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*Organo della Società Siciliana di Scienze Naturali*


# ABSTRACT BOOK

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Dimitrios Avgerinos, Theodora Tsourou, Maria Triantaphyllou, Nefeli Kafousia, Grigoris P. Rousakis & Aristomenis P. Karageorgis

# THE RESPONSE OF OSTRACOD ASSEMBLAGES TO THE UPPER QUATERNARY ENVIRONMENTAL CHANGES IN SARONIKOS GULF (AEGEAN SEA, GREECE)

The Saronikos Gulf is an epicontinental basin, located in the central Aegean Sea, between the southern coast of Attica and the northeastern coast of Peloponnesus (Greece). It includes five smaller basins, all formed by neotectonic activity. This land-locked basin is of high scientific interest, as its sedimentary archive is expected to reflect, besides local events, environmental changes of greater scale.

In this framework during March 2017, the Hellenic Center for Marine Research recovered six sediment cores from the northeastern slopes of Epidavros Basin, in order to study the environmental evolution of Saronikos Gulf. One of these cores (SARC-18; extending from ~43 kyr BP to present day based on AMS and U/Th datings) underwent multiproxy analyses, such as granulometric, micropaleontological, mineralogical and stable isotope analyses (Kafousia *et al.*, 2021).

The aim of the current study is to analyze both qualitatively and quantitatively the ostracod assemblages retrieved from this core, in order to record their response to late Quaternary environmental changes and to contribute with micropalaeontological evidence to the reconstruction of the paleoenvironmental conditions in the study area.

Three sedimentary units were identified, reflecting different depositional environments that alternate along the core.

The lowermost Unit C (233-350 cm) was deposited between ~43 and 26 kyr BP, consisting of sandy muds. The ostracod assemblages are composed mainly of *Sagmatocythere versicolor* and *Callistocythere crispata*, and few specimens of *Henryhowella sarsi* and *Argilloecia* sp., indicating an open marine, outer shelf environment (Tsourou, 2012; Aiello *et al.*, 2015; Angue Minto'o *et al.,* 2015; Triantaphyllou *et al.*, 2022).

Unit B (60-233 cm) is dated between ~26 and 10 kyr BP. This part of the core is composed almost exclusively of calcium carbonate minerals, dominated by aragonite, with $^{13}C$ and $^{18}O$ exhibiting both high positive values. These characteristics indicate that Saronikos Gulf was isolated, forming an evaporitic lake during the previous Glacial period. Within the carbonate sequence, sporadic thin clayey intercalations displayed oligospecific ostracod assemblages together with low abundances of benthic foraminifer *Elphidium granosum*, an euryhaline species that can tolerate high salinity and low oxygen conditions. At some levels, the ostracod assemblages are abundant but presenting low diversity indices. Their assemblage is unusual as they are almost exclusively composed of the species *Callistocythere crispata*, *Leptocythere multipunctata* and *Leptocythere bacescoi*. These *Leptocythere* species are common in infralittoral - upper circalittoral environments, with optimum at 50-70 m water depth (AIELLO *et al.*, 2015; ROSSI *et al.*, 2018). *Leptocythere bacescoi* tolerates salinity fluctuations (MAZZINI *et al.*, 1999; CIAMPO, 2003), while *C. crispata* is common in the outer infralittoral-circalittoral environments of the Aegean Sea (TSOUROU, 2012; TSOUROU *et al.*, 2015).

The uppermost Unit A (0-60 cm) is dated between ~10 kyr BP – present day and consists of sandy muds and muds. Ostracods are less abundant in this Unit but the assemblages present higher diversity. They change gradually towards the top, composed mainly of the species *Buntonia textilis*, *C. crispata*, *Bosquetina dentata*, indicating middle-outer shelf environment (DI DONATO *et al.*, 2009; TRIANTAPHYLLOU *et al.*, 2022), and the progressive establishment of the current open marine conditions in Saronikos Gulf.

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Elena Bellavere, Giampaolo Rossetti, Francesc Mesquita-Joanes, Donato Romano

# VISUAL AND COGNITIVE ABILITIES OF NON-MARINE OSTRACODS IN A COLORFUL WORLD

Miniaturized analytical systems are an emerging technology with several applications in aquatic ecology, including assessing the cognitive abilities of invertebrates through their sensory systems (Romano *et al.*, 2022). Such systems prove to be particularly suitable for the non-invasive study of the relationship between photoreception and learning in non-marine ostracods. Ostracods are bivalve crustaceans whose living non-marine representatives belong to the order Podocopida (Ostracoda) (Smith *et al.*, 2015; Meisch *et al.*, 2019). Podocopid ostracods have a simple optic system consisting of three eye cups, known as the naupliar eye, composed of specialized cells and a lens-mirror optic apparatus (Elofsson, 2006). In some species, a transparent area of the calcitic carapace serves as an additional lens (Andersson & Nilsson, 1981; Tanaka, 2005, 2006). Variations in optic system composition, size, and other morphological and ecological characteristics exist among species (Meisch, 2000). Molecular studies suggest that species in the genus *Heterocypris* synthesize wavelength-sensitive photopigments (Henze & Oakley, 2015; Palecanda *et al.*, 2022).

Romano *et al.* (2022) demonstrated that miniaturized arenas are appropriate for analyzing behavioral aspects in non-marine ostracods, specifically showing that *Heterocypris incongruens* (Ramdohr, 1808) is able to perform associative learning with light stimuli of different wavelengths. We extended the investigation of photoreception-related ethological behaviors to several species of non-marine ostracods. Using two custom-designed miniaturized arenas, we assessed photoreceptive abilities and learning ability by computational analysis of the trajectories and movement of individuals subjected to different light stimuli in the visible range. We compared responses to colored light stimuli and conditioning and conducted experiments on spatial memo-

ry integration using visual and tactile cues. Experimental groups underwent conditioning sessions, and their ability to discriminate previously light-associated stimuli was tested against unconditioned individuals. The ostracod species examined showed different responses, possibly reflecting diverse adaptations to specific ecological requirements.

Our results contribute valuable insights into the adaptive mechanisms underlying the sensorial and cognitive functions in non-marine ostracods. Furthermore, this approach is promising for broader applications in elucidating the behavioral and ecological dynamics of these organisms, thereby enhancing our comprehension of their roles in aquatic ecosystems.

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Elena Bellavere, Renate Matzke-Karasz, Donato Romano
& Giampaolo Rossetti

# VISION AND LEARNING IN NON-MARINE OSTRACODS

Photoreception and vision are probably some of the most important ways in which animals belonging to a multitude of different evolutionary lineages explore their environment, modulate their behavior, and shape their learning processes. Ostracods are small, bivalved crustaceans that inhabit a variety of aquatic environments (Smith *et al.*, 2015). Available information on the structural and physiological characteristics of the photoreceptive apparatuses of ostracods refers largely to marine species, while knowledge of these topics for non-marine species is still rather limited. The non-marine species, all belonging to the order Podocopida (Meisch *et al.*, 2019), typically have a simple optical system consisting of three eyecups known as naupliar eye, which exhibit similar features in different groups of crustaceans (Elofsson, 1992). This photoreceptive system is composed of several specialized cells and can be approximated by a lens-mirror optical apparatus (Elofsson, 2006). Notably, podocopid ostracods in the genus *Heterocypris* are known to express long-wavelength sensitive rhabdomeric opsins (Henze & Oakley, 2015; Palecanda *et al.*, 2022).

Ostracods use various sensory systems to explore their environment and interact with other organisms, such as chemoreceptors with olfactory function and mechanoreceptors that pick up tactile stimuli and, in some specific cases, hydrodynamic changes in the surrounding water generated by pressure waves and particle movement (Maddocks, 2000; Smith & Matzke-Karasz, 2008). In podocopid ostracods, the integration of chemical, photoreceptive, and other sense stimuli to detect predators and mates can be hypothesized. Non-marine ostracods seem to be able to respond to preferred light components, as demonstrated by phototaxis experiments. The role of photoreception and vision in associative learning processes, experimentally confirmed in

several invertebrate groups, is probably also important in non-marine ostracods.

The first behavioral study of light stimulus perception in non-marine ostracods is probably that of APPLEWHITE & MOROWITZ (1966), in which *Cyclocypris forbesi* Sharpe, 1897, preferred dark environments and learned to avoid light by solving a light-driven maze. It also showed associative abilities of classical pseudoconditioning by closing valves when illuminated by a light source passing through a blue frosted glass filter associated with successive electric shocks. To date, the only ethological experiments combining color perception and learning in non-marine ostracods are those conducted by ROMANO *et al*. (2022), in which miniaturized analytical systems were used to demonstrate that *Heterocypris incongruens* (Ramdohr, 1808) can exhibit associative operant conditioning.

It is not currently possible to determine whether these capabilities are present in other species of the superfamily Cypridoidea or other non-marine podocopid superfamilies. Given that the ability to learn through visual stimuli represents a significant adaptive advantage for survival and resource utilization, the paucity of research devoted to investigating the role of vision from an evolutionary and adaptive perspective in non-marine ostracods is surprising.

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# HOLOCENE BYTHOCYTHERIDAE (TRIBES BYTHOCYTHERINI SARS, 1926 AND JONESINI SCHORNIKOV, 1981) FROM SOUTHWESTERN ATLANTIC DEEP-SEA SEDIMENTS OFF BRAZIL

The Bythocytheridae Sars, 1866 is one of the oldest families of cytheroidean Ostracoda, with fossil record dating back to Silurian (Schornikov, 1988; 1990). During the Cenozoic this family became one of the main constituents of the deep-sea ostracod faunas, with some taxa reaching wide geographic distribution. Bythocytherids are, therefore, important for the understanding of evolution and paleogeographic patterns of Ostracoda in marine environments. As continuation of a broader project on deep-sea ostracods in the southwestern Atlantic Ocean, this work investigates the tribes Bythocytherini Sars, 1926 and Jonesini Schornikov, 1981. The study area includes the Rio Grande Rise and adjacent oceanic regions off Brazil. Forty-seven samples of Holocene sediments were obtained from 12 cores collected by the Iatá Piuna/Quelle expedition during April and May 2013. Part of these samples were studied by Bergue *et al.* (2023) who presented a preliminary account on the ostracod assemblages based on the analysis of top core samples. The 11 species recorded herein are attributed to the genera *Bythocythere* Sars, 1866 (four species), *Bythoceratina* Hornibrook, 1952 (two species), *Retibythere* Schornikov, 1981 (two species), *Rhombobythere* Schornikov, 1982 (two species), and *Ruggieriella* Colalongo & Pasini, 1980 (one species). Besides these genera, the studied material also revealed high richness of *Pseudocythere* Sars, 1866 which will be investigated in future. The occurrence of bythocytherid species in the study area seems to be strongly influenced by the bathymetry, they are more abundant in the shallowest site (~1,250 m) and absent beyond 3,000 m water depth. A possible explanation for this faunal change is the northward influence of the Antarctic Bottom Water (AABW) along the Brazilian margin (Silveira *et al.*, 2020).

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# ASSESSING HYDROCHEMICAL VARIABILITY WITHIN THE SANDBACH FLASHES WETLANDS, CHESHIRE, ENGLAND, USING OSTRACODS, MOLLUSCS, MACROPHYTES AND WATER CHEMISTRY

The distribution of invertebrates (including non-marine ostracod species and their assemblages) can be mapped onto the hydrochemical conditions of their host waters. In the present study, living ostracod occurrences together with records of vegetation and molluscs are compared with water chemistry (major ions, pH, alkalinity) from a number of water bodies in a small area of Cheshire, northwest England, known as the Sandbach Flashes. The importance of these wetlands is reflected in their designation as a Site of Special Scientific Interest (SSSI) by Natural England, the UK the governmental adviser for the natural environment in England and they are important habitats for endemic and migratory birds.

The SSSI designation is related to the origin of these wetlands as shallow collapse structures formed due to the dissolution of underlying Mesozoic (Permo-Triassic) salt deposits which were stated to have conferred a range of 'saline' conditions on these waters.

