed *N. monstrosa* pushing and rolling sediment-balls out of its burrow. There is an upper wide burrow that seems to have a horizontal side tunnel a couple of centimeters down. This tunnel seems to be reinforced by sediment cemented in a similar way to the mud tubes of the polychaeta *Sabella* spp. On one occasion we observed one individual "combing" a branched bryozoan colony (Anascophora). This could probably be related to feeding.



Typical distribution of *Neohela* burrows in a densely populated area (Figure right side). Frame grab from a video (st 301) showing ~15 burrows made by small (white arrows) and large individuals. Red lazer spots shows a 10 cm scale.

Photos from video showing the digging activity of *Neohela* (copyright MAREANO).

Biodiversity Assessment of Freshwater Decapods in Nee Soon Swamp Forest, Singapore
Oral CBF

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As the only primary freshwater swamp left in Singapore, the 87 ha Nee Soon Swamp Forest (NSSF) houses a rich diversity of the remaining fauna left in Singapore. Field observations and results from recent surveys of vegetation have indicated that the forest and ground condition, including surface water has changed over the last two decades. Has this change in water level affected the fauna in the area? The current study uses freshwater decapods as biological indicators to study ecological changes. Hand Sampling and Trap Sampling were carried out over 20 months period (February to July 2011, February 2013 to March 2014) in 8 sampling sites, comprised various microhabitats in outskirt, lower, middle and upper reaches of the stream system that run over the entire swamp forest to assess the crustacean decapod diversity. Water parameters including pH, flow velocity and dissolved oxygen were measured. Stream substrates, cross session, vegetation cover and riparian habitats were a;so recorded to characterise the habitats presented. Species richness, Evenness, and Shannon-Wiener's index (H') were calculated and compared for all sites in 14 sampling cycles. Population dynamics of freshwater shrimps *Caridina malayensis, Macrobrachium malayanum, M. sundaicum, M. platycheles* and Freshwater crabs *Parathelphusa maculata* and *P. reticulata* were investigated. Results show that the highest diversity appears at the middle and lower reaches, followed by outskirt of the swamp, with the upper reach having the least diversity. Few biodiversity patterns were observed and worth further investigation, i.e. (a) distribution pattern and diversity scores obtained suggest presence of strong microhabitat preferences in most of the species; (b) change in rainfall levels might account for the changes in shrimp abundance observed; (c) length-frequency profiles of the shrimps showed a consistent pattern across various cycles, implying absence of short-term seasonal trend; (d) male-biased sex ratio of 4.6: 1 exhibited on *M. malayanum*; (e) most shrimp species having various number of gravid females throughout the year, suggesting that there may be no distinct reproductive seasonality. Conservation status of the freshwater decapod species is revised and updated. *Caridina malayensis* is proposed to be a locally endangered species, and *M. platychele P. reticulata* are remained as critically endangered. *Macrobrachium idae, M. neglectum* and *Caridina gracilirostris* are believed to be locally extinct in NSSF.

References

NG, P. K. L. (1997): The Conservation Status of Freshwater Prawns and Crabs in Singapore with Emphasis on the Nature Reserves.--Gardens' Bulletin Singapore **49:** 267-272.

Comparative phylogeography and cryptic diversity of intertidal barnacles in the NW Pacific waters

Oral BEP

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The NW Pacific is a global marine hotspot, yet the pattern of the species diversity is still poorly known. The present study based on COI sequence analysis of four intertidal barnacle species (*Chthamalus malayensis*, *C. moro*, *Capitulum mitella* and *Tetraclita squamosa*) as models, aims to address the following questions: 1) Are cryptic species prevalent in the NW Pacific and how were they originated? 2) Are the phylogeographic history and gene flow pattern shared among co-distributed species? Results from molecular analysis showed that all four barnacle species contain several cryptic species or distinct genetic lineages/clades in the NW Pacific. *Chthamalus malayensis* contains three distinct clades, with the Taiwan clade endemic in Taiwan, South China clade abundant in southern China and the Indo-Malay clade distributed in the Indo-Malaysian waters. There are three COI lineages in the insular species, *Chthamalus moro*, including Ogasawara lineage dominant in the Ogasawara Island, Ryukyus lineage mainly found in Okinawa and a southern lineage present in Taiwan and Borneo waters. *Tetraclita squamosa* distributes along the South China coast, and the recently described species from the hitherto *T. squamosa*, *T. kuroshioensis* is common in Japan, Taiwan and the Philippines. The stalked barnacle *Capitulum mitella* comprises three distinct lineages occurred in Okinawa, Taiwan and South China respectively. The distribution patterns of cryptic lineages of the barnacles show that diversification was a result of allopatric isolation associated with the changes in sea level during the Pleistocene. There is no common or general phylogeographic pattern among the four species complexes. Phylogeographic pattern of intertidal barnacles are attributed to interactions between species biology, demographic history and the complex hydrology in the NW Pacific waters.

References

TSANG L. M., T. H. WU, H.-T. SHIH, G. A. WILLIAMS, K. H. CHU & B. K. K. CHAN (2012). Genetic and morphological differentiation of the Indo-West Pacific intertidal barnacle *Chthamalus malayensis*", Integrative and Comparative Biology, 52(3), 388-409

WU, T. H., L. M. TSANG, B. K. K. CHAN & K. H. CHU (2014). Cryptic diversity and phylogeography of the island-associated barnacle *Chthamalus moro* in Asia. Marine Ecology-an Evolutionary Perspective, doi: 10.1111/maec.12146.

Phylogenetic relationships amongst the thaumastocheliform lobsters (Crustacea: Decapoda: Nephropidae)

Oral GS

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Thaumastocheliform lobsters are composed of four genera, namely *Oncopareia*, *Thaumastocheles*, *Thaumastochelopsis*, and *Dinochelus*. They are a specialized lineage of lobsters with very characteristic first chelipeds that are greatly unequal with the right side extremely elongate and pectinate. As species of these genera are rather rare or only known from fossils, the relationships amongst them are unclear. Combined molecular (3 mitochondrial: COI, 16S rDNA, 12S rDNA; 2 nuclear: histone 3, NaK) and morphological cladistic analyses show that the thaumastochelidforms are more derived than the genera *Metanephrops*, *Homarus* and *Nephropsis*. The genus *Dinochelus* is more closely related to *Thaumastochelopsis* by both DNA and morphological data; *Dincohelus* shares character with *Thaumastochelopsis* in having well-developed eye rather than reduced eye in *Thaumastocheles*. The eyeless *Thaumastocheles* is less derived than the *Dinochelus* and *Thaumastochelopsis*. The fossil *Oncopareia* is intermediated between the fossil *Hoploparia* and the extant thaumastochelidforms.

References:

TSHUDY, D. (2012): *Dinochelus steeplensis*, a new species of clawed lobster (Nephropidae) from the London Clay (Eocene) of England. -- Journal of Crustacean Biology **32**(1):67-79.

AHYONG, S. T., CHAN, T.-Y. & BOUCHET, P. (2010): Mighty claws: a new genus and species of lobster from the Philippine deep sea (Crustacea, Decapoda, Nephropidae). -- Zoosystema, **32**(3): 525-535.

TSHUDY, D., ROBLES, R., CHAN. T.-Y., HO, K.C., CHU, K.H., AHYONG, S.T. & FELDER, D.L. (2009): Phylogeny of marine clawed lobster families Nephropidae Dana, 1852, and Thaumastochelidae Bate, 1888, based on mitochondrial genes. -- Decapoda Crustacean Phylogenetics: 357-368.

Worldwide genetic differentiation in the common fouling barnacle, *Amphibalanus amphitrite*

Oral BEP

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Amphibalanus amphitrite is a common fouling barnacle distributed globally in tropical and subtropical waters, probably as a result of human-mediated dispersals through shipping activities. *A. amphitrite* is, therefore, expected to propagate among distant regions and constitutes a homogeneous meta-population in its distribution range. However, subspecies with a restricted geographical distribution and morphological differentiation have also been reported. In the present study, we investigated the genetic (mitochondrial COI) and morphological differentiation in *A. amphitrite* from 25 localities around the world, including two nominate subspecies (*A. amphitrite amphitrite* and *A. amphitrite saltonensis*). Our results revealed three clades within *A. amphitrite* with a genetic divergence of approximately 4% among clades, whereas there were no diagnostic morphological differences among clades. Clades 1 and 2 are widely distributed in both temperate and tropical waters, whereas Clade 3 currently restricted to the tropical region. The deep divergence among clades suggests historical isolation within *A. amphitrite*; thus, the present sympatry is possibly a result of genetic admixture following secondary contact. Future studies should evaluate whether distance from the source, local current conditions and environmental selection prevent the complete mixing of clades. Our study highlights that genetic differentiation can exist in a common fouling organism, and future antifouling research should take into account the choice of lineages.

Tetraclita (Crustacea: Cirripedia) tests as an important habitat for intertidal isopods and other marine fauna on tropical rocky shores

Oral BEP

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The barnacle *Tetraclita singaporensis* Chan, Tsang & Chu, 2007 has a thick test to protect the animal against the environmental stresses of the tropical intertidal zone and also predation by muricid gastropods. After the death of the barnacle however, the empty test is often taken over by other marine organisms including haminoeid bubble shells, microgastropods, nematodes, syllid and eunicid polychaetes, mites, spiders, brachyurans, tanaids and sphaeromatid isopods. To date we have recorded some 12 species living inside the dead shells of barnacles in Singapore. There can also be up to 20 isopods inside a single barnacle test, with a varying ratio of sex and size classes. We examined the ensuing community and food web that builds up inside the barnacle test to show the importance of this ephemeral but significant microhabitat in the upper intertidal zone of the tropics..

References:

CHAN, B. K.-K., L.-M. TSANG & K.-H. CHU. (2007): Cryptic diversity of the *Tetraclita squamosa* complex (Crustacea: Cirripedia) in Asia: description of a new species from Singapore. Zoological Studies, **46**(1): 46–56.

Sexual dimorphism in *Atyaephyra* (Decapoda, Atyidae): through the example of *A. thyamisensis*

Oral CBF

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Sexual dimorphism is a ubiquitous phenomenon in decapod taxa. The degree of sexual differentiation can vary greatly depending on the species, from almost indistinguishable to completely morphological different sexes. Shrimps' species of the family Atyidae are sexual dimorphic and there is no difficulty in distinguishing the two sexes in mature Atyidae. Despite the primary differences in the reproductive system, secondary differences can be found, for example, in colour, chromatophore pattern, body size, chelae size, form of pleopods and pereiopods. *Atyaephyra* is the most common and widespread atyid taxon in the greater Mediterranean region, with a distribution spanning from the Middle East to North Africa, Europe and to some Mediterranean islands. Although reported in the Mediterranean region almost 200 years ago, the eventful taxonomic history, the high intra- and inter-population morphological variability observed among the *Atyaephyra* taxa, together with the sexual dimorphism make the recognition of species challenging. Up-to-day seven species have been described within the genus *Atyaephyra* but problems still remain concerning their taxonomy. This study aims at describing in detail the sexual dimorphism of the genus *Atyaephyra* using specimens of *A. thyamisensis* as an example and thus contributing to the ongoing effort of describing the morphological variability in *Atyaephyra* taxa. For this reason specimens collected with a hand dredge from Thyamis River (Epirus, Greece) over the period 2001-2005 were examined. In total, 300 individuals (100 males, 100 females, 100 ovigerous females) belonging to the species *A. thyamisensis* were studied. In order to detect possible morphological differences between the two sexes selected characters were examined on the basis of already known differences between the two sexes from the literature as well as from the authors' previous personal observations. In total 52 somatometric distances and 11 meristic characters were counted. The morphological comparison as well as the statistical analysis showed a clear separation between the two sexes. Further, a second separation has been observed between the females and the ovigerous females. Besides first and second pair of pleopods, sex related differences were observed on third and fourth pair of pereiopods, rostrum, carapace, antennula, last thoracic sternite, while differences between the females and the ovigerous females were most obvious in the abdominal.

References:

ANASTASIADOU, CH. & LEONARDOS, I. D. (2008): Morphological variation among populations of *Atyaephyra desmarestii* (Millet, 1831) (Decapoda, Natantia, Atyidae) from freshwater habitats of north-western Greece. Journal of Crustacean Biology, 28: 240-247.

ANASTASIADOU, CH., NTAKIS A. & LEONARDOS, I. D. (2011): Larval development of the freshwater shrimp *Atyaephyra desmarestii* (MILLET, 1831) sensu lato (Decapoda, Caridea, Atyidae) and morphological maturation from juveniles to adults. Zootaxa, 2877: 41-54.

BAUER, R. T. (2004): Remarkable shrimps: adaptations and natural history of the Carideans (Animal Natural History Series). University of Okalahoma Press, Norman, 316 pp.

CHRISTODOULOU, M., ANTONIOU, A., MAGOULAS A. & KOUKOURAS, A. (2012): Revision of the freshwater genus *Atyaephyra* (Crustacea, Decapoda, Atyidae) based on morphological and molecular data. Zookeys, 229: 53-110.

Habitat characterisation of freshwater crabs(Decapoda: Brachyura) in Singapore

Oral CTF

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Despite the importance of freshwater crabs in stream ecosystems, little is known about their habitats, making it difficult to implement conservation and management measures. This study aims to characterise the habitats of the four primary freshwater crabs of Singapore: *Irmengardia johnsoni*, *Johora singaporensis*, *Parathelphusa maculata* and *Parathelphusa reticulata*. Important habitat characteristics were identified using non-metric dimensional scaling analysis, and physicochemical ranges of each species were identified. The results provide quantitative evidence to support existing anecdotal accounts. The differential habitats of the four species might reflect differences in physiological tolerances. The findings of this study can thus provide useful baseline data for formulating conservation plans.

Commercial exploitation of *Eriocheir sinensis* in the Thames: fyke net trials

Oral IC

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The numbers of invasive Chinese mitten crabs, *Eriocheir sinensis*, in the River Thames have increased since the end of the 1980s. In 2006, the Natural History Museum (NHM) completed a feasibility study into the commercial exploitation of *E. sinensis* in the River Thames. Commercial exploitation of mitten crabs could provide benefits to local fishermen as *Eriocheir* is considered to be a delicacy in many Far Eastern countries including China, Japan, Korea, Taiwan, Thailand and Singapore. Furthermore, such exploitation could reduce the mitten crab population in the Thames and possibly alleviate some of the environmental damage caused by this invasive species. The NHM study compared mitten crab captures using baited pots versus fyke nets. Fyke nets proved to be the most effective method to trap these crabs. However during this feasibility study ca. 1,400 eels (*Anguilla anguilla*) were captured as by-catch while fishing for *Eriocheir*.

Concern over the decline in population of eels across Europe has recently led to the European Commission initiating an Eel Recovery Plan (Council Regulation 2007) to try to return the European eel stock to more sustainable levels of adult abundance and glass eel recruitment. Each Member State is required to establish regional Eel Management Plans. A key target for recovery is to restore successful migration of spawning stock to 40% of historic levels, pre-anthropogenic interference; this is critical as it is thought that insufficient spawning stock may be the primary reason for the population decline. *Anguilla anguilla* has also recently been listed in Appendix II of the Convention on International Trade on Endangered Species.

The main problem with a mitten crab fishery using a traditional fyke net is that a by-catch of eels could potentially deplete the Thames population. As the current market price of eel is ca. £5.75 per kg, fishermen are unlikely to return this commercially valuable fish back to the river.

The Marine Management Organisation and the Environment Agency funded a fyke net trial in the upper estuary of the River Thames. The aim of this project was to improve the efficiency of eel traps with regard to the release of undersize eels back into the river and to trial a net that will capture invasive Chinese mitten crabs yet reduce the number of fish, especially eels, caught as by-catch. A fyke that releases more undersized eels back into the environment will comply with the EU Eel Recovery Plan and recommendation of an efficient crab net may inform further discussion on establishing a mitten crab fishery with a view to reducing population numbers of this damaging invasive species in the Thames

Digital and semi-digital morphological illustrations

Oral GS

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Photography is one of the most important morphological documentation techniques. However, some details can be unclear in a photo due to the overload of structures. A drawing may contain less information, but is more selective for showing important characters in an explicit way. Drawings in optimal quality can now be produced in a much shorter time using digital drawing methods (COLEMAN, 2003, 2006, 2009), as compared to traditional inking. Other advantages are:

- lines are perfectly smooth
- excellent possibilities to change and correct the drawing
- precise drawings of minute details and fine structures are

possible as these can be enlarged enormously (up to 6400%)

- rapid arrangement of plates, scaling of detailed drawings
- easy lettering and insertion of arrows
- shading carried out quickly and easily, albeit not in optimal quality
- the plates result in very small files; they can be transferred by email
- printed result are very good (providing vector graphics are used)

The digital drawings are made using Adobe Illustrator on the basis of scanned pencil drawings or photos. If shading needs to be applied, vector graphics produced in Illustrator have to be tranformed into bitmap graphics. These can be further processed in Adobe Photoshop and shading can be sprayed on the line drawing. However, the shades do not look perfect, as the sprayed pixels sometimes appear clotted. As an alternative it is possible to print the vectorgraphics on „coquille board“, which has a rough surface structure and apply the shadings with a black wax pencil.

References:

COLEMAN, C.O. (2003): "Digital inking". How to make perfect line drawings on computers. -- Organisms, Diversity and Evolution, Electronic Supplement, **14**: 1-14, http://senckenberg.de/odes/03-14.htm

COLEMAN, C.O. (2006): Substituting time-consuming pencil drawings in arthropod taxonomy using stacks of digital photographs. -- Zootaxa, **1360**: 61-68.

COLEMAN, C.O. (2009): Drawing setae the digital way. -- Zoosystematics and Evolution, **85**(2): 305-310.

Crustacea in the Museum für Naturkunde Berlin

Poster

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The Crustacea collection of the Museum für Naturkunde Berlin includes 27,000 catalogued lots of specimens collected world-wide from all crustacean groups. The predominant taxa of the collection reflect the research interests of former curators, e.g. VANHÖFFEN and GRUNER (Isopoda), HILGENDORF (Decapoda) and SCHELLENBERG (Amphipoda).
Material from important German marine expeditions, e.g. the Gazelle-Expedition, the German Deep Sea Expedition and the German Southpolar Expedition were deposited in the Berlin collection.
As well as the wet collection there are 1,500 dry crustaceans and we have about 1,400 types and more than 5,000 microscopic slides.
The collection has been completely databased during the GBIF programme using the SeSaM collection database (zmb.sesam.senckenberg.de, for a more general description: www.senckenberg.de/sesam_en). All collection catalogues were scanned and the references of more than 20.000 books and reprints in the crustacean library databased in Endnote (http://download.naturkundemuseum-berlin.de/oliver.coleman/).
There is a focus on literature about amphipods, currently there are 8,000 scanned books and reprints in pdf-format, fully searchable, most of them on amphipod systematics. We support the scientific community with scanned papers from our reprint collection on demand.
Guests are very welcome to access the collection. Those who cannot visit us can borrow material for six months. We also provide digital images of specimens, e.g. dry material, which is not available for loan.
In the last few years we worked extensively on the improvement of the physical state of the collection and replaced thousands of leaking museum jars and old labels.
Research in the crustacean department is focused on taxonomy and functional morphology of amphipods, especially from the Antarctic, Australia and New Zealand.

Phylogeography of the *Gammarus fossarum* complex in the Romanian Carpathians: an intricate pattern of deeply divergent cryptic lineages with narrowly endemic distributions

Oral GS

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Gammarus fossarum is one of the most common and euryoecious freshwater amphipods in central and south-eastern Europe and molecular studies have shown that it comprises many divergent cryptic lineages. Although the Carpathians are known for their dynamic geomorphological past and glacial refugium role, the phylogeography of this species complex has remained unexplored in this region. Here we report the first phylogeographical study of this complex from the southern Carpathian Mountains. We sequenced two nuclear (EF1a and 28S rDNA) and two mitochondrial markers (COI and 16S) from 30 populations across its distribution area in Romania. We employed phylogenetic and molecular dating analyses to infer the evolutionary relationships and timings of divergence between populations. Furthermore, we used a general mixed Yule coalescent approach and a molecular threshold of 16% divergence of patristic distances at the COI locus to delineate putative cryptic species. We identified highly divergent lineages with narrow distribution ranges that do not exceed 80 km along the longest diagonal. Many of these lineages apparently date back to the Late Miocene, between 5 and 14 million years ago. The general mixed Yule coalescent and the 16% patristic distance molecular threshold at COI indicate 23 and 16 cryptic species, respectively. The phylogenetic relationships among the Carpathian lineages are strongly supported even though the deep nodes in the phylogeny are short, a pattern that suggests an ancient rapid radiation. Interestingly, the oldest lineages are found in north-western Romania and not in the south-west as it would be expected under a postglacial colonization scenario. Based on this mosaic pattern of numerous narrowly endemic lineages coupled with their Late Tertiary divergence times we conclude that the distribution of the *G. fossarum* complex in the Carpathians is probably of relictary nature and that the amphipod populations likely survived the Pleistocene glaciation episodes within this region.

Tropical decapod diversity: Results from massive collecting efforts

Oral GS

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Ecologists return from the field with data; taxonomists return from the field with specimens. Ecologists are obsessed by protocols and replicability; taxonomists are obsessed by species and their names. A new generation of field surveys is attempting to reconcile both worlds by saturating the sampling of macrobenthic invertebrates at discrete tropical sites covering 5-25,000 hectares of complex coastal (0-200 meters) habitats, specially targeting molluscs and decapod crustaceans. Starting with the Panglao 2004 Marine Biodiversity Survey in the Philippines, these collective efforts have involved in particular PETER NG and colleagues (Singapore), TIN-YAM CHAN and colleagues (Keelung), GARY POORE (Melbourne), and many other taxonomists worldwide in the post-expedition phase. The massive deployment of manpower in the field - with 300-600 persons-days dedicated to sampling, sorting and processing just the decapods - is combined with the use of innovative bulk sampling devices - brushing baskets, suction sampler, tangle nets - in addition to targeted collecting by specialists.
The results are both data and specimens, and reveal previously undocumented and unsuspected levels of species diversity. A 15,000 hectares site in the Philippines has thus been found to have in the order of 1,600 species of decapod crustaceans - almost as much as the whole decapod fauna of Japan and three times the size of the decapod fauna of all the European seas. Two other sites in the West Pacific have around 1,450 species (Madang, Papua New Guinea) to 1,100 species (Santo, Vanuatu), thus confirming the species diversity gradient, based on fish and corals, from the Coral Triangle to the central Pacific. A site in the Caribbean (Guadeloupe) has ca. 350 species. Despite - or perhaps because of - the intensity of the sampling effort, many species are rare, with many singletons and a long tail of rare or very rare species. A guesstimate is that at least 10-15 % of the decapods are new species, but the species-rich families are intimidating and remain essentially unstudied. All these numbers are based on morphospecies, and molecular data will likely boost them still higher up.
Decapod crustaceans make excellent outreach material and numerous species have been photographed alive for the first time, documenting colour patterns of relevance to taxonomy and creating education and awareness material.

Developing Conservation Strategies for Threatened Freshwater Decapods Worldwide

Oral GS

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Freshwater ecosystems worldwide from high latitudes to the tropics host highly diverse communities of aquatic invertebrates that often include large-bodied decapod crustaceans such as freshwater crabs, crayfish, and shrimps. However, recent studies indicate that we are rapidly losing freshwater biodiversity in all parts of the world, and that this situation is becoming increasingly serious. A series of IUCN Red List assessments of freshwater decapod groups have revealed that unexpectedly high numbers of species are threatened with extinction. Rates of biodiversity loss in general are highest in freshwater organisms because the habitats on which they depend are under imminent threat from a number of different sources. The IUCN Red List can be a useful tool for identifying conservation action and funding priorities. Our understanding of the locations of threatened species of decapods and the nature of their extinction threats has improved greatly, and global conservation efforts can now be focused on threatened species and on the areas where they are found. The limited resources available for conservation mean that species under threat should be prioritized. Species conservation strategies need cooperation between scientists, conservation managers, educators, funding agencies, and policy makers, as well as conservation agencies such as the IUCN. The need for conservation is urgent because freshwater organisms worldwide are facing increasing human demands on water resources (for food, energy, transport, and water supplies), as well as the emerging threats posed by global climate change.

Paleodrainage evolution as a template to explore cladogenesis and biogeographic patterning of freshwater decapods in the Afrotropical region

Oral CTF

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During the present study the phylogenetics relationships, divergence time estimations and ancestral area reconstruction was undertaker for the entire Afrotropical freshwater crab fauna, Potamonautidae based on four partial DNA loci. The present study represents the most comprehensive taxonomic sampling of Afrotropical freshwater crabs of any biogeographic area undertaken to date, lacking only a single genus. Combined phylogenetic analyses of the four DNA loci using parsimony, Bayesian inference revealed the monophyly of the Afrotropical freshwater crab fauna, with the West African genera (*Liberonautes*, *Potamonemus* and *Sudanonautes*) being basal in all tree topologies. Paraphyly is observed among each of the three subfamilies as well as among a number of the genera, particularly within *Potamonautes*. Taxonomic considerations are briefly discussed. The results suggest that the Afrotropical Potamonautidae diverged in the late Cretaceous, approximately 107.57 Mya. Cladogenesis within this family occurred in Tertiary, which was associated with major uplift and rifting events on continental Africa, with southern Africa being the most recently diverged. The ancestral ranges using the Bayesian binary method (BBM) suggested a West / East African ancestral range for the family, with 30 dispersal- and 15 vicariance events, and the West African genera (*Liberonautes*, *Sudanonautes*, and *Potamonemus*) formed the basal / ancestral group. Within *Potamonautes* we observed several localised radiations in southern and eastern Africa.

A global conservation assessment of freshwater shrimps (Decapoda)

Oral CBF

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Freshwater shrimps are ubiquitous in tropical, sub-tropical and many temperate regions of the world, but in many areas are threatened by human activities and encroachment. Here, we provide the results of a Red List assessment of all currently known 760 true freshwater species, excluding the anchialine fauna. Globally, 27.5% of extant species for which sufficient data are available are threatened, with Atyidae at 37% of species threatened, being substantially more endangered than Palaemonidae at 13%. In total, 289 species (38%) are considered to be Data Deficient, primarily linked to not being recorded since their type description. Two species are considered to be Extinct, with a further 22 species Critically Endangered, of which 11 are possibly already Extinct. A further 36 are Endangered and 71 are considered to be Vulnerable (primarily cave dwelling taxa), with a further 18 species Near Threatened. Only 322 species (42%) can be considered as of Least Concern. On a country basis, the highest proportions of threatened species are found in Cuba (42% threatened), USA (37.5%), China (37.0%), Indonesia (29%) and the Philippines (29%). Habitat wise, the most threatened habitats are karst caves (69% of taxa) and freshwater springs (46%). Not surprisingly, the most important threat to freshwater shrimps is pollution, which is impacting 72% of threatened species, the majority of which are impacted by sewage, herbicides, pesticides and/or elevated nutrient loadings. A further significant international driver is harvesting for the aquarium trade, which impacts 14% of threatened taxa.

Ultrastructure of the Y organ in the freshwater crab *Travancoriana schirnerae*

Oral GS

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Studies demonstrating the role of Y organ in the control of moulting in decapod crustaceans (ECHALIER, 1955) have been paralleled by several ultrastructural investigations (HINSCH et al., 1980). However, such a study on the Y organ of freshwater crabs is still missing. The present investigation on the ultrastructure of the Y organ in the freshwater crab *Travancoriana schirnerae* is reported to fill this gap and to determine the role of Y organ in ecdysteroid secretion.

The electron microscopic observations of the Y organ in *T. schirnerae* revealed elliptical epithelial gland cells with large nuclei and ample cytoplasm. The oval nuclei were often eccentric, contained 1-3 nucleoli and peripherally condensed heterochromatin. The cytoplasm showed numerous free ribosomes, highly anastomosed tubules and vesicles of smooth endoplasmic reticulum (SER), polymorphic mitochondria with tubular cristae, cisternae of rough endoplasmic reticulum (RER) and microtubules. The tubular SER were particularly concentrated towards the basal region of the cell while RER cisternae frequently found encircling the nuclear region. The mitochondria occupied more space in the cytoplasm. The gland cells were devoid of Golgi complexes. Large vesicles with flocculent substances, electron dense granules and a few lysosomal bodies could be identified in the gland cells. Aggregations of microvesicles which appeared close to the lateral plasma membrane and in close association with the SER vesicles possibly suggest the intercellular exchange of substances. Occasionally, microtubules were noticed near the cell periphery. Specialized structures such as gap junctions and tight junctions were visible on the lateral plasma membrane between cells. Frequently, granular hemocytes were observed, which portrayed a close contact with the glandular cells. These hemocytes showed elongate nuclei with patchy heterochromatin and 1 or 2 nucleoli; cytoplasm contained numerous small to large electron dense granules, mitochondria, RER cisternae, vesicular SER and microvesicles adjoining the nuclei. The plasma membrane beneath the basal lamina composed of invaginations and the apical plasma membrane possessed numerous microvilli which serve to increase the surface area for metabolic exchange. The presence of extraordinarily abundant tubular SER and high proportion of tubular mitochondria could well be elucidated in favour of steroid production by the gland cells.

References:

ECHALIER, G. (1955): Rôle de l'organe Y dans le déterminisme de la mue de *Carcinides* (*Carcinus*) *maenas* L. (Crustacés Décapodes): expériences d'implantation. − Comptes Rendus de l' Academie des Sciences Paris Série D, 240: 1581-1583.

HINSCH, G. W., SPAZIANI, E. & VENSEL, W. H. (1980): Ultrastructure of the Y organs of *Cancer antennarius* in normal and de-eyestalked crabs. − Journal of Morphology, 163: 167-174.

New insights into the evolutionary history and the present distribution of the common Southern Ocean pycnogonid *Colossendeis megalonyx*

Oral MC

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Colossendeis megalonyx, one of the most widespread Southern Ocean sea spiders, has long been considered a species with typical circumpolar distribution. However, a recent study found that *C. megalonyx* consists of several clearly distinct mitochondrial (CO1) lineages with a narrower distribution. Here we expand the CO1 dataset with more than 400 sequences with a wide geographical sampling, representing most regions on the Antarctic shelf as well as the Subantarctic islands. We complement these data with sequences of the nuclear ribosomal Internal Transcribed Spacer (ITS) for most mitochondrial clades and geographic locations. The results show that most of the Antarctic mitochondrial clades have a circumpolar distribution but show strong regional differentiation. The Subantarctic clades show a stronger degree of endemism. The ITS results only partially agree with the CO1 data. The previously identified mitochondrial clades can be grouped into larger widely distributed groups that are also mostly monophyletic according to ITS data. However, the population genetic structure within these groups is very different between ITS and CO1 data, suggesting that clades that would be considered separate species based on mitochondrial data alone can freely hybridize. Besides the ITS data, we also present preliminary results from next-generation restriction-enzyme associated DNA sequencing (RADseq) of representative specimens from the *C. megalonyx* complex. We use the data for model-based testing of hypotheses on the postglacial recolonization of Antarctica by *C. megalonyx* and the possible survival in glacial refugia on the Antarctic shelf or outside of it.

Ndumo Game Reserve: a potential hotspot of large branchiopods in Phongolo lowland floodplain South Africa.

Poster

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Temporary water bodies are important habitats for specialized and endemic large branchiopods, thereby contributing to regional aquatic biodiversity. However, in certain regions, these habitats remain largely understudied and therefore the interpretation of large branchiopod species distribution is often based on limited data. Ndumo Game Reserve, a part of Phongolo floodplain in the South Africa is a RAMSAR site, but little is known about its large branchiopod fauna. A study was carried out by sampling the active communities from 30 seasonal pans of different sizes. Sixty three percent of these pans had at least one large branchiopod species. Six large branchiopod species were collected comprising three Anostraca, one Notostraca and two Spinicaudata, representing about 13 % of known species in southern Africa. We expect to find even more species in future after hatching the resting egg banks and sampling the active communities for a second time. Considering the small size of this reserve (120 km^2) and its large branchiopod diversity, Ndumo Game Reserve can be considered an important area for South African large branchiopods, which are currently often threatened by inappropriate conservation measures. Detailed information on their distributions and diversity is therefore important to establish appropriate conservation plans.

New details of polychelid crustaceans including their giant larvae

Poster

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Polychelida occupy an important phylogenetic position within Decapoda. All modern representatives of this monophyletic group inhabit the deep sea and show a mixture of traits known from different other decapod groups. For example, they share some derived characters with Eureptantia and retain ancestral ones which they share with, e.g., Caridea. In their specific systematic position, somewhere between Caridea and Eureptantia, they can be seen as an evolutionary link between these groups. More precisely, their morphotype combines aspects of the 'shrimp' morphotype and of the 'lobster' morphotype.
Just to name some examples, Polychelida have 1) a triangular telson which is an ancestral trait they share with the ‘shrimp’ morphotype, whereas the ‘lobster’ morphotype has a rectangular telson, and 2) their dorso-ventrally compressed pleon is a typical trait of Eureptantia ('lobster' morphotype), while Caridea still have a laterally compressed pleon ('shrimp' morphotype).
Additionally, modern polychelids show peculiarities of their own evolutionary lineage. Most strikingly, besides the fact that all modern forms are blind, is that the benthic modern adulti develop from highly specialized pelagic larvae which can reach a size of several centimeters, thus represent giant larvae.
We present a detailed documentation of a modern giant eryoneicus larva taking advantage of composite autofluorescence imaging. This includes several outer structures, such as the thoracopods and pleopods, but also inner structures, such as their gizzard and its masticatory organs. Additionally, we provide the first high-resolution 3D photographs of such a larva to show its morphological structures in situ with correct topology
(Fig. 1).

Figure 1: Eryoneicus larva from lateral (stereo photography in the printed version)

Furthermore we discuss potential evolutionary transformations of morphological traits which characterise the modern giant larvae, by comparing morphological structures of modern species to those of fossil ones. The fossils were found in 150 million years old lithographic limestones of southern Germany, most famous those of the Solnhofen area. They have exceptionally preserved tiniest details, which can be seen easily with the same methods applied to the extant specimens: fluorescence microscopy. They can therefore be perfectly used for a structural comparison with extant specimens.

Functional morphology of the copulatory system of box crabs (Calappidae, Brachyura, Crustacea): Species-specific long second gonopods interact with novel feature of the female seminal receptacle

Oral GS

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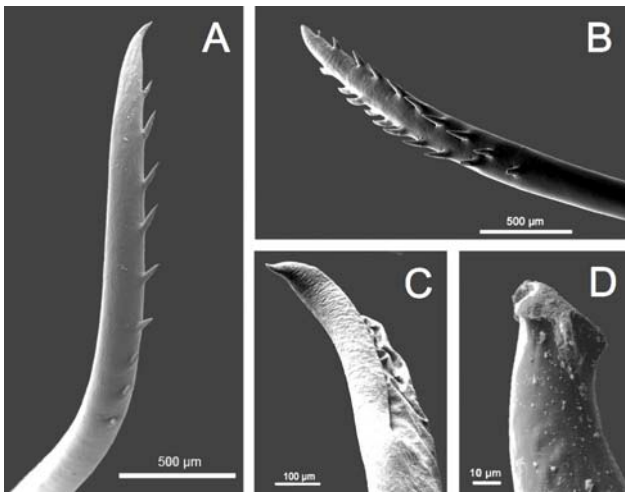

Tips of long second gonopods (male genitalia) of different species of box crabs (family: Calappidae). A – Calappa sulcata, B – Calappa ocellata, C – Calappula saussurei, D – Calappa pelii

Male genitalia show great morphological diversity. They are often species-specific and useful in taxonomic studies. This diversity is linked to their function during copulation. Understanding their function may therefore explain how this diversity is generated.

Male genitalia of True Crabs (Eubrachyura) consist of two pairs of modified legs, so-called gonopods. The first gonopod is coniforme and contains the second gonopod during copulation. Gonopods and female gonopore are in close contact when sperm is transferred into the female seminal receptacle, where it is stored until fertilization.

In many eubrachyuran taxa, the second gonopod is short and hidden within the tubular first gonopod. Only the first gonopod interacts closely with the female gonopore during copulation. In these taxa, the first gonopod is elaborate and species-specific, while the second gonopod is nondescript. This suggests that a close interaction with the female organs promotes trait diversification.

Some taxa possess second gonopods that are longer than the first gonopods. These gonopods could potentially extend past the first gonopod and interact with the female organs, promoting diversification of the second gonopod. Indeed, in box crabs (family: Calappidae), many long second gonopods are species-specific. Is there indeed a close interaction between the second gonopod and female copulatory system?

We inferred the interaction between gonopods and female reproductive organs by histological cross sectioning of male gonopods and female reproductive organs. We found that the female seminal receptacle is separated into two chambers, a ventral chamber of mesodermal and ectodermal origin and an ectodermal dorsal chamber. This dorsal chamber is the location of sperm reception and spermatophore storage. While a dorsal chamber is present in several crab taxa, its ectodermal origin is unique. Our model of copulation suggests that the second gonopod enters the seminal receptacle. It interacts closely with the opening to the dorsal chamber, into which it releases spermatophores. The close interaction between the tip of the second gonopod and the orifice of the dorsal chamber coincides with the concentration of gonopod diversity on its tip (fig. for examples).

Molecular Phylogenetic Analyses of *Ebalia* and *Lithadia* Show Need for Morphological Revision

Poster

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Among "pebble-like" crabs that live in hard substrate rubble, there is tremendous variation in carapace shape, ornamentation, sculpture, surface erosion, color, and patterns of pigmentation. Some relates to maturational stages but other appears to reflect ecomorphic qualities induced by variations in habitat. This phenomenon is poorly documented and accounts are rarely to be found in taxonomic literature.

Yet it is seen in certain small calappoid, xanthoid, parthenopid, and majoid crabs, and especially among leucosioidean crabs of the genera *Speloeophorus*, *Ebalia*, and *Lithadia*. The genera *Ebalia* (LEACH, 1817) and *Lithadia* BELL, 1855, while apparently widespread, have been poorly represented in molecular phylogenetic studies. *Lithadia* is currently comprised of 8 genera, previous revisions having removed 6 additional species to the genera *Ebalia, Speloeophorus,* or *Drachiella*. The subjectivity of morphological characters relied upon to make generic and specific assignments prompts our re-assessment using DNA sequences. As an initial investigation, we here examine phylogenetic relationships between materials that are morphologically identifiable as *Ebalia cariosa* and *Lithadia cadaverosa*, using two mitochondrial markers (16S and COI). Our results indicate close relationship between *E. cariosa* and *L. cadaverosa* and suggest the presence of at least one additional cryptic species. Our findings compel taxonomic revisions at the level of genus and species to reflect natural relationships within the subfamily Ebaliinae.

Speciation in progress: looking for cryptic species in pontoniine shrimps

Oral MSI

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The taxonomic challenge posed by cryptic species (two or more distinct species morphologically classified as a single species) has been recognized for nearly 300 years. The advent of relatively inexpensive and rapid DNA sequencing has given biologists a new tool for detecting and differentiating morphologically similar species (BICKFORD et al., 2006). Cryptic species appear to be common in a variety of marine invertebrates (KNOWLTON, 1993). They have been recorded for shrimps of the genera *Alpheus* (MCCLURE & GREENBAUM, 1994; KNOWLTON & WEIGT, 1997, 1998), *Synalpheus* (DUFFY, 1996), and *Rimicaris* (SHANK et al., 1998) among others. Little is known however about the presence of cryptic species in symbiotic shrimps of the subfamily Pontoniinae.

Pontoniine shrimps are the most radiated caridean subfamily in the marine environment, comprising 152 genera including 604 species accounting for 20% of all caridean shrimp species (DE GRAVE & FRANSEN, 2011). They are mainly inhabitants of shallow coastal waters but also occur in deep water. They are found in tropical, subtropical and temperate regions, reaching their highest diversity in the tropical coral reef environments. Most pontoniine species live in close association with other marine invertebrates like sponges, coelenterates, molluscs, ascidians and echinoderms.

By using DNA barcodes, the presence of cryptic species in various pontoniine taxa associated with a range of invertebrate hosts is surveyed. Preliminary results will be presented on: 1) sponge- and coelenterate-associated species in the *Periclimenes iridescens* complex, 2) anemone-associated Caribbean *Periclimenes*, 3) coral-associated *Paratypton siebenrocki*, 4) species in the *Periclimenes diversipes* complex associated with mushroom corals, 5) bivalve-associated Indo-West Pacific *Conchodytes*, and 6) East and West Atlantic bivalve-associated *Pontonia*.

BICKFORD, D., LOHMAN, D.J., SDOHI, N.S., NG, P.K.L., MEIER, R., WINKER, K., INGRAM, K.K. & DAS, I. (2006): Cryptic species as a window on diversity and conservation. -- Trends in Ecology and Conservation, **22**: 148-155.

DE GRAVE, S. & FRANSEN, C.H.J.M. (2011): Carideorum Catalogus. The recent species of the Dendrobranchiate, Stenopodidean, Procarididean and Caridean Shrimps (Crustacea: Decapoda). -- Zoologische Mededelingen Leiden, **85**: 195-589.

DUFFY, J. E. (1996): Species boundaries, specialization, and the radiation of sponge-dwelling alpheid shrimp. -- Biological Journal of the Linnaen Society, **58**: 307–324.

MCCLURE, M. R. & GREENBAUM, I.F. (1994): Biochemical variation in *Alpheus* (Decapoda, Caridea, Alpheidae) from the coast of Texas: evidence for cryptic species. -- The Southwestern Naturalist, **39**: 63–66.

KNOWLTON, N. (1993): Sibling Species in the sea. -- Annual Review of Ecology and Systematics, **24**:189-216.

KNOWLTON, N. (2000): Molecular genetic analyses of species boundaries in the sea. -- Hydrobiologia, **420**: 73-90.

KNOWLTON, N. & WEIGT, L.A. (1997): Species of marine invertebrates: a comparison of the biological and phylogenetic species concepts. In: CLARIDGE, M. F., DAWAH, H.A. & WILSON, M.R. (eds), Species: the Units of Biodiversity: 199-219; Chapman & Hall, London.

KNOWLTON, N. & WEIGT, L.A. (1998): New dates and new rates for divergence across the Isthmus of Panama. -- Proceedings of the Royal Society of London, B., **265**: 2257-2263.

SHANK, T. M., LUTZ, R.A. & VRIJENHOEK, R.C. (1998): Molecular systematics of shrimps (Decapoda: Bresiliidae) from deep-sea hydrothermal vents, I: Enigmatic 'small orange' shrimp from the Mid-Atlantic Ridge are juvenile *Rimicaris exoculata*. -- Molecular Marine Biology and Biotechnology, **7**: 88–96.

Intra- and interspecific differences in physiological indicators of biogeographical limits for decapod crustaceans

Oral BLC

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Biogeographical limits for animals can be set by multiple biotic and abiotic factors. Recent evidence in fish and several invertebrates, especially decapod crustaceans, shows that stress leads to a depletion of cellular energy and subsequent decreased levels of performance, summarized as the oxygen and capacity limited thermal tolerance hypothesis (OCLTT). A central regulator of cellular ATP levels is the enzyme AMP-activated protein kinase (AMPK). During thermal and other stress a changing ATP/AMP ratio activates AMPK, which in turn accelerates ATP producing-, and inhibits ATP consuming pathways. This refocusing of cellular energy metabolism allows animals to endure stressful conditions. Therefore, AMPK is a prime candidate as an early alarm signal.

We measured during a fast and progressive temperature challenge (12 to 38ºC with 6ºC/h) AMPK activity, protein and mRNA expression together with other established stress markers (HSP70, lactate accumulation, heart rate, motor activity) in three decapod crustacean species, the lobster *Homarus americanus*, the rock crab, *Cancer irroratus*, and the green crab, *Carcinus maenas*. We identified AMPK as a reliable and early alarm signal in lobster and rock crab, but not in green crabs.

The green crab, which changed in our experiments from maximum performance to no performance at all without a detectable pejus range, occurs in two color morphs: green after molting and red after prolonged intermolt. The green morph has been described by organismal parameters as more stress tolerant than the red morph. We tested for AMPK activity and other stress parameters during heat, hypoxia and salinity stress. We could not elicit a significant AMPK activity increase with any of the stressors, but especially during low salinity stress saw a differential response in HSP70 and several ion transporters and associated regulatory proteins (NaK-ATPase, NaH antiporter, carbonic anhydrase) in mRNA and protein levels. However, the green morphs showed consistently a larger scope for adaptation than the red morphs, indicating differential stress tolerance.

Investigating a broad range of potential stress markers in several decapods during different stressors has shown that energy availability (following OCLTT, assessed by AMPK activity) is an underlying theme when assessing the potential for range expansions, or the challenges posed by global warming. However, the mechanisms and respective responses are different enough between species and potentially even within a species that care needs to be taken to not over simplify the approach. Only a detailed investigation on the respective mechanisms in the respective species will allow identifying reliable indicators for biogeographical limits for decapod crustaceans.

Shelf and canyon suprabenthic assemblages from the SE Bay of Biscay

Oral GS

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During several surveys carried out in the southeastern Bay of Biscay (May 1995 and June 2001), different suprabenthic environments (see BRUNEL et al., 1978) were quantitatively sampled with a small hand-operated sled (1 station in the swash-zone of Hendaye Beach) and multinet sleds towed over the sea floor from a research vessel (4 stations on the Basque Shelf and 1 station within the Capbreton Canyon). The whole motile fauna collected during these surveys (21292 specimens) was classified into 11 major taxa (mainly crustaceans) and at least 197 species (91 amphipods, 34 mysids, 22 cumaceans, 18 decapods, 16 isopods, 5 euphausiids, 5 tanaids, 3 fishes, 1 cephalopod, 1 lophogastrid, 1 pycnogonid).

A multivariate analysis of abundance data discriminates 4 groups of stations, each characterized by the following dominant species: group 1 (swash-zone station; 0.2 m) with *Gastrosaccus roscoffensis* (mysid; 61.9% of total abundance) and *Cumopsis fagei* (cumacean; 29.7%); group 2 (inner shelf stations; 12–30 m) with *Acanthomysis longicornis* (mysid; 36.7%) and *Gastrosaccus/Haplostylus* (mix of mysid juveniles; 12.9%); group 3 (outer shelf stations; 90–175 m) with *Nyctiphanes couchii* (euphausiid; 22.5%) and *Anchialina agilis* (mysid; 14.3%) and group 4 (canyon station; 761 m) with the amphipods *Melphidippa* sp.B (new to science; 13.2%) and *Parvipalpus major* (8.5%). Species richness and diversity indices showed minimal values in the swash-zone (7 species; H'[$\log_2$]=1.4) and maximal values on the outer shelf (123 species) and in the canyon (H'[$\log_2$]=5.2). Amphipods and mysids were the most speciose taxa in all assemblages. Total abundances ranged between 1941 ind./100 m^2 (inner shelf) and 6982 ind./100 m^2 (outer shelf), with a numerical dominance of mysids (28.4–66.7% of total abundance) in the swash/shelf areas *versus* amphipods in the canyon (61.6%). The similarity level observed between outer shelf and canyon stations is probably related to the geomorphological peculiarity of the study area (a gouf-type canyon deeply incising the adjacent continental shelf), allowing both shelf species to extend their distribution down to bathyal depths (i.e. the mysid *Anchialina agilis*) and bathyal species to colonize the shelf break (i.e. the isopods *Chelator insignis* and *Munnopsurus atlanticus*) and even the outer shelf (i.e. the cumacean *Eudorella* cf. *parvula*).

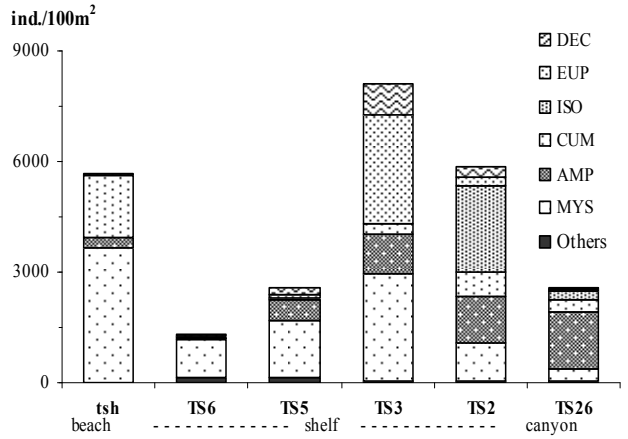

Fig. 1. Abundance of major taxa at the sampling stations. AMP: amphipods, CUM: cumaceans, DEC: decapods, EUP: euphausiids, ISO: isopods, MYS: mysids.

Reference:

BRUNEL, P. et al. (1978): Le traîneau suprabenthique Macer-GIROQ: appareil amélioré pour l'échantillonnage quantitatif étagé de la petite faune nageuse au voisinage du fond. – Internationale Revue der gesamten Hydrobiologie, 63: 815-829.

New asellote isopods from bathyal soft-bottoms of the Bay of Biscay (NE Atlantic)

Poster

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Bathyal suprabenthic assemblages (see BRUNEL et al., 1978) from the Bay of Biscay were studied during several multidisciplinary surveys carried out between 1989 and 2011. At each site, an abundant motile fauna was quantitatively sampled with multinet sleds (0.5 mm mesh size), including amphipods, cumaceans, isopods and mysids as dominant major taxa. Some of these deep species were new to science and progressively described (amphipods: *Liropus cachuchoensis* GUERRA-GARCÍA et al., 2008, *Leucothoe cathalaa* FRUTOS & SORBE, 2013; isopods: *Cornuamesus longiramus* (KAVANAGH & SORBE, 2006), *Politolana sanchezi* FRUTOS & SORBE, 2010, *Paranthura santiparrai* FRUTOS et al., 2011; and mysid: *Mysidopsis cachuchoensis* SAN VICENTE et al., 2013). Two new asellote isopods belonging to genera *Ischnomesus* (Ischnomesidae) and *Munnopsurus* (Munnopsidae) are herein presented.The genus *Ischnomesus* RICHARDSON, 1908 contains 36 species, four of them from European waters, including the type species *Ischnomesus bispinosus*, also recorded at bathyal depths in the Bay of Biscay. *Ischnomesus* sp.A can be distinguished at a glance from all known European species (*I. armatus*, *I. bispinosus*, *I. chardyi* and *I. norvegicus*) by its body aspect, covered by numerous projections on all segments except cephalon (more abundant in females than in males). It also differs from the sympatric *I. bispinosus,* by pereonites 2–6 with lateral processes and pereopod 1 carpus more elongate. The new species was recorded on bathyal bottoms between 619 and 1099 m depth. It lives on very fine sand and muddy bottoms with organic content between 3.88 and 6.31% (temperature: 9.7–10.5ºC; salinity: 35.7–35.8). Its maximum abundance (41.8 ind./100 m^2) was registered on the Aquitanian Slope at 693 m depth. The genus *Munnopsurus* RICHARDSON, 1912 contains eight species, four of them from the Atlantic Ocean, including the well-known *M. atlanticus* (BONNIER, 1896) from the Bay of Biscay. *Munnopsurus* sp.A can be easily distinguished from the sympatric *M. atlanticus* by larger size at adult stage, non-twisted article 3 of mandibular palp, pereopod 2 basis shorter than pereopod 1 basis and huge maxillipedal palp in adult males. The new species was recorded on bathyal bottoms between 462 and 1082 m depth. It lives on very fine sand and muddy bottoms, with organic content between 3.50 and 7.63% (temperature: 9.7–10.9ºC; salinity: 35.6–35.9). Its maximum abundance (73.6 ind./100 m^2) was registered on the thalweg of the Capbreton Canyon at 761 m depth.

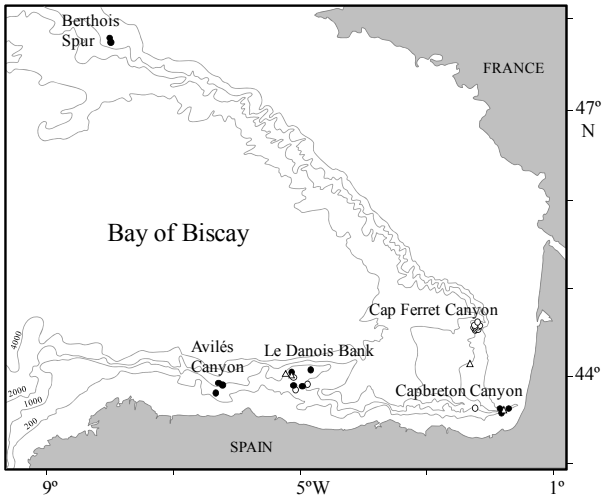

Fig. 1. Distribution of the new isopod species in the Bay of Biscay. *Ischnomesus* sp.A: empty circle; *Munnopsurus* sp.A: solid circle; both species: triangle.

Reference:
BRUNEL, P. et al. (1978) – Internationale Revue der gesamten Hydrobiologie, 63: 815–829

Embryonic development of *Limulus polyphemus* is slowed by low oxygen levels

Poster

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The American horseshoe crab *Limulus polyphemus* typically spawns in the upper intertidal zone. The developmental time of embryos is affected by various environmental factors such as temperature, salinity, and oxygen. Previously, it has been shown that developmental time is reduced at both high and low salinities and temperatures. However, little is known about the influence of oxygen. This study investigates the influence of oxygen on embryonic development in *L. polyphemus.* Gametes from one male and one female *L. polyphemus* were extracted and fertilized by artificial insemination. In order to test how oxygen affects embryonic developmental time, the fertilized eggs were exposed to four different oxygen levels: 2% O_2, 5% O_2, 10% O_2, and atmospheric air, respectively. The embryonic stages were scored every second day. The experiment showed that oxygen has a high impact on the developmental time in *L. polyphemus*. Embryos exposed to 2% O_2 developed slower than embryos exposed to higher oxygen levels, and the developmental time seems to shorten with increasing oxygen levels. In early stages the embryos showed no significant differences between the different treatments. The influence of oxygen increased with developmental time as later stages showed an evident difference in development between the different treatments. Hence, developmental time in *L. polyphemus* increases when oxygen concentration decreases.

20th anniversary of *Hemigrapsus* in Europe - A morphological perspective on a successful bioinvasion

Oral IC

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Since the mid-1990s, two western pacific brachyuran crabs, *Hemigrapsus sanguineus* and *H. takanoi*, invade rapidly and highly successful the Atlantic and North Sea coasts of Europe. Both species settle on hard substrates in the intertidal zone, where *H. sanguineus* prefers rocky structures like boulder groins, revetments, etc., while *H. takanoi* is most abundant in mussel and oyster beds.

a) *Hemigrapsus sanguineus* on a boulder groin, and b) *Hemigrapsus takanoi* on a mussel bed (*Mytilus edulis*). Adult individuals, found in List, Sylt, Germany.

Observational data for both *Hemigrapsus* spp. indicate high individual fecundity, a long reproductive period, early start of larval recruitment and at least two recruitment waves per season. These factors presumably contribute to the invasion potential, but specific characteristics that enable the high reproduction rates of *Hemigrapsus* spp. have remained unknown. Based on histological investigations we hypothesize morphological adaptations in the overall structure and seasonal development of the female reproductive system of both *Hemigrapsus* species, allowing successful reproduction in their specific habitats. First results of a comparative analysis of the female reproductive system of *H. sanguineus* and *H. takanoi* are presented and discussed in correlation to ecological data.

The GAMMA project: Variability – diversity and Ecotoxicology in Gammarids

Oral GS

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Ecological hazard assessment of chemicals for aquatic ecosystems requires the use of biological assays in order to establish relationships between contamination and effect existing in the field. This step is an essential condition for the implementation of programs meant the restoration of aquatic environments. Therefore the *in situ* experimentations based on the use of calibrated organisms from one control population seeking to limit biological confounding factors, appears today as essential to improve the diagnosis of aquatic systems. In this context, we developed a suite of markers addressing neurotoxicity (acetylcholinesterase), genotoxicity (Comet assay), digestive enzymes, feeding rate and reproduction impairments and capacity to osmoregulate (XUEREB et al., 2009; GEFFARD et al., 2010; ISSARTEL et al., 2010) in the freshwater sentinel species *Gammarus fossarum*. Then, for each marker, benchmark values taking into account their natural variability in relation to environmental confounding factors (temperature, alkalinity…) have been determined and validated in field experiments. These values lead to an accurate interpretation of marker levels in terms of contamination and toxicity of aquatic systems (COULAUD et al., 2011). However, the diagnosis using a sentinel species should be relevant towards the diversity of native populations and related species with their own history. Furthermore, the relevance of the population and the species chosen as surrogate test organisms is questionable. The potential divergence of life histories and sensitivities to pollutants between experimental and native populations is in fact an open question. The Project GAMMA aims to assess (1) the natural variability of molecular responses (AchE, digestive enzymes) and life-history traits (feeding rate, reproduction and osmoregulation) in relation to geographical location of control gammarid populations and species used as sources organisms for *in situ* tests, and (2) the divergence of the sensitivities of these markers to contaminants between populations and species. Results will be presented and their implication for ecotoxicological assessment of aquatic systems will be discussed.

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GEFFARD, O., XUEREB B., CHAUMOT A., GEFFARD A., BIAGIANTI S., NOËL C., ABBACI K., GARRIC J., CHARMANTIER G. & CHARMANTIER-DAURES M. 2010. Environmental Toxicology and Chemistry, 29 (10): 2249-2259.

COULAUD R., GEFFARD, O., XUEREB B., LACAZE E., QUÉAU H., GARRIC J., CHARLES S. & CHAUMOT A. 2011. Water Research. 45(19):6417-6429.

ISSARTEL, J., BOULO, V., WALLON, S., GEFFARD, O. & CHARMANTIER, G. 2010. Chemosphere, 81: 701-710.

XUEREB B, LEFEVRE E, GARRIC J & GEFFARD, O. 2009. Aquatic Toxicology, 94: 114-122.

New Zealand Cumacea

Poster

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The cumaean fauna of New Zealand waters is largely unknown, with only 37 species known through 2011. Most of the previous work, by CALMAN (1907, 1908, 1911, 1917), GERKEN & LOERZ (2007), JONES (1960, 1963), THOMSON (1892), and ZIMMER (1902, 1921) represented shallow water, inshore collections. JONES (1960, 1963), GERKEN (2001, 2010) and GERKEN & RYDER (2002) described a few species from deeper waters offshore, especially Chatham Rise. Recent collections by the New Zealand National Institute for Water and Atmosphere (NIWA), mainly from the Chatham Rise (east of New Zealand) and Challenger Plateau (west of New Zealand), have yielded three new genera and 85 new species, including the first record of the family Ceratocumatidae from New Zealand waters.

New species and genera from the Bodotriidae, Ceratocumatidae and Nannastacidae have been described (GERKEN 2012, GERKEN 2013) and work on the new Diastylidae is in progress. Diversity, abundance and endemism were higher on the Chatham Rise than on the Challenger Plateau, with 49 species and 11 genera found only on Chatham Rise versus 6 species found solely on the Challenger Plateau. There were 41 species and 18 genera that were found in both areas.

CALMAN, W.T. (1905) The Cumacea of the Siboga Expedition. -- Uitkomsten of Zoologisch, Botanisch, Oceanographisch en Geologisch Gebied 36, 1-23.

CALMAN, W.T. (1907) Cumacea. National Antarctic Expedition 1901-04. -- Natural History II, Zoology 6, 1-6.

CALMAN, W.T. (1908) Notes on a small collection of plankton from New Zealand. I, Crustaces (excluding Copepoda). -- Annals and Magazine of Natural History, series 8 1, 232-240.

CALMAN, W.T. (1911) On new and rare Crustacea of the order Cumacea from the collection of the Copenhagen Museum-Part II. The families Nannastacidae and Diastylidae. -- Transactions of the Royal Society of London 18, 341-400.

CALMAN, W.T. (1917) Stomatopoda, Cumacea, Phyllocarida and Cladocera. -- Natural History Reports of the 'Terra Nova' Expedition, Zoology 3, 137-162.

GERKEN, S. (2001) The Gynodiastylidae. -- Memoirs of the Museum Victoria 59(1), 1-276.

GERKEN, S., RYDER, H. (2002) Campylaspis rex, sp. nov. (Crustacea: Cumacea) from New Zealand. -- Proceedings of the Biological Society of Washington 115(2), 412-418.

GERKEN, S., LOERZ, A. (2007) Colurostylis castlepointensis, a new shallow-water diastylid (Crustacea: Cumacea) from New Zealand. -- Zootaxa 1520:37-49.

GERKEN, S. (2010) Watlingia, a new genus (Crustacea: Cumacea: Lampropidae) from the waters of New Zealand. -- Journal of Crustacean Biology 30(2) 296-306.

GERKEN, S. (2012) New Zealand Ceratocumatidae and Nannastacidae (Crustacea: Cumacea). Zootaxa Monograph 3524 1–124.

GERKEN, S. (2013). New Zealand Bodotriidae. -- Zootaxa 3630(1) 1-38.

JONES, N.S. (1960) Cumacea of the Chatham Islands 1954 Expedition. -- Bulletin of the New Zealand Department of Science and Industrial Research 139, 9-11.

JONES, N.S. (1963) The marine fauna of New Zealand: Crustaceans of the Order Cumacea. -- Memoirs of the New Zealand Oceanographic Institute 23, 1-80.

THOMSON, G.M. (1892) On the occurrence of two species of Cumacea in New Zealand. -- Journal of the Linnean Society (Zoology) 24, 263-271.

