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P-II

Natural history of *Lomanoticola brevipes* Hancock & Norman, 1863, (Copepoda, Poecilostomatoidea, Splanchnotrophidae) at the Ría de Ferrol (Galicia, NW Iberian Peninsula): external anatomy, behaviour and reproduction

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The Copepoda of the family Splanchnotrophidae, Hancock & Norman, 1863 are a small group of endoparasites that host Mollusca Gasteropoda Opistobranchia. They present a highly modified anatomy, above all in the case of the females, which can be easily distinguished by the presence of a pair of ovigerous sacs taken out through the host tegument. These present a variable number (from 3 to 8 pairs) of lateral appendages which they use to hold on to the inner organs of the nudibranch, improve the gas exchange and store new formed eggs. On the other hand, males present the typical anatomy of cyclopoid Copepoda and live freely in the host interior, moving through the body cavity of the nudibranch. In the present work, the species *Lomanoticola brevipes* Hancock & Norman, 1863 is studied. It was found at the Ría de Ferrol (Galicia, NW Iberian Peninsula) parasitizing four species of the genus *Doto* Oken, 1815 (Nudibranchia, Dendronotacea): *D. lemchei* Ortea & Urgorri, 1978; *D pinnatifida* Montagu, 1804; *D. eireana* Lemche, 1976 y *D. koenneckeri* Lemche, 1976. This parasitic Copepoda is only known thanks to the descriptions made from a small number of females; no male specimens had been found so far. This is the first time that enough material could be collected (by scuba diving with scuba suit) to make a complete description of both sexes.

P-I

Revision of the genus *Eucyclops*

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Number of taxonomic units described under generic name *Eucyclops* is definitely huge. Under some calculations it is evaluated between 128 and 168 taxons, that erects this genus as most abundant one among all Cyclopids. Even though there are many unvalid names (like *E. agilis*), doubtless synonyms (like *E. lilljeborgi* and *E. denticulatus*), confusing species obviously belonging to other genera but in some popular data bases staying within the genus (like *E. alter* Kiefer = *Afrocyclops alter* or *E. compactus* Sars = *Thaumasiocyclops compactus*). The total number of valid species/subspecies names is about 100. So high species richness makes the genus difficult to maintain not only for regular users but for taxonomists. To avoid this constraint in the frames of recent revisions based on analyses of the type collections of F. Kiefer, B. Dussart, G.O. Sars, T. Ishida, and S. Fischer the genus *Eucyclops* has been splitted into three genera: *Eucyclops s.str., Stygocyclops* Plesa, 1971, and *Isocyclops* Kiefer, 1957. The most speciose genus being *Eucyclops* on armature and ornamentation of the first and second antennae, swimming leg 4 coxal plate and caudal rami construction is separated into 7 sub-genera, with nominative *Eucyclops (Eucyclops)* subgenus as the most abundant one with species (27) and subspecies (8). Six other sub-genera comprise from 5 to 14 taxons. About 15 species in the genus are recognized as younger synonyms, 12 species replaced into other genera, 17 taxons are placed into a *nom.nud.* group where about 20 taxons are evaluated as problematic ones at this level of knowledge. Among the last group more than 10 species were not sufficiently described by K. Lindberg, who unfortunately did not left a types collection. The perspectives of future taxonomical and phylogenetic studies on this genus are discussed.

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O

Copepod biodiversity in Eastern Borneo

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South East Asian copepod biodiversity is not well studied yet due to several reasons. Large island Borneo is one of the most important areas with practically almost missing of knowledge on this group, as it was not practically explored by limnologists and zootaxonomist in aquatic group of organisms with few exceptions such as freshwater crabs and exotic fishes. In June 2011 a long distance journey (about 3000 km) was conducted to collect zooplankton in the Eastern part of Borneo in different water bodies from temporary pools in low land area of river Garama to the upstream and downstream of the longest river of the island Kinobatangan. A rich fauna of cyclopid, calanoid and harpacticoid species was discovered in these aquatic sites. In the talk, the first result of this survey are presented.

P-I

Planktonic copepods from Laguna de Términos Campeche, Mexico

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The Laguna de Términos, Campeche, Mexico is the second largest coastal system in the country. Copepods of this estuarine system have been studied since 1965; the highest percentage of species reported occurs in the summer and the lowest in winter. In 1981 it was possible to develop the first census consisting of 22 species. In order to know the current status of copepods in the system, we analyzed 30 samples of zooplankton, 15 were collected in the dry season and 15 in the rainy season of 2009. Five mins. circular tows were made at one meter deep, with a conical net with a mouth of 30 cm mesh size of 250 um and 90 cm length. Samples were also taken for the determination of temperature, salinity and dissolved oxygen water. There was a huge decrease in the number of copepod species compared with the previous census; there were only three species in the dry season and seven in the rainy season. The dominant species was *Acartia tonsa* which is considered a typically estuarine species, eurythermal and euryhaline. In relation with the previous census, this study found only 22% of the species previously reported and includes *Pseudodiaptomus pelagicus*, which is a new record for the lagoon.

P-I

Acanthocyclops sp. from the Quarry East, Ecological Reserve of San Angel Pedregal, Mexico

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Quarry east is part of the "Reserva Ecológica del Pedregal de San Angel", in the limits of Mexico City. In April 1970, the drilling/extraction of basaltic material in the area allowed aquifers to form small reservoirs that are now considered as well defined microhabitats with peculiar characteristics. With the restoration of the reserve, a series of studies was initiated to survey the aquatic biota; copepods were not considered at that time. Last year we initiated the study of copepods from the quarry and we are presenting preliminary results. Up to 21 zooplankton samples from 7 sites were obtained in these small water bodies during August and November 2010. A single species of cyclopoid copepod was present: *Acanthocyclops* sp. These are females with 17-segmented antennules, elongate caudal rami, more than 4 times longer than wide; dorsal seta shorter than ramus; setae on third endopodal segment of legs 3 and 4 unmodified; inner terminal caudal seta more than half the length of ramus and proximal part of genital somite rounded. Its general characteristics indicate that this species belongs to the *Acanthocyclops robustus* species complex; among other characters, it differs from this species in the absence of spinules near the exopodal seta of the antenna. It appears to be closer to *A. einslei* or *A. trajani*, but it could be an undescribed species considering also its peculiar habitat. In September, the average number density of *Acanthocyclops* sp. was 7.76 copepods per liter (females mean = 3.28/liter; males mean = 3.0/liter); in December, the average number density was 99.7 copepods per liter (females mean = 60.2/liter; males mean = 39.5/liter). The size of adult females in both periods ranged from 1.48 to 1.62 mm while that of adult males was found from 0.95 to 1.03 mm. The female/male ratio in the surveyed population was 1:0.66. For many years, only *A. robustus* and *A. vernalis* were known in Mexico, Central America and the Caribbean; recently, the number of known species in the region increased significantly (*A. dodsoni, A. caesariatus, A. marceloi, A. vernalis, A. robustus, A. exilis, A. rebecae*, *A. smithae*). It is expected that the regional lists of the genus will grow from the exploration of little known habitats.

O

Comparative neuroanatomical characterization of the harpacticoid copepod *Tigriopus californicus*

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Arthropods are an exceedingly successful group and exhibit a wide array of morphological, behavioral, and ecological specializations. The nervous systems of arthropods are small and elaborate, enabling a remarkable range of adaptive behaviors. Comparative neuroanatomical studies have revealed certain anatomical characters that all arthropods share, whereas other characters are typical of distinct arthropod groups. Phylogenetic systematics posits that shared derived characters (synapomorphies) are the principle basis for inferring evolutionary relationships and the application of this approach using nervous system characters has yielded major insights into the evolutionary history arthropods. In order to expand the scope of arthropod taxa used for these comparative neural cladistic analyses, this study details the anatomical organization of the harpacticoid copepod *Tigriopus californicus*. We used serial semi-thin epoxy sections to produce 3D reconstructions of the brain and its component parts as well as confocal microscopy to reveal structural details of cell bodies and their associated neuropil. Transmission electron microscopy was used to further reveal ultrastructural details of brain neuropils. Despite their small size, we find anatomical elaborations in the brain of *Tigriopus* comparable to much larger malacostracan crustacean, suggesting evolutionary continuity. These elaborations comprise a central complex with a distinct protocerebral bridge, the presence of deuterocerebral glomeruli, and ascending heterolateral projections from these glomeruli to a center in the lateral protocerebrum. Ultrastructural analysis of brain neuropil reveals the presence of T-bar-like presynaptic densities similar to those present at *Drosophila* synapses but not previously described in crustaceans. This study shows that *Tigriopus* shares many neuroanatomical specializations with much larger malacostracan crustaceans and the much more distantly related insects, suggesting an ancient origin for many of the observed neural arrangements.

O

Aiming and site specific attack by an ambush predator, *Mesocyclops leuckarti,* on their prey *Aedes aegypti*

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Predation affects the dynamics and constitution of prey communities therefore predators and preys have well established interactions. Predator-prey interactions frequently have been broken down into four keys sequences. Though key sequence for each predator may be same but each predator species should have their own strategy of capturing and handling the prey. Fast Cam filming was carried out to study any specific predation strategy by an ambush predator *Mesocyclops leuckarti,* for *Aedes aegypti* mosquito larvae. Predatory copepod *M. leuckarti* showed some additional intermediate steps such as 'aiming' and 'stalking' besides four major steps of predation: encounter, attack, capture and ingestion. To date, the aiming and stalking in predatory copepod behavior was either ignored or very less described during predator-prey interactions studies. Copepods aiming/stalking distance varied 4-8 body lengths whereas attack distance was found lower than the aiming distance. On the contrary stalking speed was found significantly lower than the attack speed. Copepods also demonstrated their strong preference for cone shaped area in front of the first antenna for attack and the least preference was observed behind the first antenna. Intermediate strategy as 'aiming' and selection of "site and direction" by an ambush predatory copepod might help in handling the prey. Thus, with the help of above mention results, we can conclude that for an ambush predatory copepod 'aiming' is an essential intermediate predation step during predation.

P-I

Does undersize predator induce behavioral modifications on larger prey?

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Predation is one of the principle causes in structuring communities in aquatic ecosystem. Size and shape of prey studied most of the times in prey-predator relationships while predator size is ignored every time in the whole prey-predator interaction. Our objective of study was to elucidate how does the small size predator affect the larger size prey? To explicate our research question, we did video filming using *Mesocyclops leuckarti* as a predator and 30 hrs old mosquito larvae as a prey in a 5 cubic cm acrylic aquarium. As a result, we found that copepod captured 16 ± 2.55 mosquito larvae in five replicates with attack speed 22.80 ± 8.52 mm/sec and attack distance for copepod was found 1.37 ± 0.54 mm. Presence of predator forced mosquito larvae to alter their foraging behavior, consequently prey browsing path and filtering path reduced significantly. In addition to this prey adapted mixed foraging tactic by mixing flexing in between filtering and browsing. As soon as prey identified their most risky behavior, bottom browsing, they reduced bottom browsing significantly. Mosquito larvae amplified their surfacing/air water interfacing significantly and showed mixed foraging strategy to protect themselves from predators. Strategic changed in foraging with subsequent reduction in filtering path established the prey behavioral modifications. These affirmative results positively conclude that the small size predators do have direct predation effect on their prey community in ecosystem.

P-II

Two new species of the genus *Apodopsyllus* Kunz, 1962 (Harpacticoida, Paramesochridae) from the South Sea, Korea

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Considered one of the dominated harpacticoids in sandy meiobenthos, Paramesochridae can be collected in various depths form beaches to deep-sea mountains. But the genus *Apodopsyllus* Kunz, 1962 was reported only sandy sediment of intertidal and shallow-water. So far, the genus *Apodopsyllus* accommodates 26 species from all around world. During survey on the harpacticoid copepods community from the subtidal zone (depth: 15m) near Cheju Island, Korea in 3 June 2010, two new species of the genus *Apodopsyllus* were found. First new species is clearly distinguishable from its congeners by several combined characters, namely; 1) A2 exopod with 3 setae 2) P5 in the female with very particular shape, 3) P6 in the female vestigial and incorporated, with 2 setae 4) P6 in the male with 3 setae at inner side, and 5) caudal rami armed with seta I. Second new species can be separated from its congeners by these characters; 1) A2 exopod with 1 seta which is not described before in this genus, 2) P5 fused with somite, 3) P6 in the male fused with both side, and 4) caudal rami armed with seta I. This study provides illustrated descriptions of two new species and updates the key to species.

S-III

Redescription of five *Asterocheres* species (Copepoda: Siphonostomatoida) and a description of a new species discovered in the collections of the Zoological Museum of Amsterdam

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A partial revision of of the genus *Asterocheres* Boeck, 1859, based on type material deposited in various museums, was recently initiated in order to clarify the rather confused systematics and phylogenetic relationships of this genus. This ongoing taxonomic revision has thus far resulted in: (1) the redescription of 11 *Asterocheres* species, (2) the reinstatement of three species previously considered as junior synonyms, (3) the ranking of *A. abyssi* (Hansen, 1923) as a *species incertae sedis*, (4) the removal of *A. mucronipes* Stock, 1960 to a new genus, *Stockmyzon* Bandera & Huys, 2008, (5) the relegation of *A. violaceus* (Claus, 1889) to a junior synonym of *A. echinicola* (Norman, 1868), and (6) the recognition of *Ascomyzon latus* (Brady, 1880) *sensu* Sars (1915) as a distinct species. The present paper re-examines the type material of five *Asterocheres* species from the collection of the late Jan Stock in the Zoological Museum of Amsterdam. This material included specimens of both sexes of *A. halichondriae* Stock, 1966 (besides the dissected holotype and allotype) and the dissected holotypes of *A. genodon* Stock, 1966, *A. proboscideus* Stock, 1966, *A. scutatus* Stock, 1966 and *A. maxillatus* Stock, 1987. Due to the discrepancies with the original descriptions, some taxonomically important appendages of these species are redescribed, illustrated and compared with those of their closest congeners. The main differences were found in the armature of the oral appendages. A vial labeled as "*A. simulans* (Th. Scott, 1898)" turned out to contain a new species. *Asterocheres hoi* sp. nov. is an associate of the echinoid *Lytechinus variegatus* (Lamarck) in Curaçao (Piscadera Bay). It is morphologically similar to *A. simulans* and *A. urabensis* Kim, 2004 but showed sufficient differences to justify its status as a new species.

O

Salinity and insular distribution as factors determining the evolutionary ecology of *Leptodiaptomus* cf. *sicilis* populations from Central Mexico

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The calanoid copepod *Leptodiaptomus sicilis* has been found inhabiting three lakes at Cuenca Oriental, Central Mexico: two of them being deep and permanent (La Preciosa and Atexcac; TDS: 1.1 and 6.5 g L^{-1}, respectively), while the other is shallow and ephemeral (El Carmen; TDS: 1.4-10 g L^{-1}); the three close one from each other (<20 km), distributed in an insular pattern, but with different limnological characteristics. Despite the possible gene flow due to their closeness by the passive dispersal of their resting stages, recent evidence shows that local adaptation is a frequent phenomenon within this type of organisms. In order to analyze if geographic isolation and salinity are important factors conducting diversification among these copepod populations, we analyzed: (1) the interpopulation genetic divergence, and (2) the haplotype network constructed identifying the different haplotypes by sequencing the cytochrome oxidase subunit I (COI) gene; (3) the morphological divergence on structures implicated in reproduction; (4) the biological fitness (patterns of survivorship and growing) at different experimental salinities; and (5) the potential genetic flow among the three populations. Our results indicate that: (1) interpopulation genetic divergence was relatively low (K2P<2%), but (2) the populations were clearly separated among them, each one with characteristics haplotypes; (3) morphological differences were only found in color and size of adults, but not in the structure or proportions of the compared characters; (4) the three populations had differential tolerance to salinity, which were: (a) local adaptation in copepods from the permanent lakes (they had the highest values in survivorship, molting efficiency, fertilization and hatching rates in their natural salinity); (b) copepods from the variable lake (El Carmen) showed a higher plasticity to salinity; and finally (5) although some differences among populations were observed, the interpopulation mating was successful among the three population, sexual recognition of mates, interbreeding and formation of viable hybrids occurred. We concluded that our copepods belong to the same biological species, having a complex process of diversification, with persistent founder effects and divergent selection of haplotypes related to the habitat, so the geographical isolation but mainly salinity may represent important ecological barriers that apparently conducted to local adaptation and prevent the natural genetic flow among these copepods, even they still have the potential to interbreed.

O

Advances on DNA barcoding as a tool for pelagic copepods identification in the Gulf of California, Mexico.

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Pelagic copepods are maxillopodan crustaceans that due to its abundance and frequency are an important link in the marine food web. Their great diversity demand accuracy in the species identification, because in some cases they share morphometric and merístic features which tend to confuse the identity of the species. To identify specimens key species usually are used; however, since late 20th century molecular tools for the study of biodiversity has been used, specifically through the use of a fragment of DNA with cytochrome c oxidase I (IOC) gene. As part of a broader project, presents the advance of the identification of copepods through DNA barcoding. Copepods were obtained with a bongo net with 500 µm filter mesh, preserved with ethyl alcohol at 100%; individuals were picked out from samples and identified to species, and processed to DNA extraction and sequencing in the Chetumal Node of the National Laboratory of Barcode and Canadian Centre for DNA Barcoding (University of Guelph), respectively. Sequences were lined up with MEGA 5 and GenDoc software, in order to obtain the tree of similarity using Neighbor Joining (NJ) algorithm. Copepod species for which a genetic sequencing was obtained are *Sapphirina scarlata, Calanus pacificus, Candacia curta, Rhincalanus nasutus* and *Temora discaudata*. Subsequently, a tree similarity was built, and we observed that all species were separated with at least 2% of divergence. Currently in the process are more than 120 specimens belonging to at least 30 species obtained in different geographic locations within the Gulf of California and Marias islands.

P-II

Harpacticoid copepods of the marine benthos in the Channel of São Sebastião, SP, Brazil and vicinity

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The study of Brazilian marine benthic copepods has merited little attention, until recently. Kihara (2003) listed all the literature available at the time and the species of harpacticoids found until then, adding many new data of her own research. This paper and the following of this series of publications add information on what is already known about this region. São Sebastião Channel waters suffer strong influence from the nearby town - a tourist resort, from the port which receives many cargo ships, and, during the rainy season, of subterranean and surface waters which flow down the mountains of the Serra do Mar. Their salinity and temperature rise and fall according to the in- and outflowing of local warm coastal to cold southern waters pushed into the channel by the winds and tides. The following taxa were added till now from the benthos of the Channel: Longipediidae - *Longipedia americana* Wells, Canuellidae - *Ellucana secunda* Coull, Harpacticidae - *Harpacticus boehleri* Pesta, Dactylopusiidae - *Paradactylopodia brevicornis* (Claus), Ameiridae -*Stenocopia limicola* Willey, *Nitocra affinis* Gurney, Miraciidae - *Amphiascus minutus* (Claus), *Amphiascoides subdebilis* Nicholls, *Melima papuaensis* Willen, *Robertsonia knoxi* (Thompson & A. Scott), *Robertgurneya* sp., *Bulbamphiascus denticulatus* (Thompson), *Amonardia normani* (Brady), Paramesochridae - *Kliopsyllus* sp., Ectinosomatidae - *Ectinosoma* spp. and *Halectinosoma* sp., Cletopsyllidae - *Cletopsyllus papillifer* Willey, Tetragonicipitidae - *Phyllopodopsyllus* sp.n.1, *Phyllopodopsyllus* sp.n.2, *P. aegypticus* (Nicholls), *P. setouchiensis* (Kitazima), *Laophontella horrida* (Por), *Oniscopsis* sp., Laophontidae - *Laophonte galapagoensis* Mielke, *Quinquelaophonte varians* Bjornberg, *Galapagolaophonte variabilis* (Coull & Zo), Cristacoxidae - *Noodorthopsyllus tageae* Huys & Kihara, Nannopodidae - *Laophontisochra* sp.. *Ellucana secunda* Coull, *Harpacticus boehleri* Pesta, *Laophonte galapagoensis* Mielke, *Galapalaophonte variabilis* (Coull & Zo), *Melima papuaensis* Willen and *Bulbamphiascus denticulatus* (Thompson) are new occurrences in Brazilian marine waters.

O

Identification key for species groups of the pelagic copepod family Oncaeidae in the world ocean

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The family Oncaeidae is one of the most abundant copepod taxa in oceanic areas, occurring from polar seas to tropical areas, and from the epipelagic zone to abyssal depths. Over 100 species are known to date, which are difficult to identify due to their small size and their morphological similarity. Many of the known species have been insufficiently described in the past and several of these formerly described species in fact have turned out to represent species complexes consisting of a considerable number of closely related sister or sibling species. In ecological studies, oncaeid copepods are often considered at higher taxonomic levels (family/genera) only, due to the difficulties in accurate species identification and the lack of universially valid identification keys for this taxon. If oncaeid species names are actually given in publications, the identification is often incorrect or uncertain, due to the unknown or unnoticed existence of local sister or sibling species in the area investigated. A worldwide identification key of Oncaeidae is not within reach at present, but based on preliminary phylogenetic considerations, a taxonomic grouping of the numerous species can be achieved, which will be helpful in delimiting the range of species to be considered in the identification process. For subsequent species identification, regional identification keys will then be required, because morphologically similar looking specimens from different regions of the world ocean might belong to different species. In the present study it is attempted to develop a computer-based worldwide identification key for the approx. 25 species groups of Oncaeidae and the status of the ongoing study will be presented here. Examples for regional sister species will be given for the *Triconia conifera*-complex.

S-I

Copepods and anchialine caves: a review

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The exploration of anchialine systems over the past three decades has revealed an astonishing diversity of crustaceans. This exciting discovery phase revealed a copepod fauna of great novelty: copepods from five orders and at least 17 families have been found in anchialine caves. Many of these families were new and preliminary analysis suggests that these lineages mostly have shallow-water, marine hyperbenthic origins. No parasitic lineages are represented and few marine planktonic taxa have colonised these caves. Some lineages found exclusively in caves retain numerous plesiomorphic character states and it has been suggested that these habitats can serve as refuges for ancient lineages. The zoogeography of anchialine crustaceans, including copepods, is remarkable – with many taxa exhibiting extreme disjunct distribution patterns. Comparative faunistic studies at widely separate localities revealed remarkable similarities and led to the development of the concept of the 'typical anchialine faunal suite' consisting of, for example, a remipede, a thermosbaenacean, a *Danielopolina*, an epacterisicid copepod, etc. Narrative explanations of the origins and history of such anchialine crustacean faunas have been developed and applied to copepods. How well are such explanations supported? The available evidence base is reviewed for copepods and it is concluded that copepod distributions patterns reflect tectonic history, but they may also reflect trans-oceanic dispersal, and they appear to be strongly influenced by sea-level changes (especially by stranding during regressions). It is suggested that explanations of anchialine copepod zoogeographic patterns will have strong regional components and may be taxon specific.

S-III

Copepods from strange places: sphyriids and pennellids from faeces and regurgitated crop contents of marine birds and mammals

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Behavioural ecologists often encounter parasitic copepods, together with the partially digested remains of their fish hosts, in crop or stomach contents, vomit, or faeces of marine birds and mammals. Although the internal tissues of the parasites are usually digested, their chitinous exoskeletons are more resistant and can be well preserved. Indeed, for large embedded mesoparasites, such as members of the siphonostomatoid families Sphyriidae and Pennellidae, the intricate branching processes of the holdfast are frequently recovered intact. Since the holdfasts are difficult to dissect out successfully because they penetrate deep into host organs and tissues, specimens that have been digested out of the host provide a unique opportunity to study variation in holdfast structure. Material from localities around the Southern Ocean (mostly collected by Yves Cherel) is reported here, including new genera and species of Pennellidae. In addition, observations on fragments as well as whole specimens of *Lophoura* provide insight into the feeding biology of this genus of Sphyriidae.

S-II

Calanoid genes and morphology: working together towards a phylogeny

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We still have not arrived at a comprehensive, objective phylogenetic hypothesis for the Calanoida. Here we report on progress and show how morphological and genetic analyses are being combined to advance this subject. **First**, we present the results of an analysis based on morphology [Bradford-Grieve, JM; Boxshall, GA; Ahyong, ST; Ohtsuka, S. 2010. Cladistic analysis of the calanoid Copepoda. *Invertebrate Systematics* 24: 291-321.] Superfamilies Augaptiloidea, Centropagoidea and Clausocalanoidea were retrieved with high jackknife support. A monophyletic Megacalanoidea was not retrieved. There was low support for Pseudocyclopoidea and a superfamily Epacteriscioidea that includes Ridgewayiidae. A novel result was an enlarged monophyletic Bathypontioidea to include the Fosshageniidae, supported moderately by jackknife analysis. A number of unresolved questions arise from this work. Relationships at the base of the tree have poor jackknife support and imply that a hypothesised derived 10-segmented antenna exopod arose twice – a proposition that intuitively seems wrong. Some character analyses might be considered to be controversial. Is a 10-segmented condition of antenna exopod derived; is a supplementary geniculation a synapomorphy for the Bathypontioidea; and were we right to conclude that the ancestral calanoid had a 9-segmented antenna exopod, a genital operculum, a pair of seminal receptacles and no coxal epipodite on the maxilla? We also suggest morphological problems that may be resolved using genetic information. **Second,** we present the results of a more comprehensive genetic analysis, than previously attempted, based on 18S, 28S, CO1 and Cyt b [Blanco-Bercial, L.; Bradford-Grieve, J.; Bucklin, A. 2011. Molecular phylogeny of the Calanoida (Crustacea: Copepoda). *Molecular Phylogenetics and Evolution* 59: 103-113]. Patterns of divergence of ribosomal RNA genes were shown to be heterogeneous among superfamilies, providing an explanation for disparate results from other studies. This multigene phylogeny recovered a monophyletic Calanoida as well as superfamilies Augaptiloidea, Centropagoidea, Bathypontioidea, Eucalanoidea, Spinocalanoidea and Clausocalanoidea. The enlargement of the Bathypontioidea to include the Fosshageniidae had high bootstrap support. A Megacalanoidea superfamily was not well supported in this analysis. The superfamilies Epacteriscoidea, Pseudocyclopoidea and Ryocalanoidea were not included in this analysis. This analysis resolves a sister relationship (with strong bootstrap support) between the Centropagoidea and the clade that includes the unresolved Megacalanoidea, Bathypontioidea, Eucalanoidea, Spinocalanoidea and Clausocalanoidea. This removes the necessity to postulate two independent origins of a derived, 10-segmented antennal exopod condition. **Third,** we present the results of a combined analysis, and suggest subjects for future work. Combined analysis on a dataset (that did not include the plesiomorphic families) improved the results obtained from the genetic analysis as superfamily relationships were resolved, and the Megacalanoidea recovered. Also, morphological weight calibration, based on the data for which both genetic and morphological data were available, was performed, and the effect on the morphological dataset discussed.

S-I

Copepoda from freshwater caves with special emphasis on epikarst

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Karstic caves are ecosystems inhabited with about 300 specialised cave-dwelling copepods (i.e. stygobionts). Copepods, living in caves (i.e. fissured aquifers), are different from those living in other types of groundwater (i.e. porous aquifers). The first records on cave-dwelling Copepoda were reported in 1920' from France. Later on, more species were found in Europe, especially in Italy, Austria, former Yugoslavia and Romania. Outside Europe knowledge on strict cave-dwelling copepods is still rather scarce, although preliminary studies indicate a very rich fauna there. In caves they inhabit different habitats: sinking rivers, lakes, springs and pools filled with river water or water dripping from the ceiling. In the last decade it appeared, that space above the cave, especially the topmost part, called epikarst, is inhabited with specific copepod fauna. Epikarst is actually an ecotone between surface and underground. It is a three-dimensional network of narrow cracks and voids not more than less than one or few mm wide and partly or completely filled with water. Space is exclusively filled with rainwater. Taxa living there share some common characteristics with other cave-dwelling copepods (de-pigmentation, reduction of eyes and segments), but have also some specific morphological adaptations, like enlarged and claw-like spines on P1 and spinules or spine-like setae on furca. Epikarstic copepods are present in tropical and temperate zone. They have a high degree of endemism not only on species but also on genus level resulting in high biodiversity, too. The main reason for poor knowledge on epikarstic copepods is un-adequate sampling technique. Equipment must be adapted to filter very small amounts of water (sometimes only few ml) and able to retain very small particles (50 – 60 μm).

O

Cannibalism on naupliar stages by adult *Acartia sinjiensis*, a tropical calanoid copepod

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Cannibalistic behaviour of the tropical calanoid copepod *Acartia sinjiensis* was examined under laboratory conditions. Cannibalism by adult females was significantly higher than by males (1.2 ± 0.3 vs. 0.1 ± 0.1 nauplii copepod^{-1} day^{-1}; $p < 0.05$). Early nauplius stages (NI to NIII) were significantly ($p < 0.05$) more susceptible to adult female predation than later stage nauplii (2.2 ± 0.6 vs. 0.4 ± 0.2 nauplii female^{-1} day^{-1}). Both the quantity of microalgae provided as food ($p < 0.05$) and naupliar prey density ($p < 0.01$) significantly influenced female predation rates. When microalgal food ration was increased from 50% to 100% of the optimal feeding concentration the average cannibalism rate decreased significantly ($p < 0.05$) from 1.8 ± 2.1 to 1.0 ± 1.6 nauplii female^{-1} day^{-1}. Further decrease in feeding ration did not significantly influence cannibalism rate. Meanwhile, average predation rate increased significantly with prey concentration ($p < 0.01$) from 0.0 ± 0.0 nauplii female^{-1} day^{-1} at a prey density of 1 nauplius l^{-1} to 5.7 ± 0.5 nauplii female^{-1}/day^{-1} when naupliar concentration was up to 1320 l^{-1}. Predator starvation was also found to be a factor significantly influencing *A. sinjiensis* cannibalistic behaviour ($p < 0.01$). The average predation rate was 1.4 ± 0.2 nauplii female^{-1} day^{-1} when predators were fed, increasing to 3.1 ± 0.3 nauplii female^{1} day^{-1} when predators were starved for duration of 24h. Surprisingly, extending starvation period to 48 or 72 hours did not led to a further increase in cannibalism. Knowledge obtained from these experiments will be significant to improve management of *A. sinjiensis* culture for tropical aquaculture hatcheries.