The main aim of this project was to assess the degree of hydrochemical variability across these sites and to determine whether this was reflected in other biotic proxies, particularly ostracods. Some of the sites examined are isolated, others are interconnected and some of those form part of a local river system. Our results suggest that despite this original designation, the wetlands that we have been able to sample are currently of freshwater aspect (oligohaline) with similar ionic chemistry throughout with no sign of geologically derived salts, they all share broadly similar patterns of vegetation and invertebrate assemblages, including ostracods.

These results question the rationale behind assessing the Sandbach Flashes as an SSSI due to their elevated salinity although they remain important refugia for birds. The ostracod assemblages from the Sandbach Flashes

demonstrate no direct evidence of even transient elevated salinities (mesohaline) across the study area but, paired with water chemistry data, it does provide useful autecological constraints for those ostracod taxa recorded.

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# FLUCTUATIONS IN THE OSTRACOD ASSEMBLAGES FROM THE BLACK SEA SINCE THE LAST GLACIAL MAXIMUM

During the Late Pleistocene-Holocene, the Black Sea basin suffered a major shift from a freshwater environment to a brackish one, which is mirrored in the biotical turnover. The transition of the Black Sea from an inland lake to a marine basin during the last glacial/deglacial episode is still generating debates. In the Late Pleistocene – Holocene interval, the water level of the Black Sea was controlled by regional rather than global climatic modifications (Lericolais *et al.*, 2010). During the Last Glacial Maximum (LGM, 25,000–18,000 years BP), the eustatic level of the Black Sea was approximately 200 m lower than today and the basin had a freshwater character (Fedorov, 1972; Yanko, 1990; Ryan *et al.*, 1997). Throughout this period the ostracod community was represented by Ponto-Caspian fresh-brackish water species, with a continuous presence of *Graviacypris elongata* and the occurrence of cold-water ostracod species (Briceag *et al.*, 2019). Afterwards, during Heinrich Stadial 1 (HS-1, 18,000-14,700 years BP), the first Fennoscandian Meltwater Pulse in the Black Sea occurred, which recorded a high deglacial sediment load represented by the deposition of reddish-brown clays in the western part of the basin. Thereby, the sediment accumulation rate values indicate an almost four-fold increase and the ostracod diversity and abundance recorded higher values, suggesting an increase in nutrient delivery into the basin. In this study, high resolution microfaunal analyses were performed on one Kullenberg gravity core, 09 SG 13 (396 cm long) from 200 m water depth and one core, MN 103_04 collected with a multi-corer (29 cm long) from 78 m water depth, revealed changes that occur in the Black Sea from the Last Glacial Maximum through the transition to the present day semi-enclosed marine basin. The youngest sediments contain a brackish ostracod assemblage, with low diversity and abundance. This interval is characterized by the presence of

polyhaline ostracods with Mediterranean origin. The ostracods from this assemblage tolerate salinities comprised between 17-21 ‰ and characterize a sub-littoral environment. Regarding the shallower core, the shift in macrofauna and the decrease in the ostracod abundance suggests a sea-level rise during the Holocene. Fluctuation in ostracod assemblages, based on qualitative and quantitative studies, are presented herein, together with a (paleo-) environmental characterisation.

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# FIRST RECORD OF LAGO-MARE OSTRACODS FROM NORTHEASTERN ALGERIA (EL EULMA BASIN)

In Algeria, Lago - Mare episodes are only known in the western part of the country especially in Chelif basin where Messinian deposits were studied in detail.

In the present study, four stratigraphic sections were sampled and micropaleontological analysis has been made to verify the existence of the Lago-Mare episodes in the El Eulma Basin belonging to the larger Neogene Constantine Basin (Northeastern Algeria).

A total of 29 samples were examined and several sedimentary levels show high concentrations of Messinian Lago-Mare ostracod associated to some charophytes. These samples yielded six Ostracod species mostly dominated by *Cyprideis torosa,* Müller, 1900 and *Cyprideis agrigentina* Decima, 1964 associated to some *Ilyocypris gibba* (Ramdohr, 1808), *Zonocypris membranae* Livental, 1956*, Candona angulata* Müller, 1900 and *Cyclocypris* cf. *laevis* (Müller, 1776).

The new data collected will contribute to a better knowledge of paleoenvironmental evolution of the El Eulma Basin during the post evaporitic phase of the Late Messinian.

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Cycyk Romain & Queiroz Neto Joao

# INTRASPECIFIC VARIABILITY IN REPRESENTATIVES OF THE GENUS *KROEMMELBEINCYPRIS* POROPAT & COLIN, 2012

The intraspecific variability of an Aptian, non-marine group of Cypridids, endemic to the African-American rift valleys prior to the South-Atlantic spreading is discussed below. When Poropat & Colin (2012) created the genus *Kroemmelbeincypris,* they formalized the species *Kroemmelbeincypris angulata* and *K. symmetrica,* originally described by Krömmelbein & Weber (1971), as *Hourcqia angulata angulata* and *Hourcqia angulata symmetrica*, and reassessed as *Pattersoncypris* (Bate, 1972) in this same paper. The diagnosis of *Kroemmelbeincypris* is based on a typical, sharp posterodorsal angle. After observing the same feature on *Harbinia crepata* published by Do Carmo *et al.* (2013), Buratti & Dupont (in preparation) consider including the species in *Kroemmelbeincypris*.

This study aims to illustrate a range of different morphotypes to display the intra- specific variation for each species of the discussed genus. The species are differentiated based on the inclination of the anterodorsal and posterodorsal margins and the height/width ratio values. For this purpose, some morphotypes related to the different *Kroemmelbeincypris* species are discussed based on specimens illustrated in the literature and in-house material.

With an array of different morphotypes of each species, it was possible to ensure that the posterodorsal angle is highly variable at specific level. For each of the three species, the intraspecific variation trends show one end-member holding a well-developed posterodorsal angle, while the opposite morphotype has a rounded posterodorsal margin and the characteristic angle is not observable. This spectrum of margin shapes could be linked to a strong effect of polymorphism within the species as stated by Tomé *et al.* (2014). It would suggest that the posterodorsal margins difference between *Kroemmel-*

*beincypris* and the related genus *Pattersoncypris* (BATE, 1972) cannot be properly evidenced and used as a morphological criterion. Therefore, it raises the question of the validity of the *Kroemmelbeincypris* genus.

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Nataliia Dykan

# OSTRACODS OF THE TYRRHENIAN SEA: SYSTEMATICS, ZOOGEOGRAPHY, BIOSTRATIGRAPHY

Upper Pleistocene and Recent ostracods were studied from Quaternary and modern deposits of the southwestern part of the Tyrrhenian Sea, the African-Sicilian Threshold, the areas of the Tunis and Kitira Straits (shelf, continental slope, deep-water depression, 65- 3500 m water depth; the research ship "Donuzlav" of the National Academy of Sciences of Ukraine, 1987). The systematic description of the ostracods includes 69 species of the order Podocopida (16 families, 37 genera) and of the order Platycopida (two families, two genera), of which eight species are new to science.

The analysis of the vertical and lateral distribution of the ostracods in the deposits of the different lithofacies, the assessment of the diversity of species composition of associations of the Recent ostracods in the biotopes of the littoral, bathyal and abyssal zones of the sea, and the data on the ecology of the Recent ostracods (the degree of species tolerance in relation to depth water and substrate type) were supplemented.

The zoogeographic analysis of the ostracods (reconstruction of modern and fossil biotopes, possible routes and directions of ostracod migration) was based on the data of the geographical distribution of the ostracods (Mediterranean region and Ocean) in the stratigraphic range "Paleogene-Recent". Seven zoogeographic groups of the ostracods (Arctic- North Atlantic, West Atlantic, South Antarctic, Indian-Pacific, Mediterranean, Black Sea, semicosmopolitans) were determined.

The biostratigraphic analysis is based on data on the stratigraphic position and geographical distribution of ostracods in the Mediterranean basin (the Mediterranean Sea with inland seas, the Black Sea, and the Caspian Sea) and the Ocean. The species-markers of the Upper Pleistocene for the Mediterranean basin are identified. The data obtained allow us to correlate

the Upper Pleistocene deposits of the Tyrrhenian and Mediterranean Seas and can be used for further studies of the Quaternary history of the Mediterranean basin.

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Naturalista sicil., S. IV, XLVIII, 2024, pp. 26-28

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# PALAEOBATHYMETRIC RECONSTRUCTION OF THE LATE CALABRIAN-LATE CHIBANIAN TOL-1 SECTION (MERSIN, TURKEY), THROUGH MARINE OSTRACOD ASSEMBLAGES: A NEW EVALUATION OF THE MIDDLE PLEISTOCENE UPLIFT RATE OF THE CENTRAL ANATOLIAN PLATEAU SOUTHERN MARGIN

The southern margin of the Central Anatolian Plateau (CAP) is a tectonically active region of the Eastern Mediterranean area, which records high Neogene-Quaternary uplift rates. According to Cosentino *et al.* (2012), O retmen *et al.* (2018), and Liberatore *et al.* (2022) it was affected by uplift rates around 0.24–0.25 mm/yr (late Tortonian), 3.21–3.42 mm/yr (Middle Pleistocene), and 0.9 and 1.5 mm/yr (late Holocene), respectively. Here we re-evaluate the Middle Pleistocene uplift rate through palaeobathymetric reconstructions using marine ostracod assemblages of a new section (Tol-1), located in the Mersin region (Turkey) Tol-1 section (72 m thick) crops out at 1177 m a.s.l. and consists of calcareous massive marls, laminated clayey marls, and decimeter calcarenite layers. The section was sampled around every meter, for a total number of 68 samples.

The age of the sedimentary succession has been estimated using calcareous nannofossils. The bottom occurrences of *Gephyrocapsa omega* near the base of the section (sample 3) and of *Emiliania huxleyi* near the top of the section (sample 65) constrain its age between 0.96 Ma and, at least, 0.26 Ma (according to the new Mediterranean calcareous nannofossil zonation proposed by Di Stefano *et al.*, 2023), thus spanning from late Calabrian to late Chibanian.

The taphonomic analysis of the ostracod assemblages show the presence of "mixed fossil assemblages" in almost all of the samples, made by a contingent of allochthonous reworked Neogene taxa, allochthonous displaced Pleistocene taxa, and 62 autochthonous taxa identified at the species level or left in open nomenclature.

The autochthonous contingent is made of littoral taxa (among which, *Aurila convexa*, *Aurila nevianii*, *Carinocythereis carinata*, *Celtia biflexa*, *Grin-*

*ioneis haidingeri*, *Callistocythere* sp., *Semicytherura* sp.), eurybathic taxa (*Acanthocythereis hystrix*, *Argilloecia acuminata*, *Argilloecia fatua*, *Krithe compressa*, *Krithe iniqua*, *Krithe pernoides*, *Parakrithe dimorpha*), and epibathyal/bathyal taxa (*Bythocypris producta*, *Cytherella robusta*, *Henryhowella sarsi profunda*, *Oblitacythereis mediterranea*, *Parakrithe rotundata*) that characterise different assemblages along the section.

Using the Cluster Analysis (Bray-Curtis similarity index, UPGMA) in Q-mode and the autoecological characteristics of the most represented taxa it was possible to reconstruct the palaeobathymetry of the Tol-1 sedimentary succession. The sedimentation starts in a lower circalittoral environment and, through circalittoral to upper epibathyal palaeobathymetric oscillation, at around 15-36 m from the base of the section it reaches its maximum depositional depth in the upper epibathyal environment (not deeper that 400 m for the presence of *Occultacythereis mediterranea*). Going upwards, through alternate oscillations between upper epibathyal and upper circalittoral environment, the top of the section can be referred to an infralittoral environment.

The late Chibanian age for the top of Tol-1 section is in agreement with Racano *et al.* (2020), which show the maximum uplift rates of the CAP southern margin between 350 and 150 ka. Considering the present elevation of the section, the depositional sea depth of the top of the section of around -50 m and the eustatic sea level that, at 0.26 Ma was at around -90 m (Dutton *et al.*, 2009), the new uplift rate of the CAP southern margin has been estimated around 5 mm/yr.