ZIMMER, C. (1902) Cumaceen. -- Hamburger Magalhaensischen Sammelreise 1-18.

ZIMMER, C. (1921) Results of Dr. E. Mjoebergs Swedish Scientific Expeditions to Australia 1910-1913, 26, Cumaceen. -- Kungl. Svenska Vetenskapsakademiens Handlingar 61: 4-13.

Context-dependent effect of the larval environment on postmetamorphic survival in an intertidal barnacle

Oral EMC

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A considerable amount of research in larval ecology attempts to address the question of how larval processes affect recruitment. Most of this work focuses on variations in settlement densities as mediators of the effect of the larval environment on recruitment. Settlement responds to larval supply and behaviour and may co-determine the magnitude of density-dependent processes. However, we still know little about how variations in traits of individuals mediate the effect of the larval environment on juvenile survival (trait-mediated effects: GIMÉNEZ 2004). We know that the larval environment can produce phenotypic changes in juvenile stages (latent effects: PECHENIK 2006) but it is still unclear in which environmental contexts, variations in the phenotype result in differential recruitment. The objective of this work was to determine the role of trait-mediated effects of larval experience on recruitment under different environmental contexts. Using the intertidal barnacle *Austrominius modestus* as a model species, we manipulated the food concentration experienced by nauplius stages, outplanted settlers in two different environments (intertidal levels) and observed patterns of survival over a period of 5 months (Fig. 1).

There were three larval food treatments (diatom *Skeletonema costatum* concentration in cells ml^{-1}: low = $1x10^5$, medium: $2x10^5$, high: $3x10^5$); settlers were out planted at a site in the Menai Strait (Isle of Anglesey, UK) at two shore levels within the barnacle zone (low: +3.0m, high: +4.8); the experiment was repeated twice (September and October 2011).

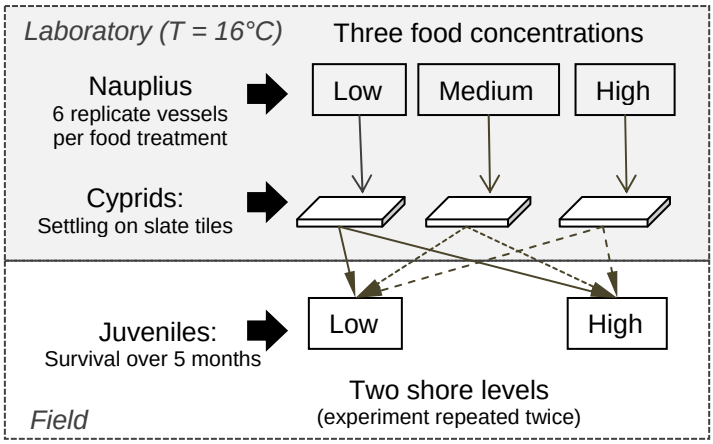

Fig. 1 Experimental set up to evaluate the combined role of larval food environment and habitat on juvenile survival in the barnacle *Austrominius modestus*

In the September experiment, high food density reduced juvenile mortality at the low shore level. At the high shore level, mortality was high irrespective of the larval food density, presumably due to limited feeding and prolonged exposure to air. By contrast in the October experiment, larval food density affected juvenile survival at both shore levels. Most mortality occurred during the first two weeks and mortality was higher in September (when temperatures were higher) than in October. When present, differences in barnacle abundance due to larval conditions were maintained over 10 to 22 weeks (September and October experiments respectively). Our experiment shows that trait-mediated effects of larval experience on juvenile recruitment are context-dependent: a harsh environment (high shore level in September) may blur the effect of larval experience on recruitment.

References

GIMENEZ, L. (2004) Marine Ecology Progress Series, **283**: 303-310.
PECHENIK, J. A. (2006) Integrative and Comparative Biology, **47**: 1-11.

Digging deep: the circulatory system of Xiphosura enlightened

Oral MC

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Horseshoe crabs (Xiphosura) have been an object of zoological research for almost 200 years. Their unique morphology, their phylogenetic position as sister taxon to arachnids and an evolutionary history in which they seem to have gone through almost no major changes for 400 million years have attracted the interest of a number of researchers. Although some morphological work on the circulatory system has been done, however, the three-dimensional structure of this complex organ system has never been shown satisfactorily and some crucial questions remain unanswered. We investigated the circulatory system using a powerful combination of an injection method and micro computer tomography (µCT). Data were processed and 3D-visualized using reconstruction software. Furthermore, some features of the circulatory system were investigated ultrastructurally via transmission electron microscopy. Our results show the high degree of complexity of the Xiphosuran circulatory system and provide insight into its three-dimensional structure and relationship to other organ systems such as the central nervous system. We were able to reveal structures which have not been described before and show that the major sinuses, previously described as vessel-like, though indeed highly ramified are clearly distinguishable from arteries as their ultrastructural appearance differs explicitly. Similarities and differences between the Xiphosuran species and arachnids are highlighted and possible phylogenetic implications and evolutionary scenarios discussed.

Lepidepecreum BATE & WESTWOOD, 1868 (Amphipoda, Lysianassidae, Tryphosinae), a new record from the Southwestern Atlantic Ocean

Poster

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A significant number of studies have identified amphipods from the superfamily Lysianassoidea DANA, 1849 in many seas. This group of amphipods is very diverse in morphological, ecological and behavioral characteristics. The superfamily Lysianassoidea includes 22 established families and 3 subfamilies with approximately 1400 species. The subfamily Tryphosinae LOWRY & STODDART, 1997 is a large group of the Lysianassidae DANA, 1849, with 40 genera. Among these genera, *Lepidepecreum* BATE & WESTWOOD, 1868 is a widespread lysianassid genus known from all oceans of the world and can be distinguished from other tryphosine by the combination of an elongate peduncular article 3 on antenna 2 and a long carpus on gnathopod 1. Currently, 37 species of *Lepidepecreum* with wide bathymetric distribution are identified.

In this paper we describe a new species of *Lepidepecreum* from shallow waters (10 m) of Espírito Santo State, southeastern Brazilian coast. *Lepidepecreum* sp.nov. exhibit head with large lateral cephalic lobe, apically rounded; antenna 1 peduncular articles 1 and 2 with anterodistally rounded lobe, flagellum with callynophore and calceoli; mandible with palp 3-articulate, article 1 well developed; gnathopod 2 with palm obtuse; pleonites without middorsal carina; urosomite 1 projecting over urosomite 2, dorsodistally acute; uropod 3 with outer ramus article 2 short, inner ramus with plumose setae; telson deeply cleft, with 3 dorsal robust setae and 1 apical robust seta on each lobe. *Lepidepecreum* sp. nov is very similar to *L. somchaii* LOWRY & STODDART, 2002 reported from the Andaman Sea (Thailand). It can be distinguished from this species by the antenna 1 with calceoli, shape of mandible palp and the presence of plumose setae on inner ramus of uropod 3. This is the first record of *Lepidepecreum* from the southwestern Atlantic Ocean and brings the total records of lysianassoids species to 18 from Brazilian waters. However, still more species are to be expected when regarding the lysianassoid fauna as result of large projects that aim to characterize the marine environment of Brazilian coast.

References

HORTON, T. & DE BROYER, C. (2014): Lysianassidae Dana, 1849. *In*: Horton, T.; Lowry, J. & De Broyer, C. (2013 onwards) World Amphipoda Database. Accessed through: Horton, T.; Lowry, J. & De Broyer, C. (2013 onwards) World Amphipoda Database at http://www.marinespecies.org/amphipoda/aphia.php?p=taxdetails&id=101395 on 2014-04-28

LOWRY, J. K.; H.E. & STODDART (2002): First records of lysianassoid amphipods (Crustacea) from the Andaman Sea. *In*: Biodiversity of Crustacea of the Andaman Sea. Proceedings of the International Workshop on the Crustacea in the Andaman Sea, Phuket Marine Biological Center, 29 November–20 December 1998, ed. N.L. Bruce, M. Berggren & S. Bussawarit. Phuket Marine Biological Center Special Publication 23(1): 165–188.

Gonad development in mature females of tidal spray crab *Plagusia depressa* (Crustacea: Brachyura: Plagusiidae).

Poster

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Information on the development of the ovaries of a given species is very important to properly understand their population dynamics from the aspects of reproduction, such as growth characteristics and differences between populations (SHINOZAKI-MENDES et al., 2011). The objective of this study was to describe macroscopic and microscopic stages of gonadal development of females of *Plagusia depressa* (FABRICIUS, 1775). Thirty females of *P. depressa* were captured manually from May 2012 to September 2013 on the reefs of the south coast of the state of Alagoas, Brazil, between the coordinates 10 ° 08 ' 34.96 " S and 36 ° 07' 29.65 " W 10° 09 ' 45.85 " S and 36 ° 08' 07.69 " W. The specimens underwent analgesia by decreasing temperature to collect the gonads. Fragments of dissected gonads were cut transversely into small pieces, fixed in a mixture of Bouin and taken to the Histology Laboratory/ICBS/UFAL. The gonads were dehydrated in solutions of increasing concentrations of ethanol, diaphanized in xylol, infiltrated and embedded in paraffin histology, sectioned by microtome blades of steel (4μm), deparaffinized in xylol, rehydrated in decreasing concentrations of ethanol, stained with hematoxylin-eosin (HE), dehydrated in ethanol, and immersed in xylol. The macroscopic and microscopic appearance of the ovaries, as well as the frequency of germ cells and their location in the organ, was used to determine the stage of gonadal development, following the method of SOUZA & SILVA (2009). Four stages were defined for the specie. Stage 1 (rudimentary or post-spawning) - the ovaries have saggy lobes and slender with a translucent yellow color. This is the stage that marks the end and beginning of gonadal maturation cycle. The germinal zone is tightly reduced with few oogonia. Pre-vitellogenic oocytes are rarely observed. Stage 2 (developing) - have from yellow to orange color and firm consistency. The germinal zone is well defined. Oogonias and pre-vitellogenic oocytes are observed at this stage, as well as a few vitellogenic oocytes at the periphery of the organ. Stage 3 (developed) - the gonads have a color between red and dark brown. The ovaries are full of oocytes undergoing vitellogenesis. The gonad is already presents many mature oocytes. Stage 4 (advanced) - the ovaries have a tinge from dark brown to almost black. The gonodutos can extend up to the third abdominal segment. This gonadal stage is characterized by the abundance of mature oocytes that occupy almost the entire organ. The macroscopic appearance of the female reproductive system, the characteristics of germ cells and their development and changes during gonadal maturation of *P. depressa* corroborate with the normally found in Malacostraca (NAGARUJA, 2011).

References:

NAGARAJU, G. P. C. (2011): Reproductive regulators in decapod crustaceans: an overview. - The Journal of Experimental Biology, (1)**214**: 3-16.

SHINOZAKI-MENDES, R. A; SILVA, J. R. F; SOUSA, L. P. & HAZIN, F. H. (2011): Histochemical study of the ovarian development of the blue land crab *Cardisoma guanhumi* (Crustacea: Gecarcinidae). -Invertebrate Reproduction & Development, London, (3)**56**:191-199.

SOUZA, L. P. & SILVA, J. R. F. (2009): Morphology of the female reproductive system of the red-clawed mangrove tree crab (*Goniopsis cruentata* Latreille, 1803). - Scientia Marina, Barcelona, (3)**73**: 527-539.

Herbivorous peracarid crustaceans homogenize rafting assemblages on floating seaweeds

Oral EMC

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Seaweeds provide habitat, shelter and food for diverse assemblages of associated organisms. In benthic habitats epibiotic organisms select their preferred seaweed hosts for structural, chemical and positional traits. Thus, the high mobility and host preferences of many epibionts lead to host-specific assemblages on benthic seaweeds. Once detached from the benthic substratum some seaweeds are able to float at the sea surface for extended time periods carrying with them a great variety of rafting organisms. However, compared to rich benthic seaweed beds floating algae may represent a limiting habitat at the sea surface. Accordingly, rafting organisms may be rather unselective and colonize any available seaweed patch at the sea surface. Therefore, we hypothesize that habitat limitation at the sea surface leads to homogenization of epibiotic assemblages on floating seaweeds. To test this hypothesis we compared the assemblages on benthic and floating individuals of the fucoid seaweeds *Fucus vesiculosus* and *Sargassum muticum* in the northern Wadden Sea (North Sea). Species richness was about twice as high on the morphologically complex *S. muticum* as on the structurally more simple *F. vesiculosus*, both on benthic and floating individuals. In both seaweed species benthic samples were more diverse than floating samples indicating a loss of species which are unable to persist on floating algae. However, the species composition differed significantly only between benthic thalli, but not between floating thalli of the two seaweed species. Separate analyses of sessile and mobile epibionts showed that the homogenization of rafting assemblages was mainly caused by mobile peracarid crustaceans. Grazing isopods from the genus *Idotea* as well as the amphipod *Gammarus locusta* reached extraordinarily high densities on the floating samples from the northern Wadden Sea indicating rapid accumulation of these crustaceans during the rafting journey through colonization from other floating seaweed patches and successful reproduction. These herbivores feed intensively on the floating algal host as well as on structuring epiphytes thereby destroying the floating habitat and initializing the homogenization of the rafting assemblage. Frequent exchange of mobile associates among progressively limiting floating habitats finally eliminates structural differences between rafting assemblages. The enhanced break-up of algal rafts associated with intense feeding by these abundant and voracious herbivores might force rafters to recolonize benthic habitats. These colonization processes may enhance successful dispersal of rafting organisms and thereby contribute to population connectivity between sink populations in the Wadden Sea and source populations from up-current regions.

Phylogeography Study of *Charybdis japonica* in East China Sea and Yellow Sea: A new barrier to gene flow in Yellow Sea

Oral BLC

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Some major hypotheses have been proposed to explain genetic patterns of marine species in the Northwestern Pacific Ocean, such as Pleistocene glacial cycles causing genetic differentiation and population expansion, ocean currents driving genentic homogeneity, and Yangtzer River outflow imposing a physical barrier to gene flow. Here, we examined the relative importance of such factors on population structuring of the Asian paddle crab, *Charybdis japonica*, in Yellow Sea, East China Sea and adjacent areas. Genetic variation in nine populations of *C. japonica* (n = 169), ranging from the Bohai Sea, Yellow Sea, East China Sea and the Sea of Japan, was determined from partial mitochondrial cytochrome c oxidase subunit I (COI) gene. Among the 14 haplotypes defined, a dominant haplotype H1 existed in all populations, and a relatively abundant localized haplotype H2 was found in three of the northern populations. Apparent trends in haplotype frequncy along China's coastal waters were detected. The percentage of common haplotype H1 decreased from South to North. A weak, but significant, genetic barrier was detected in Haizhou Bay, which divided species into two groups (a northern group and a southern group). The local marine gyres and isolation by distance might be responsible for the divergence of northern and southern groups. Lack of genetic structure in the southern group and northern group populations indicates that ocean currents within groups facilitated the dispersal of *C. japonica*. Our study highlights the importance of local marine gyres for generating genetic structure in marine coastal species, especially those which exhibit inshore spawning in the Northwestern Pacific. The assumption that ocean current will result in broad dispersal should be carefully examined.

Darwin returns: the biology, conservation and phylogeography of Ascension Island land crabs

Oral CTF

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During the voyage of the Beagle, Darwin visited Ascension Island in 1836 and noted the presence of land crabs, *Johngarthia lagostoma*, but did not comment in any detail. When the island was first landed on in the early 1500s the presence of these crabs was noted, and at that time they were the only land animals of any size. There were no scientific studies of these crabs until the 21st century.

The basic biology of the crab was first investigated from 2004-2007 with support from the Leverhulme Trust and the AI Conservation Department, plus local volunteers (HARTNOLL et. al., 2006, 2009, 2010). This provided a basic understanding of the crab (summarised in the talk), but raised questions still to be answered. These included the extent of breeding sites, frequency and abundance of recruitment, population size, and age and growth rate.

In 2012 the Darwin Initiative (a UK Government fund) set up a two year Biological Action Plan project for the Island, including the land crab. This facilitated further funding from Fauna and Flora International Flagship Species programme. This work (including a substantial PIT tagging exercise) is in progress, and very promising initial results on breeding sites, recruitment, population size and age structure are reported. Conservation issues have also been addressed,

A wider dimension is to examine how *J. lagostoma* reached Ascension, and its relation to the other species of the genus found in the East Atlantic and the West Pacific (HARTNOLL, 2011). Important markers include the timing of the closure of the Central American land bridge, and the geological age of the various island sites of the species. Some speculative phylogeographic hypotheses will be considered.

HARTNOLL, R. G. (2011). Ascension Island: Contrasting biogeography of land and rock crabs. In: PESSANI, D., T. TIRELLI & C. FROGLIA (eds). -ATTI IX Colloquium Crustacea Mediterranea Torino, September 2-6, 2008. 375-385. Museo Regionale di Scienze Naturali, Torino.

HARTNOLL, R. G., MACKINTOSH, T. & T. J. PELEMBE. (2006). *Johngarthia lagostoma* (H. MILNE EDWARDS, 1837) on Ascension Island: a very isolated land crab population. -Crustaceana **79**: 197-215.

HARTNOLL, R. G., A. C. BRODERICK, B. J. GODLEY AND K. E. SAUNDERS. (2009). Population structure of the land crab *Johngarthia lagostoma* on Ascension Island. - J. crust. Biol. **29** 57-61.

HARTNOLL, R.G., A. C. BRODERICK, B. J. GODLEY, S. MUSICK, M. PEARSON, S. A. STROUD & K. E. SAUNDERS. (2010). Reproduction in the land crab *Johngarthia lagostoma* on Ascension Island. -J. crust. Biol. **30**: 83-92.

Terrestrial adaptations of the sense of smell in terrestrial Anomura and Brachyura

Oral CTF

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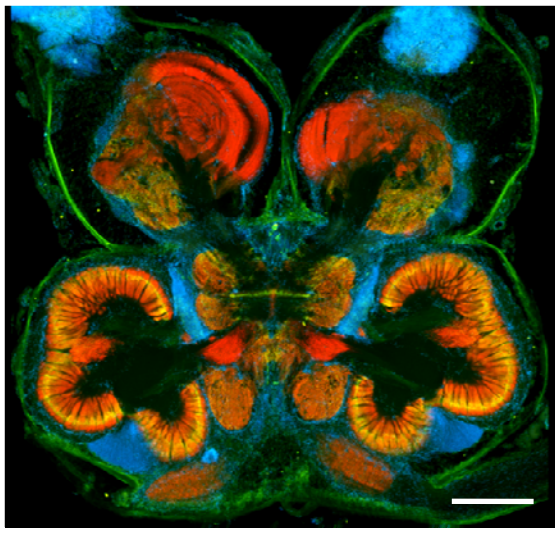
Physiological adaptations to master a terrestrial life style after an evolutionary transition from sea across fresh water to land raises the need for sensory organs to function in air instead of in water. In olfaction, such a transition that molecules need to be detected in gas phase instead of in water solution. Marine crustaceans live in a world full of chemical information. They use chemicals e. g. to locate mates, signal dominance, and find favored foods. However, aquatic *versus* land-living animals detect highly different substances, because the medium as such raises different demands on the compounds used. In water, molecules have to be more or less water-soluble and stable enough to travel from one individual to another. On land, odorants have to be light enough to form a gas in the ambient temperatures where animals live and have to be sufficiently chemically stable. These new selection pressures together take part in reshaping the sense of smell during the invasion of a new, terrestrial habitat. Malacostracan Crustacea that live in aquatic habitats use several systems for detecting chemicals and these are distributed over their body surface, walking appendages and mouthparts, but are also concentrated on two pairs of antennae. Previous behavioral and neuroethological studies have suggested that the land hermit crabs (Coenobitidae, Anomura) may have evolved aerial olfaction during the evolutionary conquest of land. Here, we summarize ongoing efforts to characterize the olfactory systems of representatives of the Coenobitidae (*Coenobita clypeatus, Birgus latro)* by molecular methods such as antennal transcriptomes and neuroanatomical methods such as electron microscopy, classical histology followed by 3D reconstruction and immunocytochemical studies combined with confocal laser-scan microscopy. We compare these results to neuroanatomical studies in various terrestrial Brachyura. Our results indicate that the Coenobitidae in fact have evolved aerial olfaction and that their central olfactory pathways are indeed most prominent. Olfaction seems to be a major sensory modality processed by their brain, and for these animals, exploring the olfactory landscape seems vital for survival in their terrestrial habitat. However, in Brachyura both peripheral and central olfactory pathways are much reduced compared to their aquatic cousins suggesting that terrestrial Brachyura have failed to evolve much of the molecular and anatomical machinery to detect volatile stimuli.



Horizontal brain section of *B. latro* triple labeled for allatostatin-like immunoreactivity (green), synapsin immunoreactivity (red) and a nuclear marker (blue). Scale bar = 500 µm.

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Biology of stomatopod larvae – new insights from old collections

Oral GS

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Our knowledge of the biology of stomatopod larvae is still very limited. For most cases we even do not know which larva corresponds to which adult. Of the five hundred known species of mantis shrimps the larval sequence of only a handful is known. This lack of knowledge is the main reason why most stomatopod larvae in museum collections, where millions of them are deposited, are not assigned to any species. Nevertheless, we can still infer many aspects of their biology based on these specimens. We point out three aspects of mantis shrimp larval biology inferred from the numerous specimens collected during the famous Dana expeditions in the 1920s and 1930s:

1) The disparity of stomatopod larvae is larger than previously anticipated. We found several new types of large, centimeter-sized erichthus larvae. All of them are characterised by a shield hypertrophied into different dimensions.
2) Not only outer morphology, also inner structures such as the nervous system can be inferred from historical museum specimens, without preparation, by using cross-polarised light imaging.
3) Based on functional morphology and preserved postures, aspects of the behaviour can be inferred. We present a case of possible defensive behaviour of erichthus-type larvae.

With these examples, we stress the importance of museum collections in biological sciences. It must be emphasised that museum collections contribute to scientific research not only in taxonomic aspects, but can also contribute to studies of, e.g., disparity, anatomy and behaviour.

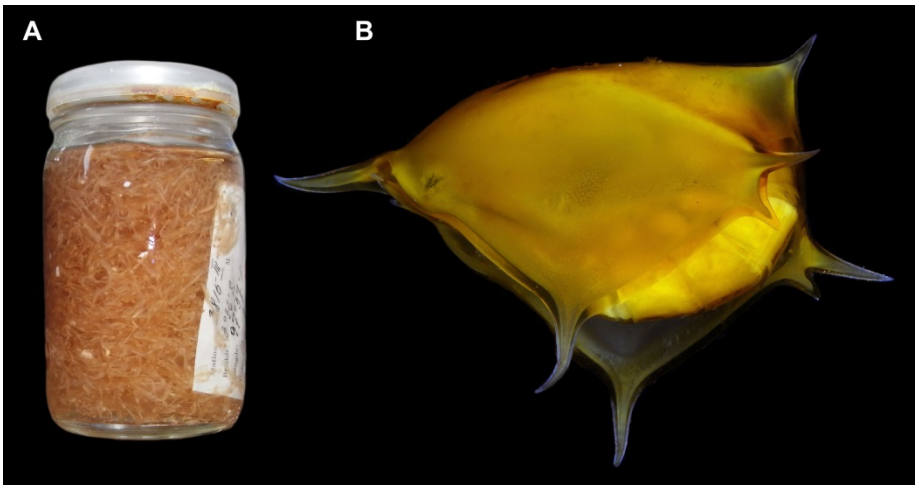

Figure: Larval stomatopod specimens collected during the Dana expeditions. A. A single sample from the Natural History Museum Copenhagen, containing hundreds of larval stomatopod individuals. B. A specimen in defensive position in lateral view (see also Haug & Haug accepted; Contributions to Zoology).

The evolution of modern decapod larvae – new insights from 150 million years old fossils
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Numerous ingroups of modern malacostracans possess highly specialised larval forms. Especially within Decapoda different evolutionary lineages have independently evolved very distinct forms. We present several examples of fossil larval specimens. Such fossils are known from 150 million and 90 million years old deposits. The preservation of these fossils is exceptional; the specimens preserve finest details, not only including shield, tergites and appendages with tubercles and spines, but also tiny structures such as sensorial setae or ommatidia of the eyes. With this, these fossils allow a direct comparison to modern forms.
The fossil forms demonstrate unexpected diversity. For example, modern achelate lobsters possess a highly specialised and fragile appearing giant larva, the phyllosoma. Despite their fragile appearance, thousands of specimens of phyllosomata have been found in the fossil record. Among these are larval forms that resemble modern forms, but others show distinct mixtures or larval and juvenile characters. Hence, in the past the disparity of the larval forms of achelate lobsters was significantly higher than today. Other examples are known from polychelid lobsters. While modern forms are deep-sea inhabitants with large-sized larvae, 150 million years old relatives are shallow-water forms, and even smallest specimens already resemble the adults. We present new 90 million years old fossils that show an intermediate morphology.
Additionally, we present numerous new examples of finely preserved fossil larvae from natant shrimps, but also different other reptantian in-groups. All these forms provide important new details for the emergence of the modern forms and allow the reconstruction of finely graded evolutionary scenarios.

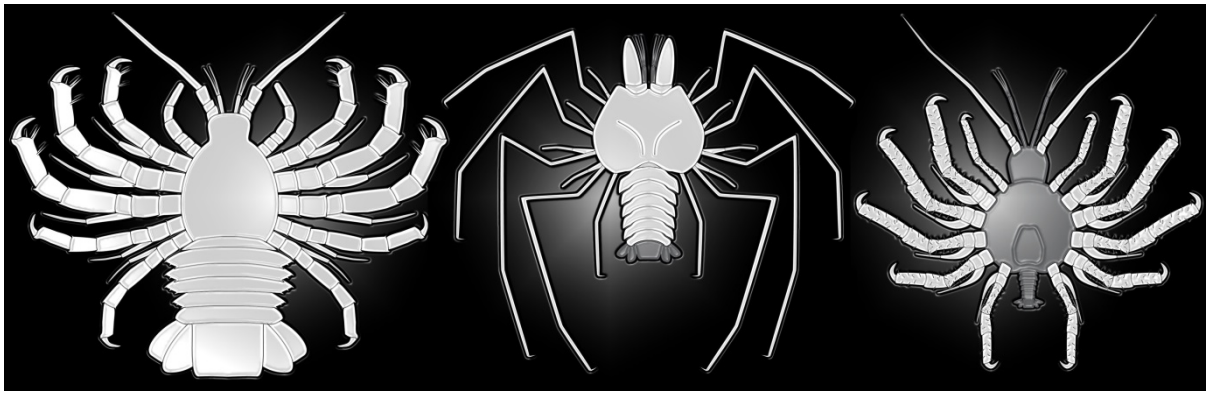

Figure. Larvae of extinct achelate lobsters, which show a distinct mixture of phyllosoma and post-phyllosoma characters. Left: 90 million years old fossil from Lebanon, *Polzicaris sahelalmae*. Middle and right: 150 million years old fossils from southern Germany. Middle: Larva of a putative slipper lobster. Right: Larva which could be a developmental stage of the early slipper lobster *Cancrinos claviger*.

A new type of spermatheca? The twisted world of the Leucosiidae

Oral GS

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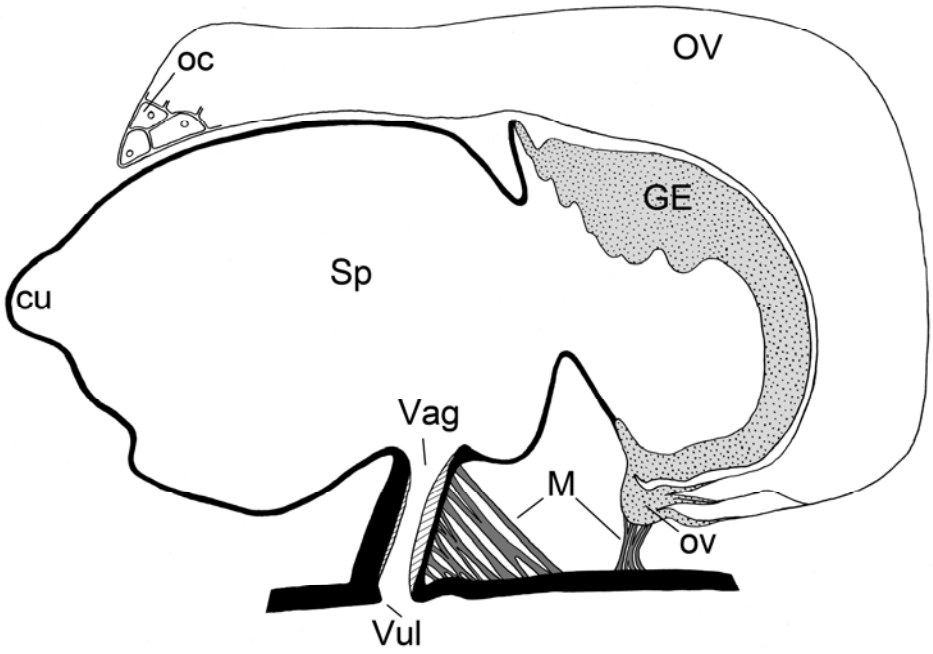
The Leucosiidae are a family of subtidal eubrachyuran Crustacea that are commonly found in subtropical and temperate regions. The various species are very diverse in their phenotypes as well as in their size. In this study, the morphology and function of the female reproductive organs of the species *Ebalia tumefacta, Ilia nucleus* and *Persephona mediterranea* were investigated using histological methods and Magnetic Resonance Tomography (MRT). Models were produced of the spermathecae which were then compared with other eubrachyuran spermathecae presently known.

For all three species, the vagina was found to be of the concave type as described by HARTNOLL (1969). However, the spermathecae were found to differ greatly from the familiar pattern of the Eubrachyuran spermathecae: the epithelia or chambers were not orientated dorso-ventrally but either anterior-posteriorly or laterally. The glandular epithelium was found to be always of the holocrine type. The oviduct entrance was found to be located at the basal region of the spermatheca, close to the vagina in the glandular epithelium. It is connected to the sternum via strong musculature. This is the first time that this musculature has been documented for the Eubrachyura.



Schematical drawing of the spermatheca of *E. tumefacta* as an example of the Leucosiidae; cu: cuticle; GE: glandular epithelium; M: musculature; oc: oocyte; ov: oviduct; OV: ovary; Sp: spermatheca; Vag: Vagina; Vul: Vulva

Reference:
HARTNOLL, R.G., 1969. Mating in the Brachyura. Crustaceana 16, 161-181.

Phylogeography and conservation of the potamid freshwater crabs of Hainan Island, China

Oral CTF

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Of the 1300 known freshwater crab species, nearly 30 percent inhabit islands or island archipelagos. Islands are therefore ideal places to study the evolutionary processes underlying diversification and modern patterns of freshwater crab biodiversity. Here, we focus on potamid freshwater crabs of Hainan Island. Field investigation and collection were conducted across the entire distribution of the Potamidae, in which three ecologically diverged genera are recognized (*Apotamonautes*, *Neotiwaripotamon* and *Hainanpotamon*).

Species diversity and weighted richness per 0.2° cell indicate that the highest levels are concentrated around central and southern mountain systems and relatively low in peripheral low hills and plains. Using multiple sequence data, phylogenetic analyses recovered a monophyletic relationship for all potamids on Hainan Island, suggesting a single colonization event of the island for the potamid freshwater crabs. The phylogenetic tree split into two main clades. One clade comprised all four subspecies in the genus *Apotamonautes*; their smooth and flat carapaces allow them to easily hide in crevices along riverside or under stones in rivers or streams, and their entire life history are normally limited to freshwater systems.

The second clade is further separated into two subclades corresponding to the *Neotiwaripotamon* and *Hainanpotamon* groups which exhibit distinct burrowing behavior: the former usually hide in tree holes, and the latter hide in mud holes because of their swollen and convex carapaces. Genetic divergence between species/subspecies within a genus was discordant with morphological affiliation. Ancestral range reconstruction revealed that early diversification of potamids in Hainan Island began in the central and southern mountains. These results provide a better understanding of potamid phylogeography on Hainan Island and highlight the need for protecting endemic freshwater crab biodiversity under global climate change.

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Intertidal crustacea from Iranian coast of the Gulf of Oman

Poster

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Crustaceans are important members of benthic community and are one of the pillars of the global marine ecosystem. As a member of epifauna, crustacean biodiversity is affected by environment variety and ecological changes. Selected as the sampling site, the eastern part of the Gulf of Oman (Chabahar-Gowatr) is the nearest and best access point from Iran to the Indian Ocean. The Gulf of Oman generates a wide range of conditions due to the interaction of seasonal monsoons and a surrounded ocean basin. Iranian coastline of Oman Sea includes highly diverse and structured marine habitats which resulted in high biodiversity in this region. Recent publications through Iranian marine environment have confirmed the great diversity of crustacean fauna in this region. The main groups of crustacea in this region are: Brachyura: Grapsidae *(Grapsus albolineatus)*; portunidae *(Thalamita prymna, Thalamita admete)*; Leucosiidae (*Ryphila sp.*); Ocypodidea; Dotillidae (*Dotilla sp.*);
Caridea: Alpheidae (*Athanas indicus, Athanas dimorphus*); Anomura: Diogenidae (*Diogenes avarus, Clibanarius sp.);* Coenobitidae (*Coenobita scaevola).* Maxillopoda: Sessilia (Order): Chthamalidae (*Chthamalus sp.*), Balanidae (*Balanus trigonus*); Megabalaninae (*Megabalanus coccopoma*). Among them the group of Amphipoda is especially successful and well developed in many habitats. Intertidal amphipods in this region are represented by following families*:* Hyalidae (*Parhyale fascigera*); Aoridae (*Grandidierella sp.*); Melitidae; Ampithoidae (*Cymadusa sp.*); Urothoidae (*Urothoe grimaldii*); Caprellidae.

The genus *Lebbeus* (Caridea: Hippolytidae) in the Mexican Pacific

Poster

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Posteriorly to the contribution of KOMAI et al. (2004) who considered a total of 42 species of *Lebbeus* worldwide, 18 species have been described from different regions of the world. With 60 species know to date, *Lebbeus* is therefore one of the most specious genera of Hippolytidae. Only three species have been recorded from off the Pacific coast of Mexico: *L. scrippsi* WICKSTEN & MÉNDEZ, 1982; *L. vicinus montereyensis* WICKSTEN & MÉNDEZ, 1982; and *L. washingtonianus* (RATHBUN, 1902) (WICKSTEN & MÉNDEZ 1982). During an exploratory survey of deep-water communities inhabiting the continental slope below the Oxygen Minimum Zone (OMZ) core, 131 specimens belonging to *L. scrippsi* , *L. splendidus* WICKSTEN & MÉNDEZ, 1982, *L. polaris* (SABINE, 1824), *L. bidentatus* ZARENKOV, 1976, *L. carinatus* ZARENKOV, 1976, *L. washingtonianus*, and *L. vicinus montereyensis* WICKSTEN & MÉNDEZ, 1982 were collected by the R/V "El Puma" of the Universidad Nacional Autónoma de México (TALUD III-XV cruises). With a total of 13 collecting sites and 93 specimens, *L. scrippsi* was the most abundant and widely distributed species in the area, while the other species were found in three or less localities. *Lebbeus carinatus* is partly redescribed. Depth ranges of the collected species varied from 750 to 1586 m. Except in the case of *L. washingtonianus*, all specimens were captured in dissolved oxygen concentrations lower than 0.9 ml O_2/l thus indicating a strong tolerance to moderate hypoxy. *L. scrippsi*, the most abundant and frequently collected species, occurred between 772 and 1586 m and in dissolved oxygen concentrations of 0.22 to 0.88 ml O_2/l. Together with species of deep-water shrimps (e.g., Pandalidae), squat lobsters (e.g., *Munidopsis*), and lobsters (e.g., *Nephropsis* and Polychelidae), *Lebbeus* species are an important component of the crustaceans community living below the OMZ in the Mexican Pacific.

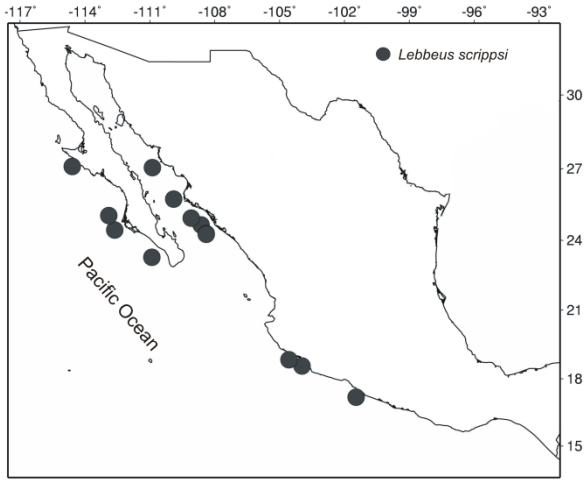

Fig. 1. Distribution of *Lebbeus scrippsi* samples collected during the TALUD cruises.

References

KOMAI, T., K.-I. HAYASHI, K.-I. & KOHTSUKA, H. (2004). Two new species of the shrimp genus *Lebbeus* White from the Sea of Japan, with redescription of Lebbeus kuboi Hayashi (Decapoda: Caridea: Hippolytidae). Crustacean Research 33: 103-125.

WICKSTEN, M.K. & MENDEZ G., M. (1982). New records and new species of the genus Lebbeus (Caridea: Hippolytidae) in the eastern Pacific Ocean. Bulletin of the Southern California Academy of Sciences 81(3): 106-120.

A new deep-water species of *Odontozona* (Decapoda: Stenopodidea: Stenopodidae) from the East Pacific, and new record of *O. foresti* Hendrickx, 2002

Poster

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The genus *Odontozona* is currently represented worldwide by 16 species (DE GRAVE & FRANSEN 2011; ANKER & TAVARES 2013; GOY & CARDOSO 2014) of which three have been recorded in the East Pacific: *O. rubra* WICKSTEN, 1982, *O. spongicola* (ALCOCK & ANDERSON,1899) and *O. foresti* HENDRICKX, 2002.

A new species of *Odontozona* is described from deep-water off the west coast of Mexico. It is distinguished from the three other species of the genus known in the area, from *O. rubra* WICKSTEN, 1982, and *O. foresti* HENDRICKX, 2002, by the absence of a series of spines on the posterior half of the carapace, behind the post-cervical groove, and from *O. spongicola* (ALCOCK & ANDERSON, 1899) by the presence of spines on the ventral margin of somites 1-5 (smooth in *O. spongicola*) and by the much slender third pair of pereiopods in the new species. A new record is provided for *O. foresti*, and the male specimen, the second specimen on record, is compared with the female holotype.

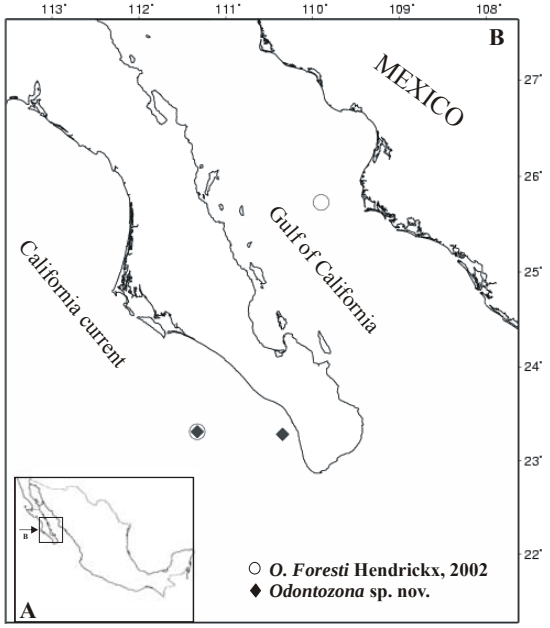

Fig. 1. Distribution of species of *Odontozona* in the Mexican Pacific.

References

ANKER, A., & TAVARES, M. (2013). Description of a new deep-water stenopodid shrimp of the genus *Odontozona* HOLTHUIS, 1946 (Crustacea, Decapoda) from Brazil. Marine Biology Research 9 (4): 412–430.

DE GRAVE, S. & FRANSEN, C.H.J.M. (2011). *Carideorum catalogus*: the recent species of the dendrobranchiate, stenopodidean, procarididean and caridean shrimps. Zoologische Mededelingen, Leiden 85: 195–588.

GOY, J.W. & CARDOSO, I.A. (2014). Redescription of *Odontozona edwardsi* (BOUVIER, 1908) (Decapoda: Stenopodidea: Stenopodidae) and description of a new species of *Odontozona* commensal on the deep-water coral, *Lophelia pertusa* (LINNEAUS, 1758). *Zootaxa* 3774 (6): 552–566.

The biology of parasitic barnacles

Oral GS

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Perhaps contrary to common perception, the successful evolution of parasitism in terms of species number or ecological dominance has occurred but few times within the Metazoa. The parasitic barnacles (Rhizocephala) exemplify one such success story, but often they are presented as modeled almost entirely over a one or a few textbook species such as *Sacculina carcini* infesting the shore crab *Carcinus maenas*. It is only during the last 20 years that the taxon has become appreciated as both speciose, biologically diverse and ecologically very important. In fact, rhizocephalans, with their 250+ species, represent more than one quarter of all cirripedes, and they therefore form a major part of the already tremendous success story of barnacles in general. Within rhizocephalans there exists an impressive diversity in terms of development, metamorphosis, details of the sexual system, type of host and host-parasite that all call for an ecological and evolutionary explanation. While adult rhizocephalans are so reduced that they cannot by themselves be recognized as arthropods, the larval development is up to the time of attachment of the cypris larva in almost all details similar to that seen in other barnacles.

It is in the ensuing metamorphosis that rhizocephalans differ drastically, not only from other barnacles, but between different rhizocephalan taxa and even between the sexes of the same species. The complicated metamorphosis involves either infection of the host or the implantation of dwarf males in parasitic females, and the process implicates stages that are the most reduced as to almost defy belief. The morphology and sexual system of the ensuing adult parasite differs to the extent that the taxon was until recently often suspected to be polyphyletic as few if any structural characters could be pinpointed as potential synapomorphies. While most species infest brachyuran or anomuran decapods, the range of host animals also extends to carideans, peracaridans, stomapopods and even to suspension feeding barnacles. Only within the last 10 years has it become clear that all rhizocephalans represent as monophyletic group and we are now rapidly approaching a robust intrinsic phylogeny which will radically transform the currently used taxonomy. All these advances open up for ecologically and evolutionarily framed questions as to how and why the ancestral rhizocephalan evolved into the present panoply of structures and life forms.

Western Australian sponge barnacles: diversity, phylogeny and host specificity – preliminary results

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This paper discusses the preliminary results of an ongoing project on the diversity, phylogeny and host specificity of the Australian species of the Acastinae. Utilising molecular techniques we are testing hypotheses of host sponge diversity and sponge barnacle phylogeny across Australia of this speciose group. The majority of the Acastinae are found embedded in members of the sponge class Demospongiae, with only two species known to inhabit the Calcarea and Hexactinellida and eight found in Cnidaria. In Western Australia, at least 24 described species of sponge inhabiting barnacles are present and are found inhabiting nine orders, 21 families and 59 species of sponges and one cnidarian. From this dataset we can see that host specificity is variable between species. Few barnacles are known to inhabit multiple host species across different orders, but many are known from single genera or families. Conversely, a sponge species is normally host to only a single species of barnacle. A major barrier to understanding to Acastinae host preferences has been the historic lack of information on host species. Future research directions are outlined.

Morphological and ecological aspects on the evolution of horseshoe crabs

Oral MC

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All four extant horseshoe crab (HSC) species belong to the family Limulidae which consists of two subfamilies, Limulinae and Tachypleinae. Limulinae has only one species *Limulus polyphemus* and is distributed in Atlantic coast and Mexico Bay in North America. Tachypleinae possesses three species, *Tachypleus tridentatus*, *T. gigas* and *Carcinoscorpius rotundicauda* and occur in Indo-West Pacific coastal waters. How these three Indo-West Pacific HSC species evolve has drawn our attentions. We propose to examine their morphological traits that related to habitats and reproduction.

Among the HSC species, *C. rotundicauda* differed from the other three HSC species in (1) habitat: *C. rotundicauda* is distributed in mangroves whereas the others occur in sandy coastal area; (2) body size: *C. rotundicauda* is the smallest one, *T. tridentatus* the largest, and *T. gigas* the intermediate; (3) male chelae of the first and second walking legs for grasping female: male *C. rotundicauda* has claspers with little modification on immovable digit of the fifth segment of the first two walking legs. These digits are always present. By contrast, the males of the other three species exhibit enlarged and thickened fifth segment with constriction at the base of immovable digit. This immovable segment breaks easily, in particular during the male's first pairing. Thus, the male's chelae appear to be a hook-like clasper and may be advantageous to seize large-sized female; (4) marginal spines on female's opisthosoma: those of *C. rotundicauda* and *L. polyphemus* are with the same length while in *T. tridentatus and T. gigas* the three posterior spines are shortened. The latter case favors male to hold female closer; (5) cross-section of the telson: only *C. rotundicauda* has round edges on a subtriangular cross-section while the others exhibit sharp edges on a triangular cross-section; (6) the ratio of telson length to body length: *C. rotundicauda* appears to have the highest ratio. Based on these differences, we propose that *C. rotundicauda* evolves through paedomorphosis. In addition, only male *T. tridentatus* has two notches on the anterior margin of prosomatic carapace, benefiting male to hold female tightly. This change suggests that in Tachypleinae, *T. tridentatus* evolves more recently than *T. gigas* and *C. rotundicauda*. We also postulate that *C. rotundicauda* evolves through ecological speciation after mangroves appeared in Indo-West Pacific coastal areas. Exploration of mangrove habitat may be adaptive because of diminishment of habitat competition. Since male *L. polyphemus* has only one pair of hook-type claspers on the first walking leg and female has long marginal spines on her opisthosoma, these features may hinder the male to hold the female tightly. Consequently, the failure of one-to-one pairing pseudo-copulation favors the evolution of mating system with satellite males. All these aforementioned morphometric traits will be measured to test against our proposition.

Physiological performance of krill species from the high Arctic Kongsfjorden, W-Spitsbergen

Oral BLC

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The high Arctic Kongsfjorden (79°N) is mainly influenced by cold Arctic but also warmer Atlantic water masses. In recent years, the proportion of Atlantic inflow increased, attributed to climate change. Concurrently, two boreal and one subtropical krill species are now being regularly found in Kongsfjorden – in addition to the previously prevailing arcto-boreal species *Thysanoessa inermis* and *T. raschii* (BUCHHOLZ et al. 2010). Krill occupy a central trophic position in the pelagic food-web. Although a change in a krill population may have a significant impact on the ecosystem, knowledge on the physiological performance of the species inhabiting Arctic waters is still scarce. In our study we aim at investigating the thermal limits of metabolic adaptability and the allocation of energy reserves in order to predict each species' potential to persist in this challenging environment, in which temperature and food supply are among the most important factors determining survival. Total lipid content and lipid class composition show remarkable differences between species, reflecting the specific adaptations to the environments of origin. Furthermore, *Thysanoessa spp.* appear more stenotherm than the boreal and the subtropical krill species: the upper level of respiration is reached at temperatures < 12°C (Fig. 1). The other krill species show a higher tolerance to temperature changes, which may support the species' success in northward expansion as reported through increasing abundances at lower latitudes (e.g. ZHUKOVA et al. 2009). Accordingly, at least one of the latter species may profit from the increasing "Atlantification" of the Kongsfjord ecosystem. In turn, due to the differences in biochemical composition, a change in species composition may result in significant changes in the marine food-web of Kongsfjorden - especially for higher trophic levels.

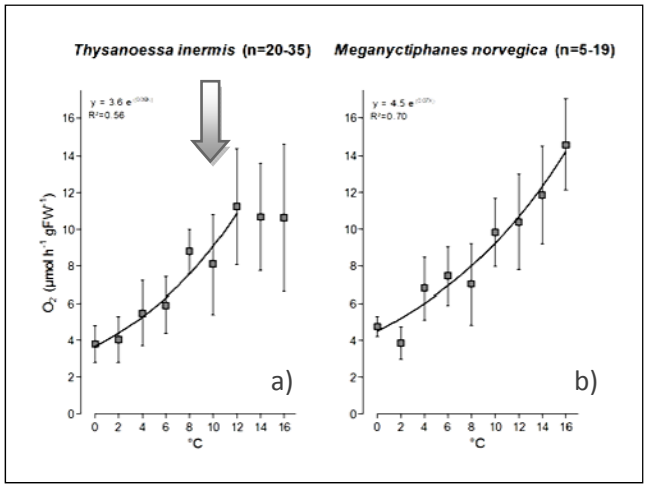

Fig. 1: Respiration rates with increasing temperature in a) arcto-boreal *T. inermis* compared to b) boreal *M. norvegica*. Arrow points to thermal limit < 12°C.

References:

BUCHHOLZ, F., BUCHHOLZ, C. & WESLAWSKI J. M. (2010): Ten years after: krill as indicator of changes in the macro-zooplankton communities of two Arctic fjords. Polar Biology, **33**:101-113.

ZHUKOVA, N. G., NESTEROVA, V. N. & PROKOPCHUK, I. P., RUDNEVA, G.B. (2009): Winter distribution of euphausiids (Euphausiacea) in the Barents Sea (2000–2005). Deep Sea Research Part II: Topical Studies in Oceanography, **56**: 1959–1967.

Western Tethys in space and time: perspective from the decapod crustacean fossil record

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In the past, the Western Tethys (WT) as part of the Tethys Realm covered the area of the modern Mediterranean and adjacent areas from the Bay of Biscay to Pakistan, Somalia and Zanzibar. Significant biogeographic differentiation of this area has been documented (Harzhauser et al. 2007), mainly during the Miocene, when connections between Proto-Mediterranean, Paratethys and Proto-Indo-West Pacific (Proto-IWP) were intermittently opening and closing. These seaways allowed migration of marine faunas. It has been argued that the centre of radiation and evolutionary hotspot, situated in WT during the Oligocene and Early Miocene, shifted towards IWP, thus establishing today's biodiversity hotspot there (Renema et al. 2008). In this respect, major shifts of taxa in WT during the Oligocene and Miocene were documented for molluscs and echinoderms (Harzhauser et al. 2007). Herein, it is argued that decapod crustaceans can contribute to the debate. The Cenozoic fossil record of decapods suggests two periods of major diversification, in the Eocene and the Miocene. It remains, however, to be tested whether the shift of taxa is enhanced by the poor sampling of the Cenozoic fossil record in IWP, and thus rather represents biodiversity hotspot area contraction as opposed to shift of the centre of diversity. For instance, several recently published biogeographic studies based on molecular data (Groeneveld et al. 2007; Sotelo et al. 2009) argued for IWP as an ancestral area of today's Mediterranean taxa, whereas interpretation of the fossil record argues for the opposite (Hyžný & Müller 2012). Although decapods were used as palaeobiogeographical indicators before, no detailed analysis of the Tethyan taxa has been conducted so far.

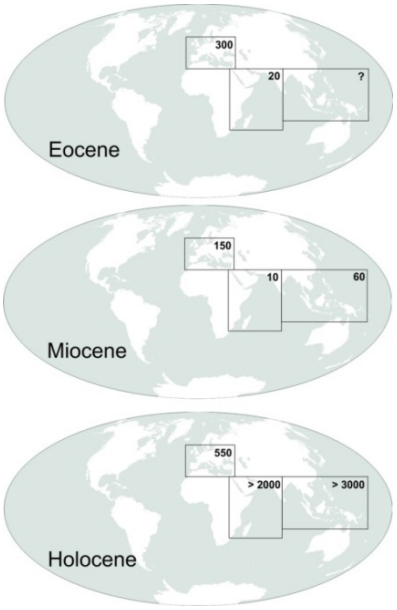

Figure: Decapod (Pleocyemata) species estimations for respective time slices. Squares represent Western Tethys (left), Eastern Tethys (middle) and Indo-West Pacific (right). The data are from the personal database and http://www.iobis.org/.

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References:

GROENEVELD, J. C., GOPAL, K., GEORGE, R. W., MATHEE, C. A. (2007): Molecular phylogeny of the spiny lobster genus *Palinurus* (Decapoda: Palinuridae) with hypotheses on speciation in the NE Atlantic/Mediterranean and SW Indian Ocean. – Molecular Phylogenetics and Evolution, **45**: 102-110.

HARZHAUSER, M., KROH, A., MANDIC, O., PILLER W. E., GÖHLICH, U., REUTER, M., BERNING, B. (2007) Biogeographic responses to geodynamics: a key study all around the Oligo-Miocene Tethyan Seaway. – Zoologischer Anzeiger, **246**: 241-256.

HYŽNÝ, M., MÜLLER, P. M. (2012) The fossil record of *Glypturus* Stimpson, 1866 (Crustacea, Decapoda, Axiidea, Callianassidae) revisited, with notes on palaeoecology and palaeobiogeography. – Palaeontology, **55**: 967-993.

RENEMA, W., BELLWOOD, D. R., BRAGA, J. C., BROMFIELD, K., HALL, R., JOHNSON, K. G., LUNT, P., MEYER, C. P., MCMONAGLE, L. B., MORLEY, R. J., O'REA, A., TODD, J. A., WESSELINGH, F. P., WILSON, M. E. J., PANDOLFI, J. M. (2008) Hopping hotspots: global shifts in marine biodiversity. – Science, **321**: 654-657.

SOTELO, G., MORÁN, P., POSADA, D. (2009) Molecular phylogeny and biogeographic history of the European *Maja* spider crabs (Decapoda, Majidae). – Molecular Phylogenetics and Evolurion, **53**: 314-319.

Morphology of the branchiuran fish-louse *Dolops ranarum* from *Clarias gariepinus* in Egypt

Oral GS

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Dolops ranarum (STUHLMANN, 1891) (Crustacea: Branchiura) was found attaching to the gill filaments and excretory breathing organs of the catfish *Clarias gariepinus* (Burchell, 1822) collected from the river Nile in Egypt. The present investigation throws light on the morphological features of *D. ranarum* as seen by light and scanning electron microscopy. The body of *D. ranarum* is divisible into three distinguishable parts: cephalon, thorax and abdomen. A well-developed carapace covers the cephalon and extends posteriorly covering the thorax and base of abdomen. The cephalon is formed of five completely fused segments bearing five pairs of appendages: antennules, antennae, maxillules, maxillae and mandibles. Thoracic segments show obvious segmentation and bear four pairs of swimming legs. The abdomen is formed of two kidney-shaped lobes fused anteriorly with the fourth thoracic segment. Hand drawings, as well as, scanning electron microscope illustrations are included in the presentation.

Comparative study of the impact of cadmium on osmoregulation mechanisms between reference and historically metal-contaminated amphipod populations

Poster

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Ecotoxicological hazard assessment of metallic contamination for aquatic organisms is generally measured via standardized laboratory and *in situ* biotests, using controlled populations. However, improving their reliability and their ecological relevance still constitutes scientific challenges, as the potential divergence of life histories and sensitivities to contaminants between experimental and native populations may interfere with results. In order to explore the importance of life history and sensitivity of tested organisms in ecotoxicological studies, we investigated the impact of a Cd exposure in different natural populations of the amphipod *Gammarus fossarum* from different rivers of south-eastern France. Among the five populations sampled, two of them live in chronically/acutely Cd contaminated rivers (i.e. geochemical background and mine effluent, respectively). Osmoregulation is one of the most important regulatory mechanisms in crustaceans, highly energy consuming, and we have shown that it represents a valuable biomarker to evaluate crustacean health (LIGNOT et al., 2000; ISSARTEL et al., 2010). As an endpoint of local physiological adaptation to Cd, the osmoregulatory capacity was assessed in the five populations. In order to regulate the osmolality of their hemolymph within a given range, freshwater - hyper-osmoregulating - crustaceans use active transport enzymes (e.g. Na^+/K^+-ATPase) to maintain intracellular ion concentrations within cell tolerance limits. Under controlled laboratory conditions, specimens of *G. fossarum* from the five populations were experimentally exposed to 9 µg Cd^{2+}/L for 7 days and hemolymph osmolality (HO) was individually measured at the end of the experiment. Results show that in each population, high inter-individual variations in HO values were noted, resulting in their separation into unimpacted and impacted (with lower HO) animals. Furthermore, both mean HO values and data distributions were differently altered in each population. In a previous study, we showed that impacted Cd-exposed amphipods displayed altered gill structure as well as distribution and abundance of Na^+/K^+-ATPase determined through immunolocalization, illustrating the dramatic Cd effects on osmoregulatory effectors (Issartel et al., 2010). These histological biomarkers will be assessed in the five natural population specimens ranked according to their respective osmoregulatory capacities in order to highlight possible osmotic compensations during Cd exposure and the presence of adaptive mechanisms.

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References:

ISSARTEL, J., BOULO, V., WALLON, S., GEFFARD, O., CHARMANTIER, G. (2010): Cellular and molecular osmoregulatory responses to cadmium exposure in *Gammarus fossarum* (Crustacea, Amphipoda). Chemosphere, **81**: 701-710.

LIGNOT J.-H., SPANINGS-PIERROT C., CHARMANTIER G. (2000): Osmoregulatory capacity as a tool in monitoring the physiological condition and effect of stress in crustaceans. Aquaculture, **191**: 209-245.

The ovary organization and oogenesis in Spinicaudata and Laevicaudata (Branchiopoda)

Poster

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The fine structure of the ovary and the ultrastructural features of oogenesis were analyzed in two branchiopod species: *Cyzicus tetracerus* and *Lynceus brachyurus,* representing two separate orders, Spinicaudata and Laevicaudata, respectively. The female gonads have not been investigated in these species/groups yet. Our microscopic and histochemical studies revealed that the structure of the ovaries is highly uniform in both investigated species (JAGLARZ et al., 2014). The ovaries are generally sac-shaped, elongated and covered with characteristic protrusions sticking out into the haemocoel. The protrusions house ovarian follicles in different stages of oogenesis. Each ovarian follicle consists of four germline cells connected by intercellular bridges and surrounded by somatic (follicle) cells forming a simple epithelium. Initially, all germline cells are morphologically similar but during oogenesis they differentiate into one oocyte and three supporting nurse cells. Ultrastructural studies revealed that the rough endoplasmic reticulum and Golgi complexes are involved in the proteinaceus yolk synthesis indicating the autosynthetic mode of vitellogenesis. The follicular epithelium is flattened and supported by a thin basal lamina. In early vitellogenic ovarian follicles, the cytoplasm of the follicle cells is penetrated by a characteristic canal system probably involved in transfer of nutrients from the haemocoel to the surface of the growing oocytes. The ovary organization in *Cyzicus* and *Lynceus* is similar to that described in *Triops* (Notostraca), but it also shares morphological similarities with the basal hexapods: Protura, Diplura: Campodeina and Collembola (Trentini and Sabelli Scanabissi, 1978; Bilinski, 1993). The latter similarities are of particular interest in the light of the Pancrustacea/Tetraconata hypothesis.

This work was supported by a research grant from the National Science Centre (NCN) (DEC-2011/01/B/NZ4/00595).

References:

BILINSKI, S. (1993): Structure of ovaries and oogenesis in entognathans (Apterygota). -- International Journal of Insect Morphology and Embryology, 22: 255-269.

JAGLARZ, M. K., KUBRAKIEWICZ , J., JEDRZEJOWSKA, I., GOLDYN, B., BILINSKI, S.M. (2014): Ultrastructural analysis of the ovary and oogenesis in Spinicaudata and Laevicaudata (Branchiopoda) and its phylogenetic implications. -- Zoology, dx.doi.org/10.1016/j.zool.2013.12.002.

TRENTINI, M., SABELLI SCANABISSI, F. (1978): Ultrastructural observations on the oogenesis of Triops cancriformis (Crustacea, Notostraca). I. Origin and differentiation of nurse cells. -- Cell Tissue Research, 194: 71-77.

The copulatory system of spider crabs (Decapoda: Brachyura: Majoidea) similar characters despite different body shapes?

Oral GS

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With approximately 800 species and different body shapes, spider crabs (Majoidea) are a diverse group within the Heterotremata. Various majoid species do not resemble the characteristic oval and flattened body shape of the Brachyura. Since long, the reproductive systems and the position of the genital openings are regarded as very useful when working in the field of brachyuran phylogeny. We investigated the reproductive systems of male and female majoids. The male gonopods and penes and additionally the female seminal receptacles were examined. The external copulatory system in male brachyurans is situated under the ventrally folded pleon; it is constituted by the paired first and second gonopods and the paired, tube–like extensions of the gonopores, the penes. We used scanning electron microscopy to compare the gross morphology as well as cuticular fine structures such as setae on the gonopod surface. The female seminal receptacles are sperm storage chambers that have a direct connection with the female ovaries and appear to have a distinct composition in different brachyuran groups. Histological methods were applied to ascertain the morphology and organization of the female seminal receptacles. Species from three different majoid groups were examined: *Stenorhynchus seticornis* (Inachidae), *Mithraculus sculptus* (Majidae) and *Acanthonyx lunulatus* (Epialtidae). Despite their different body shapes, both pairs of gonopods show numerous highly similar characters among the species investigated. The first gonopod is long and slender with a slightly bulbous, pointed tip that shows a sub-terminal opening surrounded by denticles. The second gonopod is always shorter than the first and has a compact, smooth shaft. The distal tip bears an appendix and an apical girdle with denticles. Histological sections of the female reproductive system will reveal whether the female reproductive morphology of majoids shows the same uniformity as that of the males. This would imply that while the evolution has formed different body shapes in closely related groups, it had no visible effect on the morphology of the reproductive system.