P-II

A new species of Leptopontiidae Lang, 1948 from the Ría de Ferrol (NW Iberian Peninsula)

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The benthic fauna of the Ría de Ferrol (NW Iberian Peninsula) is well-known; many zoological groups have been studied along the last 30 years (Polychaeta, Bryozoa, Mollusca, …). Unfortunately, there is just a superficial knowledge about meiofaunal taxa in general, and Copepoda Harpacticoida in particular. With this research, a new species of harpacticoid copepod, *Leptopontia* sp. nov. (Leptopontiidae), is described from the Ría de Ferrol. Samples were collected between 2008 and 2011 by means of a van Veen grab, and maintained in the lab in buckets with circulating marine water. The genus *Leptopontia* was created in 1902 by T. Scott. In 1927, this genus was included in Canthocamptidae by Monard. In 1948, Lang created the subfamily Leptopontiinae, composed by *Leptopontia* and *Arenopontia*, and included it as a subfamily within the family Cylindropsyllidae. In 1994, Martínez Arbizu and Moura raised Leptopontiinae to the family status and included Cylindropsyllinae within Campthocamptidae. The family Leptopontiidae comprises a group of harpacticoid copepods typical from the marine interstitial, but some species are brackish water, and other species are found in freshwater interstitial habitats. This family comprises three subfamilies: Leptopontiinae, Psammopsyllinae and Arenopontiinae. The genus *Leptopontia* is the only species of the subfamily Leptopontiinae, and, to date, seven species of *Leptopontia* were described from North European coasts, Mediterranean Sea, Galapagos and the Atlantic seaboard of North America. *Leptopontia* sp. nov. can be clearly distinguished from other *Leptopontia* by the presence in the anal operculum of a median spinous process flanked by two large processes (longer than the median one). Other minor differences are the large size of the females if compared with the other species of the genus, a very large and pointed triangular rostrum, the setation of A1 in both sexes, the setation of P1 and P3 in both sexes.

P-I

Distribution and abundance of limnetic, freshwater copepods (Calanoida, Cyclopoida) from a mesotrophic sinkhole of Quintana Roo, Mexico

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The spatio-temporal abundance of limnetic, freshwater copepods from a mesotrophic dissolution system (sinkhole) was surveyed in relation to some environmental variables. The sinkhole is located at southeastern Mexico, in surface =9600 m^2 wide, and 16 m depth as maximum. The species *Thermocyclops inversus*, *Tropocyclops prasinus*, *Mastigodiaptomus nesus*; as well as nauplii and copepodids inhabit it. Not significant differences in the species abundance among seasons were found, except in the copepodids abundance. The highest abundance was recorded in winter storm season, and the lowest in dry and rainy seasons ($F=5.272$, $p<0.05$). After considering the annual average, nauplii were the most abundant forms (maximum abundance 112.05 ± 47.74 ind/L) followed by *T. inversus* (24.4 ± 11.3 ind/L), *T. prasinus* (2.7 ± 1.9) and *M. nesus* (1.25 ± 0.86). All the species and the instars were distributed mainly in the epilimnion, except *M. nesus* which was found in the hypolimnion. The abundance of nauplii, copepodids and adult cyclopoids in the water column was significantly explained ($p<0.05$) by the dissolved oxygen ($r_s = 0.57$; $r_s = 0.77$; $r_s = 0.58$), the water temperature ($r_s = 0.58$; $r_s = 0.81$; $r_s = 0.72$), pH ($r_s = 0.58$; $r_s = 0.78$; $r_s = 0.51$), the conductivity ($r_s = -0.74$; $r_s = -0.67$; $r_s = -0.77$), and the salinity ($r_s = -0.86$; $r_s = -0.87$; $r_s = -0.84$). *Mastigodiaptomus nesus* abundance was not related to any of the variables surveyed here. Further studies are necessary in order to understand the effect of biotic factors such as predation on copepod populations in these tropical dissolution lakes

P-I

Effects of food and light on *Calanus sinicus* swimming behavior

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The calanoid copepod *Calanus sinicus* is a keystone species in the shelf waters of the North West Pacific from Japan to Vietnam where it constitutes a major food item for commercially important fish. Here we have examined the combined effects of food availability and light on the swimming behavior of this species. We used an experimental protocol consisting in a 2-level factor design where adult females were video recorded at 30 frames.s^{-1} under varying light intensity and food availability. The behavior of the species exhibited different states that were analyzed using symbolic dynamics tools: probability density function of the residence times in each state; transition probability at each time step; Shannon entropy and dynamic entropy. It is shown that the complexity of the *C. sinicus*' swimming paths increases in light absence regardless food availability, and reach maximal complexity in presence of food. *C. sinicus* modifies its swimming behavior, likely to optimize vulnerability to predation and increase feeding, in response to changes to their environmental conditions. The results are discussed in regards to the ecology and life history of the species in the East China Sea.

O

The diversity of a tropical Harpacticoida (Copepoda) fauna – verification of some ecological hypotheses

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At the present time the species diversity of a tropical Harpacticoida is not complete investigated. In this respect, a several interesting hypotheses, involving the general principles of the spatial distribution of the biodiversity, remain without proper verification. On the contrary several of illusory assumptions are not disprove. I use the extensive database on tropical Indo-Pacific harpacticoids to describe the patterns and trends of their abundance, diversity, endemicity and biogeographical zonation. Information about the fauna of the South China Sea, the Philippine Islands, the internal Malay Archipelago Seas, the New Guinea, the Yellow Sea and the Andaman and Nicobar Islands is taken. According to the currently known data, the species richness of a tropical harpacticoid faunas are less than in northern regions. The peak of species richness located in seas of the temperate and subtropical climatic zones. A prevalence of endemic species (> 50%) in the fauna of tropical Indo-Pacific is illusory. This is due to a poor exploration of a species distribution. High biogeographical heterogeneity of faunas in Indo-Malayan region is also questionable. Little number of interstitial species in the fauna of tropical Indo-Pacific is illusory. Small genuine interstitial forms are usually underestimated due to limitations of the sampling techniques. Further investigations of tropical fauna will clarify the current understanding about the distribution of harpacticoid biodiversity.

P-I

Copepoda as a model in life science education

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We elaborated a curriculum for life and/or environmental science that uses an animal model to teach fundamental principles of both living organisms in general and invertebrates/animals in particular for adjustable age-groups and school forms. It is particularly the ease of acquisition from marine or fresh- waters and ease of cultivation that makes copepods suitable "lab mice" to convey principles of aquatic biology and adaptation. The Copepoda reside in all moist and aquatic habitats as a group of small crustaceans: from the canopy of rain forests, to terrestrial leave-litter, groundwater, wells, streams, rivers, lakes, from the deep-sea benthos throughout all marine pelagic waters and sea-ice to the interstitial of shores, being free-living, or associated with aquatic plants and animals. Such stuntingly different habitats led to an unprecedented diversity in copepod life forms and morphologies, in their behavior, their physiology, and ecology. Copepod reproductive biology shows many facettes and their life cycles are complex. Copepod biochemical and molecular performances must be enormous, but are virtually untapped as yet for fundamental life science and applied purposes. What became very clear in the last decades: copepods are ideal models for several branches of life science, *in situ* and *in vitro* – not only for purposes of research but also for education. Their taxonomic diversity provides appropriate indications for environmental hazards in the field. They are not only important for benthic and particularly pelagic food-chains and the conversion of matter and energy, but serve also as ideal first-food and in the application of vitamins and drugs for fish-larvae in mari- and aquaculture. On the other hand, technological means are demanded where copepods threaten the harvest from oceans and freshwaters as vectors of diseases or parasites of economically important organisms. In turn, they can be used to control mosquito-transmitted diseases because they predate on mosquito larvae. The latter examplifies the impact aquatic invertebrates may have on the daily life of people and their economic and applied importance that provides also professional opportunities for students of animal life science.

P-II

A review on *Tigriopus* (Copepoda, Harpacticoida, Harpacticidae) with a new species from Thailand

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We provide a species description of a new harpacticid copepod species that can be used as a model in combining barcode library information as "a genetic field guide" with a visual description that allows a meaningful characterization and an instant phylogenetic allocation. Both genders of *Tigriopus sirindhornae* sp. nov. are described from individuals collected from a brown alga *Padina* sp. in Rayong Province, Thailand. This habitat strikingly contrasts to the common splashpool habitat of the genus *Tigriopus*. *Tigriopus sirindhornae* sp. nov. shares with its closest relative *T. thailandensis* Chullasorn et al. 2011 two setae on the third exopodal segment of leg 4 while other congeners bear 3 inner setae. However, allobasis and exopod of antenna in both genders are much more slender and elongate than in *T. japonicus*. *Tigriopus sirindhornae* are more slender, the posterior border of cephalothorax smooth, and the whole body ornamented with few sensillae. The new species further differs from *T. thailandensis* by details of antennules, mandibles, maxillules, maxillae, maxillipeds, leg 1, leg 2, leg 4, leg 5 and leg 6. Molecular details of the COI sequence indicated that *T. sirindhornae* sp. nov. was closely matching with *T. thailandensis*, both together forming a sister taxon relationship with other representatives of the genus.

P-II

Meiobenthic communities in sediments of seagrass beds

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Marine seagrasses are spread worldwide throughout temperate and tropical waters and have an important role in the productivity of coastal ecosystems, supporting diversity and productivity of communities of invertebrates and fishes. Free-living marine harpacticoid copepods commonly represent the secondmost abundant metazoan taxon in marine sediments, but in phytobenthic habitats, harpacticoids represent commonly the dominant meiobenthic taxon A multiyear study of a meiobenthic copepod community in the sediments of seagrass beds was carried out at Banpaklok, Phuket Island. Seagrass beds were dominated by 6 species of seagrasses: *Cymodocea rotundata, C. serrulata, Halophila ovalis, Halodule uninervis, Thalassia hemprichii and Enhalus acoroides.* The present study provides the first report of harpacticoid copepod assemblages from seagrass beds in Thailand with particular focus on their diversity and abundance, gender ratio, and reproductive performance. Harpacticoid copepods were represented by twelve families: Ameiridae, Canuellidae, Cletodidae, Cylindropsyllidae, Ectinosomatidae, Harpacticidae, Laophontidae, Longipediidae, Metidae, Miraciidae, Porcellidiidae and Thalestridae. The five most abundant families were: Ectinosomatidae, Miraciidae, Ameiridae, Laophontidae, and Cletodidae. Harpacticoid abundances were low compared to values from the literature. Wet and dry season differed. Adult female harpacticoids predominated to males during the whole study period.

S-III

Three artotrogids (Copepoda: Siphonostomatoida) from the Ross Sea, Antarctica

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The Artotrogidae currently accommodates 117 species in 21 genera. Most of these species (65%) are poorly or incompletely described and have not been recorded since their original descriptions. Others have sporadically been recorded in recent decades but typically in very low numbers. During the last forty years, 37 species have been described and only one previously known species has been redescribed. Although the majority of these new species were collected from the Sea of Japan (East Sea), four of them were recorded from Antarctica. During the 19th Antarctic expedition of the *RV* ‘‘*Italica*’’ to the Ross Sea in the austral summer of 2004, samples were obtained from two depths transects inside and outside Cape Hallett Bay. At each transect a slightly modified Rauschert, with a mesh size of 500 µm and an opening of 0.5 m, was used to collect samples between 84 and 515 m depth. Copepods were found in washings of invertebrate hosts from outside Cape Hallett Bay (72º15.7’S, 170º24.8’W) at 160–410 m depth and preserved in 70% ethanol. This paper redescribes two species of artotrogid copepod, *Neobradypontius neglectus* Eiselt, 1961 and *Cryptopontius latus* (Brady, 1910), and provides the first description of a male in the genus *Neobradypontius* Eiselt, 1961. In addition, a new species of *Sestropontius* Giesbrecht, 1899 is described, raising the number of known species in this genus to three.

O

The phylogeography of *Paracalanus parvus* s.l. (Claus 1863) based on morphology and molecular data

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The abundant calanoid copepod *Paracalanus parvus* s.l. Boeck 1865 (Calanoida, Crustacea) is a species complex with a worldwide distribution from temperate to tropical shelf waters. Due to confusion with morphologically similar species such as *P. indicus* or *P. quasimodo* as well as within the species complex itself its biogeography is not well resolved. Furthermore, *P. parvus* is probably often confused with other morphological similar species. The aim of the current investigation is to examine the morphological and molecular characteristics of *P. parvus, P. indicus* and *P. quasimodo* and define their geographic distribution. We analysed 100 specimens from various shelf regions of the Atlantic, Pacific and Indian Ocean, and characterized a set of morphological traits such as the distal edge of the exopod 3 of swimming legs 2 – 4 and the number of spinules on the posterior surfaces of the swimming legs for each species. A molecular delineation of the species was carried out with two mitochondrial gene fragments Cytochrome b and COI. Based on the mitochondrial barcoding data, there is molecular evidence for the existence of cryptic species within *Paracalanus parvus* s.l.. Among the 70 specimens in our study, we identified 4 lineages which were differentiated at a level commonly regarded as reproductively isolated species. We will present preliminary results of the relationships within and among the specimens of *P. parvus, P. indicus* and *P. quasimodo* to provide a clearer view of the phylogeography of this ecologically important and evolutionarily successful calanoid species group.

P-II

Vasa, a molecular marker of the gonads in salmon louse (*Lepeophtheirus salmonis* Krøyer, 1837)

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Salmon louse is an important pathogen in salmon aquaculture and a serious threat to wild populations. Knowledge about basic biological processes such as reproduction is crucial for the prevention of this parasite and can facilitate development of a vaccine. Vasa genes are members of the DEAD-box helicase gene-family encoding an ATP-dependent RNA helicase, a widely dispersed family found in all eukaryotes. The DEAD box proteins exhibits high substrate specificity and they participate in a variety of processes including RNA transcription, editing, and decay. Vasa protein plays a crucial role in formation and maintenance of germ cells as demonstrated by removal of transcript by knock down experiments in embryos and adult animals. Here a novel marker of gonads, *Lepeophtheirus salmonis* Vasa (LsVasa) was characterised. The sequence of LsVasa showed highest similarities to Vasa genes found in insects including the parasitoid wasp *N. vitripennis* (60% a.a. identity). Like other DEAD-box proteins, LsVasa contain highly conserved core regions characterized by signature motifs. Quantitative PCR analysis demonstrated that transcription is developmentally regulated with higher levels found in adult stages. *In situ* analysis established that transcription of *LsVasa* takes place in the ovaries and testicles of adult and preadult individuals. Transcripts were also found in the oviducts and eggs of reproductive females. Immunoflourescence studies and western blotting demonstrated translation of the LsVasa protein in ovaries, oviducts and oocytes. The sequence characteristics, histological localisation and transcript regulation suggest that LsVasa is a homologue of Vasa and Vasa like genes found in other organisms. LsVasa is also likely to be a useful marker of gonads in earlier lifestages of the salmon louse, where gonads can be difficult to identify morphologically.

P-I

Dynamics of three calanoid copepods interactions: presumption for behavioural defense in order to reduce possible predation?

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Invertebrate predator induced density decline and changes in depth selection behaviour of several zooplankton species are known from literature. For cold water stenotherm *Limnocalanus macrurus* Sars, initially discovered as herbivore and omnivore, predaceous feeding habit has been described in numerous experimental and field research. Its increasing impact on other zooplankton specimens is noted, as well as its feeding on nauplii, copepodites and adult copepods. *Eudiaptomus gracilis* Sars and *Eudiaptomus graciloides* (Lill.) are coexisting, common herbivore species having different responses in order to reduce fish predation, also their migration behaviour is observed.cIn this research vertical interactions between adult *L. macrurus* and adult calanoid copepods *E. gracilis* and *E. graciloides* as possible preys were discussed from two Latvian lakes – Dridzis (*L. macrurus* absent) and Svente (all three species present) during season in 2010 from June to September. In addition, several environmental variables (temperature, pH, dissolved oxygen, chlorophyll and total dissolved solids) were assessed. During the season, in Lake Svente there were two abundance maximums established both for adult *L. macrurus* and adult *E. gracilis*, *E. graciloides* species. In Lake Dridzis *E. gracilis* dominating population was replaced by *E. graciloides* population with a rapid increase of its abundance in August, while in Lake Svente both *Eudiaptomus* species populations had similar development trend with *E. gracilis* as the dominating. In Lake Dridzis *E. gracilis* seems to be located deeper during the time while in Svente *E. gracilis* was located preferably in the water layer 0-10 meters. Whereas *E. graciloides* had different distribution regarding the season and depth in both lakes. Both *E. gracilis* and *E. graciloides* were positively affected by temperature in Lake Svente and Lake Dridzis; meanwhile, *L. macrurus* as expected showed negative correlation with temperature ($p<0.05$). In Lake Dridzis chlorophyll concentration positively affected *Eudiaptomus* spp., no such effect was observed in Lake Svente. There was a positive correlation between both *Eudiaptomus* spp. from Lake Svente ($p<0.05$); however, negative impact of *L. macrurus* on *Eudiaptomus* spp. was not statistically verified, and the maximums of *L. macrurus* were observed ahead of *Eudiaptomus* spp. population's increasing maximums, although both were overlapping. Surprisingly oxygen concentration limit in Lake Svente seemed to have no statistically obvious effect on distribution and abundance of specimens, hence suggesting kind of adaption developing in long-term due to the annual oxygen decrease in the season.

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P-I

Copepod spatial changes in abundance, biomass and community structure in the tropical Southeastern Atlantic Ocean

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Copepod spatial changes in abundance, biomass and community structure down to 250 m depth were studied in the southeastern Brazilian coast along one year. The biological material examined was attained as part of the Habitats Project - Campos Basin Environmental Heterogeneity by CENPES/PETROBRAS. Zooplankton samples were obtained in the 2009 during the rainy (March-April) and dry seasons (August-September), in 48 stations distributed along six transects perpendicular to the coast between the isobaths of 25 and 3,000 m depth. Horizontal hauls were done in the Tropical Water (TW). Both abundance and biomass of copepods did not differ significantly ($p < 0.05$) between sampling seasons, but presented a longitudinal-latitudinal variability. The abundance peaks corresponded to the biomass peaks. The highest values were observed at the south continental shelf during the dry season under the influence of an upwelling system. This area supported the highest levels of copepod biomass, with an order of magnitude more than five times those found in the rainy season. Copepod abundance and biomass ranged from 42 to 64,753 ind.m^{-3} and from 0.08 to 113 mgC.m^{-3}, respectively. One hundred and two taxa of copepods, with 71 widely distributed species, occurred in the 0–250m water column; with 8 and 35 species exclusively recorded in the rainy and dry season, respectively. Clausocalanidae and Paracalanidae families contributed with 51% of the total abundance for both seasons. Copepod biomass was mainly represented by the Temoridae (*Temora turbinata* and *Temora stylifera*) and *Undinula vulgaris* (ca. 50%) during the rainy season, and Clausocalanidae, *Calanoides carinatus*, Temoridae (*Temora turbinata* and *Temora stylifera*), Paracalanidae, Subeucalanidae and *Calanopia americana* (ca. 70%) during the dry season. The ANOSIM analyses showed that copepod community were characterized by three different groups ($p>0.05$). Each group was further separated by the sampling season and the latitudinal variation, and was classified as rainy season-continental shelf (1), dry season-continental shelf (2), and rainy/dry seasons-slope (3). Copepods were divided into four categories based on the feeding pattern: suspension feeders, detritivores, carnivores and parasites. In terms of abundance, the most dominant group was suspension feeders (mainly Calanoida) and detritivores (mainly Poecilostomatoida). In terms of biomass, suspension feeders (calanoid copepods *Calanoides carinatus* and *Temora stylifera*) were the major component (ca. 10% each species). These results are compared with the previous studies in the same region and to others studies developed worldwide.

O

Marine zooplankton assemblages during simulated natural gas blowouts

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Accidental blowouts during exploration activities in natural gas (NG) in continental shelf present potential risks to the marine communities. In order to study possible changes in zooplankton community structure caused by NG blowouts, experiments in the field were accompanied by plankton hauls. Four campaigns were conducted in the external area of Suape Bay (northeastern Brazil), during spring and neap tides in the dry and rainy seasons of 2007 and 2008. Horizontal surface and oblique hauls with plankton nets of 120 µm and 300 µm mesh size were carried out before, during and after NG was injected (totaling 66 samples). There were no differences in zooplankton composition, abundance and biomass between flow moments. However, differences in specifics groups of zooplankton were found, mainly in Copepoda. Copepoda was the dominant group in all campaigns, and alterations in the community structure were manifested as increased proportion of small size organisms of this group (nauplii and *Oithona hebes*), during the NG flux. In addition, tychoplankton individuals (mainly diverse juvenile gastropods) were registered in the surface during NG flow. The NG flux can accumulate the small size fraction of plankton and dislocate species to others environments (benthic to pelagic) causing changes in communities' assemblages and important biomass transport. The NG effects evaluation on the plankton community was hindered by gas dilution and exposition time.

S-III

An overview of a comprehensive study on collected *Nesippus* species

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Species of *Nesippus* (Pandaridae) are part of the pandarids that have a second free thoracic segment without plates. They have a cosmopolitan distribution and are found on the gill arches and in the mouths and nasal passages of their hosts. Currently there are five species i.e. *N. crypturus*, *N. nana*, *N. orientalis*, *N. tigris* and *N. vespa*. Except for *N. tigris*, which are mostly found in the nasal cavities of *Galeocerdo cuvier*, the other species are most often found on the gill arches and in the mouth cavities of various hosts. Many different hosts, caught in the nets of the Natal Sharks Board along the east coast of South Africa, were examined for the presence of *Nesippus* species. *Nesippus orientalis* specimens were found to consist of cryptic species which were separated by their host species. Careful examination of their morphological characters did not show any meaningful differences in the morphology of the two cryptic species. An investigation of the morphology of the all collected species indicated morphological features useful in the identification of the various species. Additionally, an investigation into the ecological aspects of the various species indicated that even though *N. orientalis* did not have the highest prevalence, their mean intensity and mean abundance values were much higher than those of the other species.

P-I

Modelling of the phytoplankton and nutrients seasonal dynamics in the Baltic Sea using 3D CEMBS model

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Recently developed Community Earth System Model (CESM from UCAR-University Corporation for Atmospheric Research) has been adopted to the Baltic Sea. It consists of Community Ice Code (CICE model, version 4.0) and Parallel Ocean Program (version 2.1). The models are coupled through CPL7, which is based on MCT (The Model Coupling Toolkit) routines. The model was forced by ERA40 reanalysis and interim data. Coupled Baltic Sea model has also ecosystem part (3D CEMBSv2 model. It consists of 11 main compartments: zooplankton, small phytoplankton, diatoms, cyanobacteria, two detrital classes, and the nutrients nitrate, ammonium, phosphate and silicate. The small phytoplankton size class is meant to represent nano- and pico-sized phytoplankton, and may be Fe-, N-, P-, and light-limited. The larger phytoplankton class is explicitly modeled as diatoms and may be limited by the above factors as well as Si. Growth rates of the cyanobacteria may be limited by Fe, P, and light. Many of the biotic and detrital compartments contain multiple elemental pools as we track carbon, nitrogen, phosphorus, iron and silicon through the ecosystem. Initial results for the seasonal dynamics of phytoplankton and nutrients will be shown.

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P-I

Modelling *Pseudocalanus minutus elongatus* population dynamics in the Gulf of Gdańsk (south-eastern Baltic Sea)

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The population dynamics of a dominant species in the southeastern Baltic Sea have been investigated as part of a grant supported by the Polish State Committee of Scientific Research. This paper outlines an approach to couple a structured zooplankton population model adapted to *Pseudocalanus minutus elongatus* into the marine ecosystem model (3D CEMBSv1) for the Baltic Sea. The copepod model consists of ten state variables with masses W_i and numbers Z_i for each of five model stage, grouping stages to: the non feeding stages and eggs are represented by the stage – eggs–N2, following are the naupliar stages – N3–N6, then two copepodite stages – C1 – C3 and C4 – C5 and finally the adult stage – C6. The annual cycle simulated for 2000 under realistic weather and hydrographic conditions was studied with the three-dimensional version of the coupled ecosystem–zooplankton model in the Gulf of Gdańsk (south-eastern Baltic Sea). The simulated population dynamics were compared with observations at the Gulf of Gdańsk. The numerical simulations show that one complete distinct generation developed throughout the year in the Gulf of Gdańsk. In the case of the Baltic Sea, food concentration and temperature are the main factors controlling copepod development, and salinity is a masking factor. It is included in the present study. The numerical studies are a following step in understanding how the population dynamics of a dominant species in the south-eastern Baltic Sea interact with the environment.

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O

The value of DNA barcoding of freshwater Copepoda: highlights and cryptic species

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DNA barcoding has been widely used in many animal groups, but in the case of freshwater copepods, to our knowledge, there is not any previous work using this technique in a broad number of species or a wide geographical region. Here, we present results from 224 specimens representing 26 species collected from Guatemala, Mexico, and Canada. In most cases, morphological identifications were coincident with the DNA barcodes, with some exceptions: several species have a distribution more restricted than previously known and they are cryptic. For example, *Leptodiaptomus garciai* is a microendemic valid species, related to *L. novamexicanus*, but restricted to a saline lake in a semidesert region. Other possible species complexes highlighted are *Arctodiaptomus dorsalis* and several from *Mastigodiaptomus* genus: *M. nesus*, *M. albuquerquensis* and *M. reidae*. *Leptodiaptomus* has a wider distribution as *L. siciloides* from the Great Lakes to the north of Mexico. Genetic distances are in agreement with some old classical researchers as Kiefer, who noticed some differences in *Mastigodiaptomus* from Patzcuaro Lake in Mexico, and designed it as a different subspecies (*M. albuquerquensis patzcuarensis*). Finally, we want to make emphasis in the relevance to keep vouchers of sequenced material, and the use of integrative taxonomy to take nomenclatural decisions.

P-I

The effect of *Acanthocyclops americanus* (Marsh) (Copepoda) as competitor and predator in freshwater zooplankton communities

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The ecological position of *Acanthocyclops americanus* within the aquatic food web is important because its naupliar, copepodite and adult stages have a great influence on the structure of zooplankton communities, through competition and predation. We evaluated the feeding rates and functional responses of *A. americanus*, using different concentrations and food types of *Scenedesmus acutus* (Chlorophyceae), *Brachionus havanaensis* (Rotifera), *Moina micrura* (Cladocera) and nauplii of *A. americanus.* All species were collected in Lake Huetzalin, Xochimilco, Mexico City. The nauplii consumed only algae thereby competing with cladoceran neonates because their grazing rates of 0.43 $x10^6$ cells hr^{-1} and 0.54 $x10^6$ cells hr^{-1} respectively, are similar. The functional response of *A. americanus* showed similar rates of consumption of prey nauplii (2.55 ind. h^{-1}) and cladocerans neonates (2.73 ind. h^{-1}). The copepod had a higher preference for the rotifer *B. havanaensis* regardless of its availability with regard to other tested prey species. The nauplii of *A. americanus* could be strong competitors of cladoceran neonates since both these crustaceans feed on similar diets while the adult copepods are voracious predators consuming their own nauplii, rotifers and cladocerans. Thus, *A. americanus* exerts considerable impact on zooplankton communities by competing with them for algal food during the early developmental stages and exhibiting a voracious predatory behavior during the copepodite and adult stages.

S-IV

Long-term changes of the community structure of marine copepod populations: are they really sensitive?

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Copepod populations and communities must cope with a wide range of physical and chemical variability both in space and time within natural ranges. Lately much concern has emerged about copepod responses to environmental variation forced by climate change. These changes may alter observed natural ranges or cause irreversible trends of key environmental variables. Under this perspective, copepods have been suggested as suitable indicators of perturbations of the whole marine ecosystem as forced by climate change. In order to assess how populations and communities of copepods are responding to climate change, long-term observations have become the key tool. Several time series studies, mostly in coastal waters, are dealing with copepods. These vary widely in terms of sampling frequency and methods, and the time period they cover, as well as in their main study focuses. However, despite being so diverse, these time series studies have revealed some general patterns and findings highly relevant as to assess how much sensitive are copepods as to assess the impact of climate change on the marine ecosystems. In this context, alterations in the phenology, biogeographic patterns, diversity and population and community dynamics, constitute clear evidence that copepods can act as sentinels for marine ecosystem perturbations. In this work, time series studies about copepods from various regions are compared and their key findings are summarized and discussed. An integrated synthesis of the key findings is attempted aiming at understanding whether copepods may respond to climate variability, what can be their key responses and if they can serve as proxy to project future changes in the marine ecosystem.

P-I

Copepods of the different-type water bodies of the northern part of the Central Palearctic

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Great number of lakes and small water bodies is a typical feature of high latitude landscapes: lowland and mountain tundra, forest-tundra and northern taiga. Taxa composition and ecology of Copepods of 6 large lakes and 75 small lakes and water bodies, situated beyond Arctic Circle in the European North-East tundra and in the Central Siberia in the west Spurs of the Putorana Plateau (Russia) were analyzed. Climate of these regions is subarctic continental. In both studied regions the eurythermal copepod species prevailed and the stenothermal psychrophilic copepod species were presented. Biomass of copepods was higher than biomass of cladocerans in 45% of the European North-East tundra water bodies and in 67 % of the Siberian lakes. The composition of the copepod fauna was different in the large and small water bodies. In the large system of tundra lakes 7 species (4 – Cyclopiformes and 3 – Calaniformes) in plankton and 13 species (7 – Cyclopiformes and 6 – Harpactiformes) in benthos were found, and 27 species (15 – Cyclopiformes, 1 – Calaniformes and 11 – Harpactiformes) occurred in the small tundra water bodies. The species composition in the small water bodies depended on type (the stage of ecosystem succession) and size of a water body, pH, colour of water. In taiga and forest-tundra lakes of the Siberian region 31 copepod species (11 – Calaniformes, 15 – Cyclopiformes and 5 – Harpactiformes) were found. The known areal of some species (*Arctodiaptomus acutilobatus* (Sars)*, Acanthodiaptomus tibetanus* (Daday)) was widened owing to the findings in this region. The comparison of the species lists from different northern regions showed that the species diversity (total number of species) of copepods does not change significantly from west to east.

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P-I

Intensive production of the copepod *Pseudodiaptomus euryhalinus* and use during first-feeding of the spotted rose snapper (*Lutjanus guttatus*)

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A study was conducted on the intensive culture (7000 and 1000 L) of the calanoid copepod *Pseudodiaptomus euryhalinus* as first-feed for the spotted rose snapper *Lutjanus guttatus*. Marine fish larvae in nature thrive on copepods which provide a source of high energy and easily digestible live prey. According to the feeding protocol established by Garcia-Ortega and colleagues, where three mixed diets consisting of rotifers (*B. rotundiformis*), copepods (*P. euryhalinus*) and *Artemia* were fed successfully to *L. guttatus* larvae in grow-out facilities at CIAD-Mazatlán. The effect of copepods as sole feed for *L. guttatus* at pilot scale had not been explored prior to this study due to an inadequate supply of copepods. *L. guttatus* were obtained from naturally spawning broodstock reared at CIAD-Mazatlán. Twelve 3000 L white-bottomed tanks with black sides were each filled with 21.5 ml eggs (approx. 2000 eggs per ml^{-1}) using the green water technique process (*Nannochloropsis oculata* 500 cel·μl^{-1} & *Isochrysis galbana* 50 cel·μ l^{-1}). Four replicates of each treatment were performed for aduration of 30 days. Temperature varied between 27.3±1.5º C and salinity at 30.9±1.3‰. Two airstones were placed at the bottom of each tank for aeration and covered with black mesh (25% light reduction) with no water renewal until day 15 post-hatch when a slight flow of water was permitted. Treatments were kept at a stocking density of T1: 1 cops ml^{-1}, T2: 0.5 cops ml^{-1} + 5 rotifers ml^{-1} and T3: 10 rotifers ml^{-1}. On the 7^{th}, 14^{th} and 21^{st} dph, feed quantity was increased by 50%. The highest survival rate was obtained in the rotifers treatment (2.6±0.8%), approximately three times higher than in the copepod-only treatment (0.7±0.7%). However, the larvae fed on copepod-only diets gave better growth rates: Total length= 25.5±0.7 mm $larva^{-1}$ and wet weight = 334.1±31.8 mg $larva^{-1}$, while the rotifers only diet gave a mean value of 8.8±1.3mm $larva^{-1}$ for total length and 12.5±4.6 mg $larva^{-1}$ for wet weight. *Artemia* were added on 15 days post-hatched to T1, one day earlier than reported by García-Ortega and colleagues. Also, they were found to be more resistant to management practices than the other two feeding regimes.