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# ENVIRONMENTAL CHANGES IN SW PORTUGAL DURING THE LAST 3900 Y BP: PRELIMINARY OSTRACOD, GEOCHEMICAL AND SEDIMENTOLOGICAL RESULTS

The present work aims to enhance the use of ostracods in Quaternary palaeoecological studies in the Algarve continental shelf, a dynamic oceanographic area, situated between the equatorward surface Canary Current and the northward North Atlantic Current, with seasonal influence from the coastal upwelling off S. Vicente Cape (Relvas & Barton, 2002). Deeper currents are generally of Mediterranean origin (Mediterranean Outflow Water; García- Gallardo *et al.,* 2017). Since ostracods are sensitive to variations in salinity, temperature, sediment texture and nutrient content (Athersuch *et al*., 1989), they have the potential to bring new knowledge regarding changes in water mass patterns. Nevertheless, at present, Ostracoda studies in the Algarve region are restricted to superficial samples collected along the coast (e.g., Luz, 2011; Cabral & Loureiro, 2013; Matias *et al*., 2015; Barata, 2022), to Holocene sedimentary records collected from coastal lagoons and estuaries (e.g., Trog *et al*., 2013) and the Iodp site U1386 for the period Pleistocene-Pliocene (Ducassou *et al*., 2016).

We reconstruct Mid-Late Holocene climatic change by analysing a 144 cm long sediment core collected offshore Sagres at 85 m water depth. The core was sampled every 10 cm for Ostracoda analyses and every 5 cm for the deposit texture and organic matter content. Chronology is supported by a C14 date at the core base.

The assemblages are composed predominantly of juveniles (80-92%), with few articulated carapaces, indicating this is a depositional area from species living nearby. The dominant species (here defined as a species representing >5% of the assemblage in a sample) are the sublittoral *Costa runcinata* and sublittoral-littoral species, such as *Heterocythereis albomaculata*. These results confirm the patterns observed in superficial samples collected offshore Sagres (Cabral *et al.,* 2011; Luz, 2011; Matias *et al.,* 2015).

Cluster analyses, stratigraphically constrained, identified six units based on the dominant and common species, the latter defined as taxa present in at least 8 out of the 14 samples analysed (Constrained Incremental Sum of Squares (CONISS), Bray–Curtis similarity matrix). Unit 1 (core depth 135cm) and Unit 2 (125cm) represent the highest and lowest species richness, respectively, with Unit 2 coinciding with low sand content. Unit 3 (115–105cm) and Unit 2 are characterized by the absence/negligible incidence of species more typical of deep waters (such as *Pterygocythereis jonesii* and *Rectobuntonia rectangularis*) and systematically accounted for in the remaining samples. However, Unit 3 has twice as many specimens as Unit 2 (1 specimen=1 valve/carapace). Unit 4 (95–35cm) shows a systematic increase in sand content, peaking after 70 BC (Warmer Roman period; ~55cm), accompanied by an increase in total valve count. Unit 5 (25–15cm) shows a decrease in total valve count despite marginal changes in sand content. Unit 6 (5cm) shows a modest increase in valve total count, probably favoured by lower hydrodynamics (favouring valve preservation).

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# THE OLDEST OSTRACODS FROM COLD SEEPS: A NEW COMMUNITY FROM THE LATE JURASSIC OF SOUTH-EASTERN FRANCE BASIN

Cold seeps are among the most extreme marine habitats where hydrogen sulfide, methane and other hydrocarbon-rich fluids are emitted. They nevertheless harbor rich biological communities structured around chemosynthesis rather than photosynthesis. The Terres Noires Formation (Bathonian–Oxfordian) in the south-eastern France basin contains sedimentary bodies that have long remained enigmatic and are now interpreted as representing the activity of cold seeps. We describe the Sahune outcrop, in the Drôme department, which illustrates a new fluid emission site in the Upper Jurassic, as demonstrated by geochemical markers. The associated fauna composed of benthic and planktonic foraminifera, radiolarians, crinoids, echinoids and ostracods is unique and indicates seeps in the bathyal zone. The Sahune site provides the oldest ostracod community reported to date in such environments, opening new perspectives on understanding their adaptations to these extreme conditions. The newly described species *Procytherura praecoquum*, for example, seems to be restricted to seepage zones and could illustrate the oldest known example of ectosymbiosis among ostracods. The Sahune assemblage also demonstrates that the ostracod communities of cold seeps have been composed of a mixture of taxa from platforms and oligotrophic deep zones, since the Late Jurassic. The post-Jurassic diversification of cold seep ostracods thus seems to have been the consequence of colonization events and diversification of families populating these ecosystems at least since the Oxfordian.

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# UNEXPECTEDLY HIGH TAXONOMIC DIVERSITY OF OSTRACODS IN THE ARID NORTHERN CAPE PROVINCE OF SOUTH AFRICA

The Northern Cape is the largest Province of South Africa, characterized by an arid climate and a gradient in annual rainfall. The western region of Succulent Karoo receives less than 100 mm of rainfall annually, primarily in winter, while the eastern region of Nama Karoo receives up to 500 mm of rainfall per year, predominantly in summer (Strydom *et. al.*, 2019). Due to the arid or semi-arid climate and low annual rainfall, most waterbodies are ephemeral or episodic, making them challenging habitats for living organisms and highly endangered by climate change. The current knowledge on the ostracod fauna in this Province is limited, with records from only nine sites documenting the occurrence of 12 species (Daday, 1913; Sars, 1924; Rome, 1965; Meisch, 1985; Martens, 1986). The aim of the present study was to determine the taxonomic composition and structure of the ostracod assemblages inhabiting temporary waters in the Northern Cape. Samples were collected in September 2012 from 11 sites in both the eastern and western regions of the Province, yielding a total of 12,593 specimens. The collected ostracods represented 31 species belonging in 13 genera and four families (Candonidae, Cyprididae, Ilyocyprididae, and Limnocytheridae), and our survey confirmed the presence of only three species previously reported from the Province. Together with other published historical records (*op. cit*.), the inventory of ostracod fauna of the Northern Cape now includes 40 species, approximately one-third of the total number of non-marine species known from South Africa (Martens, 2001), making this Province one of the most species-rich. The species accumulation curve of the observed number of species, however, did not asymptote, indicating that several more species remain to be sampled in the Province. Extrapolation showed that the total expected number of species varied between 39 and 91, which suggests that

we captured between 34 and 79% of the total expected number of species present in the sampled area. Species richness at the individual sites (Alpha diversity) was moderate and varied between 1 and 11, with a mean of 4.1, comparable to alpha diversity reported in the Eastern Cape (NAMIOTKO *et al*., 2023) and North-West (SZWARC *et al*., 2023) Provinces of South Africa or in Botswana (SZWARC & NAMIOTKO, 2022). Notably, the studied sites exhibited high variability in species composition, with 22 species present at only one site, resulting in a global Beta Whittaker diversity of 6.58. The most abundantly represented family was Cyprididae, comprising 24 species and 90.1% of all collected specimens. The collected material included cosmopolitan species such as *Cypridopsis vidua* (O.F. MULLER, 1776) and *Heterocypris incongruens* (RAMDOHR 1808), species previously reported from southern Africa as well as four putative new species of the genus *Sarscypridopsis* Mc Kenzie, 1977. Overall, the species of the latter genus were the most frequently occurring, being present at 36.4% of the sites, followed by *Potamocypris mastigophora* (Methuen, 1910) and *C. vidua*, each found at 27.3% of the sites. Further taxonomical surveys can illuminate the undiscovered life of this arid region and reveal its ostracod diversity, while ecological studies could show correlations between ostracod assemblages and environmental conditions.

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# LITTORAL LIVING OSTRACODA FROM THE BRACCIANO CALDERA-LAKE (SABATINI VOLCANIC COMPLEX, CENTRAL ITALY)

Bracciano Lake occupies a volcano-tectonic depression in the Regional Natural Park of Bracciano-Martignano (Latium, central Italy). It is a freshwater lake with a surface area of about 57 km$^2$, a perimeter of about 31.5 km, and a maximum depth of 188 m below the hydrometric zero, located at 163 m a.s.l. Its water input is provided by precipitation, runoff waters, small ditches connected to meteoric events, and groundwater inflows. The natural outlet of Bracciano Lake is the Arrone River, whose discharge has gradually decreased over the last decades and has stopped since 2016. The lake was considered oligo-mesotrophic and warm monomictic, with a mixing phase from November to February (Ferrara *et al.*, 2002).

With the aim to improve the knowledge on the ecology of the lake, in the frame of the National Project CARG Bracciano in collaboration with ISPRA (National Institute for Environmental Protection and Research) and the Bracciano-Martignano Regional Natural Park, during 2022-2023, four seasonal campaigns were carried out to collect ostracods from the littoral area of the lake (0.5-15 m of depth). Thirty-eight samples from 14 sampling sites located around the lake were collected each season using different methodologies depending on the depths. At each station, the main chemical and physical parameters of the bottom water were measured, and the characteristics of the substratum, including grain size and the composition of aquatic macrophytes, were evaluated.

In this paper we present some preliminary data related only to the summer and autumn surveys. In those seasons, eleven taxa were collected: *Darwinula stevensoni* Brady & Robertson, 1885, *Neglecandona angulata* (G. W. Müller, 1900), *Cyclocypris* sp., *Cypria* sp., *Ilyocypris* sp., *Herpetocypris* sp., *Heterocypris* sp., *Cypridopsis vidua* (O.F. Müller, 1776), *Limnocythere inopinata* (Baird, 1843), *Paralimnocythere* sp., and *Cyprideis torosa* (Jones,

1850). In comparison with previous studies carried out on the lake (ZSCHOKKE 1911; MASTRANTUONO 1995; MASTRANTUONO & MANCINELLI, 2005) in our samples we failed to find living specimens of *Cytherissa lacustris* (Sars, 1863) and *Strandesia* sp. Conversely, we increased the ostracod list, adding *Cyclocypris* sp., *Cypria* sp., *Herpetocypris* sp., *Heterocypris* sp., *Paralimnocythere* sp., and *Cyprideis torosa* (Jones, 1850).

*Darwinula stevensoni* and *Cyprideis torosa* were the most commonly found species in most sampling sites (12 and 11 respectively) at all the sampled depths. *Neglecandona angulata* mostly occurred in samples at 15 m of depth, associated with *Cyprideis torosa* and often also with *Darwinula stevensoni* and *Ilyocypris* sp.

Extensive beds of Characeae were present at most of the sampling sites, especially at -7 m and to a lesser extent at -15 m. Few ostracod taxa were associated with dense macrophyte cover, namely *Darwinula stevensoni*, *Cyprideis torosa*, and *Ilyocypris* sp. The maximum number of ostracod taxa per sampling site was 9, collected at 0.5-1 m in the summer; two taxa (*Cyclocypris* sp. and *Herpetocypris* sp.) were exclusively found within the stands of *Ludwigia hexapetala* (Hook. & Arn.) Zardini, H.Y.Gu & P.H. Raven, an invasive alien macrophyte that was particularly widespread at that site.

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# EXCEPTIONAL PRESERVATION OF CARBONIFEROUS MARINE OSTRACOD SOFT PARTS

The ostracod fossil record is mainly based on carapaces which is often the only structure to be preserved. The taxonomy of fossil forms is therefore mainly based on their morphologies. This constitutes a major issue for the comparison of extant and fossil taxa, as extant forms are mainly distinguished on the basis of their soft parts and appendages (e.g., Martens *et al*., 2012).

In Paleozoic marine environments, ostracod faunas were massively dominated by species of Palaeocopida, which disappeared at the beginning of the Late Triassic (Carnian). However, recent works suggest that this order would be composed of a mixture of true Palaeocopida and other clades, notably Podocopida and Myodocopida. For example, *Pauline avibella* described from Herefordshire by Siveter *et al*. (2013) has a carapace whose morphology is typical of Palaeocopida but the preserved soft parts are those of a Myodocopida. Such discoveries are of fundamental importance, in order to clarify the taxonomic affinities of fossil taxa and thus revise biodiversity curves based on a robust taxonomy, the uncertainty of the nature of Palaeocopida being a major scientific obstacle in the Paleozoic.