Phylogeny and phylogeography of the freshwater crabs in *Sinopotamon* endemic to China derived from mitochondrial and nuclear gene markers

Oral CTF

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The genus *Sinopotamon* Bott, 1967 is endemic to China and the most species-rich freshwater crab assembly globally. It comprises 84 species and subspecies, and widely distributed across 17 provinces in China. This striking species diversity and broad distribution make it an ideal model for researching the diversity and evolution of freshwater crabs. However, phylogenetic affinities among *Sinopotamon* are poorly understood and because of this it remains unknown how a high diversity and wide distribution evolved in this group. In this study, we sampled 50 species across the nearly whole geographical distribution area of *Sinopotamon*.

The phylogeny, genealogical network and divergence time was reconstructed and estimated based on mitochondrial COI and 16S rRNA, and nuclear 28S rRNA sequences. The results showed that none except the concaved lobes group of the previously proposed four species groups was monophyletic. Three well-supported clades (A, B and C) were recovered within the *Sinopotamon* species sampled, in which the basal A-clade was composed of the species around the Sichuan Basin. The A-clade diverged from the other two at the late Miocene. The B-clade and C-clade diverged at the Pliocene. Our results suggest that the diversification of *Sinopotamon* began at as early as the late Miocene, which is most likely to be associated with the uplift of the Himalaya-Tibetan plateau and evolution of Asian monsoons since the late Miocene. Present study enlightens us the important role of geological events and paleoclimate evolution in the diversification of *Sinopotamon*, and more sampling and more nuclear markers should be adopted to uncover the whole diversification process of *Sinopotamon* in further studies.

This work was supported by the National Natural Science Foundation of China (No. 31071902) to SHY

Establishing of a primary cell culture system for the hemocytes of *Cherax quadricarinatus*

Oral GS

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Hemocyte plays a vital role in the immune system of crustaceans. This study was conducted the first time for the culture of the hemocytes of red claw crayfish, *Cherax quadricarinatus*. Anticoagulant citrate dextrose solution B (ACD-B), phosphate buffered saline (PBS) and modified PBS were used and compared in this experiment. The results showed that ACD-B anticoagulation is better than PBS. L-15 medium, 2×L-15 medium、Grace medium、DMEM medium and I-max serum-free medium were also compared in this experiment. Grace medium and L-15 medium are more suitable for the survival and growth of the hemocytes and they could live more than 7 days. However, hemocytes in L-15 medium had a better status than Grace medium after 72 hrs. The effects of different concentrations of fetal bovine serum on the hemocytes' growth were compared between L-15 medium and Grace medium. There were no significant influences on the hemocytes of red claw crayfish at 10%, 15% or 20% concentration of fetal bovine serum. The shapes of hemocytes in Grace and L-15 medium were also different.

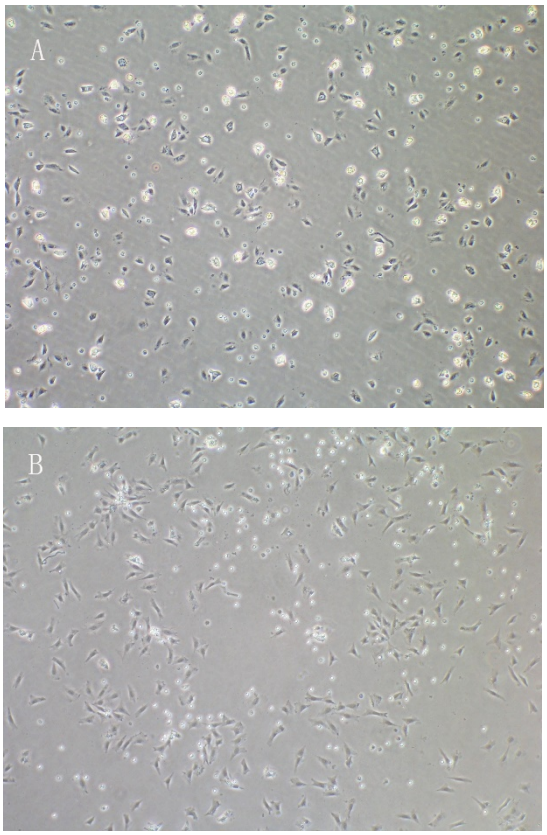

Figure. Light microscopy of hemocytes of *C. quadricarinatus* in L-15 (A) and Grace (B) medium culture (100×)

Analysis of gene expression changes, caused by exposure to nitrite, in metabolic and antioxidant enzymes in the red claw crayfish, *Cherax quadricarinatus*

Poster

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We evaluated the effect of acute exposure to nitrite stress on expression of antioxidant and metabolic enzyme genes in gill tissue of advanced juvenile *Cherax quadricarinatus*. A 48 h nitrite exposure was conducted, using four test concentrations (NO_2-N = 0.5, 1, 1.5 and 2 mg L^{-1}) plus a control group. The relative mRNA expression of mitochondrial manganese superoxide dismutase (mMnSOD), cytosolic MnSOD (cMnSOD), extracellular copper/zinc SOD (exCu/ZnSOD), catalase (CAT), glutathione S-transferase (GST), arginine kinase (AK), glutamate dehydrogenase (GDH), mitochondrial malate dehydrogenase (mMDH), Na^+/K^+-ATPase α-subunit and phosphoenolpyruvate carboxykinase (PEPCK) in gill tissue was measured. Significantly increased mRNA expression was observed for all the antioxidant enzymes after 12 and 24 h. After 48 h, they all decreased at high nitrite concentrations. The gene expression levels of AK, GDH, mMDH and Na^+/K^+-ATPase α-subunit showed similar trends as the antioxidant enzymes. Significant depression of gene expression levels of PEPCK occurred throughout the experimental time at high nitrite concentrations. The results indicated that nitrite could induce oxidative and metabolic stress in *C. quadricarinatus*, in a time dependent manner, which suggests they could be helpful in predicting sublethal nitrite toxicity in crustacean and useful as an early warning tool in environmental monitoring studies.

Larval development of the deep-water shrimp *Heterocarpus abulbus* (Decapoda, Caridea, Pandalidae)

Oral EMC

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The deep-sea caridean shrimp genus *Heterocarpus* consists of 29 species in the world and nine are found from Taiwan. Larval development in deep-sea shrimps is rarely known and previously only two species (namely *H. ensifer* and *H. sibogae*) have their larvae described. The present work successfully hatched and cultured the first four zoeal stages of *H. abulbus* for the first time. The larvae reached the fourth zoeal stage nine days after hatching, under the water temperature of 21±1□. The characteristics of the four larval stages are: Z_1- Eyes sessile and having three pairs of maxillipeds. Z_2- Eyes stalked and first pereiopods developed. Z_3- Antennule peduncle segmented, uropods with exopods. Z_4- first pereiopods well-developed, uropods with endopods. The main differences amongst the larvae of *Heterocarpus* species are body size, setation on antennule exopod and spine development at anteroventral margin of carapace.

References:

IWATA, Y., SUGITA, H., KOBASHI, T. AND DEGUCHI, Y. (1986): Larval development of the Pandalid shrimp *Heterocarpus sibogae* De Man. Bulletin of the College of Agriculture and Veterinary Medicine - Nihon University, **43**: 140-150.

JIANG, G. C., CHAN, T. Y. AND SHIH, T. W. (2014): Morphology of the first zoeal stage of three deep-water pandalid shrimps, *Heterocarpus abulbus* Yang, Chan & Chu, 2010, *H. hayashii* Crosnier, 1988 and *H. sibogae* De Man, 1917 (Crustacea: Decapoda: Caridea). Zootaxa, **3768** (4): 428-436.

LANDEIRA, J. M., LOZANO-SOLDEVILLA, F., ALMANSA, E. AND GONZÁLEZ-GORDILLO, J.I. (2010): Early larval morphology of the armed nylon shrimp *Heterocarpus ensifer ensifer* A. Milne-Edwards, 1881 (Decapoda, Caridea, Pandalidae) from laboratory culture. Zootaxa, **2427**: 1-14.

Study of Factors Influencing Shell Preference in Hermit Crab *Clibanarius zebra* (DANA 1852)

Poster

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The aim of the present study was to evaluate the factors influencing shell preference in *Clibanarius zebra*. The study was carried out from March 2012 to March 2013 at four different sites along the Saurashtra coast, Gujarat state, India. The crab specimens were collected and categorized in three groups *viz* male, female and ovigerous female. The crab specimens were weighed and different morphological characters like shield length, shield width and major chela length were measured. The gastropod shells were identified using standard literature and keys and different morphological characters were measured. Total 804 individuals of hermit crab were captured (416 males, 230 females and 158 ovigerous females), occupying 24 different species of gastropod shells. Amongst all the shell species identified, *Cerithium scabridum* (41.8%) was highly occupied by the crab species followed by *Turbo intercostalis* (10.6%), *Astrea stellata* (7.8%), *Lunella coronata* (6.6%) and *Chicoreus brunneus* (5.6 %). Male and female of *C. zebra* utilized a wide range of shell species (Male: 22 species; Female: 21 species), while ovigerous female used a specific set of gastropod shell species (14 species). *C. zebra* males and females were significantly larger in size than the ovigerous females. The crab body size differences strongly influence the shell utilization pattern; shells of *C. brunneus* have largest size among studied shells and are utilized only by *C. zebra* males and females. Significant correlations were observed between various morphological characters of crabs and shells. Shell dry weight showed strong correlation with all the morphological characters of hermit crab (Table 1). Data was also collected on density of common shell species occupied by *C. zebra* using quadrate sampling where the density of *C. scabridum* was recorded very high at all the study sites. Above mentioned results revealed that different morphological characters and availability of gastropod shells do influence the shell preference of *C. zebra.*

Relationship	r value
SL × SDW	0.7
SW × SDW	0.7
MCL× SDW	0.73
CW × SDW	0.79

Table 1: Correlation coefficient (r) value

References:

MANTELATTO, F. L. M. & GARCIA, R. B. (2000): Shell utilization pattern of the hermit crab *Calcinus tibicen* (Anomura) (Diogenidae) from Southern Brazil. Journal of Crustacean Biology, **20**: 460–467.

TRIVEDI, J. N, ARYA, S. & VACHHRAJANI K. D (2013): Gastropod shell utilization preferences of hermit crab *Clibanarius zebra* (DANA, 1852) (Diogenidae, Anomura). Taprobanica, **5 (1):** 7-13.

A preliminary study on the phylogenetic position of *Paguristes jalur* (Decapoda: Anomura: Diogenidae)

Poster

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Specimens of *Paguristes jalur* MORGAN, 1992 were collected from Kosrae state, Micronesia by scuba diving during an expedition conducted by a joint group of Korean scientists in 2013. Typical characteristics of genus *Paguristes* include the followings: left and right chelipeds subequal; with a pair of gonopores on coxa of third pereopod in female, of fifth pereopod in male; with a pair of first pleopods. One of the current female specimen of *P. jalur* showed additional third gonopore on the coxa of the left fourth pereopod. This feature which thought as mutation is not seen in other hermit crabs. And one of male specimen showed no first pleopods. This feature which thought as abnormal is not found in other species of the genus *Paguristes*. And last of male specimen showed paired first pleopods that are transformed to gonopods. Because of these unique characteristics of the current specimens of *P. jalur*, we tried to look at the phylogenetic position of this species by using DNA barcodes of the available species of the family Diogenidae which were collected in Micronesia, Korea. In our comparative study, we included COI sequences of members of the genus *Paguristes*, genus C*libanarius* and genus *Calcinus* from NCBI in this study. According to the resulting Neighbor-joining tree, each genus showed a monophyletic clade, but the current specimens of *P. jalur* clustered with the species of genus *Clibanarius,* not with the species of genus *Paguristes*. At this moment, it is premature to conclude the taxonomic status or the phylogenetic position of the current specimens. We need a further study about this issue through various approaches including biogeographical, ecological, micromorphological, comparative morphological, and population genetics studies. In this presentation, we provide descriptions and colored pictures of the current specimens of *P. jalur* and the phylogenetic tree of family Diogenidae based on specimens collected in Micronesia and Korea. The specimens examined in this study are deposited in the Marine Arthropod Depository Bank of Korea (MADBK), Seoul National University.

Figure: *Paguristes jalur* Morgan, 1992 collected from Kosrae state, Micronesia

References:

MCLAUGHLIN, P.A. (2003): Illustrated keys to families and genera of the superfamily Paguroidea (Crustacea: Decapoda: Anomura), with diagnoses of genera of Paguridae. -- Memoirs of Museum Victoria, 60(1): 111-144.

MCLAUGHLIN, P.A., KOMAI, T., LEMAITRE, R. & RAHAYU, D.L. (2010): Annotated checklist of Anomuran Decapod crustaceans of the world (exclusive of the Kiwaoidea and families Chirostylidae and Galatheidae of the Galatheoidea) part I - Lithodoidea, Lomisoidea and Paguroidea. -- The Raffles Bulletin of Zoology, 23: 5-107.

MCLAUGHLIN, P.A., LEMAITRE, R., KOMAI, T. & CHAN T-Y (2007): A catalog of the hermit crabs (Paguroidea) of Taiwan, 1: 365 pp. ; National Taiwan Ocean University.

MORGAN, G.J. (1992): The hermit crabs (Crustacea: Decapoda: Coenobitidae, Diogenidae, Paguridae) of Christmas and Cocos (Keeling) Islands, Indian Ocean, with description of a new species of *Paguristes*. -- Raffles Bulletin of Zoology, 40(2): 163–174, figs 1, 2.

SANT'ANNA, B. S., TURRA, A., & ZARA, F. J. (2010): Simultaneous activity of male and female gonads in intersex hermit crabs. -- Aquatic Biology, 10: 201–209.

Male claspers in clam shrimps (Crustacea, Branchiopoda) in the light of evolution: a case study on homology versus analogy

Poster

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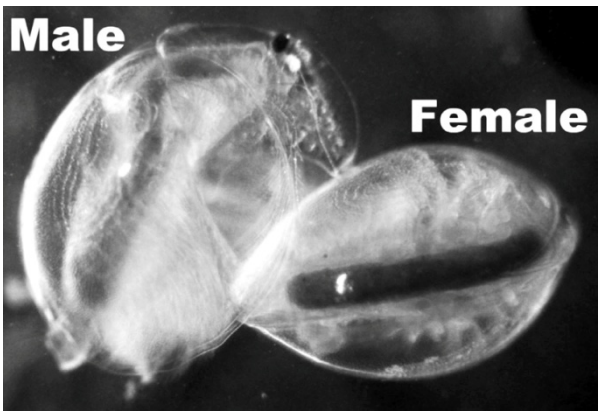

Copulating clam shrimps (Kaji et al. 2014).

Male "clam shrimps" possess highly modified first (and second) trunk limbs for clasping the carapace of females during copulation. Claspers are present in all three clam shrimp taxa (Laevicaudata, Spinicaudata and Cyclestherida) but despite striking similarities in their morphology and function, the matter of their homology is controversial; most of previous studies suggested that the similarities of claspers are the result of analogous transformations of the first trunk limbs. Because of some lack of morphological/developmental information, we believed that the subject in question is of wider importance and hold a reexamination to be justified.

In this study, we address the question of the homology and evolution of these structures by comparing the developmental transformation of an unspecialized trunk limb into a clasper. In addition, we study the musculature and the nervous system in trunk limbs and claspers using confocal laser scanning microscopy.

We establish that most (but not all) of the various parts of the claspers are homologous between clam shrimp taxa. We suggest that a single pair of claspers was already present in the ground pattern of Diplostraca, probably most comparable to those in Cyclestherida. The claspers, therefore, do not represent a case of analogy.

References:

KAJI, T., FRITSCH, M., SCHWENTNER, M., OLESEN, J. & RICHTER, S. (2014) Male claspers in clam shrimps (Crustacea, Branchiopoda) in the light of evolution: a case study on homology versus analogy. Journal of Experimental Zoology Part B: Molecular and Developmental Evolution. DOI: 10.1002/jez.b.22574

Barcoding of ancient lake ostracods reveals cryptic speciation with extremely low divergence rates

Oral MSI

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Cryptic speciation is a well-documented phenomenon in all metazoan taxa, mostly detected by the mitochondrial COI sequences. Very often it is hard to establish morphological differences between cryptic species even with divergence rates up to 15%. This is especially true with organisms with few observable morphological characters. Within Crustacea, ostracods are one of the morphologically most reduced taxa, and the number of characters is relatively limited. In addition, the most prominent characteristic of the group, the bivalved shell, is thought to be the most homoplastic of all, with a high rate of polymorphism even within a single species. Here I present a case study on cryptic speciation in ostracods, based on *Cypria biwaense* OKUBO, 1990, an endemic of the ancient Lake Biwa in Japan. Previous studies indicated a possibility that its populations may contain cryptic species based on small differences in the shell shape, but the study of the soft parts morphology concluded that there are no observable characters whatsoever. A quick look at the sample containing *C. biwaense* clearly highlights two forms: a black and a white, of which the black ones also tend to be smaller. However, examination of large samples reveals some intermediate individuals in terms of coloration and size. To get an indication of molecular diversity in *C. biwaense,* I sequence the COI of black and white forms, as well as some intermediate cases from different depths. The phylogenetic trees constructed using all three common methods (maximum parsimony, maximum likelihood and neighbor joining) have very high bootstrap values (97 and 94) for black and white forms, which are separated by about 5% divergence rates, while divergence rates within clades do not exceed 2% in the white and 1% in the black. The intermediate forms cluster either with black or with white. By studying a large series of specimens I show that, although the most prominent, coloration and size are not the only characters which separate these two cryptic species. In fact the shape of the shell and several morphometric data of the soft pars underline that intermediate forms do not exist. With this study I show that even a small divergence in COI is clearly reflected on the morphology and that it is only a question of detailed study and a large enough series to distinguish ostracod species, especially when they live sympatrically. There are also some indications that these two cryptic species show niche partitioning (with the black being more dominant at 41 m and the white at 79 m), which may be another indication that their sympatry is relatively recent. Specimens from the same depth do not cluster together neither in the black nor white clade, suggesting a high gene-flow within each cryptic species.

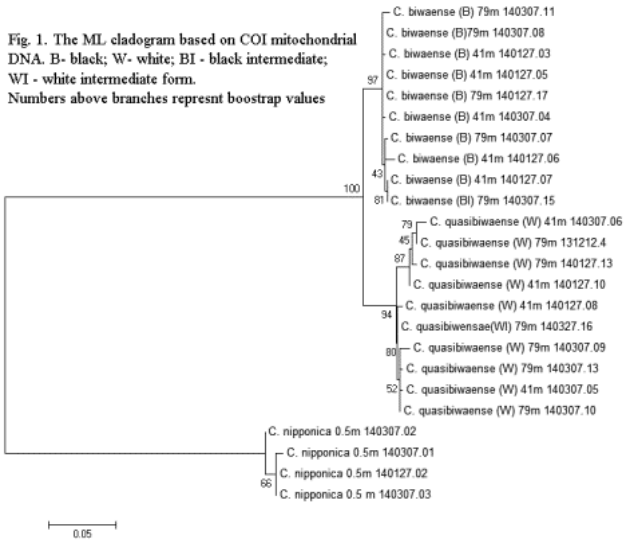

Fig. 1. The ML cladogram based on COI mitochondrial DNA. B- black; W- white; BI - black intermediate; WI - white intermediate form. Numbers above branches represnt boostrap values

Copepods in studies of dispersal strategies and habitat invasions: global, regional, and microscale

Oral GS

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Copepods are arguably the most ubiquitous aquatic animals, and probably the most successful of all crustaceans in habitat exploitation. In addition to numerous parasitic lineages and free-living forms from the ocean surface to abyssal depths, copepods are also extremely successful in colonizing continental waters across the entire salinity spectrum. Their enormous dispersal potential was long hypothesized based on resting larval and adult stages and resistant eggs, but little work has been done on studying specific dispersal strategies and colonization pathways. In this talk I will focus on some of my recent studies of cyclopoid and harpacticoid copepod habitat invasion and dispersal on three different scales, and in very different environments, from European mountain lakes to hypersaline subterranean aquifers of Australia. Using a variety of molecular markers (CytB, COI, 12S, 16S, 18S) and a whole range of species, I will try to demonstrate some common principles and problems that face phylogeographic studies of small planktonic and benthic crustaceans. A comparative study of the mtCOI lineage diversity between a cyclopoid copepod (*Eucyclops serrulatus*) and a cladoceran branchiopod (*Daphnia longispina*) demonstrates that dispersal advantages of the latter, such as parthenogenesis and long-lasting propagules, give no real advantage in colonizing the very dynamic mountain lake environments in the region of East Europe. These two planktonic crustaceans show very similar geographical patterns of diversity despite their differences in life cycles and dispersal abilities, and harbor no cryptic lineages in mountain lakes, although this would be expected from their pronounced morphological variability. Series of studies of benthic harpacticoids in a small palaeochannel in Western Australia reveal an unprecedented diversity of subterranean taxa for this part of the world, resulting both from repeated colonizations and explosive radiations. Pronounced size differentiation of sympatric and parapatric species, most of which are short-range endemics, is here a result of different phylogeny, not of parallel evolution and character displacement. Most astonishingly, different dispersal strategies of three dominant harpacticoid families in this palaeochannel reflect their different origins, where an active dispersal upstream can be demonstrated for a number of taxa of marine ancestry. In testing my old hypothesis of anthropogenic translocation of planktonic freshwater cyclopoids associated with early shipping activities, I examine global molecular and morphological diversity of several species. Reconstructed phylogenies present strong evidence for anthropogenic translocation, with the same haplotype found in highly disjunct populations on different continents, although this is probably associated with more recent human endeavors. A very high level of cryptic speciation in these taxa suggests that our current methods of morphological examination are inadequate. I explore cuticular pores and sensilla in a number of copepod taxa, and their potential use in species delineation and phylogenetic reconstructions.

Morphological and genetic analyses reveal high diversity in the *Potamon ruttneri* and *P. gedrosianum* complex of freshwater crabs

Poster

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There is an urgent need for a better understanding of biodiversity of freshwaters in the Middle East, where temperate freshwater crabs of the genus *Potamon* find their easternmost distribution, extending to the western tributaries of the Indus River.
Many species and subspecies were described from this region in different studies. Brandis et al. (2000) synonymised them and ranked them at species level. Based on current knowledge, two species of *Potamon* are known from this region: *Potamon gedrosianum* ALCOCK, 1909 and *Potamon ruttneri* PRETZMANN, 1962. In this study we use genetic information and morphological characters in order to establish, whether the current classification is reliable and reflects actual species boundaries between species and also to reveal possible hidden diversity. For the phylogenetic reconstruction, sequence data from two mitochondrial gene fragments, a ribosomal gene (16S rRNA) and the protein coding cytochrome oxidase subunit I (Cox1), were obtained from some freshly collected specimens and museum vouchers.
The results suggest that some populations are very divergent and question the taxonomic status of *P. ruttneri* and *P. gedrosianum*. Therefore, overall species diversity seems to be considerably higher than currently recognized, and some synonymised species deserve to be revalidated to species level.

References:

BRANDIS D., STORCH V &, TÜRKAY M. (2000): Taxonomy and zoogeography of the freshwater crabs of Europe, North Africa, and the Middle East. Senckenbergiana Biologica, **80**: 5-56.

Phenotypic disparity of anomalan crustaceans (Crustacea: Decapoda: Anomala) and the evolution of a crab-like body form
- a fascinating insight into the evolutionary process of carcinization -

Oral GS

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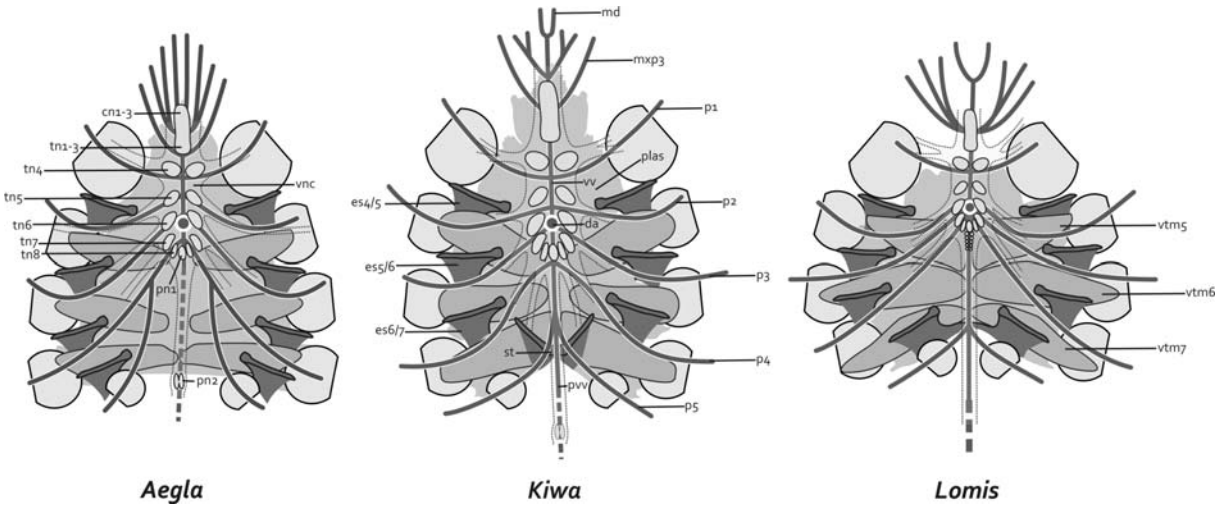
Anomala is probably the most phenotypic disparate taxon within decapod crustaceans. They comprise various morphological 'types' such as crabs, squat lobsters and hermit crabs. Curiously, a crab-like body form has evolved three times independently within Anomala, independently from true crabs (Brachyura). The evolutionary transformational process 'into a crab', which has been termed carcinization almost one hundred years ago, resulted in a broadened carapace and the pleon flexed under the cephalothorax in each of these crab-like taxa. Carcinization, however, effected not only the external morphology but also internal organ systems such as the endophragmal skeleton, the hemolymph vascular system and the nervous system. By the use of micro-computer tomography and computer-aided 3D reconstruction we studied each the whole anatomical framework of representatives of the crab-like taxa and their closest relatives to obtain a comprehensive picture of the spatial relations of the integument and the various organ systems. Although coherences (structural dependences) between internal and external morphology could be identified showing that the process of carcinization indeed involves the entire organism, the different kinds of coherence reflect the independent evolution of carcinization.



Legend: Schematic drawings of the various organ systems in the ventral portion of the cephalothorax in various representatives of Anomala. Cn1-3, cephalic neuropils (ganglia); da, merging point of descending artery and ventral vessel; p1-5, leg arteries; md, mandibular arteries; mxp3, artery of third maxilliped; plas, sternal plastron; pn1-2, pleonal neuropils (ganglia) of the ventral nerve cord; pvv, posterior ventral vessel; st, sella turcica; tn1-8, thoracic neuropils (ganglia); vnc, ventral nerve cord; vtm5-7, ventral thoracic muscles; vv, ventral vessel.

Structural variations in the brains of marine *versus* terrestrial isopod crustaceans

Poster

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The evolutionary transition to land in several crustacean lineages coincided with substantial morphological and physiological adaptations. These modifications relate for example to gas exchange, ion and water balance, excretion, thermoregulation, molting and reproduction. Moreover, sensory systems have to function in air instead of water. This had in many cases a profound impact on the morphology and physiology of visual, mechanosensory and chemosensory systems, reshaping these organs during the evolutionary transition. Using immunohistochemical labeling and confocal laser scanning microscopy, this study sets out to trace the morphological variations of the peripheral and central olfactory pathway in various marine and terrestrial isopod representatives. Substantiated by previous studies, we show that the evolutionary size reduction of the first pair of antennae in terrestrial isopods (Oniscidea) had a considerable cascading effect on associated structures within the brain.

Supported by DFG grant Ha 2540/9-1.

Zoogeography of *Cymodoce* Leach, 1814 species (Crustacea: Isopoda: Sphaeromatidae) from the Persian Gulf

Poster

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The isopod genus *Cymodoce* LEACH, 1814, is a species-rich genus of the family Sphaeromatidae LATREILLE, 1825. Nineteen species of this genus are known from the Indian Ocean, distributed mainly along the western coasts (SCHOTTE & KENSLEY 2005). To date, only three *Cymodoce* species are known from the Persian Gulf: *C. fuscina* SCHOTTE & KENSLEY, 2005; *C. delvarii* KHALAJI-PIRBALOUTY, BRUCE & WÄGELE, 2013, and *C. waegelei* KHALAJI-PIRBALOUTY & RAUPACH (accepted). Of these *C. fuscina* has exclusively been found from Arabian waters (Kuwait, Saudi Arabian, Bahrain and United Arab Emirates), and *C. waegelei* and *C. delvarii* were collected along the Iranian coast (KHALAJI-PIRBALOUTY et al*.,* 2013).
The latter also is known from the western (Saudi Arabian) coast of the Gulf. Interestingly, *C. delvarii* is sympatric with two other species in some areas, whereas C. *fuscina* and *C. waegelei* exhibit allopatric distribution. Several factors may affect the distribution patterns of the *Cymodoce* species in the Persian Gulf including: salinity, temperature, habitat availability, and quality. Habitat availability appears unlikely to regulate distribution due to continuity of sea-grass bed habitats (e.g., *Sargassum*). The Persian Gulf has a high annual temperature variation, with water temperatures exceeding 32°C in summer and dropping below 20°C in winter (TSANG *et al*. 2012); this also is similar across their geographic range. Differences in salinity are much more likely to be the major factor restricting distribution of *Cymodoce* species in the Persian Gulf. Although the Iranian coasts show comparatively low salinities (36.5–38 ppt), the western and northern parts of the Gulf have salinity values above 40. Effects of salinity on distribution of the intertidal brachyuran crabs along the northern and southern coasts of the Persian Gulf was noted by APEL & TÜRKAY (1999) and NADERLOO et al. (2011). Therefore, ability to withstand lower, higher, and variable salinities may explain different distribution patterns of the three *Cymodoce* species in the Persian Gulf.

References:

APEL, M. & TÜRKAY, M. (1999) Taxonomic composition, distribution and zoogeographic relationships of the grapsid and ocypodidcrab fauna of intertidal soft bottoms in the Arabian Gulf. Estuarine, Coastal and Shelf Science, **49**: 131–142.

KHALAJI-PIRBALOUTY, V., BRUCE, N. L. & WAEGELE, J. W. (2013) The genus *Cymodoce* LEACH, 1814 (Crustacea: Isopoda: Sphaeromatidae) in the Persian Gulf with description of a new species, Zootaxa, (3686) **5**: 501-533.

NADERLOO, R. TÜRKAY,M &. APEL, M. (2011) Brachyuran crabs of the family Macrophthalmidae DANA, 1851 (Decapoda: Brachyura: Macrophthalmidae) of the Persian Gulf, Zootaxa, 2911: 1-4.

SCHOTTE, M. & KENSLEY, B. (2005) New species and records of Flabellifera from the Indian Ocean (Crustacea: Peracarida: Isopoda) Journal of Natural History, (39)**16**: 1211–1282.

TSANG, L. M, ACHITUV, Y. CHU, K. H. & CHAN, B. K. (2012): Zoogeography of Intertidal Communities in the West Indian Ocean as Determined by Ocean Circulation Systems: Patterns from the Tetraclita Barnacles. PLoS ONE, (7) **9**: 1-11.

Confocal laser scanning microscopy three-dimensional visualization of a new species of *Clausidium* (Copepoda: Poecilostomatoida) associated with mud shrimps from Persian Gulf, Iran

Oral GS

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A new clausidiid copepod was found associated to the mud shrimp *Neocallichirus jousseaumei* (Nobili, 1904) from the Persian Gulf, along the Iranian coast. This is the first record of genus *Clausidium* in Iran. The new species shares with *C. travancorense* PILLAI, 1959, the armature formula of legs 2 to 4, but can be easily distinguished from its congeners by the unique characteristics observed in the females – antenna with prominent spine on endopod-1, maxilliped armature and swimming legs with elongated basis. Other differential features observed in males are the maxilliped with distinct projections and armature of legs 1 and 4.

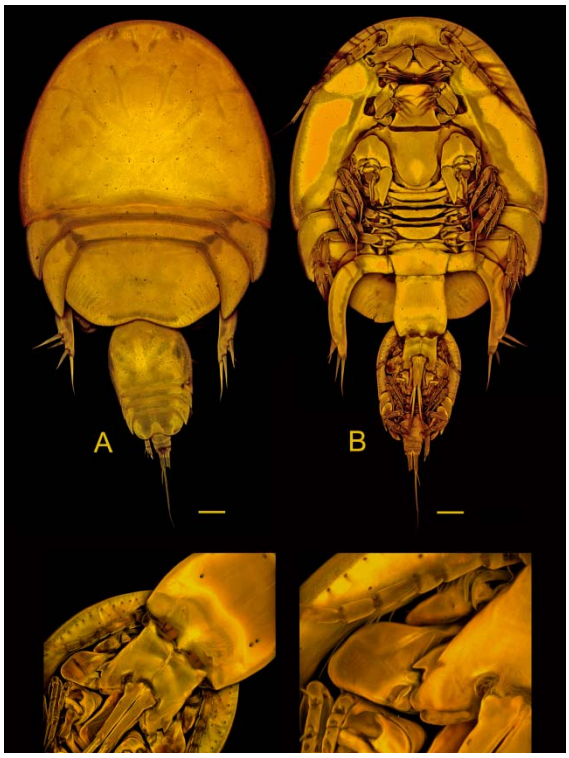

Figure 1: *Clausidium* sp. nov. (female and male), confocal laser scanning microscopy images: A, Habitus, dorsal; B, Habitus, ventral; C, Male maxilliped attachment to female urosome; D, Detail of the male maxilliped attachment to female urosome. Scale bars: A-B 100 µm, C 25 µm, D 10 µm.

In addition to the traditional descriptions, confocal laser scanning microscopy (CLSM) has been used to obtain high resolution images (Fig. 1) and 3-D reconstructions from entire animals. Appendages or structures with taxonomical importance and complex shapes (male maxilliped and female urosome) were also scanned. The resultant printout models gave valuable insights about female/male interlocking mechanism that were not possible with conventional methods.

A new species of the genus *Coxicerberus* (Crustacea: Isopoda) from several localities in Korea and their molecular diversity

Oral GS

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Most of isopods living in open water have relatively large body compared to their meiobenthic relatives, especially the interstitial isopods of the suborder Microcerberidea. Animals belonging to this suborder have tiny (meiobenthic scale), slender and elongated bodies, allowing them to move through narrow spaces. There are only three taxonomic studies concerning Microcerberidea from the East Asia, and they involve Japanese marine interstitial. The interstitial isopods so far received little attention during the survey of the meiobenthic fauna of Korea. Recently, a new *Coxicerberus* species was collected from several localities on the East Coast of the Korean Peninsula. This study aims to describe the new species. Beside morphological characters we use mitochondrial COI sequences to study potential cryptic speciation and divergence rates between different populations. Our sequences are the first such data on the GenBank for the entire suborder.

Reference:
ITO, T. (1974): A New Species of Marine Interstitial Isopod of the Genus *Microcerberus* from Hokkaido. Jour. Fac. Sci. Hokkaido Univ. Ser. VI. Zool. 19(2), 1974.

Not only for men: A functional pleon holding mechanism in female calappids

Oral GS

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Male brachyurans have a pleon holding mechanism which secures the pleon when it is folded underneath the cephalothorax. The most prevalent holding mechanism is known as a typical press-button mechanism. It consists of a pretuberance on the sternite of the fifth segment of the cephalothorax and a corresponding socket on the sixth pleon segment (GUINOT & BOUCHARD, 1998). Due to the strong morphological change by widening and flattening of the pleon with maturity in female brachyurans, a loss of the press-button mechanism in female crabs has been assumend for most genera. In this study a functional press-button mechanism in adult female calappid crabs has been documented in 9 out of 13 examined species from museum collections (Figure 1).

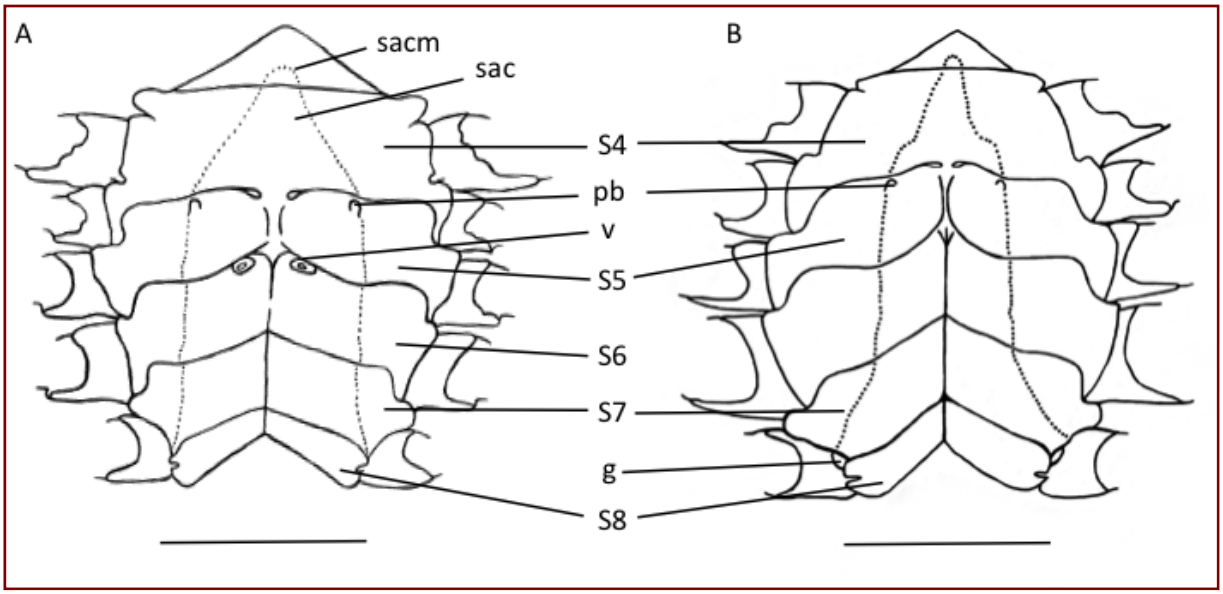

Fig. 1: Sternum of *Mursia armata* De Haan, 1837. A: female, B: male. g: male gonopore , pb: press-button pretuberance, S4-S8: sternite 4-8, sac: sterno-abdominal cavity, sacm: sterno-abdominal cavity margin, v: vulva. Initial part of pereiopods indicated at the margin of the sternite sections.
Scale bar: 1 cm.

References:

GUINOT D. & BOUCHARD J.-M. (1998) Evolution of the abdominal holding systems of brachyuran crabs (Crustacea, Decapoda, Brachyura). *Zoosystema*, 20: 613-694.

Evolution of Southeast Asian freshwater crabs

Oral CBF

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Southeast Asia is on a global scale one of the most diverse regions in terms of species richness. This is also true for primary freshwater crabs that occur in Southeast Asia with the two families Potamidae and Gecarcinucidae. A general question is why such tropical ecosystems harbour such a high level of biodiversity. Here I ask wether cyclical vicariance and dispersal during the glacial periods acted as a "species pump" for freshwater crabs in Sundaland. It shows that local insular species radiation contribute a large part of the freshwater crab's species diversity. The morphological evolution of such an insular species complex is presented.

Cladistic analysis of the intrinsic phylogeny of Tantulocarida

Oral GS

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Tantulocarida is a class of tiny parasitic crustaceans recognized only 30 years ago by Boxshall and Lincoln (1983). They are characterized by a very complicated life cycle including both ectoparasitic and free-swimming stages representing partenogenethic and sexual phases. Tantulocarida maybe the most poorly studied group among Crustacea, their internal structures has never been described using TEM, their relationships with other crustaceans are far from being understood, their life cycle is not fully reconstructed. Intrinsic phylogeny of the group has not been reviewed since 1996 (Boxshall, 1996), and it became clear that the systematics of Tantulocarida is more likely artificial, while formal cladistic analysis has never been carried out at all. Currently, four families of Tantulocarida are recognized: Basipodellidae, Deoterthridae, Microdajidae and Doryphallophoridae. Formal cladistic analysis of the group was conducted for the first time, 64 morphological characters of tantulus larva and adult males were used to estimate the relationship between 34 out of 36 currently described species, belonging to four families. Bootstrap and neighbour joining trees constructed in Paup 4.0 revealed the following results:

1. Families Deoterthridae, Basipodelidae and Doryphallophoridae are more likely polyphiletic
2. The only monophyletic family is Microdajidae.
3. Three monophyletic genera are recognized: *Arcticotantulus*, *Tantulacus* and *Deoterthron*.
3. Previously existing family Onceroxenidae is now formally considered to be invalid as its diagnosis is based on the incorrect features.

Our results also show that even such an extensive dataset is not enough to reconstruct the tree of Tantulocarida mainly because real biodiversity of the class is underestimated and it is impossible to score all characters for all known tantulocaridan species due to the insufficient description.

References:

BOXSHALL, G.A. (1996). Classe des Tantulocarides (Tantulocarida Boxshall and Lincoln, 1983). -- Traite de Zoologie, **7**: 399-408.

BOXSHALL, G.A. & LINCOLN, R.J. (1983).Tantulocarida, a new class of Crustacea ectoparasitic on other crustaceans. -- Journal of Crustacean Biology, **3**: 1-16.

Crabs on the move - Telemetric analyses of migrations and circadian activity of the giant robber crab *Birgus latro* on Christmas Island (Indian Ocean)

Oral CTF

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The giant robber crab *Birgus latro* (LINNAEUS, 1767) (Anomura, Coenobitidae) is the largest land living arthropod and its populations are distributed over small Indo-pacific islands as for example Christmas Island (Indian Ocean). Although these animals have served as models in anatomical, physiological, and ecological studies, behavioral analyses of *B. latro* are surprisingly rare. To investigate their migratory behavior GPS-based telemetric studies were conducted for the very first time on an arthropod. Experiments were carried out in Christmas Island's rain forest during the wet seasons in 2008 and 2010, and during the dry season in 2011. In total, we equipped 56 male robber crabs with GPS-tags along a defined transect and data were recorded at 1 h intervals over as long as 2 months. The tags were also equipped with a triaxial accelerometer module that served to monitor locomotory activity of the animals. In addition to territorial behavior with small-distance excursions, our data show large-distance migrations of robber crabs between the coast and the inland rain forest. Large distance migrations occurring mainly during the wet season are likely related to mating, but may also target food sources and saltwater. These findings are corroborated by acceleration data that indicate a decrease of locomotory activity whenever climate parameters promote evaporation (such as wind speed, temperature and relative humidity). A subgroup of twelve specimens was translocated to different directions showing that animals were capable of homing over large distances. Searching behavior induced by displacement indicates at least two possible navigation strategies including route following and path integration. This study was supported by the Max Planck Society.

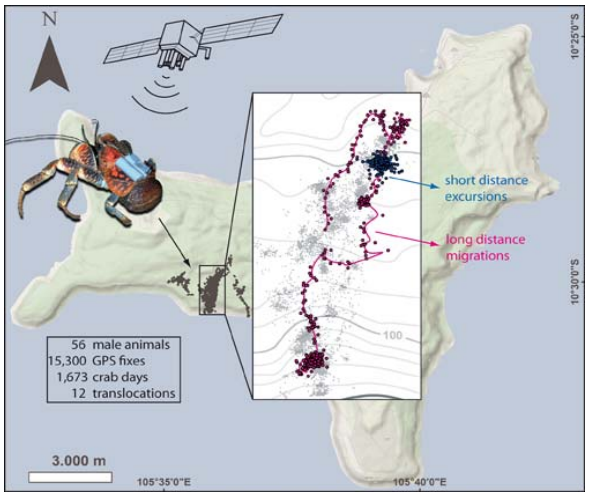

Figure shows an animal carrying a GPS transmitter and typical movement patterns (blue and pink paths) plotted from all waypoints (black dots on background map).

Calcitic sclerites at the base of malacostracan pleopods (Crustacea) – part of a coxa

Oral GS

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Cuticular specialisations such as joints and membranes play an important role in the functionality of arthropod limbs, including sclerotisations and mineral incrustations of cuticular areas to achieve more rigidity or flexibility. Malacostracan crustaceans are characterised by a well-calcified cuticle. Their thoracopods 1–8 have limb stems comprising a coxa and basipod. However, pleopods, the limbs of the posterior trunk part, are regarded to lack a coxa. Instead several calcitic sclerites occur between ventral body and limb stem, seemingly "swimming" in the body-limb articulation membrane. The question is if these calcitic elements represent specialisations of the membrane due to functional requirements, formed *de novo*, or if they are remnants of originally larger limb portions, i.e. the coxa, or in fact represent it. Indeed, Crustacea are characterised by the presence of two alternative structures proximal to the base of their limbs, which cannot co-occur. One is a separate setae bearing "proximal endite" at the inner edge of the phylogenetically old basipod. The other is a sclerotised cuticular portion, which completely surrounds the base of post-antennular appendages, called "coxa". As the only exception, malacostracan pleopods seem to have only a uniform limb stem. To pursue the question about the nature of the calcifications, we investigated 16 species of selected malacostracan taxa of all major in-groups. Calcitic sclerites occur in constant numbers and position within a species and usually even within a supra-specific taxon. In general the sclerites connect proximally via two pivot joints (condyli) to the sternite medially and the tergopleura laterally, and two more to the limb stem distally. Based on this, we reconstructed the ground-pattern conditions for the sclerite pattern of the examined taxa and the Malacostraca. All examined malacostracan taxa possess the calcitic sclerites, and the pattern of calcified sclerites appears to be characteristic for each monophyletic taxon. The highest number of sclerites, as developed in Phyllocarida and Hoplocarida, represents, most likely, the plesiomorphic state. The examined representatives of caridoidan in-groups have fewer sclerites, and even further reduction was observed in Anaspidacea and within Peracarida and Eucarida. Sclerite arrangement in these taxa is rather special and correlates well with functional changes within taxa, therefore providing an important but until now neglected character complex for phylogeny studies within Malacostraca. Concerning the origin of the sclerites, at most only two pivots should be developed according to the two hypotheses of an original proximal endite or existence of only a basipod. The existence of four points, therefore, to the existence of a coxa. Its generally low degree of sclerotisation, particularly on the posterior side, may be explained by the enhanced flexibility of the pleopods in the course of the their major role as swimming devices, at least basically. Independently, the coxal cuticle includes calcifications, which basically were more numerous but became reduced in their number on the way to more specific use of the pleopods in the particular in-groups – yet highly conserved even in specialized limbs such as petasma limbs. Modifications are clearly functional, lead to dislocation of pivots or their loss, e.g. in Anaspidacea, which stretch their pleopods laterally. Both the pivot joints and the proximal and distal extension of the calcitic sclerites demarcate the minimum area of the coxa, while the degree of sclerotisation appears rather variable between the taxa and functionally influenced. Accordingly it is often difficult to distinguish between a soft coxal body and the surrounding membrane, a reason why the coxa has not been recognized for so long. With this, sclerites, if calcified or just sclerotic, appear to us as very valuable also in shedding more light on the putative relationships between Malacostraca, myriapods, Insecta and Remipedia.

Observations on a freshwater crustacean: *Lepidurus arcticus* (Branchiopoda, Notostraca) in Svalbard in the European High Arctic

Oral BR

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This abstract describes the ecology of Arctic tadpole shrimp *Lepidurus arcticus* (Branchiopoda, Notostraca) in permanent and temporary ponds on Spitsbergen, Svalbard, Norway (78°–79° N, 11°–16° W, Figure). *L. arcticus* lives in freshwater lakes and temporary ponds in the Arctic region, where it has a circumpolar distribution. This High Arctic crustacean lives in ponds between the Arctic Ocean and glaciers in Svalbard. *L. arcticus* living in Svalbard occupy the most extreme aquatic environments in Arctic region. It is notable that the northernmost known occurrence of *L. arcticus* is at Mosselhalvøya (79°N) in the Svalbard. The water temperature (July-September) varied between 0.2 – 5.4 °C and the sediment temperature varied between -1.9 – 4.9 °C in *L. arcticus* habitats in Svalbard. The air temperature may be below the freezing point even in summer. It must be taken into account that adult *L. arcticus* burrow in the sediment (≈1 cm) as they move and search for food on the bottom. Even if the temperature was below freezing point in the sediment. This species should be considered as stenothermal, because it seems to be able to live only within narrow temperature range.

Legend: The Arctic tadpole shrimp *Lepidurus arcticus*
Drawing: Hanna-Kaisa Lakka

Highly adapted large branchiopod *L. arcticus* do not merely survive under extreme conditions but also grow and reproduce. Effective reproduction capacity was a unique feature of the *L. arcticus* populations in Svalbard. *L. arcticus* females reached sexual maturity at smaller body size and sexual dimorphism appeared in smaller animals in Svalbard than anywhere else in the subarctic or Arctic regions. *L. arcticus* females were able to carry more eggs (up to 12 eggs per female) than has been observed in previous studies. Another interesting feature of *L. arcticus* in Svalbard was their potential to grow large, up to 39.4 mm in total length. Also cannibalistic behaviour seemed to be common in Svalbard *L. arcticus* populations. Males occur in some *L. arcticus* populations in Svalbard. An exception to this aggressive cannibalistic behaviour was only the interactions between females and males. Sexual reproduction in *L. arcticus* is likely more common than was previously believed.

L. arcticus is a keystone species in High Arctic ponds, which are exposed to a wide range of environmental stressors. However, *L. arcticus* is clearly a true Arctic species that requires a high oxygen concentration and cool water.

References:

LAKKA, H-K. (2013): The ecology of a freshwater crustacean: Lepidurus arcticus (Branchiopoda; Notostraca) in a High Arctic region. -- Ympäristöekologian tutkimuksia ja raportteja, Ympäristötieteiden laitos Lahti, Helsingin yliopisto, No. **111** 151 pp.

A record of a rare male of the Arctic tadpole shrimp *Lepidurus arcticus* (Branchiopoda, Notostraca) on Spitsbergen, Svalbard in the European High Arctic

Poster

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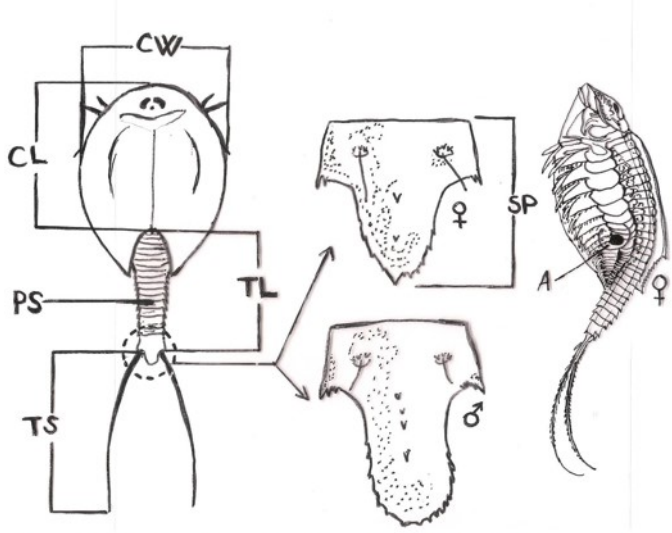
The Arctic tadpole shrimp *Lepidurus arcticus* (Branchiopoda, Notostraca) is the only Notostracan species found in permanent and temporal ponds in Svalbard, Norway. This abstract describes the male morphology of *L. arcticus*.

The males were very rare in the Svalbard ponds. Differences between males and females are demonstrated in Figure. The male/female ratio was only 1:6-1:41 (mean 1:16) in six pond where males were observed. Males were not found in the others 13 ponds. Males were remarkably large in Svalbard. The total length of the male rarely exceeded 18 mm, but in few cases had reached a total length of 27.5 mm and a carapace length of 9.1 mm. The total length of *L. arcticus* did not significantly differ between males and females. Still, in mid- and late-summer males were on mean 8-30 % smaller than females in Svalbard.



Legend: Morphological parameters of *L. arcticus* and the differences between female and male supra-anal plates and the place of female egg-capsule (A). CL=Carapace length, CW=Carapace width, TL=length of telson from carapace to the end of supra-anal plate, TS= length of intact telson setae, SP= length of supra-anal plate and PS= number of posterior segments not covered by the carapace.
Drawing: Hanna-Kaisa Lakka

Males had very strong and robust legs and the supra-anal plate was blunt and shovel-shaped. The ratio of carapace length to supra-anal palate (CL/SP) is considered as a good way to identify *L. arcticus* species. The carapace should be 20 mm long and the CL/SP ratio should be then around 12 in adult animals (LONGHURST 1955). Such large carapaces were not observed in Svalbard. The *L. arcticus* supra-anal plate is very small, but the size of the supra-anal plate showed large variability in Svalbard. Males had a slightly higher supra-anal plate ratio (mean 15.3) than females (mean 14.97) in Svalbard.

External morphology of the male of *L. arcticus* in Svalbard; 1.) No egg-capsules, the structure of 11th pair of legs of males is the same as than the pairs immediately preceding and following it. 2.) Very strong and robust legs. 3.) The supra-anal plate (SP) is blunt and shovel-shaped.

References:

LAKKA, H-K. (2013): The ecology of a freshwater crustacean: *Lepidurus arcticus* (Branchiopoda; Notostraca) in a High Arctic region. -- Ympäristöekologian tutkimuksia ja raportteja, Ympäristötieteiden laitos Lahti, Helsingin yliopisto, No. **111** 151 pp.

LONGHURST, A.R., (1955): A review of the Notostraca. Bulleting of the British museum (Natural History). – Zoology, **3**: 1-57.

Food manipulation and selection in the omnivorous crab *Neohelice granulata*

Poster

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Neohelice granulata (Decapoda, Varunidae) is an omnivorous semi-terrestrial burrowing crab endemic of Southwestern Atlantic saltmarshes that behave as herbivore when inhabit vegetated saltmarsh areas or deposit feeder in bare mudflats. In order to elucidate how non-specialized crabs manage to rely on low quality diets, we studied how they use feeding appendages to manipulate the different food items commonly eaten, and evaluated their ability to sort particles when they act as deposit feeders. According to the source of food consumed, different behaviors and mouthparts involved in food processing were observed.

Differences were found in handling *Spartina densiflora* leaves in the herbivore feeding mode among crabs of different sex and size. Females and younger males separated the longitudinal fibers of a leaf with their chelae and cut a thin strand with their mandibles. Large males used their chelae to bend the entire leaf before cutting it along the fold with their mandibles, handling the resulting piece with both chelae. The subsequent phase of fractioning and ingestion was similar in both sexes: dactylus of 3rd maxilliped holds and guides cut pieces into the mouth, food was manipulated by the dactyl of 2nd maxilliped and processed by mandibles; finally the small sectioned pieces were ingested. When feeding on sediment, no differences were observed between sexes. Each individual roamed through the area introducing occasionally their chelae into the sediment and carrying some mud into the mouth. During this raking, sometimes crabs found larger items (mainly plant detritus) taking them between propodus and dactylus before carrying to the mouth. Otherwise, they eventually stopped in a given area and ingest sediments with one or both chelae alternately as spoons. Third maxillipeds were not used in sediment manipulation and remained open. In contrast, dactyls of 2nd maxillipeds actively pushed the sediment obtained by chelae into the mouth or helped to expel undesirable portions. Activity of maxillules, maxilles and first maxillipeds was not evident during feeding on sediment.

In deposit feeding, a concentration of N-rich items in stomach contents was detected. Diatoms and nematodes concentration was lower in stomach than in sediment; ostracods, copepods and foraminifera were more abundant in stomach content; *S. densiflora* remains did not differ between sediment and stomachs. C and N content in feces was higher than in sediment.

Neohelice granulata is found in all areas where some species of *Spartina* are present. The ability of this crab to degrade cellulose and feed on vascular plants is presumably associated to their success in colonizing Southwestern Atlantic marsh environments. However, it is also able to select energy rich items from sediment, compensating the limited periods of feeding after each tidal receding allowing them to obtain the necessary complement to an N-low diet. In spite of lacking the main morphological characteristics associated to feeding on sediment, as small spooned chelae or profuse and diverse setation in feeding appendices and/or body surface, *N granulata* could be an effective deposit feeder.

Aspects of the biology of the tiger prawn, *Penaeus monodon* (Fabricius) off the Niger Delta area of Nigeria.

Oral GS

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The growth pattern, food habits, sex ratio and fecundity of the tiger shrimp, *Penaeus monodon*, a new invasive shrimp in the Niger Delta of Nigeria were investigated. The total length of the examined specimens ranged from 19.5cm to 34.4cm (carapace length, 3.3cm to 7.9cm) and weighed 51.5g to 303.4g. The shrimps exhibited allometric growth with regression coefficient (b) of 2.89 for females and 2.95 for males. There was high correlation between length and weight of the shrimps with correlation coefficient (r) ranging between 0.8722 and 0.8822. The condition factor ranged between 0.59 and 0.79 and was higher in the females. The shrimps fed mainly on crustaceans and molluscs. Algae and diatoms were also encountered in the stomachs. The sex ratio was 1:1.36 (male/female) which was significantly different from the expected 1:1 sex ratio ($p>0.05$). The fecundity ranged from 315,240 to 700,140eggs. The average fecundity was 522,385 eggs. The tiger shrimps attained bigger sizes and fed on the young of the indigenous pink shrimp, *Penaeus notialis*. It may soon displace the native pink shrimp.

Keywords: *Penaeus monodon*, *Penaeus notialis*, growth, food habits, reproduction biology.

Deep sea spider crabs of the genus *Oxypleurodon* Miers, 1885 from the Nan Hai cruise in the South China Sea with a description of a new species (Decapoda: Brachyura: Majoidea: Epialtidae)

Oral GS

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The deep sea spider crab genus *Oxypleurodon* MIERS, 1885 (type species *O. stimpsoni* MIERS, 1885) (family Epialtidae) is widely distributed in the Indo-West Pacific and there are currently 29 recognised species (RICHER DE FORGES & NG, 2009; RICHER DE FORGES, 2010; RICHER DE FORGES & CORBARI, 2012). The diversity of the genus is high and eight Pacific species have been described only in the last five years.

During a recent expedition in the South China Sea, three species of *Oxypleurodon* were collected of which, two, *O. stimpsoni* MIERS, 1885, and *O. auritum* (RATHBUN, 1916) are new records for the area. The third species is one of the largest known *Oxypleurodon* and is here described as new.

References:

RICHER DE FORGES, B. & P. K. L. NG (2009): On the majoid genera *Oxypleurodon* Miers, 1886, and *Sphenocarcinus* A. Milne-Edwards, 1875 (Crustacea: Brachyura: Epialtidae), with description of two new genera and five new species. The Raffles Bulletin of Zoology, Supplement **20**: 247–266.

RICHER DE FORGES, B. (2010): Majoid crabs from the Mozambique Channel with the description of a new species of *Oxypleurodon* Miers, 1886 (Decapoda, Brachyura). In: Fransen, C., S. De Grave & P. K. L. Ng (eds.), Lipke Bijdeley Holthuis Memorial Volume. Crustaceana Monographs, **14**: 645–653.

RICHER DE FORGES, B. & L. CORBARI (2012): A new species of *Oxypleurodon* Miers, 1886 (Crustacea, Brachyura, Majoidea) from the Bismarck Sea, Papua New Guinea. Zootaxa, **3320**: 56–60.

Seasonal population dynamics of dominant brachyuran crabs in sublittoral muddy bottoms of the northwestern Persian Gulf

Oral EMC

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The Persian Gulf is a shallow semi-enclosed marginal sea which located in the sub-tropical latitudes and connected to the Gulf of Oman through the 56 km wide Strait of Hormuz. This region comprises a key center of the oil industry (exploration, exploitation and exportation) in the world. After oil, fisheries represent the second most important natural resource, but the first important renewable one (SALE et al., 2011). For studying population dynamic of the dominant brachyuran mega-crabs (as major fishing targets), seasonal samplings were carried out at four different sites along the Khuzestan coasts in vicinity of Musa Estuary during one year from spring of 2010 to winter of 2011. At each site, three replicates samples were collected using a commercial fishing trawler. In total, 522 specimens of the six species were identified as dominant brachyuran decapods, comprising 75% of total species abundance. *Portunus segnis* and *P. pelagicus* with 176 specimens (together), *P. hastatoides* with 159 specimens, *Philyra globus* with 61 specimens, *Eurycarcinus integrifrones* with 59 specimens and *Matuta pelanipes* with 67 specimens are recorded at all sites and seasons. Two way ANOVA didn't show the significant differences in species abundances among sites and the interaction term of sites and seasons, while there were significant differences among seasons in *P. segnis/pelagicus* (p=0.0094) and *M. pelanipes* (p=00.0033). According to the post hoc's tests maximum abundance of *P. segnis/pelagicus* was in spring and summer, while minimum was in winter. Abundance of *M. pelanipes* varied drastically with seasons. Moreover weaker differences were obtained in abundances of *P. hastatoides* (p=0. 0564) and *Ph. globus* (p=0. 0814), only between spring and summer. There were strong correlations between *P. segnis/pelagicus* and environmental variables, including sediment total organic matters, temperature and oxygen, and also between *P. hastatoides* and *Ph. globus* with Salinity. These relations could reveal the crab's physiological adaptations to environmental conditions. Generally many abiotic/biotic factors potentially could control the species quantitative distributions. As such seasonal community variations could be strongly influenced by their reproduction activities and predators feeding pressure (GREENSTREET et al., 2007). Finally it seems that subtidal muddy substrates of the northwestern Persian Gulf are poorly settled by brachyuran crabs, probably due to anthropogenic activities such as i) overexploitation through intensive fishery trawling and ii) marine pollutions which reported by many literatures from this area (ALI 2001; ABDOLLAHI et al., 2013; ABDOLAHPUR et al., 2012).