O

Patterns of copepod colonisation and diversity in newly constructed temporary ponds in the Doñana National Park, Southern Spain

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Empty ponds offer a unique opportunity to study colonisation processes, species accrual, and metacommunity dynamics through time. We studied colonisation in recently (2005) constructed temporary ponds in a large wetland area in Southern Spain. The study area is a 2,700 ha former marshland, which was cultivated for 20 years and restored in a major effort in 2004/2005. It is now part of the Doñana National Park (77,260 ha), one of Europe's largest protected wetlands and a major wintering area (over 500,000 birds per year) for migrating waterbirds. We present the results of a 4-year study of copepod assemblages in 48 experimental ponds, and a variety of natural reference ponds with hydroperiods between 3-6 months per year. Within the entire National Park area, 18 copepod species were recorded, while in the study area a smaller subset of 13 copepod species was found. The experimental ponds were initially colonized and numerically dominated by the cyclopoid copepod *Metacyclops minutus,* followed by three calanoid copepod species. We discuss the effect of abiotic factors, spatial configuration and the presence of other zooplankton groups on the colonisation history of the copepod fauna in this experimental pond group.

S-I

Dissecting copepod diversity at different spatial scales in Southern European ground water

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It is widely recognized that species diversity is scale-dependent, and this empirical observation led most researchers to evaluate scale-effects in determining community composition. Copepod diversity in Southern European ground water at different spatial scales has been examined. A nested spatial hierarchy was defined and a stratified sampling strategy adopted at four spatial scales: (1) the region, (2) the hydrogeographic basin, (3) the aquifer type (karstic *versus* porous), (4) the habitat type (unsaturated and saturated zones in karstic aquifers, hyporheic and phreatic zones in porous aquifers). A total of 681 sites were sampled in four regions, namely: the Cantabria (Spain), the Jura Massif (France), the Lessinian mountains (Italy), and the Krim Massif (Slovenia). Our research was aimed at evaluating the spatial scale sensitivity of stygoxenic, stygophilic and stigobiotic copepods and at assessing differences in assemblage composition along the spatial scales analysed. The multivariate statistical analyses performed (MDS, clustering, and ANOSIM) returned marked differences in assemblage composition at the largest regional spatial scale. Although regions displayed approximately the same diversity, measured as Taxonomic Distinctness, in the hierarchical multivariate analysis of variance based on stygobiotic species, regions accounted for 51% of the overall variation. Statistically significant differences were also found at the same spatial scale in mean relative endemism, which returned high values in all regions, except the Jura Massif, suggesting that historical factors are the major determinants in shaping copepod assemblages at this scale. Aquifer type accounted for 13% of variation, although the observed differences were not statistically significant. The smallest spatial scale analysed, i.e. the habitat type, accounted for 10% of variation, while residual, unexplained variation was 26%. Habitat specialization was higher in unsaturated karstic habitats, which showed a higher relative endemism accompanied by lower taxonomic uniqueness; both historical and ecological factors seemed to have operated together in shaping copepod assemblages among habitat types. A negligible effect on copepod assemblages was observed at the hydrogeographic basin scale. Moreover, stygoxenic and stygophilic species did not affect the observed patterns, due to their random distribution along the spatial hierarchy analysed: stygobiotic copepods were, by far, the most sensitive to spatial scale-effects.

P-I

Parasitic dinoflagellates (genus *Blastodinium*) infecting copepods off the coast of the State of Baja California Sur

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In Mexico, there is little information about symbiotic associations among dinoflagellates and diatoms on marine planktonic crustacean. In this study, we report some cases of copepods infected by marine dinoflagellates. Samples were collected with a 20-µm mesh net in Bahía de La Paz (off PEMEX and Cuenca Alfonso), Bahía Magdalena, and offshore of San José del Cabo, Baja California Sur, Mexico from 2009 through 2010. We found several copepods species infected by the dinoflagellate *Blastodinium* spp. The copepod *Paracalanus* cf *parvus* was parasitized by *Blastodinium contortum* in samples from the three collection areas. *B. contortum* was previously reported Petróleos Dock in Bahía de La Paz, however, this is the first record for Cuenca Alfonso There are no previous records of *B. contortum* in the plankton of Bahía Magdalena and offshore of San José del Cabo, which is an extension of the range of this species. *Blastodinium oviforme* infected females of the cyclopoid copepods *Oithona plumifera* in samples from Bahía de La Paz and San José del Cabo. This is the first report of a host-parasite association in Mexican waters. Other copepods infected by *Blastodinium* spp. were *Acartia* sp. and *Oncaea* sp. Infection by *Blastodinium* spp. is not typically lethal, but does have a negative effect on fitness of the host.

P-I

Contribution of copepods to contents of essential highly unsaturated fatty acids in freshwater zooplankton according to climatic factor

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We compared 11 lakes from various climatic zones to reveal probable mechanisms of effect of climate change on content of polyunsaturated fatty acids (PUFA) in freshwater zooplankton. The increase of water temperature was found to result in the decrease in the PUFA level in zooplankton. This finding agrees with the hypothesis of homeoviscous adaptation, however, it was mainly due to changes in taxonomic structure of communities rather than changes in PUFA content of particular species. Biomass of zooplankton was dominated by *Cyclops abyssorum* Sars, *Eucyclops macruroides* (Lilljeborg), *Megacyclops viridis* (Jurine), *Thermocyclops oithonoides* (Sars), *Acanthodiaptomus denticornis* Wierzejski, *Arctodiaptomus* sp. (each in 1 lake), *Cyclops scutifer* Sars, *Mesocyclops leuckarti* (Claus), *Eudiaptomus gracilis* (Sars) (each in 2 lakes) and *Eudiaptomus graciloides* (Lilljeborg) (in 4 lakes). When temperature increases, cladocerans, that characterized by high value of eicosapentaenoic fatty acid (EPA), replace copepods rich in docosahexaenoic fatty acid (DHA). Content of DHA in biomass of zooplankton as food are known to be of key importance for the development of fish larvae. Thus, global warming likely leads to a decrease in DHA production in zooplankton and, consequently, in a reduction in fish production of aquatic ecosystems.

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P-II

On a small collection of Laophontidae T. Scott (Copepoda: Harpacticoida) from Mexico. I. New species and new records of *Laophonte* Philippi and *Paralaophonte* Lang

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As a continued effort for the better knowledge of the Mexican harpacticoid fauna, new records and new species have been reported during the last 14 years, and a number of new species and new records still have to be published. This is the first of two contributions in which new species and new records of Laophontidae T. Scott collected since 1991 from central and southern Sinaloa State (north-western Mexico) and from the Gulf of Mexico, are presented. In this contribution some new species and new records of the genera *Laophonte* Philippi (*L. paradduensis* sp. nov., attributable to the *cornuta*-group and closely related to *L. adduensis* Sewell) and *Paralaophonte* Lang (*P. pacificaemulator* sp. nov., *P. pacificavicinum* sp. nov., *P. pacifica* Lang, *P. congenera* (Sars) and *P. zimmeri* (Douwe)) are reported. *Paralaophonte pacificaemulator* sp. nov., *P. pacificavicinum* sp. nov., and *P. pacifica* are hypothesized to co-occur sympatrically in north-western Mexico.

P-II

On a small collection of Laophontidae T. Scott (Copepoda: Harpacticoida) from Mexico. II. New records of *Quinquelaophonte* Wells, Hicks & Coull and description of *Onychoquinpes permixtionis* gen. nov. et sp. nov.

S. Gómez [1] & F.N. Morales-Serna [2]

A number of new species and new records of harpacticoids have been published during the last 14 years as an effort aiming at the better knowledge of the Mexican harpacticoid fauna. This is the second contribution dealing with the description and new records of laophontid species collected since 1991 from central and southern Sinaloa State (north-western Mexico) and from the Gulf of Mexico. In this contribution, new illustrated records of *Quinquelaophonte quinquespinosa* (Sewell) and *Q. capillata* (Wilson) are provided. Also, a new genus and species, *Onychocamptus permixtionis* gen. nov. et sp. nov. is described. The new genus and species herein proposed exhibits a mixture of character states typical for *Onychocamptus* Daday and *Folioquinpes* Fiers & Rutledge.

P-II

A new species of *Alteutha* Baird from north-western Mexico

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A number of new species and new records of harpacticoids have been published during the last 14 years as an effort aiming at the better knowledge of the Mexican harpacticoid fauna. The material presented herein clearly belongs to the group of species of *Alteutha* without inner armature in the P2-P4 EXP1 (*A. trisetosa*, *A. rara*, *A. oblonga* and *A. austrina*). The new species here in presented seems to be more closely related to *Alteutha rara* and *A. oblonga* and resembles more *A. oblonga* from Norway and Argentina given the armature of the A2 EXP and armature of P1 EXP2. The Mexican species differs from the Norwegian material in the position of the lateral seta of the first endite of the maxilla and in the P1 EXP:ENP length ratio. The Mexican species matches also the written description of the Argentinean specimens, but no conclusive comparisons could be made regarding the P1 EXP:ENP length ratio, the relative position of the setae/spines of bucal appendages and swimming legs.

P-II

Preliminary results on parasitic copepods in large pelagic fishes catched by sportfishing fleet in Cabo San Lucas, B.C.S. Mexico

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The presence of large pelagic fishes around the tip of the Baja peninsula is the base for an important sportfishing fleet in Cabo San Lucas, B.C.S. Among these species are: striped marlin (*Kajikia audax*), blue marlin (*Makaira nigricans*), black marlin (*Makaira indica*), sailfish (*Istiophorus platypterus*), swordfish (*Xiphias gladius*), mahi mahi (*Coryphaena hippurus*), wahoo (*Acanthocybium solandri*), yellowtail (*Seriola lalandi*), yellowfin tuna (*Thunnus albacares*), Mako shark (*Isurus oxyrinchus*) and others. Late 2010, from fishes catched by the sportfishing fleet we started a serie of observations on striped marlin and Mako shark due to they were clearly parasited. This is the first preliminar documented record of parasitic copepods of genus *Alebion* sp, in shortfin Mako shark (*Isurus oxyrinchus)*, and *Dinemoura* sp, in striped marlin (*Kajikia audax*) in Cabo San Lucas area (23°N 110° 08'W). Both species fishes were captured by sportfishing fleet in October 2010 and January 2011. Copepods were extracted with a knife from the epithelium of several part of the body. The attachment location of the siphonostomatoid copepod in one Mako shark (seven specimens) was in the dorsal fin, and in four striped marlins (fiftheen specimens) was in the ventral area close to the annus. The sea surface temperature was 29.4°C in October and 27.8°C in January. The areas for fishing activities are located in Golden Gate 23° 02´ lat. N 110° 15´long. W and Pozo de Cota 23° 02' lat. N 110° 09'long. W, in the west coast of the Baja California peninsula. The range sizes for striped marlins were 190-210 cm and 240 cm for the Mako shark. The survey which we are involved in is focused to register the highest number of observations on sharks and marlin species, as well as other sport species in the area in order to increase the knowledge of parasites and to try to figure out why apparently parasites occur in just a few species.

P-I

Calanoida and Cyclopoida from ephemeral and permanent freshwater systems in Chiapas, Mexico: richness and comments about biogeography

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Scarce manuscripts recording the freshwater copepods richness from Chiapas, Mexico have been published. The region of Chiapas has some of the deepest lagoons in Mexico, is abundant in inland water. Previous records show an inventory of around five Cyclopoida species in the region; in this study we have added at least seven more species from samples collected in freshwater lagoons and ponds at 1500 masl in the state of Chiapas in a region considered as a natural, protected area called “Parque Nacional Lagunas de Montebello”. The recorded species showed the influence of Neartic and Neotropical regions. This research provides a full morphological description of both the adult males and females and compares and contrasts them with previous taxonomical reports of the species from other geographical regions. Detailed analysis and illustration of the specimens morphology have been carried out with the aid of camera lucida light microscopy, and scanning electron microscopy. The presence of *Mastigodiaptomus* cf. *purpureus* and *Acanthocyclops einsle* Mirabdullayeb & Defaye, 2004, as new records in Mexico is noteworthy. On the other hand *Aglaodiaptomus clavipes* (Schacht, 1897) has been recorded in USA, and North of Mexico. Therefore, the register presented here, is the southest record of these species. The tropical *Thermocyclops inversus* Kiefer, 1936 and *Tropocyclops prasinus* (Fischer, 1860) were present too, as well as one form very similar to *Eucyclops bondi* Kiefer, 1934.

P-I

Length-weight relationship of six pelagic copepods from Bahia de La Paz, Mexico

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The relationship between dry weight (DW) and prosome length (PL) were assessed for seven species of pelagic copepods from Bahia de La Paz: *Acartia clausi, A. lilljeborgii, Centropages furcatus, Labidocera johnsoni, Temora discaudata,* and *Undinula vulgaris*. The species of higher length and dry weight was *U. vulgaris* (1. 99±0. 12 mm, 218. 54±33. 04 µg, respectively) and the lowest was *A. clausi* (0. 82±0. 03 mm, 0. 044±0. 01 µg, respectively). The dry weight-prosome length relationships were significant for three copepod species: *A. clausi* (logDW=1.06LogPL-1.49, $p< 0.05$), *L. johnsoni* (logDW= 0.56LogPL+0.26, $p<0.05$), and *T. discaudata* (logDW= 1.175LogPL-1.61, $p<0.05$). The effect of food conditions on the relationship was examined using the condition factor. Next step is adjusted mean weight and length along the year to establish a comprehensive regression equation by examining samples collected in as many months as possible.

O

Egg production rate of *Acartia lilljeborgii* Giesbrecht, 1889, *Labidocera johnsoni* Fleminger, 1964, and *Centropages furcatus* (Dana, 1849) in a Mexican subtropical lagoon

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The chlorophyll (Chl) *a* and egg production of the copepods *Acartia lilljeborgii* Giesbrecht, 1889, *Labidocera johnsoni* Fleminger, 1964, and *Centropages furcatus* (Dana, 1849) were estimated daily between 11-15 October, and 22-26 November in Ensenada de la Paz, Baja California Sur, México. Temperature ranked 25.8 and 26.5°C in October 2010, and between 21.9-23°C.in November 2010. Chlorophyll *a* concentration in October was around 1. mg m^{-3}, reducing in 50% in November indicating oligotrophic conditions with < 0.06 Chl *a* mg m^{-3}. *A. lilljeborgii* had a higher egg production rate in October of 2010 compared to November 2010; remarkable variability within and between each day of October was observed. Mature females of *L. johnsoni* were found in a few days in October and the EPR in this month was slightly higher than in November. The variability was very high between days. *C. furcatus* had the highest EPR of all species, especially during November. Notable was the reduction of EPR of *A. lilljeborgii* and *L. johnsoni* in November, indicating a seasonal change in the reproduction strategy of this species. *C. furcatus* is a species that can produce eggs continuously at low concentrations of chlorophyll, what is certainly an important factor to keep it as one of the more abundant species in the study area.

S-II

Mouth parts, leg parts, nucleotides and RNA secondary structure: bridging the gap between morphology and molecules in *Cyclops* and *Mesocyclops*

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Selection and evaluation of morphological and molecular markers for systematic revision and phylogenetic analysis begin at delimitation of species and continue until the phylogenetic analyses are completed. Universally useful characters do not exist. Informative characters for a particular taxon are challenging to choose because diagnostic values of traits depend on factors not often apparent at the beginning of systematic studies. We compare two freshwater freeliving copepod genera: the cold adapted *Cyclops* restricted to the northern hemisphere and including morphologically closely allied species, and the primarily tropical *Mesocyclops* distributed worldwide and comprised of highly diverse forms. We discuss the relative utility of morphological characters (e.g. mouth parts versus leg parts) and molecular characters (18S ribosomal DNA versus internal transcribed spacer region) in systematic analyses. The basis for hypothesizing homology among morphological characters is widely deemed to be more robust than that for molecules, whose homology is typically inferred using similiarity of the nucleotides adenine, cytosine, guanine, and thymidine (or uracil). Additionally, large numbers of nucleotides are often ambiguously aligned and discarded from analyses when outgroup taxa are aligned with ingroup taxa. In an attempt to increase the rigor with which hypotheses of homology are constructed in molecular analyses and reduce the amount of discarded data, a third "class" of character is discussed: the secondary structure of RNA molecules inherent in DNA sequences. The computer program, RNAsalsa, that builds secondary structures of RNA molecules for each taxon and aligns these structures may provide one bridge across the gap between morphology and molecules.

S-II

Integrating molecules and morphology: consensus or conflict in the symbiotic copepods?

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No group of plants or animals on Earth exhibits the range of morphological diversity as seen among the extant Crustacea. This structural disparity is best demonstrated by the symbiotic Copepoda. Given their moderately high host specificity in conjunction with the incredible spectrum of potential marine hosts, it is highly conceivable that parasitic copepods significantly outnumber their free-living counterparts in species diversity. Their successful colonization or utilization of virtually every metazoan phylum has generated a great diversity in copepod body morphology, which is arguably unparalleled among the Crustacea. For example, some highly modified copepods such as the polychaete-associated Herpyllobiidae and Melinnacheridae lack any external trace that could positively identify their crustacean affinity and their divergent body plans defy any attempts to place them in a higher level classification on morphological grounds alone. Other families such as the Monstrillidae and Thaumatopsyllidae demonstrate how extremely powerful natural selection can be in shaping morphology to meet functional needs so that distantly related taxa may appear uncannily similar. Small subunit ribosomal sequence data (18S rDNA) can help resolving some of the controversial issues that had reached a temporary impasse in the phylogeny and classification of the symbiotic copepods, such as the placement of the Monstrillidae and Thaumatopsyllidae, the paraphyly of the Cyclopoida and the origin of parasitism in the freshwater environment. Examples will be given that demonstrate the usefulness of such data in the classification of highly transformed and morphologically reduced taxa, the inference of colonization events and the placement of *incertae sedis* known exclusively from juvenile stages. I will present evidence that illustrates how the use of 18S sequence data can lead to the discovery of previously overlooked morphological characters and how they can potentially impact on the ordinal level classification of the Copepoda.

P-I

Spatial and temporal distributions of copepods in the South China Sea

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The species composition and distribution of copepods were determined at the South East Asian Time-series Study (SEATS) Station and in the northern South China Sea in 9 seasonal cruises between March 2000 and November 2002 covering the area 18° - 22° N and 116° - 120° E. A total of 58 genera, 28 families and 150 species were identified. The copepod community was dominated by the taxa *Euchaeta*, *Labidocera*, *Corycaeus*, *Pleuromamma* and *Centropages*. The species composition varied seasonally with the higher abundance in spring and the lower in summer. *Euchaeta*, *Labidocera*, *Corycaeus*, *Centropages*, *Oithona* and *Pleuromamma* were the most dominant taxa in spring and they constituted about 40% of the total copepod community. Rank frequency diagrams suggest a high diversity in the studied area, as well as marked inter-annual variations. *Acartia*, *Corycaeus*, *Oithona*, *Euchaeta*, *Clausocalanus* and *Labidocera* ranked at the highest occurrence in the South China Sea. Comparison among cruises further suggests that copepod horizontal distribution is primarily affected by water circulation pattern, which is driven by South West monsoon forcing in the region. These results provide the first synoptic picture of the composition and variability of the copepod community in the South China Sea.

O

Effects of NE monsoon on the distribution of *Calanus sinicus* in the waters of Taiwan, western North Pacific Ocean

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Calanus sinicus (Copepoda: Calanoida) has a key role in the dynamics of marine food web and also on fish recruitment in the west Pacific Ocean, particularly in the Yellow Sea, the East China Sea and the coastal waters of Japan. The spatial distribution of this copepod can be traced further south such as north and west of Taiwan, Hong Kong, Hi-Nan Island and Vietnam. To understand the mechanism of how this key species distributes spatially and temporally, two long-term monitoring programs of the planktonic copepods have been conducted since 1998. The spatio-temporal distribution pattern of this copepod in the studied areas showed a clear relationship between the intrusions of cold-water mass of the China Coastal Currents (CCC) during the northeast monsoons into north and west Taiwan thus transporting this copepod further south with high concentrations. *Calanus sinicus* can be considered a biological tracer of CCC during NE monsoon originating from the Yellow Sea and the East China Sea to the north and west of Taiwan and further south up to Hong Kong, Hi-Nan and Vietnam.

S-I

Habitats of anchialine cave copepoda

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Anchialine caves consist of inland pools and associated subterranean passageways in either solutional limestone caves or volcanic lava tubes, generally located within a few kilometers of the coast. Such caves occur on islands or even on peninsulas that have hydrologic conditions similar to islands. The water column is salinity stratified with a more or less well defined halocline. Due to the absence of light, photosynthesis is lacking and as such, levels of dissolved oxygen and organic matter are typically quite low. A cloud-like layer of hydrogen sulfide and sulfur reducing bacteria with associated anoxia may occur at the halocline, but in some caves, dissolved oxygen reappears below the halocline indicating the presence of deep subterranean water circulation. Since hydrological connections to the sea are constrained, tidal amplitude is diminished and the period is delayed. Water currents are for the most part very low or not detectable and consequently cave waters are exceptionally clear with little to no suspended particulate matter. Anchialine stygobitic fauna consists primarily of crustaceans with characteristic groups of taxa at the genus or family level occurring in widely separated localities on a global scale. Copepods are one of the dominant groups in many anchialine localities including Bermuda, the Bahamas, Yucatan Peninsula, Canary Islands, Balearic Islands, and Cape Range Peninsula. Specialized cave diving techniques including side mounted scuba tanks and closed circuit rebreathers are essential tools since most anchialine animals are only found in fully marine cave waters occurring at considerable depth and distance from the entrance pools. In a few seafloor caves in the Bahamas, divers penetrating to significant depth (>60 m) or distance (>1.5 km) have discovered habitats comparable to inland cave environments populated by fauna typically characterized as anchialine suggesting that anchialine habitats may occur under the ocean as well as under land.

S-III

New data on the diversity, host specificity and distribution of crustacean copepods associated with stony corals (Cnidaria: Anthozoa: Scleractinia) of the Indo-Pacific coral reefs

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Symbiotic copepods associated with scleractinian corals from four geographical sites (Ningaloo Reef of the West Australia, Heron and Lizard Islands of the Great Barrier Reef, and Vietnam) were collected in 2010. In total 258 colonies of 83 identified species of scleractinian corals representing 28 genera in 15 families (Acroporidae, Agariciidae, Dendrophylliidae, Faviidae, Euphyllidae, Fungiidae, Faviidae, Pectiniidae, Pocilloporidae, Poritidae, Oculinidae, Merulinidae, Milleporidae, Mussidae, and Siderastreidae) were collected and photographed alive using SCUBA at depths from 3 to 30 m. The corals were placed in plastic bags, brought to the surface, and were washed in a solution of sea water and ethanol with the obtained residue filtered through a fine net. This procedure revealed a diverse and abundant fauna of symbiotic copepods representing orders Cyclopoida, Harpacticoida, Poecilostomatoida, and Siphonostomatoida. All copepods were preserved in 95% ethanol for both morphological and DNA study studies. Vouchers and DNA subsamples of all inspected colonies of corals were identified and are deposited in the Museum of Tropical Queensland and Zoological Museum of Moscow State University. All field and taxonomic data obtained about the copepods and their hosts, including underwater photographs of the living corals and their skeletons, are present in an Access database. Two methods of DNA extraction: standard automated CCDB bind-wash-elute protocol (Ivanova et al. 2006) and HotSHOT alkaline lysis (Montero-Pau et al. 2008) in combination with voucher recovery protocol (Porco et al. 2010) were used for DNA extraction; LCO1490 and HCO2198 primers (Folmer, 1994) were used for PCR amplification. Results of diversity from tests of mitochondrial COI (cytochrome oxidase subunit I) of 119 specimens from more than 40 species of copepods collected at the Lizard Island station are represented in the families Asterocheridae and Coralliomyzontidae of Siphonostomatoida and Rhynchomolgidae and Xarifidae of Poecilostomatoida. The results generally confirm species boundaries established by morphological features as well as existing boundaries of the copepod's families and orders.

S-III

Two new species of monstrilloid copepods from Korean waters

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Monstrilloid copepods are one of the least known groups of Copepoda. Monstrilloids have a bizarre, protelean life history, comprising endoparasitic naupliar stages and free-swimming, non-feeding, pelagic adults. Eggs hatch into lecithotrophic nauplii that locate a mollusc or polychaete host and burrow into its tissues. Adult females produce large egg masses that are attached to the ovigerous spines, which are capable of growth and can carry more than one egg batch. Despite their high fecundity, monstrilloids usually represent only a very small fraction of marine planktonic copepod communities. The Korean monstrilloid fauna is poorly studied and undersampled. Several monstrilloids were collected along the east coast of Korea during nighttime using a light trap. Taxonomic analysis showed that two male specimens could not be attributed to any known species. The first one is identified as a new species of *Cymbasoma* and is probably most closely related to *Cymbasoma chelemense* Suárez-Morales & Escamilla, 1997, originally described from the northern Yucatán Peninsula. Differences include the size of the dorsal ocelli and the armature formula of the antennules. In the new species the ocelli are more prominent and the antennule has a plumose seta (instead of a spine) on the first segment, and four branched setae and a plumose seta (instead of five non-branched setae) on the terminal segment. The second new species is attributed to the genus *Monstrillopsis* and displays a characteristic ridged crescent along the proximal anterior margin of the distal antennulary segment. This character is shared with *Monstrillopsis sarsi* Isaac, 1974, known from south-west British waters, however, the new species differs in the number of branched setae on the antennule.

P-II

Structure, development and evolution of the “lunule” in caligid copepods

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Evolutionary novelty is one of the main focuses of the modern evolutionary biology. Copepods are considered as the best animals to understand the evolutionary trends, since it is relatively easy to trace the homology of characters. The genus *Caligus* (family Caligidae) has a notable structure named “lunule” on the anterior margin of the frontal plate. The lunule is a pair of cup-like suckers for attachment to their host. On the other hand, other caligids such as *Lepeophtheirus* are lacking of lunules. This character distribution makes it possible to compare “ancestral” and “derived” character states among the closely related caligids. Therefore, the lunules seem to be a notable example for understanding the evolutionary novelty, but the structure and development of the lunule are not studied yet. The purpose of the present study is to understand how the lunule has evolved from the ancestral state. The structure and development of the anterior margin of the frontal plates are compared between *Pseudocaligus fugu* and *Lepeophtheirus sekii,* by using scanning electron, transmission electron and laser confocal microscopes. This observation suggests that the lunule is originated from the marginal membranes of the frontal plate. Furthermore, the observation also revealed the presence of “marginal membrane- or lunule-specific primordial cell population” in the frontal plate. Based on these observations, the evolutionary scenario of the novel organ “lunule” is discussed at cellular level.

S-III

Acanthochondria (Copepoda: Chondracanthidae) parasitic on flatfishes in Southern California, U.S.A.

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Acanthochondria Oakley, 1927 is the largest genus of Chondracanthidae Milne Edwards, 1840 containing 51 valid species. This genus can be distinguished from other chondracanthid genera by the lack of outgrowths (in the form of processes, knobs, or protrusions) in the trunk region, except for a pair of posterolateral processes, and two pairs of modified bilobate legs in the transformed adult female. Members of this genus exhibit sexual dimorphism typical of this family of copepods, with the female being noticeably larger (ranging from 4 to 10 mm) and morphologically distinct from the male (less than 1 mm). The males of *Acanthochondria* do not show specific morphological differences, therefore, species identification is based solely on the female. To date, five species of this genus have been found in Southern California: *A. alleni* Tang, Kalman & Ho, 2010*, A. dojirii* Kabata, 1984*, A. hoi* Kalman, 2003*, A. margolisi* Kabata, 1984, and *A. fraseri* Ho, 1972. All five species appear to be host specific to the pleuronectiform flatfish families Paralichthyidae and Pleuronectidae and three of the five species have thus far only been collected from a single flatfish species. Prevalence values for these parasites range from 1.1% to 74.1% and mean intensity ranges from 1.2 to 2.7.

S-III

The 1st International Workshop on Symbiotic Copepoda (IWOSC) at Cabrillo Marine Aquarium, San Pedro, California, U.S.A.

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The 1st International Workshop on Symbiotic Copepoda (IWOSC) was held from 4–8 December, 2010, at Cabrillo Marine Aquarium (CMA) in San Pedro, California, U.S.A. The participants included 24 full-participants, three organizers, and three tutors from 13 different countries. We believe this workshop was timely as many parasitic copepod experts have recently retired or will be retiring shortly, and as such, there is a declining trend of training and recruitment of young scientists in the parasitic copepod field. Hence, we believe this workshop will continue to be essential for maintaining the scientific legacy of this comparatively smaller, but equally important, group within the global copepod and parasitology communities. This workshop was organized independent of WAC, was co-sponsored by CMA and FRIENDS of CMA, and excluded the free-living copepod groups. During the workshop, participants learned new methods for collecting symbiotic copepods and included, among others, computer software methods for organizing illustrations into plates more easily and eco-friendly. Further, participants had the opportunity to discuss their work with local university science professors, students, and aquarium staff during the welcome reception, presented their research findings during the oral and poster presentation sessions, contributed to a 'roundtable' discussion regarding ways in which we can further promote our field to current and future young scientists as well as the general public, obtained assistance with identification of their own material, developed scientific collaborations with interested participants and, most importantly, was given the opportunity to submit a paper for publication in the international journal *Zoosymposia* (sister journal of *Zootaxa*). The 2nd IWOSC is planned for summer of 2013 and will be held either again at CMA in the U.S.A., a Fisheries Institute in Thailand, or Universidade Federal da Bahia in Brazil.