Several hundred fossil ostracods have been found within a phosphatized nodule from the Pennsylvanian (Late Carboniferous) of the San Gregorio Formation (e.g., Braun *et al*. 2003) exposed in Lago Rincon del Bonete (San Gregorio de Polanco), Uruguay. A part of this nodule has been scanned at the Soleil synchrotron (Saint-Aubin, France), highlighting the preservation of soft parts in many specimens, unknown to date in marine ostracods of this age. The assemblage is poorly diversified, with all the adult specimens belonging to a unique species of Palaeocopida based on the morphology of carapace. Specimens of similar morphology but showing important variations in size range indicate that different ontogenetic stages are represented within the nodule.

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# THE ROLE OF OSTRACODS IN DETERMINING PALAEOENVIRONMENTAL CHANGES IN THE EARLY /MIDDLE MIOCENE DEPOSITS OF PAPUK MT. (CROATIA)

This work aims to identify ostracods found in Miocene deposits from the southwestern slopes of Mt. Papuk in Croatia. The investigated area was part of the North Croatian Basin (NCB), situated along the southwest margin of the Central Paratethys. The evolution of NCB is associated with global sea level changes that occurred during the Miocene epoch and its connection with the Mediterranean Sea.

The sedimentary record evidence deposition influenced by volcaniclastic input and the presence of marine, brackish, and non-marine fossils indicate a complex palaeoenvironment (Hajek-Tadesse *et al.,* 2023). Based on sedimentological data and fossil content, the sediments can be divided into four units: 1) acidic tuffitic sediment, characterized by relatively low concentrations of palynomorphs and diatoms without ostracods; 2) greyish-green gravelly silty-sandy sediments containing planktonic and benthic foraminifera, red algae, ostracods, coccoliths, and palynomorphs; 3) siltstone with silty sand layers characterized by various fossils, e.g., diatoms, palynomorphs, calcareous nannofossils, ostracods, gastropods, fishes, and crocodile tooth; and 4) dark and light grey horizontally laminated siltstones intercalated with thin bentonite and clayey, silty sand layers, rich in leaves and other plant remains, palynomorphs, diatoms, calcareous nannofossils, ostracods, molluscs, and fish remains (Hajek-Tadesse *et al.,* 2023).

The ostracod faunas, which occur in all units with exception of the tuffitic sediment (first unit), are moderately diverse. Sixteen ostracod taxa were identified, most of which remained in open nomenclature. These include four marine and twelve non-marine ostracod taxa belonging to the ostracod families Cytherellidae, Xestoleberidae, Bythocyprididae, Krithidae, Darwinulidae, Candonidae, and Cyprinidae.

Only the second unit contains marine ostracods (*Cytherella*? sp., *Xestoleberis* sp., *Bythocypris*? sp. and *Parakrithe*? sp.), while twelve non-marine ostracod taxa are detected in the third and fourth units. The most common records of non-marine ostracods come from the genera *Cypridopsis*, *Cypria*, *Eucypris*, *Potamocypris*, and *Fabaeformicandona*. Marine ostracods are rare and poorly preserved, while non-marine ostracods are well preserved, with slightly compressed carapaces in most samples. Furthermore, remains of the glassy infill of carapaces were found (possibly caused by an increased silica content), some with poorly preserved shells.

The composition of ostracod assemblages depends mainly on salinity and water depth. Marine ostracods (unit two) lived in a marine environment with good communication with the open sea and proximity to an estuarine environment (HAJEK-TADESSE *et al.*, 2023). Non-marine ostracods were found in brackish lacustrine environments related to temporary or short-term marine incursions. These marine incursions can increase the salinity of the lake and alter the non-marine assemblages. Higher salinity is reflected in more ornamented valves of *Cypridopsis* or a drastic reduction in non-marine ostracod abundance (HAJEK-TADESSE *et al.*, 2023).

Most investigated sediments were deposited during the Miocene Climate Optimum (MCO; 17–14.7 Ma) under humid subtropical and tropical conditions. According to the sporomorphs the highest annual mean temperature (MAT), (MAT: 17.7-21.7°C – 19.5°C) observed in the third unit could coincide with the known temperature maximum event at 16,5 Ma in Central Paratethys., and one interruption at the end of the third unit with lower temperatures (MAT: 13.3-21.3°C – 17.3 °C) could be a consequence of the known cooling event at 16.06 Ma in the Central Paratethys (HAJEK-TADESSE *et al.*, 2023).

This research was conducted in the scope of the internal research project "Development of Miocene paleoenvironments in Croatia and their connection with global events (RAMPA" at the Croatian Geological Survey, funded by the National Recovery and Resilience Plan 2021–2026 of the European Union – NextGenerationEU, and monitored by the Ministry of Science and Education of the Republic of Croatia.

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# BIODIVERSITY HOTSPOTS OF RECENT FRESHWATER OSTRACODA IN BRAZIL

Brazil occupies almost half of the surface area of South America and covers different climatic zones, which leads to great ecological diversifications, forming distinct biogeographical areas or biomes. This reflects the megadiversity of Brazilian flora and fauna, including the high level of endemism.

A literature review in 1994 recorded 260 species in 53 genera of recent non-marine ostracods from South America (Martens & Behen, 1994). Of these, 91 species in 32 genera occurred in Brazil according to a 1998 checklist (Martens *et al.*, 1998).

Here, we present the results of recent inventories of freshwater ostracods from Brazil, including an overview of the geographical distribution of species. The expeditions of the PELD (Long-term Ecological Research Program in the Upper Paraná River Floodplain) and SISBIOTA (National Biodiversity Research System program - carried out in four Brazilian floodplains), increased these numbers to 133 species in 41 genera, including the descriptions of 31 new species in nine new genera (e.g. Ferreira *et al.*, 2020; Almeida *et al.*, 2023). The highest richness of ostracods has been found in the Atlantic Forest biome, which includes the upper Paraná River floodplain. The Amazon biome, where the Amazon floodplain is located, had the lowest diversity of ostracods but has also received much less attention in recent decades: the upper Paraná River floodplain has almost continuously been monitored since 2004, while only two (2011 and 2012), relatively short, collecting trips have been made in the Amazon floodplain. Thus, these results emphasize the relevance of long-term biodiversity monitoring studies. In addition, our results show that there is still little knowledge about the biodiversity of Brazilian ostracods, given that extensive areas remain unexplored.

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Naturalista sicil., S. IV, XLVIII, 2024, pp. 45-46

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# SIZE AND SHAPE VARIABILITY OF *CYPRIDEIS TOROSA* ON DIFFERENT SPATIAL AND TEMPORAL SCALES

Organism size and shape are considered a master trait influencing virtually every aspect of life; however, the underlying mechanisms of phenotypic variation are still poorly understood (Hart & Bycheck, 2011). Whether and to what extent these variations are controlled by selection (natural and/or sexual), genetics and/or environment is often the focus of research but remains unclear (Seifert *et al.*, 2022; Stillwell *et al.*, 2010).

In this study we examined the valve size (length, height and width) and shape (outline) of an ostracod species (*Cyprideis torosa*) at different spatial (regional, local) and temporal (living, dead, Holocene) scales on samples from Mansfeld Lakes, Central Germany, German Baltic Sea, and Camargue (Mediterranean Sea). Statistical methods were applied to explore valve size and shape variation between and within the sexes and sample locations, as well as the relationship between size traits and physical and chemical parameters (salinity, oxygen, temperature, pH).

Size variability in *C. torosa* is superimposed by large scale patterns like Bergmann s and Rensch s rules but shows regionally specific size clusters. Valve shape differs between the sexes, but regional cannot be separated. Ecological conditions weakly influence morphological patterns and only on local scales. On all investigated scales (regional, local, seasonal) as well as environmental related size variability, morphological variability shows sex-specific patterns. We observed strongest variability in traits closely related to reproduction. Since shape and size dimorphism in *C. torosa* (elongated males, bulbous females) reflects the different reproduction roles of the sexes, morphological variability reflects differing selection pressures.

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# ECOLOGY OF OSTRACODS INHABITING GROUNDWATERS IN BENIN, WEST AFRICA, WITH POTENTIAL USE OF STYGOBITES AS INDICATORS OF GROUNDWATER QUALITY

Ostracods are a significant component of groundwater ecosystems, affected by both abiotic environmental factors and biotic interactions. This study investigates the factors influencing ostracod communities in groundwater from dug wells in several regions of Benin, West Africa, which experiences chronic anthropogenic disturbances such as nutrient enrichment from sewage and fertilizer infiltration. We evaluated the presence of ostracod species in 219 wells across seven catchment areas, examining 31 predictor variables, which include a variety of water quality parameters, hydrology as well as several well characteristics such as closure, usage and well construction type. The influence of these variables was analyzed using distance- based linear models and redundancy analysis.

Our research identified 60 ostracod species, which we classified into two ecological groups: 1) 36 stygobitic species from the family Candonidae, representing an endemic evolutionary radiation, and 2) 24 non-stygobitic species, mostly from the family Cyprididae. Through our analysis, we identified several key factors influencing ostracod community structure, with consistent patterns observed at both species and genus levels. The primary predictors, aside from well descriptors, included water chemical and physical properties, such as electrical conductivity, pH, temperature, and bicarbonate concentration, along with $NO^{2-}$ concentration, a factor not previously demonstrated to be crucial for ostracod assemblages.

Elevated nitrite levels in groundwater were found to significantly affect the distribution of stygobitic and non-stygobitic ostracods. Stygobites were notably less frequent in environments with higher $NO^{2-}$ concentrations, likely due to their greater vulnerability to periodic or chronic anthropogenic disturbances compared to non-stygobites. Therefore, we suggest that stygobitic

ostracod species, identifiable even at the genus level, have a potential as reliable indicators of groundwater quality in the tropical regions of western Africa.

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# LATE PLEISTOCENE OSTRACOD FOSSIL ASSEMBLAGE IN YANGZONG LAKE, YUNNAN PROVINCE, CHINA AND ITS PALAEOENVIRONMENTAL SIGNIFICANCE

Yangzong Lake is a pull-apart tectonic plateau lake on the Xiaojiang Fault Zone in Yunnan Province, with a catchment area of 192 km$^2$. Located in southwestern China, the hydrology and climate of the lake area are influenced by the Asian Summer Monsoon. Fan *et al.* (2023) studied the event sediments in Yangzong Lake area by means of paleoseismic research methods . On this basis, the fossil assemblages of aquatic organisms in the sediments of Yangzong Lake are analyzed to reflect the palaeonenvironmental conditions of the lake area, which were linked to the summer monsoon.

Two sediment cores, YZHa and YZHb, were drilled near the depth of about 27 m in Yangzong Lake, with their ages spanning from 25 ka ago to the present. Samples from these two cores were analysed for ostracod taxon composition and population age structure, to provide new insights into the aquatic environment in the profundal zone of the lake and the regional hydrological condition of the lake area since the Late Pleistocene.

Our data indicate that the ostracods in both cores are dominated by the Family Candoninae, especially the Genus *Fabaeformiscandona*, and the species diversity is low. In samples around 3 ka B.P., the ostracod species diversity increased, and members of the Family Cyprididae and the Superfamily Cytheroidea appeared. Based on the age structure analysis method used by Zhai *et al*. (2013), we found that the age structure of the dominant ostracod, *Fabaeformiscandona*, was skewed towards early and middle instars in most parts of the cores. Combining evidence from the species composition and that from the population age structure, we suggest that Yangzong Lake retained relatively stable, high lake levels for most of the past 25 ka, although there was a brief decline in water stand around 3 ka B.P., which may represent a weakening of monsoon precipitation. This is consistent with the find-

ings of WÜNNEMANN *et al.* (2024) on the inversion of Holocene hydroclimatic changes through the paleoenvironment of the Dian Lake region , that is, about 3.1 ka B.P.-1.73 ka B.P., the lake level reached its lowest, which may indicate the weakening of the Asian summer monsoon.

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# METABOLIC RATES AND CRITICAL OXYGEN TENSION OF HONG KONG OSTRACODS

Ostracoda is a highly diverse and abundant class of microcrustaceans (measuring up to a few millimeters) found predominantly in aquatic habitats. Most known species in the group have heavily calcified shells with high preservation potential. These animals are widely used as indicators in paleoecological studies to infer past environmental conditions (Horne *et al.*, 2012). Thus, ostracods are sentinels for global change (Ruiz *et al.*, 2005). Although ostracods are used as indicators for changes in parameters such as temperature and dissolved oxygen in the water (Cronin *et al.*, 2002), little is known about the physiology of living marine species and how it responds to environmental change. To fill this gap in knowledge, we aim to uncover how the metabolic rates of marine ostracods respond to temperature increase and to what extent they can withstand low oxygen concentration in the water.