References:

GREENSTREET, S., ROBINSON, L. & REISS, H., et al., (2007): Review of theoretical community ecology: implications for marine communities. Fisheries Research Services, Col. Report No 08/07: 127 pp.

SALE, P.F., FEARY, D.A. & BURT, J.A., et al., (2011): The growing need for sustainable ecological management of marine communities of the Persian Gulf. Ambio. 40: 4-17.

ABDOLLAHI, S., RAOUFI, Z., &FAGHIRI, I., et al., (2013): Contamination levels and spatial distributions of heavy metals and PAHs. Marine Pollution Bulletin. 71: 336-345.

ALI, T.S., (2001): Effects of shrimp trawlers on the fisheries status and environment of the Northwestern Persian Gulf. Acta Ichthyologica et Piscatoria. 313: 77-86.

ABDOLAHPUR M.,F., PEERY, A. &GHASEMI, A.F., et al., (2012): Distribution of Metals in the Tissues of Benthic, *Euryglos saorientalis* and *Cynoglossus arel*., and Bentho-Pelagic, *Johnius belangerii*., Fish from Three Estuaries, Persian Gulf. Bulletin of Environmental Contamination and Toxicology. 89, 489-494.

Diel patterns in vertical distribution and feeding rhyhtm in the marine cladocerans *Penilia avirostris* and *Pseudevadne tergestina*

Oral BR

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Diel vertical migration (DVM) is widely reported in freshwater and marine zooplankton. Most species migrate to the food-rich surface layer at dust and descend to deeper waters at dawn. The behavior is considered to be an important predator avoidance strategy in zooplankton. DVM produces diel patterns in feeding, although many investigators believe that the two behaviors are independent. We report here the diel patterns in vertical migration and feeding rhythm in the marine cladocerans *Penilia avirostris* and *Pseudevadne tergestina* in Tolo Harbour, an landlocked bay with a mean depth of about 15 m in the northeastern corner of Hong Kong, in summer (26–27 August, 2009) and spring (22–23 April, 2010).

P. tergestina showed prominent reverse DVM in both summer and spring. The amplitude of DVM was small, but the mean depth (MD) of the population in the water column was significantly higher at noon (MD = 3.70 m in summer and 2.74 m in spring) than at mid-night (MD = 5.61 m in summer and 5.08 m in spring). By contrast, *P. avirostris*, a suspension feeder, did not exhibit clear DVM. In summer, the population was nearer to the surface at sunrise than at other times of the day. In spring, the population stayed nearer to the surface at noon and sunset than at midnight and sunrise. *P. tergestina* showed strong diel feeding rhythm. Gull fullness was significantly higher at noon than at mid-night in both summer and spring. By contrast, *P. avirostris* showed diel feeding rhythm only in summer, with higher gut fullness scores at mid-night than at noon.

Reverse DVM and daytime feeding suggest that *P. tergestina*, a raptorial feeding podonid with a large compound eye, must stay in the well-illuminated surface layer to feed. For *P. avirostris*, the absence of DVM and the presence of a diel rhythm in gut fullness, suggest that the two behaviors are independent. Both species depend on small and transparent body to avoid visual planktivores.

A contribution to the Knowledge of Taiwanese Galatheidae (Decapoda, Anomura)

Poster

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Fourteen species of the Family Galatheidae, 2 species of the genus Allogalatheathe, 8 species of the genus Galathea, 2 species of the genus Lauriea and 1 species of the genus Phylladiorhynchus, are recorded for the first time from Taiwan and the genus Coralliogalathea is also new record in Taiwan fauna. Five additional species, Galathea aegyptiaca, G. genkai, G. inflate, G. mauritiana and G. platycheles are recorded for the second time. G. genkai was recorded for first time by single specimen obtaining from the stomach of a fish and now we have more ecological data of this species. G. platycheles was originally described from two Taiwanese specimens collected in 1932. The type material may have been lost and no further specimen has been collected from Taiwan before the present work. Here we set up a lectotype material for this species. Colour photos and distributional information of these species are presented in this work.

Key words: Anomura, Galatheidae, *Galathea*, *Lauriea*, *Coralliogalathea*, *Phylladiorhynchus*, new records, Taiwan.

Phylogeny and systematics of the Acrothoracica

Oral BEP

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The Acrothoracica are small, diecious barnacles burrowing into calcareous substrata such as mollusk shells, corals, bryozoans, thoracican barnacles or limestone and calcareous chalk. They represent the most generalized group within Cirripedia and have featured prominently in phylogenetic speculations concerning these crustaceans. Traditionally, two orders the Pygophora and Apygophora were recognized for the Acrothoracica. The Apygophora had uniramus cirri and lack an anus, whereas Pygophora had biramus terminal cirri and an anus and was further divided into two families, the Lithoglyptidae and Cryptophialidae. Recently the phylogeny of the Acrothoracica was reconstructed on the base of numerous morphological traits of adult and larval stages and they were rearranged into two new orders, the Lithoglyptida and Cryptophialida (KOLBASOV, 2009). The Lithoglyptida consists of the families Lithoglyptidae and Trypetesidae those females have a wide aperture, large saddle like labrum and developed mouth cirri. The females of order Cryptophialida with monotypic family Cryptophialidae have bottle-shaped mantle sac with narrow necked operculum, elongated, tongue-shaped labrum, and reduced mouth cirri. Logically, the studies of molecular genetics of the Acrothoracica are necessary to complete these works. We collected 25 species from 7 genera of orders Lithoglyptida and Cryptophialida for molecular analysis. We used molecular techniques to resolve the systematics of the acrothoracican barnacles, using the mitochondria DNA, COI, 16S region and the nuclear marker 18S and histone 3 region. The resulting phylogenetic tree of the Acrothoracica supports the recent taxonomic arrangement in KOLBASOV 2009 and provide insight into the evolution pattern of different morphological characters of acrothoracican barnacles.

References:

KOLBASOV GA. 2009. Acrothoracica, Burrowing Crustaceans. KMK Scientific Press, Moscow, Russia, 452 pp.

Climate-driven range retraction of an Arctic freshwater crustacean

Oral BR

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We report on recent range retraction of a freshwater crustacean, the Arctic fairy shrimp *Branchinecta paludosa* (Branchiopoda, Anostraca) from alpine ponds of southern Norway, a southern outreach of its otherwise arctic range. The species was mapped during two separate surveys, in 1970 and 2011. In 1970 it occurred in numerous ponds from the tree line at 900 m altitude to high alpine sites at 1500 m. Re-sampling of the same ponds 41 years later revealed extinction of populations from ponds along the lowest 200 m of its altitudinal range. Reconstruction of summer temperatures for the periods 1965-1970 and 2005-2010 revealed a thermal increase for the period, corresponding to a ~200 m upward shift of the local isotherms. More specifically, the number of warm summer days had doubled in the lowest 200 m of the region, which might be particularly detrimental for the species. The extinctions at lower altitudes were not compensated for by corresponding upward colonization. The range retraction of *B. paludosa* is possibly associated with invasions of new invertebrate predators, and could be facilitated by water browning and increased protection against UV radiation.

A glycosyl hydrolase family 16 gene is responsible for the endogenous production of β-1,3-glucanases within decapod crustaceans

Oral CTF

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β-1,3-glucanase (laminarinase) is an enzyme which is present within the digestive fluid of decapod crustaceans. It hydrolyses β-1,3-glycosidic bonds to digest hemicelluloses such as laminarin and callose. Although a β-1,3-glucanase has been previously purified from the midgut gland of two decapod crustaceans (the gecarcinid land crab, *Gecarcoidea natalis* and the crayfish, *Cherax destructor*) (Allardyce and Linton 2008), the gene responsible for its production has yet to be identified in crustaceans. It is also unclear if the gene is expressed widely in Crustacea. Therefore the aim of this study was to sequence the gene in Crustacea and to confirm that the gene corresponded with the previously purified enzyme. PCR utilising degenerate primers and rapid amplification of the 3' and 5' ends was used to successfully sequence laminarinase cDNA from the midgut glands of *G. natalis* and *C. destructor*. The open reading frame (1098 bp for *G. natalis* and 1093 bp for *C. destructor*), encoded putative proteins which were respectively 365 and 364 amino acid residues long and had estimated molecular masses of 41.4 and 41.5 kDa. The putative protein contained both catalytic and binding domains that are characteristic of a GHF16 β-1,3-glucanase. In order to match the gene described here with the β-1,3-glucanase described previously, the previously purified enzyme was partially sequenced using Orbitrap mass spectroscopy. Two short peptides (8-9 residues) were successfully sequenced from *G. natalis*. Both the molecular masses and amino acid sequences of these products matched that of part of the putative amino acid sequence. Taken together, these results provide strong evidence that the sequences presented here encode the enzymes characterised previously (Allardyce and Linton 2008). To confirm the expression of the gene in crustacean generally, GHF16 cDNA from the midgut glands of other amphibious (*Myctris platycheles* and *Paragrapsus laevis*) and terrestrial decapod species (*Coenobita regosus*, *C. perlatus, C. brevimanus* and *B. latro*) were also partially sequenced. All sequences aligned with other crustacean GHF16 proteins primarily found in the haemocytes that had been previously identified as lipopolysaccharide and β-glucan binding proteins. Interestingly all of the aligned sequences contained totally conserved catalytic and binding domains. Hence, like the sequences from *G. natalis* and *C. destructor*, they may also possess enzyme activity. There are three possible hypothesised functions for the GHF16 β-1,3-glucanase: 1) a digestive enzyme, 2) an enzyme which helps to break open the cell walls to release cell contents or 3) an immune protein which can hydrolyse the cell walls of potentially pathogenic micro-organisms.

Reference:

ALLARDYCE BJ & LINTON SM (2008) Purification and characterisation of endo-b-1,4-glucanase and laminarinase enzymes from the gecarcinid land crab *Gecarcoidea natalis* and the aquatic crayfish *Cherax destructor*. Journal of Experimental Biology 211 (14):2275-2287

Ontogenic changes of feeding structures in *Eulimnadia braueriana* Ishikawa, 1895

Oral BR

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Development of larval morphology has been studied in several branchiopod species, but seldom has it been followed beyond the juvenile stage. In order to explore the ontogenic changes of their foraging mechanism, we compared the morphology of feeding structures among the nauplii, juvenile and adult stages of *Eulimnadia braueriana*, which lives sympatrically with two other species of large branchiopods in the temporary wetland Siangtian pond in Yangmingshan National Park, Taiwan. Feeding structures were examined with light microscope and scanning electron microscopes. Naupliar feeding structures were similar to those of other studied species, suggesting a sweeping mode of feeding. In addition to the development of carapace and thoracopods, feeding structures of the nauplii, such as the basis, second and third segment of the mandible as well as the nauplius process, gradually degenerate during the juvenile stage. Moreover, the molar surface, maxillae and second antenna also undergo changes, reaching their adult form already at the later juvenile stages. Adults, however, do not show structures capable of scraping, as was found in Laevicaudata. Morphological comparison between different stages showed that throughout development, almost all the main feeding structures of the nauplii either degenerate or change while juvenile morphology is similar to that of adults, suggesting that the most significant changes in morphology and feeding method occur at the early juvenile stage.

Human activities and climate change shape copepod assemblages in a eutrophic tropical lagoon in Taiwan, western Pacific Ocean

Poster

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We studied the spatio-temporal distribution patterns of copepod communities and hydrology in Tapong Bay from 1999 to 2013. This is a hypertrophic tropical lagoon with a single tidal inlet connecting to the sea off southwestern Taiwan. Three important instances took place in these years: extensive oyster-culture racks and cage-farming facilities were present (1999 to 2002), but then all aquaculture facilities were removed (2003 to 2004), and intensive construction took place in the Bay (2009 to 2013). Our results showed that the oyster-rack removal caused an increase in salinity, chlorophyll *a* concentration, species richness and abundance of copepods, and reduced the ranges of seasonal and spatial differences in salinity and copepod abundance. The recent coastal constructions in the Bay decreased the abundance of copepods, but left it still higher than before the removal of aquaculture facilities. However, copepod species richness was generally higher in dry winters and in the outer Bay, lower in wet summers and in the inner Bay. The result of principal component analysis also indicated distinctive variation of copepod assemblages among the three periods, particularly before and after the removal. We conclude that the increase in copepod abundance and species richness in the Bay after the removal was the result of an increased water exchange rate, increased availability of phytoplankton due to the absence of a competing oyster population which filter–feed on phytoplankton, and a reduction of the feeding impact by moon-jelly that previously heavily aggregated in the inner Bay where their polyps settled and strobilated from the oyster-culture racks before they got removed.

New Zealand's amazing Amphipoda

Oral GS

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New Zealand is in the southwestern Pacific, a region which has the world's highest species diversity amongst many marine invertebrate groups, notably among the peracarid crustaceans. More than 400 marine species of Amphipoda are known from the New Zealand Exclusive Economic Zone, but that is only a small fraction of what's out there.
Snapshots of different areas of amphipod research are presented, such as the first Amphipoda-Bryozoa inquiline relationship; an interactive key of the deep-sea family Synopiidae; the unexplored Benthic Boundary Layer and evolutionary links between New Zealand and the Ross Sea.

On a new species of parasitic barnacle (Crustacea, Rhizocephala), *Sacculina shiinoi* nov. sp., parasitizing Japanese mud shrimps (Upogebia, Thalassinidea, Upogebiidae).

Poster

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The rhizocephalan *Sacculina shiinoi* nov. sp. parasitizes three species of *Upogebia* in Japan. It is described morphologically and compared with another *Upogebia* parasite, *Sacculina upogebiae* Shiino, 1943 from Japan and Korea. DNA analyses have demonstrated the two species to be separate. The cuticle differs in being provided with close-set branched and spiny excrescences in *S. shiinoi*, while it is even but divided into small scales in *S. upogebiae*. In *S. upogebiae* the bulbous sperm-producing part and the narrow receptacle duct are separated by a compartmentalized mid portion, which is missing in *S. shiinoi*. A ridge with a U-shaped course and a thick split-up cuticle passes across the visceral mass between the two receptacle openings in *S. shiinoi*. Such a structure has never been described in other rhizocephalans and its function is uncertain.

The phylogeny of the superfamily Gonodactyloidea GIESBRECHT, 1910 (Crustacea: Stomatopoda)

Poster

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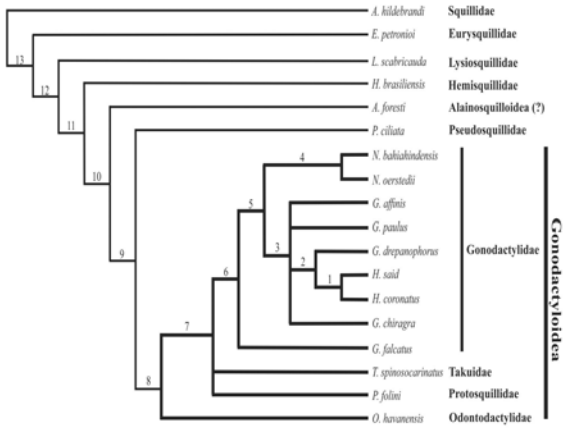
Gonodactyloidea is the second largest superfamily within the Stomatopoda, regarding the number of species. The morphological complexity and the representativeness of specimens in Brazilian waters, mainly of the genus *Neogonodactylus*, brought attention to the importance of studying this group. The monophyly of the superfamily, family and genera have not been proved yet, increasing the interest and the necessity to review the group. Therefore, the present work aimed to test the monophyly of the superfamily Gonodactyloidea, and of the family Gonodactylidae as well. The material was mainly provided from the carcinological collections of Museu de Oceanografia Prof. Petrônio Alves Coelho (Brazil) and National Museum of Natural History (USA), covering eighteen taxa and 59 characters. The present work was based on the characters matrixes, generated on DELTA 1.0-RC4 program to evaluate the superfamily and family. Cladistics analysis were based on this matrixes, through the PAUP 4.0b10 program, by heuristic source method, with 1000 replicates. The characters were not weighted neither ordinated. The Bremer and Bootstrap indexes were used to evaluate the branch consistency. The out-groups were representatives of the superfamilies Squilloidea and Lysiosquilloidea, with Eurysquilloidea as a sister group. The heuristic source found two most-parsimonious trees of lenght 139; CI 0.6043; HI 0.3957; RI 0.6099; RC 0.3686. Three strong synapomorphies were found to support Gonodactyloidea as monophyletic group, excluding Alainosquillidae which can be a new superfamily related with Hemisquilloidea and Pseudosquilloidea. *Hoplosquilla said* and *Hoplosquilloides coronatus* share a synapormorphy that made them part of a monophyletic family, with *Gonodactylopsis drepanophorus* as sister group. The results showed *Neogonodactylus*, represented by *N. oerstedii* and *N. bahiahondensis*, as monophyletic, with one synapomorphy. Thus, the present study proposes the monophyly of the Gonodactyloidea, Gonodactylidae and the genus *Neogonodactylus* and the exclusion of Alainosquillidae of this superfamily. Thereby, the present work contributed in an unique way to a better understanding of Gonodactyloidea.



Legend: Cladrogram of the superfamily Gonodactyloidea

References:

AHYONG, S.T. & HARLING, C. (2000): The phylogeny of the stomatopod Crustacea. Australian Journal of Zoology, **48**: 607-642.

AHYONG, S,T. & JARMAN, S.N. (2009): Stomatopod Interrelationships: Preliminary Results Based on Analysis of three Molecular Loci. Arthropod Systematics & Phylogeny, 67(**1**): 91-98.

PORTER, M.L.; ZHANG, Y.; DESAI, S.; CALDWELL, R.L. & CRONIN, T.W. (2010): Evolution of anatomical and physiological specialization in the compound eyes of stomatopod crustaceans. The Journal of Experimental Biology, **213**: 3473-3486.

Variation in host use by the herbivorous amphipods *Cymadusa filosa* and *Sunampithoe pelagica*

Oral EMC

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Small marine herbivores commonly use macroalgae as food and habitat. The role of the host as food is one of the main driving factors of the small herbivore-macroalga interaction (DUFFY & HAY 1991, POORE & STEINBERG 1999). Hence, in order to comprehend this interaction, one must know the association between the herbivores and their hosts in the field, as well as the feeding habits of these consumers (e.g., feeding preference and rate). We assessed the distribution of the herbivores *Cymadusa filosa* and *Sunampithoe pelagica* (Amphipoda: Ampithoidae) among three brown seaweeds (*Sargassum filipendula*, *Dictyota cervicornis* and *Padina gymnospora*; N = 4 *per* host) during summer in the subtidal shore in Ubatuba, São Paulo State, southeastern Brazil. In addition, we explored their feeding habits offering two brown seaweeds (*Sargassum filipendula*, *Dictyota cervicornis*) and one red seaweed (*Hypnea musciformis*) in multiple choice and no-choice experiments. In the field, *Cymadusa* occurred on all three brown seaweeds, but in higher densities on *Dictyota* (3.73±1.01 ind./g) and *Padina* (3.79±2.75 ind./g) when compared with *Sargassum* (0.17±0.08 ind./g). *Sunampithoe* occurred only on *Sargassum* (1.55±0.18 ind./g) and, at lower density, on *Padina* (0.55±0.38 ind./g). In the multiple choice experiments, *Cymadusa* and *Sunampithoe* prefered consuming *Sargassum* (Hotelling's T^2 test; *Cymadusa*: T^2=52.63, F=24.77, P<0.001; *Sunampithoe*: T^2=12.69, F=5.97, P=0.012). When there was no choice, *Cymadusa* consumed *Sargassum*, *Dictyota* and *Hypnea* at the same rate (ANOVA, $F_{(2, 47)}$=1.91, P=0.159). In the other way, *Sunampithoe* consumed mostly *Sargassum* (ANOVA, $F_{(2, 41)}$=110.28, P<0,001; Tukey's test *a posteriori*). Despite the preference for *Sargassum* displayed by the two herbivores, we found different patterns of distribution and feeding rates. The agreement between feeding preference and field distribution observed for *Sunampithoe* suggests that intrinsic host qualities, such as nutritional value, are the main factor determining host use for this small herbivore (POORE & STEINBERG 1999). On the other hand, the lack of that agreement for *Cymadusa* suggests that other habitat requirements, such as refuge, are more important than intrinsic factors in determining herbivore-host interaction (Duffy & Hay 1991). The variation in host use between these herbivores highlights the importance of considering specificities of each species in order to understand the impact of these consumers on the community of benthic macroalgae.

References:

DUFFY, J. E. & HAY, M. E. (1991): Food and shelter as determinants of food choice by an herbivorous marine amphipod. Ecology, **72**(4): 1286-1298.

POORE, A. G. B. & STEINBERG, P. D. (1999): Preference-performance relationships and effects of host plant choice in an herbivorous marine amphipod. Ecological Monographs, **69**(4): 443-464.

Integrative study of marine clines: genetic and morphological gradients in the portunid crab *Liocarcinus depurator*

Poster

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Genetic clines, that is, geographic zones in which genetically differentiated populations interbreed, occur throughout the oceans (AVISE 2001). Because the width and shape of genetic clines commonly represent an evolutionary balance between selection and dispersal, clines provide researchers with the ability to powerfully analyze both evolutionary forces simultaneously. In this study, the population structure of the portunid crab *Liocarcinus depurator* was assessed using both genetic and morphology data collected from a total of 10 areas along the Mediterranean Sea and the Atlantic Ocean. One mitochondrial gene (COI) was sequenced in 287 individuals and 280 individuals were genotyped using 11 polymorphic microsatellite markers. Furthermore, a geometric morphological analysis was performed in a larger collection of 350 crabs from both Mediterranean and Atlantic waters. The sampling design allowed us to detect the level and pattern of differentiation between populations, and define barriers for dispersal. After carrying out an integrated cline analysis of both genetic and morphological data, the presence of significant genetic gradients was discovered for both the mitochondrial (cline width = 0.291 - 0.396) and nuclear (cline width = 0.505 - 0.789) markers. The analyses of morphological shape changes along space did not show any significant gradient (cline width = -0.023 - 0.028). Our results indicate a clear reduction of gene flow between Atlantic and Mediterranean populations, with a stronger reduction in mtDNA than microsatellites. This could be related to different effective sizes in both the nuclear and the mitochondrial genomes, to different selective pressures or to different migration rates in males and females.

Acknowledgment:
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References:

AVISE, J. C. (2001) Phylogeography: the history and formation of species. Harvard University Press, Cambridge, Massachusetts, USA.

PALUMBI, S.R. & SOTKA, E.E. (2006) The use of genetic clines to estimate dispersal distances of marine larvae. - Ecology **87**(5): 1094-1103.

Systematics of the genus *Persephona* Leach, 1817 (Leucosiidae: Brachyura)

Poster

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The genus *Persephona* LEACH, 1817 is restricted to American waters of the Western Atlantic and Eastern Pacific Oceans. This taxon has at times been placed in different subfamilies and its phylogenetic placement and species composition remain poorly defined. We conducted a comparative study based on morphology and molecular phylogenetics for all ten recognized species of *Persephona* plus *Iliacantha hancocki*. We tested whether *Persephona finneganae*, *P. lichtensteinii*, and *P. crinita* represent a single taxon as suggested by some authors; whether specimens identified as *P. punctata*, *P. mediterranea*, and *P. aquilonaris* are indeed different taxa that can be separated on the basis of morphology and molecular genetics; and whether *I. hancocki* is indeed a junior synonym of *P. subovata*. Diagnostic morphological characters (morphology of carapace, chelipeds, front, and third maxilliped; presence of spines and/or granules on the carapace) were used along with gonopod features and coloration. The 16S rRNA and the Cytochrome Oxidase I (COI) (DNA barcoding) mitochondrial genes were used as molecular markers. Both morphological and molecular analyses revealed that putative specimens of *P. crinita* from Brazil and *P. finneganae* were no different from specimens presently assignable to *P. lichtensteinii*. Thus *P. finneganae* is a junior synonym of *P. lichtensteinii*. We restrict use of the name *P. crinita* to specimens we examined from the Gulf of Mexico, while specimens from Brazil that have been previously reported as *P. crinita* are herewith relegated to the synonymy of *P. lichtensteinii*. Additionally, *Iliacantha hancocki* is placed as a junior synonym of *P. subovata,* while *P. aquilonaris* is concluded to be distinct from *P. mediterranea*, their populations herewith being treated as valid species. The slight genetic separation between northern and southern subclades of *P. lichtensteinii*, based on samples from three zoogeographic areas (Caribbean, Brazilian, and Argentinian provinces), is not evident in morphological features that we examined. For now, we do not recommend their separation at the species level. Likewise, genetic variation observed among populations of *P. punctata* is not mirrored in comparisons of morphology. On the basis of our revisions, nine species of *Persephona* are considered valid and the originally reported distribution for *P. crinita* is restricted.

Autocidal control on *Procambarus clarkii*

Oral IC

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The Invasive Decapod Species (IDSs) such as *Procambarus clarkii* cause major damage to agriculture production, infrastructures, river banks, irrigation systems and agriculture fields determining consistent economic losses (GHERARDI et al., 2007). Agriculture production (i.e. rice field) is damaged by *P. clarkii,* which consume young seedlings and seeds and also cause substantial water loss from field areas. In fact, about 82% germination rate observed in the absence of crayfish dropped to 16% with crayfish (ANASTACIO et al., 2005). Moreover, *P. clarkii* appears as vectors of the omycetes *Aphanomyces astaci*, causing the crayfish plague one of the major, and growing, causes mortality of endemic European crayfishes. The economic losses caused by IDSs, require cost effective and reliable options for managing their abundance and eradicating them. Currently, these options are extremely limited. At small scales, invasive crayfish can be controlled by the use of barriers, introduction of predators, trapping activities, and sterile male release technique (SMRT), but none of them can be considered totally satisfactory. The past decade has seen immense development in genetic related technologies, resulting in a renewed interest in the possibility of controlling invasive species using genetic techniques (i.e. autocidal approaches and sexual manipulation). Crustacean species endogenously produce specific hormone peptides, which control the main physiological processes of their life cycle. The Moult Inhibiting Hormone (MIH) presides over the change of the exoskeleton, the Gonad Inhibiting Hormone (GIH) negatively interfere on the yolk protein production and a third neuropeptide, the Crustacean Hyperglycemic Hormone (CHH) is a pleiotropic molecule, which acts on many different aspects, such as the glycaemia regulations. The CHH is expressed at high levels during stress situations and reported to increase intraspecific aggressiveness (AQUILONI et al., 2012). The main idea is to provide these hormones as synthetic peptides through oral administration in food baits. Supported by the LIFE10 NAT/IT/000239 RARITY project, after obtaining the eyestalk transcriptome of *P. clarkii,* we characterized the GIH, consisting of 77 aa residues and a mass of about 9160 Da, and 2 new paralogs of the CHH. Moreover, from some preliminary results obtained by knocking down the GIH through RNA interference, we confirmed the action of GIH on the gonads of *P. clarkii.* After the treatment animals had an average Gonado-Somatic-Index value (GSI) of 0.89±0.19 (n=8), while the control group a GSI of 0.42±0.09 (n=8) and the bilaterally eyestalk ablated group a GSI of 0.40±0.10 (n=7). Also the oral administration of the CHH, has provided interesting results on the bait formulation to carry functional neurohormones in the animals. In this golden era of research on autocidal control and strain replacement we want to propose a novel approach for controlling and eradicating invasive decapod species without using xenobiotic, pesticides or pollutant substances, which could negatively affect the environment, the agriculture production and forestry sectors, but also autochthonous species.

References:

ANASTÁCIO, P.M., PARENTE, V.S. & CORREIA, A.M. (2005): Crayfish effects on seeds and seedlings: identification and quantification of damage. – Freshwater Biology, 50 (4): 697-704.

AQUILONI, L., GIULIANINI, P.G., MOSCO, A., GUARNACCIA, C., FERRERO & E., GHERARDI, F. (2012): Crustacean Hyperglycemic Hormone (cHH) as a Modulator of Aggression in Crustacean Decapods. – Plos One, 7(11): p. e50047

GHERARDI, F. (2007): Biological Invaders in Inland Waters: Profiles, Distribution and Threats. Springer Ed., pp. 536.

On shrimps from São Paulo coast, Brazil: the building of DNA library and the insights around the evolutionary knowledge

Poster

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The main objective of this long-term project is to sample and generate DNA sequences (Cytocrome Oxidase I and 16S genes) from all of the 101 species of shrimps (77 Caridea, 1 Stenopodidea and 23 Dendrobranchiata) reported from São Paulo coast (Brazil). Besides building the DNA library, we intent to use molecular data to test species boundaries, and perform populational and phylogenetic analyses. To date, we have collected 66% of the shrimp fauna reported to São Paulo coast and we have obtained sequences of 72% of these species. Some results can be emphasized, such as: two new species of snapping shrimp of the genus *Alpheus* were described and three new alien species (two of *Athanas* and one of *Processa*) are now reported to São Paulo coast. Based on genetic analysis, some species showed low intraspecific variability among Brazilian localities, such as the Dendrobranchiata *Artemesia longinaris*, *Farfantepenaeus paulensis*, *Sicyonia dorsalis* and *S. typica*, and the freshwater caridean *Potimirim brasiliana* and *Macrobrachium olfersii*, this latter also demonstrated low genetic divergence among individuals from Brazil and Caribbean localities. On the other hand, the estuarine caridean *Palaemon pandaliformis* and the marine one *Hippolyte obliquimanus* had high genetic divergence between these two regions. The taxonomic status of the freshwater caridean *Atya scabra* throughout its long distribution in western Atlantic was validated, with high intraspecific genetic divergence between specimens from Mexico of those from Brazil+Caribbean. Apart from that, species without pronounced diagnostic characters like juveniles and females of the *Macrobrachium olfersii* complex (*M. acanthochirus*, *M. crenulatum*, *M. digueti*, *M. faustinum*, *M. hancocki* and *M. olfersii*) can be diagnosed through the mitochondrial genes analyses. Likewise two species of commercially exploited Dendrobranchiata, *Farfantepenaeus brasiliensis* and *F. paulensis*, were confirmed as valid species, but the traditional morphological characters are not enough to identify the juveniles of both species correctly. All these findings contribute to increase the taxonomic knowledge about each studied shrimp and aim for publication of an up-to-date checklist for all species of shrimps of the São Paulo coast, supported by a genomic library.

Brachyuran megalopae from Iberian Peninsula (SW Europe). Results of the MEGALOPADN project

Poster

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The main objective of the MEGALOPADN project was to optimize the application of molecular techniques, specifically the analysis of mitochondrial DNA sequences (16S and Cox1), in conjunction with morphological techniques for a correct identification of brachyuran megalopae collected from the plankton around the Iberian Peninsula. The list of Iberian crabs was updated to 136 valid species (from 113 previously). A database was built including the corresponding 16S and/or Cox1DNA barcode sequences for 123 of those species. Thanks to this database, the 90% of the Iberian crabs (adults or larval stages) can now be identified with confidence to species level. The remaining 10% are mainly rare and infrequent species. Furthermore, the megalopae of 57 different species were identified using this database after analyzing morphological and molecularly more than 2000 megalopae collected in the plankton. The megalopal phase was unknown for 11 of these 57 species, and they are being described in detail. Megalopae of the remaining 46 species, of which previous descriptions were available, have been used to revise characters, setation patterns, missing data, correct minor mistakes and analyze the variability found among megalopae from the plankton and those obtained in the laboratory. Megalopae had to be re-described in 3 species because previous descriptions were incomplete or contained too many errors. These new descriptions and re-descriptions, along with the existing ones, have enabled the development of an illustrated key for the identification of the megalopae of 78 Iberian crab species. The availability of this database of DNA barcodes has also allowed us to study the phylogenetic relationships of these species and their taxonomic validity. As a result there have been a number of proposed changes in the systematics of some species, comprising synonymization, establishment of new genera and a new subfamily, and changes in the systematic position of the genus *Ergasticus* (MARCO-HERRERO et al., 2013).

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References:

MARCO-HERRERO, E., TORRES, A.P., CUESTA, J.A., GUERAO, G., PALERO, F. &ABELLÓ, P. (2013) New molecular and morphological evidence challenge the current systematic position of *Ergasticus* (Decapoda, Inachidae) and allied genera. -- ZoologicaScripta, **42**: 427-439.

"Bradfordian" calanoid copepods from the near-bottom of the World Ocean

Oral GS

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Owing to the recent development of specially designed gear for deep-water near-bottom sampling, collections of benthopelagic calanoids became more representative. The diversity of calanoids dwelling in the vicinity of the sea bed in the World Ocean is now estimated as being rather high. Since the beginning of the new century 31 benthopelagic genera and 97 species were described and a great number of new taxa await their description. The analyses of the near-bottom calanoid collections revealed the superfamily Clausocalanoidea as a main component of the benthopelagic calanoid community (63% of genera) and among them 37% constitute genera of Diaixidae, Tharybidae, Scolecitrichidae, Parkiidae, Phaennidae, Rostrocalanidae and Kyphocalanidae, informally named "Bradfordians". Little was known of their diversity, until sampling in this habitat became recently possible. Rich collections of "Bradfordians", obtained by German expeditions DIVA I–III and ANDEEP I–III added to the list of the near-bottom taxa 2 families, 8 genera and 15 species described as new, and enable the detailed study of "Bradfordian" morphology. Compared to their pelagic relatives benthopelagic "Bradfordians" demonstrate plesiomorphic characters, lost in their pelagic relatives and are characterized by heterobathmy. Sensory setae of their maxilla and maxilliped show striking morphological diversity (MARKHASEVA, SCHULZ & MARTINEZ ARBIZU 2008). Possession of sensory setae at maxilla and maxilliped is synapomorphy of "Bradfordians" that makes them the most advanced clausocalanoideans. Clausocalanoidea is considered the most apomorphic of Calanoida (BRADFORD-GRIEVE, 2004), thus, "Bradfordians" might be speculated as the most evolutionary young calanoids. In order to re-evaluate complicated and still inconsistent system of the "Bradfordian" families and to shed the light on their phylogenetic relationships, taxonomical, molecular and cladistic approaches have been used (MARKHASEVA, LAAKMANN & RENZ 2013). Provisional testing by methods of morphologically based cladistic analysis yet is not satisfactory, apparently, because of the high number of homoplasies typical for this group of families. Benthopelagic species representing different existing "Bradfordian" families were analyzed on the basis of single and multi-gene analyses comprising both nuclear and mitochondrial gene fragments and at present do not demonstrate highly supported relationships among or between the different currently used "Bradfordian" families, probably, because they are evolutionary young. Ongoing studies are continued and, hopefully, new materials from the deep near-bottom environment will add more information for comprehensive analysis of this amazing group of calanoids.

References:

BRADFORD-GRIEVE, J.M. (2004): Deep-sea benthopelagic calanoid copepods and their colonization of the near-bottom environment. -- Zoological Studies, **43**: 276-291.

MARKHASEVA E.L., SCHULZ, K. & P. MARTINEZ ARBIZU. (2008): New family and genus *Rostrocalanus* gen. nov. (Crustacea: Calanoida: Rostrocalanidae fam. nov.) from deep Atlantic waters. -- Journal of Natural History, **42**: 2417–2441.

MARKHASEVA, E.L., LAAKMANN, S. & J. RENZ. (2014): An interim synopsis of the Bradfordian families with a description of *Thoxancalanus spinatus* (Copepoda: Calanoida), a new diaixid genus and species from the deep Atlantic Ocean. -- Marine Biodiversity, **44**: 63–88.

DNA Barcoding: new species and boundaries distribution of *Penaeidae*

Poster

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DNA Barcoding studies have been performed to better understand aspects of diversity and geographic distribution of several groups, including the penaeid shrimp. In this study we analyzed penaeid speciemens of the genera *Farfantepenaeus*, *Xiphopenaeus* and *Litopenaeus* collected in 16 areas of the Brazilian coast. Partial amplification of the mitochondrial Cytochrome Oxidase subunit I (COI) gene was performed by using specific primer sets designed for amplifying the COI gene of all Family *Penaeidae,* avoiding the coamplification of Numts. DNA barcoding approaches were performed including dispersion graphic, neighbor Joining tree under K2P model and barcoding gap.

The values of interspecific distance among all species were higher than 2% and the values of intraspecific distance were below 2% except for the species *Farfantepenaeus subtilis* and *Xiphopenaeus kroyeri* that presented maximal intraspecific distances of 6% and 14%, respectively. The dispersion graphic pointed at a possible existence of complexes of cryptic species within the species *F. subtilis* and *X.* koyeri. Due of the presence of these complexes of species, it was not possible to observe a barcoding gap for the group of penaeid shrimps studied here. In neighbour joining tree, four clades were identified within *Farfantepenaeus*: *F. brasiliesis*, *F. paulensis* and two clades within *F. subtilis* named as *F. subtilis morphotype I* and *F. subtilis morphotype II*. Genetic distance mean between both *F. subtilis* clades was 5,7%. *F. subtilis* specimens were collected in areas in which they were never reported before, thus, increasing its range for more than 1000km. Two clades also were obserded for *Xiphopenaeus* species (*Xiphopenaeus kroyeri* and a cryptic species) with 13,7% mean distance between them. This cryptic species had been previously reported in two regions, and its geographic distribution was now extended.

Financial Support: CNPq

Atlas of Crustacean Larvae

Poster

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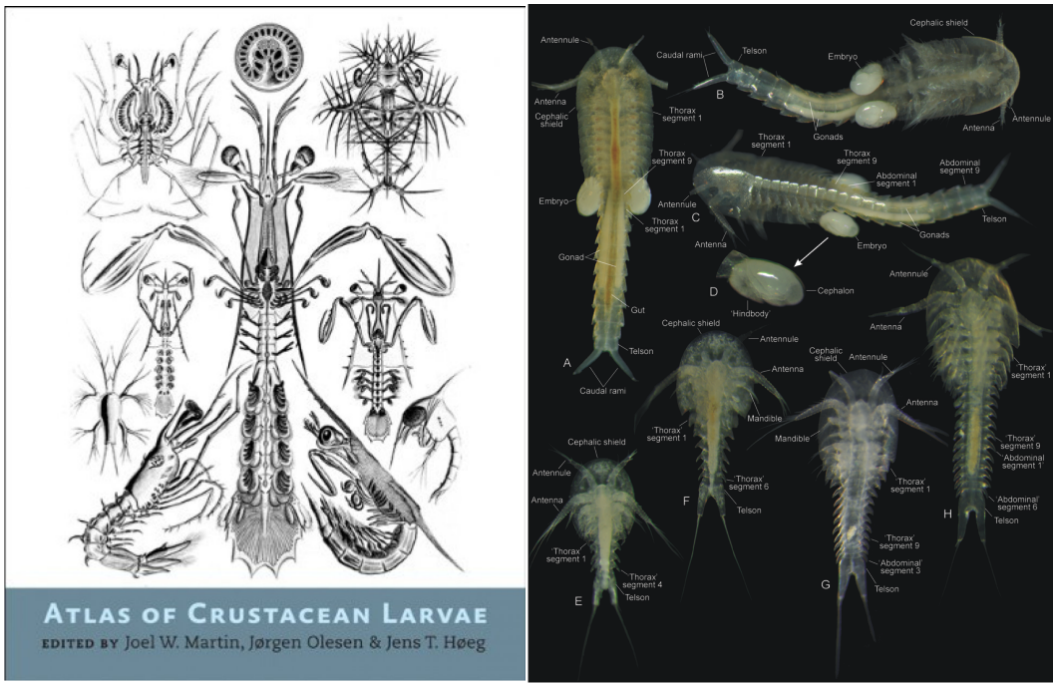
The great biodiversity of the Crustacea, both in terms of the number of species and in terms of the tremendous morphological range, continues to fascinate and challenge us. And the larval forms of the Crustacea are no less diverse. Indeed, they are spectacular in their variety of size and form, elegant in their function, and aesthetically simply beautiful. To many of us, these larval stages are even more fascinating biologically than are the adults.

Knowledge of basic crustacean larval biology has increased tremendously in recent years and advances in digital photography and SEM techniques have provided us in recent decades with unprecedented detail and spectacular images of a wide variety of larval forms. At the same time, advances in our understanding of basic crustacean biology have led to recent revelations of long-standing questions, such as the mode of larval development in the Remipedia, the parentage of such long-standing "larval genera" as *Cerataspis*, and (at last!) the developmental stage that follows the mysterious larvae that constitute the Facetotecta.

For these reasons it has for some years been a goal of the three editors to compile the best available images of the wonderful and diverse larval forms of the Crustacea into a single volume. This has resulted in a book treating the morphology of crustacean larvae divided in 54-chapter book (46 authors) covering all major recent crustacean taxa and some fossil (those with well-preserved larvae), which we hope will be of use for both new and advanced students of the field. The book contains a large number of photos which has never been published before.



Predictive models of marine Isopoda around Iceland

Oral GS

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Samples used in the present study were taken at 409 sites using an epibenthic sledge at different depths around Iceland during different cruises of the BIOICE project. Crustaceans belonging to the peracarid order Isopoda were sorted at Sangerdi Marine Station, Iceland. Specimens belonging to 11 families viz. Desmosomatidae, Nannoniscidae, Munnopsidae, Macrostylidae, Ischnomesidae, Haploniscidae, Arcturidae and Leptanthuridae were identified to species level by a group of taxonomic experts. A total of 51.569 specimens were assigned to 96 species, 15 of them new to science. Species were unevenly distributed in the study area with only 9 species (31.603 specimens) present at more than 50 sites. Species present at 10 sites or more (48.594 specimens belonging to 42 species) were selected for training the models. The distribution of Isopod species was predicted using randomForest models for the whole Icelandic EEZ area. Patterns of diversity and community structure will be discussed in an oceanographic context.

Population Dynamics of the American Horseshoe Crab (*Limulus polyphemus*) in an Urban Estuary Since the Turn of the New Millennium.

Oral MC

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These results are from a community based, long-term research project investigating the life history and population ecology of the American Horseshoe crab (*Limulus polyphemus*) in Long Island Sound (LIS) located in the northeast of the United States. Since 1997, 86,000 horseshoe crabs have been tagged with 18,770 reported recaptures; a 21% recapture rate. Mark/recapture analyses indicates that 98% of crabs tagged in LIS are recaptured in LIS and they are recaptured 50% of the time where they were originally tagged and then with equal probability east and west of the tag site. Of the adult females that come up on the beach to spawn, increasing numbers appear on the beach without a mate with a peak of 35% in 2012. Females with multiple mates were found to be less than 10% of the total females tagged. In addition to tagging, horseshoe crab spawning surveys have been conducted from 2008 to 2013 on over 30 beaches surrounding LIS. Spawning Indices (0.002 females/m^2) are 3-4 orders of magnitude lower than found in Delaware Bay (MATTEI et al. 2010). Spawning surveys also indicate that the spawning population is relatively stable with some annual variation. Recent analyses of the physical characteristics of beaches with spawning activity revealed no significant correlation between grain size, beach slope, beach width and spawning indices. Ongoing juvenile surveys suggest the presence of three cohorts in marshes and intertidal zones. The Connecticut Department of Energy and Environmental Protection should consider 'male only' harvests to increase egg production, juvenile recruitment and ultimately spawning density of horseshoe crabs on Connecticut beaches. Increased Limulus egg production could also benefit local shorebird populations (BEEKEY et al. 2013).

References:

BEEKEY, M. A., J. H. MATTEI & B. J. PIERCE. (2013): Horseshoe crab eggs: A rare resource for predators in Long Island Sound. Journal of Experimental Marine Biology and Ecology **439**:152-159.

MATTEI, J. H., M. A. BEEKEY, A. RUDMAN & A. WORONIK. (2010): Reproductive behavior in horseshoe crabs: does density matter? Current Zoology **56**(5):634-642.

Giant sperm in non-marine Ostracoda

Oral GS

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Up to date, little is known about the exceptionally long spermatozoa in non-marine ostracods (i.e. Cypridoidea), although they were first reported more than 200 years ago (RAMDOHR 1808). Scattered studies, mainly from the second half of the last century (e.g. MÜLLER (1894), BAUER (1940), GUPTA (1968), WINGSTRAND (1988), ZISSLER (1969)) showed that in contrast to other giant sperm, the cypridoidean sperm is aflagellate; its length is almost entirely made up by a very elongated axial rod, which is formed by nuclear material and a subacrosomal substance. Although ostracod sperm can reach lengths of more than a centimeter, the entire sperm enters the egg during fertilization and curls up just below the shell (MATZKE-KARASZ 2005).

Our -studies give new insights into sperm morphology, variation and distribution in the Cypridoidea and show that there appears to be only a loose relationship between phylogeny and sperm length.

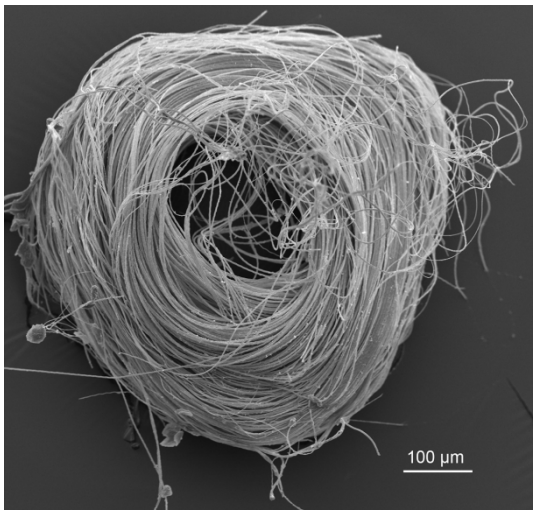

Fig. 1: Sperm clump taken from a male *Mytilocypris mytiloides* (body length ca 3mm). It consists of mature spermatozoa prior to transmission to the female.

Investigations of the reproductive behavior of *Mytilocypris mytiloides* (Cyprididae, Cypridoidea) produced a robust dataset on mating anatomy, mating success, the fate of sperm inside the female, and sperm use for egg fertilization - data, that is essential to fully explore the evolution and function of giant sperm. We further present new facts about the persistence of reproduction with giant sperm in ostracods in earth history.

BAUER, H. (1940): Über die Chromosomen der bisexuellen und der parthenogenetischen Rasse des Ostracoden *Heterocypris incongruens* Ramd. Chromosoma, **1**, 620–637.

GUPTA, B. L. (1968): Aspects of motility in the non-flagellate spermatozoa of freshwater ostracods. In: Miller, P. L. (ed.), Aspects of cell motility. Symposia of the Society for Experimental Biology, **22**, 117–129.

MATZKE-KARASZ, R. (2005): Giant spermatozoon coiled in small egg: fertilization mechanisms and their implications for evolutionary studies on Ostracoda (Crustacea). Journal of Experimental Zoology (Mol Dev Evol) **304**B: 129–149.

MÜLLER, G. W. (1894): Die Ostracoden des Golfes von Neapel und der angrenzenden Meeresabschnitte. In: "Fauna und Flora des Golfes von Neapel, **21**, 404 pp. R. Friedländer & Sohn, Berlin.

RAMDOHR K. A. (1808): Über die Gattung *Cypris* Müll. und drei zu derselben gehörige neue Arten. Der Gesellschaft naturforschender Freunde zu Berlin Magazin für die neuesten Entdeckungen in der gesammten Naturkunde **1**: 83-93.

WINGSTRAND, K. G. (1988). Comparative spermatology of the Crustacea Entomostraca. 2. Subclass Ostracoda. Biologiske Skrifter **32**, 1–149.

ZISSLER, D. (1969): Die Spermiohistogenese des Süßwasser-Ostracoden Notodromas monacha O. F. Müller. I. Die ovalen und spindelförmigen Spermatiden. Zeitschrift für Zellforschung, **96**, 87–105.

Functional Aspects of Gammaridean Mandibles and the Role of the Lacinia mobilis (Crustacea, Amphipoda)

Poster

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Structures at the mandibular gnathal edge include an incisor process, a molar process and a lacinia mobilis in-between. Functional aspects have not yet been considered sufficiently. This is mainly because direct observations of movements and interactions of malacostracan mandibles in living animals are impossible due to their topological situation being covered by posterior mouthparts. To understand more of the functionality of this feeding apparatus, we investigated mandibles of gammaridean crustaceans, using scanning electron microscopy. Based on the static situations observed we produced a 3d model of the mandibles to test the system. One specific feature observed and of high functional significance is a proximal outgrowth at the lacinia mobilis, the articular condylus. This structure acts, in accord with the adjacent incisor process, as a switch to flip the lacinia mobilis into a downward and upward position, and with the incisor process of the opposing mandible clicking the switch – a rarely observed, if not the first, report of an actively used mechanical switch in nature. Cuticular stress during deformation helps to reset the tooth into its original position. The entire action of right and left mandibles during the feeding act also explains the asymmetrical morphology of the associate structures at the mandibular coxal "gnathal" edges of gammarideans, possibly of other malacostracans too, at least those sharing a lacinia mobilis. This also serves as an example to uncover the multi-functionality and complexity of many morphological structures in crustaceans and arthropods more generally.

Phylogenetic relationships in Lophogastrida

Oral GS

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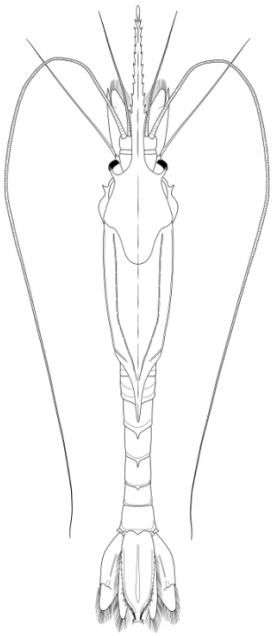
We sequenced partial Cox1, CytB, 28S, and 18S genes from species of *Eucopia*, *Gnathophausia*, *Lophogaster*, *Paralophogaster* and *Pseudochalaraspidum.* Bayesian and Maximum Likelihood estimation of trees on concatenated unlinked data gave high support for monophyletic genera assuming *Pseudochalaraspidum* as a basal lineage. *Gnathophausia gigas* and *Gnathophausia ingens* have previously been transferred to *Neognathophausia*, but our phylogeny shows that this taxonomic practice makes the remaining *Gnathophausia* paraphyletic. *Eucopia crassicornis* is clustering with *Eucopia unguiculata*, questioning their species status, while the recently described *Gnathophausia bergstadi* (MELAND & AAS 2013) is clearly distinguished from its sister species *Gnathophausia zoea. Gnathophausia* and *Eucopia* are sister groups. Interestingly *G. gracilis* and *E. sculpticauda* which have similar morphological characteristics in ornamentation and gastric mill morphology (CASANOVA et al. 1998) are placed respectively as the most basal lineages in the two genera. The Cox1 gene fragment shows uncorrected p-distances between groups up to 23 %, non-synonymous substitutions within species, and an extra codon apparently inserted in *Eucopia*, *G. affinis* and *G. gracilis in part.* This raises some questions concerning gene homologies, cryptic species, or misidentification of some sequenced individuals.



References:

CASANOVA, J.-P., DE JONG, L. & FAUREET, E. (1998): Interrelationships of the two families constituting the Lophogastrida (Crustacea: Mysidacea) inferred from morphological and molecular data. -- Marine Biology, **132**: 59-65.

MELAND, K.. & AAS, P.Ø. (2013): A taxonomical review of the *Gnathophausia* (Crustacea, Lophogastrida), with new records from the northern mid-Atlantic ridge. -- Zootaxa, **3664** (2): 199–225

Motor Proteins can Explain Unique Crustacean Mechanoreceptor

Oral GS

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Leg joints of crustaceans are equipped with mechanoreceptive neurons situated with their distal, dendritic processes inserted into elastic strands that span the joints. Some of these neurons signal movement of the joint in one direction or the other. The movement-sensitive neurons are unique in responding to movement in only one direction, insensitivity to joint position, and discharge frequency limited by mechanical properties. Unlike the crustacean abdominal stretch receptors or the vertebrate muscle spindle receptors, all of which produce action potentials whose frequency increases as a function of increasing stretch, the movement receptor neurons respond only during change in length of the elastic strands they innervate. One subset of movement-sensitive neurons at each joint signals only lengthening of the elastic strand, while the rest signal only shortening, and the responses are hardly influenced by where within the arc of motion the movement occurs. In previous work using *Pachygrapsus crassipes,* I found that movement receptor neurons in isolated PD organs are responsive only to either lengthening or shortening of the strand whereas twisting of the strand has no effect and proposed, without biophysical support, a theoretical ratchet-like process to explain movement sensitivity. Using intracellular recording in neurons of PD organs of *Callinectes sapidus*, I showed that the spike trigger zone of the receptor neuron lies far distal to its soma - near the point where mechanotransduction must occur, and that the cell is capable of impulse discharges at frequencies up to 250/sec. Electron microscope (EM) examination of joint receptor organs showed that the distal processes (dendrites) of two receptor neurons extend into an enclosure in the strand known as a scolopidium where they end in structures reminiscent of cilia, containing thin filaments that run axially in the most distal endings of the neurons. Further work on the fine structure of movement- and position-sensitive neurons led to the proposal that differences in the supporting structures and a mechanism of slippage of the neuron distal process could underlie the specificity for movement. The unique features of the crustacean movement receptors – insensitivity to position, responsiveness in only one direction, and the circa 40/sec periodicity of their spike discharges have never been satisfactorily explained, but might be underlain by the characteristics of an otherwise well-known system: the actin-myosin motor system. The presence and function of actin and myosin in vertebrate inner ear hair cells has been intensively studied, and actin, as well as tropomyosin - which regulates the actin-myosin interaction under the influence of Ca^{2+} - have been found in homologous sense organs, the scolopidia of insects: *Periplaneta americana* and *Schedorhinotermes lamanianus*. Here I show the presence of f-actin, myosin and regulatory proteins in movement receptors of *Carcinus maenas* and discuss how their unique transducer properties can be explained by those of the motor proteins.

References:

ASHMORE, J. & AVAN, P., et al. (2010). The remarkable cochlear amplifier. *Hear Res* 266, 1-17.

BURKE, W. (1953). An organ for proprioception and vibration sense in Carcinus maenas. *Journ. exp. Biol.* 31, 127-138.

MENDELSON, M. (1963). Some Factors in the Activation of Crab Movement Receptors. *J. Exp. Biol.* 40, 157-169.

MENDELSON, M. (1966). The Site of Impulse Initiation in Bipolar receptor Neurons of *Callinectes sapidus* L. *J. Exp. Biol.* 45, 411-420.

MILL, P. J. & LOWE, D. A. (1971). Transduction processes of movement and position sensitive cells in a crustacean limb proprioceptor. *Nature* 229, 206-8

WHITEAR, M. (1962). The Fine Structure of Crustacean Proprioceptors I. The Chordotonal Ogans in the Legs of the Shore Crab, *Carcinus maenas*. *Phil. Trans. R. Soc. Lond. B* 245, 291-324.

WIERSMA, C. A. G. (1959a). Movement Receptors in Decapod Crustacea. *J. Mar. Biol. Ass. U.K.* 38, 143-152.

WIERSMA, C. A. G. & BOETTIGER, E.G. (1959b). Unidirectional movement fibers from a proprioceptive organ of the crab, *Carcinus maenas*. *Journ. exp. Biol.* 36, 102-112.

WOLFRUM, U. (1991). Tropomyosin is co-localized with the actin filaments of the scolpale in insect sensilla. *Cell Tissue Res* 265, 11-17.

Cirripedia associated with maritime buoys signaling in a major port in southern Brazil: prevalence of exotic species.

Poster

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The introduction of species is a threat to the integrity of ecosystems. It occurs in estuaries most intensely in port areas, made possible by the exchange of ballast in ships or transport of water attached to the hull individuals. Artificial substrates may contribute to the introduction of species (GLASBY et al., 2007) and is necessary to evaluate the consequences of unintentional introductions promoted by these structures (SHEEHY and VIK, 2010). Given this problem and the record of several introduced species in Paranaguá bay, southern Brazil, we conduct a survey of barnacles attached to buoys signaling the navigation channel of the Port of Paranaguá, one of the largest in Latin America. Samples from the biota on buoys of various sectors of the estuary were obtained in 2011 by scraping the substrate from water line to 2.5 m deep. Barnacles were identified and compared with the records of the occurrence of barnacles in the surrounding natural and artificial substrates. Nine barnacle species were identified, occurring together with mussels, sea squirts, bryozoans and a rich vagile fauna. Three species are considered introduced to the region: *Megalobanus coccopoma*, *Amphibalanus reticulatus* and *Striatubalanus amaryllis*. Four other species were considered cryptogenic because of the wide geographical distribution and lack of previous data: *A. eburneus*, *Balanus improvisus*, *B. trigonus* and *Amphibalanus amphitrite*. Only two species were classified as native to the region: *Chthamalus bisinuatus* and *Fistulobalanus citerosum*. There was a clear predominance of exotic species compared to native or cryptogenic. All species observed at buoys have been recorded over the bay of Paranaguá on both rocky and artificial substrates such as concrete and plastic (NEVES et al., 2007; CANGUSSU et al., 2010; TCP, 2010; MELPORT, 2013). The three exotic species presented high abundance, surpassing in most of the points the cryptogenic and native. The port signaling buoys are facilitators for dispersal because they offer substrate for attachment of larval of organisms fixed on ship hulls, serving as dispersal corridors or stepping stones (ASTUDILLO et al., 2009). The data show a high incidence of introduced species on buoys and potential of this type of substrate as a facilitator of their dispersion.

References

ASTUDILLO, J.C., M. BRAVO, C. P. DUMONT & M. THIEL. 2009. Detached aquaculture buoys in the SE Pacific: potential dispersal vehicles for associated organisms. Aquatic Biology 5: 219-231.

CANGUSSU, L. C., ALTVATER, L., HADDAD, M. A., CABRAL, A. C., HEYSE, H. L. & ROCHA, R. M. 2010. Substrate type as a selective tool against colonization by non-native sessile invertebrates. Brazilian Journal of Oceanography 58: 219-231.

GLASBY, T.M., CONNELL, S.D., HOLLOWAY, M.G. & HEWITT, C.L., 2007. Nonindigenous biota on artificial structures: could habitat creation facilitate biological invasions? Mar. Biol. 151, 887–895.

MELPORT. 2013. EIA/RIMA Projeto Litoral II- Melport Terminais Marítimos LTDA. Paranaguá.

NEVES, C., ROCHA, R. M., PITOMBO, F. B. & ROPER, J. 2007. Use of artificial substrata by introduced and cryptogenic marine species in Paranaguá Bay, southern Brazil. Biofouling 23(5): 319-330.

SHEEHY, D. J, &VIK, S. F. The role of constructed reefs in non-indigenous species introductions and range expansions. Ecological Engineering 36: 1-11.

TCP. 2010. EIA/RIMA Ampliação do terminal de Conteineres de Paranaguá. TCP, Paranaguá.

Character Displacement in Sympatric Populations of Fiddler Crab (genus *Uca*)

Oral EMC

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The density and distribution patterns of eleven species of sympatric fiddler crab were studied on the island of Kaledupa, South East Sulawesi. Fiddler crabs (*Uca.* spp.) are frequently found living in areas of high sympatry. However, this number of species is unprecedented, which provides an opportunity to study extensive questions about microhabitat preferences and the role of competition in community structure. Ecological character displacement is thought to have an important role in the structure of communities, especially as competition between species appears to drive displacement (DAYAN & SIMBERLOFF, 2005). The question here is whether the fiddler crab species are displacing certain morphological traits in the occurrence of sympatry.

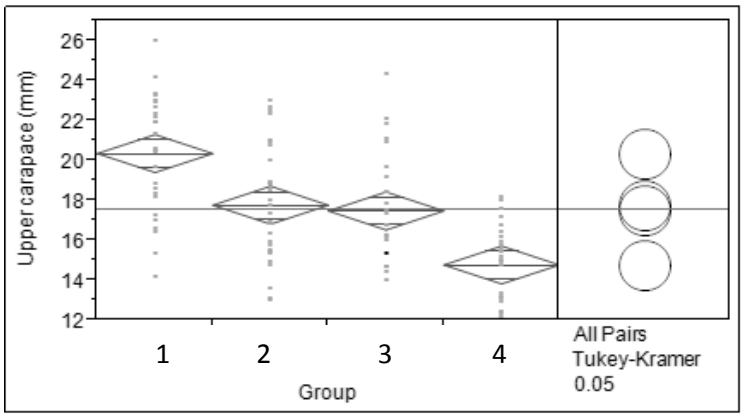

Figure 2. Male carapace size of four subpopulations of *U. jocelynae* in areas of low (1), medium (2 and 3) and high (4) interspecific competition

In order to assess how levels of interspecific competition can affect certain traits, *U. jocelynae* was used as a focal species, as it was found at different levels of interspecific competition and at high abundances. Character displacement studies (Figure 1) showed that *U. jocelynae* in areas of high sympatry (ten species) were significantly smaller than those in areas of low sympatry (two species) ($p < 0.01$). This was true of males and females, from measurements of upper and lower carapace, length of carapace, and major cheliped in males.