P-II

A new species of the genus *Ectinosoma* Boeck, 1865 (Copepoda: Harpacticoida: Ectinosomatidae) from Thailand

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A new harpacticoid copepod species *Ectinosoma* sp. nov. is described from the green alga *Neomeris vanbosseae* sediments in Rayong Province, Thailand. Sediment samples were collected on 9th September 2007 at low tide down to 1 cm depth by using a 3.5 cm diameter x 10 cm length hand corer, then fixed and stained in a solution of 10% formalin and rose bengal. Copepods were separated and studied in detail. The family Ectinosomatidae provided most of the harpacticoid individuals among the 11 families present in the samples. The genus *Ectinosoma* Boeck, 1865 belonging to the family Ectinosomatidae Sars, 1903 was the second most abundant after *Halectinosoma* Vervoort, 1962 among the four ectinosomatid genera present in the sample. The diagnostic characters of the new species *Ectinosoma* sp. are as follows: 6-segmented antennules, P1-P4 inner seta of middle segment dilated at base and irregularly serrate at tip; P5 with a total of 4 marginal setae; baseoendopod of P5 furnished with 2 curved rows of minute spinules on inner margin; 1 row of spinules on anterior surface of the inner spineless seta. Otherwise is the body fusiform with a triangular cephalothorax similar to *Ectinosoma carnivora.*

S-I

Explosive radiation and size differentiation of harpacticoids in a small subterranean island in Western Australia

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Arid Western Australia, and especially the Yilgarn region, is well known for numerous isolated calcrete aquifers that lie along palaeodrainage channels and range in diameter from tens of kilometres to hundreds of meters. Highly porous and carbonate rich sediments here represent an ideal habitat for various groups of stygofauna (aquatic subterranean fauna), including dytiscid beetles, amphipods, isopods, bathynellids, ostracods, and copepods. Previous genetic and morphological studies suggested that individual calcretes are equivalent to closed island habitats, which have been isolated for millions of years. Majority of stygobitic species evolved within individual calcretes following independent colonisation by epigean ancestors. The diversity of stygofauna is mostly dependent on the size of the calcrete, and typically includes one to three species from each major group, most of them endemic to that site. Recent investigations of one of the larger calcretes in the uppermost reaches of the Carey Palaeochannel, revealed an unprecedented diversity of copepods. Using morphological methods we were able to distinguish 22 different species, from six families, which represent 70% of the previously recorded copepod diversity in the whole region, although the area investigated is less than 3% of its surface. Mitochondrial DNA sequence data from cytochrome C oxidase subunit I (COI) confirmed all these and revealed additional three cryptic species. Reconstructed phylogenies suggest that both multiple colonisations and explosive radiation are responsible for this richness. The genus *Schizopera* is especially rich, containing eight different species in this calcrete (almost twice the number of species previously known from this whole region), and up to four species in a single sampling bore. This is usually associated with a remarkable size differentiation, comparable only to that previously observed in some dytiscid beetles. The genus *Kinnecaris* is represented with six species here, but they are all allopatric and with only minute morphological differences. Reconstructed molecular phylogenies and morphological data suggested that these two harpacticoid genera colonised the palaochannel from opposite directions. Both morphological and molecular data confirm that other major groups in this calcrete are much less diverse, containing the usual number of one to three species, which would suggest different age and colonisation history for different groups. Detailed hydrological and geological studies, as well as fine level distribution of different species, revealed that what was initially perceived as a single calcrete is in reality a very complex and patchy habitat. This translates into high speciation potential and is probably responsible for the high copepod diversity, in combination with fresher waters in the upper reaches of this palaeochannel and their role in a long accumulation history. Some harpacticoid lineages here, like the genus *Kinnecaris*, probably postdate the Permo-Carboniferous glaciation (≤300 million years).

O

Anthropogenic translocation of freshwater cyclopoids associated with early shipping activities

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Invasive species are a global problem, which costs world economy billions of dollars and world ecosystems millions of tons of herbicides, pesticides and other –cides. Invasive species in aquatic ecosystems pose among the greatest threats to biodiversity, ecosystem integrity, agriculture, fisheries, and public health. In some cases, these invaders, freed of the natural controls of their native range, can proliferate in new waterways, displace native species, and significantly degrade ecosystems. Copepods are well known invaders. Anthropogenic translocation associated with shipping activities sometimes results in introduction of marine and estuarine species to ecosystems outside their historic ranges through ballast water discharge. Recent studies on freshwater copepods in Australia and New Zealand also suggested presence of some freshwater invasive cyclopoids in lotic and subterranean habitats, which was hypothesized in Karanovic (2005) to be a result of early shipping activities by European settlers. In those days, sailing ships would carry over 100 butts, containing the water that came straight out of a local European river, and was used mostly for cooking and washing, and refilled wherever possible. So, when Captain Cook in 1769 first landed in New Zealand and refilled his butts with local freshwater, the first few "cosmopolitan" cyclopoids could have been introduced. Absence of almost any morphological variability between highly disjunct populations in Australia and New Zealand was used as indirect evidence, as well as absence of cosmopolitan calanoids and harpacticoids (with resting stages being either eggs or cysts in the benthos). Here we use patterns of haplotype frequency of DNA and RNA sequences to further test this hypothesis. We studied populations of several "cosmopolitan" cyclopoid species from Western Australia, New South Wales, Tasmania, New Zealand, Japan, Czech Republic, Ukraine, Russia, Germany, England, Scotland, France, Bosnia and Herzegovina, Bulgaria, Romania, Montenegro, Slovenia, and the United States. Five different sequences were studied, although not all for all species: mitochondrial DNA cytochrome C oxidase subunit I (COI), nuclear 18S gene (18S), mitochondrial ribosomal 12S rRNA (12S), mitochondrial ribosomal 16S rRNA (16S), and non-functional international transcribed spacer rRNA (ITS). The preliminary results are surprising in every respect. This is the first step in our studies of early stages of speciation, using invasive copepod species in Australian marine and freshwater habitats as surrogates for understanding processes of colonization and niche shifting.

O

Making the unseen visible: Confocal Laser Scanning Microscopy (CLSM) as a non-invasive method in the study of copepods

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The potential of confocal laser scanning microscopy (CLSM) for imaging arthropod structures has been explored since Galassi (1997a, b) applied the technique to substantiate taxonomic descriptions of copepods. Later, other authors took advantage of the natural fluorescence exhibited by the arthropod cuticle to visualize the external morphology of small crustaceans (Galassi *et al.*, 1998; Michels, 2007; Michels & Buntzow, 2009, Buttino *et al.*, 2003), insects (Klaus & Schawaroch, 2006) and mites (Valdecasas & Abad, 2011). At the present time, the crescent necessity of obtaining the maximum amount of information from a limited number of specimens leads us to search for innovative and non-invasive techniques. In this study, we will demonstrate how CLSM, using easy and inexpensive preparation methods, can provide accurate information on external copepod morphology without damaging the material or compromising the molecular studies. In addition, three-dimensional models based on CLSM image stacks can permit angles of view not possible with the light microscope. We will also explore the optical sections and recognition of differences in material composition to identification and better understanding of internal structures. Further applications of this technique can be visualization of specific structures/systems using antibodies stains and species identification through fluorescence *in situ* hybridization method (FISH).

P-II

Three new species of *Cerviniella* Smirnov, 1946 (Copepoda: Harpacticoida) from the Arctic

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Considered one of the most common harpacticoid families in deep sea benthos, the Aegisthidae can be found in various marine sediments and at different depths. During the fourth leg of the ninth expedition of RV Polarstern into the Arctic Ocean (ARK-IX/4) in 09/1993, three new representatives of the genus *Cerviniella* were collected in multicorer samples from the Laptev Sea at a depth of 760-2017m. Although this genus had already been record from the Arctic Ocean by Smirnov (1946), the present research raises the number of species known for the region from 1 to 4, and to 11 worldwide. *Cerviniella* sp. nov. 01 and 03 can be easily distinguished from their congeners primarily by the segmentation of the antennules, maxilla and leg 4, and setation of legs 1-5. *Cerviniella* sp. nov. 02 differs from the other species by the following combination of characters: shape of the rostrum and armature of leg 1 and leg 3 endopods. The study of adults and copepodites also provided significant information about the development and morphological adaptation of the swimming legs in this group.

This study was supported by the Census of Marine Life project “Arctic Ocean Diversity”:www.arcodiv.org

P-II

Pontostratiotes Brady, 1883 (Copepoda: Harpacticoida) from Angola deep-sea Basin (Southeast Atlantic, DIVA 1)

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Pontostratiotes constitutes the most specious genus in Aegisthidae and a common presence in the deep sea benthos. Twenty six species can be found in the Atlantic, Pacific and Indian oceans, in various sediments and at depths ranging from 920 to 5590m. During the first leg (METEOR 48/1) of the project DIVA (Latitudinal gradients of Deep Sea BioDIVersity in the Atlantic Ocean), samples were taken in 6 areas along a transect of about 700 km crossing the southern part of the Angola Basin, in July and August of 2000. A total of 143 adult specimens of *Pontostratiotes* were sampled with epibenthic sledges at depths between 5117 and 5455m, revealing 8 new species that can be clearly distinguished from the other known species of this genus mainly by the dorsal processes that ornament the prosome. Other minor differences in the first antennulary segment, armature of the P5 and morphology of the caudal rami were also observed. The most abundant species was *Pontostratiotes* sp. nov. 6, dominant in the North part, followed by 3 species (*P.* sp. nov. 1, 2 and 3) those occurred in both extremes of the transect. Three other species (*P.* sp. nov. 5, 7 and 8) were restricted to single areas and were poorly represented.

This study was supported by the Census of Diversity of Abyssal Marine Life (CeDAMar).

S-III

Sabelliphilid copepods associated with the tube anemone *Pachycerianthus maua* (Carlgren, 1900) and the horseshoe worm *Phoronis australis* Haswell, 1883 in New Caledonia

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Tube-dwelling anemones or cerianthids are solitary anthozoans, living buried in soft sediments. Tube anemones live and can withdraw into a mucilaginous tube, which is made from secreted mucus and threads of nematocyst-like organelles, known as ptychocysts. The virtually cosmopolitan horseshoe worm *Phoronis australis* Haswell, 1883 (Phylum Phoronida) lives as an inquiline commensal embedded in the tube-wall of cerianthids, generally of the genera *Cerianthus* and *Pachycerianthus*. Examination of washings of *Pachycerianthus maua* (Calgren, 1900) and its symbiont *Phoronis australis* collected in New Caledonia revealed two copepod associates belonging to the family Sabelliphilidae. *Phoronicola spinulatus* Boxshall & Humes, 1988, originally described from *P. australis* associated with the cerianthid *Cerianthus filiformis* Carlgren, 1893 in Hong Kong was found on both the lophophore of *P. australis* and the tentacular crown of *P. maua*. Minor discrepancies were found between the New Caledonian material and the original description, which are probably due to observational errors in the latter. A second, as yet unknown, sabelliphilid species belonging to the genus *Myxomolgus* Humes & Stock, 1972 was found on the cerianthid host. The genus *Myxomolgus* currently contains three species, all of which live embedded in the mucus tube of sabellid polychaetes belonging to the genus *Myxicola* Koch in Renier, 1847: *M. myxicolae* (Bocquet & Stock, 1958), *M. proximus* Humes & Stock, 1973, and *M. invulgus* Kim, 2001. The new species, *Myxomolgus hoi* sp. nov. shares with *M. proximus* and *M. invulgus* the armature formula (II, I, 5) of the distal exopod segment of leg 4 but can be distinguished from these congeners by the presence of four setae on the maxillule, the vestigial inner coxal seta of leg 4, the different shape of the female genital double-somite and the significantly shorter caudal rami.

P-II

A new species of *Enhydrosoma* (Copepoda: Harpacticoida: Cletodidae) from the sublittoral zone, Gwangyang bay, Korea

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Enhydrosoma sp. nov. is described from the materials collected from the sublittoral zone in Gwangyang bay, Korea. The new species has superficial resemblance with the *Enhydrosoma intermedia* Chislenko, 1978 in following characters: (1) A2 exopod with 2 setae, (2) P2-P5 setal formula. However, it differs from the congener in the following characters: (1) triangular rostrum, (2) 3 setae on the P1 endopod, (3) the setal type and the shape of P5 exopod, (4) the shape of CR. The new species has sexual dimorphism in the antennule, P5, P6 and genital segmentation. The male antennule is subchirocer. The P5 baseoendopod with 2 setae, exopod elongated with 2 terminal setae. Genital somite with vestigial P6 forming one fixed and one articulating plate. Present new species shows remarkable apomorphy without apophysis on the P3 endopod in the male, which is clearly distinguished from the congeners.

P-II

A new species of *Cirracanthus* (Poecilostomatoida: Taeniacanthidae) parasitic on a marine fish of Taiwan

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Taeniacanthidae is an unusual family of copepods parasitic on both invertebrates and vertebrates in the ocean. Although most of them live as parasites of marine fishes throughout the world oceans, 14 species in three genera (*Clavisodalis*, *Echinirus*, and *Echinosocius*) live exclusively in the esophagus of sea urchins from the Indo-West Pacific. Twenty-two species of taeniacanthid copepods belonging to six genera (*Irodes*, *Makrostrotos*, *Metataeniacanthus*, *Pseudotaeniacanthus*, *Taeniacanthus*, and *Taeniastrotos*) have been reported from the marine fishes of Taiwan. Recently, a new species of an unrecorded taeniacanthid genus from Taiwan, *Cirracanthus* Dojiri & Cressey, 1987, was discovered. It was found from the branchial cavity of a circular seabat, *Halieutaea fitzsmonsi* (Gilchrist & Thomson). Three species of *Cirracanthus* are currently known. The new species, *Cirracanthus longus* n. sp., can be distinguished from its three congeners by the combination of the following character states: (1) with 6 (instead of 7) elements at the tip of the antenna, (2) mandible carrying 2 (instead of 3) elements at tip, (3) distal endopodal segment of leg 1 carrying 6 (instead of 7) setae, and (4) the armature formula of the distal exopodal segment of leg 2 is III, I, 4 (instead of II, I, 4 or II, I, 5). All four species of *Cirracanthus* are known of female only.

P-I

Copepod assemblages in the waters around Taiwan during two distinct monsoon seasons

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We investigated the variation of copepod assemblages in the waters around Taiwan, western North Pacific, during two distinct seasons (winter-northeasterly monsoon versus summer-southwesterly monsoon, 2006) and evaluated their relationships with the hydrographic conditions. In winter, 122 taxa of copepods belonging to 33 genera and 20 families were identified, the 5 predominant species were *Parvocalanus crassirostris* (15.6 %), *Oncaea venusta* (12.5%), *Paracalanus parvus* (11.1 %), *Temora turbinata* (10.1%), and *Undinula vulgaris* (8.2 %); while in summer, 117 taxa of copepod belonging to 31 genera and 20 families were recorded, the five predominate species were *O. venusta* (18.0 %), *T. turbinata* (16.1%), *P. parvus* (12.6 %), *Parvocalanus crassirostris* (9.7 %), and *Bestiolina amoyensis* (4.7 %). Higher abundance and species richness were found in summer than in winter. In both seasons, higher abundance and lower species diversity were generally found in the shelf waters west of Taiwan where the China Coastal Current might prevails, and an opposite trend was observed in the oceanic waters east and south of Taiwan where the South China Sea Surface Current and Kuroshio Current dominate. Two seasonal groups of copepod assemblage were distinguished, and the distributions of copepods were closely linked with the hydrographic conditions in each season. Our results implied that the distribution patterns of copepods were apparently influenced by the succession of water masses driven by seasonal monsoons in the study area.

O

First Records of Cyclopoid Copepods (Cyclopoida: Copepoda) from Peruvian Amazon Basin

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Since 2006, staff of the Natural History Museum of San Marcos University have been surveying freshwater zooplankton assemblages throughout Perú, with emphasis on habitats in the Amazon Basin. Copepod research in Peru began with Marsh (1906), who first reported the cyclopoid copepod *Cyclops mendocinus* (*Metacyclops leptopus* and *M. mendocinus*) from Lake Titicaca in Southeastern Peru (Puno Department). Subsequent studies in this same region by Kiefer (1926, 1943, 1958), Delachaux (1928), Brehm (1951), Harding (1955), Lindberg (1955, 1957) and Herbst (1960) yielded a total of 21 species of Cyclopidae, including representatives from subfamilies Cyclopinae (n = 8 spp.) and Eucyclopinae (n = 13 spp.; del Río y Valdivia, 1989). More recent surveys of rivers in the Amazon Basin, including the Madre de Dios, Los Amigos, Tambopata, Heath, Ucayali, Purús, Pachitea and Nanay, have yielded a total of 34 species (Cyclopinae, n = 19 spp.; Eucyclopinae, n = 15 spp.). The most species rich genera were *Mesocyclops* (n = 8 spp.), *Tropocyclops* (n = 6 spp.) and *Microcyclops* (n = 5 spp.). These genera were also the most ubiquitous, being present in 57% of the samples. *Diacyclops* was the only genus found to have a restricted geographic distribution, being represented by only one undescribed species in the Chauya Lagoon (Ucayali drainage; D.M. López, 2009). Within the Amazon Basin, regional diversity of cyclopoid copepods was greatest in the southeast (n = 30 spp.), followed by central (n = 8 spp.) and northern (n = 3 spp.) Peru. Thirteen of the cyclopoid copepod species we present are new records for Perú and 34 are new records for the Peruvian Amazon. Before the real richness, geographic distribution, and habitat preferences of cyclopoid copepods in Peru can be known with any certainty, more data are needed, especially from the central and northern parts of the country.

O

Trophic interactions of planktonic copepods in a hypertrophic shallow lake. A study using mesocosms

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Hypertrophic lakes are usually shallow water bodies with unbalanced nutrient and oxygen regimes and high productivity. The zooplankton assemblage is dominated by small sized organisms, mainly rotifers. Copepods could be present with very low species richness. Additionally, in tropical lakes, small size, omnivorous fishes are very common and can exert different and opposite effects on the plankton components. The objective of the present research was to study the trophic interactions of the copepods, fishes, cladocerans, rotifers and phytoplankton in an urban, shallow (0.5-1.0 m depth), hypertrophic lake: Lake Tezozomoc, located in Mexico City. Twelve mesocosms (100 L) were located in situ into the lake. Four different treatments (each run by triplicate) were used: open (in contact with the sediment) with fish, closed (no contact with the sediment) with fish, open without fish and closed without fish. Mesocosms were filled with lake water. In each of 6 mesosocosms twenty adult (10 males + 10 females) small omnivorous fishes (*Poecilia reticulata,* guppy) were added. Mesocosms were sampled weekly along a six week period. Lake samples were used as control. The experiment was made at the end of the rainy season (September-October) of the 2010 year. The only copepod species found belong to the *Acanthocyclops robustus* complex, a cyclopoid. In the lake samples copepods were never observed, but they grew in the mesosocoms. Statistical differences were not found ($F= 1.18$ $P>0.05$) between treatments but mean adult copepod density values were higher in the fishless treatments, indicating a weak fish predation pressure on the copepods. A negative relationship ($r= -0.6$, $P<0.05$) was found between adult copepod density and the total rotifer number. The relationship was stronger ($r= -0.7$ $P<0.05$) with the rotifer species belonging to the *Brachionus* genus (mainly *B. angularis* and *B. caudatus*). On the other hand, a positive relationship ($r= 0.54$ $P<0.01$) was observed between the adult copepod densities and the small cladoceran *Moina macrocopa*. No relationship was found between copepods and chlorophyll *a* concentration. Our results indicated that *P. reticulata* is not a main consumer of *A. robustus,* but the rotifers, especially brachionids, are an important food source for the copepods. *M. macrocopa* seems to be a low importance food source for copepods and both species can growth together. In hypertrophic conditions, the role of the small size omnivorous fish as zooplankton abundance control factor, can be secondary in the case of some copepod species.

S-III

New records of *Colobomatus* (Copepoda: Cyclopoida: Philichthyidae) parasitic in the lateral line system of Japanese finfish

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Philichtyid copepods occupy spaces associated with the sensory canals of the lateral line and skull bones of marine actynopterygian fish. Of the 9 genera of philichthyids, the genus *Colobomatus* comprises more than 60 species, 19 of them reported from the Mediterranean Sea. In Japan, 5 species of *Colobomatus* (*C. mylionus, C. pupa*, *C. exilis*, *C. fusiformis*, and *C. westi*) have been reported so far from 5 fish families (Chaetodontidae, Mullidae, Serranidae, Sillaginidae, and Sparidae). Currently, no copepodologist has attempted to search for this group of cryptic copepods. Hence, this study explored the lateral line system of tropical marine fish from Okinawa. Phylichthyid copepods were recovered from the hosts by combining the standard dissection technique with "double-netting." A total of 6 species of *Colobomatus* were collected from the head canals and lateral line scales of 7 host species. Of the 6 species of *Colobomatus*, 5 species were undescribed and were parasitic in *Pterocaesio digramma* (Caesionidae), *Gymnocranius grandoculis* (Lethrinidae), *Parupeneus ciliatus* (Mullidae), *P. multifasciatus, Acanthurus olivaceus* (Acanthuridae), and *Pterois volitans* (Scorpaenidae). Additionally, one species of *Colobomatus* collected from *Hemiramphus far* (Hemiramphidae) was identified as *C. collettei*. Therefore, this study describes the females of the 5 species of *Colobomatus* and redescribes *C. collettei* based on new material collected from Japanese hosts. No males were found. Moreover, this study reports 7 new host records of *Colobomatus* and one new locality record for *C. collettei*, which was previously reported from Australian waters. Our results indicate that a careful examination of this microhabitat would reveal more undescribed species not only from Japanese waters but from all over the world. Further studies are needed for a better understanding of this group of parasitic copepods.

S-III

Double-netting: an efficient method for the recovery of parasitic copepods from finfish

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To date, the vast literature on parasitic copepods focuses on the taxonomy and host ranges of specific species, vaguely explaining the methods used for the recovery of these parasites. Moreover, the techniques available for the collection of parasitic copepods are scarce and inefficient. Hence, this paper introduces an efficient method for the detection and collection of parasitic copepods from cultured and wild freshwater and marine finfish by combining 'double-netting' (DN) with the standard dissection technique. 'Double-netting' consists of double-filtering the dislodged debris after washing and shaking all parts dissected by the standard technique. During DN, two different sized hand-nets (≤ 200 μm in mesh size) are used simultaneously. The debris entangled in the first net is recovered by washing the first net in the second one. A total of 5,877 copepods belonging to five families (Bomolochidae, Caligidae, Philichthyidae, Lernaeopodidae and Lernanthropidae) were collected from 446 sparid fishes by combining the standard dissection technique and DN. A total of 4,429 specimens were collected only by the standard technique, while 1,448 individuals were additionally recovered by applying DN. The most abundantly recovered copepods were bomolochids (882), caligids (202) and philichthyids (132). The total number of bomolochid and philichthyid copepods recovered by DN increased up to 250% and 178%, respectively. Four additional species were recovered after applying DN, 3 of them belonging to the genus *Colobomatus*. In conclusion, this method has been proved to be efficient in recovering cryptic copepods from the body cavities and canals of the host, providing more accurate results in quantitative parasitological studies. Finally, this paper is intended to serve as a guide for the detection and recovery of parasitic copepods from cultured and wild marine and freshwater finfish for present and future generations of copepodologists.

O

Diversity and abnormalities of cyclopoid copepods around hydrothermal vent fluids, Kueishantao Island, Taiwan

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Diversity and abundance of cyclopoid copepods were investigated at four stations along the hydrothermal vent fluids, Kueishantao Island, Taiwan. Stations were chosen according the distance from hydrothermal vents fluids. Samples were collected at each station by surface tows (0-5m) with standard North Pacific Zooplankton net (200µm mesh size). Qualitatively, a total of 21 species of cyclopoids belonging to 5 genera and 3 families were observed. Highest abundance was observed at Station-2 (228.38 ind. m^{-3}) and least at Station-4 (55.64 ind. m^{-3}), respectively. The percentage composition of each genera are *Oncaea* (35.89%), *Oithona* (21.10%), *Farranula* (14.49%), *Corycaeus* (8.30%) and *Lubbockia* (0.17%) and copepodites (20.05%), respectively. We observed some abnormal protrusions on cyclopoid copepods. Protrusions were more frequent on the dorsal body surface rather than the ventral and were prominent in family Corycaeidae. Abnormalities were highest at station-3 (57.97 %), which was within the hydrothermal vent fluid region and least was observed at station-04 (3.34 %), which was very far from the vent fluid site, respectively. It was already reported that potentially high levels of toxic minerals erupted from the hydrothermal vents weakens the exoskeleton of these copepods and thereby making them more susceptible to infections. Eventhough this might be a reason for abnormal protrusions, we still need further investigation in order to conclude the possible reasons for these abnormalities.

P-I

Comparative study on copepod distribution under three different mesh-sizes around Kueishentao Island, Taiwan.

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Comparative distributions of copepods from three different mesh-sized plankton nets (100µm, 200µm and 333µm) were studied around Kueishentao Island, Taiwan. Samples were vertically towed from five stations using standard North Pacific Zooplankton nets. Qualitatively, a total of 147 species of copepods belonging to 55 genera and 23 families were observed. Highest abundance was observed under 100µm size group (1111.90 ± 958.36 ind. m^{-3}), whereas least was observed with 333µm size group (388.27 ± 406.45 ind. m^{-3}), respectively. Principle component analysis showed that all the 100µm size samples belong to the same group, whereas 200µm and 333µm size showed similarities with each other. We observed that the abundance was more in 100µm sized nets, but diversity was less than the other two different size groups i.e. 200µm and 333µm. Therefore we assume that this might be due to the impact of clogging on these small sized nets, but our assumption needs to be further investigated.

P-I

The distribution of *Boeckella poppei* (Calanoida, Centropagidae) in continental Argentina and Tierra del Fuego

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Boeckella poppei (Mrázek, 1901) is the only species of the genus still extant in Antarctica. It has been considered a typical representative of the biogeographic Subantarctic track (Menu-Marque et al. 2000). It also appears in some Circumantarctic islands of western longitude. Most diagnostic traits in this group refer to the shape and armature of the male fifth legs. Within the clade of South American *Boeckella* this is the taxon showing the greatest variation in these diagnostic features. British Antarctic Survey genetists are interested in checking if such morphological variation has a genetic basis. It would be also interesting to find out if there is any correlation between geographic location and morphology. As a first step, the geographic distribution of *B. poppei* in continental Argentina and Tierra del Fuego has been mapped. Data were obtained from the literature and from extensive surveys of the zooplankton fauna of freshwater environments of Argentina, carried out during many years by the first author. Repeated samplings were performed in the Argentinian section of Tierra del Fuego and Patagonia. All the localities where *B. poppei* was registered fall within the wedge shaped southern part of the Andean Biogeographic Region, spanning from an Andean lake at 34°34´S in the north to temporary ponds 54° 52´S close to Beagle Channel and in longitudinal extension from the Andes to close to the Patagonian coast. The exception is represented by an isolated population at 31°37´S, 64°54´W at Pampa de Achala, a plateau over 2000 m a.s.l. within the Monte Province of the Neotropical Region, which has been considered an Andean-Patagonian relict. Corrections are made of data attributed to *B. poppei*, which were misdeterminations.

P-I

Copepod community characterization in the Gulf of Cariaco, Venezuela

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Biomass and composition of the planktonic copepod community in the Gulf of Cariaco were studied from May 2003 to March 2004. Net samples were collected in the depth interval 0-25 m at five stations in the southern and northern sections of the gulf. Water transparency, salinity and temperature were also measured. In the southern stations, the values for these variables ranged from 4.4 to 9 m, 10 to 38.2 and 24.6 to 28.6 ºC, respectively, while in the northern stations they ranged from 6.7 to 13.8 m, 32 to 38, and 24.9 – 26.8°C, respectively. 55 species were identified; 44 species were observed in the southern section, while 36 species were observed in the northern one. *Temora turbinata, Paracalanus quasimodo, Acartia tonsa*, and *T. stylifera* were the most abundant and frequent species. In the southern stations, dry biomass and copepod density ranged from 1.53 to 178.64 mg.m^{-3}, and 20 to 10,463 ind.m^{-3}, respectively, while for the northern stations the values ranged from 1.43 to 131.30 mg.m^{-3}, and 42 to 1,221 ind.m^{-3}, respectively. The highest densities were recorded in June/2003, April and March/2004. The community showed significant differences with respect to time which were related to coastal upwelling; however, there were not spatial significant differences. The highest abundance was detected for the northern stations; the result may be due to the fact that these stations are farther from the plume of the Manzanares River than the southern ones. Community composition is typical of tropical conditions. Tropical/Subtropical copepods represented 63% of the individuals, while Tropical/Equatorial and Temperate only represented 23 and 14%, respectively. Finally, the community comprised two assemblages. The first one formed by temperate/transitional species, and the second one formed by tropical species typical of the Gulf of Cariaco.

P-I

Discovery of a stygobiotic population of the epigean diaptomid calanoid *Eudiaptomus intermedius* (Steuer, 1897) in Central Italy

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In the frame of a research project aimed at investigating the crustacean diversity of the vast karstic network of the Frasassi Cave (Marche, Central Italy), several stygobiotic populations of a cave-dwelling diaptomid calanoid copepod were discovered. The populations are planktonic, never found in the hyperbenthos, and widespread in the saturated karst of this complex groundwater system, represented by lakes always characterized by a chemoautotrophic benthic layer, which represents the main source of organic matter for the stygobiotic fauna living in this challenging environment. The specimens show typical stygomorphic features, such as anophtalmy, depigmentation, reduced fecundity (the females bring no more than 2-4 large eggs) and a continuous reproduction through the year. Surprisingly, the morphology of both males and females is almost identical to that of the widespread epigean species *Eudiaptomus intermedius*, which normally lives in permanent and temporary water bodies in Slovenia, Croatia, and Central and Northern Italy. In order to evaluate whether the morphological similarity may be related to the cryptic species-concept, frequently evocated for other stygobiotic species, with disjunct distribution in several groundwater systems in the world, two mitochondrial molecular markers (16S and Cyt-b) were used to test whether the Frasassi cave populations are to be considered as belonging, or not, to the epigean species *E. intermedius*. The molecular approach supported the identity of the cave population as *Eudiaptomus intermedius*, and shed new light on the interpretation of the "adoption" of stygomorphic traits in subterranean populations belonging to an epigean species.

O

Calanoida, a new taxon for the meiobenthos?

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Calanoid copepods are the most abundant metazoans in marine plankton. They are considered as typically pelagic, displaying a variety of adaptations to life in the water column. There are, however, primitive groups of Calanoida that live close to the bottom and are frequently collected in benthic samples. They belong to the families Pseudocyclopidae, Pseudocyclopiidae, Ridgewayiidae or Arietellidae (*Paramisophria*). These copepods are considered "hyperbenthic" because they swim close to the bottom without penetrating into the sediments and abandon the bottom only for nightly migrations to the water column. We hypothesize here that some species of this groups may also penetrate the sediments at least temporarily. They display important morphological features that we interpret as adaptations for digging into marine sands. Some Pseudocyclopidae as *P. mirus* (Banc d'Arguin, Senegal), *P. giussanii* (Lake Faro, Sicily, Italy) and two additional new species discovered by us at Pianosa, Elba, Italy and the Baltic Sea display a modified first leg, which formally three endopodite segments are fused into a single robust segment that could be used for digging. We interpret also as digging organs the modified plate-like first antennulary segment of *Placocalanus* (Ridgewayiidae). A new genus of Ridgewayiidae discovered by us at Pianosa display interesting modifications in the swimming legs that will be presented here. All these species have in common a body shape that is laterally compressed so that dorsal cephalothorax width is smaller than lateral high. This body shape resembles that of *Platycopia* (Platycopioida), which leads to a reinterpretation of the intermaxillipedal process as digging organ too. We will review these morphological features and compare with the adaptations present in other copepod orders. Interestingly, biogeographic analysis, including own new records of *Pseudocyclops* and *Placocalanus*, show that all psammic calanoid copepods have been hitherto recorded from biogenic calcareous sands only.