In this ongoing study, we are investigating ostracods metabolic rates and tolerance to hypoxia in a range of temperatures. To obtain these parameters, we are measuring their oxygen consumption (MO2) in a constant volume respirometry system. Through this method, metabolic rates at different levels of dissolved oxygen in the water are measured. We selected three common and abundant species of Hong Kong ostracods as models for our study: a subtidal species, *Bicornucythere bisanensis*; a low-intertidal level species, *Neocyprideis agilis*; and a mid-intertidal level species, *Stigmatocythere costa*. The specimens are being collected from Tai Tam and Tung Chung wetlands, Hong Kong SAR, China. We are measuring the MO2 of individuals from each species in temperatures ranging from 28 °C to 45 °C. With the MO2 and oxygen saturation in the water, we calculate the critical oxygen tension (Pcrit), i.e., the oxygen level in the water below which the animal cannot regulate its oxygen consumption, which becomes dependent on external oxygen concentration (Bridges & Brand, 1980). The Pcrit is a metric for hypoxia tolerance (Speers-Roesch *et al.*, 2013). We used two methods to cal-

culate the Pcrit: the piece-wise regression (ROGERS *et al.*, 2016) and model selection (modified from MARSHALL *et al.*, 2013 and REEMEYER & REES, 2019).

Our preliminary results with ostracods exposed to 28 °C showed higher metabolic rates in *S. costa* compared to *B. bisanensis* and *N. agilis*. The two methods used to calculate the Pcrit had different results, with lower Pcrit values in the model selection (mean±SD, 14.5±20.4% and 16.3±11.2% for *B. bisanensis* and *S. costa*, respectively) compared to the piece-wise regression (15.3±14.15% and 25.3±16.4% for *B. bisanensis* and *S. costa*, respectively). The MO2 in *B. bisanensis* and *S. costa* increased with decreasing oxygen saturation until reaching the Pcrit, from which MO2 decreased. *Neocyprideis agilis* MO2 did not increase, but decreased with decreasing oxygen saturation in the water. Our preliminary results indicate that *B. bisanensis* and *S. costa* are oxyregulators which can withstand low oxygen concentrations in the water while *N. agilis* is an oxyconformer which has decreasing performance at low oxygen concentrations. Our future experiments will reveal further aspects of the ostracods' thermal physiology and their vulnerability to hypoxia.

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# LABRUM MORPHOLOGY IN CYPRIDID OSTRACODS: UNVEILING NEGLECTED CHARACTERS WITH DIAGNOSTIC POTENTIAL

The taxonomy of non-marine ostracods requires the use of more soft-part characters and structures that can be preserved. One such feature is the upper lip or labrum, which is a neglected aspect of the soft-body morphology of non-marine ostracods and is rarely represented in publication drawings (Bonilla-Flores *et al*., 2024). However, the importance of its morphology has been emphasized from time to time (Claus, 1893; Schulz, 1975; Meisch, 2000). Detailed morphological characters, such as the position of the pseudosetae on the labrum of Cypridoidea, were noted by Smith (2000), who highlighted the importance of the morphology of the labrum at the species level, noting its conservative nature since the Cretaceous. Considering that the labrum may be one of the best preserved soft-body parts in the fossil record (Matzke-Karasz *et al*., 2013), its shape variation could also be used as a reliable feature (Karan-Žnidaršič & Petrov, 2014; Karan-Žnidaršič *et al*., 2018). The aim of this study is not only to provide insights into previous studies, but also to report on the descriptions of labrum characteristics for six species within four genera of the Cypridinae and Eucypridinae.

Two to eight specimens of each species, some of which belonged to different populations, were dissected and their soft parts were examined and photographed using a Leica DFC295 microscope equipped with a camera. The ratio of labrum height (h) to length (l) was calculated by measuring these distances from the photographs using TPSdig 2.12 (Rolph, 2008).

The shape of the labrum of *Cypris pubera* is broadly rounded in the anterior region with an h/l ratio of about 0.3 and pseudosetae present in the middle and posterior part. A similar shape and ratio can be found in *Eucypris virens* and *Eucypris* cf. *kerkyrensis*. Their pseudosetae are similarly distributed and somewhat shorter than those of *Cypris*. *Eucypris pigra* has a very pronounced oval labrum shape with a maximum height approximately in the centre, an h/l

ratio of about 0.2 and lacks conspicuous pseudosetae. *Prionocypris zenkeri* has a bluntly rounded labrum with a maximum height in the anterior region, an h/l ratio of ~0.2 and long pseudosetae only in the posterior part. In *Tonnacypris lutaria* the labrum has a somewhat angular shape with a prominent bump in the anterior region, an h/l ratio of ~0.2 and long pseudosetae in the posterior part.

These results emphasize the importance of including soft-part characters such as the labrum in the taxonomy of non-marine ostracods, which may have implications for understanding evolutionary relationships. Future research should focus on increasing the sample size by including a larger number of individuals, populations and species within these taxa. This would allow the application of statistical analyses and geometric morphometrics to further assess labrum traits at intra- and interspecific levels.

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# NEW DATA ON MOLECULAR DETECTION OF ENDOSYMBIOTIC BACTERIA OF THE GENUS *CARDINIUM* IN NON-MARINE EUROPEAN OSTRACODS OF THE SUBFAMILY CANDONINAE

Intracellular endosymbiotic bacteria may have a significant impact on the biology of their host. Considering that endosymbionts are maternally inherited, their infections can shape genetic variation of the host mitochondrial DNA (mtDNA), for example by altering the frequency of individual haplotypes in the population (Kambhampati *et al.*, 1992; Engelstädter & Hurst, 2009). Such reports seem particularly relevant in view of the widespread use of mtDNA genes in barcoding for species delimitation (Hurst & Jiggins, 2005).

Earlier studies have detected bacterial endosymbionts belonging to the genus *Cardinium* (phylum Bacteroidota) in taxonomically diverse non-marine ostracods at remarkably high incidence, compared to other arthropods (Nakamura *et al.*, 2009; Çelen *et al.*, 2019). However, more comprehensive sampling, including poorly screened groups and habitats are needed.

Candoninae is one of the most abundant subfamilies of currently living ostracods, but to date, representatives of this subfamily have not yet been included in a large-scale study of the prevalence and incidence of *Cardinium*. So far, data documenting the infection with the mentioned endosymbionts of species belonging to this subfamily come from initial screening of 60 individuals from 11 populations of 10 species belonging to five different genera from Poland (Sas *et al.*, 2022), Turkey (Çelen *et al.*, 2019) and Russia (Khalzov *et al.*, 2021).

Therefore, the aim of our study was to present new data on molecular detection of *Cardinium* infection in selected non-marine European ostracods of the subfamily Candoninae based on amplification of the gene fragment encoding the 16S rRNA subunit of this endosymbiont. Analysis was conducted on 104 specimens of 22 species belonging to nine genera and four

tribes, collected from various aquatic environments. Endosymbiotic *Cardinium* bacteria were detected in 50 individuals, corresponding to a prevalence of 48%, and these individuals represented 16 different Candoninae species, making the incidence rate as high as 73%.

Our results corroborate findings from previously published studies (SCHÖN *et al*., 2019; ÇELEN *et al*., 2019), and enhance the current understanding of *Cardinium* infections in non-marine ostracods.

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# NEW STYGOBITIC OSTRACOD SPECIES OF THE GENUS *CANDONOPSIS* (CANDONIDAE) FROM INTERSTITIAL WATERS OF NOUVELLE-AQUITAINE, FRANCE

The subfamily Candoninae, one of the most species-rich lineages of non-marine Ostracoda, includes now about 550 extant species across more than 50 genera classified in seven tribes (MEISCH *et al*., 2019). The tribe Candonopsini is usually distinguished on the basis of the absence of posterior seta on the caudal ramus, but due to the frequent reductions of setae and claws in a number of various candonid species, to correctly diagnose Candonopsini this feature must be considered carefully and in concert with other morphological traits (carapace shape, elongation of terminal segments of mandibular palp, chaetotaxy of the cleaning leg or the male clasping organs and hemipenis morphology) (Higuti & Martens, 2012), and if only possible supplemented with molecular data in integrative taxonomy. In general, the proper assignment of a new candonid species to the tribe and genus remains often challenging due to considerable homoplasy frequently occurring in this group.

The genus *Candonopsis* Vávra, 1891 is the type genus of the tribe Candonopsini and comprises 33 recent species classified in two subgenera (Meisch *et al*., 2019): *Abcandonopsis* Karanovic, 2004 with seven species restricted to Australia (Karanovic, 2004) and *Candonopsis* with 25 species. Although the nominotypical sugenus has a worldwide distribution, most species occur in the Southern Hemisphere (Karanovic & Marmonier, 2002; Karanovic, 2012). Of the six species known from Europe, two are epigean and four hypogean (Schäfer, 1945; Danielopol, 1980; Karanovic & Petkovski, 1999; Meisch, 2000).

In this study, we describe a new species of the subgenus *Candonopsis* from male and female individuals collected from hyporheal of three rivers within the catchment of the Dordogne-Garonne Rivers in the Corrèze

Department of Nouvelle-Aquitaine in central France. The samples were taken following the protocol of the PASCALIS project (MALARD *et al*., 2002). The newly identified species based on morphological evidence differs from other members of the genus by its unique carapace shape and also the structure of the male copulatory organs (mainly shape of the inner lope of the hemipenis). Additionally, phylogenetic analysis based on cytochrome oxidase subunit I mitochondrial gene (COI mtDNA) and a nuclear region (28S rDNA nDNA) provided further support for the differentiation of the new species, which formed a distinctly separate clade, yet with the closest relationship with *Candonopsis kingsleii* (Brady & Robertson, 1870), the other species of the genus used in our genetic analysis.

The present study underscores the significance of employing an integrative approach, which combines the analysis of carapace, morphology of limbs (soft-body) as well as molecular data, to accurately characterize the biodiversity of groundwater ostracods.

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Silvia Kolomaznik & Peter Frenzel

# QUARTERNARY OSTRACODA OF EASTERN GERMANY – AN ASSESSMENT

Ostracoda are one of the most useful fossil groups in continental systems, especially in the Quaternary. However, their application is hampered by our imperfect knowledge on ostracod ecology and distribution in space and time.

The eastern part of Germany is rather well studied in respect to Quaternary ostracod distribution and taxonomy but this knowledge is mostly hidden in small geoscience journals of the former German Democratic Republic, unpublished reports, and several collections of sampled material. The most important authors in this field were Kurt Diebel & Erika Pietrzeniuk (Berlin), as well as Roland Fuhrmann (Leipzig). Examples for other researchers covering ostracods of the area are Burkhard Scharf (Magdeburg, now in Bremen), Dietrich Flössner (Jena), Dietrich Mania (Jena), Finn Viehberg (Stralsund) and the second author of the present poster. The huge ostracod collection of Diebel & Pietrzeniuk is housed at the Museum of Natural History in Berlin. Fuhrmann (2013) published an overview on Quaternary Ostracoda in Central Germany, i.e. the southern part of our research area, and Frenzel & Viehberg (2004) published a checklist for the northern part of the study area. The collection of Fuhrmann's published and unpublished work is housed at the natural science museum Mauritianum in Altenburg (eastern Thuringia). Additionally, there is the third largest collection of Quaternary ostracods from the study area compiled by the micropalaeontologist Jutta Rusbühlt (Schwerin) during her work for the state-owned exploration company Erdöl-Erdgas Gommern in the 1960ies to 80ies. This collection comprises more than 1000 slides with picked ostracods and is not analysed yet.