Character displacement is a widely discussed and often controversial subject and interspecific differences could readily be argued as randomness or chance. BROWN & WILSON, in 1956, first suggested that when species live sympatrically, the interspecific differences must be accentuated, as opposed to when living apart where similarities can be greater. This research looks at intra- and inter-species diversity, across sites with varying levels of coexistence, to study the potential for character displacement.

References:

BROWN, W.L. & WILSON, E.O. (1956). Character displacement. Systematic Zoology, **5**: 49-64.

DAYAN, T. & SIMBERLOFF, D. (2005). Ecological and community-wide character displacement: the next generation. Ecology Letters. **8**: 875-894.

Impact of Cirripedia *Balanus improvisus* on Bivalvia *Cerastoderma glaucum* community in the southwestern Caspian Sea

Oral BEP

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We studied the possible negative impact of *Balanus improvisus* on *Cerastoderma glaucum* in southwestern Caspian Sea where results of few studies are available on the effects of alien species on endemic species. Massive movements of live Bivalvia attached by Cirripedia colonies to coastline strengthens the hypothesis of negative effects of exotic species. Different live stages of both animals including meroplankton and macro-invertebrate were considered in analysis. Bivalvia larvae showed a downward trend in contrast with upward trend of Cirripedia larvae from 1996 to 2013.

Abundance of *C. glaucum* decreased along west to east sea shore in contrast with increasing biomass of *B. improvises.* More than half specimens in each region were attached by Cirripedia with a range of 0.1 to 2.8 g/.cm^{-2} on Bivalvia specimens. Distribution pattern of both species were described based on temperature, salinity gradients and local nutrient contents.

Non-linear growth model of Bivalvia confirmed the short term effects of Cirripedia. In addition, the main role of *B. improvisus* in movement of *C. glaucum*, movement of another Cardiidae, namely *Adacna vitrea* with no attached Cirripedia complicates the contribution role of several other factors including ecosystem degradation.

Keywords: *Cerastoderma glaucum* , *Balanus improvisus* , *Adacna vitrea,* abundance Caspian Sea

Biology of *Nymphonella tapetis*, a harmful pycnogonid endoparasitic on some bivalves with special reference to their taxonomy

Oral MC

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Nymphonella tapetis is a pycnogonid endoparasitic on some bivalves. After the first discovery of this species in 1926, there were scattered records from several places in Japan on a small scale. In 2007, *N. tapetis* appeared suddenly in the commercial bivalve, *Ruditapes philippinarum* (Manila clam) and several other bivalves on some tidal flats in Tokyo Bay, which caused a mass mortality of the bivalves in the area. Adults live freely on or just under the surface of sandy bottoms. The larva enters the host bivalve, attaches to various soft parts, and feeds on the body fluid (Fig. 1). Eleven different developmental stages can be distinguished from the youngest parasitic larvae to the subadults. Adults leave the host probably just after the maturation molt.

Figure 1. Larval and juvenile *N. tapetis* endoparasitc on Manila clam (SL = 4 cm).

Three species of *Nymphonella* have been described from Japan, the Mediterranean, and southern Africa. They are very similar in morphology, which leads to potential taxonomic confusion. For example, the Mediterranean specimens were first identified as *N. tapetis* (LE CALVEZ, 1950), but later described as a new species based on some morphological differences (Guille & Soyer, 1968). These differences are, however, small enough to cast significant doubt on their new species status (MIYAZAKI, 2011). Interestingly, there have been no parasitic records in *Nymphonella* species other than Japanese one. They are mostly free living adults, excepting the one confusing case from the Mediterranean with free living juveniles.

A taxonomic discussion based on a further re-examination of some morphological characteristics and some molecular phylogenetic analyses will be presented.

References:

GUILLE, A. & SOYER, J. (1968) Nouvelle signalisation du genre *Nymphonella* Ohshima à Banyuls-sur-Mer: *Nymphonella lecalvezi* n.sp. Vie et Milieu 18: 345–353.

LE CALVEZ, J. (1950) Un Pycnogonide nouveau pour la Mediterranée: *Nymphonella tapetis* Ohshima. Arch. Zool. Exp. Gén. 86: 114–117.

MIYAZAKI K. (2011) On the species validity of *Nymphonella lecalvezi* (Pycnogonida, Ascorhynchidae): A re-evaluation of some morphological characteristics. Proc. Arthropod. Embryol. Soc. Jpn. 46: 35–37.

Life history and development of *Ammothella biunguiculata* (Pycnogonida, Ammotheidae) of the two populations in Japan: Are they same species?

Poster

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Ammothella biunguiculata is a shallow-water species of pycnogonid, which can be distinguished from congenic species by the robust appearance and the extreme reduction of main claws. It was originally described from the Mediterranean (DOHRN, 1881), and subsequently recorded from California, Japan, Australia, Hawaii, Madagascar and Korea, showing a pantemperate distribution.

Although no differences can be seen in adult morphology between the two populations of *A. biunguiculata* in Japan, Shimoda (Izu Peninsula) and Shirahama (Kii P.) (Fig. 1.), we have found some remarkable differences in their life history and larval development: 1) The larvae of the Shimoda population (IZU) show endoparasitism on an actinian, *Entacmaea quadricolor* (Fig. 2), whereas those of Shirahama population (KII) are free-living (MIYAZAKI, 2002; MOCHIZUKI & MIYAZAKI, in press). 2) The number of postembryonic stages is eleven in the IZU, whereas the KII apparently has one additional stage (MOCHIZUKI & MIYAZAKI, in press). 3) The spinning spines at the larval chelifores disappear from the second instar in the IZU, whereas they retain until subadult in the KII (MOCHIZUKI & MIYAZAKI, in press).

These differences cast doubt upon the species identity of the two populations, and thus we re-examined available information on morphology, development and life history of "*A. biunguiculata*" from previous records and newly collected specimens. Possible phenotypic plasticity and presence of cryptic species will be discussed partly based on a preliminary molecular phylogenetic analysis using COI gene.

Figure 1. Map showing the localities of the two populations.

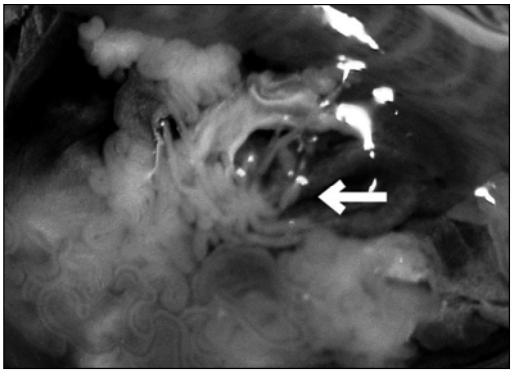

Figure 2. Endoparasitic larval *A. biunguiculata* of the IZU (arrow) embedded in the host tissue.

References:

DOHRN, A. (1881) Die Pantopoden des Golfes von Neapel und der angrenzenden Meeresabschnitte. Monogr. Fauna Flora Golfes Neapel 3: 1–252.

MIYAZAKI K. (2002) Occurrence of juvenile forms of a pycnogonid, *Ammothella biunguiculata* (Pycnogonida, Ammotheidae) in an actinian, *Entacmaea actinostoloides* (Anthozoa, Stichodactylidae). Proc. Arthropod. Embryol. Soc. Jpn. 37: 43–44.

MOCHIZUKI Y. & MIYAZAKI, K. (in press) Preliminary notes on the life history of a pycnogonid, *Ammothella biunguiculata* (Pycnogonida, Ammotheidae): Comparison between the populations of Izu and Kii peninsulas. Proc. Arthropod. Embryol. Soc. Jpn. 48.

Occurrence of salmon lice (*Lepeophtheirus salmonis*; Krøyer, 1837) in Danish wild Atlantic salmon (*Salmo salar*)

Oral GS

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The salmon louse, *Lepeophtheirus salmonis* is an ectoparasitic copepod on salmonid fish in the Northern hemisphere, causing great economic losses to the Atlantic salmon farming industry. The pathology is primarily caused by the lice feeding on mucus, epidermis and blood resulting in severe skin damages of the fish. In areas with intensive salmon farming, the salmon louse may further constitute a serious threat to wild populations of salmon and sea trout. In this study, 62 salmon lice collected from wild Atlantic salmon in the Skjern River, Denmark. All lice were identified as *L. salmonis* based on morphology and GenBank blasts. In addidtion, the occurrence of hyperparasites was recorded and eggs of the the monogenean worm, *Udonella caligus* were found on 11 % of the lice. This is the first study in recent years confirming the presence of *L. salmonis* in Danish rivers and suggests that sea lice might be more prevalent in Danish waters than first assumed. With the planned expansion of sea-based salmonid production in Denmark, further studies framing potential lice threats to the protected wild Atlantic salmon as well as cultured Rainbow Trout stocks in Denmark should be undertaken in order to develop an adequate prevention and control practice and a solid base-line knowledge.

Feasibility of a new amphipod record as introduced species to the Persian Gulf

Poster

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Due to high maritime traffic throughout the Persian Gulf, from the past as well as now (near to 50000 ships per year), transferring possibility of alien species from other parts of the world's ocean to the region has increased. During a comprehensive study on intertidal amphipods of the Persian Gulf, numerous *Parhyale fascigera* were recorded from harbors and other human man-made structures. This species originally described by Stebbing, 1897, from Atlantic Ocean. Other records of *P. fascigera* belong to the Caribbean Sea, Colombia and adjacent waters. There is no record of *P. fascigera* in the previous studies have been conducted in the Persian Gulf. Material of the Persian Gulf is in concurrence with the type description of *P. fascigera* without any remarkably variation. The new record of *P. fascigera* in the Persian Gulf could be considered as alien species based on CHAPMAN & CARLETON (1991) criteria for describing invasive species. Bio-invasion possibility of *Parhyale explorator* was mentioned for Turkish waters (SUAT ATEŞ et al., 2013), while invasion ability *P. fascigera* is ignored. Dispersal ability by rafting, direct development in the life cycle and biogeographical separation between amphipod fauna of Atlantic and Indian Ocean are main reasons strengthens our hypothesis for bioinvasion of *P. fascigera* in the Persian Gulf.

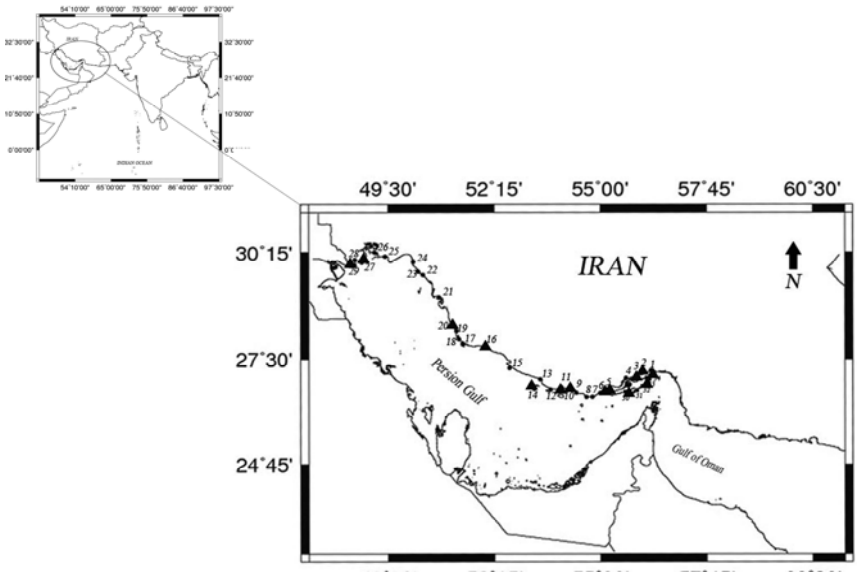

Figure 3: the sampling stations in the Persian Gulf. *Parhyale fascigera* was recorded from stations that marked by triangle.

References:

CHAPMAN, J.W. & CARLTON, J.T. (1991). A test of criteria for introduced species: the global invasion by the isopod *Synidotea laevidorsalis* (MIERS, 1881). Journal of Crustacean Biology 11: 386-400.

SUAT ATEŞ, A., KATAĞAN, T., SEZGIN, M. & ÖZCAN, T (2013) Exotic crustaceans of the Turkish coast. Arthropods , 2(1): 20-25.

Evidence of high pressure neurological syndrome (HPNS) in a shallow-water caridean shrimp: Implications on the potential for climate driven bathymetric range shifts

Oral BLC

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Little is known about the ecological and physiological processes governing depth distribution limits in species: temperature and hydrostatic pressure are considered to be two dominant factors. Research has shown that some marine ectotherms are shifting their bathymetric distributions in response to rapid (anthropogenic) ocean surface warming. Shallow-water species unable to undergo latitudinal range shifts may depend on bathymetric range shifts to seek refuge from warming surface waters. Our study examined differential gene expression in response to acute pressure and temperature exposures in juvenile shrimp *Palaemonetes varians.* Significant increases in the transcription of genes coding for an NMDA receptor-regulated protein, an ADP ribosylation factor, β-actin, two heat shock protein 70kDa isoforms (HSP70), and glyceraldehyde-3-phosphate dehydrogenase (GAPDH) were found in response to elevated pressure. NMDA receptors have been implicated in pathways of excitotoxic damage to neurons and the onset of high pressure neurological syndrome (HPNS) in mammals. These data indicate that the sub-lethal effects of barotrauma are associated with transcriptional disturbances within the nervous tissue of crustaceans, and cellular macromolecular damage. Such transcriptional changes lead to the onset of symptoms similar to that described as HPNS in mammals, and may act as a limit to the organism's prolonged survival at depth. Further, our data provide the first molecular evidence of the synergistic/antagonistic effects of hydrostatic pressure and temperature. Insight into these combined effects suggest that our current predominant ocean water column (i.e. warmer shallow-water, colder deeper-water) represent the least penetrable temperature and pressure scenario for shallow-water adapted ectotherms. Additionally, an isothermal water column or warming water with depth represent scenarios in which the physiological barriers to deep-sea migration may partially or completely ameliorated.

Zooplankton illustrated guide for Portuguese Waters

Poster

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A guide to promote the oceans' literacy, through the illustration of species and taxa of the main zooplankton groups, including jellyfish, from Northestern Atlantic Waters, combined with information on their natural history and morphology, is presented. The illustrations were constructed by using microscope and stereomicroscopy, both equipped with a *camera lucida*. The illustration technics explored are: collared pencil and acrylic ink on Polyester and indian ink on scratchboard, for species general views, and Indian ink on Polyester for details. After scanning, the draws are finalized using digital software to create the final layout. In order to allow an easier approach for non-specialists, the illustration technics described and the information are applied representing the species in a realistic and appealing way. Information about the methods of collection and biology/ecology of the main zooplanktonic groups will be also presented.

As part of the guide's first presentation, ten common species were chosen from plankton samples of the Portuguese coast and Mondego estuarine waters to be presented here. They are: *Homarus gammarus, Pisidia longicornis* and *Scyllarus spp.,* from Decapoda; *Temora longicornis, Acartia tonsa, Coryceus spp.* and *Oncaea spp.,* from Copepoda; *Podon intermedius,* from Cladocera; *Octopus vulgaris,* from Cephalopoda; and *Sardina pilchardus* from Piscis.

Diversity of shrimps of the genus *Macrobrachium* Spence Bate, 1868 (Crustacea: Decapoda: Palaemonidae) from Lobe River coastal region of Cameroon, West Africa.

Oral CTF

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Historical records show that the first observation of shrimps from Cameroon dates back to 1472 by the Portuguese Fernando Pô. Until now, this fauna has not yet been properly studied compared to other West African countries. Field surveys were undertaken in Lobe River during August to November 2013 in order to collect freshwater decapod specimens. The collected species of the genus *Macrobrachium* SPENCE BATE, 1868 were dissected and, examined under a Leica stereomicroscope and described. The following characters of taxonomic importance were described and measured for comparison: tailfan, carapace, rostrum, mandibular palp, mandibular process, maxillipeds, pereiopods, abdomen, scaphocerite, and stylocerite. These characters enabled us to confirm the presence of seven morphotypes, here presumed to be species, *viz*., *Macrobrachium* sp1 - sp5, *Macrobrachium dux* (LENZ, 1910), and *Macrobrachium vollenhovenii* (HERKLOTS, 1857). *Macrobrachium* sp1 is markedly different from all other known species and potentially new. *Macrobrachium* sp2 - sp5 each possess some distinctive features (e.g., telson & rostrum characters, and morphometric differences), however, they share several characters with *M. vollenhovenii* while being distinct from all other West African species of *Macrobrachium*. Consequently, we tentatively refer to them as the *M. vollenhovenii* species complex. We conclude that Lobe River might harbor new species of *Macrobrachium* spp. and more data, particularly involving DNA barcoding, will be necessary to accurately determine the taxonomic status of the species that are close to *Macrobrachium vollenhovenii.*

Keys words: *Macrobrachium*, morphotypes, Lobe River, Cameroon, West Africa.

Taxonomy and Phylogeny of the wide-front fiddler crabs (Decapoda: Brachyura: Ocypodidae: *Uca*) in the Indo-West Pacific.

Oral GS

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Wide-front fiddler crabs (genus *Uca*) of the Indo-west Pacific (IWP) are potentially paraphyletic and comprise three subgenera, *Austruca* BOTT, 1975 (eight species), *Cranuca* BEINLICH & VON HAGEN, 2006 (one species), and *Paraleptuca* BOTT, 1973 (six species). Phylogenetic analysis using 16s rRNA revealed more complexity within wide-front *Ucas* in IWP, which are well supported by detailed morphological examination, in particular, using median plate of gastric mill and first gonopod morphology. Wide-front fiddler crabs in the IWP are divided into following six groups:

Uca annulipes group (currently in the subgenus *Austruca*: *U. albimana*, *U. annulipes*, *U. iranica, U. cheni* n. sp. and *U. cryptica*) is a good monophyletic group. The first three species are restricted to the Western Indian Ocean (WIO), whereas, the recently described species *U. cryptica* was recorded from Indonesia and Philippines and *U. cheni* n. sp. are widely distributed in the Eastern Indian Ocean to west and southern Pacific.

The *Uca lactea* group (currently in the subgenus *Austruca*: *U. lactea*, *U. perplexa*, *U. mjoebergi*) is distributed from Japan to north Australia. *Uca mjoebergi* with distribution from Northern Australia to New Guiana is a genetically separate subclade, whereas morphologically is clearly distinguishable.

The *Uca chlorophthalmus* group (currently in the subgenus *Paraleptuca*: *U. chlorophthalmus*, *U. crassipes* and *U. splendida*) is a monophyletic group, genetically and morphologically distinct from other wide-fronts. *Uca chlorophthalmus* occurs in the East African coast and *U. splendida* is limited to continental East Asia and Vietnam, while *U. crassipes* is widely distributed from the eastern Indian Ocean to the central and southern Pacific Ocean.

The *Uca triangularis* group (currently in the subgenus *Paraleptuca: U. triangularis* and *U. bengali*) is genetically and particularly morphologically positioned intermediately between *U. annulipes* and U. *chlorophthalmus* groups. *Uca bengali* is distributed from the eastern Indian coast to northern Indonesia, whereas *U. triangularis* is widely distributed from eastern Indian Ocean coasts to central and southern Pacific Ocean.

Uca inversa is the only species of the monospecific subgenus *Cranuca*. This wide-front *Uca* is closely allied to narrow-front fiddler crabs of the subgenus *Gelasimus* rather than other IWP wide-front crab, using genetic and morphological characteristics. This species is widely distributed in the Western Indian Ocean from East Africa to the Persian Gulf.

Uca sindensis is an aberrant species within the wide-front fiddler crabs of IWP. This species was first described as a subspecies of *U. inversa* and is currently included in the subgenus *Paraleptuca*, but most likely must be transferred to a new subgenus. *Uca sindensis* has a limited distribution range from the West Indian coast to the Persian Gulf.

Trends in Decapoda biodiversity in Greek coastal waters

Poster

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Coastal regions, especially those residing in enclosed embayments or protected gulfs, are often subject to pollution as a result of anthropogenic activities, such as aquaculture, sewage, or maritime traffic. Water quality and biodiversity are the imminent effects of this, the negative impact of which is, in some cases, irreversible. Benthic macroinvertebrates might comprise a good bio-indicator of habitat health, as they are very susceptible to environmental changes. As a matter of fact, it has been showed that macroinvertebrates tend to have a low diversity in polluted waters.

Among the organisms of the macrobenthos, crustacea constitute one of the most important components of the marine benthic community.

The present study is based upon work that was carried out within the context of the Water Framework Directive (WFD) for the Hellenic coastal waters. It shows the results for the composition and abundance of decapod crustaceans and it covers a period of two-year sampling in a total of 65 stations, mainly enclosed water bodies all over Greece.

Samples were taken during March and April of two subsequent years, from coasts of the Aegean and the Ionian Sea. 26 of the stations, which are characterized as monitoring stations, were sampled both times, whereas in addition there were 14 and 25 more stations (surveillance monitoring types) for the first and the second year, respectively.

57 species were found in total and 298 individuals were identified, 106 in the first period and 192 in the second, out of 1.852 crustaceans that were sampled overall.

Potential impacts of prolonged drought on a highly threatened crab *Johora singaporensis*

Oral CTF

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As one of the largest anthropogenic disturbance of this century, the effects of climate change are gaining prominence and include increase in temperature and rainfall variability. However, little is known about how these changes will potentially impact freshwater crabs. The critically endangered Singapore freshwater crab *Johora singaporensis,* which is one of the top 100 most threatened species globally, is known only from a few hill streams in Singapore. Recently (Jan–Mar 2014), Singapore experienced the longest period of drought in its recorded history in which various portions of the streams dried up, resulting in changes in overall water quality parameters and population density of the crab. These changes are likely to influence the population dynamics of the species and may be detrimental to its long-term survival. Here we highlight physico-chemical changes in the stream ecosystem and responses in the crab prior to this unprecedented drought episode. With the unabated production of greenhouse gases, climate change is likely to worsen in the future and will complicate existing conservation efforts for many species. Novel management measures therefore need to be developed to mitigate such impacts to ensure aquatic species survival.

Revision of the genus *Discoplax* A. Milne-Edwards, 1873 (Brachyura, Gecarcinidae)

Oral CTF

PETER K.L. NG & HSI-TE SHIH

The gecarcinid land crab genus *Discoplax* A. Milne-Edwards, 1867, is revised on the basis of new suites of morphological as well as genetic characters. Currently, five species are recognised from the Indo-West Pacific: *D. celeste* Ng & Davie, 2012, *D. gracilipes* Ng & Guinot, 2001, *D. hirtipes* (Dana, 1851), *D. longipes* A. Milne-Edwards, 1867 (type species) and *D. rotunda* (Quoy & Gaimard, 1824). At least three new cryptic species are identified, two from the western Pacific and one from the eastern Indian Ocean. The taxonomy and biogeography of these species are discussed in the context of the new data.

Prevalence of the two ectosymbiotic worms *Holtodrilus truncatus* and *Scutariella japonica* on the host shrimp *Neocaridina* spp. from the Sugo River in western Japan in 2003-2013.

Poster

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I discussed microhabitat distribution and some aspects of behavior of branchiobdellidan *Holtodrilus truncatus* (Annelida Clitellata) from the Sugo River at the TCS Greece convention（NIWA et al. 2014). And I focused on the behavior and interaction between branchiobdellid *H.truncatus* and temnocephalid *Scutariella japonica* (MATJAŠIČ 1990) (Platyhelminthes) and their host *Neocaridina* spp. at the Costa Rica convention. *Neocaridina denticulata denticulata* (family Atyidae) is an endemic species of freshwater shrimp known to be distributed throughout western Japan. This shrimp is used as live bait for sport fishing in Japan (NIWA et al. 2005, NIWA & OHTAKA 2006) . In recent years the resources lessened, many live *Neocaridina* spp. were imported from China and South Korea as live bait. In 2003, Niwa *et al*. found an ectosymbiont annelid *H. truncatus* attached to freshwater shrimp *Neocaridina* spp. in the Sugo River that had previously been reported present only in China (Henan and Guangdong Provinces) (NIWA et al. 2005, NIWA & OHTAKA 2006). This was the first report of the species, *H. truncatus,* in Japan (NIWA et al. 2005) . They might have been imported unintentionally with the shrimp into Japan, and dispersed and settled in the Sugo River. Branchiobdellids (Annelida) and temnocephalids (Platyhelminthes) are both known to be ectosymbionts of the decapod crustaceans. Their original geographical distributions are separate, the former in the northern and the latter in the southern hemisphere (GELDER 1999). The Sugo River is an exceptional area of overlap, as both the branchiobdellid *H.truncatus* and the temnocephalid *S. japonica*, can be found together attached to the same host *Neocaridina* spp. (Niwa & Ohtaka 2006). Attachment ratio of the two worms to the host shrimp were examined. A total of 6173 host shrimp were observed from 2003 to 2013. 1586 shrimp had attached *H.truncatus* (25.7 %: Max 47.7%-Min3%) and 2176 shrimp had attached *S. japonica* (35.3 %: Max53.9%-Min3.3%). Each year the attachment ratio of *H. truncatus* were as follows: 21/44=47.7% in 2003, 528/1870=28.2 % in 2004, 629/1842=34.2% in 2005, 48/156 = 30.8% in 2006, 48/371=12.9% in 2007, 216/1012=21.3% in 2008, 11/29 = 38% in 2009, 13/329 =4.0% in 2010, 59/364 = 16.2 % in 2011, 10/56=17.9% in 2012, 3/100=3% in 2013. On the contrary, each year the attachment ratio of *S. japonica* were also as follows: 927/1870=49.7 % in 2004, 993/1842=53.9% in 2005, 63/156 = 40.4% in 2006, 78/371=21.0% in 2007, 60/1012=5.9% in 2008, 3/29=10.3% in 2009, 11/ 329 =3.3% in 2010, 23/364 = 6.3 % in 2011, 3/56=5.4% in 2012, 13/100=13% in 2013. Cohabitation ratios (Max 19.7% -Min0%) were as follows: 273/1870=14.6 % in 2004 , 363/1842=19.7% in 2005, 26/156 = 16.7% in 2006, 14/371=3.8% in 2007, 4/1012=0.4% in 2008, 0/29=0% in 2009, 0/ 329 =0% in 2010, 5/364 = 1.4 % in 2011, 3/56=5.4% in 2012, 2/100=2.0% in 2013. The actual number of the two worms needs to be considered as there will be more than one individual per host in a real situation. In addition, the decrease in resources of *H.truncatus* (2006, 2009) should be considered and this will be discussed in Frankfurt.

References:

GELDER S.R. (1999) : Zoogeography of branchiobdellidans (Annelida) and temnocephalidans (Platyhelminthes) ectosymbiotic on freshwater crustaceans, and their reactions to one another *in vitro*, Hydrobiologia, 406, 21-31.

NIWA N., OHTOMI J., OHTAKA A., GELDER S. R. (2005) : The first record of the ectosymbiotic branchiobdellidan *Holtodrilus truncatus* (Annelida, Clitellata) and on the freshwater shrimp *Neocaridina denticulata denticulata* (Caridea, Atyidae) in Japan, Fish. Sci., 71, 685-687.

NIWA N., OHTAKA A .(2006) : Accidental introduction of symbionts with imported freshwater shrimps, In:KOIKE F, CLOUT M. N, KAWAMICHI M, DE POORTER M, IWATSUKI, K.[editors].: Assessment and Control of Biological Invasion Risk: Kyoto Japan and Gland, Switzerland: Shoukadoh Book Sellers and The World Conservation Union (IUCN), 182-186.Niwa N., Archdale Vazquez Miguel, Matsuoka T, Kawamoto A., Nishiyama H. (2014): Microhabitat distribution and behavior of Branchiobdellidan *Holtodrilus truncatus* found on the freshwater shrimp *Neocaridina* spp. from the Sugo River, Japan Cent. Eur.J.Biol, 9 (1), 80-85. DOI:10.2478/s11535-013-0184-3

Habitat occupation by *Callinectes bocourti* in a river from the semi-arid, Brazil

Oral GS

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The genus *Callinectes* is widely spread throughout the Atlantic and Pacific coasts of the Americas. In Brazil, *C. bocourti* occurs in estuarine as well shallow coastal areas. Estuarine crabs can migrate from the river towards the sea to spawn and habitat usage can vary between males and females as well among different life stages. Monthly samples were performed from January to December 2011 covering an area of approximately 30 km in length from Jaguaribe river mouth (4° 26' S; 37° 48' W) to an artificial barrier, a dam, at Itaiçaba city (4º 40' 28" S; 37º 49' 21" W), this sampling design was chosen to cover an area through which the animals can move. Four sampling site were chosen distant from the river mouth by 29 km site I, 18 km site II, 8 km site III and 3 km site IV using a round net with 50 cm of mouth and 30 cm length. Individuals size (CW= cephalothorax weight), abundance, and presence/absence of ovigerous were recorded. Observations of this species in Jaguaribe river showed that from the mouth of the river up to the first artificial barrier, a dam, the species is widely spread with size varying throughout the sampled area and among months. Larger females were recorded at the extremes of sampling area at sites I and IV while larger males were at sites II and III. Abundance was significantly higher for both males and females at site I, the lowest at site IV where only one male was caught while most of the females at this site were ovigerous. It was not possible to establish recruitment area. Either animals recruit outside sampling sites, e.g. among mangrove trees roots, or the sampling method, i.e. the mesh size, selected animals larger than 40 mm CW. We strongly believe that both are taking place with juveniles, i.e. animals smaller than 40 mm CW, remaining and foraging among mangrove trees roots. We can conclude that females are migrating towards the sea to spawn and mating is probably occurring between site II and III. Therefore, females, movement throughout the year can be described as moving towards the ocean around June to spawn, recruiting between 3 to 8 km far from the mouth, foraging and spending adult life as far as 29 km from the sea and mating around 18 km where adult males spend most of their adult life.

Larvae, limbs, fossils, and phylogenies – a branchiopod evolution cocktail

Oral BR

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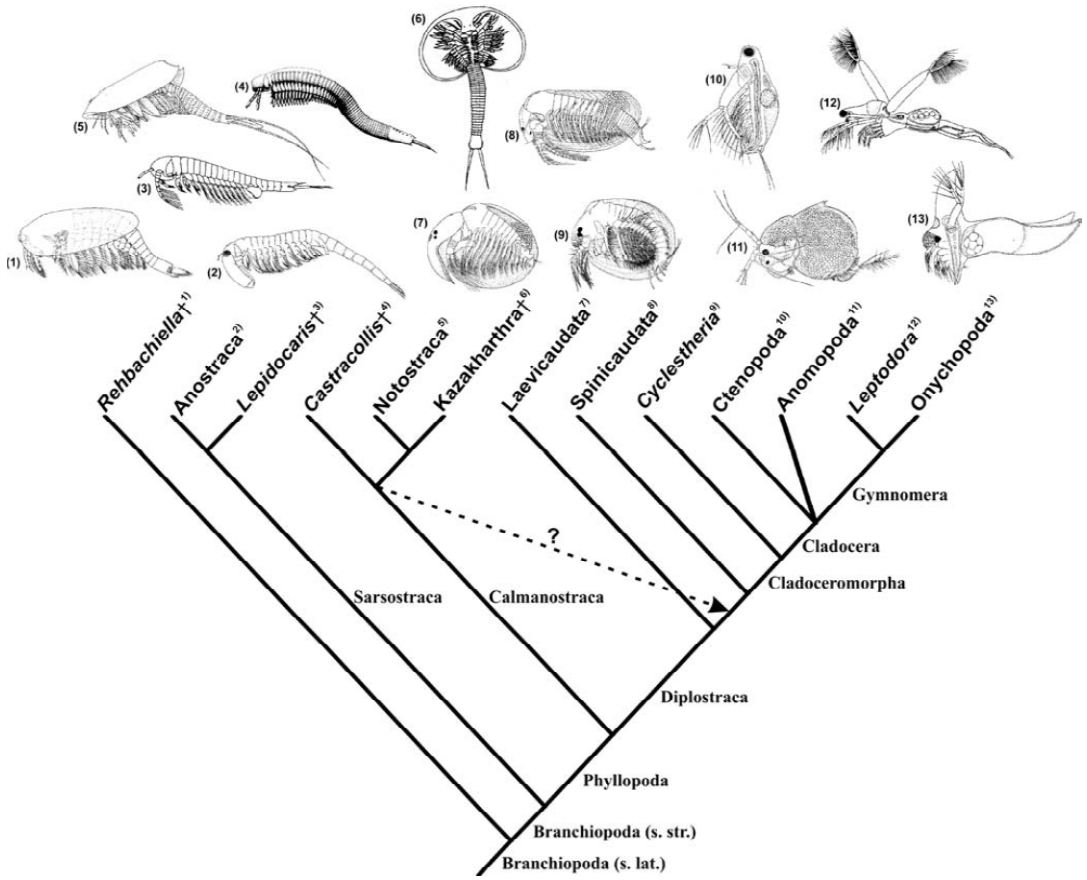
Much evidence regarding branchiopod evolution from many different has appeared in recent years and a consensus about the higher-level phylogeny is near. Much morphological data has been generated or re-interpreted in a cladistic framework, a reasonable number of genes have been sequenced, and a number of Cambrian and Devonian well-preserved fossils have been described or re-interpreted, all of which have contributed to getting closer to establishing the phylogeny of the Branchiopoda. It is well-known that a robust phylogeny in general is an important background for many analyzing many questions relating to evolution.
With this new and relatively robust branchiopod phylogeny as a background, a logical next step in the study of the Branchiopoda is to consider the most likely pathway of a number of morphological aspects such as the carapace and the appendages. Here I will present a number of case studies of a variety of branchiopods such as Laevicaudata, Onychopoda and Haplopoda and explore the general trends in evolution from the fairy shrimps at the base of the tree to the most specialized water fleas such as *Leptodora.*



Reference:
OLESEN, J. 2009. Phylogeny of Branchiopoda (Crustacea)—Character evolution and contribution of uniquely preserved fossils. Arthropod Systematics and Phylogeny 67(1): 3-39.

The unique dorsal brood pouch of Thermosbaenacea (Crustacea, Malacostraca) and description of a late embryonic stage of *Tulumella unidens* from the Yucatan Peninsula (Mexico), with a clarification of mouth part homologies to other Malacostraca

Poster

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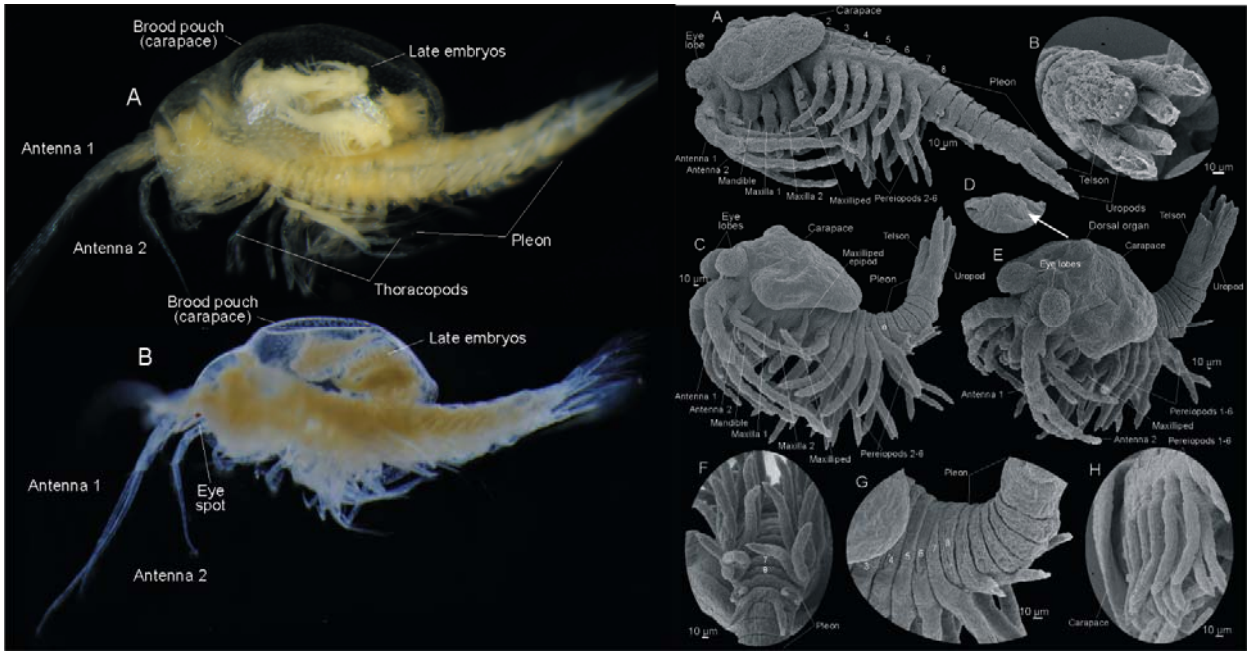
Among malacostracan crustaceans only Thermosbaenacea brood their offspring dorsally under an enlarged carapace, superficially similar to what is seen in certain branchiopod crustaceans (water fleas), ostracods, and ascothoracid thecostracans. This unusual habit is of evolutionary interest since all presumed close relatives brood their embryos in a ventral marsupium (other peracarids), between the thoracopods (leptostracans), attached to pleopods (Pleocyemata), or they have free larvae only (e.g., krill and dendrobranchiates). All information is based on two species only, and primary data has not appeared in more than 40 years. Dorsal brooding was first discovered in *Tethysbaena argentari* from an Italian cave system (at Monte Argentario) and later confirmed in *Thermosbaena mirabilis*, the first thermosbaenacean described (from hot springs in Tunisia).

Here we provide new observations on an ovigerous female and on late embryos of *Tulumella unidens* collected from an anchialine cave at the Yucatan Peninsula, which is only the third report on developmental stages of Thermosbaenacea and the first for *Tulumella*. We describe the external morphology by SEM of a late embryonic stage and report hitherto unexplored structures inside the brood chamber (large lobes) and on along its posterior margin (large spines). Particular focus has been on the morphology of the early limb buds of the late embryo. We the morphology of the limb buds to establish conventional malacostracan mouth part terminology (coxa, basis, etc.) for Thermosbaenacea, thereby providing a hypothesis for the broader homologies of these quite derived mouth parts (due to specialised feeding).



Per offspring investment, developmental plasticity, and their interaction: On the evolution of lecithotrophy and abbreviated development

Oral EMC

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Decapod crustaceans develop through a spectrum of larval developmental modes from obligate planktotrophy to direct development. The evolutionary transition from obligate planktotrophy to obligate lecithotrophy is associated with increases in per offspring investment, abbreviation of development, and development independent of external food resources. Within decapods developmental plasticity, which is manifest as variations in larval instar number, is fairly common. However, the interaction between per offspring investment and developmental plasticity and the implications of this interaction for larval ecology and latent effects are poorly understood. Similarly, the potential role of this interaction in the evolutionary transition from planktotrophy to lecithotrophy has not been investigated.
Here, we present data on the effects of temperature and starvation period on larval instar number and the implications of this developmental plasticity for larval development within the caridean shrimp, *Palaemonetes varians* (OLIPHANT et al. 2013, OLIPHANT & THATJE 2013, OLIPHANT & THATJE 2014). We then present data on the interaction between per offspring investment and developmental plasticity and the effects of this interaction on larval development, ecology, and latent effects, again, within *P. varians* (OLIPHANT & THATJE 2013). We conclude by proposing a scenario for the role of the interaction between per offspring investment and developmental plasticity in the evolutionary transition towards lecithotrophic development within decapods crustaceans.

References:

OLIPHANT, A. & THATJE, S. (2013): Per Offspring Investment implications for crustacean larval development: evolutionary insights into endotrophy and abbreviated development. Marine Ecology Progress Series **493**:207-217

OLIPHANT, A. HAUTON, C. & THATJE S, (2013): The implications of temperature-mediated plasticity in larval instar number for development within a marine invertebrate, the shrimp *Palaemonetes varians*. PLoS ONE 8(9)e75785

OLIPHANT, A. & THATJE, S. (2014): Energetic adaptations to larval export within the brackish living palaemonine shrimp *Palaemonetes varians*. Marine Ecology Progress Series doi: 10.3354/meps10767

The feeding system of the enigmatic epibiont barnacle on sharks "*Anelasma squalicola*"

Poster

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The lepadomorph barnacle, *Anelasma squalicola*, is an obligate parasite on the velvet-belly lantern shark, *Etmopterus spinax*. The peduncle of *A. squalicola* is embedded into the skin and flesh of the host, and is modified to a devise that via some unknown mechanism is transferring nutrients from tissue and blood of the host to the parasite. Despite the fact that peduncle feeding apparently has replaced the conventional barnacle filter feeding, the original feeding system, including the oral cone, trophi, cirri and the alimentary tract, is still present. The present study examines the variation of the morphological reductions of the filter feeding apparatus, based on the examination of an extended number of specimens.

Population structure and size at onset of sexual maturity of the European edible crab (*Cancer pagurus*) in the Isle of Man

Oral EMC

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The European edible crab, *Cancer pagurus* LINNAEUS 1758, is one of the most important commercial fishery species in terms of economic value (nearly £0.4M in 2011) in the Isle of Man (DEFA, 2012), but its population structure and reproductive biology remain unknown for this region. This study aimed to assess information on spatio-temporal distribution and the size at onset of maturity (SOM) of *C. pagurus* in the waters surrounding the Isle of Man to inform the sustainable management of crab stocks. Data were collected by baited crab pots, scallop dredges, and trawls in 2012 and 2013. Juvenile crabs were also collected during the shore surveys. To provide spatial and temporal comparisons of abundance, sex ratio, carapace width, and weight frequency of *Cancer pagurus,* data were standardised to reporting areas of c. 75 km^2. This study indicates that catches are seasonally-dominated by female crab catches, particularly in the south-west of the Island, which may be related to their migratory behaviour. Sex ratio in catches exhibited great variability between areas and seasons. There are apparent regional differences in mean crab size and weight, with western and south-western coasts having larger and heavier individuals.

Furthermore, the mating, spawning and hatching periods of *Cancer pagurus* were also determined. There was a peak in occurrence of sperm plugs in females during summer and autumn which provided insights into the timing of mating. Ovigerous crabs were found from October to May (134 to 215 mm carapace width), and they carried an estimated 0.4 – 3.0 million eggs. SOM was estimated by morphometric (carapace width, carapace length, cheliped length, cheliped height, pereipods' merus width and pereipods' merus length, abdominal somites) and reproductive characters (testes and gonad development stages). The sizes at first maturity was estimated for males based on mature testes at 100mm CW and for females based on mature gonads at 114 mm CW. Additionally, impacts of some environmental factors (e.g. location, season, temperature) on SOM were examined. The current minimum landing size is 130mm CW in the Isle of Man and this study shows that escape panels on pots provide sustainability of this fishing sector. However, scallop dredges give a rise to collection of relatively high numbers of ovigerous crabs in autumn.

Reference:

DEFA (2012): Isle of Man Government's fisheries statistics. Department of Environment, Food and Agriculture. Fisheries Directorate, Thie Slieau Whallian, Foxdale Road, St John's, Isle of Man, IM4 3AS.

The Synthetic Phylogeny of the Decapod Crustaceans: Insights to Conservation and Extinction

Oral CBF

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Phylogenetic systematics is heading for a renaissance where we shift from considering our phylogenetic estimates as a static image in a published paper and taxonomies as a hardcopy checklist to treating both the phylogenetic estimate and dynamic taxonomies as metadata for further analysis. The Open Tree of Life project (opentreeoflife.org) is developing synthesis tools for harnessing the power of phylogenetic inference and robust taxonomy to develop a synthetic Tree of Life. We demonstrate this approach and the insights that come from such a synthetic tree using decapod crustaceans. After a 5 year effort to estimate phylogenetic relationships, build and revise taxonomies, and integrate phylogenetic work by researchers from around the world, we use these newly developed synthesis tools to estimate a comprehensive phylogeny for the decapod crustaceans, document areas in need of future phylogenetic work, and explore diversity patterns through time and space for the major decapod lineages. We explicitly map IUCN Red List categories across the freshwater crayfish clade to examine conservation assessment efforts and phylogenetic distribution of species of concern. We identify a number of species of special concern based on a combination of endangerment and phylogenetic distinctiveness.

Assemblage structure of deep-water benthic and benthopelagic decapod crustaceans below the oxygen minimum zone in the southern Gulf of California and relationships with environmental drivers

Oral GS

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The composition of benthic and benthopelagic decapod crustaceans of the continental slope of the southern Gulf of California (SE Pacific) was analyzed below the Oxygen Minimum Zone (OMZ) (HELLY & LEVIN, 2004) at depths ranging from 785 to 2235 m. Samplings were performed in 2000-2001 with a benthic sledge. Environmental variables (temperature and oxygen) were collected at near-bottom. Additionally, total organic carbon in sediments was analyzed and surface production 1-6 months before the samplings was obtained from satellite data. The relationship between abundance patterns and environmental variables was explored using multivariate techniques. A total of 28 species were collected. Decapod crustaceans were absent in 20% of the samples, probably due to the patchy character of deep ecosystems. The community structured as a function of depth and three main assemblages (800-1000 m; 1000-1300 m; >1300 m) were detected (Fig. 1). The shallowest assemblage was dominated by low-mobile species (i.e. *Munidopsis depressa*), and more natatory species (e.g. *Acantephyra brevicarinata*, *Benthesicymus tanneri*) with higher metabolic rates (SEIBEL & DRAZEN, 2007) dominated deeper. Abundance of decapod crustaceans was greatest at shallower depths, but maximum biomass was at 1000-1300 m, which suggests the presence of larger individuals at this depth interval. Diversity was also greatest at 1000-1300 m, at intermediate values of oxygen and temperature. The distribution of decapod crustaceans was mainly driven by oxygen availability, which increased with depth below the OMZ core probably enabling the presence of more mobile species deeper. Temperature and surface production prior to samplings (2 and 5 months) were also important drivers of decapod crustaceans assemblage structure, as observed in other parts of the world (FANELLI et al., 2013).

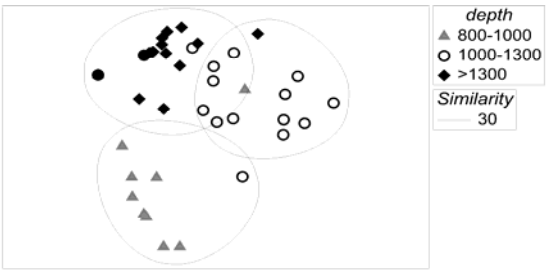

Fig. 1. nMDS ordination plot of abundance data from sled catches. Black circles define clusters at 30% level of similarity, based on cluster analysis.

References

FANELLI, E., CARTES, J.E., PAPIOL, V. & LOPEZ-PEREZ, C. (2013). Environmental drivers of megafaunal assemblage composition and biomass distribution over mainland and insular slopes of the Balearic Basin (Western Mediterranean). Deep-Sea Research I 78: 79-94.

HELLY, J.J. & LEVIN, L. (2004). Global distribution of naturally occurring marine hypoxia on continental margins. Deep-Sea Research I 51: 1159-1168.

SEIBEL, B.A. & DRAZEN, J. C. (2007). The rate of metabolism in marine animals: environmental constraints, ecological demands and energetic opportunities. Philosophical transactions of the Royal Society B 362: 2061-2078.

Effective Sperm Competition Avoidance in the Crab *Metacarcinus edwardsii:* Polyandry Mating but Genetic Monogamy.

Poster

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In polyandrous species with female storing sperm in a specific structure (i.e. seminal receptacle) sperm competition is typically strong but in the same time, males develop divers strategies to ensure single paternity (PARKER, 1984). From this balance, patrons of mating systems appear as a key component of the biology of the sexual organism. This research describes the mating systems from a highly exploited crab species (*Metarcinus edwardsii*), integrating 1) the individual level; by assessing the mating behavior in a potential polyandry scenario, 2) organ level; by examining histological sections of seminal receptacle from localities with contrasting fishery pressure (i.e. a proxy for sex ratio), and 3) molecular level; by measuring the number of parents involved in a egg clutch with the use of polymorphic microsatellite. Multiple mate (20% of females) and a important abundance of receptacle with more than one ejaculate was found in all localities regardless the fishery intensity. Conversely to expected with the multiple mating, genetic analysis revealed the presence of only one male as a father of all progeny in each egg clutch. Multiple mating without a direct consequence in genetic diversity in the progeny can trigger a sexual conflict: Males compete strongly to be the single male that mate with a receptive female, spend energy in guarding behavior and losing opportunities to get more mates, but females are beneficed by multiple mating by a prolonged guarding behavior, protecting them from predation after molt (soft shell period). The mating system of *M. edwardsii*, is define as female polyandry with genetic monogamy, this can be a common system in species with high level predation and sperm competition with last precedence. FONDECYT 1110445

Reference:

PARKER, G.A. 1984: Sperm competition and the evolution of animal mating strategies. In Sperm competition and the evolution of animal mating system. Smith R.L. editor. Academic Press, San Diego, Califoria. 2-60.

Report on the three species of the genus *Lebbeus* (Crustaea: Decapoda: Hippolytidae) from Gangwon Province, the East Sea, Korea

Poster

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Lebbeus WHITE, 1847, the most speciose genus of the family Hippolytidae, consists of 63 species worldwide. Members of the genus are discovered at the entire oceanic geographical regions including tropic and polar region, but they are mostly found in North Pacific region. These species of *Lebbeus* live in shallow to deep water, and hydrothermal vents. Some species often are associated with other invertebrates such as sea urchin, sea lilies, and jelly fish. In the course of faunal study on the Korean hippolytid shrimps, three species were collected from the northernmost region of the East Sea, Republic of Korea from 2011 to 2014: *Lebbeus kuboi* HAYASHI, 1992, *L. longipes* (KOBJAKOVA, 1936), and *Lebbeus* sp. *L. kuboi* and *L. longipes* have been known to live in the Sea of Okhotsk and eastern part of the East Sea. They were collected from continental shelf in depths of 100 to 300m by the shrimp-potting of fisher-boat. These two species are first reported from Korea. Three females of *Lebbeus* sp. were collected by scuba diving in depth of 34m. They were found in the artificial fishing banks with other shrimps: *Eualus leptognathus, E. kikuchi,* and *Spitontocaris prionota*. This *Lebbeus* sp. is morphologically most similar to *L. groenlandicus* by having abdominal somite with angular shape, but is easily distinguished from *L. groenlandicus* by abnormal rounded epipod on the third pereopod, different number of teeth of first to fifth abdominal pleura, and different location of dorsal rostral teeth. A brief note on the taxonomy and distribution of these three species is also provided. The specimens examined in this study are deposited in the Marine Arthropod Depository Bank of Korea (MADBK), Seoul National University.

References:

HAYASHI, K. (1992): Studies on the hippolytid shrimps from Japan -VIII. The genus *Lebbeus* White. Journal of Shminoseki University Fisheries, 40: 107-138.

KOMAI, T., HAYASHI, K. & KOHTSUKA, H. (2004): Two new species of the shrimp genus *Lebbeus* White from the Sea of Japan, with redescription of *Lebbeus kuboi* Hayashi (Decapoda: Caridea: Hippolytidae). Crustacean Research, 33: 103-125, 2004

NYE, V. (2013) New species of hippolytid shrimps (Crustacea: Decapoda: Caridea: Hippolytidae) from a southwest Indian Ocean seamount. Zootaxa, 3637 (2), 101-112

Histological contributions to the knowledge of ovarian developmental cycle of narrow- clawed crayfish, *Astacus leptodactylus* (ESCHSCHOLTZ, 1823) in Romania

Poster

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Narrow-clawed crayfish has a wide distribution in Romania, recorded in the west, east as well as in the south and northernmost areas. But the anthropogenic effect, pollution and potentially invasive carriers of pathogens could alter or diminish their areal. The study was conducted between October 2012 and September 2013 and several females were collected during each month. Gonadosomatic index and length-weight relationship were obtained. The general structure of the ovary was described using the hematoxylin-eosin-alcian blue staining and light microscopy. Cell measurements were taken for each type of oocyte from three consecutive slides, for each individual. Ovaries consist of two anterior and one posterior lobe, which are covered by thin epithelium and connective tissue layers. The germinal epithelium (germarium) from which the oogonia and follicle cells are derived lies centrally in the ovarian lobes. Oocytes were classified by diameter and histochemical characteristics in: oogonia, early previtellogenic, late previtellogenic, early vitellogenic, late vitellogenic, mature, spent and oobsorptive. Biometrical comparisons between these eight developmental stages of the ovarian follicles and the structural differences between each category of oocytes help in offering a better description of the female narrow-clawed crayfish gonad and the changes that occur from proliferative during spring and summer seasons to rapid accumulation of yolk proteins during autumn and winter seasons. This data points to a slightly particular ovarian cycle in this species which could be influenced by the physico-chemical parameters of their specific environment.

Phylogenetic position of the Tantulocarida: molecular and morphological approaches.

Oral GS

ALEXANDRA S. PETRUNINA & GREGORY A. KOLBASOV

Tantulocarida is a group of the smallest parasitic crustaceans recognized as a separate class only in 1983. They have a remarkably complex life cycle including both free-swimming and ectoparasitic stages, while reproduction involves both sexual forms and parthenogenesis. The complex life cycle, the minute size of all stages and the difficulties in sampling live specimens all combine to impede comprehensive studies of these crustaceans. Due to the parasitic mode of life tantulocaridans present few morphological characters that could be used to indicate their relationship among Crustacea. Therefore molecular datasets would be an obvious alternative, but until now DNA sequences of tantulocaridan species have not been available. A more precise hypothesis is that the Tantulocarida are closely related to the Thecostraca, a class including Ascothoraciada, Cirripedia and Facetotecta. Possible synapomorphy for such a relation is the position of male and female gonopores. Complete 18S rDNA sequences of two species of the Tantulocarida from the White Sea were obtained for the first time and used for estimating the relationship of the class with other Crustacea. Tantulocarida were proved to be very close relatives of the class Thecostraca. Moreover, with lower confidence the Tantulocarida are also indicated as nested within the Thecostraca, being sistergroup to the Cirripedia. The cement gland of the tantulus larva and the cirripede cyprid might be homologous structures, but similarities in host infection and root systems between the Tantulocarida and the Rhizocephala are likely to be homoplasies evolved by convergent evolution into advanced parasitism. The precise position of the Tantulocarida must be pursued by a more extensive database of genetic markers.

Long-term changes in crustacean communities on sandy beaches of the Eastern Gulf of Thailand

Poster

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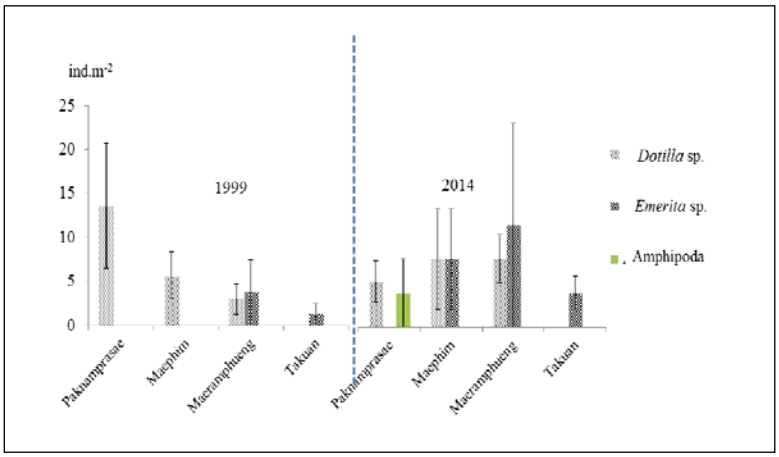
This study aimed to investigate long-term changes in sandy beach ecosystems with focusing on the relationships between macrobenthic community and the environmental factors, i.e. beach profile, median grain size, organic content of sediment, salinity, pH and temperature of surface water. Temporal changes in crustaceans were carried out at four sandy beaches of Rayong Province, the Eastern Gulf of Thailand. The monitoring program was divided into two periods. The initial study period was conducted in 1999 and re-sampled again in 2014 using the same gear and techniques. Three major crustacean species were recorded i.e. soldier crab *Dotilla* sp., mole crab *Emerita* sp. and amphipods. Soldier crabs *Dotilla* sp. were found at Paknamprasae Beach, Maephim Beach and Maeramphueng Beach. *Emerita* sp. was found in all beaches, except at Paknamprasae Beach.The amphipods were rare species, found only at Paknamprasae Beach. The densities of crustaceans were low in both periods. Regarding the long – term temporal change, the density of dominant species, *Dotilla* sp. (13.58 $\pm$ 7.11 ind.m^2) at Paknamprasae Beach was much higher than that found in 2014 (4.94 $\pm$ 2.24 ind. m^2). The zonation of *Dotilla* sp. was found at supralittoral and littoral zones. The amphipods were found at supralittoral zone while *Emerita sp*. was found at littoral and sublittoral zones. In addition, the relationship of crustacean assemblages and organic content of sediment was also found. However, the knowledge on long-term changes of sandy beach ecosystem is quite scarce in this region, the researches related to sandy beach ecosystems in various aspects in details are urgently required.



Legend: Comparision of the density of crustaceans in 1999 and 2014

References:

LABRUNE, C., GREMARE, A., GUIZIEN, K., & AMOUROUX, J.M.. (2007): Long-term comparison of soft bottom macrobenthos in the Bay of Banyuls-sur-Mer (north-western Mediterranean Sea): A reappraisal. Journal of Sea Research, **58**: 125–143.

NADERLOO, R., TÜRKAY, M., SARI, A. (2013): Intertidal habitats and decapod (Crustacea) diversity of Qeshm Island, a biodiversity hotspot within the Persian Gulf. Marine Biodiversity, 43:445–462.

Environmental change as a driver of diversification in temporary aquatic habitats

Oral BR

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Over the past 65my, the Australian continent experienced a pronounced shift from predominantly wet, tropical, conditions to a much drier climate. Little is known, however, about the effect of this important continent wide event on freshwater organisms and ecosystems. Fairy shrimps (Crustacea; Anostraca) are ancient and specialist inhabitants of temporary and saline aquatic habitats that typically prevail under semiarid conditions. Therefore, they present suitable evolutionary models to study scenarios of historic environmental change and the impact of a drying climate on aquatic ecosystems in particular.

Focussing on both macro- and micro-evolution in the fairy shrimp genus *Branchinella* using mitochondrial DNA data (16S and COI), we evaluated whether patterns of contemporary genetic variation reflect historic climate change.

There is a close match between episodes of Cenozoic climate change and macro- evolutionary diversification in Australian fairy shrimps, presumably mediated by a progressive increase in the abundance and diversity of temporary aquatic habitats on the continent. Micro-evolutionary patterns reflect both range expansion and recent contraction, linked to extreme drying events during the Pleistocene glacial periods.

This study effectively illustrates the potential long term effects of environmental change on the diversity and the evolutionary trajectories of the fauna of temporary waters. Moreover, it demonstrates the importance of adaptation to new environments and non-adaptive processes, such as divergence in isolation, for explaining extant diversity patterns in this particular environment.

Decapod larval communities along the northern Gulf of Cadiz in relation to transport processes between the Mediterranean Sea and the Atlantic Ocean

Oral EMC

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Decapod crustaceans species include many exploited marine species with high commercial value and large investments have been made to study their biological cycles. However, larval retention and dispersal mechanisms are lacking fundamental information due to the complex processes involved and the need of interdisciplinary studies. This knowledge is fundamental for sustainable use of exploited species, definition of marine protected areas and for coastal management plans.

To understand the mechanisms involved in the retention, dispersal and connectivity range of invertebrate larvae, we analyzed data on decapod larvae, and ocean water masses from summer surveys in three areas along the Gulf of Cadiz and the Western Mediterranean Sea.

Our results showed similar decapod larval communities across the sampling area mainly constituted by larvae from coastal benthic species, although some pelagic and deep-water species can also be significant. The origin of larvae, the adult habitats, the larval vertical displacement range and the larval cycle duration are key environmental and behavioural factors controlling dispersal range, promoting retention in the area. The most abundant larval species were distributed in the upper 50-75 m. We hypothesize that the main water masses affecting decapod larvae dispersion during summer are waters associated with coastal upwelling and inner shelf counter currents, in the case of the northwestern Gulf of Cadiz (south coast of Portugal), and the Atlantic inflow in the Alboran Sea (western Mediterranean Sea).

References:

CHAMPALBERT G (1996) Characteristics of zooplankton standing stock and communities in the Western Mediterranean Sea: relations to hydrology. Sci Mar 60 (S2): 97 – 113

ECHEVARRIA F, LAFUENTE JG, BRUNO M, GORSKY G, GOUTX M, GONZÁLEZ N, GARCÍA CM, GÓMEZ F, VARGAS JM, PICHERAL M, STRIBY L, VARELA M, ALONSO JJ, REUL A, CÓZAR A, PRIETO L, SARHAN T, PLAZA F, & JIMÉNEZ-GÓMEZ F (2002) Physical-biological coupling in the Strait of Gibraltar. Deep-sea Res II 49: 4115 – 4130

GREZE VN, KOVALEV AV, BALDINA EP & BILEVA OK (1985) Zooplankton transfer through the Gibraltar Strait and peculiarities of its taxonomic composition and distribution in adjacent areas. Inv Pesq 49 (1): 3 - 13

PELIZ A, BOUTOV D, CARDOSO RM, DELGADO J & SOARES PMM (2013) The Gulf of Cadiz-Alboran sea subbasin: Model setup, exchange and seasonal variability. Ocean Modelling 61: 49 - 67

Liocarcinus corrugatus – a cosmopolitan crab?