O

Calanoid copepods are more efficient grazers than cladocerans in an oligotrophic tropical lake

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Omnivorous zooplankton (calanoid copepods and cladocerans) affect phytoplankton populations directly through grazing, and indirectly by altering the nutrient conditions through nutrient regeneration. La Preciosa (Puebla, Mexico) is an athalassohaline lake (1.1 g/L). The calanoid copepod *Leptodiaptomus* cf. *sicilis* and the small cladoceran *Ceriodaphnia lacustris* dominate the zooplankton community. In this study the effects of mesozooplankton on individual taxa, size classes, total biomass and phytoplankton morphology were examined. Field experiments were conducted at different hydrodynamic conditions in 2009: mixing, onset and full stratification of the water column. Treatments were set as follows: 1) only copepods, 2) only cladocerans, 3) copepods and cladocerans and 4) no zooplankton addition (control), with four replicates each; and were incubated 48 h *in situ*. Phytoplankton was counted with the Utermöhl method; cell biovolume was calculated and transformed to biomass. Results show differential effects of zooplankton on total biomass, size classes and individual taxa of phytoplankton. Most of the effects of *Leptodiaptomus* were negative (biomass decrease), while *Ceriodaphnia* induced positive changes in the biomass of phytoplankton species (biomass increase). Differential effects may be due to different modes of feeding of zooplankton, as well as to the efficiency of phytoplankton in the uptake of nutrients regenerated by microcrustaceans, enhanced by the removal of competitors through grazing.

O

Depth structuring of pelagic copepod biodiversity in waters adjacent to an Eastern Indian Ocean coral reef.

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Much of our knowledge of copepod biodiversity and ecological role in the tropical ocean is derived from samples collected with relatively coarse-mesh nets, resulting in under-appreciation of the role of the most abundant pelagic Copepoda, which are small in size. In this study, we compare pelagic copepod communities at three (400+ m) stations adjacent to Scott Reef (14°S), a shelfbreak reef in Australia's Indian Ocean territory, to those within the shallow (ca. 50 m) atoll lagoon. The metazooplankton assemblage sampled by our 100µm multinet system was dominated by small (<1.0mm) copepods. We have identified over 220 copepod species, belonging to 5 of the 9 Orders. Of these, 68 (31%) are new records for Australian waters and at least 14 are likely to be undescribed. Redundancy analysis indicated that depth stratum was the most important determinant of community structure: distinct communities were associated with the epipelagic (within which the atoll lagoon community was further distinguished by reef-associated copepods), the chlorophyll maximum/thermocline, the upper mesopelagic and the hyper-benthos. At Scott Reef, the family Oncaeidae was highly speciose (>62 taxa) and progressively more important with increasing depth. Though Paracalanidae and Oithonidae dominate in the mixed layer of the tropical ocean, the Oncaeidae are by far the most important metazooplankters of the upper mesopelagic.

P-I

Production of three dominant calanoid copepods in Saint Peter and Saint Paul Archipelago, a tropical ecosystem from Brazil

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Saint Peter and Saint Paul Archipelago (SPSPA) is a high productive seamount located close to the Equator, in Atlantic Ocean (0°55'06"N and 29°20'48"W). The aim of this study was to assess the spatial variation production patterns of the three most abundant copepod species around SPSPA, to understand their role in this high productive area. Plankton samples were collected with a 300 µm mesh size net at 16 stations distributed in four transects (North, East, South and West to the SPSPA). In each transect, four equidistant stations a half nautical mile one from the other were plotted. *Undinula vulgaris*, *Acrocalanus longicornis* and *Calocalanus pavo* were the most abundant species, presenting more than 60% of total copepod density in three of four transects. *U. vulgaris* showed the higher mean production rate (1.52 ± 1.80 µgC m^{-3} d^{-1}), followed by *A. longicornis* (1.04 ± 0.87 µgC m^{-3} d^{-1}) and *C. pavo* (0.36 ± 0.18 µgC m^{-3} d^{-1}). The most productive stations were those closer to the Archipelago, one in the north (N1) and other two in the east side (E1 and E2). E1 and E2 were aligned towards the Equatorial Under Current, that flows east-west below the surface on the equator, interacting with the topography and causing nutrient suspension, increasing the production. N1 station presented higher production and this is a result of its alignment with the opening of the bay formed by the Archipelago and an exportation flux. The results showed the importance of SPSPA to high Copepod production, highlighting the importance of similar areas as "oasis" in oligotrophic tropical regions.

P-I

Effects of cyanobacteria on the muscles of *Pseudodiaptomus hessei* and *Thermocyclops neglectus*

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The effects of three cyanobacteria (*Cylindrospermopsis raciborskii*, *Anabaena solitaria* and *Anabaena flos-aquae*) on the copepods *Pseudodiaptomus hessei*, and *Thermocyclops neglectus* were studied using two complementary approaches. Electronic microscopy (MET, MEB) showed histological and morphological effects: different degrees of muscle degeneration resulting in a hypercontraction. Then, neurotoxic effects were studied by measuring the enzymatic acetylcholinesterase activity (AChE). These first results suggest that the effects would not be related to traditional cyanotoxins, but rather related to the presence of other metabolites emitted either by the cyanobacteria, or by the associated flora since the cultures used were not axenic. Complementary study is planned to confirm the neurotoxic effects.

P-I

Ionoregulation organs in a copepod calanoid *Pseudodiaptomus hessei* (Mrazek, 1894)

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The capacity of some aquatic organisms to live in a large range of salinity (from freshwater to hyperhaline ecosystems) is due to their osmoregulation capacity maintaining their internal homeostasis. This capacity has been extensively studied on Crustacea, but only few studies deal with Copepoda. This work concerns *P. hessei* a common species found in African brackish coastal (lagoons, estuaries) and freshwater (coastal lakes) ecosystems at salinity ranging from 0 to 80. Ionoregulation structures of specimen from the Senegal River hydrosystem are described using transmission electron microscopy (TEM). These structures are roughly similar to those described in Malacostracea.

P-I

Current knowledge and main taxonomic problems of *Eucyclops* (Cyclopoida: Eucyclopinae) in Mexico

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The genus *Eucyclops* is the most diverse group of the Eucyclopinae, it includes 106 of the 185 nominal species and subspecies currently recognized. However, this is one of the most complex genera among the Cyclopidae because the taxonomic characters used to separate species have been insufficiently stable. In Mexico, a country in which the Neotropical and the Nearctic regions coexist, there are approximately 460 records of the genus, including 16 nominal species. Many of these records have been assigned to taxa that are: 1) currently known to occur only in the Old World (v. gr. *Eucyclops serrulatus, Eucyclops speratus*) or 2) regarded as cosmopolitan in the continent. Furthermore, different authors have noticed morphological variations in Mexican specimens when compared to original species descriptions and/or drawings, thus suggesting that undescribed species have been recorded under the names of the commonest species. We conclude that the diversity of *Eucyclops* in the country is underestimated. Currently, a higher number of species with Neotropical affinity in Mexico suggests a greater influence from South America. However, several species with a restricted distribution pattern in north and central Mexico have been described recently; also, potentially endemic forms have been described in the Mexican plateau. It is suggested that local speciation events profiled part of the diversity in the country and that the influence of the Nearctic fauna is stronger than previously thought. A comprehensive and detailed taxonomical revision of the Mexican *Eucyclops* will help clarify the taxonomic status of species in the country and the historical distributional patterns involved.

P-I

The first record of the genus *Metacyclops* Kiefer, 1927 (Copepoda: Cyclopidae: Cyclopinae) from Mexico

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During a study on the biodiversity of aquatic habitats of arid and semi-arid areas of northern Mexico we found several specimens of cyclopoid copepods in a locality named Puente El Refugio, Cerro Bola, state of Coahuila. These were tentatively identified as *Apocyclops panamaensis*. A closer examination revealed that they belong to the cyclopine genus *Metacyclops*, which has not been hitherto recorded in Mexico. This is also the third record of the genus in North America after *M. gracilis* and *M. cushae*. The specimens reported belong to the "A-group", with a spine formula of 3443 as the main character and bear one spine on the apical margin of the second endopodal segment of P4 and three setae on its external margin. These specimens have 11-segmented antennules and appear to be closely related to the Portuguese *M. lusitanus*. Measurements, line drawingss, and SEM photographs of the specimens are presented; these probably represent an undescribed species. The absence of the genus in regional keys could be associated with the lack of records in this area; furthermore, records of the genus *Apocyclops* should be revised in order to ensure their taxonomical status. This contribution is an addition to the list of many potentially endemic species in this region of North America, which enhances the importance and need to preserve the water systems in this transitional biogeographic area.

O

Distributional patterns of freshwater genus *Eucyclops* (Copepoda: Cyclopoida: Eucyclopinae) in the Americas: a track analysis

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A panbiogeographic analysis based on the track analysis was performed for analyzing historical biogeographic patterns of the freshwater copepod genus *Eucyclops* in the Americas. Distributional data were largely obtained from literature. The panbiogeographical analysis allowed the recognition of 19 individual and two generalized tracks: (1) Western Amazonian Track, including the Amazon subregion and a small portion of the Puna province (South American Transition Zone) and (2) Mesoamerican-Northwestern South American Track, involving the Neotropical region, the Mexican Transition Zone, and the Nearctic region. A single panbiogeographic node was determined and it suggests the mixture of Neartic and Neotropical fauna after the closing of the Panama Isthmus, when the connection of the two subcontinents was consolidated. The development of the Amazon system, the Mexican and Centroamerican plateaus, the uplift of the Andes, the Sierras Madre in Mexico, the marine barrier of the Isthmus of Tehuantepec and Panama and Pleistocene rivers and terraces are some events and physiographic features associated with the distribution of the genus. The remarkable disjunction in the distribution of some species (v. gr. *E. pectinifer, E. leptacanthus, E. delachauxi*) supports the notion of a taxonomically complex genus; different species have been recorded under a single name and a complete morphological revision of many records is needed to define more accurately the biogeographic patterns of the genus in the continent.

O

Molecular-genetic based revision of the *Acanthocyclops robustus* group

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Taxonomical position and relations among species in so named *Acanthocyclops robustus* complex is complicate and ambiguous. Beginning from F. Kiefer's designation of *A. robustus* Sars as older synonym of *Acanthocyclops americanus* Marsh, a lot of contradictory data on ecological, morphological and behavioural differences inside this complex have been accumulated. Molecular-genetic tool (barcode COI) was applied to handle the problem with taxonomy in this genus. For analysis we used alcohol preserved specimens collected from the terra typica and/or type water bodies when known. The type populations used in this study include: *A. robustus* specimens collected from Oslo, Norway, *A. americanus* from Wisconsin, USA, *Acanthocyclops vernalis* from Peterhof, Russia, *Acanthocyclops trajani* from Etang de Noes, France and *Acanthocyclops einslei* from Lake Creteil, France. Individuals of the *A. robustus* complex from several other localities in Spain, France and USA were also compared, using both molecular-genetic and morphological approaches. COI tree analysis revealed that *A. robustus* and *A. vernalis* from the type localities are different species that are well separated species from all other *Acanthocyclops* studied from other sites. Specimens from the type locality of *A. trajani* and *A. einslei,* from France, although with some small differences between them, were placed together by the COI analysis in the group of *Acanthocyclops* indicated as *A. americanus* from Wisconsin and other sites in USA. Populations from other sites in Spain and France with morphologies similar to *A. trajani* or to *A. einlei* were also placed inside the *A. americanus* group that possibly reflects the traces of species invasion into Europe. Inside the *A. americanus* group is possible some subdivision accounting for the two forms *A. trajani* and *A. einslei*, although they are scarcely differentiated by COI. Re-erection of *A. americanus* as a valid species evaluated as a younger synonym and separation of it from North European species, such as *A. robustus* and *A. vernalis* is suggested. These three species are re-described under previous names and an updated key for the species of the genus *Acanthocyclops* is proposed.

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P-I

Seasonal and spatial distribution of copepod and associated assemblages in the Paranaguá Bay Estuarine Complex, southern Brazil

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This work analyzed the seasonal distribution of zooplankton community in an impacted (Paranaguá Bay) and non-impacted (Laranjeiras Bay) area of the Paranaguá Bay Estuarine Complex. Zooplankton and phytoplankton were collected every two months, between August 2003 and June 2004. Phytoplankton community was numerically dominated by diatoms (78%) and dinoflagellates (19%). Zooplankton abundance varied between 670 and 100,716 ind. m^{-3}, with the dominance of copepods, mainly the calanoids *Acartia lilljeborgi*, *Acartia tonsa* and *Pseudodiaptomus acutus*. A clear seasonal pattern was observed; copepods were significantly more abundant during the rainy than in the dry season. On the other hand, differences of abundance between the two bays were detected only for barnacle larvae, which was more abundant in Paranaguá Bay. The Principal Component Analysis showed that temperature, salinity and rainfall were important parameters controlling zooplankton population dynamics.

P-I

A comparison between the *Pseudodiaptomus euryhalinus* copepod and *Artemia* sp. as feed for juveniles of the seahorse *Hippocampus ingens*

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The performance of the juvenile seahorse *Hippocampus ingens* fed three diets consisting of copepods (*P. euryhalinus*), *Artemia* and a mixed 1:1 of both organisms reared in 110 L aquariums with semi-closed recirculation system was evaluated. Three replicates of each treatment were performed for 45 days. Temperature varied between 24.0±0.9 ºC, salinity at 30.7±4.4‰, dissolved oxygen at 4.50±0.53 mgL^{-1} and below 12light/12dark photoperiod conditions. Plastic tubes (3 mm diameter) were placed at the bottom of the aquariums and weighted with a stone. *H. ingens* were obtained from naturally spawning broodstock reared at [2]*INGENS* Cultivos Marinos hatchery. Eleven organisms were stocked after 41 DPH (3.2 ± 0.7 initial length) in the aquariums. Feed quantity was increased by 30% every 7th day. Copepods were cultured in 200L cylindrical white plastic containers with approximately 350 $cel \cdot \mu l^{-1}$ *Chaetoceros calcitrans* and an airstone was placed at the bottom of each tank for aeration and then left in a shaded area. *Artemia* were raised in 300L pools and fed on barley with no aeration added and no shadow provided. Results show that the juvenile seahorses consumed 2500 adult copepods while they only consumed 130 *Artemia* in 24 h. In the mixed diet, their preference was for copepods rather than the *Artemia*. After a 30 min feeding period, almost half of the seahorses fed on the copepods only diet hold on the plastic tubes. According to Sheng and colleagues, adhering to the tubes is considered a mature behavior. The percentage of holding animals was reported as 42% for the treatments fed solely copepods, then with the mixed diet was 6.06 % and for the solely *Artemia* diet only 1.51%.

S-III

Seasonality of parasitic copepods on the bullseye puffer *Sphoeroides annulatus* (Pisces: Tetraodontidae) from the northwest coast of Mexico

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Seasonal occurrence of parasitic copepods in wild bullseye puffer fish *Sphoeroides annulatus* was analyzed in conjunction with variation of biotic and abiotic factors. Eleven samples were taken between February 2007 and February 2008 in Santa María La Reforma lagoon (northwest coast of Mexico). A total of 337 fish was examined; 5 parasitic copepod species were observed, including *Acantholochus zairae*, *Caligus serratus*, *Lepeophtheirus simplex*, *Pseudochondracanthus diceraus*, and *Parabrachiella* sp. The most common species were *L. simplex*, *P. diceraus*, and *C. serratus* (overall prevalence, 59, 53, and 35%, respectively), which significantly varied in prevalence and mean intensity between sampling months. A seasonal pattern was only observed for *L. simplex*, with higher infection levels in the warmest month than in the coldest month. Statistical analyses indicated that the intensity of *L. simplex* was positively correlated with water temperature. At the infracommunity level, 2 descriptors used (mean species richness and mean number of individuals) varied significantly between sampling months, but no seasonality was observed, except for a slight increase in the number of individuals during the warmest month. A significant positive association was detected between number of individuals and water temperature, and between host size and both species richness and number of individuals. This is the first account of the ecology of these 5 parasitic copepods. Although no significant association was detected between fish condition factor and the burden of parasitic copepods, given the high occurrence of the sea louse, *L. simplex*, we suggest that this copepod could represent a threat for the culture of *S. annulatus*.

P-I

Interannual changes of population structure of Copepoda in the Southern Baltic (Gulf of Gdansk, 2006-2007)

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Coastal zone is exposed to many changes of natural and mostly anthropogenic factors. Therefore this region requires particular attention and systematic research. Our investigation was focused on examining the Copepoda as the permanent and very important part of local pelagic community. Biological material was collected from 6 stations in the western part of the Gulf of Gdansk (the Southern Baltic) in 2006 and 2007. Samples were taken by vertical hauls every month, using Copenhagen net with 100µm mesh size and analyzed according to HELCOM standards. In 2007 the average abundance of Copepoda were more then two times higher then in 2006 (27 263ind./m^3 and 10 838ind./m^3 respectively). Maximum concentration of copepods was noted in July (in both years), and minimum in wintertime. Copepods community was represented by typical species for investigated area: the most important were *Acartia* spp. and *Temora longicornis,* less abundant were other species, like *Pseudocalanus minutus elongatus*, *Centropages hamatus* and *Eyrytemora* sp. Among adult specimens of genus *Acartia* - *A. longiremis was* predominant generally. In September 2006 and 2007, and November 2006 *A. tonsa* was most numerous species. The third species of *Acartia* - *A. bifilosa* was truly permanent element of copepods community, but not very abundant. During two years of observations we noted constant presence of nauplii and younger development stages of *Acartia* spp., which indicates permanent reproduction of this genus within year (probably with different periods for different species of *Acartia*). Population structure of *T. longicornis* indicated two reproduction periods – in late spring and in the end of summer. The similar life history was observed for *C. hamatus* (spring and autumn). These observations confirm a relatively constant structure of Copepoda community of this region. In the Gulf of Gdańsk copepods concentration are variable (high or low) and depend on an environment factors, mostly on temperature. But in our point of view the species diversity and population structure of these crustaceans shows relative stability.

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S-III

Caligus epidemicus (Copepoda: Caligidae), a pathogenic sea louse of wild and farmed fishes in the Indo-West Pacific region: a review

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This review compiles information on the biology of the caligid copepod *Caligus epidemicus* Hewitt based on the literature published from 1971-2011. This species was originally described in 1971 based on specimens from Australia and has been reported ever since from various countries in the Indo-West Pacific region, including India, Indonesia, Malaysia, Thailand, Vietnam, Philippines, Taiwan, and Japan. The species is not host specific and has been found on more than 30 teleost species and also even on cultured shrimps. It has ten developmental stages, comprising two nauplii, one copepodid, six chalimus, and one preadult (young adult) stages. A rearing period of 17 days at 24–25ºC is necessary for *C. epidemicus* to develop to an ovigerous female after egg hatching. The intensity of infection of *C. epidemicus* is generally low on wild fish but fluctuates markedly between years. Cultured fish are in contrast more heavily infected by *C. epidemicus* than fish in the wild. Neither preadult nor adult copepods are responsible for significant pathology in infected fish, but copepodids are known to cause epidermal erosion. Mortalities in both wild and captive fish, especially in small fish, are induced by massive infection.

S-III

Seasonal occurrence and host-associations of *Neoergasilus japonicus* (Copepoda: Ergasilidae) infecting bluegill (*Lepomis macrochirus*) in a reservoir in a temperate region of Japan

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Females of the ergasilid copepod *Neoergasilus japonicus* (Harada) are ectoparasites of freshwater fishes. While this species is believed to be of East Asian origin (Taiwan, China, Korea, Japan and Russian Far East), it has been reported from other geographic regions ranging from the tropics to subarctic, including southern Asia (India), Europe (UK, France, Germany, Italy, Slovakia, Hungary, Finland and Russia), North America (USA and Mexico), and the Caribbean (Cuba). In most of these regions, it is regarded as an alien parasite. Despite its importance as an alien species, our knowledge on the ecology of the species is very limited. The present study examines seasonal changes in infection level of *N. japonicus* on bluegill (*Lepomis macrochirus*) caught in a reservoir in a temperate region of Japan. This study also examines the site selection of *N. japonicus* on bluegill, as well as the infection pattern in relation to fish size. Sampling was conducted in Budo Reservoir on the campus of Hiroshima University from October 2007 to December 2008. Females of *N. japonicus* were in low abundance from fall to the following early summer but very abundant in mid- and late summer. Almost all parasite individuals possessed egg sacs from mid-March to mid-October but no egg sacs were observed in the remaining sampling months. These results indicate that water temperature may be a key factor controlling the seasonal population dynamics of the species. Infection level of *N. japonicus* steadily increased with an increase in fish size. The dorsal fin, especially the posterior soft ray area, was most heavily infected, followed by the anal fin, caudal fin, pectoral fins, pelvic fins, and skin.

S-III

Synopsis of symbiotic copepods of aquatic organisms of Japan, with a historical review of research on this group in Japan (1895-2011)

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Information on the symbiotic copepods from aquatic organisms (algae, echiurans, cnidarians, sipunculans, annelids, molluscans, echinoderms, crustaceans, tunicates, agnathans, elasmobranchs, teleosts, amphibians, reptiles, and whales) in marine and fresh waters of Japan, published between the years 1895 to 2011, is assembled as a Copepod-Host List. This list contains about 400 nominal species that belong to the order Harpacticoida, Cyclopoida, and Siphonostomatoida. A history of research on the symbiotic copepods in Japan is also reviewed. The first paper dealing with this group was published in 1895 by Tsunenobu Fujita, who reported *Ceratosomicola* sp.? (as *Splanchnotrophus* sp.) from a nudibranch. Subsequently, many symbiotic copepods were described between the 1930s and 1960s mainly by Satyu Yamaguti and by Sueo M. Shiino, and later by Ju-shey Ho and his co-workers (Tran The Do, Masahiro Dojiri, Il-Hoi Kim, and others). In addition, Shigeko Ooishi contributed immensely to the taxonomy of symbiotic copepods of Japanese tunicates, while Kunihiko Izawa conducted landmark studies on the larval development of symbiotic copepods. Currently, taxonomic and ecological studies on copepods infecting marine and freshwater fishes from southern Japan have been conducted at Hiroshima University.

O

Feeding behavior of the copepod *Leptodiaptomus cuauhtemoci* (Osorio-Tafall) (Copepoda)

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We quantified functional responses and prey selection using rotifers (*Brachionus rubens*, *Brachionus havanaensis*, *Brachionus angularis*, *Plationus patulus*) and copepod nauplii by the adult *L. cuauhtemoci* under laboratory conditions. This copepod was isolated from Lake Zempoala (Morelos) while the prey rotifers were isolated from the State of Mexico. The rotifers were cultured using the green alga *Chlorella vulgaris* while the copepods were cultured on a mixture of rotifers and microalgae. Functional response curves of *L. cuauhtemoci* on most prey rotifer species showed typical type 2 pattern. When offered a mixture of rotifers, *L. cuauhtemoci* selectively fed on *B. rubens*, *B. havanaensis* and *B. angularis* but avoided *P. patulus*. When offered mixed zooplankton consisting of *P. patulus*, *B. rubens* and nauplii, *L. cuauhtemoci* preferred *B. rubens* and avoided nauplii as well as *P. patulus*. On the other hand when nauplii were offered exclusively as prey, *L. cuauhtemoci* consumed 20% of the prey. These results are discussed in the context of zooplanktivory and cannibalistic tendency of *Leptodiaptomus cuahtemoci* and are compared to the feeding behavior of other species of *Leptodiaptomus*.

P-I

Mexican cyclopoid biodiversity recorded by the Copepod training course, October 2008, FES Iztacala (Universidad Nacional Autónoma de México).

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In October 2008, Universidad Nacional Autónoma de México, a monthly training course on copepod taxonomy, systematics and biodiversity was conducted. Students from different universities and localities collected and identified more than 30 species of cyclopoids, belonging to 9 wide spread genera of two subfamilies. As result of these collective efforts some regular species turned to be the first records for the country, one species (*Eucyclops* cf. *serrulatus*) possibly appeared an example of recent human-mediated invasion from Palearctic area to Neoarctic. *Acanthocyclops americanus* Marsh, found in many localities around Mexico City and in fact a native American species described from USA, but often mistaken as the European *Acanthocyclops robustus* Sars. Morphological confirmation of this was obtained via statistically tested measurements of an appropriate amount of *A. americanus* males and females. The highest cyclopoid biodiversity was found in ancient lake Xochimilco, Mexico City. Dormant stages were specified in several local species of cyclopoids collected during field tour. A full list of cyclopoid species identified during the course and illustrated with digital images is presented as well as some morphological peculiarities in the most interesting findings across Mexico are discussed.

S-III

Phylogenetic analysis of the family Macrochironidae, with the description of an undescribed species of *Paramacrochiron* from the Gulf of Thailand

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Two edible species of the Rhizostomeae, *Rhopilema hispidum* and *Lobonemoides robustus*, are used in Chinese cuisine. In the Gulf of Thailand these medusae harbored a variety of ectosymbionts, including copepods, shrimps, ophiuroids and juvenile fish, although the precise nature of their different symbiotic interactions varies. An undescribed new species of the copepod genus *Paramacrochiron* (Cyclopoida; Macrochironidae) was associated with *R. hispidum*. It can be distinguished from other congeners in body length and in the morphology of the urosome, labrum and appendages. Early copepodid stages to adults were found on the host, suggesting that growth and development of, at least, the postnaupliar stages takes place on the host. Since the host medusae disappear from the water column in the Gulf during winter to early summer, this symbiotic copepod may have a dual mode of life, alternating between planktonic and benthic phases. The family Macrochironidae has hitherto accommodated four genera and 29 species including the species described herein. Most are associated with Cnidaria, but a few species have been reported from Echinoidea and Ascidacea. A preliminary phylogenetic analysis revealed a high degree of homogeneity within the family as a whole, and especially within the genera *Paramacrochiron* and *Pseudomacrochiron*. The largest genus, *Macrochiron*, was the most heterogeneous.

O

The life cycle and ultrastructure of the histophagous apostome ciliate *Vampyrophrya pelagica* on marine planktonic copepods

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The histophagous apostome ciliate *Vampyrophrya pelagica* highly infected planktonic copepods in the Seto Inland Sea, Japan during warm-water seasons. The host-specificity was not so strict, but some species of *Oithona* and *Microsetella* were totally rejected. The life cycle consisted of four morphologically/functionally different stages, i.e., resting phoronts, feeding trophonts, divisional tomonts, and infective tomites. Hatching of the phoronts was naturally triggered by predation of invertebrate predators such as medusae and chaetognaths on infected copepods, but not by fish larvae. Injuries on copepod body also stimulated their hatching. Body fluids released from injured or ingested copepods seem to stimulate excystment. Hatching trophonts devoured copepod tissues and then metamorphosed into tomonts within empty copepod cuticles. Tomites were released from the tomont, searching for a new host. Production of tomites was greatly influenced by water temperature, causing a remarkable seasonal change in the occurrence of the phoronts on host copepods. Damaged copepods were finally killed by the parasitoid ciliates. The ciliates consumed copepod preys in the guts of invertebrate predators earlier than did the latter, suggesting that the parasitism influences not only copepods but also higher trophic levels. Considering these phenomena, this apostome appears to play an important role in marine trophodynamics. The ultrastructures of tomites, phoronts and trophonts of *V. pelagica* were examined by electron microscopy. A cytologically unique structure of the phoront and trophont is the multilamellar membrane structure, possibly supplying lipid materials for making food vacuoles as feeding of the trophont proceeds. It is likely that this structure is related to rapid consumption of food. In the phoront cells these membranes were not initially present in the cytoplasm but several oil droplets were observed instead. Formation of the multilamellar structures was initiated from the surface of the oil droplets several hours after settlement on a new host copepod. Metamorphosis from the tomite to the phoront was also characterized by the following secretory processes: encystment seemed to be completed by secretion of cell wall materials from small membrane-bound vesicles, and a stalk for anchoring to a host was formed by secretion of electron-dense materials from tubular membrane invaginations that were formed near the anchoring site. Cilia remained intact throughout the metamorphosis, although the distribution patterns of cilia were different between these stages. In the trophont the cell size shortly increased by ca. 30 times in volume by feeding. A large cytostome was opened at a specific position between two ciliary rows. The multilamellar structures disappeared from the cytoplasm at the final stage of the trophont maturation. Thus these membrane-bound organelles were drastically reorganized in accordance with the different functions of the life-cycle stages.

P-I

Variation of the planktonic copepod community in the hypersaline gradient of Rio Lagartos lagoon Yucatan, Mexico

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The composition, distribution and abundance of copepods collected from Rio Lagartos, a shallow coastal lagoon on the north of the Yucatan Peninsula, are analyzed. Samples were gathered monthly (from January to December 1997) with a standard conical net (0.30 m diameter; 300µm mesh), with tows of five minutes on the surface layer. The hydrological data were registered with YSI/50FT. The cluster analysis (Bray-Curtis index) of the hydrographic data, revealed three distinct areas (Cuyo, Coloradas and Rio Lagartos) and three climatic seasons (dry, rains and "northerlies"). The copepod fauna at Rio Lagartos was comprised by 21 species, being *Acartia tonsa* the most abundant (53.8% of total copepod numbers), followed by *A. lilljeborgii* (18.3%), and *Calanopia americana* (17.4%), whereas *Labidocera* was the most diverse genus (five species). The highest species richness was recorded towards the lagoon inlet due to an intense hydrographic exchange and mixing between the estuarine and marine faunas. Spatially, the species were mainly related to the salinity gradients (30-98 psu), temperature, and planktonic productivity. The dominant species (*A. tonsa* and *A. lilljeborgii*) could be found in a wide range of environments and therefore, they were capable to colonize more saline environments. Instead, the distribution variation from the remaining copepodological fauna was related to their tolerance to salinity changes.

P-I

Planktonic copepods of a coastal lagoon and adjacent areas in the northern Yucatan Peninsula, Mexico.

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The spatial and temporal variation of the copepod community of the Chakmochuck lagoon, on the northern coast of the Yucatan Peninsula and the adjacent marine area was analyzed during an annual cycle (2007). A total of 12 sites were sampled monthly with a neuston net (mesh: 0.5 mm). A cluster analysis (Bray-Curtis Index) of hydrolographic data revealed two distinct zones (lagoon and marine) and two climatic seasons (dry and rainy). The highest mean copepod abundance was recorded at the lagoon zone (5861 ind./100m3) and lowest values were found at the marine zone (3271 ind./100m3). Seasonally, highest average abundances occurred during the dry season (5569 ind./100m3) and lowest values were recorded in the rainy season (3564 ind./100m3). The copepod community was similar to that known from other coastal lagoons in the Mexican Caribbean Sea, but little is known about the local changes of the community in relation to salinity and thermic gradients. Up to 90 species were determined: *Acartia lilljeborgii*, *A. spinata*, *Paracalanus quasimodo*, *Centropages velificatus* and *A. tonsa* were emphasized due to their abundance, together they represented 85.3% of the total copepod fauna. The highest species richness was found in the marine zone (89) and the lowest one in the lagoonal area (33), with a similar number of species between seasons (dry: 71; wet: 74). The overall space distribution of copepods was related to the saline and thermic gradient and marked by the abundance of *A. lilljeborgii* and *A. tonsa* at the inner part of the lagoon, and *A. spinata* in the marine zone. The temporal variation of copepods was related to food availability.