We just started a new research project funded by the German Research Foundation for compiling and using the information about the distribution

of Quaternary Ostracoda in eastern Germany. Our goal is to document distribution patterns and to test several hypotheses linked to applications of Quaternary ostracods. The first step is to compile the already published data for eastern Germany based on literature data and analysis of collections. This includes species lists, ecological tolerance values and preferences where abiotic data are documented, Recent and fossil areal distributions, stratigraphical ranges for the region etc. In a second step, palaeoecological analyses including the MOTR method created by HORNE (2007) will be used to reconstruct palaeoenvironmental and palaeoclimatic changes in the study area during the Quaternary. Furthermore, we will investigate palaeobiogeographical and biostratigraphical patterns. The taxonomic work will not only include identification of species but also detailed documentations of selected taxa and the development of an AI-based automated identification of common species. We intend to document the Quaternary ostracods of Central Europe better this way and to make them more applicable.

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# THE CRETACEOUS OSTRACODS OF CAVA PORCILI (MINERVINO MURGE-SOUTHERN ITALY)

Cava Porcili is a limestone quarry located south of the town of Minervino Murge in the western Murge area (Apulia foreland, southern Italy). It is one of the most important quarries in the region, due to the discovery of six well-preserved karst caves, that are included in the list of Apulia geosites. The well-bedded succession cropping out along the quarry wall is 90 m thick and consists of peritidal and shallow subtidal carbonate lithofacies associations occasionally interbedded with continental silty clays. These facies features suggest that carbonate sedimentation occurred in protected shallow-water environments affected by periods of temporary interruption of carbonate production due to subaerial exposure. This stratigraphic architecture suggests that high-frequency relative sea-level changes were probably the main controlling factor on carbonate sedimentation. The studied succession, whose age, according to Iannone *et al.* (1979), is here preliminary referred to the upper Albian-lower Cenomanian, developed in an inner sector of the Apulia Carbonate Platform that, during the Cretaceous, was situated along the southern margin of the Tethys Ocean, and was part of the continental Adria Plate (D'Argenio, 1974).

Preliminary analyses on thin sections reveal a high concentration of ostracods in many samples coming from the whole studied succession; often, the ostracods constitute the only bioclastic component of the facies. Since their high abundance and variety of sizes and shapes, a detailed study on ostracods could led to significantly enhance our understanding on paleoclimate and paleoenvironment during the Cretaceous period in Apulia. However, given the great scientific and touristic importance of the site, which falls within an area of an aspiring UNESCO Geopark (Tropeano *et al.*, 2023), it would be interesting to conduct studies covering all aspects of the flora and fossil fauna found in the exposed rocks at the quarry.

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# INSIGHTS INTO SEASONALITY OF PAST CONTINENTAL CLIMATE USING CLUMPED-ISOTOPE TECHNIQUE

The projected future global temperature increase will affect continental areas differently depending on their geographic position. Understanding past seasonality (i.e., temperature and hydrological conditions) at regional scale is fundamental to forecast the environmental (e.g., vegetation and moisture availability) and social economical (e.g., food availability) impact. The carbonate clumped isotope (Δ47) technique reveals the temperatures at which calcium carbonate (CaCO3) precipitated, thus of the waterbody, and in combination with δ18O provides the δ18Ow that give insight on the hydrological conditions. Ostracods are small aquatic crustaceans (0.3 - 5 mm), with a very stable low Mg calcite shell, capable of recording climatic and environmental changes at high-resolution in sedimentary archives of modern and ancient lakes. The novel ostracod-Δ47 lacustrine thermometer disentangles and quantifies the effects of global climate changes at regional scale and has several advantages that makes it an attractive tool for paleoclimatic reconstructions: (i) It is not affected by vital effect, thus, it is independent of ostracod species and geography. (ii) It is applicable throughout geological time (iii) by combining knowledge of ostracod shell precipitation time that is species-dependent, it is possible to reconstruct past seasonality. (iv) Temperature reconstructions for all environments where ostracods live are within reach. At Lake Trasimeno (Italy) record (last ca. 50000 years) the application of the ostracod-Δ47 thermometer identifies warmer/colder and humid/dryer conditions during Greenland Interstadial and Greenland Stadial/Heinrich events respectively. A reduced seasonality is recorded during the early Holocene. The establishment of this new lacustrine proxy opens the door to new high-resolution continental paleoclimate and paleoenvironmental reconstructions.

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# GEOCHEMICAL ANALYSIS OF OSTRACOD SHELLS FROM MIOCENE DEPOSITS IN EASTERN SLOVENIA

The first geochemical analysis on ostracod shells was done in the 1950s (Sohn, 1958). Initially, only measurements of the trace elements were made (Sohn, 1958), but in the early 1980s, a systematic study of the relationship between the trace elements in ostracod shells and water temperature and composition was being carried out (Chivas *et al*., 1983). In addition to the trace elements, there have been studies on the isotopic composition of the shells. Since the shells are composed of low-magnesium calcite, oxygen and carbon isotopes are the most commonly analysed. In the presented study we analysed the trace elements on 31 samples and oxygen and carbon isotopes on 10 samples along two separate outcrops.

Stable carbon and oxygen isotope compositions of approximately 150-200 g carbonate samples were determined applying the carbonate-orthophosphoric acid reaction at 72°C (Spötl & Vennemann, 2003) and using an automated GASBENCH II sample preparation device attached to a Thermo Finnigan Delta Plus XP mass spectrometer. The isotopic compositions of carbonate samples are expressed as δ13C and δ18O in ‰ relative to V-PDB (Vienna Pee Dee Belemnite), with a precision better than ±0.1‰ from standards. To calculate the temperature from the oxygen isotopes the equation presented in Xia *et al*. (1997a) was used.

For the following trace elements Mg, Ca, Sr, Mn, Fe, and Al we used the following method: For the concentration determination, the available amount of sample (1 - 10 mg) was digested in 1 mL of HCl (37 %, supra pure) in a PE vial. The solutions were put on a hot plate and heated to 40 °C for 1h. After obtaining a clear solution, Milli-Q water was added to obtain a total volume of 10 mL. The concentrations were determined by an inductively coupled plasma mass spectrometer (ICP-MS, Agilent 7900).

With the combination of these two methods, we were able to approximate the changes in the environment. The samples that were correlated to the Sarmatian and Badenian had a higher temperature (20°C<) that those correlated to the Pannonian (20°C>). This trend fits the data provided by ostracods and the trace elements as there has been a significant change from the Sarmatian to Pannonian. We were also able to compare the differences between two localities and what it showed is that the two "basins" were in fact connected as previously thought to be separate. It should be noted that the Badenian and Sarmatian samples both gave us a temperature higher than 30°C, but we later agreed that this result was not feasible, and we attributed the calculated temperature to recrystallization of the ostracod valves.

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Koen Martens & Isa Schön

# OSTRACOD RADIATIONS

Ostracods presently occur in almost all aquatic habitats, be they freshwater, brackish or marine, surface or groundwater, stagnant or flowing, in large lakes and small phytothelmata, in permanent or temporary pools, as well as in (semi-) terrestrial habitats. Some of these habitats are species-poor, other habitats harbour large numbers of species. Some of these species can be widespread (cosmopolitan and even ubiquitous), but others are endemic to a single lake or watershed. Why did speciation in certain ostracod lineages lead to large numbers of species in certain habitats, while other "ostracod lineage vs habitat type" combinations did not lead to such, often spectacular, morphological speciation events?

A speciose lineage of ostracods which derived from a single ancestor is called a species flock.

In ancient lakes such as Lake Baikal (Siberia, Russia), Lake Tanganyika and Lake Malawi (East Africa), several such ostracod species flocks exist side by side. These ancient lakes are excellent examples where ostracod radiations, including several species flocks, can be studied in situ, in the cradle in which they originated, namely in ostracod lineages such as *Cyprideis s.l.*and *Cytherissa* (Cytherideinae) (in Tanganyika and Baikal, respectively), *Gomphocythere* (Timiriaseviinae) and *Cypridopsis s.l.*, (Cypridopsinae) (in both Tanganyika and Malawi) to name only a few. Other examples of ostracod radiations are in the subfamily Candonidae in groundwaters in Pilbara (Australia), Texas (USA) and in Benin (West Africa). Several lineages in the family Cyprididae radiated in temporary water bodies on various continents, for example the genus *Bennelongia* (Bennelongiinae) in Australia, the genus *Sclerocypris* in the Megalocypridjnae in Africa and *Cypretta* (Cyprettiinae) and *Strandesia* (Cypricercinae) in the southern Hemisphere (excluding Antarcti-

ca) as a whole. A special case are the species of the genus *Elpidium* (Timiriaseviinae) occurring in bromeliad phytothelmata in South and Central America. A new field of diversity discovery is in the identification of genetic species, which might not be identifiable based on the phenotype, aka "cryptic species".

Various intrinsic (pertaining to the specific biology of the organism) or extrinsic (habitat-related) factors can contribute to large speciation events, resulting in ostracod radiations and species flocks. Yet, in some habitats where at least some of the extrinsic factors are present, no vast ostracod species flocks can be found. This is mostly due to historic events, such as in the African lakes Kivu and Turkana.

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# THE FRESHWATER ANIMAL DIVERSITY ASSESSMENT (FADA)

Although unfrozen freshwater covers less than one percent of the Earth's surface, almost ten percent of all animals occur only in freshwaters. This discrepancy, where biodiversity in freshwater is one or two order(s) of magnitude higher than what can be expected from the surface coverage on the planet, is known as the "paradox of freshwater". Several virtual research infra-structures, such as the Global Biodiversity Information Facility (GBIF), document extant freshwater biodiversity. Such global databases require reliable taxonomic backbones, which are also a prerequisite for their interoperability. The current Freshwater Animal Diversity Assessment (FADA) comprises a comprehensive set of global taxa lists for freshwater animal groups with 125,530 described species and 11,388 genera (Balian *et al.,* 2008a, b). The data on the ostracod fauna were discussed by Martens *et al.* (2008) and were later translated into a global checklist (Martens & Savatenalinton, 2001; Meisch *et al.*, 2019). However, taxonomy is a living scientific discipline where new taxa are continuously being described and existing taxa are being placed in new taxonomic positions. FADA therefore needs to be updated, both technically and in terms of content. infraFADA, a three-year project funded by the Belgian Scienced Policy (Belspo), is developing FADA into an up-to-date research infrastructure by revamping the FADA consortium of about 150 taxonomic experts and developing an online taxa information management system which allows FADA experts to curate, maintain and publish their taxalists. This tool will also link the FADA taxa lists as taxonomic backbone to international research infrastructures such as Catalogue of Life (CoL), GBIF, and the Freshwater Information Platform (FIP). Other potential users include DISSCo, IUCN, eBIOAtlas and various initiatives within the LifeWatch consortium as well as individual researchers around the globe.

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# COMPARATIVE FEEDING HABITS OF SWIMMING AND NON-SWIMMING OSTRACODS (OSTRACODA) IN A BRAZILIAN TROPICAL FLOODPLAIN

Ostracods exhibit a wide variety of feeding habits, including herbivory, detritivore, and carnivory, with a preference for consuming algae and organic detritus. Ostracods disperse passively, but differ in locomotion mode, influencing for their food exploration.

This study aimed at identifying and comparing the ecological attributes (richness and abundance) of food items, as well as diet composition of swimming and non-swimming ostracods associated with the root systems of the floating plant species *Eichhornia crassipes* (Mart.) Solms from the Upper Paraná River floodplain. We tested the hypothesis that the richness, abundance, and diet composition differ between both groups. We expect a higher richness and abundance of food items consumed by swimming ostracods.

Ten faecal pellets from each of three swimming (*Triangocypretta hirsuta* Ferreira et al. 2023; *Cypricercus alfredo* Almeida *et al.* 2021; *Cabelodopsis hispida* (Sars, 1901)) and three non-swimming species (*Alicenula serricaudata* (Klie 1935); *Cytheridella ilosvayi* Daday, 1905; *Vestalenula pagliolii* (Pinto & Kotzian, 1961)) were analysed to identify the items consumed by these microcrustaceans.

A total of 29 food items were recorded. Higher richness and abundance of food items were found in faecal pellets of swimming ostracods. However, the results were not significantly different ($p > 0.05$). In contrast, the diet composition between the groups was significantly distinct ($p = 0.001$), with diatoms being the main food item for swimming species, and fungi for non-swimming species. The aphotic zone in the roots of the aquatic macrophyte encourages fungal proliferation, which were consumed by non-swimming ostracods that have restricted mobility. However, despite swimming ostracods tend towards herbivory and non-swimming towards fungivory, both

groups also consumed cyanobacteria, green algae, oligochaetes and other invertebrates, detritus, and plant tissue. This study shows the impact of the locomotion mode on feeding of ostracods, contributing to the knowledge of trophic ecology of these species.