Oral GS

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Swimming crabs of the genus *Liocarcinus* STIMPSON, 1871 occur with 11 valid species in the Northeast-Atlantic and in the Mediterranean Sea. Only one species, *Liocarcinus corrugatus* (PENNANT, 1777) has an extraordinary large distribution range reaching into the Indo-West-Pacific and the China Sea. This study investigates if *L. corrugatus* actually is a brachyuran crab with a global distribution, or if the Atlantic (European) and Pacific (Asian) specimens are two separated species. Therefore specimens from nearly the entire distribution range were investigated morphologically (gonopods), morphometrically (linear measurements and shape variation) and phylogenetically with molecular markers (partial 16S rRNA, tRNALeu, ND1, COX1, H3). Results show that the Asian and European *L. corrugatus* cannot be distinguished by first gonopods and traditional morphometry. Comparisons of shape revealed that European specimens have a wider carapace than the Asian specimens. Finally, a phylogeny of *Liocarcinus* and related species shows good support for the split between an eastern and a western clade of *L. corrugatus* that diverged 1.2 - 2.8 Mya.

Peracarida Crustacean Populations of Three Mediterranean Harbours

Poster

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The increase of commercial and tourist traffic in Mediterranean ports requires port authorities to develop strategies of management and conservation to ensure both the development of tourism and the protection of natural resources. This entails the need to know spatial variability patterns in macrobenthic assemblages, and to be aware of the mechanisms that dominate the marine environment in harbours.
Peracarida is an important component of the marine benthic soft sediment community. Due to the great variation of their life traits (e.g. habitat, feeding type, sensitivity and response to stress) Peracarida can be a good indicator of changes to the environment caused by anthropogenic stress.
Quantitative samples were taken during three seasons: in February (before the tourist season), in May (at the beginning of the tourist season) and in September (at the end of the tourist season). The samples were taken from soft sediments in a number of stations differing in location and human use in three ports in the Mediterranean (five stations in Cagliari, Italy; three stations in El Kantaoui, Tunisia; four stations in Heraklion, Crete).
The examination of approximately 6087 specimens of Peracarida revealed that Amphipoda were the most abundant group dominated by the species: *Pseudolirius kroyeri, Medicorophium runcicorne and Apocorophium acutum.*
Peracarida abundance, biomass and species number were at their highest during May, at the beginning of the tourist season, probably due to recruitment. Subsequently univariate/multivariate statistical methods were used in order to investigate community patterns among different sampling sites.

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Molecular phylogeny and the geographic origins of Neotropical freshwater crabs of the family Pseudothelphusidae (Crustacea, Brachyura)

Oral CTF

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Primary freshwater crabs comprise more than one fifth of the total diversity of described brachyuran crabs and are distributed throughout the tropical and subtropical regions of the world. Their complete independence from the marine realm and their limited dispersal capability between river systems, resulting from a direct development following the loss of planktonic larval stages, leads to a high degree of endemism. Consequently, the phylogenetic pattern of freshwater crabs often reflects the palaeogeographic or palaeoenvironmental history of their range. The Neotropical freshwater crab family Pseudothelphusidae consists of approximately 278 described species and is distributed from Mexico in the north to the southern tributaries of the Amazon, also occurring on most Lesser and Greater Antilles. In the absence of a robust phylogeny, only scarce knowledge of pseudothelphusid origins and range evolution is available. In the last comprehensive revision of the Pseudothelphusidae, two subfamilies have been recognized, the Epilobocerinae on the Greater Antilles Cuba, Hispaniola and Puerto Rico, and the Pseudothelphusinae comprising all other Pseudothelphusidae. Two competing hypotheses on the origin and historical biogeography of the Pseudothelphusidae and the diversification of its subgroups have been put forward. Both hypotheses are based on morphology, especially on the supposed evolution of the male reproductive apparatus, namely the first pair of pleopods (gonopods) that are involved in sperm transfer. Here we present the first molecular phylogeny for the freshwater crab family Pseudothelphusidae with the aim of (1) evaluating the different morphology- based phylogenetic hypotheses of the family's relationship, and (2) testing the corresponding biogeographical scenarios against a time-calibrated phylogeny.

The larval nervous system of the barnacle *Austrominius modestus* (Darwin, 1854) (Cirripedia: Thoracica).

Poster

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The details of nervous system architecture are broadly used for the phylogenetic analyses in many invertebrate groups including Crustacea. The ever growing data in this area include descriptions of both adult and larval nervous systems within several crustacean groups. However, the main attention has always been paid to those of Malacostraca, while the data for other crustacean groups are rather scattered. For the current study we choose the late embryonic stages and the early nauplius stages of the sessile barnacle *Austrominius modestus*. We performed fluorescent immunocytochemical staining against acetylated-α-tubulin facilitated with confocal laser microscopy and computed 3D reconstruction.

The general anatomy of the naupliar nervous system corresponds mostly with that of other crustaceans. It comprises four paired central ganglia and a set of peripheral nerves running to different organs of the larva. The first three ganglia form a tri-partite brain arranged in a circumoesophageal ring. The protocerebral commissure has a characteristic architecture and can be subdivided into a prominent anterior portion, a slender posterior part, and a pair of dorsally placed globular neuropils, which are responsible for the innervation of the nauplius eye. The nauplius eye consists of five distinct units arranged in three cups. Some specific structures of the cirriped nauplius like frontolateral horns and headshield setae are innervated by intersegmental nerves. Additionally, current work provides more refined data compared to previous studies on the frontal filament complex, the stomatogastric nervous system, the limb innervations as well as the postnaupliar ventral nervous system.

The presented data are preliminary and can be later used for the ongoing discussions on the structure of the arthropod protocerebrum and the ventral nerve cord as well as the crustacean nauplius eye and the frontal filament complex.

Functional Morphology of Anomalan Chelipeds

Oral GS

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In most reptant decapods the first pereiopods are transformed into chelipeds for prey capture, defense, mating, grasping, clipping or holding etc. Some species additionally use their cheliped for burrowing or climbing. Here, we analyzed this varying employment of the chelae (the two distal elements of the cheliped) under functional morphological aspects. Function and biological role are two different aspects of the form-function complex in animals. With the development of new three dimensional techniques, biological function can be analyzed and subsequently compared to the realized biological roles in the interplay of the structure with its environment. We did µCT scans of the right cheliped of 12 Anomalan species, covering nearly the entire diversity of the taxon, and one thalassinidean and one brachyuran representative for out group comparison. 3D models were built from the µCT data and used for analyses by the finite element method (FEM) and 3 dimensional geometric morphometrics. The group of Anomala appeared particularly interesting because of their robust and disparate chelipeds. Geometric morphometry provides an excellent tool for representing the shape of the components of the chelipeds, propodus and dactylus, and FEA gives some indication for their functional capability without reference to the actual biological role. The cluster analysis shows that the function does not reflect the phylogenetic relationships.

Ten years into DNA barcoding of crustaceans: BOLD, BINs, and beyond

Oral MSI

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The last decade has seen a growth in the use of molecular methods for species identification, in particular DNA barcoding, which uses COI sequences (in animals) to assign unknown specimens to known species. A large amount of data has been generated so far (~3 million barcodes, March 2014), being stored in BOLD (The Barcode of Life Data System, www.barcodinglife.org). This online workbench offers the opportunity of linking specimen data (taxonomy, image, geography, habitat) with molecular data (multiple molecular markers) in a dynamic environment, which allows constant updates of the existing information together with various tools for data analysis and publication. Barcoding such a large and diverse group like crustaceans had inherent challenges resulting in a database of only ~66,000 sequences after a decade of research. These sequences represent 4,000 species names plus a large amount of unnamed specimens, still far away from reaching the target of 50,000 crustacean species described and 150,000 estimated worldwide. In this context, we propose and discuss the value of using the Barcode Index Number (BIN) system for a DNA-based registry of worldwide crustaceans. This system provides a fast and accurate clustering of COI sequences based on the RESL algorithm, using a 2,2% threshold between presumptive species. BINs provide fast-track for documenting biodiversity where taxonomic resources are scarce. Moreover, this system will help taxonomy by screening large amounts of data and highlighting those cases that need detailed investigation. For instance, 8,000 BINs are available for crustaceans in BOLD and a rapid initial investigation would require morphological identification of roughly 8,000 specimens as opposed to 66,000 screened through DNA sequencing.
A growing database, which follows specific standards for data quality, will certainly be useful for large-scale analyses in crustacean phylogeography, biogeography and biodiversity assessment and will offer support for technological advances such as next-generation sequencing.

Barcoding Crustacea: looking back and forward

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During the last years, DNA barcoding has become an effective molecular method for species identification regardless of the development stage of the analyzed specimen (Hebert et al., 2003). For (most) animals, the classical DNA barcode consists of a 658 base pairs (bp) fragment of the mitochondrial cytochrome *c* oxidase subunit 1 (CO1) gene. Most important, the idea of DNA barcoding relies on the concept that the intraspecific CO1 variation is lower than the interspecific variability, resulting in unique barcodes for each species.

Despite the fact that DNA barcoding has been criticized, feared, not accepted and/or simply not understood, DNA barcodes have become an important and increasingly used tool as part of an integrative taxonomy in modern species descriptions (YOSHIDA et al., 2011; CHEN et al., 2012; RIEHL & KAISER, 2012) as well as various other biological disciplines, e.g. ecology or conservation biology (WITT et al., 2007). Whereas DNA barcoding has been successfully used for the molecular identification of a broad variety of taxa, including fish (e.g. LAKRA et al., 2011), birds (e.g. TAVARES & BAKER, 2010) or various insect groups (e.g. HAUSMANN et al., 2011), studies analyzing crustaceans are still rare (e.g. COSTA et al., 2007; DA SILVA et al., 2011).

In my presentation I will give a summary of the use of DNA barcodes for the identification of crustaceans during the last eleven years and present latest data of our running project which focuses on the build-up of a comprehensive barcode library of the crustaceans of the North Sea. Furthermore, I will highlight alternative methods for a rapid species identification of crustaceans, e.g. the use of proteome data (LAAKMANN et al., 2013).

References:

CHEN, Y.-Y., LIN, H.C. & CHAN, B.K.K. (2012): Description of a new species of coral-inhabiting barnacle, *Darwiniella angularis* sp. n. (Cirripedia, Pyrgomatidae) from Taiwan. -- ZooKeys, **214**: 43-74.

COSTA, F.O., DEWAARD, J.R., BOUTILLIER, J., RATNASINGHAM, S., DOOH, R.T., HAJIBABAEI, M. & HEBERT, P.D.N. (2007): Biological identifications through DNA barcodes: the case of the Crustacea. -- Canadian Journal of Fisheries and Aquatic Science, **64**: 272-295.

DA SILVA, J.M., CREER, S., DOS SANTOS, A., COSTA, A.C., CUNHA, M.R., COSTA, F.O. & CARVALHO, G.R. (2011): Systematic and evolutionary insight derived from mtDNA COI barcode diversity in the Decapoda (Crustacea: Malacostraca). -- Public Library of Science ONE, **6**: e19449.

HAUSMANN, A., HASZPRUNAR, G. & HEBERT, P.D.N. (2011): DNA barcoding of the geometrid fauna of Bavaria (Lepidoptera): successes, surprises, and questions. -- Public Library of Science ONE, **6**: e17134.

HEBERT, P.D.N., CYWINSKA, A., BALL, S.L. & DEWAARD, J.R. (2003): Biological identifications through DNA barcodes. -- Proceedings of the Royal Society of London Series B: Biological Sciences, **270**: 313-321.

LAAKMANN, S., GERDTS, G., ERLER, R., KNEBELSBERGER, T., MARTINEZ ARBIZU, P. & RAUPACH, M.J. (2013): Comparison of molecular species identification for North Sea calanoid copepods (Crustacea) using proteome fingerprints and DNA sequences. -- Molecular Ecology Resources, **13**: 862-876.

LAKRA, W.S., VERMA, M.S., GOSWAMI, M., LAL, K.K., MOHINDRA, V., PUNIA, P., GOPALAKRISHAN, A., SINGH, K.V., WARD, R.D. & HEBERT, P.D.N. (2011): DNA Barcoding Indian marine fishes. -- Molecular Ecology Resources, **11**: 60-71.

RIEHL, T. & KAISER, S. (2012): Conquered from the deep sea? A new deep-sea isopod species from the Antarctic shelf shows pattern of recent colonization. -- Public Library of Science ONE, **7**: e49354.

TAVARES, E.S. & BAKER, A.J. (2010): Single mitochondrial gene barcodes reliably identify sister-species in diverse clades of birds. -- BMC Evolutionary Biology, **8**: 81.

WITT, J.D.S., THRELOFF, D.L. & HEBERT, P.D.N. (2007): DNA barcoding reveals extraordinary cryptic diversity in an amphipod genus: implications for desert spring conservation. -- Molecular Ecology, **15**: 3073-3082.

YOSHIDA, R., OSAWA, M., HIROSE, M. & HIROSE, E. (2011): A new genus and two new species of Peltogastridae (Crustacea: Cirripedia: Rhizocephala) parasitizing hermit crabs from Okinawa Island (Ryukyu Archipelago, Japan), and their DNA-barcodes. -- Zoological Science, **28**: 853-862.

On the Origin of Parasitism in Thoracica: the phylogenetic position of the pedunculate barnacle, *Anelasma squalicola*, parasitizing the velvet belly lantern shark, *Etmopterus spinax*

Oral BEP

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The parasitic barnacle, *Anelasma squalicola*, is found on deep-water sharks of the family Etmopteridae, or lantern sharks.

The barnacle is uncommon, but occur at an unusually high prevalence on the velvet belly lantern shark, *Etmopterus spinax*, in restricted fjord areas of western Norway. A phylogenetic analysis based on ribosomal DNA data (16S, 18S, and 28S) from 99 selected barnacle species, shows that *A. squalicola* is most closely related (sister taxon) to the pedunculate barnacle *Capitulum mitella*. *C. mitella* is a conventional suspension feeding barnacle from the rocky intertidal in south east Asia, and the phylogenetic analyses now makes it possible to establish morphological homologies between *A. squalicola* and its sister taxon. This provides an evolutionary framework, which can explain the unprecedented transition from a filter feeding barnacle to a parasitic mode of life.

Crab esterases can degrade plastic (PET) derivatives

Poster

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The term plastics comprises a set of highly stable polymers, mostly polyethylene (PE), polypropylene (PP), polyvinyl chloride (PVC), polystyrene (PS), or polyethylene terephthalate (PET). The latter (PET) is a member of the huge group of polyesters. It is used for the production of synthetic fibers, film, plastic containers or plastic bottles. Due to extensive use, these plastics are littered into the environment and accumulate in the oceans where they may be gradually crushed into smallest fragments, the so called microplastics. The biological potential to hydrolyze polyesters is generally assigned to bacteria or fungi (SHARON & SHARON 2012). Crustaceans, however, do also possess highly active and stable digestive enzymes which include ester hydrolases (esterases) (SABOROWSKI et al. 2004). Therefore, we studied the ability of crustaceans to hydrolyze polyester bonds.

We selected a number of decapod species and extracted the gastric fluid from the stomach and the midgut gland tissue. The samples were subjected to plate-clearing assays which contained diethylphthalate (DEP). Extracts showing activity were fractionated by liquid chromatography. The isolated enzyme was analyzed for its functional and molecular properties.

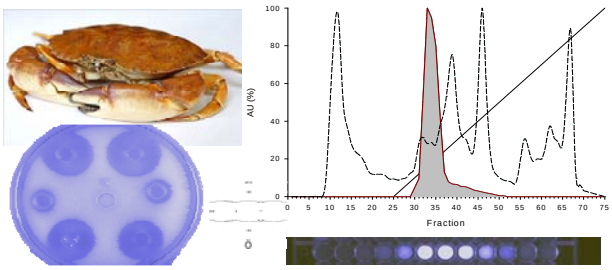

Figure 1: Midgut gland extracts of *Cancer irroratus* are capable of hydrolyzing diethylphthalate. A single enzyme was isolated by anionic exchange chromatography.

Two species, the Rock crab *Cancer irroratus* and the Sea spider *Hyas araneaeus*, showed DEP-activity. Since *C. irroratus* possessed only one distinct activity band we focused our research on this species (Fig. 1). The enzyme was only present in extracts of the midgut gland but not in the gastric fluid of the stomach. The apparent molecular mass of the native enzyme accounted for about 60 kDa. The enzyme was thermo-labile and inhibition by PMSF, a specific serine hydrolase inhibitor, was moderate. The enzyme did not depend on calcium or magnesium ions. The esterase of *C. irroratus* seems to be associated to the membranes of the midgut gland cells.

The ability to hydrolyze diethylphthalate does not mean that these crabs are adapted to digest plastic. It rather confirms the high catalytic potential of their digestive system. The natural function of these enzymes may be the degradation of alimentary ester compounds such as lipid or lipid derivatives (RIVERA-PÉREZ et al. 2004). Moreover, potent ester-hydrolases may be capable of eliminating secondary metabolites from the food which, otherwise, would impair the digestive process, the integrity of the digestive organs, or the health of the animal.

RIVERA-PÉREZ, C., GARÍA-CARREÑO, F.L., SABOROWSKI, R. (2011): Purification and biochemical characterization of digestive lipase in Whiteleg shrimp. Marine Biotechnology 13: 284-295.

SABOROWSKI, R., SAHLING, G., NAVARRETE DEL TORO, M.A., WALTER, I., GARÍA-CARREÑO, F.L. (2004): Stability and the effects of organic solvents on endopetidases from the gastric fluid of the marine crab *Cancer pagurus*. Journal of Molecular Catalysis B: Enzymatic 30: 109-118.

SHARON, C., SHARON , M. (2012): Studies on biodegradation of polyethylene terephthalate: a synthetic polymer. Journal of Microbiology and Biotechnology Research 2: 248-257.

Fish are key controls of arthropod assemblages in temporary semi-arid pools

Oral EMC

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Temporary pools are aquatic environments found in semi-arid biomes. The formation and persistence of these environments are heavily dependent on environmental conditions, especially rainfall and temperature, being one of the most threatened environments by climate change. These pools offer essential ecosystem services and are home to diverse biota, and their conservation relies on the understanding of how these aquatic systems respond to environmental variability. In this study we investigated the effect of environmental variability on biota assemblages of temporary pools in the semiarid region of the Northeastern Brazil. In this region, temporary pools are found on the top of rock formations (rock pools) and on riverbeds of intermittent streams and rivers during the dry season (stream pools). We sampled the biota of 24 rock pools during the wet season (June 2013), and during the following dry season (September 2013), when only 4 of these pools remained. Temporary stream pools were formed only during the dry season, and were sampled from October 2012 to January 2013. Arthopods were represented mainly by ostracods and insects in all temporary pools. The proportion of ostracods to insects was significantly different between rock pools and stream pools. Stream pools showed lower Ostracod to Insect ratios in comparison to rock pools. The arthropod assemblage structure in all rock pools was similar during the wet season, but during the dry season, rock pools with fish showed arthropod assemblages distinct from those pools without fish. Fish was recorded in all stream pools, but was present in only a few rock pools. Fish assemblages in stream pools were more diversified than in rock pools. The gut content of *Poecilia vivipara* (the most common fish predator in these environments) from stream pools showed that Ostracods and Cladocerans made most of the diet of these fish. Our results suggest the presence of fish in temporary pools is a key factor in determining the structure of arthopod communities in these environments. The lower proportion of ostracods to insects in stream pools is likely to be a result of higher predation pressure upon ostracods in stream pools in comparison to rock pools, which is probably a result of the higher diversity of fish assemblages in stream pools in comparison to rock pools.

Crustacean Disparity – challenges for Evolutionary Morphology

Oral GS

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Crustaceans display a particularly high degree of phenotypic disparity. Crustacean taxa differ in tagmatization, limb type, the presence or absence of a carapace and various other respects. Understanding evolutionary character transformations – which has been in the focus of evolutionary biology for the last 150 years – therefore poses a particular challenge. Within the framework of Evolutionary Morphology (Richter & Wirkner 2014), one important step is to identify those evolutionary units (characters) which are not just observations but which need to be conceptualized after description. As an example the entomostracan "abdomen" will be used, which shares the absence of limbs but differs in many other respects. The question here, therefore, is whether the "abdomen" (independently of the exact number of segments included) constitutes an evolutionary unit (having only evolved once) or any combination of limb-less segments?

One other goal of Evolutionary Morphology is to identify 'coherence' between evolutionary units (their non-accidental presence in the same organism) regardless of whether the mechanism responsible is external or internal. This will be exemplified by two case studies, (1) the evolution of cladocerans from a conchostracan-like ancestor, and (2) the evolution of a crab-like habitus in several anomuran (Decapoda, Anomala) lineages in an evolutionary process called carcinization.

In the first example, the Cyclestherida play a major role as the sister group to the water-fleas (Cladocera) because although they are a recent taxon they represent in many respects an intermediate step between clam shrimps and water fleas. In the second case study, I compare carcinization in king crabs (Lithodoidea) with that in porcelain crabs (Porcellanidae). The question I ask is whether or not certain aspects of internal anatomy evolved along with the external shaping into a crab.

References:

FRITSCH, M., BININDA-EMONDS, O.P.R., RICHTER, S. (2013): Unraveling the origin of Cladocera by identifying heterochrony in the developmental sequences of Branchiopoda. Frontiers in Zoology 2013, 10:35

KEILER, J.; RICHTER, S.; WIRKNER, C.S. (2013): Evolutionary Morphology of the hemolymph vascular system in hermit and king Crabs (Crustacea: Decapoda: Anomala). Journal of Morphology 274:759–778.

RICHTER, S.; WIRKNER, C.S. (2014): A research program for Evolutionary Morphology. Journal of Zoological Systematics and Evolutionary Research. In press.

Multiple offshore-onshore colonizations by deep-sea macrostylids (Asellota: Isopoda)?

Oral GS

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Macrostylidae HANSEN, 1916 is a common and ubiquitous taxon of the deep-sea benthos (bottom-living fauna). While most macrostylid species have been found in the abyssal region (3000–6000 m depth), some have been recorded in relatively shallow waters of the cold Antarctic, Arctic as well as Boreal regions (see e.g., Sars 1899; Riehl & Kaiser 2012). This makes them an ideal model for studying evolutionary question, particularly shelf versus deep-sea colonizations.

Macrostylids are considered to be amongst the descendants of the first isopod lineage to colonize the deep sea with their origin lying more than 250 million years in the past (LINS et al. 2012). Applying a combination of taxonomic and phylogenetic approaches, DNA data and morphology, I studied macrostylid characters, developed homology concepts for morphological traits, and inferred both, the position of Macrostylidae amongst Janiroidea as well as within-family relationships.

The findings from the phylogenetic analyses of shallow-water macrostylids from the Antarctic, off the coasts of Western Australia, and from the North Atlantic revealed that these shallow-water species were only distantly related. This result suggests that the shelves have been colonized from the deeper waters multiple times independently. As a further result, the isopod family Macrostylidae is revised.

Using macrostylids as a model group, I could show that the deep sea seems to be an important source of biodiversity for continental-shelf environments. Repeated shelf-deep-sea colonization processes (and vice versa) might have played a significant role in shaping deep-sea biodiversity. On the other hand, considering severe environmental changes that are thought to have made parts of the deep sea uninhabitable during the Mesozoic (JABLONSKI et al. 1983)), the continental shelves might have also acted as refuges for deep-sea fauna.

References:

HANSEN, H. J. (1916) Crustacea Malacostraca: The order Isopoda. *Danish Ingolf Expedition*, 3(5), 1–262.

JABLONSKI, D., SEPKOSKI, J. J., BOTTJER, D. J. & SHEEHAN, P. M. (1983) Onshore-Offshore Patterns in the Evolution of Phanerozoic Shelf Communities. *Science*, 222(4628), 1123–1125.

LINS, L. S. F., HO, S. Y. W., WILSON, G. D. F. & LO, N. (2012) Evidence for Permo-Triassic colonization of the deep sea by isopods. *Biology Letters*, 8(6), 979–982.

RIEHL, T. & KAISER, S. (2012) Conquered from the deep sea? A new deep-sea isopod species from the Antarctic shelf shows pattern of recent colonization. *PLoS ONE*, 7(11), e49354.

SARS, G. O. (1899) *An account of the Crustacea of Norway: with short descriptions and figures of all the species: Isopoda*. (Cammermeyer, A., Ed.) Bergen: Bergen Museum.

The biogeography of *Caridina* (Caridea: Atyidae) in the Indo-Australian Archipelago

Oral CTF

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Caridina MILNE EDWARDS, 1837 is widely distributed throughout the Indo-West Pacific region, where it is abundant in various freshwater habitats including cave systems. With more than 250 described species, it is the most speciose genus of Atyidae and freshwater shrimps in general. *Caridina* is well represented in SE Asia, with both many widespread species and species with a more restricted distribution. The highest number of endemic *Caridina* (n=35 spp.) is found on the Indonesian island Sulawesi, followed by the Philippines. Marked differences in the number of endemic species between islands such as Sumatra, Kalimantan, Java, Sulawesi and New Guinea suggest that the species inventory of this region is fairly unbalanced and incomplete.

The biogeography of SE Asian *Caridina*, particularly the origin of the endemic species assemblages on Sulawesi and other parts of the Indo-Australian Archipelago (IAA), has been poorly studied to date. We here present the first comprehensive molecular phylogeny of *Caridina* from the IAA. Our data, based on sequences of two mitochondrial gene fragments (COI and 16S), reveal several interesting biogeographic patterns: (1) All endemic species that are restricted to single islands or parts of these have abbreviated larval development (estimated from egg size), while all species with a wide distribution throughout the IAA have prolonged larval development. (2) The evolution of abbreviated larval development and land-locked species (groups) has occurred several times independently, basically at least once on each island. The land-locked species of *Caridina* from Sulawesi, e.g., have their origin in two independent colonization events. (3) Similarly, each endemic troglomorphic cave lineage (different genera, but clustering within *Caridina*) in the Philippines and Sulawesi has a separate origin, again involving the independent evolution of abbreviated larval development. Including the cave lineage (*Marosina* CAI & NG, 2005), land-locked clades have evolved three times on Sulawesi alone. (4) The sister group relationship between the two land-locked clades from Sulawesi and clades with abbreviated larval development from mainland SE Asia or Java offers the theoretical possibility of vicariance across Makassar Strait as an explanation for the origin of the endemic Sulawesi clades.

In addition, our molecular data suggest the existence of several undescribed land-locked species from both epigean and cave habitats. A more comprehensive taxonomic inventory of *Caridina* from the IAA and other parts of SE Asia should be a research priority and would help to gain a better understanding of the evolution of this important freshwater taxon in a region with an extremely high rate of anthropogenic habitat loss.

Morphological details of the zoea III of *Homarus gammarus* and the metamorphosis of the European lobster

Poster

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The American lobster *Homarus americanus* and the European lobster *H. gammarus* are sister species. Both species show a quite short, abbreviated larval phase with only three zoeal stages and one megalopa stage (decapodid, "post-larva"), as most other nephropid lobsters. Both species, according to literature, differ during their larval stages mainly through overall size and the shape of the chelipeds. Hence, the laval development of these species should be very similar.
We re-investigated the larval development of *H. gammarus* with a focus around the metamorphic moult between the last zoea and the megalopa. Specimens were documented with composite fluorescence microscopy, exploiting the autofluorescence capacities of the cuticle.
The development of different appendages does not occur in the same pace. Antennula and antenna develop gradually from zoea II to III, and make a "jump" towards the megalopa where the flagella gain significantly in length. Mandible, maxillula and maxilla hardly change, even their size gain is relatively small. The maxillipeds also hardly change in shape, but gain more size than the maxillula and maxilla. Hence, the entire feeding apparatus is far developed from early on. Posterior thoracopods gain size by elongating mainly the merus and propodus, and reduce the exopod in the moult to the megalopa. Yet, there is a certain degree of variation in how long the vestigial of the exopod is in the megalopa. Pleopods develop very gradually, as do the uropods.
While the overall morphology described in former studies is supported, our observations slightly deviate from former ones concerning certain details. First, the similarity between *H. gammarus* and *H. americanus* is not uniform throughout the sequence. Zoea II and megalopa look much more alike than the zoea III specimens. Here the difference between the two species is most significant. Zoea III of *H. gammarus* is significantly further developed than that of *H. americanus* and the morphological transition to the megalopa is more gradual in *H. gammarus*. We will discuss possible evolutionary interpretations of these findings.

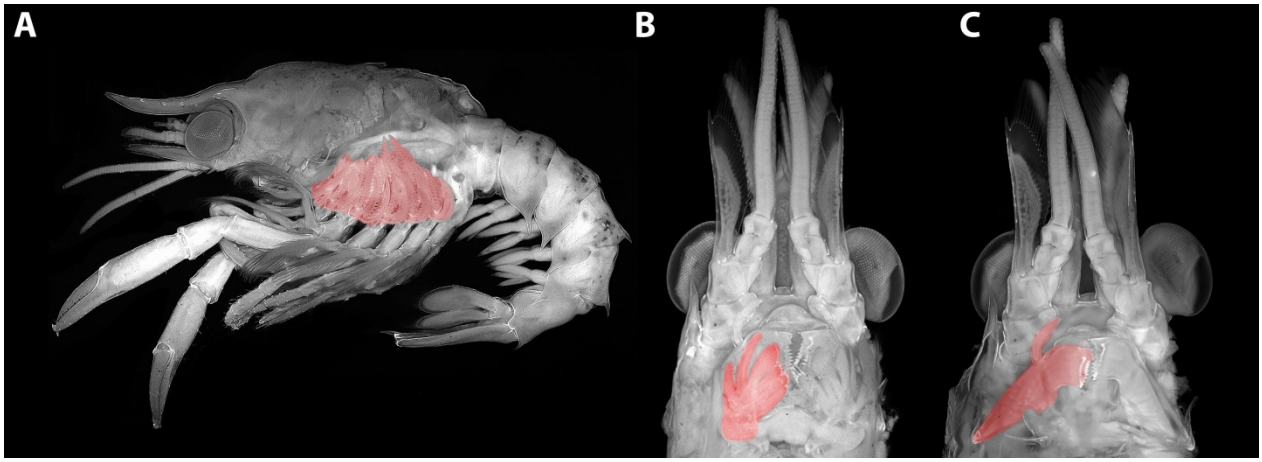

Figure. Details of a zoea III of *Homarus gammarus*. A. Lateral view. Parts of carapace removed to reveal the gills. B. Ventral view. Maxillipeds removed to reveal the maxilla. C. Ventral view. Maxillipeds, maxilla and maxillula removed to reveal the mandible. Structures colour-marked in the electronic version.

Relating anostracan distribution to physical habitat characteristics in North America (Crustacea: Branchiopoda)

Oral BR

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Nine anostracan biogeographical regions are defined for North America: Appalachia/Ozark, Southwest Arid, Great Plains, Coastal Plain, Neotropical, California, Cold Deserts, Beringia/Canadian Shield, and Transmontane. These regions are quantitatively defined using species distributions compared through Jaccard's Coefficient of Community Similarity and substrate geochemical components (%$CaSO_4$*H2O, %$CaCO_3$, salinity, and dominate salt cations), and in relation to climate. Relationships between these parameters and the distributions of all 63 US species were discovered. Similar relationships were found for species assemblages as well. Community assemblages are quantified using Fager's Index of Recurring Species Groups. The average Fager's Index for each bioregion, as well as the percentage of taxa co-occurring, generally decreases with the length of geologic time the region has been available for colonisation. The strong Fager's Index/colonisation time availability relationship suggests that the Monopolization Hypothesis of De Meester et al. may function at larger landscape scales. Furthermore, two widespread species were found to occur in very different habitat types in different biogeographical regions. Upon closer examination, these two taxa were each found to be comprised of more than one species.

Genetic variability of *Pagurus bernhardus* (Linnaeus, 1758) (Crustacea, Decapoda, Paguridae) in the Northeastern Atlantic Ocean

Poster

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Pagurid decapods are an abundant and ecological important benthic taxon of the North Eastern Atlantic Ocean. Anyway, there is only little knowledge about their demographic history and recent population structure. Here, it is unknown if the population of the North Sea and around the British Islands is homogeneous or descents from different lineages due to a recolonialisation after a Glacial Maximum from different refugia. In this study we analysed the genetic variability of *Pagurus bernhardus,* the most common and abundant pagurid in this area, using mitochondrial cytochrome *c* oxidase subunit I sequences. We calculated a phylogenetic haplotype network revealing the existence of a homogeneous population in the North Eastern Atlantic Ocean. This was also supported by F_{ST}-values, pairwise mismatch distribution as well as other indices like haplotype or nucleotide diversity.

How do microplastics impair Crustacea ?

Oral EMC

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Plastic pollution is an emerging global threat for wildlife. The various plastic polymers are very resistant against chemical or biological degradation. They accumulate in the environment and, particularly, in the oceans (THOMPSON et al., 2004). Reptiles, birds, or fishes may be killed by plastic litter after entanglement or ingestion of fragments. UV-radiation and mechanical abrasion crush plastic litter into small particles, referred to as microplastics. These microplastics can be ingested by a wide range of small animals from the bases of the food webs. Numbers of reports on microplastic ingestion by invertebrates is increasing (COLE et al. 2013). However, the uptake of microplastics by crustacean and their hazardous effects are not well investigated yet and, therefore, the aims of our investigations.

We added commercial fluorescent microbeads (0.1 to 10 µm in diameter), custom-made plastic fragments (up to 100 µm in size), and plastic fibers (up to 1000 µm in length) to the food of various crustacean species. The concentrations of the particles ranged between 12 and 350 per mg food. The uptake and the distribution of the microplastics within the digestive organs were studied by fluorescence microscopy and scanning electron microscopy. Bioassays were run with selected species to investigate the effects of acute microplastic exposition on survival and growth.

Plastic particles were readily ingested by different species of branchiopods, mysids, and isopods. Marine isopods, *Idotea emarginata*, were studied most intensively. Ingested microbeads (10 µm), fragments, and fibers were present in the stomach and the gut where they were evenly distributed (Fig.1). No particles were present in the midgut gland tubules. Apparently, the complex filter systems in the stomach prevent intrusion of particles in the µm range. The microparticles were egested at the same rate as they were ingested, indicating that the particles did not accumulate in the digestive organs of the animals. Exposition to microparticles over several weeks did not negatively affect the vitality of *I. emarginata*.

Fig. 1: Fluorescent microbeads in the gut of the marine isopod *Idotea emarginata*.

We conclude that the effects of microplastics on marine invertebrates are not consistent but depend on various factors such as size, deposition, and availability of plastics in the environments. Moreover, the feeding mode of the consumer, its physiology and internal anatomy are crucial for the deposition and the fate of microplastics within the organism (HÄMER et al. in press).

COLE, M., LINDEQUE, P., FILEMAN, E., HALSBAND, C., GOODHEAD, R., MOGER, J. & GALLOWAY, T.S. (2013): Microplastic ingestion by zooplankton. Environmental Science & Technology 47: 6646-6655.

HÄMER, J., GUTOW, L., KÖHLER, A. & SABOROWSKI, R. (2014): The fate of microplastics in the isopod *Idotea baltica*. Environmental Science & Technology (in press).

THOMPSON, R.C., OLSEN, Y., MITCHELL, R.P., DAVIS, A., ROWLAND, S.J., JOHN, A.W.G., MCGONIGLE, D., RUSSELL, A.E. (2004): Lost at sea: where is all the plastic? Science 304: 5672.

Appropriate Crab Pot Escape Vent Sizes for Blue Swimming Crab (*Portunus pelagicus*) Fishery in Southeast Sulawesi Waters, Indonesia

Oral GS

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The blue crab fishery in Indonesia has important contribution in providing job for fishermen and foreign exchange earnings from fisheries sector. Its uncontrolled exploitation has given a huge pressure. This phenomenon also happens in Southeast Sulawesi waters as shown its production was around 2,000 tons in 2000s and declined > 50% in 2012. The most rational and faster effort to tackle the pressure of blue crab population is to create a selective fishing gear in order some small sizes geting into a trap have opportunity of escaping, while only sizes needed retaine in the crab pot. Design of crab pot ("*bubu*") equipped with escape vent in the left and right sides (Figure 1) is hoped to overcome the problems due to small sizes may escape and return to the sea. Therefore, those small sizes of blue crabs have opportunity to grow and attain maturity stage and take reproduction to produce more offsprings. The aim of study on escape vent sizes which consisting of 3 sizes of 4,0 cm x 3,5 cm; 4,5 cm x 3,5 cm and 5,0 cm x 3,5 cm was to find out the appropriate escape vent size which only blue crab of ≥ 10 cm carapace width retaine in the crab pot, while blue crab of < 10 cm escape from crab pot and return to the sea. Each escape vent in the crab pot was equipped with a "codend" attached and tied using plastic rope in the vent. The test of escape vent sizes of crab pot was undertaken in three different fishing grounds of Southeast Sulawesi from December 2013 to February 2014. The number of crab pot tested was 50 units in the respective fishing ground which consisted of 17 units of each escape vent. Those crab pots were all tied in plastic main rope. In the respective of blue crab caught in the crab pot (retained) and escaped in the codend was identified its sex, measured its carapace length and width using caliper, wet weighed its body using electronic balance, and identified its gonad maturity stage and then all recorded in the data sheet. In the same time of crab pot inspection water parameters of temperature, salinity, pH, and transparency were also measured. The blue crab data obtained was analyzed using "the gear selection ogive" which formulated in the mathematic equation forming sigmoid curve (SPARRE & VENEMA, 1989).

Figure 1. Design of collapsible crab pot having two rectangular vescape vents (yellow dash circled) at the left and right sides (the dimension of 44 cm in length, 30 cm in width and 17 cm in height)

Based on an analysis of 3 escape vent sizes using "the gear selection ogive" were found an ideal and rational to be recommended is $L_{50\%}$ of 10.74 cm carapace width at the escape vent size of 5.0 cm x 3.0 cm. Blue crab in the Philippines reached size of matutiry of 10.56 cm for female and 9.64 cm male (INGLES & BRAUM, 1998; INGLES, 1996), while in Australian waters reached the first maturity of 9 cm for female and 7 cm for male. The present study recommended supports the recommendation of Indonesia Blue Crab Processing Association (APRI) of ≥ 10 cm and the recommendation of the Philippines government of > 10.16 cm.

References

INGLES, J.A. & E. BRAUM. (1989). Reproduction and Larval Ecology of the Blue Swimming Crab *Portunus pelagicus* in Ragay Gulf, Philippines. Int. Rev. Hydrobiol. 74:471-490.

INGLES, J.A. (1996). The Crab Fishery off Bantayan, Cebu, Philippines. Institute Mar. Fisheries and Oceanol.. 33pp.

SPARRE, P. & S.C. VENEMA. (1998). Introduction to Tropical Fish Stock Assessment. Part 1: Manual. FAO Fisheries Technical Paper No.306.1 Rev.2. FAO of UN, Rome. 407p.

Season-dependent secretory activity of Mandibular organ of a field crab (Brachyura; Decapoda): An Ultrastructural Study.

Oral GS

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Mandibular organ (MO) in decapods is suggested to play regulatory role in reproduction; in few species, however, MO is considered to control growth. The present study addresses this question by an ultrastructural study on the MO in the field crab, *Paratelphusa* sp.

Our sampling for consecutive years (2008 – 2012) revealed that *Paratelphusa* sp. devotes July – October for reproduction, judged by the occurrence of growing ovaries and the berried females. From November to the succeeding June, the females are in a state of reproductive arrest (non-reproductive period); ovaries during the season would appear as white bands with no signs of yolk deposition. Morphologically, MO of *Paratelphusa* sp. appears as a pale white, spherical shaped gland of approximately 1mm diameter, positioned posterior to the mandibles and in close apposition with the distal end of the mandibular apodeme. Histological examination reveals that the gland cells possess eccentric nuclei, with a high nucleo-cytoplasmic ratio. Our season-wise study reveals fluctuation in the gross morphology of MO; the gland attains the maximum size (1.5-2mm) during the reproductive period. Our electron microscopic observation reveals that the MO is highly secretory during the reproductive period, judged by the occurrence of sacculated Golgi bodies having dense inclusions within, several mitochondria with tubular cristae and profuse and extensive networks of SER and RER. During the non reproductive period, however, the MO is least active; RER, mitochondria and the golgi are hardly seen. Interestingly, the plasma membrane exhibits a highly convoluted appearance all the way through the non-reproductive period .With respect to the mode of release of the secretory materials, we failed to observe the signs of either apocrine or holocrine mode of secretion; presumably, the mode of release of the secretory product is merocrine.

The present study suggests that the secretory activity of MO of *Paratelphusa* sp. is entrained with reproductive activity. The existence of a high correlation between MO secretory activity and ovarian growth, implicates the former's role in reproduction.

Deep-sea invertebrates of New Zealand: diversity, tools and opportunities

Poster

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A recent inventory of the New Zealand Animalia (including vertebrates) by D.P. Gordon listed a total of ~35,000 terrestrial and aquatic species. Notably, only about a third of these (just over 13,000) are marine, despite the fact that the New Zealand marine realm is 15 times larger than its land mass. This difference becomes even more striking when one considers the deep-sea environment: not even 800 invertebrate species are known from depths >1500m, meanwhile, these deep waters cover more than 65% of the New Zealand Exclusive Economic Zone. The first deep-sea samples in this region were taken by the HMS Challenger in 1874 with intermittent extensive regional sampling since then. More recently, new technologies, including camera systems, are adding exciting new resources and opening up new opportunities.
We highlight the ongoing research efforts in the New Zealand deep sea (beyond the continental shelf), showcasing some of the technological advancements that are adding a wealth of information and data that in turn allow insights into deep-sea biodiversity and ecosystem functioning. While it is not surprising that the recognition of new taxa happens at a rate much faster than they can be described, some encouraging progress has been made over the last years. Nevertheless, the possibilities for discovery remain endless.

Strung up along the Kermadec Arc,
faunal changes along seamounts of a deepsea ridge in the Southwest Pacific

Oral GS

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The Kermadec-Tonga volcanic arc runs in a near north-south direction between Tonga and New Zealand and has been characterised as an archetypal intra-oceanic arc-back-arc system. It spans a diverse range of environmental oceanic and tectonic characteristics along its 2,500km course. WRIGHT et al (2006) interpret geochemistry data for seamounts of the southern half of the Kermadec arc and propose a separation into three segments (northern, southern and central) based on variations of lava chemistry. Very little information is available to date about the effects of the background geochemistry on the resident benthic assemblages. This study presents comparative analyses for seamount communities of arthropods, cnidarians, echinoderms and poriferans to examine compositional shifts along the arc between 25-37° southern latitudes. Extensive pre-analysis data treatment was carried out to ensure multivariate analysis of presence/absence assemblage data from seamount assemblage composition is robust. Various environmental variables are correlated with the assemblage pattern observed. Initial analyses support previous studies that found dissimilarity between seamount assemblages increased with increasing geographic distance. However, observed patterns don't appear to correspond with the geochemistry sectors proposed by WRIGHT et al (2006). Further research is required to establish the wider generality of these findings.

WRIGHT IC, WORTHINGTON TJ, &GAMBLE JA (2006) New multibeam mapping and geochemistry of the 30°-35° S sector, and overview, of southern Kermadec arc volcanism. Journal of Volcanology and Geothermal Research 149: 263-296.

Hidden diversity in munnopsid isopods revealed by integrative taxonomy

Oral MSI

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Among isopods as well as peracarids in general, the presence of species complexes is an obvious and reoccurring theme, especially since the increased use of DNA barcoding for morphologically undistinguishable species. An integrative approach of combining genetic and morphological data has been proven to be beneficial for asellote isopods (BRIX et al. 2014). Species complexes are known from previous studies in the case of several families e.g. Janiridae (CARVALHO & PIERTNEY 1997), Munnopsidae (WILSON 1982), Paramunnidae (JUST & WILSON 2004), Serolidae (HELD 2003) as well as from other peracarid crustaceans such as amphipods (LÖRZ et al. 2012). Munnopsidae is one of the largest isopod families known. The heterogeneity and complexity of the genus *Eurycope* within the subfamily Eurycopinae has been discussed by many authors and has not yet been completely revised (e.g. MALYUTINA & BRANDT 2006). Large collections of specimens belonging to the genus *Eurycope* were made during the two recent IceAGE expeditions (*Icelandic Marine Animals: Genetics and Ecology*). About 70 individuals of the putative species complex *Eurycope producta* were sampled and successfully sequenced for three molecular markers (COI, 16S and 18S). We hypothesize that populations of this species complex around Iceland are split by geographic region and water masses with different characteristics although the distribution of munnopsid species around Iceland shows a trend to be not significantly influenced by the abiotic factors temperature and salinity (SCHNURR et al. 2014).

References:

BRIX, S., LEESE, F., RIEHL, T. & KIHARA, T.-C. (2014): A new genus and new species of Desmosomatidae Sars, 1897 (Isopoda) from the east South-Atlantic abyss described by means of integrative taxonomy. *Marine Biodiversity***.** DOI: 10.1007/s12526-014-0218-3**.**

CARVALHO, G. & PIERTNEY, S. (1997): Interspecific comparisons of genetic population structure in members of the *Jaera albifrons* species complex. Journal Marine Biological Association United Kingdom, **77**: 77-93.

HELD, C. (2003): Molecular evidence for cryptic speciation within the widespread Antarctic crustacean *Ceratoserolis trilobitoides* (Crustacea, Isopoda). Antarctic Biology in a Global Context:135–139.

JUST, J. & WILSON, G.D.F. (2004): Revision of the *Paramunna* complex (Isopoda: Asellota: Paramunnidae). Invertebrate Systematics **18**: 377-466.

LÖRZ, A.-N., SMITH, P., LINSE, K. & STEINKE, D. (2012): High genetic diversity within *Epimeria georgiana* (Amphipoda) from the southern Scotia Arc. Marine Biodiversity, **42**: 137-159.

MALYUTINA, M. & BRANDT, A. (2006): A revaluation of the Eurycopinae (Crustacea, Isopoda, Munnopsidae) with a description of *Dubinectes* gen. nov. from the southern Atlantic deep sea. Zootaxa, **1272**: 1-44.

SCHNURR, S., BRANDT, A., BRIX, S., FIORENTINO, D., MALYUTINA, M. & SVAVARSSON, J. (2014): Composition and distribution of selected munnopsid genera (Crustacea, Isopoda, Asellota) in Icelandic waters. Deep Sea Research Part I: Oceanographic Research Papers **84**: 142-155.

WILSON, G.D.F. (1982): Systematics of a Species Complex in the Deep-sea Genus *Eurycope*, with a Revision of Six Previously Described Species (Crustacea, Isopoda, Eurycopidae). University of California Press, Berkley, Los Angeles, London.

Twisted, doubled, in the wrong place - the biological significance of crustacean malformations

Oral GS

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Naturally occurring malformations are not very frequent in Crustacea. Nevertheless, during the last 260 years or so a number of reports have accumulated in which a variety of patterns has been described. As with all malformations, unusual crustacean morphologies have always attracted human curiosity and interest. Accordingly, malformed crustaceans are found in old natural history collections, "Wunderkammern" (curiosity cabinets), and today in the internet. Aberrant structures have been described in embryos, larvae and adult crustaceans. Apparently, most malformations are not mutants at the genetic level but are caused by chemical and/or mechanical perturbations during development and regeneration. Most cases of observed malformed structures relate to crustacean appendages. These show various degrees of loss, fusion, or multiplications of branches or appendage segments. The most famous of these appendage aberrations are the so-called Bruchdreifachbildungen (triplication of structures after damage), often found at the claws of decapod crustaceans and reported already from the Early Jurassic. In addition, homeotic alterations such as antennae at the position of eyes clawed maxillipeds, and other limb types in "wrong" places have been reported. Trunk anomalies are comparatively rare. These relate to asymmetries, to missing or partly fused segments and hypertrophied segments or to the phenomenon of spiral segmentation. A special case are intersexes and gynandromorphs which show a combination of transformed appendages, in particular, gonopods and segmental structures such as gonopores. The most dramatic malformations concern the duplication of parts of the longitudinal body axis that leads to the occurrence of conjoined twins with different duplication patterns.
In my talk I present examples of malformations in crustaceans. The different cases will be classified and possible causes and mechanisms are discussed. A comparison within arthropods and with other animals will lead to a discussion about the significance of malformations for our understanding of evolutionary transformations.

The impact of resting egg banks and temporal dispersal on year-to-year changes in the genetic composition of adult populations and population differentiation in Spinicaudata (Branchiopoda)

Oral BR

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Resting eggs enable many taxa living in temporary aquatic habitats to endure adverse ecological conditions. By accumulating in the sediment, they build-up a resting egg bank from which all subsequent generations are derived. The actual population of a pond does not only include the hatched specimens (= one generation) but also all dormant resting eggs. Through the hatching of 'old resting' eggs, genotypes absent from previous generations may be re-introduced (termed temporal dispersal). Although resting eggs are easily dispersed, observed levels of genetic differentiation between populations are often high. This 'dispersal-gene flow paradox' has been explained by a combination of persistent founder effects and local adaptations of the resident population (Monopolization Hypothesis). Here the resting egg bank is assumed to act as buffer against effective dispersal and gene flow with newly arriving individuals having to compete with the whole resting egg bank.

We studied the genetic composition and differentiation of successive adult populations of two Spinicaudata species within a single Australian temporary pool by sequencing mitochondrial COI. The year-to-year genetic differentiation was compared to the differentiation among geographically neighboring populations. The species exhibited pronounced year-to-year differences in their genetic compositions, mainly due the occurrence of haplotypes not present in the preceding generation. This suggests that stochastic hatching of 'older' resting eggs was of greater importance for the formation of the adult population than the input from the preceding one.

Genetic differentiation between subsequent years was significant and of similar magnitude as between neighboring populations. Observed genetic differentiation between adult populations is here suggested to represent an artifact of stochastic hatching from a genetically diverse resting egg bank and not the result of limited gene flow as assumed by the Monopolization Hypothesis. This has important implications for population genetic and phylogeographic studies of taxa with resting egg banks: population differentiation might generally be a result of changes in the resting egg banks and not in their short-lived generations which are stochastic products.

Historical and spatial distribution of shell disease in shrimp in the North Sea

Poster

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Shell disease is an increasing problem affecting various freshwater and marine crustaceans. This syndrome is distributed worldwide and has a potential risk for both ecology and economy. Shell disease is caused by chitinoclastic or lipolytic bacteria which settle on the shell of their host, resulting in black erosive lesions and discolorations in the cuticle of the exoskeleton. The abundance and occurrence of black spot disease in brown shrimp (*Crangon crangon* (LINNAEUS, 1758)) was investigated in different locations in the North Sea from 1909 to 2014. The location and size of the lesions on each shrimp were analyzed with respect to sex and size of the organisms and subsequently correlated to locality and year.
Highest prevalence of shell disease was found in the 1980´s near the estuary mouth of Elbe and Weser.
Preliminary results show higher lesion incidence in larger shrimps whereas no differences between sexes were found.

Correlating morphological species with genetic units in the crab genus *Perisesarma* (Sesarmidae: Brachyura).

Poster

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Sesarmid crabs are among the most diverse and important faunal components of mangrove forest communities worldwide. Following recent taxonomic and phylogenetic studies, the family nowadays presents a stable monophyletic taxon. However, within-family phylogenetic relationships and taxonomic units are not fully resolved. One of the most conspicuous, speciose and also taxonomically complex genera of this family is *Perisesarma* DE MAN 1895 from African, Asian, and Australian mangroves, with the type species *P. dussumieri* A. MILNE-EDWARDS, 1853. This genus consists of species previously attributed to the subgenus *Sesarma* (*Chiromantes*) sensu TESCH (1917) and includes 22-24 species, among them three from western Africa which may have to be re-classified according to their morphological characteristics.
For the present study, we re-examined most species of the genus *Perisesarma* morphologically and characterized them molecularly with the mitochondrial markers Cox1 and 16S to establish the number of genetic units and to investigate, if their current species definition corresponds to these units. Our study reveals cases in which there are more genetic units than described and named species. On the other hand, we found cases in which more than one species name corresponds to the same genetic unit. Consequently, the genus is in need for further taxonomic work, as for example describing and naming new species or synonymizing some of the valid taxa.

Biodiversity of Indo-West Pacific fiddler crabs (genus *Uca*) revealed by DNA barcoding and DNA taxonomy

Oral MSI

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There are 102 extant species of fiddler crabs (Ocypodidae: genus *Uca*) in the world, with 44 recognised species belonging to six subgenera from the Indo-West Pacific region (updated from NG et al., 2008). In this study, the cytochrome oxidase subunit I (COI) sequences are used as the barcoding marker to test 43 of these species from the Indo-West Pacific. The results show that the COI supports 39 known species, with the identification success rate estimated at 91%. For species that cannot be separated by the COI marker, they are probably young and other markers with better resolution will need to be used. For example, *Uca boninensis* from Bonin (Ogasawara) Island, Japan can be separated from *U. crassipes* by mitochondrial control region (D-loop). Four closely related species: *U. borealis*, *U. dampieri*, *U. vocans* and *U. vomeris* cannot be discriminated by COI (and 16S), but *U. borealis* can be separated from the others by the nuclear internal transcribed spacer 1 (ITS-1). From the barcoding results, an additional 12 operational taxonomic units (OTUs) were revealed, which may suggest the presence of cryptic species. With regard to the Indo-West Pacific subgenera, the present study treats 17 species of *Tubuca* (with four cryptic species), 7 species of *Australuca*, 10 species of *Gelasimus* (excluding *U. formosensis* but with two cryptic species), 4 species of *Paraleptuca*, 1 species of *Cranuca* and 16 species of *Austruca* (with 6 cryptic species). More morphological studies are also necessary to confirm the identities of the 12 cryptic species. The present study supports the usefulness and efficiency of DNA barcoding in identifying Indo-West Pacific species of fiddler crabs, especially for juveniles and females.

References:

CRANE, J. (1975): *Fiddler Crabs of the World* (Ocypodidae: Genus *Uca*). Princeton University Press, Princeton, New Jersey. 736 pp.

NG, P. K. L., GUINOT, D. & DAVIE, P. J. F. (2008): Systema Brachyurorum: Part I. An annotated checklist of extant brachyuran crabs of the world. *The Raffles Bulletin of Zoology, Supplement* **17**: 1-296.

SHIH, H.-T., NG, P. K. L. & LIU, M.-Y. (2013): Systematics of the Indo-West Pacific broad-fronted fiddler crabs (Crustacea: Ocypodidae: genus *Uca*). *The Raffles Bulletin of Zoology* **61**: 641-649.

Amphipods Associated with Invertebrates from Korea

Oral GS

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Amphipods are known to be associated with various invertebrates such as ascidians, bryozoans, cnidarians, echinoderms, mollusks, sponges, and crabs. For amphipod species, the associations with other invertebrate are considered to be advantageous with respect to obtaining food resources from the hosts and using them as hiding places.

In Korea, there have been some reports on the amphipods associated with invertebrates. SHIN et al. recorded three gammaridean amphipods living in the mantle cavity of cultured abalones in 2005: *Ampithoe valida* SMITH, 1873, *Elasmopus rapax* COSTA, 1853 and *Melita rylovae* BULYCHEVA, 1955. Subsequently, in the current study the Korean species, *Melita anmyeonensis* SHIN, COLEMAN & KIM, 2013, was discovered to be associated with bivalve *Barnea dilatata* (SOULEYET, 1843). *Melita anmyeonensis* also lives inside the mantle cavity of the bivalve, and seems to be supplied with food and shelter from their host. Recently, two amphipod species, *Metopa* sp. and *Dactylopleustes* sp., are detected to be associated with invertebrates from East Sea of Korea. Of them, *Dactylopleustes* sp. is collected from the surface of the sea urchin *Mesocentrotus nudus* (A. AGASSIZ, 1863), and *Metopa* sp. is found inside the mantle cavity of a brachiopod species. There is not much known about the association between amphipods and brachiopods. In this study, we discuss the association between amphipod species and their hosts.

Figure: Photograph of the inner side of bivalve *Barnea dilatata*. The amphipod *Melita anmyeonsis* is found in the mantle cavity of the host.

References:

SHIN, M. H., C. O., COLEMAN, & W. KIM. 2013. Discovery of a new species of *Melita* (Amphipoda: Melitidae) associated with *Barnea dilatata* (Bivalvia, Mollusca) from South Korea. Journal of Crustacean Biology, 33(6): 882-893.

VADER. W. 1970. The amphipod, *Aristias neglectus* Hansen, found in association with Brachipoda. Sarsia 43:13-14.

VADER, W. 1972. Associations between amphipods and molluscs. A review of published records. Sarsia 48: 13-18.

VADER. W. 1978. Associations between amphipods and echinoderms. Astarte 11: 123-134.

Isolation and characterization of the functional domains of the Ecdysteroid receptor gene *(EcR)* from an estuarine crab (*Metopograpsus messor*) from the Indian peninsula.

Oral GS

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In crustaceans, molting is a seasonal event. It is well established that the cascade of events leading to the ecdysis proper is being regulated by ecdysteroid hormone. Recent research has shed light on the mode of action of the ecdysteroids on the target tissues. Although the ecdysteroid receptor (*EcR*) has been characterized and sequenced in several insect species, this aspect has been worked out only in few crustaceans. Keeping this in view, this paper presents the data on the sequence information of the DNA binding domain (DBD) and the ligand binding domain (LBD), the two major functional domains of the *EcR* gene isolated from the grapsid crab, *Metopograpsus messor* that inhabits the Muzhupilangad estuary of the Indian peninsula. Our sequencing analyses reveal that the EcRDBD of *M. messor* (*MmEcRDBD*) is 189bp long, while that of the LBD (*MmEcRLBD*) is 674bp long. Using the sequence alignment studies, the paper also discusses the phylogeny of this estuarine grapsid crab (*M. messor*). Significantly, this is the first report of the sequence information on the ecdysteroid receptor from a brachyuran crab belonging to grapsid family.

As we compare the nucleotide sequences of *MmEcR* LBD with other brachyurans crabs, *UpEcR* LBD appears to be the closest, the other species in the decreasing order of relatedness are, *Gecarcinus lateralis*, *Eriocheir sinensis, Scylla paramamosain, Carcinus maenas, Portunus tritiberculatus* and *Callinectes sapidus,* in 11 instances though, the nucleotide substitutions were found to be non-synonymous. Further, we examined if the discrepancy in amino acids (existing between EcRLBD) would affect the binding of the ligand (ecdysterone) through *in silico* docking studies involving the LBDs (3D – modelled ecdysterone) of the species. The study revealed that the binding efficiency of the LBD with the ligand (ecdysteroid) would not be disturbed in spite of the difference in amino acids.

References:

CHANG, E.S., MYKLES, D.L. (2011): Regulation of crustacean molting: A review and our perspectives.Gen.Comp. Endocrinol. **172**: 323–330.

DURICA, D.S., XIAOHUI, WU., ANILKUMAR, G., HOPKINS, P.M. & CHUNG, A.C.K. (2002): Characterization of crab *EcR* and *RXR* homologs and expression during limb regeneration and oocyte maturation. Mol. Cell. Endocrinol. **189**: 59–76.

SHYAMAL, S., SUDHA, K., GAYATHRI, K & ANILKUMAR, G. (2014): The Y-organ secretory activity fluctuates in relation to seasons of molt and reproduction in the brachyuran crab, *Metopograpsus messor* (Grapsidae): ultrastructural and immunohistochemical study**,** General and Comparative Endocrinology, Elsevier, **196**: 81–90, 2014.

SIRINART, T. & CHUNG, J.S. (2013): Ecdysone and retinoid-X receptors of the blue crab, *Callinectes sapidus*: Cloning and their expression patterns in eyestalks and Y-organs during the molt cycle. Gene, **527**: 139-53

Shrimp larvae from anchialine caves of Yucatan Peninsula, Mexico: development, morphology, and swimming behaviour

Poster

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Very little is known about shrimp larvae from anchialine caves and their development and swimming behaviour. Based on morphological studies and video-recordings, 36 caridean larvae collected from two anchialine caves (Cenote Mayan Blue and Cenote Naharon) of Yucatan Peninsula, Mexico, were studied with respect to the number of developmental stages and functional morphology in relation to swimming. 25 of these larvae were found to belong to the same species based on morphological evidence (*Typhlatya* sp.). Six different developmental stages of this species were recognized, which are termed zoea I-IV, decapodid, and postlarva, respectively. The development therefore seems to be abbreviated, which is further supported by the larvae having extensive amounts of yolk and undeveloped mouthparts, which indicate that they do not feed. The larvae are all collected from the upper freshwater part of the caves, which also correspond with the abbreviated development. Video-recordings show how the larvae are swimming in a backward manner with telson foremost. The swimming function is passed from anterior to posterior, with the larvae first using their maxillipeds, then additionally their pereopods, and later also their pleopods. Developmental stages with their uropods present are also observed to perform an escape response by rapidly bending the abdomen against the thorax, which sends the larva fast backward. The remaining 11 shrimp larvae found in the same caves deviate significantly in both size and/or morphology, which indicate that larvae of more caridean species are present in these caves.

Different developmental stages of caridean larvae (*Typhlatya* sp.) from anchialine caves of Yucatan.