O

Reproductive biology of *Leptodiaptomus garciai* (Copepoda: Calanoida) in a tropical, oligotrophic crater lake

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Leptodiaptomus garciai is an endemic calanoid copepod inhabiting the warm monomictic Lake Alchichica (Central Mexico), where is the dominant zooplanktonic species along the year. The goal of this investigation was to describe for the first time its reproductive biology and to explore its relationship to temperature and potential diet. In situ temperature profiles, counts of phytoplankton, measurements of females from the field, and laboratory observations were performed monthly from January 2008 to January 2009. Average temperature in the oxygenated zone of the lake oscillated from 14.9 ± 0.1 ºC in January (mixing of the water column) to 18.2 ± 1.1 ºC in September (late stratification, when the hypolimnion is anoxic). *L. garciai* is an egg-carrying copepod, the eggs are held within a sac attached to the urosomal segment of the female; it reproduces along the whole year and only one clutch is produced after every mating event. No resting egg were produced by females or recorded in the sediments of the lake. Clutch size ranged between 2 and 16 eggs/female, and showed a sigmoid trend, with the lowest average in May (2.1 ± 0.5 egg/female) and the highest in November (9.3 ± 2.0 eggs/female). Egg size fluctuated widely (between 0.22 and 2.35) also with a sigmoid trend: eggs were smaller in August (0.35 ± 0.04 µg/egg) and bigger in March (1.17 ± 0.28 µg/egg). Clutch size and egg size were inversely correlated ($R = -0.58$, $P < 0.05$). Reproductive output (RE = egg size × clutch size) ranged from 1.45 to 5.91 µg/female. Hatching success at 18 ºC was usually above 85%, though in March dropped to 65%. Hatching success was inversely correlated to egg size ($R = -0.83$, $P < 0.01$). Temperature was correlated only to egg size ($R = -0.75$, $P < 0.05$). Reproductive biology of *L. garciai* showed a very clear seasonal pattern regarding clutch and egg size that can be related to the food availability, which in turn is dependent on the alternation of the mixing and stratification of the water column: At the beginning of the stratification (during which food became increasingly scarce) females produced few, large offspring that could better withstand starvation; later on, at the end of the stratification period, females produced many small descendants, perhaps to take advantage of the increased availability of food associated with the vernal mixing. In consequence, number and size of offspring of this copepod can be strongly related to future conditions of food availability to nauplii, not only to maternal effects of diet and temperature.

P-I

Copepod communities in the lagoon of Ahe atoll (Tuamotu Archipelago, French Polynesia). Spatiotemporal variations and trophic relationships.

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The present work is a part of a multidisciplinary project analyzing the causes of a recent crisis in the production of the pearl oyster *P. margaritifera,* which is a major economical tool in the French Polynesia. Here we present a field study of the metazooplankton in the Ahe atoll at three periods in 2008-2009. Metazooplankton abundance, biomass (<60, 200 - 500 and >500 μm) and community structure were studied together with their relationships with environmental factors. Holoplankton was dominated by copepods with *Oithona* spp., *Paracalanus parvus*, *Clausocalanus* spp., *Corycaeus* spp*., Acartia fosase,* and *Undinula vulgaris* as major species. Meroplankton included mainly bivalve and gastropod larvae. The results suggest a clear wind influence on the structure and horizontal distribution of the zooplankton communities. The metazooplankton trophic network appears mainly controlled by food resources. The high abundance of nano-particle grazers (mainly *Oithona* spp, *Paracalanus* and bivalve larvae) contrasting with low nanophytoplankton biomass and production suggest the importance of the microbial loop in the food transfers.

O

Copepods of the Gulf of Tehuantepec during a quiescent upwelling period

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The Gulf of Tehuantepec has been considered one of the most productive regions of the Eastern Tropical Pacific. During the winter–early spring occur intense wind-induced upwelling and a cyclonic eddy that fertilize the surface waters: During summer a stratification of the water column promotes oligotrophic conditions. These eddies propagate offshore constituting significant mesoscale structures that fertilize the offshore waters generate productivity rates similar those of coastal to upwelling regions. The zooplankton variability has poorly documented in this region particularly during the summer season. We analyzed summer copepod community during July of 2007 and June 2008. Zooplankton hauls were made using a Bongo net. Copepods were sorted out from the samples of 505 mm mesh and identified to the species level. In July were identified 70 species and 31% of these were new registers for this area. In June were identified 89 species, but only 8% of these were new registers for this area. The most abundant copepod species in both cruises were *Subeucalanus subcrassus* (July 34% and 22% in June), and a group of several oceanic and neritic species (*Euchata indica, Undinula vulgaris, Canthocalanus pauper* and *Haloptilus mucronatus*). The principal factors analyses confirm the presence of two copepod assemblages of species characteristic of the neritic and oceanic ecosystems. Cross-shelf gradients have significantly more influence in the copepod community than the anticyclone eddy observed in the western region of the gulf. The absence of estuarine-coastal copepods like *Acartia*, showed a low influence of the riverine and rain runoffs over the gulf. However, this freshwater influence must significant during the rainy season.

P-I

Offshore egg production rates of *Centropages furcatus* in the Gulf of California, Mexico during autumn environmental conditions

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Temperature, chlorophyll-*a* concentration, and egg production rates (EPR) of the calanoid copepod *Centropages furcatus* were measured in the central region of the Gulf of California during September-October, 2010. This represents the first offshore estimation of *C. furcatus* EPR in Mexico because previous EPR measurements were done in several bays located at both coasts of Baja California peninsula (Magdalena, La Paz, and Concepción). Mean daily egg production rates were 16±7 eggs female^{-1} d^{-1}. The mean and maximum daily EPR increased in regions with high chlorophyll-*a* concentrations and well mixed water column. *C. furcatus* was one of the most abundant species in the Gulf of California and spawns in a broad sea surface temperature range (15.7-25.8°C). However, the mean EPR recorded in offshore waters were only 13% of known maximum EPR (120 eggs female^{-1} d^{-1}) detected in the Gulf of Mexico. These EPR were of similar magnitude to Feb 1998 and Oct 2002 in Magdalena bay and about half of EPR values measured in Feb 2002 and autumn-winter 2000-2001 in La Paz bay. This confirms that *C. furcatus* is a neritic tropical species that can reproduce offshore, but autumn conditions in the Gulf of California represented stressing environmental conditions that limited it EPR.

P-I

How big is the influence of most dominant antarctic copepods on siphonophores foraging behavior?

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"Research" on the trophic ecology of Cnidaria usually based only on casual observations, especially in the Southern Ocean. As we know, copepods are significant component of siphonophores diet. Presumably, some species can even "choose" preferring type of food. Our investigation was based biological material which was collected in the summer and winter seasons from the Croker Passage (Antarctic Peninsula). Samples were collected by double plankton net of different sizes mesh (150, 200, 500 μm). Stratified vertical hauls were made to a max. depth of 1200 m.The result of the research showed that seasonal changes in vertical distribution of the dominant interzonal Antarctic copepods, i.e. *Calanoides acutus, Calanus propinquus* and *Rhincalanus gigas* was significantly positive correlated with the distribution in the water column mostly abundant siphonophores *Pyrostephos vanhoeffeni* and *Dimophyes arctica.* This relationship was very significant in summer and in late summer. In this time siphonophores and copepods dominated in the corresponding layers of water column respectively 200-400 m (December and January) and 1000-1200 m (April). During the antarctic winter (June, July) siphonophores – adequately to the copepods – concentrated in the lower parts of the water column > 800 m, but correlation was non-significant positive as in the summer time. Due to the isothermal nature of the Croker Passage, the results of our investigation showed that the most likely cause of seasonal vertical siphonophores migration is to follow the higher density of typical antarctic copepods, which then are easier to catch.

P-II

A new species of the genus *Paraleptastacus* (Copepoda: Harpacticoida: Leptastacidae) from the subtidal zone of Naksan beach, Korea.

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Generally leptastacid harpacticoid copepods are abundant in sandy beaches. So far, there are no reports about family Leptastacidae in Korea. A new species of the genus *Paraleptastacus* was found in brackish water near Naksan beach, east coast of Korea. The genus *Paraleptastacus* consisted of 14 species before this study. The new species is placed in the genus *Paraleptastacus* with a combination of characters including the developed triangular rostrum, 7-segmented antennule and 2-segmented P1 exopod. The new species is closely related to *Paraleptastacus supralitoralis,* and *P. brevicaudatus* with the characters of setae formula of legs. However, the new species is clearly distinguishable from congeners by the different setae formula in P3 and P4.

P-I

Occurrence characteristics of the estuarine copepods *Pseudodiaptomus inpopinus* and *P. poplesia* (Calanoida, Pseudodiaptomidae) in the Mankyung River Estuary, Western Korea

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Seasonal occurrence patterns of the two closely related *Pseudodiaptomus* species, *Pseudodiaptomus poplesia* and *P. inopinus* were monthly investigated in the Mankyung River estuary, western Korea along a salinity gradient. *P. poplesia* and *P. inopinus* mostly occurred in mesohaline to polyhaline conditions throughout the year. However, *P. poplesia* retains its individuals in the polyhaline condition in the winter and showed the largest peak abundance in mesohaline condition in spring when chlorophyll *a* concentration was highest, while *P. inopinus* didn't nearly appeared in all salinity ranges in the periods and showed its peak abudance in mesohaline condition in November after small peak abundance of *P. poplesia* occurred in October when chlorophyll *a* concentration was relatively lower. On the other hand, the ratio of the ovigerous female of *P. poplesia* was high in the mesohaline and polyhaline conditions in spring, but that of *P. inopinus* in summer and winter. These facts indicate that their seasonal occurrence pattern can be controlled by the salinity gradient and concentration of their foods.

P-I

Two new species of freshwater Diaptomidae (Calanoida) from Paraná River (South America)

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During sampling of planktonic copepods in rivers and reservoirs in the basin of the River Plate (Argentina, Bolivia, Brazil, Paraguay and Uruguay), the second largest basin of South America, two new species of Diaptomidae were found. Complete taxonomic diagnosis and illustrations of male and female specimens are presented in this work. Significant populations of both species were found in the Yaciretá Reservoir – Paraná River (Argentina/Paraguay), but they were found up to 1,000 km downstream of the reservoir, in the Paraná River. They are provisionally referred to as "*Diaptomus*" *curvatus* new species (etymology refers to the strong curvature of lateral spine in the exopod of the rigth fifth leg of male) and "*Diaptomus*" *frutosae* new species (etymology in tribute to Dr. Margarita S. Frutos – Corrientes, Argentina). "*Diaptomus*" *curvatus* had some features that resemble the genus *Odontodiaptomus* (Kiefer, 1936) (e.g. segments 10 and 11 of the male rigth antennule, chitinous protuberances on the urosome of males and females), and "*Diaptomus*" *frutosae* shares similaties with the genus *Scolodiaptomus* (Reid, 1989) (e.g. triangular shape of the last segment of exopod of right fifth leg of male). However, each exhibits other character states that distinguish them from their respective genera, and it was therefore decides to place them in "*Diaptomus*" *sensu lato* (Westwood, 1836), until detailed phylogenetic analysis has been completed. Such character states in "*Diaptomus*" *curvatus* include: fifth right leg with endopod well developed and lateral spine of segment 3 large, curved and longer than the segment in which it is inserted; the presence of a large dorsal processes in urosome 3 of female, about 5-6 times smaller than in the male. For "*Diaptomus*" *frutosae* they include: well developed ornamentation of dorsal spinules on prosome 4-5 of males and females; the male right antennule with small chitinous protuberances at base of modified seta on segment 13, and differentiated hook-shapes process on segment 20 with chitinous protuberances at its base; the last segment of right leg 5 of male triangular in shape, and the lateral spine about 3.5 times smaller than the terminal claw, inserted distal to mid-level of this segment. For both species, antenna, bucal apparatus and leg 1-4 showed no distinguishing features.

P-I

Geographic distribution of freshwater Cyclopoida in La Plata River Basin, South America

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The spatial distribution of cyclopoid copepods in La Plata River Basin, in Argentina, Bolivia, Brazil, Paraguay and Uruguay is given. Samples were taken at 43 stations along river courses and in reservoirs, in summer 2009-2010 (rainy season) and winter 2010 (dry season) with 68µm mesh size plankton net, by vertical hauls. A total of 19 species was found, representing 8 genera as follows: *Mesocyclops* (5 species); *Microcyclops* (4); *Thermocyclops* (3); *Metacyclops* and *Eucyclops* (2 species each); *Megacyclops*, *Macrocyclops* and *Acanthocyclops* (1 species each). *Thermocyclops decipiens*, *Thermocyclops minutus*, and *Mesocyclops meridianus* were widely distributed in both kinds of aquatic systems sampled. Conversely, *Thermocyclops inversus* and *Mesocyclops ogunnus* occurred only in reservoirs in the high Paraná River Basin. *Acanthocyclops robustus* occurred from São Paulo State, in Brazil, to the mouth of Paraná and Uruguay rivers. Species such as *Eucyclops* cf. *elegans, Eucyclops* cf. *ensifer, Megacyclops* cf. *viridis, Mesocyclops ellipticus, Mesocyclops longisetus curvatus, Metacyclops mendocinus, Microcyclops finitimus,* and *Microcyclops mediasetosus* were common in river stretches, but appeared only infrequently and in low numbers in samples, almost certainly because their habitats were not adequately sampled (samples were taken in open waters), since they are considered as being widely distributed in the area according to the literature.

P-I

Copepod production in a highly impacted metropolitan estuary in tropical Brazil

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This study aimed at analyzing and describing the pelagic Copepoda production from an urbanized tropical estuarine system in Recife city, Brazil. Environmental factors (rainfall, temperature and salinity) were also analyzed to correlate with Copepoda. Sampling were carried out with a plankton net (200 µm mesh size) through horizontal hauls during ebb and flood tides, at three fixed stations from January to October 2008. It was identified 28 Copepoda species. *Acartia lilljeborgi*, *Centropages velificatus*, *Oithona hebes*, *Temora turbinata*, *Oithona oculata*, *Pseudodiaptomus acutus*, *Parvocalanus crassirostris*, and *Corycaeus giesbrechti* were responsible for 90% of the total density. Highest density (12.701 ind m^3) was observed in the rainy-dry intermediate season, showing the rainfall influence in the Copepoda community structure. The most productive Copepoda species in terms of biomass and secondary production were *Acartia lillgeborgii* (mean values of 215.785 µg C m^{-3} and 5.722 mg C m^{-3} $year^{-1}$), *Centropages velificatus* (270.176 µg C m^{-3} and 1.924 722 mg C m^{-3} $year^{-1}$), *Temora turbinata* (42.048 µg C m^{-3} and 1.663 mg C m^{-3} $year^{-1}$) and *Oithona hebes* (13,642 µg C m^{-3} and 1,078 mg C m^{-3} $year^{-1}$). The low copepod biomass found in this impacted Brazilian bay resulted in these production rates, which are considered relatively low if compared to other regions that exhibit similar features, and are close to oligotrophic oceanic ecosystems. This is probably a consequence of the high pollution load received by the estuarine system from Recife city.

S-III

Two species of Tantulocarida from the White Sea: what new could they tell us about morphology, anatomy and phylogeny of these minute parasitic crustaceans?

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Arcticotantulus pertzovi (Fam. Basipodellidae) parasitising two species of harpacticoid copepods, and *Microdajus tchesunovi* (Fam. Microdajidae) parasitising a tanaid, inhabit pelit slit at depths of 20-50 m in the vicinity of the Moscow State University White Sea Biological Station. All stages of the life cycle except sexual female and putative nauplii were collected for enhanced morphological and anatomical studies. Free swimming definitive males of Tantulocarida (of both species) were reared for the first time. They were investigated using scanning electron microscopy. Analysis of their morphological characters and ultrastructure revealed several features typical of all known males of Tantulocarida. Anatomy of definitive male and parthenogenetic female was studied for the first time using transmission electron microscopy. Cephalon of a tantulus larva contains glands which are probably used to secrete cement, four ducts of these glands lead into the funnel-shaped organ, which could be protruded via a separate opening on the ventral side of the oral disk. Unpaired stylet located centrally is hollow in its distal part but has a solid tip. A rootlet system which is a direct extension of the gut of the parasite penetrates into host tissues under the attachment site. No muscular structures were observed in the cephalon of a metamorphosed tantulus, which could probably indicate the result of resorption. Cephalothorax of a definitive male contains a “comb-like” structure of unknown function, which occupies almost one half of the head. Full 18S ribosomal DNA sequences of Tantulocarida (of *Arcticotantulus pertzovi* and *Microdajus tchesunovi*) were obtained for the first time. It enabled preliminary analysis of the phylogeny of the class.

P-I

Demographic responses of cyclopoid copepod (*Mesocyclops aspericornis)* to insecticidal phytochemical piperine ((E, E)-1-piperoil-piperidine)

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The freshwater cyclopoid *Mesocyclops aspericornis* has been observed to be an effective biocontrol agent of mosquito immature and is advocated to be put into operational vector control program. In the present paper we studied the effects of the natural alkaloid insecticide, piperine ((E, E)-1-piperoil-piperidine), isolated from *Piper nigrum* Linn on demographic parameters of *M. aspericornis.* We investigated the effect of piperine, at a concentration lethal and sublethal for mosquito larvae, on the post embryonic developmental rates, and life table demography (Longevity, life expectancy, generation time, age at first reproduction, and gross and net reproduction rates of *M. aspericornis. M. aspericornis* was not susceptible to piperine, at a concentration (500mg L^{-1}) lethal (LC_{100}) to the early instars of mosquito larvae. The LC_{50} value of piperine for *M. thermocyclopides* was two times higher than the LC_{100} of piperine for mosquito larvae. However, the copepod showed slower growth rate and longer Naupliar duration at 250 and 500mgL^{-1}concentraion of piperine. Copepodid duration was adversely affected 500mgL^{-1} but not at 250mgL^{-1} piperine concentration. The piperine effect was more pronounce on fecundity than on survival. Both, survival (average longevity and life expectancy at birth) and reproduction were affected at 500mgL^{-1} piperine concentration but only reproduction (Gross and Net reproduction rate) was affected at 250 mgL^{-1}. The present results suggest that although the piperine concentration being lethal to the mosquito larvae does not show any immediate adverse effects on *M. aspericornis*, it does affect growth, survival and reproductive attributes at longer time scale.

P-I

Predation by *Pseudodiaptomus annandalei* (Copepoda: Calanoida) on rotifer prey: size selection, egg predation and effect of algal diet

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The brackish water calanoid copepod *Pseudodiaptomus annandalei* is perennially found with higher abundance in estuaries and brackish water ponds in Indo Pacific regions. This species is considered to be herbivorous, and being cultured as livefeed for grouper fish larvae. However, we observed both males and females *P. annandalei* preying on the rotifer, *Brachionus rotundiformes* and its eggs. Prey consumption rates on neonate and adult rotifers were recorded in the presence and in the absence of algae the smaller *Isochrysis galbana* and the larger *Tetraselmis Chui.* We also studied prey size selection and prey switching by offering neonate and adult rotifers in different proportions. The copepods were able to utilize both neonates and adults of *B. rotundiformes* and prey consumption rates were not affected significantly by the alternate algal diet. Prey consumption rates were significantly lower in males than in females of *P. annandalei*. However prey consumption did not differ significantly between ovigerous and non-ovigerous females of *P. annandalei*. The prey consumption rates were significantly higher on neonates (140-148 Ind d^{-1}) than on adults (45-58 Ind d^{-1}) of *B. rotundiformes*. Both male and female copepods satiated preying on 6 and 10 rotifers respectively in 90 minutes. The satiation time decreased with increasing prey density. Both male and female copepods were also observed utilizing rotifer eggs and embryo while releasing the outer egg sheath attached with the adult female. The present study provides first information on predatory efficiency of *P. annandalei,* and attests its omnivory feeding habit. *Pseudodiaptomus annandalei*, being abundant in many tropical brackish ponds and estuaries, may be playing a major role in shaping the community structure through predation.

S-IV

Stories of synergy: how human diseases have informed copepod studies, and vice versa

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Copepod crustaceans are intermediate hosts or direct vectors of microbes that cause several human diseases. Cestode tapeworm parasites including sparganosis caused by species of *Spirometra* (formerly *Diphyllobothrium*), anisakiasis caused by *Anisakis* or *Pseudoterranova,* dracunculiasis caused by the guinea worm *Dracunculus medinensis*, and cholera caused by the bacterium *Vibrio cholera* are the principal human maladies that are transmitted in one way or another by copepods. Efforts to understand the biological dynamics of these microbes have stimulated basic research on the taxonomy and biology of copepods. The history and present understanding of these relationships are reviewed.

O

Copepods and climate change: processes behind regime and biogeographic shifts

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Rapid poleward expansion of copepods, other plankton and fish over recent decades have been described from a number of oceanic regions around the world, including the Northeast Atlantic, East Australian Current, the Western Antarctic Peninsula and Korea with more limited movement in the Northwest and Northeast Pacific, all apparently associated with rising temperatures. Stepwise changes (regime shifts), especially reflected in copepod assemblages, have likewise been described from a number of regions and have been variously linked to top-down or bottom-up forcing. Many of these events show regional and possibly global synchronicity and it has been suggested that atmospheric teleconnection provide the linkage between different events. In reality, the true processes behind these events are poorly understood. A global overview will be presented with a discussion of the relative contribution that ocean hydrography, atmospheric circulation or ecosystem interactions (including fishing) make to these events. We will also discuss a possible further biogeographic expansion of some copepods against projected IPCC climate change scenarios.

O

Meiobenthic copepod abundance and biodiversity in relation to freshwater releases into a subtropical coastal lagoon

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Meiobenthic harpacticoid copepod abundance and diversity were compared among three sites that differ in impact from freshwater releases from an inland lake. These manmade releases from Lake Okeechobee increase soft sediments and lower the salinity in the coastal Indian River Lagoon. Understanding the effects of these releases on the benthos may assist managers in planning the timing and duration of freshwater inputs to minimize impacts. Ogeechee cores (17 cm^2) of 2 cm depth were collected at three sites that varied in distance from the mouth of the St. Lucie River Estuary. Eight cores were taken at each site during the wet (summer 2010) and dry (winter 2010) seasons. 10 cm of water above the sediment (170 mL) was collected from each core as well to ensure that copepods sitting on the surface of the sediment and possibly disturbed by the coring device were collected. Harpacticoid copepods were examined in detail for diversity and abundance in relation to season and site. Other meiofauna counted included foraminiferans, polychaetes, oligochaetes, nematodes, amphipods, kinorhyncha, ostracods, isopods, cumaceans, mollusks and larval stages of many marine invertebrates. Copepod abundance ranged from 60 to 413 in the cores and from 7 to 126 in the core water. The most common taxa overall were: *Longipedia americana* (37%), *Euterpina acutifrons* (19%), Ameiridae (14%), *Stenhalia* sp. (11%), *Tisbe* sp. (6%), *Leptocaris brevicornis* (5%) and Peltidiidae (3%). The site furthest away from the mouth of the river and considered to be the most pristine did have the highest summer abundance (322), but the lowest winter abundance (106). At this site, *Euterpina acutifrons* was predominant in the summer (29% vs. 21% *L. americana*) whereas *L. americana* dominated in winter (42%) compared to *E. acutifrons* (11%). The site between the river and ocean inlet had a mix of species at both times of the year, with increasing abundance from summer (184: 25% *L. americana*, 24% *E. acutifrons*) to winter (304: 24% *L. americana*, 27% *E. acutifrons*). The site closest to the mouth of the river and presumed to be the most disturbed had comparable abundances in summer (183) and winter (226) comprised mainly of *L. americana* (59% in summer, 31% in winter). This site had the highest number of copepods retained in the core water for both seasons (57 copepods, 81% *L. americana* in the summer; 77 copepods, 43% *L. americana* in the winter). *Longipedia americana* has been described as an emergent species, but has not been previously noted in such high abundance in benthic core samples. Due to the shifting densities among the sites, *L. americana* does not appear to have a seasonal pattern. The high abundance in the sediment and core water at the most disturbed location at both times of the year and in the sediment at the other sites in the winter may indicate that *L. americana* is an opportunistic species in the Indian River Lagoon.

P-II

The urinary bladder of freshwater fishes: a new microhabitat for copepods of the family Ergasilidae in Brazil

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Specimens of a new genus and new species (possibly two) of parasitic copepods from the family Ergasilidae were found inside the urinary bladder of the non-migratory fishes *Hoplias malabaricus* (Characiformes, Erythrinidae) and *Cichla monoculus* (Perciformes, Cichlidae). Fishes were collected during an expedition to the Cristalino River (13^{o} 22' 20.2'' S and 50^{o} 52' 8.5'' W), a tributary of the Araguaia River near Bananal Island, Goiás, Brazil. Another seven populations of *H. malabaricus* and one of *C. monoculus* were examined for urinary bladder parasites using the same methodology, but the result was negative for copepods, including host populations from the upper Araguaia River basin, suggesting that the parasites may be endemic to that region. Over 2000 species of copepods parasitize marine and freshwater fishes, but these are the first ever found in the urinary bladder of a fish. Documenting this new microhabitat on the host is important since fish parasitologists should now include the bladder in their routine examination for copepods. Preliminary study of the gross body morphology suggests that this species represents a new genus with a unique tagmosis pattern for the Ergasilidae. Superficially it resembles the body pattern of kroyeriids, a marine family specific to elasmobranch and holocephalan hosts. The new genus has a narrow neck-like region formed by the second and third pedigerous somites anterior to the long genito-thoracic trunk region. The discovery of parasitic copepods in the urinary bladder of fishes is unique and new to science, representing a new microhabitat for copepods, and the description of the new ergasilid will improve our knowledge of the diversity of copepod parasites of fishes from Brazil. The biology and evolution of this curious association will be discussed.

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P-I

Morphological variations in limnetic, freshwater copepods (Calanoida, Cyclopoida) from sinkholes in Quintana Roo, Mexico.

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The taxonomic study of copepods from continental waters in Mexico has followed an interesting historical process since 1940: decades of intense work followed by gaps without important contributions, except a few national researchers work, or with extensive regions without basic knowledge of the richness. In this work, a detailed analysis of the morphology of freshwater limnetic copepods collected in ten sinkholes, from the north to south of Quintana Roo state, Mexico has been done. The calanoid order was recorded with two genera (*Mastigodiaptomus*, *Arctodiaptomus*) and three species [*M.* cf. *nesus*, *M. texensis* (M. S. Wilson, 1953) and *A. dorsalis* (Marsh, 1907)]; ciclopoids were represented by *Thermocyclops inversus* Kiefer, 1936; *Apocyclops panamensis* (Marsh, 1913), and *Tropocyclps prasinus aztequei* Lindberg, 1955. These species had been already reported in the region. However, we have found some morphological differences in structures considered as taxonomically important, after the specimens were compared with the original descriptions, mainly in calanoids. For instance, the presence of one spine on segment 16 of right A1, or the abundant spinules on the fourth urosomal somite in the males of *A. dorsalis* not previously recorded. Additionally, in the females of the specimens classified as *M.* cf. *nesus* the dorsal projection on the fifth pediger (recorded in *M. nesus* s. str.) was absent, and spinules on the dorsal surface of the male urosomites are present; these are not recorded in the original description. These morphological variations were noticeable into, and between the surveyed populations. Further studies will establish if these morphological differences are result from phenotypical variations (related with the life history theory), or a result of actual differences between species.

O

Population genetic analysis of the small subtropical planktonic copepods in marine lakes of Palau

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Empirical studies on allopatric speciation of marine organisms have been limited, because geographical barriers and isolation of populations are difficult to discern. Little is known about the speciation or genetic differentiation among populations, as the initial phase of speciation, for marine holoplankton on a smaller temporal-spatial scale. This study focused on the “marine lakes” of the Palau islands as an ideal research field to study allopatric speciation for marine organisms. The marine lakes of Palau are isolated from the outer open ocean to varying extents. The fauna and water environment also are different among each lake. Thus, such uniqueness may provide insights into how selection acts under a variety of environmental conditions. In this study, based on the hypothesis that isolated marine lakes might accelerate allopatric speciation of marine organisms, it is hoped that the data will reveal how ecological and genetic changes occur in marine holoplankton after geographic isolation. Planktonic copepods were chosen as the target species, since they occupy an important ecological niche in marine lake ecosystem. A copepod population within a marine lake could be regarded as an isolated population. To study the process of genetic differentiation in the planktonic copepods as a consequence of geographic isolation, we analysed the genetic structure of conspecific populations using the mtCOI sequences as a molecular marker. Results from assessing genetic diversity showed that the level within a population was relatively low, while that among populations was high, indicating the restricted gene flow or complete isolation. Observed haplotype network showed that there were no shared haplotypes between marine lake populations and unique substitutions occurred in each marine lake. The present study thus provides for the first time the empirical data of genetic differentiation of copepods in isolated environment.

P-I

An update on the knowledge of the geographical distribution of *Boeckella* and *Neoboeckella* (Copepoda: Calanoida: Centropagidae) in Peru

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Since 2002 we have been collecting plankton samples in different localities along the Peruvian Andes, in the southern (Puno, Moquegua, Arequipa, Ayacucho and Apurímac departments), central (Junín, Lima, Pasco, Huancavelica and Huánuco) and northern regions (Ancash, La Libertad and Cajamarca) of the country. We found six species of *Boeckella* (*gracilis, calcaris, poopoensis, occidentalis, titicacae* and *palustris*) and only one of *Neoboeckella* (*loffleri*). All species of *Boeckella* and *Neoboeckella* were found in southern Peru. In addition, *B. palustris* and *B. calcaris* were found in one locality of the central Andes (Pasco). *B. titicacae* appears to be restricted to the Titicaca Lake basin. *B. poopoensis* occurs in saline water bodies with elevated conductivity and was found only at Salinas Lake in Arequipa. *B. occidentalis* is a widespread species all along the Andes, from South to North, and was also recorded in the Amazonian lowlands, in Ucayali, at 150 m elevation. The fact that all species of these genera were found in southern Peru, suggests that the Titicaca basin, is their center of diversity, as with the fish genus *Orestias*. Intensive exploitation of natural resources by the mining industry is impacting negatively the integrity of the lakes and ephemeral water bodies of the Peruvian Andes, for which reason the documentation of their hydrobiological components represents an urgent priority. All samples are deposited in the limnological collection of microinvertebrates of the Museo de Historia Natural, Universidad Nacional Mayor de San Marcos, Lima, Peru.

O

Feeding habits of mesopelagic copepods in Sagami Bay, central Japan.