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# ENTERING THE AMBER WORLD OF STRACODA

Amber has always fascinated mankind, but the foundation for palaeoentomological amber research was not laid until 1742, when Nathanael Sendel published his monograph on the impressive collection of amber inclusions owned by Friedrich August I, Elector of Dresden and King of Poland (Sendel 1742).

Early reports on amber-embedded Crustacea (e.g. ZADDACH 1864) mainly concerned terrestrial representatives, rarely aquatic ones (e.g. Lucks 1928). It took over 270 years of scientific work on amber before the first amber-trapped ostracods were described (KEYSER & WEITSCHAT 2005), and since then only a few more studies have been added. In particular, amber deposits from Chiapas (Mexico) and Kachin (Myanmar) have a higher probability of producing amber pieces with ostracods. These and other potential deposits represent a unique opportunity to improve the knowledge of ostracod phylogeny, as it is otherwise rarely possible to obtain their appendages in fossils. It is therefore worthwhile to present here aspects that are considered important when working on and with ostracodes embedded in amber.

After a brief introduction to the components and classification of amber, the relevant localities of origin are presented, including possible scientific disagreements, as in the case of Bitterfeld amber, or even ethical concerns, as in the case of Myanmar amber.

Looking back at the studies of all ostracods documented in amber so far and considering personal experience in analysing amber ostracods, the following aspects are more closely addressed: Which imaging techniques can be used to analyse amber ostracods, and what are their limits? Which quality of preservation can be expected? Which information can potentially be extracted? Which errors should be avoided? Which problems can occur around the

type material and the deposition there-of? And finally: What is the monetary value of ostracod inclusions?

This overview may serve as an introduction and decision-making aid in the rather new, promising, and exciting field of the investigation of ostracods trapped in amber.

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# TRACING THE TAXONOMIC JOURNEY OF OSTRACODS: FROM LINNAEUS TO LATREILLE, THROUGH MICHELI-TARGIONI TOZZETTI'S COLLECTIONS

In 1746, in his Fauna Svecica Carl Linnaeus described the ostracod genus *Monoculus* with the code 1185, as an apterous insect. In 1748, in his Systema naturae he named the first ostracod *Monoculus* as *Concha pedata* describing it an "*aquatic worm with tree-horned antennae*". Ten years later, he renamed the same species as *Monoculus conchaceus*. Otto F. Muller renamed it as *Cypris pubera* O.F. Muller, 1776 (Mesquita-Joanes *et al.*, 2020). Only in 1806, the French Pierre André Latreille (1762–1833) established the Subclass Ostracoda Latreille 1806. What happened to the classification of specimens stored in the collections of the scientists of that period? Were they following Linnaeus classification or were they following their own?

Pier Antonio Micheli (1679-1737) was a mentor and friend of Giovanni Targioni Tozzetti (1712-1783) who continued his scientific studies and between 1742 and 1745 conducted naturalistic explorations in Tuscany for the Botanical Society, documented in "*Viaggi fatti in diverse parti della Toscana*" (Reports of journeys through some parts of Tuscany). In 1763, he catalogued the Tribuna of the Medicean Gallery's collection. Known for his meticulous observations, Targioni Tozzetti gathered thousands of naturalistic samples, detailed in various documents, reflecting the history, scientific knowledge, environmental conditions, and life of his period where the origin of the material is reported.

The naturalistic specimens collected by Targioni Tozzetti are housed at the Museum of Natural History of Florence (Italy). Among his historical mollusk collection, 3 vials containing several dry ostracod carapaces and valves have been found. Each vial is labelled as "XV *Colymbis natatrix* Targ." on the side and "Firenze" (Florence) with a progressive number from 1 to 3 on the top, closed by a cap. In the 11 tomes of his archive, the material is classified

under *Testacea fluviatila* section 3 *Conchae fluviatilis*, referring to GUALTIERI'S book "Index Testarum Conchyliorum", published in 1742. Later, he referred to the ostracods as insects (TARGIONI TOZZETTI, 1768). Targioni Tozzetti described the samples as *Colymbis*, stating that some of them were previously part of the Micheli's collection. All of them were collected in Florence and its surroundings: a terracotta pot in the Giardino dei Semplici, a plant's pot in the terrace of Micheli's house, a plant's saucer in Targioni Tozzetti's garden.

The vials are capped by a cork and cannot be opened due to preservation issues. Analyzing the vials under a microscope, the ostracod could be determined as *Herpetocypris reptans* (vials 1 and 2), *Heterocypris incongruens* and *Cypridopsis vidua* (vial 3).

Targioni Tozzetti's observations on the movements of the ostracods led him to note that the animals were moving as shrimps. His observations of the swimming animals are extremely detailed and include some speculations about them having eyes. Targioni Tozzetti lived during a particular period when Linnaeus's ideas were beginning to make an impact in the academic world, though with many dilemmas and uncertainties. His son Ottaviano later worked on the malacological collection and on the catalogue adopting the binomial nomenclature and naming the specimens *C. natatrix*.

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# TRACING THE ORIGIN OF LAGO MARE BIOTA: OSTRACODS AND MOLLUSKS FROM THE LATE NEOGENE OF THE SLAVONIAN MOUNTAINS IN THE SOUTHERN PANNONIAN BASIN (NE CROATIA)

Lake Pannon was a huge central European, long-lived endorheic lake occupying the Pannonian Basin System during the late Neogene. The benthic fauna of this originally sparsely populated brackish lake went through a spectacular adaptive radiation leading to a great number of autochthonous species. Although largely endemic, some of these species are excellent stratigraphic markers of the Lago Mare interval in the Mediterranean Basin. This situation apparently reflects a short-termed unidirectional migration-wave in the latest Miocene. The latter interval marks the final phase of a major environmental perturbation followed by a massive evaporite deposition termed the Messinian Salinity Crisis. The Section Bozara, located in the southern Pannonian Basin at the southern slopes of Mt. Papuk, bears a well-preserved benthic fauna representative of Lake Pannon. It is embedded into a 25-m-thick succession of alternating mud and sand packages. We detected therein 25 ostracod and 18 mollusk taxa enabling, along with a sedimentary facies analysis, an integrated evaluation of the depositional setting, biostratigraphic position, and paleogeographic distribution pattern. Accordingly, the depositional environment shows a shallowing upward trend from deep-water sublittoral and distal prodelta settings to deltaic high-energy littoral conditions. The biostratigraphic markers, such as the bivalve *Rhombocongeria rhomboidea* (Hornes, 1867) and the ostracod *Caspiocypris pontica* (Sokač, 1972), constrained its stratigraphic position to the Portaferrian interval (8.0–4.5 Ma). Of 16 ostracod taxa determined at the species level, 10 are shared with the Eastern Paratethys, whereas only 3 are present in the Mediterranean Lago Mare deposits as well. In contrast, among 12 corresponding mollusk taxa, only 4 are known from the Eastern Paratethys, all being absent in the Lago Mare interval. Such a paleobiogeographic pattern suggests that the time

window of the outflow event from Lake Pannon into the Eastern Paratethys was not synchronous with, but must have preceded, the hypothetic Eastern Paratethys drainage event generating the Lago Mare depositional conditions in the Mediterranean Basin.

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# OSTRACODS AS AN ENVIRONMENTAL PROXY FROM THE LAKES OF THE AMYNTAION BASIN, WESTERN MACEDONIA, N. GREECE

In recent years, extensive research has been carried out on the water quality of Greek lakes and the documentation of the flora and fauna that inhabit them. Studies of ostracods, however, are still limited, although they provide useful insights both for paleoenvironmental investigations and for assessing the impact of human activities on aquatic ecosystems.

In the region of Western Macedonia in Northern Greece, there is a complex of four lakes including Vegoritida, Petron, Zazari, and Chimaditis. They are interconnected and share the same catchment area as part of the Amyntaion Basin (formerly known as the Eordaia Basin) (Bobori *et al.,* 2016). This industrialized area is located within the Ptolemais basin and is rich in lignite with several coal-fired electricity power plants (Fytianos *et al*., 1995) and it is under severe pressure.

The present study was undertaken with the aim of recording the ostracod species composition and diversity of these four lakes and to link their assemblages using a multi-parameter dataset (temperature, salinity, pH, TDS, DO, grain size, nutrient load, magnetic susceptibility and heavy metals). 2122 ostracod valves were counted, and ten taxa were identified. A more detailed study was conducted on Lake Vegoritis and Lake Zazari, leading to the planning of a larger network of sampling sites. In Lake Vegoritis, some stations lack any ostracod fauna while the southern stations present the most rich and diversified ostracod assemblages. The most abundant taxon is *Candona* (mostly juveniles). In general, ostracod abundance and diversity display a gradual decrease with increasing depth, resulting in their total absence in stations exceeding 40 m depth (northern part of the lake). The same trend was observed with increasing TOC and nutrient content. In Lake Zazari, which is the most polluted out of the four lakes, no ostracod fauna was detected in any

of the sampling sites. Lake Chimaditis has almost no ostracods, while Lake Petron presents the highest abundance (~ 300 valves/50 ml) of all four studied settings. Overall, ostracods belonging to the Candonidae are dominating, mostly in the early stages of moulting. *Darwinula stevensoni*, *Limnocythere inopinata* and *Cypria opthalmica* were the most common species, while the rest of the ostracod assemblage was found in low abundance. Our results provide a comprehensive documentation of the ostracod fauna of northern Greece lakes. This will allow us to assess their effectiveness as environmental proxies in freshwater ecosystems.

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# UNVEILING THE RARITY: ECOLOGICAL SIGNIFICANCE AND DISTRIBUTION PATTERNS OF *TUBEROLOXOCONCHA* SPP.

When it comes to micro invertebrates, which are often barely visible to the naked eye, assessing rarity of living taxa poses unique challenges. This difficulty arises from the intricacies of sampling the precise micro-environment at the right time, such as during specific seasons. Ostracods, a class of small bivalved crustaceans inhabiting a variety of environments, include genera that are seldom encountered in the scientific literature. Examples of rare ostracod species extend to diverse and extreme environments, such as interstitial or hypogean habitats, sulfidic groundwater ecosystems, and deep-sea hydrothermal vents or wood islands. In transitional zones like deltas, estuaries, and coastal marshes, dominant ostracod species like *Cyprideis torosa* typically prevail. The genus *Tuberoloxoconcha* Hartmann (1973) has been recorded in Europe and North America (Danielopol, 1980). Species of this genus are rarely encountered, usually in marine environments where they are considered to live among seaweeds or interstitially in sand. Notably, recent discoveries have revealed the presence of living *Tuberoloxoconcha* spp. in the sediments of Portuguese estuaries, underscoring their importance within estuarine salt marsh ostracod communities (Horne *et al.*, 2022).

Sampling sediment for fossil ostracods requires an appreciation of the time-transgressive nature of assemblages if scientists are to interpret the complex dynamics of past ostracod communities and their responses to environmental shifts over time.

The study of the ostracod assemblages from sediment cores retrieved from the Corinth basin during Exp. 381 provides valuable insights into the temporal dynamics of *Tuberoloxoconcha* spp., particularly during specific glacial and interstadial periods (Mazzini *et al.*, 2023).

We present the analysis of *Tuberoloxoconcha* spp. specimens from 134 samples from two cores drilled during IODP Leg 381: core M0078, drilled at

water depth of 859.5 meters below sea level (mbsl) in the center of the Corinth Gulf, and core M0080 drilled at water depth of 348.8 mbsl, in the eastern part of the gulf, in the Gulf of Alkyonides. The peculiar *Tuberoloxoconcha* spp. dominated assemblages appear only after 400 ka when the marine connection of the Corinth gulf to the Mediterranean Sea began to develop (GAWTHORPE *et al*., 2022). Relative abundance values are high in the brackish intervals, particularly for those corresponding to MIS 2-3-4-5a and in the deep stadial MIS7d. In the same intervals, brackish and euryhaline species occur together with *Tuberoloxoconcha* spp. In several samples, *Tuberoloxoconcha* spp. are dominant. These findings highlight the potential value of *Tuberoloxoconcha* spp. as indicators of past coastal environments and even sea-levels. The abundance of *Tuberoloxoconcha* spp. in both Holocene and Late Pleistocene assemblages within the sediment cores prompts further investigation into their origin, ecological significance and distribution patterns.