Mating behaviour in laevicaudatan clam shrimp (Crustacea, Branchiopoda) and functional morphology of male claspers: a video-based analysis

Oral BR

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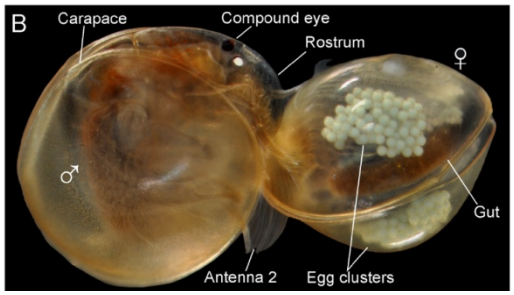
Very little is known about general mating behaviour of laevicaudatan branchiopods (clam shrimps), and almost nothing is known about functional morphological aspects of the way the male uses its anterior pair of trunk limbs, which are modified as claspers, to clasp the female during mating. Laevicaudata has, through phylogenetic studies, been shown to hold a key position in branchiopod phylogeny. Studies on mating and clasping of laevicaudatans are therefore of importance for understanding the general evolution of Branchiopoda. Based on morphological studies, several hours of video-recordings of general mating behaviour, and close-up recordings of clasper functionality in *Lynceus brachyurus*, we here present an overview. Males are observed to clasp to the carapace margin of females with a so-called "movable finger" assisted by a larger and a smaller palp, both placed in a very characteristic way at the carapace edge. Based on their movement pattern and setation, the palps are probably indirectly providing sensory input on the "finger" position. Males of *L. brachyurus* clasp both females with and without eggs and other males in a seemingly non-selective way. Fertilization is likely to be external but the specific timing for sperm transfer is not known for sure. However, during clasping males perform a "brushing" movement by moving their hind body and limbs up between the carapace valves of the female. This behaviour assists in spreading the female's carapace valves apart and must also be assumed to play a role in sperm transfer and egg fertilization. Egg extrusion is observed and it is shown that the tri-lobed lamellae at the sides of the female's hind body assist in guiding the egg mass to the tip of the egg-carriers (modified exopods) by which they are carried under the carapace. A brief comparative study of the claspers of a spinicaudatan clam shrimp shows both similarities and differences to the laevicaudatan claspers. The presence of two pairs of claspers in Spinicaudata seems to give males a better hold of the female which may play a role during extended mate guarding, which seems absent in *L. brachyurus.*



L. brachyurus (Lavicaudata). Male clasping female.

Reference:

SIGVARDT, Z.M.S & OLESEN, J. 2014. Mating behaviour in laevicaudatan clam shrimp (crustacea, branchiopoda) and functional morphology of male claspers in a phylogenetic context: a video-based analysis. PloS ONE 9(1): 1-20.

First report of an invasive Penaeid shrimp (*Metapenaeus dobsoni*) at Maputo Bay in Mozambique

Poster

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Penaeid shrimps are an important resource in crustacean fisheries and their use is responsible for more than half of gross production of shrimp worldwide. In Mozambique, shrimp fishing is one of the pillars of the economy. Recently, an invasive penaeid species has been recorded at Maputo Bay, and its occurrence has been related with a significant decrease of abundance of two most important commercial species: *Fenneropenaeus indicus* and *Metapenaeus monoceros*. The decrease in the catch of native species seems to indicate that the invasive species is occupying their niches. In the present we used a molecular approach to identify the invasive species and contribute to protection of local native species. A total of 15 individuals, five of each of the following species *M. monoceros, F.indicus,* and the invasive species were collected in Maputo Bay. Partial gene sequences encoding COI (850 pb) and 16S (350pb) were successfully amplified. Nucleotide sequences were aligned using the software Geneious R6 using ClustalW (THOMPSON *et al*. 1994). The Genetic distance was calculated between and within groups using Mega software, version 5.05 under Kimura 2-parameter method (TAMURA, *et al*. 2004). The prevalent differences between species was analysed by phylogenetic trees using Neighbour-joining (NJ-K2P) method, through bootstrapping data with 1000 replicates. Phylogenetic trees were built using *neighbor-joininng* (NJ) (Tamura *et al*. 2004). Morphology analysis followed DALLS (1990). The taxonomic analysis pointed the hypothesis that it is an exotic species native of Indo-Pacific - *Metapenaeus dobsoni.* Phylogenetic trees of both genes showed similar topology, with reliable bootstrap values. The sequence divergence between species was high for both COI gene (21.8% to 31.4%) and 16S gene (14.1% to 20.8%). The combined analysis of morphology and molecular mtDNA 16S rRNA and COI clearly showed that *M. dobsoni* is the invasive species which has increased its participation on fishery activity in the Mozambican Maputo Bay, probably in competition with native species. The negative effects that *M. dobsoni* might bring to Mozambique are very detectable, because whenever there is a fishery involving this species, there is a total absence of native species Fortunately, our results was able to surely identify this invasive species and warn its potential disturb on local biodiversity. This is the first report on the presence of this species in the Mozambique Coast, and might represent powerful information for management of this invasive species and protection and conservation of native ones. Financial support: CNPq

References:

DALL W, HILL BJ, ROTHLISBERG NW & STAPLES DJ (1990) The Biology of Penaeidae. Advances in Marine Biology, 27, 1–484.

TAMURA K, NEI M & KUMAR S (2004). Prospects for inferring very large phylogenies by using the neighbor-joining method. *Proceedings of the National Academy of Sciences* (*USA*) 101:11030-11035.

THOMPSON JD, HIGGINS DG, GIBSON TJ & CLUSTAL W (1994): improving the sensitivity of progressive multiple sequence alignment through sequence weighting, position-specific gap penalties and weight matrix choice. Nucleic Acids Res. 22:4673-4680.

Potential for expansion of bathyal king crabs onto the Antarctic shelf

Oral GS

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King crabs and other durophagous (skeleton-breaking) predators have been essentially absent from the Antarctic shelf for millions of years. The resident benthic fauna has evolved in isolation with limited defenses against durophagy. Now, however, deep-sea populations of king crabs appear to be expanding their bathymetric range up the continental slope off the western Antarctic Peninsula (WAP). An invasion onto the Antarctic shelf could devastate the vulnerable, endemic fauna and drastically restructure benthic food webs. Between 2010 and 2013, we established two 100-km^2 study sites off the WAP to investigate the current population status of king crabs in this area and to examine putative ecological barriers that might prevent expansion of king crabs onto the Antarctic shelf. At our first study site off Marguerite Bay, we observed 422 individuals of the king crab *Paralomis birsteini* in photographic transects at 841–2265 m depth. We measured a maximum population density of almost 4500 individuals per km^{-2}. At our second study site off Anvers Island, approximately 380 km northeast of Marguerite Bay, we observed a further 99 *P. birsteini* individuals at 924–1941 m depth, at a maximum density of almost 2500 individuals per km^{-2}. Observations of copulating pairs and juveniles at depths as shallow as 841 m suggest the populations of *P. birsteini* observed were reproductively viable. We compared four ecological variables between slope and shelf environments: temperature, food source, the potential for predation, and microhabitat availability. None of these variables appeared to represent barriers limiting the bathymetric expansion of *P. birsteini.* Dense populations of king crabs are widespread on the continental slope off the WAP, with few or no ecological impediments to their expansion onto the Antarctic shelf.

PYCNOIB: Biodiversity and biogeography of Iberian pycnogonids

Oral MC

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There are few studies comparing the distribution patterns of benthic organisms between Atlantic and Mediterranean waters around Iberian Peninsula. Pycnogonida (sea spiders) are a clear example of both endemicity and diversity, but biodiversity and distribution patterns of pycnogonids are poorly studied worldwide. The main objectives of this study are to provide a complete review of species, including their distributions and bathymetric ranges within the IP waters covering all faunistic paper published and data from unpublished cruises. All these data have been now compiled and georeferenced into the Pycnoib-Database using MS Access, and mapped using a geographic information system, GIS (ARCGIS 10.0 program, ESRI, Redlands, CA). The present study comprises distribution information of 65 species of pycnogonids from 343 sample locations. A total of 17762 pycnogonid occurrences from Iberian Peninsula have been recorded (fig. 1). Occurrences were dominated mostly by members of the Ammotheidae family (~80%), and the most abundant genera were *Ammothella* (47%) and *Achelia* (31.5%), and around three quarters of the total abundance corresponded to *Ammothella longipes* (43.5%) and *Achelia echinata* (29.5%). A total of 47 species are found in the Atlantic (25 of them exclusive from this area) and 35 in the Mediterranean (10 exclusively found there). The main genus *Colossendeis* was exclusive from Atlantic waters. There was only one genus *Trygaeus* with its single species *T. communis* exclusive to the Mediterranean coast. Finally, *Anoplodactylus nanus* has been recorded for the first time in the occidental basin of the Mediterranean Sea (Costa Brava coast, NE Iberian Peninsula).

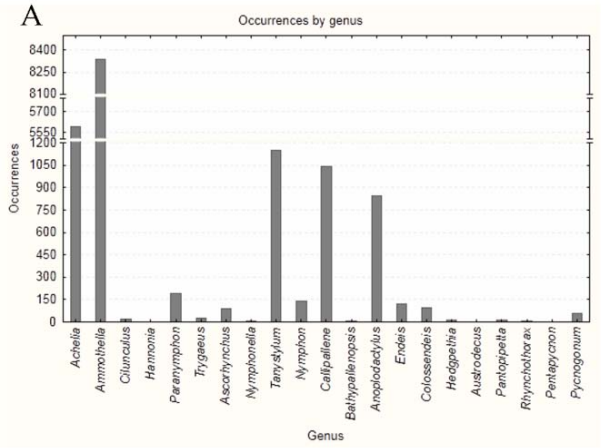

Figure 2. Occurrences per genus of Iberian pycnogonids

Figure 1. Total of occurrences of Iberian Pycnogonida recorded up-to-date.

Composition of the Epibenthic Decapod Fauna in the German Exclusive Economic Zone: Comparison and Analysis of Past and Recent Surveys

Poster

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Recent analysis of two long-term datasets from the Dogger Bank and the Helgoland Trench (North Sea) revealed a benthic community shift and a biodiversity decrease, together with the increase of warm-water species from Atlanto-Oceanic regions around the turn of the last millennium. In order to support these observations in detail, a comparison of epibenthic samples of decapod megafauna (> 1 cm²) of the German Exclusive Economic Zone (EEZ) of the North Sea was undertaken. For this purpose, beam trawl surveys on numerous stations in the years 1987, 1990, 2007 and 2013 were used and the composition of the fauna was compared.
A decrease of decapod species in the research area with time is obvious from the results of the data sets. A series of benthic indices was generated using the data of the 2013 cruise. Only few locations exhibited with a stable richness and biodiversity. Furthermore, the dependence of the epibenthos composition from environmental parameters of the research area as depth and temperature is presented through the example of the 2013 cruise. Decapod species depletion and reduced biodiversity, together with the increase of warm-water elements hold also through in the context of this comparison on a medium time scale.

Taxonomic study of Giant river prawn *Macrobrachium rosenbergii* DE MAN, 1879 from Indus River, with the notes on occurrence of its largest specimen

Oral GS

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The giant freshwater prawn *Macrobrachium rosenbergii* (DE MAN, 1879) is the largest known palaemonid in the world (Holthuis, 1950 and 2000). *Macrobrachium rosenbergii* is native to Indo-west pacific region however, it is introduced to all continents, and its introduction has been reported in total 77 countries for the purpose of aquaculture (NEW, 1995). Information on o taxonomy of *M. rosenbergii* from Indus River has been mystery since long. For the best of our knowledge previously all the studied specimen of *M. rosenbergii* belonged to East Pakistan (presently Bangladesh), originating from Ganges River.

In total four specimen of *M. rosenbergii* were found from Chuharh Jamali, District Thatta (24° 24' 0" North, 67° 59' 0") after the continuous survey of lower reaches of Indus River. All four samples used for the study were male, length (TL) of largest specimen was 36 cm and its weight was 430 g. to the best of our knowledge this is the largest specimen of *M. rosenbergii* ever reported, previously maximum recorded size of male *M. rosenbergii* in total body length was 32 cm (HOLTHUIS, 1950; WOWOR & NG, 2007).

Average length (TL) cm and weight g was 29.9±8.13 and 257±155.31, respectively. Rostrum of all studied specimen over reaching the scaphocerite, basal crest was moderately elevated. The average dorsal and ventral teeth were 12.75±0.95 and 10±1.63, respectively. Second pereopod (chelate leg) dark blue in color and was covered with large, widely spaced spines. Telson over reaching the outer lateral spine of uropodal exopode. The tip of the telson over reaching the tip of movable spine.

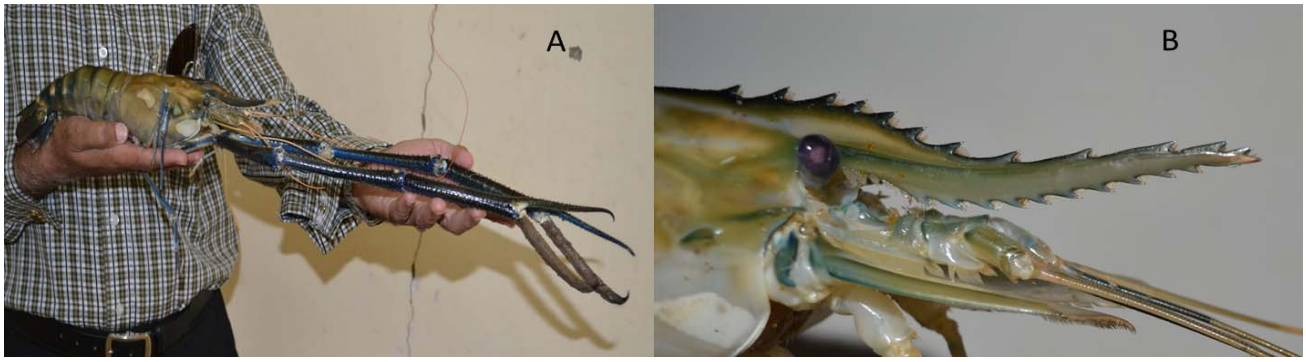

Figure 1. (A) Largest specimen of *Macrobrachium rosenbergii* (B) Rostrum of a freshly captured specimen of *Macrobrachium rosenbergii* from downstream reaches of Indus River

References:

HOLTHIUS, L. B. (1950): The decapoda of the Siboga expedition, Part X: The Palaemonidae collected by Siboga and Snellius expedition, with remark of other species, Part 1: Sub family Palaemonidae. In Sobiga-Expeditie, 39a[9]

NEW, M. B. (1995): Status of freshwater prawn farming: a review. Aquaculture Research 26: 1-54.

WOWOR, D. & P. K. L. NG. (2007): The Freshwater Prawn of *Macrobrachium rosenbergii* species group (Crustacea; Decapoda; Caridea; Palemonidea). The Raffles Bulletin of Zoology 55 (2): 321-336.

Redescription of the larval development of *Lysmata amboinensis* (De Man, 1888) (Decapoda: Caridea) reared under laboratory conditions

Poster

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Complete larval descriptions are only known for three of the 43 currently existing worldwide species of the genus *Lysmata*. The present study describes and illustrates the larval development of *Lysmata amboinensis* (DE MAN, 1888), reared in laboratory conditions. *L. amboinensis* larval development is composed by a total of nine zoea and a decapodite stage. The number of stages will be discussed according to the "Cleaner" clade group species.
All larval stages are described and illustrated according to modern standards.
The larvae were reared in 2 litter tanks at a density of 30 larvae per litter. Temperature was kept at 25±1ºC, salinity 35 and nitrogenous compounds were kept below detectable levels. The water was continuously renewed, and larvae fed on newly hatched *artemia nauplii ad libidum* conditions.
Morphological characters will be compared with *L. seticaudata*, *L. ensirostris* and *L. wurdemanni*, which are the ones for whose completed larval descriptions is known.

References:

CÁTIA BARTILOTTI, RICARDO CALADO, ANDREW RHYNE &·ANTONINA DOS SANTOS (2012) Shedding light on the larval genus *Eretmocaris*: morphological larval features of two closely related trans-isthmian *Lysmata* species (Decapoda: Caridea: Hippolytidae) described on the basis of laboratory cultured material. Helgol Mar Res 66:97–115

S. DE GRAVE & C.H.J.M. FRANSEN (2011) Carideorum Catalogus: The Recent Species of the Dendrobranchiate, Stenopodidean, Procaridideanand Caridean Shrimps (Crustacea: Decapoda). Zool. Med. Leiden 85:427-430

Fauna and ecology of portunoid crabs (Crustacea: Decapoda: Portunoidea) of the Red Sea
Oral GS

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The entire Red Sea coast of Saudi Arabia was recently covered by the Red Sea Biodiversity Survey (RSS 2011 – 2013), organized by the King Abdulaziz University (Jeddah, Saudi Arabia) and the Senckenberg Institute (Frankfurt am Main, Germany) (http://www.redseabiodiversity.org/). A particular attention was given to Portunoidea, one of the most species rich superfamilies of Decapoda. All new material has been treated along with the analysis of literature and re-examination of historical collections in the European museums. In a total 63 species occur in the Red Sea excluding the outer strait of Bab al Mandab, 4 extra species are known from the latter area.

With regard to preference to particular depth ranges and habitats several ecological groups may be identified. The first group includes the species occurring in the intertidal zone but often extending to 10-55 m. The second group combines the species that have not been found in the intertidal zone (but often in the shallow subtidal zone) and extend down to 60 – 70 m. These two groups can be further subdivided into the subgroups preferring soft, hard and mixed substrates, a small subgroup of characteristic inhabitants of coral habitats, and a subgroup of symbiotic species. The scarcity of exclusively intertidal species in the Red Sea fauna may be explained by a relatively low tidal magnitude and extreme conditions in the intertidal zone in summer, and in the northern Red Sea in the winter as well. The third ecological group includes the species living in mid- to lower subtidal zone mostly at soft substrates. Finally *Charybdis acutidens* is a characteristic species of the deep Red Sea fauna living on the soft bottom. Documentation of live color during RSS shows that these ecological groups are also characterized by coloration patterns.

Indo-Pacific species constitute more than half (57%), the Western Indian Ocean species make up 9.5% of the fauna. The Red Sea specimens assigned to several wide spread Indo-Pacific species have some morphological peculiarities. Part of them also show (up to current knowledge) a disjunctive distribution from their Indo-Pacific counterparts (*Lupocyclus* cf. *philippinensis*, *Monomia* cf. *gladiator*, *Xiphonectes tenuipes*). Further studies are required to conclude if peculiar Red Sea populations of the widespread Indo-Pacific or Indian Ocean species (11% of the fauna) deserve a separate specific or subspecific status. The species endemic for the Northwestern Indian Ocean (NWIO), or the waters around the Arabian Peninsula comprise 9.5% of the Red Sea fauna. The Red Sea hosts nearly all known NWIO endemic portunoids. Besides of them there are species which can be considered endemic for the Red Sea (8 %).

Different levels of evolutionary differentiation of the NWIO/ Red Sea endemics and peculiar forms of the Indo-Pacific species had been probably the result of multiple isolation events caused by sea level changes and periodic reversals in the Straits of Bab al-Mandeb (KLAUSEWITZ, 1983, 1989; TÜRKAY, 1996; TÜRKAY & SPIRIDONOV, 2006; SPIRIDONOV & TÜRKAY, 2007). These processes might have been started since eventual but continual connection of the Red Sea with the Indian Ocean which began 2-5 million years ago (BRAITHWAITE, 1987; SHEPARD et al., 1992). Within the same period of time the Red Sea also underwent numerous environmental crises when the refugia for the endemic shallow and the deep fauna might be maintained in the neighboring parts of the Gulf of Aden, so the species expanded to the appropriate habitats in the NWIO and repopulated the Red Sea afterwards.

Phenotypic differences between crab populations inhabiting close but contrasting habitats. *Neohelice granulata* as a case study.

Poster

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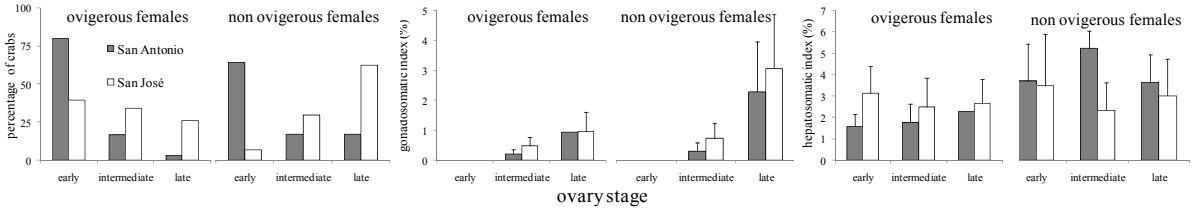
Phenotype varies among natural populations of a species that occupy different environments and are affected by diverse selection pressures, probably conferring a local fitness advantage; different phenotypes could be the result of local adaptation, if gene flow among populations is restricted, or phenotypic plasticity, when genetic differentiation is absent. Two large populations of the Southwestern Atlantic burrowing crab *Neohelice granulata* (Brachyura, Varunidae) inhabit bays that drain into a Patagonian gulf: San Antonio Bay (SA) and San José Gulf (SJ). They are separated by only 190 Km but differ in substrate characteristics and vegetation. Both populations showed no genetic differentiation between them and the hydrological pattern suggests a larval connectivity. However, crab morphometry varied markedly between sites and dramatic differences in maximal size were detected. The main goal of this study was to examine and quantify life history traits and reproductive biology on the basis of samples (substrate and crabs) collected on successive days in the middle of the reproductive season in both saltmarshes and mudflats of each site. Granulometry and organic matter content of sediment were measured as well as burrow dimensions. The following crab life history information was obtained: density, size frequency distribution (CW = carapace width), size-weight relationship, sex ratio, percentage of ovigerous females, fecundity, reproductive effort, hepatosomatic (HIS) and gonadosomatic (GSI) index of ovigerous and non ovigerous females with ovaries in three developmental stages (early, intermediate, late) and of males, and size at morphometrical maturity of females.

Substrate was hard in SA with a high proportion of gravel and scarce organic matter whereas it was soft in SJ, with twice as silt and clay and higher organic matter content. Burrows were three times longer and twice as wider in SJ than in SA. Crab density was higher in saltmarsh than in mudflat in both sites, and higher in SA than in SJ mudflats. Size frequency distributions differed markedly between populations, crabs of both sexes being larger in SJ (maximum CW: males 38.3 *vs* 32.8 mm; females 35.5 *vs* 29.0 mm); recruits were present only in SA. Size-weight relationship did not differ between sites. Sex ratio was female biased in SJ but not in SA. Percentage of ovigerous females was lower and differed between habitats in SJ. Fecundity did not differ between sites but reproductive effort was higher in SA. Percentage of females with ovaries in each developmental stage, GSI and HSI differed between sites:



Male HSI did not differed between sites but GSI was higher in SJ. The size of the smallest morphologically mature female did not differ between sites but the size at maturity range was shorter in SJ. The obtained results indicate the existence of differences in several life history traits and reproductive schedule between populations that will serve as a basis for an ongoing experimental study designed to understand its causes under the hypothesis of an effect of food availability and, finally, to evaluate the effects of local adaptation and phenotypic plasticity.

Funding: UNMdP EXA 618/12 and CONICET PIP 830/13

Immature and mature spermatheca of the brachyuran crab *Parasesarma plicatum*, Latreille: An electron microscopic study

Oral GS

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The spermathecae of the crab, *Parasesarma plicatum*, are a pair of saccular structures, connected to the distal part of the ovary, and opens to the exterior through the gonopore situated ventrally to the third thoracic segment. In its gross morphology and histology, the spermatheca of *P. plicatum* exhibited changes in relation to stages of maturity. Based on the disposition of oviduct, the spermathecal lumen could be divided into upper and lower chambers. Spermathecae of immature females (10 – 11 mm carapace width), appear translucent and spherical. The spermathecal lumen (immature females) is found to be homogenously eosinophilic, with no spermatozoa or spermatophores within.

The spermathecae of mature females (carapace width >13 mm) appear milky white, apparently due to the presence of sperm received during mating. The multilayered columnar epithelium that lines the spermathecal lumen shows signs of high secretory activity, judged by the profuse presence of vesicular RER, SER, ribosomes, golgi bodies and mitochondria of varying sizes. The epithelial cytoplasm shows the presence of three types of secretory products, electron dense granules and vesicles, and electron lucent vesicles. Our close observation on the mode of secretion reveals that the small sized electron vesicles and electron dense granules coalesce to become larger entities, before being released into the lumen. We could observe profuse presence of microvilli at the epithelial tip, which in turn are packed with dense (secretory) materials, to be released into the lumen by pinching off the apical portion of the epithelium (a typical apocrine mode of secretion). The lumen also shows the presence of free spermatozoa, and the spermatophores, embedded in an ensemble of eosinophilic and basophilic materials, apparently a mix of the spermathecal secretion and the seminal plasma.

Our microscopic observations on the spermathecal luminal contents, in a time - dependent fashion reveal the spermatophore wall showing signs of dissolution ever since the sperm had been transferred to the female tract. Five to seven days after insemination, we could observe complete dissolution of the spermathecal wall, leaving the sperm cells as free entities. Research is currently underway in our laboratory on the biochemical nature of the spermathecal secretions and its role (if any) in facilitating long-term sperm storage.

Acknowledgement: Fund received from UGC Minor project [No: F. MRP-3929/11 (MRP/UGC-SERO) Link No: 3929] is gratefully acknowledged.

Establishment of a rapid and easy method for isolating of the androgenic gland from the kuruma prawn *Marsupenaeus japonicus*

Poster

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The male secondary sex characteristics of crustaceans are controlled by an androgenic gland hormone (AGH), which is specifically synthesized by and secreted from the androgenic glands (AG) attached to the male reproductive organ. Until now, AGH has been purified and structurally determined only from the terrestrial isopod *Armadillidium vulgare* (OKUNO et al., 1999). AGH-like peptides have also been found in several decapod species and designated as insulin-like androgenic gland factors (IAG). Recently, a cDNA encoding the kuruma prawn *Marsupenaeus japonicus* IAG (Maj-IAG) has been cloned (BANZAI et al., 2011). Using gene expression of Maj-IAG as an index, it has been elucidated that AG cells of *M. japonicus* localize in apical part of the vas deferens. But, there are no differences between AG and vas deferens in color and shape. Therefore, a rapid and easy method for isolating of AG from *M. japonicus* was developed in this study. The male reproductive organs were dissected from the male prawns and subsequently subjected to vital staining with methylene blue. Consequently, blue spot was observed at apical part of the vas deferens. The blue spot was cut out and then fixed in Bouin fixative or 4% paraformaldehyde in 0.1 M phosphate buffer (pH 7.4) for overnight at 4℃. The fixed blue spot was embedded in paraffin and sectioned at a thickness of 5 µm. Sections were subjected to *in situ* hybridization.

A Maj-IAG antisense cRNA probe was hybridized to large part of the blue spot. No signal was detected in the negative control, in which the sense probe was employed. These results indicate that living AG cells in *M. japonicus* are able to be easily distinguished by vital staining with methylene blue.

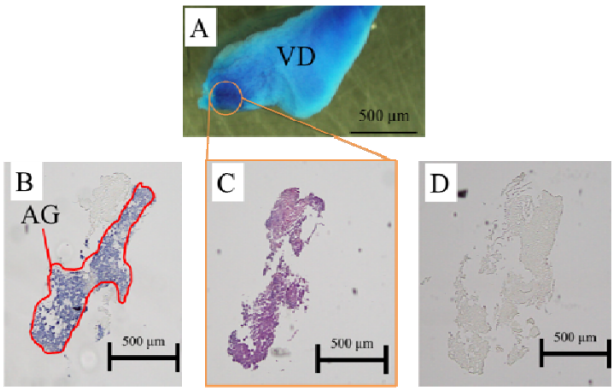

Fig.1. Vital staining with methylene blue (A), *in situ* hybridization using Maj-IAG antisense probe (B) and sense probe (D), and hematoxylin eosin staining (C). AG: androgenic gland, VD: vas deference.

References:

BANZAI, K., ISHIZAKA, N., ASAHINA, K., SUITOH, K., IZUMI, S. & OHIRA, T. (2011): Molecular cloning of a cDNA encoding insulin-like androgenic gland factor from the kuruma prawn *Marsupenaeus japonicus* and analysis of its expression.-- Fisheries Science, **77**: 329-335.

OKUNO, A., HASEGAWA, Y., OHIRA, T., KATAKURA, Y. & NAGASAWA, H. (1999): Characterization and cDNA cloning of androgenic gland hormone of the terrestrial isopod *Armadillidium vulgare*. --Biochemical and Biophysical Research Communications, **264**: 419-423.

On the larval development of two Hermit crabs, *Pagurus lanuginosus* (de Haan, 1849) and *P. maculosus* (KOMAI & IMAFUKU, 1996) (Decapoda, Anomura, Paguridae): An evidence for Phylogenetic relationship.

Oral GS

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The taxonomic status of Hermit crabs, *Pagurus lanuginosus* (de Haan) and *P. maculosus* (KOMAI & IMAFUKU) is based on studies of the reproductive behavior and subtle differences in adult morphology. Their morphological similarities turn our attention to their phylogenetic relationship. Here, we observed and compared larval development between these two species. Since, being structurally and biologically different from the adults, the morphological features of larvae also could provide information of additional important characters for taxonomic and phylogenetic analysis. A few differences in morphological characters of larvae and post larvae provided strong support that they are two distinct but closely-related species. The described larval characters will be a supplementary support for species identification of planktonic larvae.

References:

KOMAI T & IMAFUKU M (1996) Redescription of *Pagurus lanuginosus* with the establishment of a neotype, and description of a new closely related species (Decapoda: Anomura: Paguridae). *Journal of crustacean Biology,* 16(4): 782-796.

Comparative phylogeography of four parapatric freshwater crabs of the genus *Sinopotamon* at high latitudes

Oral CTF

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The eastern Qinling Mountains, Yellow River and middle and lower reaches of the Yangtze River form an extensive transition zone of mutual penetration between southern and northern animals in China. Comparative studies of the molecular phylogeography of species in this transition zone helps us understand the deep influence of the Tibetan Plateau uplift and historical climate changes caused by glacial-interglacial oscillation on distribution pattern and evolutionary process since the Quaternary. The present study focuses on four species of *Sinopotamon* endemic to China, *S. yangtsekiense*, *S. honanense*, *S. shensiense* and *S. acutum* distributed at the northern edges of the genus' range, from the so-called acute lobes group. We have obtained 1,500 specimens from 106 sample locations. Molecular data from mitochondrial *nad5* and *cox1* gene fragments for nearly 960 individuals and genotypes for nine polymorphic microsatellite loci from all sampled individuals have been analyzed. By combining geographical and molecular analyses we have defined intraspecific phylogeographic divergence of the four focal *Sinopotamon* species. Comparative analyses across temporal and spatial scales indicate that historical climate and environmental changes have affected the geographic distribution, genetic diversity, lineage differentiation and genetic structure of these species. Furthermore, Interspecific introgressive hybridization has been found among the two species pairs via combining maternal and biparental molecular markers. Historical population dynamics and gene flow analyses indicate that *S. honanense* has been affected by historical climate change and exhibited large-scaled continuous population dispersal in a north-south direction, resulting in extensive introgression with the two neighboring *S. yangtsekiense* subspecies. Genetic introgression between *S. shensiense* and *S. acutum* was only detected by microsatellite DNA. Meanwhile, male-biased dispersals were detected in these species. These results have provided a better understanding of the phylogeny and biogeography of *Sinopotamon* freshwater crabs at high latitudes in mainland China. It is worth noting that in the eastern Qinling fan-shaped transitional zone, the four focal species are neighboring and sometimes sympatric. Further studies of this nature will provide insights into the evolution of species diversification of *Sinopotamon* crabs.

This work was supported by the National Natural Science Foundation of China (No. 31071902) to SHY

Impacts of the oil spill on crustacean macro-infaunal and meiofaunal communities on coral reefs in the Gulf of Thailand

Poster

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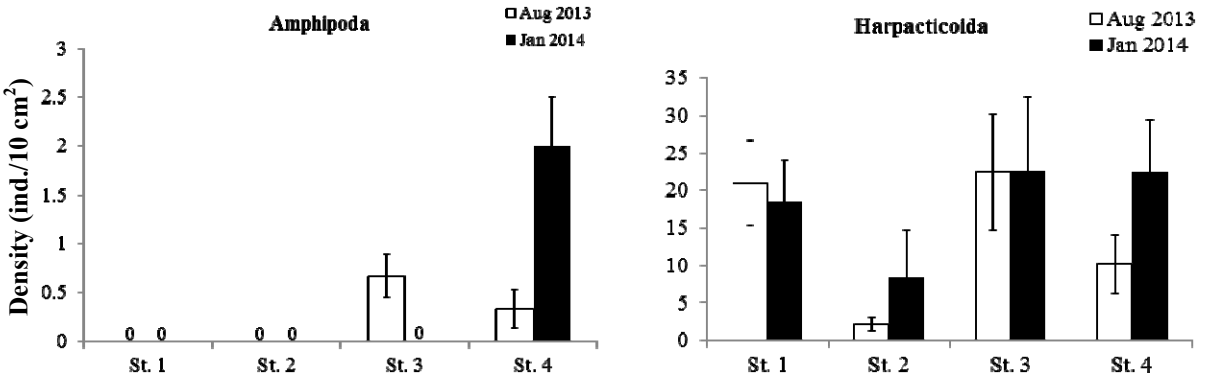
It is recognized that oil pollution is an important threat to coastal ecosystems and coral communities at many locations around the world. Changes in composition and abundance of macrobenthos and meiofauna may be used in order to detect an integrated response to the oil spill incident. Oil from the spill of about 50,000 liters of crude in the sea off Rayong Province, the Eastern Gulf of Thailand reached the west side of Ko Samet on July 28, 2013. The aim of this study was to monitor the impacts of the oil spill incident on shallow subtidal macro-infaunal and meiofaunal communities on coral reefs at Ko Samet. There were four study sites with different oil spill impacts: St.1 (high), St. 2 and St.3 (medium), St. 4 (low). The major groups of crustacean macro-infauna were Amphipoda, Stomatopoda, Brachyura, Caridea, Diogenidae and Cumacea. The crustacean meiofauna included Isopoda, Amphipoda, Harpacticoida, Calanoida and Ostracoda. The effects of the oil spill were clearly observed at St. 1 and St. 2 with the disappearance of the amphipods during the seven months after the spill. There was a very low impact of the oil spill on stomatopods, brachyurans, carideans, diogenids, cumaceans and harpacticoid copepods. It is suggested that long-term monitoring is urgently required to assess the specific effects of oil pollution on the macrobenthic and meiofaunal communities on soft bottom of coral reefs.



Meiofauna

Legend: density of the dominant meiofaunal species in the study area

References:

VEIGA, P., RUBAL, M. & BESTEIRO, C. (2009): Shallow sublittoral meiofauna communities and sediment polycyclic aromatic hydrocarbons (PAHs) content on the Galician coast (NW Spain), six months after the *Prestige* oil spill. -- Marine Pollution Bulletin **58**: 581–588.

YU, O. H., HYUNG-GON, L., SHIM, W. J. KIM, M. & PARK, H. S. (2013): Initial impacts of the *Hebei Spirit* oil spill on the sandy beach macrobenthic community west coast of Korea. -- Marine Pollution Bulletin **70**: 189–196.

Rapid colonization of the Atlantic rock crab (*Cancer irroratus*) in Icelandic waters

Poster

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The Atlantic rock crab (*Cancer irroratus* SAY, 1817) was discovered in Icelandic waters in the year 2006. The crab is a North American species, being reported from Florida north to Labrador. The larvae of the crab were presumably transported in ballast water to Iceland in 1998 or 1999. This is the first invasion of a large alien crustacean in Icelandic waters. The first crabs were observed in Hvalfjörður in South-western Iceland. The crab is now established in Icelandic water (GÍSLASON et al. in press). Egg bearing females have been found and all larval stages have been observed in the plankton of South-western Iceland. Since 2006, the crab has extended its distribution rapidly and adult specimens of the crab have now reported from the fjords of North-western Iceland, over 250 km north of the site where the crab first colonized Icelandic waters. The dispersal is presumably aided by the current system of Icelandic waters, where coastal currents are flowing clock-wise around this oceanic island. The temperature conditions in Icelandic waters are favourable for the development of the crab and it is predicted that the crab will extend further its distribution in Icelandic waters.

Reference:
GÍSLASON, Ó. S., H. P. HALLDÓRSSON, M. F. PÁLSSON, S. PÁLSSON, B. DAVÍÐSDÓTTIR,& J. SVAVARSSON (2014). Invasion of the Atlantic rock crab (*Cancer irroratus*) at high latitudes. Biological Invasions (in press).

Habitat descriptions and distributions of benthic organisms in Icelandic waters - new data from the IceAGE project

Oral GS

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Icelandic waters are characterized by the extensive Greenland-Iceland-Faeroe Ridge, being the only ridge crossing the North Atlantic Ocean in an east-west direction. Furthermore, the ridge is fairly shallow, with the maximum saddle depth of 840 m, separating deep waters (<4000 m) of the Arctic and the North Atlantic proper. Additionally, the hydrography of the region is complicated, but mainly characterized by an inflow of warm waters into the Nordic Seas (Norwegian, Greenland and Iceland Seas), with cold water masses dominating the deep parts north of the ridge, and additionally colder water masses crossing the ridge in a southerly direction. Despite extensive sampling in the region (the Danish *Ingolf* Expedition, the BIOICE project, etc.) little is still know of the ecology of the benthos in the region and furthermore, the genetics of the benthic organisms are yet poorly known. The IceAGE project (Icelandic marine Animals – Genetics and Ecology), was initiated to augment the understanding of the genetics and ecology of the species in the region. The first IceAGE expedition was in August-September 2011 onboard the German research vessel *Meteor* and the second expedition was in July-August 2013 onboard the German research vessel *Poseidon*. The project is discussed and data on habitats and distributions of crustaceans and other benthic organisms are presented.

The Baltic Sea: adaptation of the American crayfish *Orconectes limosus* (RAFINESQUE, 1817) to low water salinity as the ability to live in coastal waters

Poster

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Permanent colonization of the Baltic Sea by non-indigenous species has been observed for recent 50 years. The first crustacean species introduced to the Polish inland waters was *Orconectes limosus* (RAFINESQUE, 1817). This crayfish has expanded its area of occurrence very fast and gradually started to inhabit coastal brackish waters of the Baltic Sea. Its occurrence is noticed at salinity which ranges from 2.0 to 10.0 psu. To check its adaptation to low water salinity, many experiments have been conducted, also in relation to temperature. For study samples of American crayfish were collected from the Vistula Lagoon (2-3 psu) (Poland). Males had larger body sizes and body masses than females. The length of sampled crayfish varied between 77.3 and 115.5 mm with a mean of 96.47 ± SD 9.36 mm. The wet weight ranged from 12.5 – 47.4 g. The length-weight relationship curve followed a positively allometric growth pattern (b = 3.1) with R^2 = 086 (α= 0.05).

O. limosus is an omnivorous species. Behavioral observations revealed that high stocking densities intensified mutual aggression but cannibalism did not occur. Food preferences were not affected in the temperature range from 12 to 18 °C. In the laboratory conditions crayfish preferred animal feed. The maximum period of starvation was 5 weeks. Food consumption increased with increasing water temperature and when plant diet was applied.

The average total energy value estimated for females was 13.44 ± SD 2.53 J·mg $^{-1}$ DW, for males it reached 8.95 ± SD 2.21 J mg $^{-1}$ DW. Specimens were characterized by hyper- hypoosmotic type of osmoregulation process. The change from hyper- to hypoosmotic regulation was observed at 385.03 mOsm kg^{-1} (about 13 psu, isoosmotic point).

High mortality among adult specimens was associated with moulting, both at salinity of 3 and 7 psu. At salinity of 3 and 7 psu all investigated berried females carried eggs until larvae had hatched. Both salinities did not affect development of eggs and larvae. Young crayfish from 7 psu grew faster than those from 3 psu. No mortality of the first larval stadium was observed, whilst mortality of the second larval stadium was higher in higher salinity. The mortality of juveniles increased to 50% after five weeks from hatching. High plasticity, adaptive capacity and broad range of tolerance to abiotic factors mainly to water salinity and temperature, allow to suggest that *O. limosus* appears able to become a constant component of the Baltic Sea macrofauna.

Amphipods of continental waters of Russia: taxonomy, biogeography and alien species

Poster

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The Amphipoda is one of the rapidly evolving orders of Malacostraca that is distinguished by a large taxonomic diversity in continental waters. This study presents data up until the end of 2013, on the amphipod fauna of the surface and subterranean waters of Russia from 26 families, 109 genera and not less than 580 species and sub-species. It summarizes the biogeographical data from different regions, discusses current taxonomical structure of this group and pays special attention to the allochtonous complex (alien species) that have been introduced to the Russian fauna over the last 100 years. From the biogeographic analysis eleven species groups have been recognised according to geographic area and centers of origin: species of the Holarctic group, including *Gammarus lacustris* and *Gammarus tigrinus*, have dispersed across the Northern Hemisphere; the West Palearctic group includes species widely distributed in Europe and/or Asia but not farther than the west coast of Lake Baikal in the south and the Taimyr Peninsula in the north; the Baltic Sea estuarine group contains native species from this region and *Corophium volutator* of Mediterranean and Ponto-Caspian origin; the Siberia-Pacific coast group comprises species from the Far East of Russia and Eastern Siberia in a western direction but not further than eastern coast of Lake Baikal and the Lena River basin; the Amphi-Pacific group includes a terrestrial species *Traskorchestia ochotensis*; the Caucasus group comprises endemic species represented by the genera *Gammarus*, *Synurella* and *Niphargus*; the Central Asiatic group includes inhabitants of the mountain regions, endemic *Gammarus* species from mountain ponds and streams as well as Asian species of *Stygobromus* (mainly North American) extending to the Altai and Baikalian Siberia; the Baikalian group with endemic and sub-endemic species to Lake Baikal; the group of Baikalian escapees that were collected in the rivers Angara, Yenisei and rarely found in northern latitudes but not in Lake Baikal and include the "glacial relict" *Pallasea quadrispinosa* and another pallaseid *Pallasea laevis*; the group of Ponto-Caspian escapees from the Caspian, Black seas and the Sea of Azov basins and catchment rivers that have penetrated the Baltic Sea basin due to human-mediated vectors were distinguished within the group. The Baikalian species contribute 61% (276 species, 78 sub-species) of the fauna examined, Ponto-Caspian 13% (78 species), coastal brackish marine 8% (47 species), subterranean 6% (35 species) with the relicts of marine transgressions composing only 2% (10 species) and terrestrial species <2% (9 species). The recorded alien species were divided on the basis of origin into five complexes; Ponto-Caspian, Mediterranean, Circumtropical, North-American, Baikalian and local immigrants. The greatest number of species (24) is represented by the Ponto-Caspian complex. *Gmelinoides fasciatus* from Baikalian complex during last 60 years (after intentional introduction and range expansion) is wide-spread species in Russia (Siberia, European part) establishing the Baltic estuaries and even in cold-water springs of the southern Pamir. A list of aliens reported from European Russia includes 32 species.

This research was supported by grants from the Russian Foundation of Basic Research (#13-04-00614), Presidium of Far Eastern Branch of the Russian Academy of Sciences (#14-I-P30-01) and President Program (RSH-5142.2014.4).

13-Year Inventory Trend of North American Horseshoe Crab, *Limulus polyphemus* L., Populations On Long Island, New York: From Anecdote to Annual Survey, 2001-2014

Oral MC

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Considerable concern regarding the abundance of the North American Horseshoe Crab (HSC), *Limulus polyphemus*, along the coasts of New Jersey and Delaware prompted past moratoriums on collecting HSC for bait in New Jersey. The parallel population decline in migratory shorebirds such as Red Knots, *Calidris canutus*, Ruddy Turnstones, *Arenaria interpres*, and others that seasonally feed on the copious quantities of HSC eggs laid along this shoreline resulted in reduced HSC collection permits to numbers considered sustainable. In New York State's Marine District, which is mostly comprised of the Long Island coastline, there is no reliable or routine inventory network existing for determining HSC populations or habitat. Shorebird data, which has been collected by Audubon Chapters, the National Park Service and the U.S. Fish and Wildlife Service, as well as academia, have hinted at declining HSC populations. However, due to the lack of formal and extensive or reliable inventory network, assessing changing trends in HSC population levels is unattainable or mostly inaccurate. Anecdotal information from these same sources, as well as coastal enthusiasts and recreationalists providing support for a declining population of HSC in the metropolitan New York City area, however were unreliable and inaccurate. Molloy College's Long Island HSC Network provides a hot-line telephone number, survey forms and website to (1) collect data on Long Island sites which support HSC [all GPS'ed for repeated sampling]; (2) count HSC for as reliable an estimate of the HSC population as practical; (3) sex and age of individual HSC at each site; and, most importantly (4) to establish a network that can be repeated annually to detect precipitous changes in HSC population numbers, distributions and habitat. Data collection for HSC will aid in protecting the HSC population as well as bird species which require HSC eggs as food during significant migratory periods.

Results of the last 13 years for 65 sites monitored annually reveal (1) considerable reduced number of HSC than "remembered in the past"; (2) sites along the Long Island coastline now believed to support HSC have been found to have few to modest numbers of HSC; (3) a preliminary number projection of Limulus on Long Island at approximately 15,000 adult breeding individuals on beaches surveyed; (4) of the 65 beaches monitored since 2002, an increase of 22.5% has been observed for the number of beaches exhibiting "no breeding activity;" and (5) there has been observed an average of 1%/year decline in the total number of HSC's observed.

New morphological and distributional information on Homolodromiidae and Homolidae (Decapoda: Brachyura) from the Americas, with description of a new species and comments on a western pacific species.

Oral GS

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Seventeen crab species of the families Homolodromiidae and Homolidae, in seven genera, are recognized in the Atlantic and Pacific coasts of the Americas. The genus *Dicranodromia* A. MILNE-EDWARDS, 1880, is recorded for the first time from the eastern Pacific with a new species described from the Galápagos Islands. Nine species, five Homolodromiidae and four Homolidae, are taxonomically evaluated and circumscribed based on morphological information, their geographic and bathymetric distribution clarified and updated, and the similarities and differences of each with other members of the families discussed. Photographs, SEM photomicrographs and line drawings for selected species, including notes on habitat, nomenclature, and distinguishing features, are provided. Biramous uropods and complete pleopod formula in males are discovered to occur in juveniles of *Homola minima* GUINOT & RICHER DE FORGES, 1995, providing evidence that homoloidian and eubrachyuran pleonal locking-system (homoloidian and the eubrachyuran sockets) are not homologous. A checklist of all homolodromiid and homolid species known from both ocean sides of the Americas, with their bathymetric ranges, is presented. The diagnostic characters of one western Pacific species, *Lamoha williamsi* (TAKEDA, 1980), are reevaluated.

When it gets hot; a thermally induced trophic shift in an abundant and widespread Indo-Pacific shore crab *Metopograpsus frontalis*

Poster

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To understand the potential influence of climate change on the ecology of tropical and sub-tropical intertidal shores we investigated the influence of temperature, tide level and day vs night on the feeding behaviour of the widely distributed and abundant intertidal grapsid crab *Metopograpsus frontalis*.

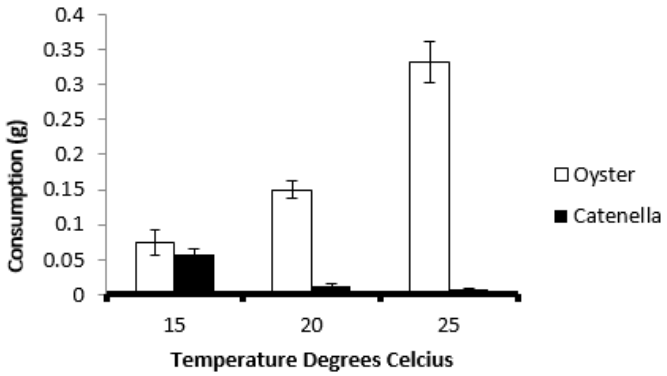

Figure 1: Average change in food weight (±SE) of *S. cucullata* and *C. nipae* across three temperatures following exposure to predation by *M. frontalis* for 12 hrs (n=144). The amount of *S. cucullata* versus *C. nipae* consumed at 15° (p=0.9727), consumption at 20 (p= 0.0001) and 25°C (p=0.0001) was significantly different.

In laboratory conditions crabs shifted from a diet of algae in winter to a carnivorous diet in summer. Controlled trials revealed that temperature was the dominant factor in this shift, with a strong relationship between the amount of flesh consumption and temperature. Conversely, the amount of algae consumed by *M. frontalis* was not significantly affected by temperature. Low tide was the crab's optimum foraging period ($p < 0.0001$). Interestingly and for the first time *M. frontalis* was observed to open rock oysters using the ungulate tips of their chelipeds as wedges and levers, possibly representing an exaptation of a trait previously considered to be a singular adaptation to grazing microalgae from hard surfaces. Given the high biomass of this species in rocky shore and mangrove habitats throughout the Indo-Pacific our data points to the potential complexity of modelling trophic ecology such environments.

Phylogeny of the deep-sea squat lobsters, Munidopsidae (Galatheoidea): preliminary results from morphology

Poster

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The most recent revision of the Galatheoidea (AHYONG et. al., 2010) includes four genera in the Munidopsidae: *Galacantha* A. MILNE-EDWARDS, 1880*; Leiogalathea* BABA, 1969*; Munidopsis* WHITEAVES, 1874 and *Shinkaia* BABA & WILLIAMS, 1998. *Munidopsis* is the most diverse genus in the family with more than 230 species worldwide, including deep waters around Australia (e.g., TAYLOR et al., 2010). Most species occur on the lower continental shelf, deeper than 500 m and around 20% occur on the abyssal plain at depths exceeding 3000 m. Some are abundant in reducing habitats such as hydrothermal vents, cold seeps, whale falls and deep-sea wood deposits; these patterns may also have a significant biogeographic component.
Munidopsis, as presently understood, is highly diverse morphologically, and is probably paraphyletic with respect to *Shinkaia* and *Galacantha (*AHYONG *et al.,* 2011). The probable paraphyly of *Munidopsis* suggests that it will almost certainly require further generic subdivision. Moreover, the oldest fossils currently assigned to *Munidopsis* are of Late Cretaceous age, whereas the oldest munidopsids overall, such as *Palaeomunidopsis*, *Gastrosacus* and *Munitheites* date from the Mid-Jurassic. These early fossil munidopsids, however, may lie within *Munidopsis* sensu lato (AHYONG et al*.,* 2011); if so, the fossil record of *Munidopsis* could be considerably extended, presenting more reliable calibration points for dating molecular analyses of Munidopsidae, currently underway. Knowledge of the phylogeny of Munidopsidae is also important for inferring the polarity of character evolution in its sister clade containing Munididae, Galatheidae and Porcellanidae. Here, we present preliminary results of phylogenetic analysis of the Munidopsidae based on morphology.

References:

AHYONG, S.T., BABA, K, MACPHERSON, E. & POORE, G.C.B. (2010) A new classification of the Galatheoidea (Crustacea: Decapoda: Anomura). *Zootaxa*, 2676, 57–68.

AHYONG, S. T., ANDREAKIS, N. & TAYLOR, J. (2011) Mitochondrial phylogeny of the deep-sea squat lobsters, Munidopsidae (Galatheoidea). *Zoologischer Anzeiger* **250**: 367-377.

TAYLOR, J., AHYONG, S.T. & ANDREAKIS, N. 2010. New records of the squat lobster genera *Munidopsis* and *Galacantha* (Decapoda: Anomura: Galatheidae: Munidopsinae) from Australia including descriptions of two new *Munidopsis* species and a key to Australian Munidopsinae. *Zootaxa*, 2652: 1–18.

Ecophysiological contributions to biogeographic limits in the Crustacea

Oral BLC

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The Crustacea inhabit a wide range of ecosystems, ranging from firm land to the deep sea, tropical to Polar Regions, hyper saline to freshwater environments. In this mini-review, and using crustaceans as a model group, I will provide an overview of ecophysiological mechanisms constraining distribution ranges of species and which, at the same time, present ecological adaptations that have enabled species to push distributional boundaries. I will elaborate on the role of complex life cycles in the success of many Crustacea to colonizing contrasting environments. The physiological origins of such adaptations are likely reflecting upon the evolutionary history of a species or clade. In this context, I will elaborate on the few available case studies presenting lineage-specific physiological adaptations (or constraints) that may help explaining past radiation histories. I advocate that this approach is essential to improve our understanding of evolutionary mechanisms driving crustacean phylogenies, and which may potentially enable us to resolve controversies of phylogenetic relatedness within the Crustacea.

Which is the correct timeframe for the panama isthmus closure and calibration of molecular clocks ?

Oral GS

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The closure of the Panamanian Isthmus, connecting the North and South American continents, was a major geological event resulting that allowed the biotic exchange between previously isolated terrestrial floras and faunas. From a marine perspective, however, it physically separated the Atlantic and Pacific oceans and isolated their biota. The consequent independent evolution of populations along both sides of the Isthmus finally led to the evolution of couples of "geminate species" along the American continent.
Until recently, it was generally accepted that the closure took place approximately 3 Mya, and this geological dating has been widely used for calibration of molecular clocks in phylogeny reconstructions. However, several recent publications questioned this timeframe and suggested a much earlier closure of the Isthmus, in the Miocene 215Mya, this way challenging the previously established molecular clocks.
In our study, we use decapod crustacean species present along both sides of the Isthmus to test from a marine perspective the early and late closure hypotheses and to determine between these two the most congruent with the observed results.
Combined results based on genetic divergence, Approximate Bayesian Computation and Bayesian model testing support a late final closure of the Isthmus, and are not congruent with a final closure during the Miocene.
As marine species have limited abilities to cross terrestrial physical barriers, these results call for a reinterpretation of the geological and biological data that would favor an earlier final closure of the Isthmus. Our results also support the validity of molecular clocks previously calibrated with transisthmian divergence of marine crustacean species and their use in future studies.

An analysis of the branchiopods (Crustacea: Branchiopoda) of weather pits on significant rock outcrops of the world with special reference to the gnammas of Australia

Oral BR

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Weatherpits are known by various names in different countries, but all are small and due to rotting of rock and often are found on granite or sandstone outcrops in arid/semi arid environments. Information is available for such pits mainly from southern Africa, USA and southwestern Australia. Invertebrate communities are restricted by short hydroperiods, dispersal limitations and space. Crustaceans generally dominate by numbers and species richness; of these the branchiopods (fairy, clam, shield shrimps and cladocerans) are best known. Generally few species are present and many are widespread and eurytopic, but southern African pools have endemic anostracans and spinicaudatans. Such pools in the wheatbelt of Western Australia have a variety of endemic anostracans, spinicaudatans, laevicaudatans, notostracans and cladocerans, particularly chydorids, but also daphniids and macrothricids. The cladoceran component decreases with decreasing hydroperiod/increasing temperature north and northeast, but not the large branchiopods. The gnamma fauna of Eyre Peninsula, South Australia is restricted by limited dispersal across the wide, waterless Nullarbor plain, but still has endemic chydorids and spinicaudatans and laevicaudatans. In contrast the gnammas of eastern Australia have few cladocerans (like the rest of the world) and spinicaudatans only. The particularly rich fauna of the west of Australia is believed to be due to speciation in refuges during climatic fluctuations over its great age.

References

JOCQUÉ, M., VANSCHOENWINKEL, B. & BRENDONCK, L. 2010**.** Freshwater rock pools: a review of their habitat characteristics, faunal diversity and conservation value. Freshwater Biology 55: 1587-1602.

PINDER, A.M., HALSE, S.A., SHIEL, R.J. & MCRAE, J.M. 2000. Granite outcrop pools in south-western Australia: foci of diversification and refugia for aquatic invertebrates. Journal of the Royal Society of Western Australia 83: 149-161.

TIMMS, B.V. 2012**.** Influence of climatic gradients on metacommunities of aquatic invertebrates on granite outcrops in southern Western Australia. Journal of the Royal Society of Western Australia 95: 125-135.

TIMMS, B.V. In Press**.** Community ecology of aquatic invertebrates in gnammas (rock-holes) of North-western Eyre Peninsula, South Australia. Transactions of the Royal Society of South Australia.

Maternal influences on early larval phenotype and performance of the shore crab *Carcinus maenas*: from genes to individuals

Oral EMC

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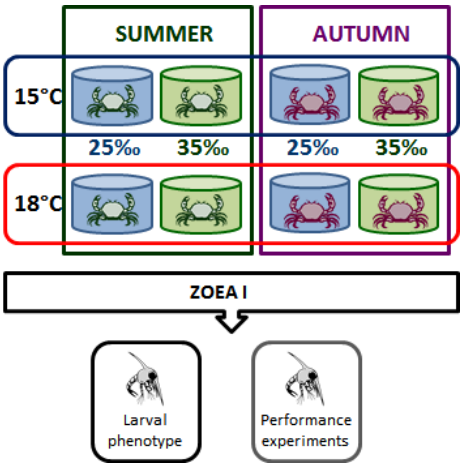
We evaluated the importance of maternal influences on phenotypic traits and performance of the first zoeal stage of the shore crab, *Carcinus maenas*. This is a predatory species, native to Europe and recently an invasive species elsewhere. The maternal influences considered here were the season at which eggs were laid and the temperature and salinity experienced during embryonic development. Ovigerous females with eggs at an early stage of development were collected in two seasons (autumn and summer) and kept at factorial combinations of two temperatures (15°C and 18°C) and two salinities (25‰ and 35‰). The traits considered were the dry body mass, elemental carbon and nitrogen content, lipid composition, relative mRNA levels of Na^+-K^+-Cl^--cotransporter and Na^+-K^+-ATPase. Larval performance was quantified as developmental and survival rates of zoea I under factorial combinations of two temperatures (12°C and 18°C) and salinities (20‰ and 35‰).

Season affected the proportion of total lipids, free fatty acids, triacylglycerol, carbon and nitrogen content of freshly hatched zoea I. As a consequence, higher body mass from autumn larvae was associated with faster development and higher survival. Season also affected the relative mRNA level of Na^+-K^+-ATPase (higher in autumn than in summer) especially at higher temperatures and salinities: in larva hatched from autumn females relative mRNA levels responded to temperature and salinity, but relative mRNA levels from larvae hatched from summer females was consistently low. The relative mRNA level of Na^+-K^+-$2Cl^-$-cotransporter was consistently high in autumn but responded to temperature in summer; in addition, lower expression was found at low salinities.

Neither salinity nor temperature experienced during embryogenesis affected larval lipid composition. On the other hand, larvae hatched from females exposed to 25‰ had higher survival rates and showed higher carbon content and higher relative mRNA level of the Na^+-K^+-Cl^--cotransporter than those originating from females kept at 35‰. There was no significant effect of temperature on larval performance in full sea water, but the combined effect of low temperature and salinity increased mortality and developmental rates.

Experimental design: ovigerous females from different seasons kept at two salinities and temperatures (many females per treatment combination). Freshly hatched zoea I were used to determine phenotype (molecular and chemical analyses) and performance (survival and developmental rates to Zoea II).

Maternal conditions related with season, temperature and salinity experienced by embryos influence the larval phenotype at different levels, from the relative mRNA level of the targeted genes relevant for ion transport, to organism level, i.e. traits related to the reserves available for growth and survival. Some of these changes correlate with subsequent larval performance, indicating that they may mediate the maternal influence on larval fitness.



Variation in larval development in Pancrustaceans: the case of *Sacculina carcini* (Cirripedia, Rhizocephala)

Oral BEP

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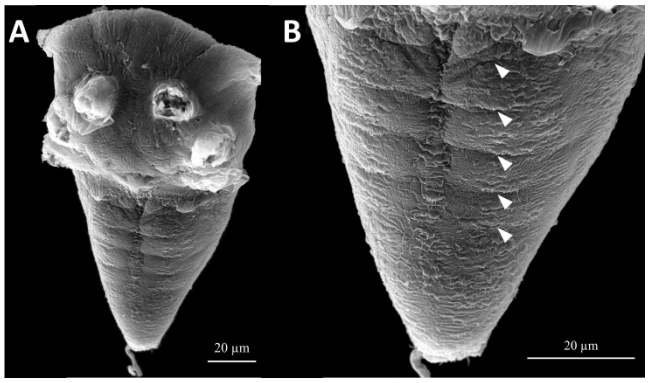
In many non-hexapod pancrustaceans, the first post-embryonic stage is a nauplius larva, composed of the first three cephalic segments. More segments are added during larval development. In most cases, these additions of segments and thereafter the formation of appendages are sequential along the anteroposterior axis. This kind of indirect development is called anamorphosis.
In cirripeds, the first stage is a typical nauplius. However, this larva has the peculiarity of having a loose outer cuticle, which prevents observation of the morphology in scanning electron microscopy (SEM). Since descriptions of larval development of cirripeds are realized using SEM observation, the morphology described is actually that of the external cuticle. To overcome this problem, we developed microdissections to remove the cuticle and accessed the hidden structures of the organism. Among cirripeds, *Sacculina* is a convenient model because it presents a synchronous development between larvae of the same brood. By sampling every 4 hours (for the same brood), we obtained a precise and reproducible table of development. Then, by SEM observations, we were able to describe the actual larval development .
Our results indicate that the larval development of *Sacculina* is clearly different from an anamorphic model because segmentation and morphogenesis of the appendages are synchronous. We are currently assessing if this simultaneity is reflected in gene expression by studying the timing of the expression of *engrailed*, a gene controlling segmentation.