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It is commonly known that species diversity of copepods is high in the mesopelagic zone. Recently, feeding niche separation among co-occurring copepods is considered as an important mechanism sustaining the high biodiversity in the mesopelagic zone, but still little is known on the feeding habits of mesopelagic copepods. We investigated feeding habits of eight species of mesopelagic copepods considered to be omnivore or detritivore in Sagami Bay by (1) analysis of carbon and nitrogen stable isotope ratio, (2) microscopic observation of gut contents, (3) semi-quantitative elemental analysis of small particles (1-20 μm in diameter) of gut contents and sinking particles with an electron probe micro analyzer (EPMA). On the basis of the EPMA analysis, we classified small particles into 4 types: Si-rich, Ca-rich, Al-Si, and others, then calculated percentages of each particle type in copepod guts and sinking particles. Eight species of mesopelagic copepods investigated in this study are *Chirundina streetsii, Euchirella rostrata, Undeuchaeta major, Scaphocalanus echinatus, Scottocalanus helenae, Scottocalanus securifrons, Pleuromamma xiphias* and *Spinocalanus magnus*. The stable isotope ratio analysis suggested that many copepods mainly consumed those particles suspended in the epipelagic zone rather than those sinking in the epipelagic and mesopelagic zone. The microscopy showed different compositions of gut contents among these copepods, most of which ingested sinking particles containing incompletely degraded phytoplankton and cyanobacteria. According to the EPMA analysis, percentages of Al-Si type in small sinking particles were significantly higher than those in most of the copepod guts, except for *C. streetsii*, suggesting that these copepods ingested sinking particles selectively. Al-Si type particles are considered to be terrigenous minerals which may not be potential food source for copepods. These observations suggest that these copepods selectively ingest sinking particles consisted mainly of fresh suspended particles, such as incompletely degraded phytoplankton, and that they differentially utilize diverse food resources.

O

Biology, culture and live feed efficacy of copepod *Nannocalanus minor* over *Brachionus plicatils* and *Artemia* nauplii

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Calanoid copepod, *Nannocalanus minor* has exhibited maximum survival with highest food concentration (20,000cells/ml) of *Chlorella marina* followed by *Nannochloropsis* sp., *Dunaliella* sp., *Isochrysis galbana, Coscinodiscus centralis, Skeletonema costatum* and *Chaetoceros affinis*. The 100% survival was extended up to 9th day of culture when the *N.minor* fed with *C.marina*. Nevertheless with other algal food sources the survival was declined so early. The considerable growth was obtained in *C.marina* fed *N.minor* (Female 1.963 mm; Male 1.756 mm) than rest of the feeds. The highest egg production and hatching succession were observed in the water temperature of 25±3^{o}C and food concentration of 20,000cells/ml. Copepod *N.minor* was cultured successfully with maximum average total population of 1,56262.4 nos./l. under captive condition. The significant growth and survival in both seabass *Lates calcarifer* and shrimp *Penaeus monodon* were recorded in copepod fed larvae than rotifer and *Artemia* nauplii fed one. The copepod fed larvae showed appreciable growth and survival might be due to the occurrence of rich n3-HUFA. The calanoid copepod *N.minor* was found to have good survival, growth, high fecundity rate, high population under captive condition and it can be considered as most suitable candidate species for mass culture as supplementary live feed for the commercial seed production of fin and shellfishes. Further the nutritional profile of the *N.minor* can supported for their candidature in aquaculture applications. Hence the present study concluded that the calanoid copepod *N. minor* can be considered being the most suitable live feed for the larval production of commercial finfish *L.calcarifer* and shellfish *P. monodon.*

O

Functional responses and grazing rates of *Mesocyclops pehpeiensis* Hu (Copepoda)

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Members of the cyclopoid genus *Mesocyclops* are predatory, feeding on many different species of zooplankton such as rotifers and cladocerans. They are also known to feed on phytoplankton and therefore regarded as omnivorous. However, for many species of *Mesocylops* quantitative data on the feeding and grazing rates are not available. In this work we quantified the feeding responses of adult *Mesocyclops pehpeiensis,* a species originally found in Asia, using rotifers (*Brachionus rubens* and *Plationus patulus*) and phytoplankton (green alga *Chlorella vulgaris*, *Scenedesmus acutus* and the cyanobacterium *Anabaena* sp.) at three temperature levels, 15, 25 and 35°C. Adult *M. pehpeiensis* were able to feed on both rotifers and phytoplankton. Functional responses of the cyclopoid using rotifers as prey indicated increased prey consumption with increasing availability of prey in the medium. However, in the presence of alga, the rotifer prey consumption by the copepods was significantly lower than when offered rotifers alone. Grazing rates of cyclopoids were higher on *Chlorella* than on *Anabaena* sp. Grazing rates on both algae and the cyanobacterium were also significantly influenced by temperature. The results were compared to previous studies on the feeding behavior of other taxa of *Mesocyclops*.

P-I

Analyses of types of two *Arctodiaptomus* (Crustacea: Copepoda) reveal a morphological feature probably useful for subgeneric differentiation

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A sample of *Arctodiaptomus* from glacial Lake Tarina 1, Bhutan, was studied and initial observations indicated that they are intermediate between *Arctodiaptomus* (*Arctodiaptomus*) *jurisowitchi* Löffler, 1968 and *Arctodiaptomus* (*Rhabdodiaptomus*) *michaeli* Reddy, Balkhi & Yousuf, 1990. Analyses of their types show no obvious specific difference, furthermore, their female antennules have two setae at segment 16, unlike any other *Arctodiaptomus* so far known. Regarding the subgeneric separation many *A. jurisowitchi* syntypes have an unexpected shape of one important feature (out of two): the process on the male antepenultimate segment of the antennule is lanceolate (instead of being either short, thick, stump-like or hook-, claw-, comb-like). Further comparison results in inconsistencies of the definition presently used for the second and last feature for subgeneric separation, the presence of a spine on segment 14 of male right antennule. Kiefer (1978) already mentioned problems with separation of subgenera *Arctodiaptomus* and *Rhabdodiaptomus*, based on the increased number of species included (today 42 species + 6 subspecies). This study shows that it might be helpful for subgeneric separation to compare the size of the spines on segments 11 and 13 of male right antennule.

O

Occurrence and diversity of calanoid copepods in the Weddell Sea, Antarctica

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The Weddell Sea hosts contrasting environments at its eastern and western extremes, both connected by the main circulation pattern of the Weddell Gyre. At the high-latitude eastern Weddell Sea, the sea ice is annual and covers the water for about 9 months of the year with leads and polynyas generated by offshore winds creating transient ice-free areas. Temperatures and salinity are seasonally relatively stable and only the near surface water masses are subject to seasonal changes, but seasonal differences are small compared with other regions. In contrast, at the western boundary of the Weddell Sea east of the Antarctic Peninsula, the sea ice is perennial and the region is difficult to reach, and hence very few studies have been carried out there. The influence on the global climate triggered the collapse of the Larsen Ice Shelf (sections A in 1995 and of B in 2002), which formerly limited the primary production in the pelagic system. Studies on abundance, species composition, horizontal and vertical distribution patterns of calanoid copepods have been carried out in the Weddell Sea since the 1985 and are still going on. Most of the studies were done in the eastern part and only a few in the western part. The results indicate differences in the abundance and species composition. At offshore stations in the western Weddell Sea, the abundance seems to be about half of that of the eastern part, whereas species numbers are slightly higher (71 versus 65) due to the occurrence of sub-Antarctic species (e.g. *Clausocalanus brevipes*). However, at shelf stations the abundance did not differ greatly between the regions, but the species number is about double in the eastern than in the western part (35 versus 18). Independent of the region, the calanoid copepod population is dominated by the small calanoid *Microcalanus pygmaeus* accounting in mean 80% and 60% of the total abundance in the western and eastern Weddell Sea, respectively, and most species (>50%) are rare and occur in low abundances (<1 ind. m^{-3}). *Calanus propinquus* and *Ctenocalanus citer,* two dominant species in the eastern Weddell Sea, seem to play only a minor role in the copepod community in the western part. Typically, surface layers tend to be poor in species number. This holds true for both regions and time periods with no seasonal trend. The significance of these findings will be discussed with respect to the relationships to environmental parameters such as ice cover.

O

Ecological role of family Eucalanidae (Copepoda: Calanoida) in the northwest coast of Paraguaná (Falcón, Venezuela)

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The family Eucalanidae contains some large species important in the food chain, and is present in areas of upwelling. We studied the species composition, spatial variation of density and total wet biomass of Eucalanidae in relation to other families of copepods in the northwestern coast of Paraguaná, Falcón State. The samples belong to the Project "Environmental Baseline Rafael Urdaneta" and were collected at the end of the upwelling season of 2007. Oblique hauls were made at the maximum depth with a twin-net (mesh size: 300 μm). There were 14 copepod families and 3 species of Eucalanidae. Individuals of family Eucalanidae in were found in low proportion (6.32%) in relation to other copepods, and their mean density values ranged between 17.17 and 737.65 org./m^3. The total biomass of copepods in the 38 stations varied between 19.25 and 382.02 mg/m^3, accounting for 7.49 to 94.16% of total zooplankton biomass. Also, the biomass of Eucalanidae was 22.05% of the total copepod biomass, with values ranging between 1.88 and 188.98 mg/m^3. These results indicate that the family Eucalanidae, in spite of being a less important group in terms of density, is significant for its contribution to zooplankton biomass in the environment studied.

P-I

Occurrence patterns of copepods occurring in main trade ports of Korea during summer

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The South Korea is surrounded by the Yellow Sea (west sea), South Sea, and East Sea showing each different ocean environments: the trade ports located in the Yellow Sea are influenced by a large tidal range and huge freshwaters from many large rivers, in particular in summer, while tidal range and influx of freshwaters in the East Sea are very small and the South Sea is intermediate between those. In this study we analyzed the abundance, distribution and diversity of copepods collected by 5 trade ports in the Yellow Sea, 3 in the South Sea, and 3 in the East Sea in the summer, respectively (total 58 stations). The temperature was highest in the western trade ports (average 25 °C) and lowest in the southern ports (average 20.8 °C). The salinity was lowest in the western ports (average 23.6 psu) and highest in the eastern ports (average 31.8 psu.). The chl-*a* concentration was lowest in the eastern ports (average 4.03 ug/L) and highest in the southern ports (average 26.31 ug/L). In total, 29 species of copepods were identified from the study areas. Of these, 24 species were recorded in the western ports, 15 species in the southern ports, and 11 species in the eastern ports. Abundances were highest in the western ports and lowest in the eastern ports. The western ports were represented by *Acartia hongi, A. ohtsukai, Labidocera rotunda, and Parvocalanus crassirostris* and the southern and eastern ports by *A. omorii*. *Pseudodiaptomus marinus* was recorded in the western and southern ports, while *Paracalanus parvus* s.l. in all ports. Cluster analysis revealed that copepod communities were classified into 3 summit groups based on the similarity index 50%: A group in only the Masan port of the South Sea, B groups all ports in South Sea and East Sea except for the Masan port, and C group in all ports of the Yellow Sea. The results indicate that copepod communities are affected by ocean physical and chemical environmental elements of Korean trade ports.

P-I

Transport of planktonic copepods at a tropical estuarine inlet in Brazil

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Studies were done at the Catuama estuarine inlet (Santa Cruz Channel, Itamaracá, Brazil) to assess the transport dynamics of the copepod community. Samplings were carried out in relation to the tidal phases and depth at three stations along a transect across the inlet, during spring (05 to 06 August, 2001) and neap tides (11 to 12 August, 2001). According to the local depth, two or three levels were sampled (50 cm below the surface, at midwater and 50 cm above the bottom) at 3-hour intervals. Plankton samples were taken with a pump and the water was filtered through two conical plankton nets (64 and 300 µm mesh size). Additionally, current velocity and direction were measured continuously with the ADCP (Acoustic Doppler Current Profiler) during all sampling stations. Temperature, salinity and dissolved oxygen data were also obtained in all stations. It was identified 20 copepod species, predominating *Oithona hebes, Euterpina acutifrons* and *Parvocalanus crassirostris*, within the microzooplankton (64 µm mesh size), and *Temora turbinata* and *Acartia lilljeborgi,* within the mesozooplankton (300 µm mesh size), all characteristic of estuarine and coastal areas. The copepod nauplii were the most representative group of microzooplankton (between 28 and 96%), and the calanoid adults were the most abundant in the mesozooplankton compartment (between 55 and 78%). The diversity and evenness were low, even with a high marine influence in this system, and the tidal phases were the main factors governing the copepod community. The mean transport of copepod nauplii was higher than 50,000 ind m^{-2} s^{-1} and the mean value of the adult copepods was close to 340 ind m^{-2} s^{-1}, with higher values during spring tide in both compartments. In relation to the copepod transport it was registered a diel net importation in the spring and neap tides. This occurred probably due to the strong marine influence in the area, the large inlet size and/or the low freshwater discharge during the studied period. It can be concluded that the adjacent continental shelf contribute with a high flux of marine copepods into the Santa Cruz Channel, even during the rainy season.

P-I

The epibiont ciliate *Trichodina* (Peritrichia) on two diaptomid copepods from Aguascalientes, north-central Mexico: a true parasite?

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The peritrich epibiotic ciliate *Trichodina diaptomi* Basson and Van As, 1991 was recorded on the body surface of two Neotropical species of the calanoid copepod genus *Mastigodiaptomus* in north-central Mexico. Specimens infested with the ciliate were collected from a pond near a large eutrophic reservoir. This ciliate was identified as *T. diaptomi* by its body size, the morphometry or shape of the taxonomically relevant structures such as the adhesive disc, macronucleus, and denticles or the modal number of radial pins, rays, and denticles. The Mexican specimens have a higher modal number of denticles with respect to other known populations of *T. diaptomi*. Ciliates were observed crawling freely over the copepod cephalothorax and attached at times, leaving a mark on the cuticle but causing no evident physical harm to the copepod. Our observations arise some doubt concerning the presumedly parasitic association of this species with copepods. This widespread species, currently known as a symbiont of 10 species of diaptomid copepods, was reported recently for the first time in the Americas, from Brazil. This is the second illustrated record of this epibiotic ciliate in the continent and the first in North America.

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O

Sequencing the salmon louse genome – lessons learned and current status

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The salmon louse (*Lepeophtheirus salmonis*) is among the most significant problems in salmon aquaculture. It has therefore been the subject of intensive multidisciplinary research for a number of years. Over the last decade molecular has become more and more frequently applied in these studies and a number of methodological platforms have been established for the salmon louse that enables studies of gene expression and function (e.g. microarrays and systemic RNAi). The establishment and use of these platforms has been facilitated by significant transcriptome (EST) sequencing. Although significant transcriptome resources are available the entire genome has been a long wanted resource that will facilitate or enhance a number of molecular approaches, e.g. characterization of single genes, functional studies by gene expression profiling etc. Although the applied values of a sequenced genome are evident, the scientifically more interesting aspects of the will be the insight into the composition and structure of a copepod genome. The Salmon louse genome sequencing project have generated decent genome assemblies and preliminary annotation will soon be initiated. The results available at the time of the 10th ICOC will be presented along with genome-sequencing experiences gathered during the project.

P-II

Comprehensive checklist of marine and brackish harpacticoid fauna in Korean waters and its implications

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The first comprehensive checklist of the Korean marine harpacticoid copepods is provided here by mean of interdisciplinary collaborations, with the purpose of being more informative compared to other conventional checklists. The checklist includes data from both marine and brackish habitats, along with reports of occurrence for a few common planktonic harpacticoids. The checklist comprises 76 taxa of species and/or subspecies belonging to 24 families and 49 genera, encompassing planktonic, free-living benthic and invertebrate-associated benthic forms. Corresponding ecological data for the listed species were provided in detail, including habitats, substratum, salinity range, life cycle, and size range. The most species rich family was the Thalestridae (12 species) followed by Miraciidae (9 species), Harpacticidae (8 species), and Porcellidiidae (8 species), primarily collected from inshore algae. Annual trends in the number of newly reported harpacticoid species from Korean marine and brackish habitats are presented as an indicator of scientific efforts in harpacticoid taxonomy. Seventy-six Korean harpacticoids are categorized according to habitat type and life form, and their distributions are further discussed. Comparisons are also made with existing checklists from other regions across the world of comparable biogeographical coverage. Finally, the limitations, significance, and role of checklists are discussed.

O

The trophic relationship between the harpacticoid *Tisbe biminiensis* and newborn seahorse *Hippocampus reidi* juveniles: who is the prey?

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The offspring of the harpacticoid copepod *Tisbe biminiensis* was tested as a live feed for newborn juveniles of the longsnout seahorse in order to replace wild copepods that are used in the commercial rearing (up to 5 days after birth) in Brazil. Initial trials determined the ingestion rate by an indirect method (clearance of an initially known number of food items during a set period of time – 5 hours) in function of prey density. The offspring of copepods, rotifers (*Brachionus plicatilis*) and newly hatched *Artemia* nauplii were tested. Higher ingestion rates were usually observed when more than 10 ind./mL or 100 ind./cm^2 were offered. The ingestion of rotifers and *Artemia* nauplii by newborn juveniles were very sporadic or not detectable by the present methodology. However, mortality during the exposure period was high when copepods were offered. Observation of the gut contents confirmed that copepod nauplii are the main live feed ingested by newborn seahorse juveniles. A second trial, in which juveniles were reared for 15 days, confirmed these results as a mix of copepods and *Artemia* nauplii resulted in significantly higher survival. Nevertheless, a high mortality was observed at the early stages of development when we observed copepods disturbing living juveniles. The possibility that juveniles used in first trial were in a poor condition was assessed by capturing wild pregnant seahorse males and using their offspring in ingestion and culture experiments. Results from this new set of trials suggest that juvenile mortality may be explained by their origin, with those originating from wild breeders presenting higher survivorship. One may therefore conclude that *Tisbe biminiensis* may predate poorly-conditioned, laboratory-reared juveniles, while well-conditioned juveniles may feed on them.

S-I

Distributional patterns of groundwater copepods in the unsaturated karst of Slovenia and northeastern Italy

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The distributional patterns of copepods in the unsaturated karstic aquifers (i.e. epikarst and upper layers of the vadose zone) were examined during the last twenty years sampling percolating water in caves, artificial tunnels, and mines in alpine, subalpine and high Dinaric karst in Slovenia as well as in the low Dinaric karst (including the Classic Karst) in southeastern Slovenia and northeastern Italy. A total of 140 sites were sampled; 71 species of harpacticoid and cyclopoid copepods were collected, 46 of them being stygobiont. An estimation of sampling efficiency using rarefaction curves and non-parametric estimators of species richness revealed that, notwithstanding the high sampling effort, approximately 80% of the total number of stygobiotic species was collected, due to the high level of rarity, endemism, and the high degree of fragmentation of the study karstic area. Non-parametric multivariate statistical analyses and one-way analysis of similarity demonstrated that the copepod assemblages of percolating waters are significantly distinct in the different karstic typologies, the lower Dinaric karst (and especially its coastal area, lacking a surface hydrographic network and with warmer climatic conditions) hosting the most peculiar assemblages. The main cotribution in differentiating the assemblages are due to endemic species of the genera *Speocyclops*, *Lessinocamptus*, *Morariopsis*, *Elaphoidella*, and *Parastenocaris*, while the non-obligate subterranean species (mainly *Paracyclops*, *Bryocamptus*, and *Attheyella*) are more common in the continental karstic areas, which hosts surface running waters and springs.

O

High-resolution survey indicates high heterogeneity in copepod distribution in the hydrologically active area, Drake Passage.

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Plankton distribution between frontal zones is more or less even, whilst at the Polar front (PF) biomass, diversity, and productivity may rise at all trophic levels of pelagic ecosystems. Distribution of the zooplankton in the Drake Passage was studied in October-November 2008 within the 0–200 m layer. The station grid comprised six parallel transfrontal sections between 57 and 60 S in the vicinity of the South PF, the distance between sections being 10 n.m. All sections were made during a 2-week period. Species composition of copepods within the PF and on both sides of PF did not change. *Oithona similis* and *Ctenocalanus citer* were the most abundant species contributing 60-90% to the total mesoplankton abundance. *Calanoides acutus*, *Calanus simillimus*, and *Rhincalanus gigas* dominated in terms of biomass. Three parameters were analyzed for the dominant copepod species: (1) abundance, (2) biomass, and (3) contribution (%) that each species makes to the plankton biomass. Abundance and biomass of the copepods in the studied area increased northward, this trend being more prominent in the upper mixed layer. In addition to this general trend, extraordinary mesoscale variability in the analyzed parameters was found within the PF. For each species, different types of distribution were observed along transfrontal sections: along some sections within the PF species abundance and biomass were maximal; along the other sections abundance and biomass were minimal. Mesoscale survey thus has proved that the PF is a zone of highest spatial heterogeneity where order-of-magnitude oscillations of copepod abundance/biomass may occur along the front. Local maxima/minima of copepod abundance/biomass observed along single sections reflect the stochastic nature of this heterogeneity. Reliable estimation of the copepod standing stock in the frontal area should, therefore, be made on the basis of a mesoscale areal survey, not on the basis of a single section.

S-III

Diversity of the Monstrilloida (Copepoda): current status and perspectives

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Monstrilloid copepods are protelean parasites of different groups of marine benthic invertebrates, only their first naupliar and adult phases are planktonic. This order currently comprises more than 115 nominal species contained in four genera of the single family Monstrillidae Dana, 1849. The taxonomic knowledge of the group has been hampered by a history of nomenclatorial and descriptive problems mainly derived from their peculiar ontogeny and poorly defined taxa. Probably one of the most relevant setbacks is the difficult of matching males to females; there is no reliable method to link the sexes of a species except for particular apomorphies shared by both genders, finding them emerging from the same host, or by the use of molecular methods. Efforts have been made during the last two decades to clarify the systematic knowledge of the group. The decadal rate of species description (1840–2010) has had several peaks, each related to the activity of a few researchers. An analysis of the world distribution of published records of the Monstrilloida revealed that the Northeast Atlantic is, by far, the best studied region (45% of all records), followed by the Northwestern Atlantic (17%); the least surveyed areas include all regions of the southern hemisphere (less than 3%). In terms of diversity, the European waters of the North Atlantic are the most speciose (32 nominal species), followed by the Caribbean Sea and Gulf of Mexico (24), the Mediterranean and the Black Sea (19), Indonesia-Malaysia-Philippines (17), Japan Seas (17), and Brazil-Argentine (16). Other than these generalized patterns, little can be added to the biogeography of the group; because of its inherent taxonomic problems, many species records are doubtful or improbable and former cosmopolitan nominal species are being revealed as species complexes yet to be studied.

P-I

Morphological characterization of *Eurytemora affinis* sibling species

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The estuarine copepod, *Eurytemora affinis* (Poppe, 1880) was suspected for a long time of being Holarctic species recorded in cold and temperate latitudes of North America, Europe, and Asia. In fact, recent molecular-genetic studies have demonstrated that *E. affinis* represents a cryptic species complex or subspecies morphologically close but isolated for million years. This species complex is widely distributed in coastal mainly brackish water environments, but also in limnetic freshwater ecosystems near the sea. In Asia, *E. affinis* is found in the Caspian Sea, in freshwater area in the Kurile Islands (Russia) and in Hokkaido (Japan). The North Atlantic clade of *E. affinis* from Chesapeake Bay was recently described as a new species *Eurytemora carolleeae* Alekseev & Souissi, 2011. The habitat of this new species is located in North America but also in the Baltic Sea in Europe due to a recent human mediate invasion. To separate these two sibling species, new morphological characters of both male and female were established. They consist on the structure of mandible and some morphometric indexes of rudiment legs 5. In this study we analyzed morphological and molecular-genetic futures to specify two other populations of *E. affinis* from the Caspian Sea and the Bering Sea (The Far East of Russia) on the basis of their quite distant mitochondrial gene COI. The Caspian and Pacific clades were also outlined by Dr Carol Lee with molecular-genetic tools but never characterized as new forms morphologically. *E. affinis* from the Caspian Sea was traditionally evaluated as an element of the Arctic relict complex that colonized the freshwater part of the sea, about 10000 years ago after glacier melting. On the basis of a deep morphological study and phylogenetic analysis, we came to a conclusion that this clade of *E. affinis* has possibly more ancient origin related to the Thetis Sea or to the period when American and Eurasian continental fauna were really connected. This form occupied, in many characters, an intermediate position between the European clad of *E. affinis* and *E. carolleeae* and is also close to the Asian clad from The Far East.

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S-III

The demise of Cecropidae Dana, 1849 and Amaterasidae Izawa, 2008

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Robust evidence supporting the validity of the siphonostomatoid (Siphonostomatoida) family Cecropidae Dana, 1849 has always been limited and cecropids (Cecropidae) and pandarids (Pandaridae Milne Edwards, 1840) share many morphological characteristics. We argue that the morphology of *Prosaetes rhinodontis* (Wright, 1876), a parasitic siphonostomatoid copepod of the whale shark (*Rhincodon typus* Smith), contributes substantially to the blurring of familial limits between Cecropidae and Pandaridae, and based on our detailed consideration of this matter we recommend that Cecropidae be recognized as a junior synonym of Pandaridae. In addition, our critical evaluation of the morphological features of the adult female and copepodid I of *Amaterasia amanoiwatoi* Izawa, 2008 revealed that the establishment of Amaterasidae Izawa, 2008 to hold the species was spurious because *A. amanoiwatoi* can be accommodated within Pandaridae. Therefore, *A. amanoitwatoi* should be transferred to Pandaridae and Amaterasidae is considered to be a junior synonym of Pandaridae. Lastly, our comparisons of morphological and ecological attributes of *A. amanoiwatoi,* specimens of "*Nesippus costatus*? Wilson, 1924" (Pandaridae) reported by Lewis in 1964, and other pandarids indicated the first two taxa to be strikingly similar and suggested them to be congeners. Within Pandaridae, *Amaterasia* spp. seem to belong to the *Dinemoura*-group based primarily on their similarity to some *Nesippus* spp., while representatives of *Prosaetes* C. B. Wilson, 1907, *Cecrops* Leach, 1816, *Luetkenia* Claus, 1864, *Philorthagoriscus* Horst, 1897, *Orthagoriscicola* Poche, 1902, and *Entepherus* Bere, 1936 are considered members of the *Dinemoura*-group based on their shared possession of a narrow third pedigerous somite and dorsal plates on the fourth pedigerous somite in the adult female and a modified leg 3 terminal endopodal segment in the adult male.

S-III

Redescription of *Lepeophtheirus acutus* Heegaard, 1943 (Copepoda, Caligidae) parasitic on two elasmobranch hosts off Okinawa-jima Island, Japan

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The caligid (Caligidae Burmeister, 1835) copepod *Lepeophtheirus acutus* Heegaard, 1943 has not been reported since its discovery from the dorsal body surface of a ribbontail stingray *Taeniura lymma* (Forsskål) captured off Apamama Island in the Gilbert Islands. In this study a detailed redescription of *L. acutus* is provided based on mature adults collected from two new hosts, the Alfred manta *Manta alfredi* (Krefft) and the whale shark *Rhincodon typus* Smith, held in sea pens for acclimation and quarantine purposes off the west coast of Okinawa-jima Island, Japan and examination of syntypes (3 immature adult females, 1 mature adult male, and 1 late chalimus female) of *L. acutus* borrowed from the Swedish Museum of Natural History. *L. acutus* can be distinguished from other congeners by the following combination of adult female characters: 1) abdomen about one-third length of cephalothorax; 2) the presence of a posterior spiniform process issuing from a sclerite situated anteriorly to the maxillule; 3) sternal furca with long, apically pointed tines; 4) leg 2 exopod with a serrated outer spine on the first and second segments and armature of II, I, 5 on the third segment; 5) leg 2 endopod with a row of large teeth and a spiniform projection on the distolateral corner of the first and second segments, respectively; 6) leg 3 with 2-segmented exopod and 6 setae on the second endopod segment; and 7) leg 4 exopod armature I-0; III. *L. acutus* is considered a serious pathogen of elasmobranchs held in captivity as this species is a low host specific parasite and often causes skin lesions, and occasionally causes blindness too, on infected hosts.

O

Spring and Autumn Copepod Assemblages in the Cilician Basin (Northeastern Mediterranean)

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Changes in abundance and community structure of epipelagic copepods were studied both in coastal and open waters of the Cilician basin (northeastern Mediterranean) within the framework of the SESAME project "*Southern European Seas: Assessing and Modelling Ecosystem Changes*". In order to collect zooplankton, vertical tows were performed using a WP-2 closing net with a mouth opening of 0.255 m^2 and 200 micron mesh size, from three different depth layers (0 - 50, 50 - 100 and 100-200 m) on board R/V Bilim-2 during March & September 2008. Copepods numerically have dominated the zooplankton with contributions ranging from a minimum of 50% to a maximum of 89% to the total zooplankton abundance. A total of 100 copepod species belonging to 47 genera were reported from the area. Shannon-Wiener diversity index values (H') varied in the range 3.5 - 4.9 with high scores obtained mainly for the 50-100 m depth layer and partly for the 100-200 m depth layer. Among the copepod species, *Temora stylifera* dominated the spring and *Oithona plumifera* the autumn fauna. Individuals of *Clausocalanus furcatus, Farranula rostrata, Oncea media* and copepodites belonging to Clausocalanus, Paracalanus, Oithona and Paracalanus have contributed significantly to the total zooplankton abundance in spring. During autumn, significant contributions to total copepod abundance were made solely by individuals of *Centropages kroyeri, Clausocalanus furcatus, Mecynocera clausi*, and copepodites belonging to Oithona, Centropages, Clausocalanus, Paracalanus, Calanopia and Acrocalanus. Females were found overwhelmingly dominant over males with ratios ranging between 1.6 and 6.5. Total copepod abundances fluctuated between 73 ind m^{-3} (F44R40, 100-200 m) and 1012 ind m^{-3} (G45T05, 0-50m) in spring and between 40 ind m^{-3} (F52Q59, 100-200 m) and 1950 ind m^{-3} (G25S37, 50-80m) in autumn. In terms of abundance, coastal populations have been found to be more heterogeneous in both planes compared to open waters with bulk of the copepod population being concentrated at the top 100 m in the basin.

P-II

First records of inland ergasilids (Copepoda: Ergasilidae) in Venezuela

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Species of family Ergasilidae are known parasites on gills of teleost fishes. Studies concerning this family in Venezuela are unknown, particularly if the high species richness of freshwater fishes and the great number of rivers is taken into account. During a study on biodiversity in Macapaima lagoon floodplain (lower Orinoco River) the presence of ergasilids species was confirmed on free water samples collected by horizontal tows in dry season of 2010. Further samples were obtained from washed gills of the fish *Hoplias malabaricus* collected in the same water body. Three ergasilids species were found in free water samples (*Pindapixara tarire*, *Vaigamus* cf. *retrobarbatus* and *Ergasilus* sp.) and a single species on gills (*Brasergasilus* sp.) accounting for a total of four species and four genera of the family Ergasilidae. It is worthy to note that most of descriptions of ergasilid species are based on females, thus the illustrations of males for *Vaigamus* and *Ergasilus* are important contributions. Ovigerous females were found for *Pindapixara* and *Brasergasilus*, while juveniles were found only for *Brasergasilus*. Measurements, photographs, and diagrams of specimens are included. This research is the first contribution to the knowledge of parasitic copepods in Venezuelan inland waters.

