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Taking a Deeper Look–A Fossil Isopod Revisited By 'Virtual Paleontology'

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Abstract Book

Disentangling Cryptic Species Complexes and Understanding Diversification in ‘Marbled Shrimps’ *Saron* spp. (Caridea: Hippolytidae): an Integrative Taxonomy Approach

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Shrimps belonging to the family Hippolytidae exhibit remarkable morphological and ecological disparity. Among hippolytids, the genus *Saron* is recognized for its astonishing coloration. Two species, *S. rectirostris*, and *S. inermis*, can be easily identified and distinguished from congeners based on morphological traits. By contrast, two other species, *S. marmoratus* and *S. neglectus* exhibit considerable morphological and color variability suggesting the existence of cryptic entities within each species. Herein, we used an integrative taxonomic approach to test whether or not *S. marmoratus* and *S. neglectus* represent cryptic species complexes. The results of multivariate analyses (PCA and DFA) based on 19 morphological traits did not reveal different entities in each of the two species. On the other hand, phylogenetic analyses based on mitochondrial (16S) and nuclear (H3) genetic markers, as well as single and multi-locus species delimitation approaches (ABGD, mPTP, GMYC, BPP) revealed the existence of 5-8 and 5-7 divergent lineages in *S. marmoratus* and *S. neglectus*, respectively. The above suggests that the genus *Saron* has likely undergone a series of allopatric/sympatric speciation events in the Indo-Pacific. The present study provides a valuable insight on cryptic species diversity in caridean shrimps, a clade with considerable ecological relevance.

Effects of Interspecific Interactions and Increased Population Density on Vitellogenesis in Intertidal Crabs *P. cinctipes* and *P. manimaculus*

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Climate change via anthropogenic activities is causing ever rising temperature changes, affecting community dynamics in the rocky intertidal. Physiological stress from increased temperature may force heat-stressed species to move into cooler environments. As a result, interspecific interactions and increased population density may threaten the fitness of both species involved through increased behavioral conflicts. Reproductive output can be measured through the concentration of a yolk protein vitellogenin (Vg) and may be used as a measure of fitness in the crab species. The development of the Enzyme Linked Immunosorbent Assay (ELISA) in our lab has allowed to quantify Vg concentration in the hemolymph of the crabs (Delmanowski et al 2017). To investigate the effects of species interactions and increased population density, *P. cinctipes* and *P. manimaculus* were collected from November 2017 through February 2018 and were put into interaction treatments. Hemolymph samples were taken from each crab before and after a seven-day heat and density stress treatment. To quantify the effects of both treatments, the ELISA was used to quantify hemolymph levels of Vg before and after treatment/control. Increased interspecific species interactions (higher densities) decreased Vg levels and thermal stress decreased Vg levels in *P. cinctipes*. These data suggest that *P. cinctipes* relocation due to thermal stress places these crabs at higher densities with an interspecific grouping of crabs, appears to decrease Vg levels, suggesting a decline in reproductive output. Energy typically used towards reproduction, appears to be redirected to competition.

Taxonomic Revision of the Genus *Pagurus* Fabricius, 1775 “Provenzano” Group (Decapoda: Anomura: Paguridae) from the Western Atlantic

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The *Pagurus* “provenzano” group currently comprises 26 hermit crab species distributed along the Western Atlantic and Eastern Pacific. The Atlantic component is represented by 12 species, occurring from Massachusetts to Argentina. Due to several problems of identification and doubts concerning the distributional boundaries involving these species, the aim of this study is to provide a taxonomic revision of the “provenzano” group, including a diagnosis, illustrations of the main diagnostic characters, and remarks about taxonomic issues of all 12 species. Specimens from the entire range of distribution of the “provenzano” group were analyzed from several carcinological collections. After the analyses of the material we could observe that: i) *Pagurus brevidactylus* and *P. provenzano* can be quickly differentiated by the setation of the chelipeds; ii) *P. brevidactylus* and *P. criniticornis* may represent a complex of sibling species; iii) *P. trichocerus* is a valid species; iv) *P. annulipes* and *P. carolinensis* have a restrict distribution in the east coast of United States and Gulf of Mexico; v) *P. protuberocarpus* remains known only from the type locality. The number of spines in ocular acicles, length of the antennal flagellum, length of the setae on antennal articles, shape and armature of the left cheliped and posterior margin of the telson were most valuable for identification purposes.

Taking a Deeper Look – A Fossil Isopod Revisited By ‘Virtual Paleontology’

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Fossils often lack supposedly crucial characters. It is ironic that this is especially often the case for fossils from so called Konservat-Lagerstätten – fossil sites that are known for exceptional preservation. For example: with few exceptions, such as chert and amber, exceptionally preserved fossils are in most cases distinctly compressed. In addition to this common loss of the third dimension the crucial characters are often on the “wrong side”. Here, we present a fossil from a type of deposit that is not likely to bear exceptionally preserved fossils (high energy environment). Yet, the surrounding rock consists of small spheres of lime (oolite) which prohibited compression. The fossil is a three dimensionally preserved isopod crustacean. The dorsal morphology of the new specimen indicates that it is a representative of *Eonatolana geisingensis*, already known from this locality. By scanning the fossil in a micro-CT we gained insight into the so far poorly known appendage morphology of this species and reconstructed the morphology with the aid of labeling contrasted structures, rendering these as surface models. This virtual paleontology method not only revealed the structure of the locomotory appendages, but also allowed the interpretation of the mouthparts. The newly observed details support the systematic interpretation of *E. geisingensis* as a non-parasitic representative of Cymothoidea. Often, the non-parasitic forms within Cymothoidea have been united in the supposedly monophyletic group Cirolanidae. Due to lack of well formulated apomorphies the monophyly of this group is however doubtful. Thus, we consider *Eonatolana geisingensis* as Cymothoidea incertae sedis.