Segmentation in early nauplius III (20h after release of the brood chamber). A: ventral view in SEM, after removal of the external cuticle. Five furrows, not visible 4h before, appear. B: magnification of A.

Molecular phylogeny of Balanomorpha barnacles: origins of symbiontic barnacles

Oral BEP

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Barnacles are a diverse group of animals that are found from the intertidal rocky shore to the deep sea. Some barnacles have a specialized life style forming a permanent symbiotic relationship with sponges and corals, in which the barnacles embed themselves. There is little known on the evolution and origin of the sponge and coral barnacles. Here, we constructed a molecular phylogeny of the Balanomorpha using sequence data from both mitochondrial and nuclear genomes to elucidate the origin and evolution of these symbiotic barnacles. We found that sponge barnacles have at least two independent origins, one in Acastinae and one in the genus *Membranobalanus*. Moreover, the monophyly of *Membranobalanus* is questioned, with some species maybe more closely related to members of Pyrgomatidae, in particular the genus *Wanella*. Similarly, the Pyrgomatidae does not form a monophyletic assemblage. In addition to the inclusion of *Membranobalanus* aforementioned, coral-inhabiting archaeobalanid *Armatobalanus* is also nested inside the Pyrgomatidae. *Wanella*, the only pyrgomatid inhabiting fire coral is highly diverged from the other coral barnacles, suggesting it may warrant a family status. Furthermore, ancestral state reconstruction showed that the most recent common ancestors of the basal lineages live on a broader range of coral host families while the derived taxa are mostly specialists. This suggests that symbiotic relationships in coral-inhabiting barnacles are phylogenetically conserved and that host associated specialization plays an important role in their diversification.

Characterization of vitellins from *Petrolisthes cinctipes* and *Petrolisthes manimaculis*

Poster

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Petrolisthes cinctipes and *P. manimaculis* are two closely related species of porcelain crab that live in the upper and middle intertidal zone along the Central California coast. As the climate continues to warm, *P. cinctipes*, living near its thermal maximum in the upper intertidal zone, may relocate into cooler areas lower in the intertidal zone. Living the mid-intertidal is *P. manimaculis* which is physically dominated by the more aggressive *P. cinctipes*. The objective of this study is to isolate, purify, and characterize vitellin from *P. cinctipes* and *P. manimaculis*. Vitellin, an egg yolk protein, is metabolized from a larger hemolymph protein, vitellogenin (Vg), which is synthesized in the hepatopancreas. Negative competitive interactions due to climate change may be detected by the changes in vitellogenin production and ultimately affect fitness. Thus, we set to describe the egg yolk proteins of these two animals. Vitellin was isolated from homogenized ovaries through a series of centrifugations and salting out extraneous proteins with saturated ammonium sulfate. After dialysis, SDS-PAGE was used to determine vitellin subunit composition. A standard curve using high range molecular weight (MW) markers were used tpo determine the molecular weight of the vitellin subunits. Interestingly, the conspecifics, *P. cinctipes* and *P. manimaculis*, vitellin consist of three major subunits that have MW of 91 ± 2 kDa, 82 ± 2 kDa, and 65.7 ± 1.4 kDa. Two minor bands were also detected at 111 ± 2.3 kDa and 40±1.3 kDa. It is possible that these minor bands are either a dimer of the three main bands or a metabolite of a larger band. Antibodies to both vitellins are currently under examination for reactivity and use in development of an ELISA.

Diversity and distribution of large branchiopods in temporary ponds: living fossils along a climate and anthropogenic disturbance gradient in Morocco.

Oral BR

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One of the most remarkable faunal groups in Mediterranean temporary ponds are large branchiopods. These primitive crustaceans (tadpole shrimps, fairy shrimps and clam shrimps) are considered flag ship species for this type of habitat, since they are very well adapted to their environment. Unfortunately, due to intensification of anthropogenic pressure and climate change, temporary ponds are degrading rapidly. Understanding the key factors shaping large branchiopod communities in Mediterranean temporary ponds, contributes to a better understanding and conservation of these ecosystems and their flagship species.
In this study, we sampled over 100 Moroccan temporary ponds, along a climate and anthropogenic disturbance gradient situated along the Atlantic Ocean, spanning arid, semi-arid and humid bioclimatic zones. We analyzed climate and land use data as well as various water quality parameters, to determine their role in structuring large branchiopod communities.
Currently, we found 17 large branchiopod species (94% of the known Moroccan taxa, representing 55% of the North African taxa), including the endemic species *Tanymastigites brteki* and *Linderiella africana*. When comparing with historical information, we aim to evaluate changes in distribution and conservation status of large branchiopod species. In this way, we contribute to research-based suggestions for the sustainable management of these vulnerable ecosystems.

A trifecta of Swiftian symbioses: Stony corals, gall crabs and their parasites

Oral GS

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Gall crabs (Decapoda: Cryptochiridae) are obligate symbionts of scleractinian corals in (sub-) tropical reef habitats worldwide. These diminutive and highly modified crabs live in galls or pits in their coral hosts and show varying degrees of host specificity at the species and genus levels (e.g., VAN DER MEIJ, 2012). Parasitic isopods and rhizocephalans (Epicaridea, Rhizocephala) are similarly, but more dramatically, reduced in morphology compared to their free-living counterparts and this derived state has resulted in difficulty of placing species in a higher-level phylogenetic framework (i.e., above the genus). Epicarideans are ecto- or endoparasites of host crabs but do not show the same effects of parasitism as rhizocephalans. Whereas isopods merely feed off the host, albeit with evidence of behavior modification, rhizocephalans castrate the hosts and turn them into what is essentially an extension of the parasite phenotype. A wide variety of brachyurans is known to be infected by these parasites, including gall crabs. The key question in the evolution of hosts and parasites is how many parasite species occur within different host lineages, and how much correlation exists between the patterns of evolution in the parasites and their hosts. Gall crabs represent an ideal test case in which the hosts are themselves co-evolved with another taxon (corals) and are likely highly derived members of the Brachyura (Thoracotremata). An in-depth study of gall crabs and their parasites allows for testing of the hypothesis of host-parasite co-evolution within a derived host taxon. Previously only two species of parasitic isopods (*Danalia hapalocarcini* FIZE, 1955 and *Carcinione platypleura* BOURDON, 1983) were known from gall crab hosts and very few records exist. During fieldwork in Indonesia, Malaysia and Curaçao gall crabs infected by parasites were collected, including parasites that are distinct from the two previously known. Species descriptions, drawings and SEM micrographs were made for each parasite taxon and tissue samples were taken for molecular work based on recently developed markers (BOYKO et al., 2013). The preliminary results of this study suggest placement of these isopod parasites in the developing epicaridean phylogeny and shows patterns of co-evolution between the parasites, gall crabs and corals.

Hapalocarcinus marsupialis from *Seriatopora* sp., with an epicaridean larva on the carapace.

References:

BOYKO, C. B., J. MOSS, J. D. WILLIAMS & J. D. SHIELDS (2013): A molecular phylogeny of Bopyroidea and Cryptoniscoidea (Crustacea: Isopoda). -- Systematics and Biodiversity, **11**: 495-506.

MEIJ, S. E. T. VAN DER (2012): Host preferences, colour patterns and distribution records of *Pseudocryptochirus viridis* HIRO, 1938 (Decapoda, Cryptochiridae). -- Crustaceana, **85**: 769-777.

New insights into sperm transfer in Ethusidae and Dorippidae (Decapoda: Brachyura: Dorippoidea)

Oral GS

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For long male and female copulatory organs of brachyuran crabs played an important role for their systematics and phylogenetics. For instance, the traditional classification of brachyurans into Podotremata, Heterotremata, and Thoracotremata (the latter two forming the Eubrachyura) is mainly based on the position of male and female sexual openings. Currently the monophyly of Podotremata and Heterotremata is under debate. Furthermore, several taxa are controversially debated as sister group to the remaining Eubrachyura. Among them is the Dorippoidea which show share some plesiomorphic characters with podotreme crabs such as the two last pairs of walking legs, which are subchelate, oriented dorsally and function in carrying camouflage-material.

To address the phylogenetic position of Dorippoidea, we used scanning electron microscopy to study the gonopods of several representatives of the two dorippoid groups, Ethusidae and Dorippidae. Within brachyuran crabs, males have evolved highly specialized paired copulatory organs. These are formed by paired penes and two pairs of modified legs (the first and second gonopods), which interact in the transfer of spermatophores into the female sperm storage organs during copulation. Our results reveal two types of sperm transfer within the Dorippoidea. In all cases, the first gonopod is tube-like, and the penis and second gonopod are inserted inside it. However in ethusids, the long and slender second gonopod protrudes beyond the slightly curved first one. The distal lumen, referred to as ejaculatory canal, is not completely closed and sideways insertion of the first gonopod seems possible. Presumably, sperm is transferred by the folded and spined tip of the second gonopod whereas the first gonopod stabilizes the position of the second one. In contrast to this, the first gonopods of dorippids are mostly more stumpy and the ejaculatory canal is longitudinally closed with only a narrow opening at the curved tip. The second gonopod is shorter than the first one and sperm is transferred by a pumping mechanism. The second gonopod pushes sperm upwards inside the ejaculatory canal of the first gonopod where it is released from the distal opening into the sperm storage organ of the female. In dorippids, the first gonopod functions as the main sperm-carrier whereas in the Ethusidae, sperm is transferred by the second gonopod. These differences are interesting and indicate a certain evolutionary flexibility of sperm transfer systems. Nevertheless, the phylogenetic polarization of these characters is not yet clear.

Embryo loss during incubation in the freshwater caridean shrimp *Macrobrachium pantanalense*

Poster

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Macrobrachium pantanalense is recently described freshwater carideanshrimp native to Brazil (DOS SANTOS et al., 2013). This work aimed to evaluate the loss of embryos during incubation in different size classes of females of *M. pantanalense*. Ovigerous shrimp were collected in "Pantanal Sul Matogrossense", transported to the laboratory and two size classes were selected: small (29-40 mm) and large (53-64 mm). A total of 120 specimens were selected: 20 small females and 20 large females brooding embryos in early (I), middle (II) and late (III) stage of embryonic development. The differences betweenegg number and volume in stage of embryonic development for small and large sized females were compared using a multifactorial analysis of variance. The number of embryos being brooded decreased along embryonic development in each female size class ($p < 0.001$). The average (± standard deviation) number of embryos in small sized females was 232 (± 42.48), 207 (± 50.43), 157 (± 43.78) for stages I, II and III, respectively; while for large sized females was 429 (± 152.56) 403 (± 80.08) 315 (± 54.54) in stages I, II and III respectively. Loss of embryos during the incubation period (stage I to III) was 32.3% and 25.6% in small and large females, respectively. No significant differences between female size was observed in egg volume ($p > 0.001$), however there was a significant effect of stage of embryonic development of the egg volume ($p < 0.001$). Egg volume increased during embryonic development averaging (± standard deviation) for small sized females 0.098 (± 0.01), 0.142 (± 0.01) and 0.249 (± 0.02) mm^3 for stage I, II and III (respectively) and 0.101 (± 0.01), 0.144 (± 0.01) and 0.251 (± 0.02) mm^3 for stages I, II and III (respectively) for large females. During the incubation period developing embryos increase in volume, this reduces the space available in the brooding chamber.In thisway,the loss of embryos in *M. pantanalense* is likely to be related to the increase in the volume of embryos in the final stages of incubation.

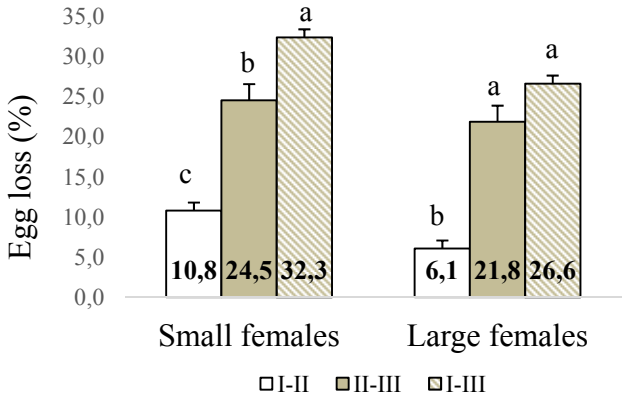

Fig 1. Egg loss (%) duringembryonicdevelopment(I-II; II-III; I-III) ofsmallandlarge females os *Macrobrachium pantanalense.*

Reference:

DOS SANTOS, A.; HAYD, L. & ANGER, K. (2013): A new species of *Macrobrachium* Spence Bate, 1868 (Decapoda, Palaemonidae), *M. pantanalense*, from the Pantanal, Brazil. Zootaxa, **4**:534–546.

Surviving ornamental crayfish in Mid-European winter

Poster

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Temperature is a crucial parameter for the survival and spread of poikilothermic organisms throughout the world. Nowadays, we are witnesses of global warming and its effects on species range. Although invasive crayfish are already present in Central Europe, new species are still arriving due to the effect of global and human frivolity. It's difficult to know the impact that invasive species will have if they can survive winter conditions and spread throughout Central Europe. Invasive crayfish may have negative impacts on native crayfish communities as well as entire ecosystems due to their contrasting life strategies. It is necessary to know whether the ornamental crayfish are able to survive winter conditions in Central Europe or not. We experimentally investigated the potential for invasive crayfish to overwinter in Central Europe, we chose 15 specimens of 4 potentially invasive crayfish species: the red swamp crayfish (*Procambarus clarkii*), the marbled crayfish (*Procambarus fallax f. virginalis*), the yabby (*Cherax destructor*) and the redclaw crayfish (*Cherax quadricarinatus*). Specimens were acclimatized and kept for 6 months in low temperatures which simulated the winter temperature regime of Central European lentic ecosystems. Crayfish were also fed during the experiment. Our results clearly showed that the redclaw crayfish was not able to survive Central European winters whereas the other species were able to withstand these conditions. However, the marbled crayfish suffered high winter mortality and in comparison to the red swamp crayfish its intakes of food were low. Although, the yabby is an Australian species, it seems to be capable of colonizing new areas in Central Europe, at least with respect to winter survival.

Abbreviation of larval development and extension of brood care as key features of the evolution of freshwater Decapoda and disadvantages under conditions of present-day environmental challenges

Oral CBF

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The transition from marine to freshwater habitats is one of the major steps in the evolution of life. In the decapod crustaceans, four groups have colonized fresh water at different geological times, the freshwater shrimps, freshwater crayfish, freshwater crabs and freshwater anomurans (ANGER 1995; VOGT 2013). Evolutionary comparison of marine, freshwater and terrestrial decapods suggests that abbreviation of larval development and extension of brood care until the juvenile stage are among the key adaptations to fresh water. Most of the marine decapods develop through a prolonged planktonic larval cycle, whereas direct development and extended brood care is the rule in freshwater crayfish, primary freshwater crabs and the aeglid anomurans. The amphidromous freshwater shrimps and crabs and all terrestrial decapods that invaded land directly from the sea have retained ocean-type planktonic development. Abbreviation of development and extension of brood care are probably adaptations to lotic habitats, food limitation in the pelagic environment and high threat of predation. These life history changes increase fitness of the offspring in fresh water and are obviously favoured by natural selection. Their costs are traded-off against fecundity, future reproduction and growth of females and perhaps against size of species but not against longevity of species. Direct development also favours the evolution of social systems, which occur in freshwater decapods in different manifestations including primitive eusociality. Direct development and extension of brood care is associated with the reduction of dispersal and gene flow between populations, which may explain the high degree of speciation and endemism in directly developing freshwater groups. Under conditions of rapid habitat loss, environmental pollution and global warming, the reduced dispersal ability of direct developers may turn into a severe disadvantage, posing a higher threat of extinction to crayfish, primary freshwater crabs, aeglids and landlocked freshwater shrimps as compared to amphidromous shrimps and crabs. For instance, if a crayfish population in a river is eradicated by a short-term wave of toxic chemicals it may be lost forever even when the previous water quality is rapidly restored. In contrast, amphidromous planktonic dispersers may soon repopulate such a lost habitat from neighbouring rivers via estuary hopping.

Brooding of juveniles in *Procambarus fallax f. virginalis* and *Geosesarma notophorum* (VOGT 2013)

References:

ANGER, K. (1995): The conquest of freshwater and land by marine crabs: adaptations in life-history patterns and larval bioenergetics. -- Journal of Experimental Marine Biology and Ecology, **193**: 119-145.

VOGT, G. (2013): Abbreviation of larval development and extension of brood care as key features of the evolution of freshwater Decapoda. -- Biological Reviews, **88**: 81-116.

***Daphnia*'s nightmare - impact of the notostracan *Triops* on cladoceran communities**

Oral BR

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It was recently suggested that notostracans may play a keystone role in temporary aquatic habitats. Using both microcosm and mesocosm experiments we tested the impact of the tadpole shrimp *Triops cancriformis* on cladoceran communities in Mediterranean temporary ponds (Camargue, Southern France). We found that tadpole shrimps effectively shape cladoceran communities, acting as size-selective top predators as well as ecosystem engineers, by modifying environmental conditions through bioturbation.
The waterflea *Daphnia* has, however, found a way to cope with this predator by evolving inducible defenses. We tested the impact of *Triops* kairomones on the hatching pattern, life history and morphology of *Daphnia magna* originating from different populations in France and Belgium. No impact was found on the hatching pattern, which can possibly be explained by the fact that *Daphnia* is never safe, neither as a dormant egg, nor as hatched individual. However, they did show significant responses in their morphology and life history traits. Although the responses were often clone-specific, *Daphnia* exposed to *Triops* generally grew larger and wider and had a longer tail spine. These induced changes were proven to be effective defense mechanisms, significantly lowering the predation rate by *Triops*.

An update on the true freshwater crabs from Guatemala (Decapoda: Pseudothelphusidae)

Oral CBF

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The true freshwater crab fauna from Guatemala is represented only by Pseudothelphusidae species, but our knowledge about their taxonomy and distribution is currently outdated. Published information for most species is scarce and usually relies on single samples or few and sporadic records. Here we compiled available data on the true freshwater crab fauna of Guatemala, based either on material recently collected (Fig. 1) or examined in the zoological collection of the Universidad del Valle de Guatemala, as well as on Guatemalan specimens deposited in the National Museum of Natural History (Washington, D.C.), Field Museum of Natural History (Chicago), Forschungsinstitut und Naturmuseum Senckenberg (Frankfurt a.M.), and Naturhistorisches Museum Wien (Vienna). Preliminary results, including the re-examination of the type specimens of several species, suggest that the Guatemalan pseudothelphusid fauna might be constituted by at least six genera and 16 species, being 14 already described and two probably new: *Elsalvadoria* BOTT, with 2 spp.: *E. tomhaasi* BOTT, 1970, and *E. zurstrasseni* (BOTT, 1956); *Phrygiopilus* SMALLEY, with 3 spp.: *P. acanthophallus* SMALLEY, 1970, *P. chuacusensis* SMALLEY, 1970, *P. strengerae* (PRETZMANN, 1965), and *Phrygiopilus* sp.; *Potamocarcinus* H. MILNE EDWARDS, with 2 spp.: *P. armatus* H. MILNE EDWARDS, 1853, and *P. magnus* RATHBUN, 1896; *Raddaus* PRETZMANN, with 3 spp.: *R. bocourti* (A. MILNE-EDWARDS, 1866), *R. mertensi* (BOTT, 1956), and *R. tuberculatus* (RATHBUN, 1897); *Typhlopseudothelphusa* Rioja, with 3 spp.: *T. mitchelli* DEMALARE DEBOUTEVILLE, 1976, T. *juberthiei* DEMALARE DEBOUTEVILLE, 1976, and *Typhlopseudothelphusa* sp.; and *Zilchia* PRETZMANN, with 2 spp.: *Z. falcata* RODRÍGUEZ & HOBBS, 1989, and *Z. zilchi* (BOTT, 1956). Five other taxa (*Gordonia longipes* PRETZMANN, 1965; *Pseudothelphusa bisunturalis* RATHBUN, 1897; *P. gracilipes* A. MILNE-EDWARDS, 1866; *P. propinqua* RATHBUN, 1905; and *P. proxima* RATHBUN, 1905) are considered *incertae sedis*, as they were described only from female specimens and, without checking the first male pleopod, their specific identity cannot be confirmed. The taxonomic status of some subspecies of *Phrygiopilus* and *Zilchia* need to be evaluated as well as the specific identity of some specimens belonging to *Phrygiopilus* and *Typhlopseudothelphusa* that were collected or found among the material studied by us. *Raddaus mertensi* and *Zilchia zilchi* are recorded for the first time in Guatemala, extending their current geographical distribution. The geographical distribution of the species, including the new material examined by us, is presented as maps. Additional sampling is needed to cover areas as well as habitats (e.g., cave systems), which have been neglected so far in order to complete the inventory of the true freshwater crab fauna of Guatemala.

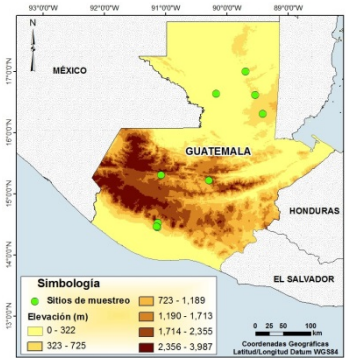

Fig. 1. Recently visited sampling locations.

Disparity of larval types of stomatopods – today and in the past

Poster

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Stomatopod larvae represent one of the most aberrant sets of morphological traits within crustaceans. This includes numerous structures, such as their large, functional raptorial maxilliped 2, their often large overall body size (up to 50mm in length), the elongated head region, or the hypertrophied shield.

Generally, there are four different types of larvae recognized within stomatopods: Two early developmental forms: Antizoea and pseudozoea, and two later developmental forms: the erichthus-type larva developing from either antizoea or pseudozoea, and the alima-type larva developing from squilloid pseudozoeae.

Figure: Two types of late stomatopod larvae. A. Elongate erichthus-type larva. Main morphological difference to the adult is the undifferentiated claw and the spines on the elongate shield (from HAUG & HAUG 2013, Bull Geosci 88, 195–206). B. Alima-type larva. Note the extremely broad shield with the elongate anterior head region, the elongate bar from which the eye-stalks arise, and the large telson. Both images are composite images under polarised light.

Here we highlight the morphologies of the two latter larval types, the alima and the erichthus larvae. Certain sub-forms of the erichthus type appear to be ancestral (plesio-morphic) in many morpholo-gical aspects while the alima appears to be very derived. In addition to the comparison of the morphologies between these two modern larval types we also show the differences between modern morphotypes and the ones found in 150 million years old fossil deposits.

For our approach we applied modern imaging technics such as composite fluorescence imaging, making use of the autofluorescence capacities of the cuticle, to display also finest details of individuals of each of these groups. Based on these data we aim at reconstructing an evolutionary scenario for the emergence of larval specializations within Stomatopoda.

Reproduction and natural history of the parasitic isopod *Athelges takanoshimensis* Ishii, 1914 (Isopoda: Bopyridae) from Hong Kong hermit crabs

Oral GS

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The bopyrid isopod *Athelges takanoshimensis* ISHII, 1914 is a common abdominal parasite of fifteen species of hermit crabs in four genera (*Clibanarius*, *Diogenes*, *Pagurodofleinia, Pagurus*) from Asia. We investigated the prevalence, reproduction, and morphology of *A. takanoshimensis* from over 1560 hermit crab hosts collected in Hong Kong between 2000 and 2004. Among these collections, *A. takanoshimensis* was found on ~7% of the hermit crab *Pagurus angustus* (STIMPSON, 1858) and 5% of *Pagurus hedleyi* (GRANT & MCCULLOCH, 1906), both of which are new host records. The male-female ratio of parasitized *P. angustus* was approximately 3:7, in contrast to a 3:2 ratio for uninfested hosts, suggesting that parasitism has an influence on apparent host sex ratio through modification of secondary sexual characteristics. Female *Athelges takanoshimensis* produced up to 5,031 embryos (average brood size = 2,852). Estimates of body size (head length, pereon length, and total length) were analyzed as predictors of fecundity but a significant correlation was only found between brood size and pereon length. The behavior of ovigerous females during release of their larvae was observed, showing movement of epicaridium larvae through the anteriormost oostegites caused by pumping action of the maxillipeds. The morphology of life history stages of *A. takanoshimensis* was examined using scanning electron microscopy (SEM), including the first investigation of epicaridium larvae for this species.

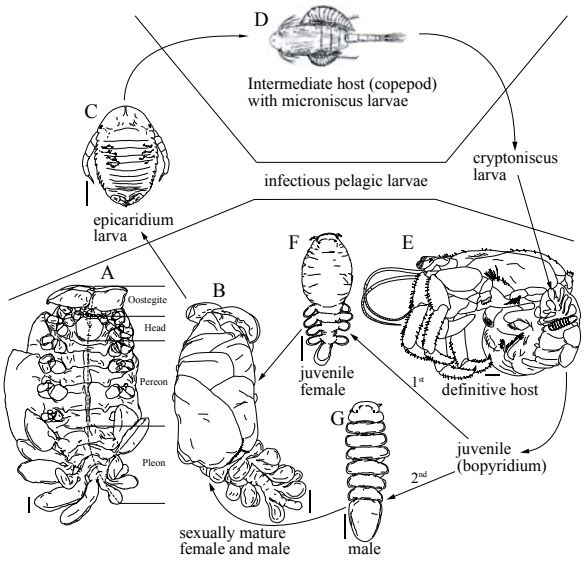

Fig. 1. Life cycle and morphology of *Athelges takanoshimensis*. A) Dorsal view of mature female parasite showing body measurements. B) Ventral view of ovigerous female. C) Epicaridium larvae released from female. D) Copepod intermediate host with two microniscus larvae. E) Definitive host hermit crab with female and male pair of parasites. F) Juvenile female parasite. G) Dwarf male parasite. Scale bars = 1 mm (A, B, E), 0.5 mm (F, G), 0.05 mm (C). Modified from McDermott et al. (2010).

Reference:

MCDERMOTT JJ, WILLIAMS JD, & BOYKO CB. 2010. The unwanted guests of hermits: A global review of the diversity and natural history of hermit crab parasites. Journal of Experimental Marine Biology and Ecology 394:2-44.

DNA-barcoding Decapoda and Stomatopoda from West-Africa

Oral MSI

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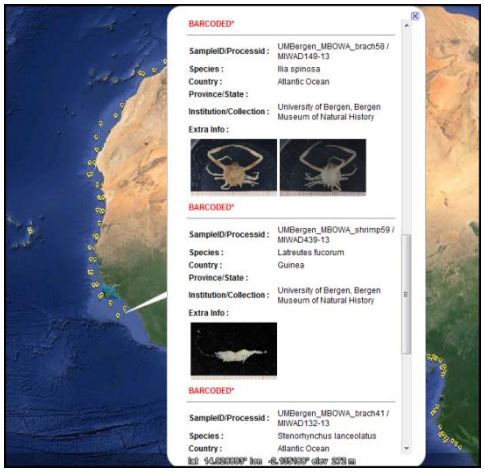
Knowledge about species biology, distributions, and autecologies is based on accumulated information provided by identifying observers from diverse time periods and from sometimes somewhat isolated scientific cultures. Traditional taxonomic revisions bear witness of the inherent challenges of specimen identification and the efforts to obtain concordant species observations that actually refer to the same natural units. "Mislabelled" species is a growing concern in population management and food industries. There is also an emerging alertness in macro-ecology of bias in estimators of species occurrences and in biodiversity assessment and modelling due to misidentifications.



Open access databases with DNA-barcodes are potentially powerful tools to discover conflicting identifications and may help in species recognition and in harmonizing the use of species taxonomies across research groups. Barcodes may also give taxonomists alerts about a need for integrative re-evaluation of taxa and their distributions. Such ideas are the background motivation for our DNA-barcoding of benthic animals from recent sampling on the West-African shelf conducted by the EAF-Nansen programme. We prepared 470 specimens of Decapoda and five Stomatopoda, in sum representing 133 identified species, for DNA-sequencing using the BOLD v3 system. Sequences were obtained from 351 samples, including 107 (80 %) of the identified species. The BOLD-system assigned the sequences to 113 BINS (RATNASTINHAM & HEBERT, 2013) of which 64 BINS were taxonomically concordant and 33 were singletons. Amongst 16 taxonomically discordant BINs, one was due to a previous record with a junior synonym, four due to identical sequences of subspecies taxa or identification to genus only. Interestingly, some of the discordant BINs, such as our sequences of the crab *Menippe nodifrons* (Menippidae) contained conspecific matches with West-Atlantic sequences in BOLD whereas another matching sequence from GenBank had been identified as a Pilumnidae. The most striking conflicting identifications in BOLD were observed with respect to the genus *Macropodia,* showing a need for taxonomic resolution and revision.

Reference:

RATNASTINHAM, S. & HEBERT, P.D.N. (2013) A DNA-based registry for all animal species: the Barcode Index Number (BIN) system. -- PLoS ONE, **8**(7): e66213. doi:10.1371/journal.pone.0066213.

DNA Barcoding of Dead Coral Head Communities Confirms Coral Triangle is Decapod Diversity Hotspot

Oral MSI

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Invertebrate fauna inhabiting coral reefs on both dead and live coral have, until recently, been largely overlooked in reef diversity studies (PLAISANCE et al., 2009; PLAISANCE et al., 2011). Here we use DNA barcode sequences from decapod crustaceans living in dead coral as a proxy for invertebrate diversity to estimate species richness in two reefs near Bali, Indonesia. In 2011, as part of a field course on marine biodiversity, we collected of 2500 decapod crustaceans inhabiting dead corals heads. Each specimen was photographed and a leg was removed for DNA extraction. The DNA barcode region of the cytochrome oxidase subunit I gene was successfully sequenced for 2150 individuals. When possible, specimens were identified to family or genus using literature and DNA sequence comparisons. For diversity analyses, genetically-defined species were delimited using a 5% dissimilarity threshold and clustered into Evolutionary Significant Units (ESUs) using MOTHUR (SCHLOSS et al., 2009). Our results are compared to dead head data from PLAISANCE et al., 2011 to calculate beta and gamma diversity across the western Pacific Ocean. Our analysis of alpha species diversity demonstrate that, of areas sampled to-date, Indonesia has the highest number of unique taxa. Additionally we examine the community composition of each location and calculated similarity indices using the program EstimateS (COLWELL, 2013) to identify which families and genera were the major drivers of diversity in each location, with a particular emphasis on the specimens from Indonesia.

References:

COLWELL, R.K. (2009). EstimateS: Statistical estimation of species richness and shared species from samples. Version 9. Persistent URL <purl.oclc.org/estimates>.

PLAISANCE, L., KNOWLTON, N., PAULAY, G., & MEYER, C.P. (2009). Reef-associated crustacean fauna: Biodiversity estimates using semi-quantitative sampling and DNA barcoding. *Coral Reefs*, 29, 977–986.

PLAISANCE, L., CALEY, M.J., BRAINARD, R.E., & KNOWLTON, N. (2011). The diversity of coral reefs: what are we missing? *PLoS One*, 6(10), e25026.

SCHLOSS, P.D., WESTCOTT, S.L., RYABIN, T., HALL, J.R., HARTMANN, M., HOLLISTER, E.B., LESNIEWSKI, R.A., OAKLEY, B.B., PARKS, D.H., ROBINSON, C.J., SAHL, J.W., STRES, B., THALLINGER, G.G., VAN HORN, D.J., & WEBER, C.F. (2009). Introducing mothur: Open-Source, Platform-Independent, Community-Supported Software for Describing and Comparing Microbial Communities. *Applied and Environmental Microbiology*, 75(23), 7537–7541.

Gonad maturity in the Chinese mitten crab *Eriocheir sinensis* females from the southern Baltic Sea - first description of ovigerous females and embryo developmental stage

Poster

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The Chinese mitten crab *Eriocheir sinensis* is one of well-known non-native species introduced in ballast tanks to European waters almost one hundred years ago. The biggest self-sustained population of this species occurs in German river Elbe and its tributaries, however due to larval retention as well as the capability of juveniles and adults to migrate long distances, specimens from this population spread often to territories of the neighbouring countries. Since 1926 adult mitten crabs have been also observed in the southern Baltic Sea, however only since few decades they are recorded in higher abundances. Although sexually mature specimens can live in fresh and brackish waters as well as in the sea, the eggs and larvae of *E. sinensis* require higher salinities (ca. 20 PSU) for successful development. Thus it is assumed that this species is rather unable to reproduce in the brackish Baltic waters and crabs inhabiting this water body are only a splinter of the "German" population. However several ovigerous females, planktonic larvae and juveniles found recently in the Kiel Fjord and neighbourhood indicate possibility of completing the whole reproduction cycle in the western Baltic Sea. Unfortunately, there is no information concerning female maturity and reproduction of *E. sinensis* in the southern Baltic Sea, where salinity is much lower compared to western parts. Therefore the objective of our study was to provide new data on gonad maturity as well as on developmental stages of embryos carried by ovigerous females of *E. sinensis* from the southern Baltic Sea.

E. sinensis females were collected in 2005–2008 and 2012 in the Gulf of Gdańsk and Vistula Lagoon (southern Baltic Sea, Poland). In the laboratory their carapace was measured and wet weighted was determined. Then gonads where extracted and examined under microscope in regard to five-scale gonad maturity stage. Eggs extracted from gravid females were examined under microscope in regard to embryo development stage.

In the southern Baltic brackish waters *E. sinensis* grow, reach maturity and mate, what is confirmed by the presence in samples from April till September (salinity 7 PSU and below) many females with gonads in the stage just before spawning as well as egg-carrying ones. Seventeen females had gonads in the penultimate stage, what indicates that they were shortly before spawning. Four other females had gonads in the last stage, what means they were already carrying eggs. They accounted on average 17.9 ± 2.9% of female weight and were in 3rd and 4th embryo development stadium.

Based on the conducted studies it might be assumed that in the southern Baltic Sea females of *E. sinensis* follow regular life cycle reaching sexual maturity, copulating and putting eggs on pleopods. It should be consider if *E. sinensis* will be able to adapt to surrounding conditions over the next few years, creating a stable, breeding population.

Differential transcriptomic responses to heat stress of three intertidal barnacle species in Hong Kong

Poster

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Inhabitants of rocky intertidal zone are subjected to periodic tidal emersions and enormous thermal stress during daytime low tides. *Tetraclita japonica*, *Tetraclita squamosa* and *Megabalanus volcano* are common intertidal barnacles found in Hong Kong, with *T. japonica* occupying mid to high intertidal zone, *T. squamosa* occupying mid intertidal zone, and *M. volcano* occupying low intertidal to subtidal zone. Our previous studies show that the three barnacle species in contrasting thermal environments displayed different responses to heat stress. At the challenge of 40°C, *M. volcano* exhibited erratic motion while *T. japonica* and *T. squamosa* first became quiescent, entered coma state, and later recovered with higher survival rates than *M. volcano*, suggesting these higher intertidal barnacles are more heat tolerant than the lower intertidal ones.

To dissect the molecular mechanisms behind the difference in thermal tolerance among the three barnacle species, we exposed them to 40°C rock temperature for different durations: (a) 0 h (control), (b) 1 h, (c) 3 h and (d) immersed in aquarium for 2 h after the 3-h treatment (recovery). Large-scale gene expression profiling was done via next generation sequencing on the 12 cDNA libraries produced, with each containing ~50 million clean reads. Expression profiles were analyzed and compared among the three species and treatments. The total number of differentially expressed genes during heat treatment was much higher than in *M. volcano* than in the two *Tetraclita* species. Moreover, there were more down-regulated than up-regulated genes in the two *Tetraclita* species, while the opposite was evident in *M. volcano*. With reference to the expression profiles of some classical heat shock proteins, *M. volcano* showed a larger fold change than the other two species. The results suggest heat stress poses much stronger effect on *M. volcano* and that the energy expenditure in *M. volcano* during heat stress is much higher, in consistence to its erratic motion under heat stress. While the detailed differential gene expression profiles among the three species are still under analysis, it is evident that *M. volcano* occupying the low intertidal and subtidal zone exhibits very different pattern of gene expression from the two *Tetraclita* species in the mid to high intertidal zone.

References:

CHAN, B.K.K., MORRITT, D., PIRRO, M.D., LEUNG, K.M.Y & WILLIAMS, G.A. (2006). Summer mortality: effects on the distribution and abundance of the acorn barnacle *Tetraclita japonica* on tropical shores. *Marine Ecology Progress Series* **328**: 195-204.

PLACE, S.P., O'DONNELL, M.J. & HOFMANN, G.E. (2008). Gene expression in the intertidal mussel *Mytilus californianus*: physiological response to environmental factors on a biogeographic scale. *Marine Ecology Progress Series* **356**, 1-14.

Temperature dependency of bioturbation activity in *Corophium volutator* (Crustacea, Amphipoda)

Poster

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Bioturbation is an important process in benthic ecosystems. Through their burrowing behavior bioturbators actively modify the structure and porosity of sediments. They redistribute oxygen and promote remineralisation, resuspension and burial of organic matter. Bioturbation activity has been shown for a great variety of benthic in- and epifaunal organisms including many crustacean species. The intertidal amphipod *Corophium volutator* (PALLAS, 1766) builds burrows to a depth of 5 cm in fine to muddy sands. The burrowing behavior of *C. volutator*, in turn, is influenced by population density and tides (DE BACKER et al. 2011). In the light of rising seawater temperatures in the North Sea the aim of this study was to investigate the effect of temperatures on the sediment reworking activity of *C. volutator*. These amphipods have a wide temperature tolerance but prefer temperatures between 15 and 20°C (MILLS & FISH, 1980; MEADOWS & RUAGH, 1980). Therefore, we hypothesized that the sediment reworking rate of *C. volutator* increases with temperature in the range of 10 to 20 °C.

We applied the luminophore tracer technique to quantify bioturbation activity of *C. volutator* within the above temperature range. The use of fluorescently marked sediment grains (grain size: 80-250 µm) allowed for direct observation of particle redistribution within the sediment and for quantifying bioturbation activity. Experimental sediment cores (diameter: 10 cm; height: 8 cm) were set up to determine temperature dependency of maximal vertical penetration depth and bioturbation rate of the amphipods over a time period of 7 days. In addition, life imaging applied to thin sediment slices in flow through aquaria (height: 8 cm; width: 30 cm; thickness: 1.2 cm) allowed for tracking the bioturbation activity of *C. volutator* over 48 hours at intervals of 15 minutes.

C. volutator readily burrowed in the experimental sediments at all temperatures. Bioturbation activity was evident in the upper 2-3 centimeters while the amphipods hardly ever advanced into sediment below 4 cm. Apparently, sediment reworking by *C. volutator* was mainly associated with ventilation and foraging activity of the amphipods at the opening of the burrows. First results from life imaging indicate that bioturbation activity of *C. volutator* is largely temperature independent. However, the experiments are just being finished and this Poster will present a finalized evaluation of the temperature dependency of bioturbation in *C. volutator*.

References:

DE BACKER, A., VAN COILLIE, F., MONTSERRAT, F., PROVOOST, P., VAN COLEN, C., VINCX, M. & DEGRAER, S. (2011): Bioturbation effects of *Corophium volutator*: Importance of density and behavioural activity. Estuarine, Coastal and Shelf Science **91**: 306-313

MEADOWS, P.S. & RUAGH, A.A. (1980): Temperature preferences and activity of *Corophium volutator* (Pallas) in a new choice apparatus. Sarsia **66**: 67-72

MILLS, A. & FISH, J.D. (1980): Effects of salinity and temperature on *Corophium volutator* and *C. arenarium* (Crustacea: Amphipoda), with particular reference to distribution. Marine Biology **58**: 153-161

Insights of species delimitation by the COI barcoding gene on marine lobsters (Decapoda, Macrura Reptantia)

Oral MSI

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Marine lobsters (Macrura Reptantia) currently consist of 54 genera and 263 species belonging to four infraoders Astacidea, Glypheidea, Achelata and Polychelida. As many of them have high commercial values, their positive identification as well as exact species delimitation are often of important concerns. DNA barcoding technique is supposed an answer to these issues. We explore the applicability of the most commonly used barcoding gene COI in defining marine lobster species and genera by attempting to compare the nucleotide divergence among as many marine lobster taxa as possible, including adding new sequences. At present, our COI dataset composed of 52 genera (96% of all the genera) and 203 species (77% of all the species, 318-657 bp, with novel sequences from 76 species). The nucleotide divergences on uncorrected distances (*p*-distance) of these 203 COI partial sequences are 0.2 to 30.6% (average= 15.4%) and 4.1 to 39.1% (average= 21.6%) amongst genera. Altogether 19 species (9.4% of all the analyzed species) have less than 3% pairwise distance from other species. Thus, COI barcoding is generally useful in marine lobster identification. Attempts to source more taxa for including in the dataset will continue. Moreover, partial sequence of the nuclear gene marker 28S rRNA gene will be added to the analysis for assisting the molecular interpretation.

References:

CHAN, T. Y. (2010): Annotated checklist of the world's marine lobsters (Crustacea: Decapoda: Astacidea, Glypheidea, Achelata, Polychelida). --The Raffles Bulletin of Zoology Supplement, **23**: 153-181.

ZUCCON, D., BRISSET, J., CORBARI, L., PUILLANDRE, N., UTGE, J. & SAMADI, S. (2012): An optimised protocol for barcoding museum collections of decapod crustaceans: a case-study for a 10-40-years-old collection. – Invertebrate Systematics, **26**: 592-600.

Connectivity of the chemosynthetic squat lobster *Shinkaia crosnieri* (Crustacea: Decapoda: Galatheidae) between the cold seep and hydrothermal vent habitats in the northwest Pacific

Poster

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The deep-sea squat lobster *Shinkaia crosnieri* is an unique crustacean previously only reported from active deep-sea hydrothermal vents in the Okinawa Trough and Bismark Archipleago, though the record of the latter locality is doubtful. Recently this species is also found from the deep-sea cold seep sites off southwestern Taiwan. Molecular genetic technique is used to investigate the connectivity between the cold seep and hydrothermal vent *S. crosnieri* populations located at the two sides of Taiwan (*i.e.* southwestern against northeastern coasts). The genetic markers used are the mitochondrial COI gene barcoding segment and the nuclear adenine nucleotide translocase (*ANT*) intron gene. The preliminary molecular genetic analysis reveals that the vent and cold seep populations form two clades in the mitochondrial COI gene with 2.4-3.8% divergence, though there is no genetic distinction on the nuclear *ANT* gene. This indicates that *S. crosnieri* from vents and cold seeps may represent distinct populations. More samples as well as more genetic markers will be necessary to confirm this interpretation.

References:

BABA, K. & WILLIAMS, A.B. (1998): New Galatheoidea (Crustacea, Decapoda, Anomura) from hydrothermal systems in the West Pacific Ocean: Bismarck Archipelago and Okinawa Trough.-- Zoosystema, **20:** 143-156.

BABA, K., MACPHERSON, E., LIN, C.-W. & CHAN, T.Y. (2009): Crustacean Fauna of Taiwan: Squat Lobsters (Chirostylidae and Galatheidae), 312 pp; National Taiwan Ocean University.

CHAN, T.Y., LEE, D.-A. & LEE, C.-S. (2000): The First Deep-Sea Hydrothermal Animal Reported from Taiwan: *Shinkaia crosnieri* Baba and Williams, 1998 (Crustacea: Decapoda: Galatheidae).--Bulletin of Marine Science, **67**(2): 799-804.

DESBRUYERES, D., SEGONZAC, M. & BRIGHT, M. (2006): Handbook of deep-sea hydrothermal vent fauna, Linz: Biologiezentrum der Oberosterreichische Landesmuseen.

Community structure of decapod crustaceans on dead branching corals in the Gulf of Thailand

Poster

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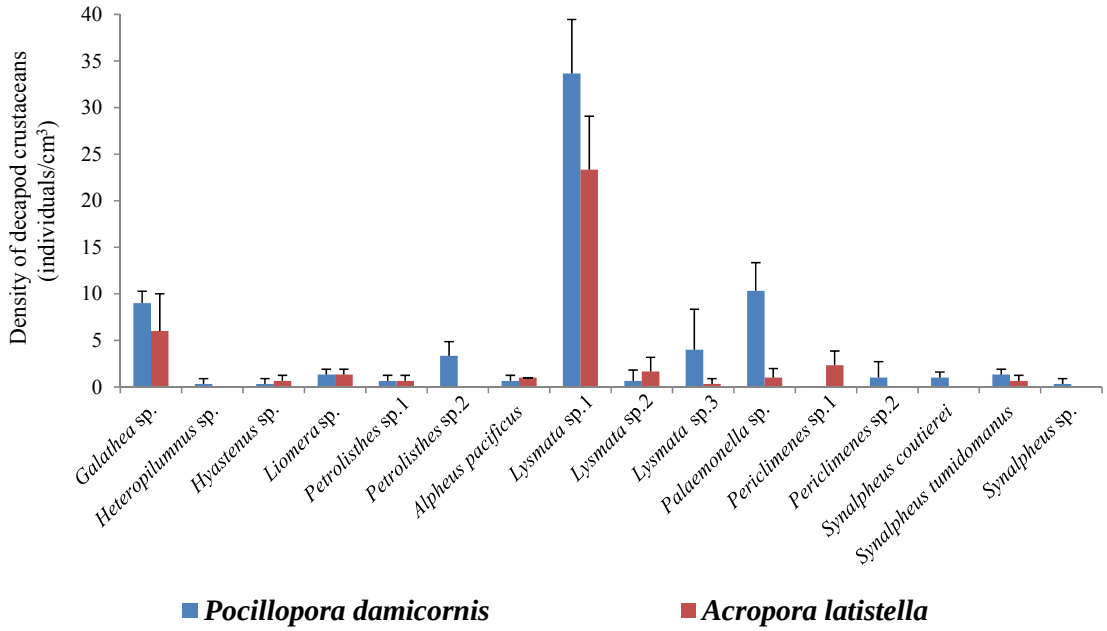
The severe mass coral bleaching event occurred in the Gulf of Thailand and the Andaman Sea during the summer months of 2010. Most colonies of the branching corals, *Acropora* spp. and *Pocillopora* spp. died after the coral bleaching. The objective of this study was to examine species community structure of decapod crustaceans associated with bleaching-induced dead colonies of *Acropora latistella* and *Pocillopora damicornis* from coral communities in Gulf of Thailand. All dead coral colonies were collected three months after the bleaching event. The decapod crustaceans associated with dead corals were identified and the space volumes of dead coral colonies were calculated. We found at least 16 species of decapod crustaceans dominated on the dead coral colonies. The composition of decapod crustaceans varied according to coral species. There were higher density and diversity in *P. damicornis* than in *A. latistella*. The shrimp *Lysmata* sp. and crab *Galathea* sp. were dominant species of all dead corals. Long-term studies on decapod crustaceans associated with dead coral colonies are needed in order to explain the effects of climate-induced coral bleaching on coral reef communities.



Legend: species composition of associated decapod crustaceans found in dead colonies of *P.damicornis* and *A. latistella*

Reference:

GOTELLI, N.J. & ABELE, L.G. (1983): Community patterns of coral-associated decapods. -- Marine Ecology Progress Series, **13**: 131-139.

YEEMIN, T., PENGSAKUN, S., YUCHAROEN, M., KLINTHONG, W., SANGMANEE, K., & SUTTHACHEEP, M. (2013): Long-term decline in *Acropora* species at Kut Island, Thailand, in relation to coral bleaching events. -- Marine Biodiversity **43**: 23–29.

Conservation first: strategic planning to save the critically endangered Singapore freshwater crab, *Johora singaporensis*

Oral CBF

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The critically endangered Singapore freshwater crab, *Johora singaporensis,* is among the 100 most threatened species in the world. The species is endemic to Singapore and known from only a few hill stream localities. Conservation approaches so far have focused mainly on research into the animal's ecology and on *in situ* site conservation and management. In an effort to ensure the long-term survival of this species, a conservation plan was recently developed along IUCN guidelines to integrate efforts and approaches into a cohesive strategy. Here we present the background, development processes, and outcomes of the *Johora singaporensis* species conservation plan*,* which to our knowledge, is the first for any invertebrate species.

A new genus of Cyprididae ostracods from the Yucatan Peninsula

Oral GS

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The Yucatan Peninsula is a well know area of high diversity and endemicity. Ostracods from this part of the world are poorly studied and, not surprisingly, new taxa are very easy to find even in ecosystems which are known to harbor widely distributed species, such as open, permanent water bodies. During a recent visit to the Yucatan Peninsula we have collected an ostracod species from brackish water in the city of Chetumal, Mexico. It is very similar to *Eucypris cisternina* FURTOS, 1936, described from the opposite side of the Peninsula (Campeche). The two species share a very similar uropodal ramus, but differ in the valve shape. Close examination of our material reveals that the Chetumal species belongs to a yet undescribed genus of the family Cyprididae (Podocopida). This family currently contains nearly 30 subfamilies, all predominantly freshwater, with only a few species found in brackish water. The new genus seems to be most closely related to *Heterocypris* CLAUS, 1892 of the subfamily Cyprinotinae. It lacks typical tubercles on either valve, and does not have any seta on the basal segment of the walking leg. In addition, the chaetotaxy of the fifth limb is very peculiar, because none of the most proximal setae ("a") on protopod are present. In fact all these characters make it hard to even place the new genus in Cyprinotinae. Therefore, we use 18S and partial sequences of 28S rDNA to test its position in Cyprididae. All three commonly used methods (Maximum Likelihood, Maximum Parsimony and Neighbor Joining) clearly indicate that the new genus stands between two subfamilies: Cyprinotinae and Eucypridinae. The solution would be to either synonymize the two subfamilies or to describe a third one. However, this is premature at the moment because both subfamilies require revision. One of the many examples is the case of *E. cisternina*. Although this species is poorly described, the morphology of valves and the uropodal ramus clearly indicate that it is not a typical Eucypridinae representative. In fact this species most probably belongs to a new genus and the new combination will be provided upon examination of the type material.

Reference:

FURTOS, C. (1936): On the ostracoda from the cenotes of yucatan and vicinity. Carnegie Institution of Washington Publication No.457.

A taxonomic review of *Septosaccus snelliusi* Van Baal, 1937 (Cirripedia: Rhizocephala: Peltogastridae), with two undescribed species

Poster

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The order Rhizocephala (Crustacea: Cirripedia) comprises approximately 260 species, all of which are parasites of decapods and other crustaceans. While rhizocephalans have planktonic larval stages (nauplii and cyprids), the adults have an internal somatic portion (interna or root system) and external reproductive portion (externa). Peltogastridae is one of the nine rhizocephalan families and comprises 15 genera and 39 species. *Septosaccus* DUBOSCQ, 1912 is one of the eight peltogastrid genera that parasitise hermit crabs. This genus comprising four species is characterized by inner surface of mantle with numerous septa. We collected *Septosaccus* sp. parasitizing on a hermit crab *Diogenes tumidus* on the coasts of the Penghu Islands, Taiwan, and the specimens were similar to the previously described species, *Septosaccus snelliusi* VAN BAAL, 1937. We examined the syntype specimens of *S. snelliusi* in Leiden (Naturalis Biodiversity Center), and we found that the unidentified species from Penghu is distinct from *S. snelliusi*: *S. snelliusi* has chitinous structure in inner receptacle, but the unidentified *Septosaccus* does not have. The chitinous structure is also found in *S. rodriguezi* and *S. cuenoti*. *S. reticulatus* is distinguishable from the other *Septosaccus* species including the present specimens from Penghu Islands by the lateral expansion of the visceral mass. Therefore, we concluded that *Septosaccus* sp. from Penghu Islands is an undescribed species. Furthermore, we found that the type series of *S. snelliusi* included two types. In the specimens on *Clibanarius striolatus*, the mantle aperture was not projected and mantle surface was covered with a cuticular layer. In the specimens on *C. longitarsus*, the mantle aperture was projected and mantle surface was not covered with a cuticular layer. Although the type series include the specimens on other *Clibanarius* species, the specimens could not be found or were not in a condition to be identified as either type. The former specimens first appeared in the description of VAN BAAL (1937). Accordingly, we propose to assign one of the specimens on *C. striolatus* as the lectotype of *S. snelliusi* and the specimens on *C. longitarsus* as undescribed species.

Reference:
VAN BAAL, I. (1937): Rhizocephala of the families Peltogastridae and Lernaeodiscidae. –Temminckia, **2**: 1-96.

Trophic position of the introduced and native crab species (Crustacea Decapoda Brachyura et Anomura) in shallow waters of the subarctic and temperate seas as revealed by $^{13}C/^{12}C$ and $^{15}N/^{14}N$ Stable Isotope Ratio Analysis (SIA)

Oral IC

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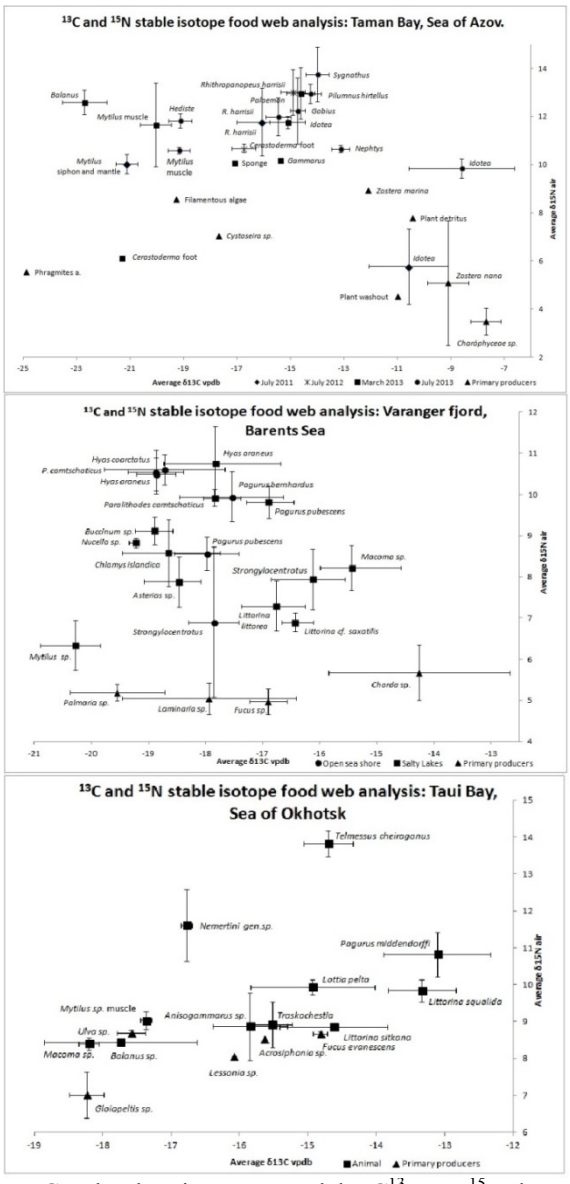
We have studied the food web structure in shallow water bays with the focus at trophic role of highly abundant alien mud crab *Rhithropanopeus harrisii* and the native brachyuran species *Pilumnus hirtellus* in the Taman Bay, Sea of Azov; native spider crabs *Hyas* spp. and introduced red king crab *Paralithodes camtschaticus* in the inner part of Varanger fjord in the Barents Sea and native helmet crab *Telmessus cheiragonus* in the Taui Bay, Sea of Okhotsk. To explore food web structure, SIA of ^{13}C and ^{15}N has been applied to several dominating plant and animal species within each region. Analyses were conducted using a mass-spectrometer Thermo-Finnigan Delta V Plus and analyzer Thermo Flash 1112. In all studied ecosystems crabs occupy central position in their $\delta^{13}C$ signature, suggesting a broad diet based on organisms acquiring carbon from different primary producers, i.e. macrophytes and phytoplankton. Crabs also appear to be positioned on the upper level of the trophic chains (relatively high $\delta^{15}N$ values) suggesting their importance as top predators. Isotopic niches of the native and alien crab species in Taman Bay and Varanger fjord are generally overlapping. Three-year study on the Taman Bay food web structure has shown a relatively stable position of *R. harrisii* in the food web, while other organisms such as isopod *Idotea balthica* shift its position over the course of time.



Graphs showing average delta C^{13} vs. N^{15} values for various species in Sea of Azov, Barents Sea and Sea of Okhotsk. Неплохо бы на рисуночках ^{13}C и ^{15}N – с цифрами впереди. Так принято.

This study was supported by the Russian Foundation for Basic Research grant 13-04-0112

Global review of freshwater decapod introductions

Oral IC

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Freshwater decapod crustaceans can be found in lentic, lotic, terrestrial, and subterranean habitats worldwide. They play important ecological roles as keystone species and ecosystem engineers, and are also culturally significant. Often used by people as food, bait, and in the ornamental trade, freshwater decapods have been translocated globally (into temperate and tropical regions) to varying consequences. Although potentially providing economic benefits, introduced freshwater decapods have been recorded to become invasive through their subsequent proliferation, spread, and negative environmental and economic impacts. This study presents a global review of the introduction of this group of crustaceans, their introduction pathways and impacts, and highlights patterns and pertinent issues related to them.

Protandric simultaneous hermaphroditism in a marine shrimp *Lysmata wurdemanni* may be regulated by an insulin-like androgenic gland factor

Oral GS

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Shrimps in the genus *Lysmata* have a unique and rare sexual system referred to as protandric simultaneous hermaphroditism, i.e. individuals mature first as males (male phase), and the female function may also develop (i.e. sex change) as shrimp grows, so that the gonad is able to produce both eggs and sperms simultaneously, a condition called simultaneous hermaphrodite (euhermaphrodite phase) that has both male and female functions. To date, the sex control in the distinguished sexual system remains poorly understood. Many studies indicate that an insulin-like androgenic gland factor (IAG) is involved in controlling sex differentiation in gonochoric crustaceans (), but its role in the protandric simultaneous hermaphrodite is still not clear. To determine whether IAG is involved in sex control in the hermaphrodite, here we cloned IAG gene cDAN sequence from *Lysmata wurdemanni*, a protandric simultaneous hermaphroditic shrimp for the first time. The open reading frame size of IAG was 528 bp encoding 176 amino acids, which consists of a signal peptide, an A chain, a B chain, and a C peptide. The organization is similar to the IAGs found in other decapods. IAG gene was detected both in male and euhermaphrodite phases, but the expression level is significant higher at the male phase than at the euhermaphrodite phase. The eukaryotic expression vector we constructed had activity, and subcellular localization result shows that fusion protein was expressed in both cell cytoplasm and nucleus. Data obtained in the present study suggest that IAG gene may be a factor to control sex in the protandric simultaneous hermaphrodite, and the euhermaphrodite phase is maintained by reduced gene expression.

References:

VENTURA, T., MANOR, R., AFLALO, E. D., WEIL, S., RAVIV, S., GLAZER, L. & SAGI, A. (2009). Temporal silencing of an androgenic gland-specfic insulin-like gene affecting phenotypical gender differences and spermatogenesis. --Endocrinology, **150**:1278-1286.

ROSEN, O., MANOR, R., WEIL, S., GAFNI, O., LINIAL, A., AFLALO, E. D., VENTURA, T. & SAGI, A. (2010). A sexual shift induced by silencing of a single insulin-like gene in crayfish: ovarian upregulation and testicular degeneration. --PLoS One, **5**(12): e15281.

Variations in structure, composition and function of the cuticle in skeletal elements of *Porcellio scaber* (Isopoda, Oniscidea).

Oral GS

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The crustacean cuticle is composed of an organic matrix and a mineral phase of mostly calcium carbonate. The organic phase is organized in at least seven hierarchical levels and forms a characteristic twisted plywood structure, which is built by stacks of planar arrays of complex chitin-protein fibrils. We have studied the ultrastructure and mineral distribution within the cuticle of tergites, the joint head of the pereiopod basis, and the partes incisivae of mandibles in *Porcellio scaber* using a variety of electron microscopic and spectroscopic techniques and electron backscatter diffraction analysis. In addition, we have analyzed the mechanical properties of the cuticle in some of the skeletal elements by nanoindentation experiments. In the tergite cuticle the chitin-protein fibrils form the common twisted plywood organisation as expected. However, in subregions of the joint head and the pars incisiva fibrils organise in parallel with their long axis oriented in the direction of maximum mechanical load. The mineral phase in the general tergite consists of calcite in the exocuticle, and amorphous calcium carbonate (ACC) and minor amounts of amorphous calcium phosphate (ACP) in the subjacent endocuticle. Higher amounts of ACP occur at transitions of tergite and joint head cuticle to the arthrodial membranes. Nanoindentation experiments show that the reduced elastic modulus and the hardness are larger in the direction of the long axis of the fibrils than perpendicular to it. Furthermore, mineralisation of cuticle with higher concentrations of ACP leads to a reduction in the elastic modulus and hardness, resulting in a more compliant cuticle. Surprisingly, the incisive edge of the mandibles is not mineralised and has a very thick epicuticle containing anisotropically oriented fibrous structures. Adjacent to the tip the pars incisiva is mineralised by ACP only, which is successively replaced by ACC towards its base. In the mandible calcite is restricted to the exocuticle of the base of the pars incisiva and the main mandible corpus. The calcite layer within the pars incisiva and the tergite cuticle consists of distinct calcite crystals with different crystallographic orientation. Interestingly, each crystal consists of microdomains in which the c- and a-axes are slightly misoriented to one another. The results show that the structural organisation of the organic matrix and the distribution of various mineral phases can vary considerably between the various skeletal elements suggesting functional adaptations.

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