P-I

Mesozooplankton and copepod community structures in the southern East China Sea during the monsoon transition period

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Field sampling was conducted before the onset of the northeasterly monsoon to investigate the influence of monsoonal winds on copepod community composition. We selected the northern coast of Taiwan within the southern East China Sea as our research area because the monsoonal effects there were expected to be most evident. In the present study, 22 major mesozooplankton taxa were found in total, with the Calanoida (relative abundance: 66.36%) and Chaetognatha (RA: 9.44%) being the most abundant. Mesozooplankton densities ranged between 226.91 to 2162.84 individuals m^{-3} (average: 744.01 ± 631.5 individuals m^{-3}). A total of 49 copepod species were identified, belonging to 4 orders, 19 families, and 30 genera. The most abundant species were: *Temora turbinata* (RA: 23.50 %), *Undinula vulgaris* (RA: 17.92 %), and *Acrocalanus gibber* (RA: 14.73 %). The chaetognath *Flaccisagitta enflata* occurred at all 8 sampling stations, providing a 95% portion of the overall chaetognath contribution. Amphipoda were abundant at stations 4 and 5, with *Hyperioides sibaginis* and *Lestrigonus bengalensis* being dominant, and comprising about 50% of all amphipods. Chaetognath abundance showed a significantly negative correlation with salinity ($r=0.77$, $p=0.027$), whereas mesozooplankton group numbers had a significantly positive correlation with salinity ($r=0.71$, $p=0.048$). Densities of four copepod species (*Calanus sinicus*, *Calocalanus pavo*, *Calanopia elliptica* and *Labidocera acuta*) showed a significantly negative correlation with seawater temperature. Communities of mesozooplankton and copepods of northern Taiwan varied spatially and according to the distance to land during the monsoon transition period. The results of this study provide evidence for the presence of *C. sinicus* in the coastal area of northern Taiwan during the early northeast monsoon transition period.

P-II

The shallow mixed layer of the subtropical South China Sea reveals a particular autumn copepod community structure

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The South China Sea (SCS) is the world's largest marginal sea being notable for vertical mixing at various scales resulting in a sequence of chemical and biological dynamics in surface waters. The relation of copepod communities and climate change has not been studied as yet in this region. We investigated the copepod composition, abundance, and distribution at six stations (including a South East Asia Time Series station (SEATS)) along a transect line in the subtropical SCS during autumn of 1999. This was done in order to understand how copepod assemblages are structured in the upper water column of the northern SCS. From 13 samples we identified a total of 33 copepod species consisting of 25 genera belonging to 19 families. The copepod composition represented 24 species of Calanoida, 3 species of Harpacticoida, and 6 species of Poecilostomatoida. Integrating all samples, the numerically most dominant genus was *Paracalanus* followed by *Calocalanus* and *Oithona* respectively. However, the most frequently occurring species was the calanoid *Acartia (Planktacartia) negligens*, which was retrieved from all samples and was followed by *Corycaeus (Farranula) gibbula* with an occurrence rate of 92.31%. Both *A. negligens* and *C. gibbula* can be used as indicator species for northern South China Sea waters during autumn. An indicator species calanoid copepod *Calanus sinicus* of the East China Sea cold water mass was not found in this shallow mixed layer along the large scale oceanic transect line in the Northern SCS even during the initial stage of the North Eastern monsoon.

S-IV

Zooplankton Trends in Massachusetts Bay, USA: 1998-2008

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Zooplankton community analyses in Massachusetts Bay (Gulf of Maine, USA) from 1998-2008 with 102 µm-mesh nets revealed seasonal and interannual variability in zooplankton abundance, with maxima in summer and minima in winter. Zooplankton was dominated by copepod nauplii, copepodites, and adults, mostly of the small cyclopoid copepod *Oithona similis*. Time-series analyses revealed a multi-year decline in total zooplankton abundance from 2000 to 2008, especially due to declines in *Oithona similis*, and *Pseudocalanus* spp. This decline was not exhibited by barnacle nauplii and *Calanus finmarchicus*. There were no significant relationships between surface or mean water column temperature and salinity for any zooplankton group except for significantly higher abundances of *C. finmarchicus* at higher surface salinity. There was a significant positive correlation between total zooplankton abundance and integrated chlorophyll. The decline in zooplankton abundance since 2000 was not obviously related to diversion of sewage effluent from the Boston Harbor outfall to Massachusetts Bay, or to natural hydrographic variability. The zooplankton decline in Massachusetts Bay highlights the importance of multi-year sampling to characterize interannual variability. Comparisons of our results with those of other programs in the Gulf of Maine are complicated by differences in sampling net meshes, but our results shared some similarities with other studies during years when these studies overlapped with ours. In particular, small copepods declined in abundance beginning around 2000 to 2001, *Calanus finmarchicus* was abundant and salinities were high during 2002 through 2004, and zooplankton and chlorophyll levels declined from 2000 through

O

Predation on copepods by two Asian bloom-forming jellyfish, *Aurelia aurita* s.l. and *Nemopilema nomurai*

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Jellyfish populations are increasing globally, as manifested in East Asian seas by the recurrent massive blooms of the common jellyfish *Aurelia aurita* s.l. and the giant jellyfish *Nemopilema nomurai* in recent decades, causing severe damage to local fisheries. Due to their aggregated occurrence and non-selective feeding by means of stinging and sticky nematocysts, the jellyfish may cause a significant predation impact on copepods and other mesozooplankton communities. Available information (e.g., biomass of both jellyfish and prey zooplankton, jellyfish stomach contents, digestion time, metabolic and growth rates) allowed an estimation of the predation impact by the jellyfish populations. *A. aurita* blooms primarily in eutrophic bays and inlets, such as Tokyo Bay and the Inland Sea of Japan, where the jellyfish carbon biomass often overwhelmed the mesozooplankton community biomass and the daily removal by jellyfish was up to 162% of the zooplankton biomass. *N. nomurai* occurs extensively over the East Asian seas, from the seeding grounds in the Yellow and East China Seas to the major feeding ground in the Japan Sea. In 2009, a big bloom year, a total of 23×10^9 young jellyfish occurred in the Yellow and northern East China Seas in July, and 90% of them were transported to the Japan Sea by September, where the total population biomass attained 329×10^6 tons of wet weight within the upper 50 m depth. At this time, the jellyfish carbon biomass (6.9 mg C m^{-3}) was almost equivalent to the mesozooplankton biomass, and the daily removal by jellyfish was approximately 30% of the zooplankton biomass. In addition, some snapshot data showed that copepods were almost entirely wiped out from the water mass where jellyfish aggregated densely.

S-III

Copepods of the genus *Hatschekia* Poche, 1902 (Siphonostomatoida: Hatschekiidae) parasitic on tetraodontiform fishes (Actinopterygii) from Japanese waters

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The genus *Hatschekia* is one of the largest genera of Copepoda parasitic on marine fishes. Since the revisional work by Jones (1968), about 100 species have been recognized as valid. All of them have been found from the gills of nearly 140 actinopterigian fish species belonging to six orders: Anguilliformes, Beryciformes, Ophidiiformes, Perciformes, Pleuronectiformes and Tetraodontiformes. Since the species of *Hatschekia* have a featureless body with a highly transformed trunk and small, vestigial appendages, the taxonomic study of this genus is difficult and insufficient. Especially, the male is usually smaller than the female and is hard to describe. Since 2005, we have examined tetraodontiform fishes collected in Japanese waters to clarify the fauna of *Hatschekia*. A total of 27 species was collected, and 22 of which were found undescribed. In 2009 and 2010, we described 18 of them as new species. Based on the present study, *Hatschekia* may be much more species than previously known. Further research is needed.

S-III

An undescribed cyclopoid copepod species from a filefish *Pseudomonacanthus macrurus* (Bleeker) (Tetraodontiformes: Monacanthidae) in the Philippines, with a reconsideration of Umazuracolidae Ho, Ohtsuka & Nakadachi, 2006

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Umazuracola elongatus Ho, Ohtsuka & Nakadachi, 2006, which is the type and only species of *Umazuracola* (Umazuracolidae Ho, Ohtsuka & Nakadachi, 2006), was originally described from the black scraper *Thamnaconus modestus* (Actinopterygii: Tetraodontiformes: Monacanthidae) in Japanese waters. The copepod resembles a group of cyclopoid families known as the "bomolochiform complex" (i.e. Bomolochidae Sumpf, 1871, Taeniacanthidae C. B. Wilson, 1911, Tegobomolochidae G. V. Avdeev, 1978, Telsidae Ho, 1967, and Tuccidae Vervoort, 1962) by having: 1) an antenna armed with a claw on the second endopod segment; 2) a mandible with 2 distal blades; 3) a maxillule with 4 elements; and 4) a maxilla with a spinulose terminal process. *U. elongatus* apparently differs, however, from members of the bomolochiform complex by having a cephalothorax without a concave ventral surface, a non-lamelliform leg 1, and modified spines on legs 2 to 4 in both sexes and a highly reduced maxilliped without a terminal claw in the female. In March 2009, a cyclopoid copepod belonging to an undescribed genus and species was collected from a filefish *Pseudomonacanthus macrurus* (Bleeker) (Monacanthidae) caught off the Philippines. The undescribed copepod possesses a maxilliped without a terminal claw in the female and a 2-segmented endopod and strongly serrated spines on each ramus of legs 2 to 4 similar to those of *U. elongatus* and a cephalothorax with a concave ventral surface, a postantennal process, and lamelliform leg 1 typical of most species of Taeniacanthidae. We argue that the undescribed species and *U. elongatus* can be accommodated in Taeniacanthidae and, hence, Umazuracolidae should be considered a junior synonym of Taeniacanthidae. We hypothesize that the undescribed copepod and *U. elongatus* were derived from species of Taeniacanthidae parasitic on filefish hosts.

P-II

Two new species of Peltidiidae Sars, 1904 (Copepoda: Harpacticoida) from Cuba

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Several species of marine harpacticoid copepods have been found recently in Cuba. Some of these species turned out to be new to science or new records for Cuba. This is the case of two new species of the family Peltidiidae herein presented. One of these species was attributed to the genus *Peltidium* and belongs to the group of species composed of *P. ovale*, *P. simplex*, *P. perturbatum* and *P. proximus*. These species share the elongate female P5 EXP, the poorly-developed baseoendopodal lobe, and the armature formula of P2-P4 ENP2 with three, four and four setae, respectively. The new species showed to be more similar to *P. ovale* and *P. simplex*, but differ in the number of setae/spines of the female P5 EXP (with five setae/spines in the latter two species, but with six elements in the new one), and in the rostrum. The description of a new species of *Eupelte* is also provided in the present contribution, and is the first record of the genus for the Caribbean Sea. This new species seems to be more closely related to *E. gracilis* and *E. aurulenta*, but differs in the P1 EXP1:EXP2 length ratio.

S-III

Pseudacanthocanthopsis secunda Yamaguti & Yamasu, 1960 (Copepoda, Chondracanthidae) parasitic on fishes from the Seto Inland Sea, Japan, and the East China Sea

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The copepod *Pseudacanthocanthopsis secunda* Yamaguti & Yamasu, 1960 (Chondracanthidae Milne Edwards, 1840) was established based on female specimens collected from the gills of the Indian perch *Apogon lineatus* Temminck & Schlegel captured in the Seto Inland Sea, off Tamano, Okayama Prefecture, Japan. *P. secunda* is currently considered a *species inquirenda* by present authorities as it apparently possesses a head incorporating both pedigers, an antenna without an atrophied tip, a large spherical leg 1 situated lateral to the oral appendages, and a triramous leg 2. In this study a detailed redescription of *P. secunda* is provided based on adult females and males collected from the type host captured in the Seto Inland Sea and the East China Sea including additional material from fine patterned puffer *Takifugu poecilonotus* (Temminck & Schlegel) and red seabream *Pagrus major* (Temminck & Schlegel) captured in the Seto Inland Sea. Our results revealed that *P. secunda* is a valid member of *Pseudacanthocanthopsis* Yamaguti & Yamasu, 1959 as it possesses: 1) a cephalothorax incorporating the first pedigerous somite and with head processes, a short neck comprising the second pedigerous somite, and a trunk with posterior processes in the female; 2) distinct body somites in the male; 3) an atrophied tip on the antenna of both sexes; and 4) two pairs of biramous legs in both sexes. *P. secunda* can be distinguished from the other three congeners by having one ventrolateral and two anterior pairs of rounded head processes, a reniform trunk, a cylindrical antennule, and a lateral swelling on the leg 1 protopod in the female. The copepod is a common parasite of the Indian perch and rarely infects other fishes such as fine patterned puffer and red seabream.

O

Interactions between vibrios and copepods: effects on pathogen persistence, survival and transmission to humans

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The role of the aquatic realm in the ecology of *Vibrio cholerae* and epidemiology of the cholera was first proposed by Colwell and coworkers in the late 1970s against the traditional belief of clinicians that human-to-human transmission was the only route of transmission and water acted as only a medium to carry the pathogen from one host to another. A major breakthrough in this respect was the discovery of the presence of *V. cholerae* O1 year-round in brackish and estuarine environments *via* its commensal association with chitinous organisms and especially copepods. It was found that *V. cholerae* occur in the gut and on the surface of zooplankters where it is protected from the external environment and proliferates, taking advantage of improved conditions of nutrition. It was also shown that a single copepod may contain as many as 10^4 to 10^5 *V. cholerae* cells thus potentially carrying a minimum infectious dose able to produce infection in humans. During the past 30 years a significant effort has been devoted to the study of the ecology of *V. cholerae* and its association with zooplankton and other aquatic organisms and matrices possibly acting as environmental reservoirs in coastal waters. At the molecular level, studies on the mechanisms involved in *V. cholerae* interactions with chitin led to the discovery of different bacterial ligands promoting adherence to chitinous zooplankton including the surface membrane protein GbpA, which is involved in colonization of both human intestine and environmental chitin surfaces *via* the same binding specificity (*i.e.*, N-acetyl glucosamine). At the ecosystem level, considerable effort was given in deciphering the effects of climate and other environmental variables on *Vibrio*-plankton interactions lead to the development of predictive models for *V. cholerae* using satellite remote sensing, and the study of the epidemiology of cholera and associated diarrheal diseases. Moreover, our understanding of the ecology of *V. cholerae* also contributed to the development of applied measures to prevent cholera by the development of simple a filtration method to remove plankton-associated *V. cholerae* from natural water in developing countries. The study on the ecology of *V. cholerae* and other vibrios in their nonhuman environment including their association with zooplankton more specifically, copepods is an overgrowing and exciting branch of research which is paving the way towards a more comprehensive understanding of persistence, dissemination and evolution, as well as transmission to humans, of these waterborne environmental pathogens.

P-II

Vertical changes in abundance and community structure of copepods down to 2,300 m in the tropical Southeastern Atlantic Ocean

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Copepod community structure was studied along one year in the southeastern Brazilian coast. The main purpose was to determine the abundance and horizontal and vertical distribution of the copepod communities in the shelf and slope, in different water masses (Tropical Water - TW, South Atlantic Central Water - SACW, Intermediate Antarctic Water - IAW, Superior Circumpolar Water - SCW and the North Atlantic Deep Water - NADW). The biological material examined was obtained as part of the Habitats Project - Campos Basin Environmental Heterogeneity by CENPES/PETROBRAS. Zooplankton samples were obtained in 2009 during the rainy (March-April) and dry seasons (August-September), in 48 stations distributed along six transects perpendicular to the coast between the isobaths of 25 and 3,000 m depth. Stratified hauls were done in each water mass from the surface to the maximum depth of 2,300 m. There was a significant difference ($p<0.05$) in copepod density among water masses, shelf and slope, and rainy and dry seasons. However, the latitudinal variation was not significant ($p>0.05$). The highest mean density value was found in the TW, and the lowest in the NADW. The TW showed the highest mean density during the dry season (10,519 ± 19,085 ind.m^{-3}) that was influenced by the upwelling system, when compared with the rainy season (2,357 ± 3,648 ind.m^{-3}). The SACW, IAW, SCW and NADW showed the smallest mean densities at the rainy season (129 ± 221 ind.m^{-3}; 205 ± 586 ind.m^{-3}; 9 ± 8 ind.m^{-3}; and 0.6 ± 0.3 ind.m^{-3}, respectively) when compared with the dry season (361 ± 823 ind.m^{-3}; 85 ± 231 ind.m^{-3}; 2 ± 1 ind.m^{-3}; 0.1 ± 0.1 ind.m^{-3}, respectively). A total of 200 taxa with 148 copepod species occurred along the 0-2,300 m water column. In total, thirty-eight species were exclusive of the four water masses analyzed, nine in the TW, seventeen in the SACW, eight in the IAW, and five in the SCW. The ANOSIM analysis showed that copepod communities differ among water masses, except for IAW, SCW and NADW during the dry season ($p>0.05$). During the rainy season all the water masses showed different copepod communities. Different compositions and abundances were the consequence of oceanic and shelf waters influences. These results are compared with the previous studies conducted in the same region and to others studies around the world.

P-II

Looking for tipping points: Case study of copepods of the West Spitsbergen Current

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Statistical methods for identification of tipping points normally require at least 5-10 observations on both sides of the break-point. The typical ecological time series from temperate coastal ecosystems available at present may not even lend sufficient testing power for statistical break-point identification methods, particularly when observations are associated with high uncertainty. Since ecological time series from high latitudes are rare, we decided to search for possible indications of changes in the mesozooplankton from the West Spitsbergen Current (WSC), in spite of relatively short time span of the available time series. WSC transports Atlantic waters (AW) and associated biota, and influences considerably properties of the Arctic Ocean. The time of our study coincided with the recent observation of increasing temperature of the AW, as well as with indications of climate warming, particularly in the Arctic. Mesozooplankton was sampled every summer from 2001 to 2008. The mesozooplankton community included over 100 species/taxa but the bulk of abundance (and biomass) consisted of a few taxa, with *Oithona similis* predominating numerically, and *Calanus finmarchicus* in terms of biomass. Relationships between the copepods' community and local (water temperature and salinity), as well as distant (e.g. NAO climate index), environmental factors were established using multivariate statistics. Different time of sampling had nearly no effect on the characteristics of the copepods community throughout the years. Temperature was found to be the main factor driving zooplankton variability. The variability displayed by a few less important species was tested using a semi-parametric approach within the Generalized Additive Models in order to find more sensitive indicators of change in the pelagic system. Most relationships between the copepods community and temperature proved to be gradual and not abrupt, except for the biomass of *Calanus glacialis* that appeared to have a threshold response around 6,5 °C.

P-II

Two *Farranula* (Copepoda, Cyclopoida, Corycaeidae) species from the Korean water

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Hitherto identification for *Farranula* species from the temperate and tropic oceans has been performed based on several fragmentary characteristics and incomplete descriptions from the temperate and tropic oceans. As a result, many identification errors like mixing of characters of some different species and/or regarding as one specific species have been occurred in many taxonomic and ecological studies. Therefore, morphological details of *Farranula* species, such as mouthparts, relative lengths of endopodal spines of swimming legs, ornamentation on surface of genital somite and proportions of lengths and widths of respective segments, which have not been noticed and/or concerned in the earlier taxonomic studies, are need to verify taxonomic criteria of the genus. In this study distinct morphological natures differentiating the genus *Farranula* from other genus within Corycaeidae are discussed on the basis of detailed redescription of *F. concinna* and *F. gibbula* from Korean waters. Additionally, the comprehensive comparisons with previous taxonomic records for the *Farranula* species are discussed.

P-II

Two new species belonging to the *dentipes*– and *conifera*–subgroup from the East China Sea

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Two new *Triconia* species of family Oncaeidae, *Triconia* sp. 1 and *T*. sp. 2 are described from the southern areas off Jeju Island (East China Sea). *Triconia* sp. 1 belongs to the *dentipes*-subgroup of *Triconia* characterized by the absence of integumental pockets on the anterior surface. It is distingusihed from the closely related species of this subgroup, *T. giesbrecht* Böttger-Schnack, 1999, *T. gonopleura* Böttger-Schnack, 1999 and *T. dentipes* (Giesbrecht, 1891) by a combination of following morphological features: in females, (1) irregularly curved "cucurbit" – like lateral margin of genital double-somite in dorsal view, (2) in P5, long outer basal seta reaching beyond paired secretory pores on posterior part of genital double-somite in dorsal view, and proportional lengths of exopodal setae, (3) the length ratio of prosome to urosome, in both gender, (4) the proportional lengths of caudal setae, and (5) the relative lengths of distal endopodal spines on swimming legs 2 to 4. *T*. sp. 2. Known as a form of *T. conifera* (Giesbrecht, 19891), or *T. redacta* ((Heron and Bradford-Grieve, 1995) is located in the *conifera*-subgroup characterized by dorsal projection on second pedigerous somite of female. However, it differs from other species of this subgroup by the following morphological charactersitics: in females, (1) distinctly small dorsal projection on the second pedigerous somite, (2) a location of the genital apertures on genital double-somite, (3) the shape of anterior part of genital double-somite in lateral and dorsal view, (4) the relative lengths of outer basal seta and exopodal seta of P5, (5) in P5, the length ratio of exopod to width, and (6) the length ratio of outer distal spine to terminal spine on P3 and P4 enp-3. Also, the new morphological criteria of the *dentipes*- and *conifera*-subgroup species are added on the basis of *T*. sp. 1 and *T*. sp. 2.

P-I

The behavioral patterns of Copepoda *Acartia tonsa* in toxic algae *Karenia brevis*

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This study investigated the influence of toxic dinoflagellates *Karenia brevis* on the swimming behavior of copepoda *Acartia tonsa*. The results showed that the swimming speed (1.52+-0.41 mm/sec) of the experimental copepoda group that were exposed to a high concentration of toxic algae, significantly exceeded that of the control group (1.08+-0.37 mm/sec). When the experimental copepoda group was exposed to moderate and low concentrations of toxic algae, the swimming speed of the experimental group (1.02+-0.2 mm/sec, and 1.1+-0.29 mm/Sec, respectively) was not significantly different from that of the control group (1.08+-0.37 mm/sec). The toxic algae *Karenia brevis* has flagellum and the capacity for mobility. After experimental observation for 30 minutes, the algae showed a significant phenomenon of clustering in the top half of the experimental container. We examined the distribution of copepoda in the container during study period. The analysis of the results showed that in an environment of toxic algae exposure, the distribution of copepoda significantly deviated toward the lower area of the container. The distribution of copepoda in the control group had a higher probability of deviating toward the upper area of the container. Therefore, we can infer that the presence of toxic algae had an influence on the behavioral model of copepoda and causes related behavioral changes.

S-II

Six year's observations of copepod community structure in a mixed semi-enclosed embayment adjacent to tropical West Pacific

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We conducted a six years study aiming to reveal the impacts of Kuroshio Current, Luzon Strait and the South China Sea on copepod community structure and succession patterns in the Nan-Wan Bay, located at the southern tip of Taiwan. Zooplankton samples were collected from surface stratum of 2-0 m during November 2001 to January 2007 comprising 24 research cruises. A total of 178 species of copepod belonging to 6 orders, 30 families and 58 genera were identified from 256 samples. The average copepod abundance (individuals m^{-3}) ranged from 91.67 ± 50.17 to 1039.77 ± 860.86, whereas average species richness (number of species $station^{-1}$) varied between 18.75 ± 5.01 and 35.50 ± 4.54. Irrespective of annual variations the species richness and total copepod abundance were significantly lower in spring (March-May) than that recorded in other seasons. Interannually in terms of abundance and species richness, the highest annual average was recorded in 2004. A clear temporal succession of top 10 most abundant species was identified at seasonal and interannual scale. The most abundant species of four seasons were: *Temora turbinata* in spring (RA: 9.50 %; MD: 39.00 inds m^{-3}) and summer (RA: 8.36 %; MD: 51.03 inds m^{-3}) *Temora stylifera* (RA: 17.97 %; MD: 98.37 inds m^{-3}) in autumn and *Oncaea media* (RA: 11.37 %; MD: 83.38 inds m^{-3}) in winter, respectively. Results of our 6 years sampling reveal that the copepod community structure and succession in the Bay are influenced by the vigorous Luzon Strait internal tides, Kuroshio Current and the South China Sea. Unlike in other coastal waters around Taiwan the copepod community is not dominated by Calanoida, but is dominated by smaller copepods of the Poecilostomatoida and Cyclopoida mainly belonging to the families Corycaeidae and Oithonidae, respectively. The copepod composition in the bay represents an assortment of various species from the Western Philippine Sea, the South China Sea and the Kuroshio Current. No copepod species turned out to be the definitive indicator of the bay; moreover the Nan-Wan bay supports higher copepod diversity and richness than those in neighboring water masses.

P-II

Resolving relationships among lineages of cyclopoids and poecilostomatoids using 18S and partial 28S ribosomal DNA sequences

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The number of copepod orders is reported to be 9, 10, or 11, depending upon the criteria used, and reflects a remarkable level of disagreement. Of particular interest is whether the traditionally defined Poecilostomatoida and Cyclopoida are truly 1 or 2 distinct orders. The exclusively marine poecilostomatoids have basal members which live in loose associations with invertebrate hosts while their derived forms are free-living and planktonic – an unusual phenomenon and a striking contrast to the typical transition from free-living to parasitic lifestyles believed to have occurred in lineages of many organisms. The cyclopoids are equally dramatic in their transitions: they have successfully invaded many freshwater habitats and many of their parasitic members are derived from basal forms. Strong similarities in cephalosome appendages, which are increasingly being recognized as phylogenetically informative, suggest that poecilostomatoids are more appropriately subsumed into the cyclopoids. We contribute formal phylogenetic analyses using complete 18S and partial 28S ribosomal DNA sequences to the growing body of data that shed light on the relationship between these two taxa. Siphonostomatoida were chosen as the outgroup taxon. Preliminary analyses suggest paraphyly in the poecilostomatoids, with families Clausidiidae and Myicolidae comprising a clade that is paraphyletic to the clade comprising cyclopoids and the poecilostomatoid families Sapphirinidae, Corycaeidae, and Ergasilidae. Our analyses point to additional taxa needed to resolve the uncertainty of these paraphyletic relationships. We present these preliminary analyses with the intent of generating discussion and receiving advice on additional taxa to add to the analyses.

P-II

Passive Carbon flux of copepod *Paracalanus indicus* (Copepoda: Calanoidea) (Wolfenden, 1905) in coastal upwelling zones of the Humboldt Current System associated with the oxygen minimum zone

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The Humboldt Current Ecosystem (HCS) exhibits variable upwelling regimes over the latitudinal gradient from 5°S to 42°S and the presence of a shallow oxygen minimum zone (OMZ). In northern Chile (~ 23°S), upwelling is intermittent throughout the year whereas in Central/southern Chile (~ 36°S), upwelling is strongly seasonal and mostly concentrated in the Austral spring-summer. We examined the variability of copepod biomass, growth rates (*g*) and production over different upwelling regimes (seasonal and intra-seasonal variation) associated with the vertical distribution of the OMZ, as estimated by the molting rate method. Oceanographic measurements showed active upwelling conditions. Remarkable differences between the abundance of organisms where observed towards the OMZ, with a decrease in total number, or in stages of development. The abundant of dead copepods increased with depth. The same pattern was found for biomass. At northern Chile (~ 23°S), *Paracalanus indicus,* showed total population biomass was 7,39 g C m^{-2}. Weight-specific *g* between 0.1 - 0.3 d^{-1}, with averages of 0.23 d^{-1}. Biomass and *g* values allowed production rates, which was ca. 1,62 g C m^{-2} d^{-1}. This represents a total biomass of dead copepods of about 1,2 mg C m^{-2} d^{-1}. This value is about 0,08% of the daily population production. Meantime, the contribution of *P. indicus* to the flux of organic matter to the OMZ was estimated to be ca. 0,97% for passive sinking. At Central/southern Chile (~ 36°S), *P. indicus* yielded a total population biomass was 1,4 g C m^{-2}. *g* between 0.1- 0.4 d^{-1}, with averages of 0.25 d^{-1}. Production rates, which was ca. 5,8 g C m^{-2} d^{-1}. This represents a total biomass of dead copepods of about 1,4 mg C m^{-2} d^{-1}. This value is about 0,02% of the daily population production. Then, the contribution of *P. indicus* to the flux of organic matter to the OMZ was estimated to be ca. 0,19% for passive sinking.

O

Distribution and ecology of harpacticoid copepods in the hyporheic zone of rivers in Slovenia

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The distribution of harpacticoid copepods in the hyporheic zone of 26 gravel bed rivers in Slovenia was investigated. Special attention was put on their distribution patterns and selected environmental factors, including geological substrate. The hyporheic zone was sampled at 92 locations, along the longitudial dimension of the rivers, covering all five Slovene river basins (Soča, Sava, Drava, Mura and Primorska) and all major geological areas. The altitudinal range spanned from 800 m a.s.l. (rivers with springs in the Alps) to 5 m a.s.l. (rivers near the Adriatic coast). Neighbour joining cluster analysis on zero-adjusted Bray-Curtis distances was used to identify clusters of samples. Environmental data were ordinated with Canonical Variates Analysis, while distance-based Redundancy Analysis was used to search for species - environment relations. Thirty harpacticoid species were recorded, belonging to 14 genera of 4 families. *Brycamptus dacicus* (Chappuis, 1923), *B. zschokkei* (Schmeil, 1893) and *Elaphoidella elaphoides* (Chappuis, 1923) were the most widespread species, found in more than 40% of locations. Species diversity was highest in the altitudinal mid-range and in the mid-western part of the sampling region (with carbonate substrate). Most found species showed no particular pattern in their distribution, but some are restricted to certain areas, e.g. *Moraria radovnae* in the Alps. The geological substrate explained only a low amount (approximately 10 %) of the variance in species data. Physical and chemical parameters accounted for a moderate amount (approximately 40 %) of the variance, thus indicating that the distribution of harpacticoid copepods is also influenced by other factors (e.g. interspecific competition).

O

Spatial and temporal variation of copepods in Venezuelan Atlantic Front

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Copepods are essential for the understanding of fluvial influence on ocean environment. Water salinity, depth and temperature were measured, and copepod community composition and density was evaluated for spatial and temporal variations in Venezuelan Atlantic Front: Gulf of Paria, Boca de Serpiente (estuarine) and Platform Deltana (neritic and oceanic domains) both in rainy and dry season. Parameters were estimated by establishing relationships among variables by data analysis and multivariate statistics. A total of 114 samples were evaluated and accounted 54 copepod species. Temperature was homogeneous, being lightly higher in Paria (non statistical significance). The salinity was higher and homogeneous in the two Platform areas (neritic = 33.69 ‰ ±1.21, oceanic = 35.37 ‰ ±0.24), lower and heterogeneous in Paria (23.29 ‰ ±3.75) and Boca de Serpiente (23.67 ‰ ±3.42). This variable was higher and homogeneous in dry season (32.78 ‰ ±1.64) than in rain (30.16‰ ±2.08). In the dry season, densities were higher, ranging from 1200-1570 Ind./m^3, noticeably in Boca de Serpiente, neritic north and oceanic far stations. *Subeucalanus subcrassus* was abundant and heterogeneous in most environments, *Oithona plumifera* most abundant and heterogeneous in the Deltana Platform during dry season. Sixteen species (29.63%) do not appear during rainy season and ten (18.52%) under dry season. Between rainy and dry season only significant difference among eleven species (20.37%) was determined. Using one-way ANOVA model, it was established that in the four environments were only significant differences for thirteen species (24.07%), at least between two areas. Spatial variations in copepod community support the proposal of Plataforma Deltana oceanic domain as characteristic mixture zone due to riverine influence and ocean-related changes in the seasonal patterns of salinity.

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