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# DIMENSIONAL-MORPHOLOGICAL AND QUANTITATIVE ANALYSIS OF FOSSIL OSTRACODS THROUGH STATIC IMAGE ANALYSIS WITH AUTOMATED OPTICAL SCANNING MICROSCOPY

Traditionally, the observation and extraction of ostracods from sediments have relied on manual techniques assisted by a stereomicroscope, typically operating at low magnifications ranging from x20 to x500 and focusing on dry sediments. However, this conventional method proves to be labor-intensive and time-consuming (Horne & Siveter, 2016).

In response to these challenges, a quantitative technique leveraging computerized optical scanning and image analysis has been introduced using Malvern Morphologi G3ID. The automated analyzer comprises several key components, enhancing its functionality and versatility: 1) a Nikon G200 Optical Microscope, 2) Motorized Three-Dimensional Scanning System (x-y-z), 3) a Lighting System, 4) Fluorite Optics. This microscope serves as the primary imaging tool, equipped with advanced features to facilitate high-resolution analysis. The inclusion of a motorized scanning system allows for precise movement and positioning of samples in three dimensions, enabling comprehensive examination (Castrovilli *et al.*, 2020). The analyzer incorporates a sophisticated lighting setup capable of transmission and reflection in various modes, including dark field, bright field, and polarization. This ensures optimal visualization of specimens under different conditions. Equipped with fluorite optics, the microscope enables analyses across the visible and near-infrared (NIR) spectra, expanding the range of detectable features and materials. Moreover, the microscope is tailored for analyzing solid particles on different substrates, whether on optical supports such as slides or plates, in dispersion within cells, or directly on sampling filters. It features a polaroid system (polarizer/analyzer) that can be manually integrated, enhancing the versatility of specimen observation.

The instrument is controlled by sophisticated software capable of filter-

ing and classifying parameters based on size and shape characteristics (MARTINELLI *et al.,* 2020). The scanning station is equipped with piezoelectric motors, offering precise movement in the x-y-z directions with an exceptional precision of 0.1 microns. This ensures accurate positioning and imaging of samples during analysis. Furthermore, the instrument facilitates the acquisition of particle images, enabling morphological analysis and extraction of morphometric and granulometric data. It incorporates an integrated system for sample dispersion, with adjustable positive pressure ranging from 0.1 to 5 bar, ensuring optimal sample preparation and analysis conditions.

In summary, the automated analyzer represents a comprehensive solution for the efficient and precise analysis of specimens, offering advanced imaging capabilities and sophisticated software-driven functionalities to streamline the process of morphological and morphometric characterization. This automated approach revolutionizes the process by enabling the discrimination, counting, and quantification of fossil ostracod valves within a sample without requiring manual separation by the operator. By employing automated scanning through optical microscopy, this method yields quantitative analyses in significantly reduced timeframes compared to manual approaches, all while maintaining excellent quality standards.

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# THE SOUTHERNMOST SILURIAN MYODOCOPE FAUNA (SPAIN), BIOSTRATIGRAPHY AND PALAEOBIOGEOGRAPHY

We report herein a new Silurian myodocope ostracod fauna from the late Silurian of Spain. This fauna was recovered in the Mina Luisa abandoned open pit mine (south of Hinojosa del Duque, province of Córdoba, Spain) dated from the late Ludlow-early Pridoli. Six myodocope species, preserved in three dimensions in nodules, were identified in the outcrop: *Sineruga insolita*, *Silurocypridina calva*, *Calocaria maurae*, *Bolbozoe anomala*, *Bolbozoe acuta* and *Bolbozoe* sp. nov. The associated fauna includes abundant orthoconic cephalopods, some phyllocarid crustaceans and rare bivalves, graptolites and porifera.

This species association bears strong similarities with other late Silurian myodocope faunas, especially with the Armorican Massif (5 species in common) and Wales (4 species in common). Although the occurrence of the cephalopod *Kopaninoceras fluminese* suggests an early Pridoli age, the presence of *Bolbozoe acuta* seems to indicate that the outcrop also encompass some late Ludlow strata as this species is restricted to the Ludlow in France and the UK (the *B. acuta* Biozone is coeval to the late Ludlow *Formosograptus formosus* graptolite biozone).

The morphology, associated fauna, depositional environment and transoceanic palaeobiogeographical distribution of Mina Luisa myodocopes suggest they had a planktonic lifestyle. Based on recent Silurian palaeogeographical reconstructions and oceanic circulation models, we suggest that their trans-latitudinal distribution is strongly linked to palaeocurrents within the Rheic Ocean.

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Jovo Pokrajac & Tamara Karan-Žnidaršič

# INITIAL CHECKLIST OF EXTANT NON-MARINE OSTRACODS IN SERBIA

In contrast to their wide distribution and occurrence in almost all aquatic biotopes, ostracods have not been studied to the same extent as other groups with similar characteristics. It was estimated that the diversity of crustaceans in the Balkan Peninsula is very high in general (Karan-Žnidaršič & Petrov 2000). However, relatively little research was done on the investigation of the overall diversity of living ostracods in this faunal area, including Serbia. In order to assess the number of extant ostracod species on this territory, a checklist was produced in an effort to summarize all past records from any investigations concerning ostracods.

The first ever record of an ostracod in this territory was made almost a century ago by Klie (1940). Since then, further research was published by Petkovski (1957, 1976) Mikulič (1970), Meisch & Wouters (1985), Karanovič (1996), Karan-Žnidaršič & Petrov (2007), Pokrajac et al. (2022) and Pokrajac et al. (2024). The collected data from the literature indicates the presence of a minimum of 56 ostracod species, belonging to 29 genera and 5 families. Species from three podocopid superfamilies can be found, with Cytheroidea and Darwinuloidea being represented with one species each, while the remainder of the species belong to Cypridoidea. A total of 37 recorded species belong to the family Cyprididae and 15 to Candonidae. The remaining four species belong to Notodromadidae, Darwinulidae and Limnocytheridae. Genera with the largest numbers of recorded species are: *Potamocypris* Brady, 1870 (7), *Heterocypris* Claus, 1892 (5), *Herpetocypris* Brady & Norman, 1889 (4), *Ilyocypris* Brady & Norman, 1889 (4) and *Pseudocandona* Kaufmann, 1900 (4). As a result of a recent study (Pokrajac *et al.*, 2024), 6 species were added to the faunal list in 2024. Those species are: *Neglecandona neglecta* (Sars, 1887) Krsti  2006, *Heterocypris reptans* (Kaufmann,

1900), *Potamocypris fulva* (Brady 1868), *Potamocypris pallida* Alm, 1914, *Potamocypris unicaudata* Schafer, 1943, and *Psychrodromus fontinalis* (Wolf, 1919).

From the number of recorded genera and species, it can be concluded that Serbia is far less explored in this aspect than many other European countries. For example, in the nearby Slovenia there are 32 genera and 70 species of ostracods, and almost double the number of recorded families (MORI & ŠALAMUN, 2022), despite its smaller size and a relatively higher homogeneity when it comes to its geomorphological features, as compared to Serbia. Continuous efforts are being made to document the diversity of ostracods in Serbia, as a thorough taxonomic study has the potential to notably increase the known diversity of these crustaceans and even recording the presence of rare and relict forms.

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Ella Quante & Peter Frenzel

# OSTRACOD ECOLOGY AND TAPHONOMY IN LAKE STECHLIN (NE GERMANY)

Lake Stechlin is still one of the bigger lakes in Germany with a relatively low trophic state. It is groundwater dominated without any other major inflows, almost 70 m deep, and has been thoroughly monitored since the 1960's due to the operation of a nuclear power plant on the west shore from 1955–1990. The cooling water was taken from the smaller, eutrophic Lake Nehmitz and discharged into the former oligotrophic Lake Stechlin, where it led to distinctly higher trophic states and higher water temperatures even in the deep. Eutrophication processes and an increase of biomass of planktic algae are still continuing today.

The ostracod fauna has only been investigated once, in the 1960's by Flößner (1985).

We study the modern ostracod fauna and distribution in benthic surface samples in several localities in the lake, to investigate potential differences caused by hydrogeological factors, anthropogenic impacts and climatic conditions. Also, species occurrences, abundances and distributions, as well as abundances of adults and juveniles, and carapaces and single valves were analysed. Living or recently died ostracods were recognized by remains of soft parts. We find that the lake includes diverse habitats with specific ostracod assemblages each, and includes at least 19 species. Anthropogenic activities show to have a strong effect on these assemblages, e.g. low abundance and diversity in sandy beach areas, or low diversity and high numbers of *Cypridopsis vidua* in fish cultures. We also see assemblage changes since the 60's due to the warming and eutrophication of the lake, e.g. the introduction of *Metacypris cordata*. Species found by Flößner (1985) that we could not rediscover are e.g. *Cyclocypris laevis, Cyclocypris serena, Cypria exsculpta* and *Fabaeformiscandona acuminata.*

Oxygen deficiency and carbonate dissolution beneath ca. 11 m depth lead to absence of ostracods in the deep lake sediments and are an important detriment for ostracod proxies. This may be aggravated by longer anoxia periods and lower water transparency during summer. However, we still find several species that sometimes are considered deep/cold- water taxa, such as *Cytherissa lacustris, Fabaeformiscandona levanderi,* and *Limnocytherina sanctipatricii*. Although differences in the natural and anthropogenically impacted areas may be significant, they underline the necessity for samples from other areas for comparison.

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# ANALYZING MULDE EVENT DYNAMICS WITH ULTRA-HIGH-RESOLUTION OSTRACOD PALEOCOMMUNITY ANALYSIS

Silurian period witnessed significant global extinction occurrences, including the Mulde/lundgreni Event (late Wenlock), which led to intricate and sudden alterations in the Earth's biota. Due to the short span of these events, conducting paleontological studies requires a high level of sampling resolution, which is rarely achieved. Ostracods, abundant and small, are ideal subjects for high-resolution studies. By combining existing data with new samples from the Gėluva-118 core (Lithuania), we have achieved a resolution of approximately 10 Ka years in analyzing ostracod paleocommunities during the Mulde/lundgreni Event (Rinkevičiūtė *et al*., 2021).

Our approach involved a custom-made binary recursive segmentation algorithm for the hierarchical subdivision of stratigraphically contiguous segments. This algorithm was applied to ostracod taxonomic compositional time-series data from the Gėluva-118 core (Lithuania). The results revealed significant changes in ostracod community composition, enabling us to delineate the event's stages. We employed a Bayesian Age-Depth model to assess the timing of these changes. The median and 95% Highest Density Interval (HDI) durations for each stage, as well as for the entire event, are as follows: Collapse – 50 Ka (11 – 171 Ka), Maximal Stress – 120 Ka (31 – 601 Ka), Recovery – 80 Ka (21 – 576 Ka), and the entire Mulde/lundgreni Event – 260 Ka (100 – 1,136 Ka). Our analysis of bootstrapped sample averages of diversity indices revealed that the Maximal Stress stage, marked by a severe scarcity of ostracods, signified a distinct shift in community diversity state. Prior to Maximal Stress stage, ostracod communities were less diverse, yet exhibited higher increases in evenness with growing diversity, indicating distinct community assembly and community structure patterns. Ostracod communities from the Collapse and Recovery stages were similar to those that been found

in the Mulde/lundgreni Event interval but showed significantly reduced abundances, lower inverse Simpson index, and higher evenness. Furthermore, our findings suggest a nonlinear recovery stage, punctuated by setbacks and stabilization phases.

These insights demonstrate the potential of high-resolution paleontological studies in deciphering the chronology and pace of intermittent global events.

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# CONTROLS ON ARCTIC LAKE OSTRACODS FROM ANALYSIS OF LATE HOLOCENE SEDIMENTS FROM BRAYA SØ, GREENLAND

The Arctic is experiencing rapid climatic change as a result of warming and changing patterns in precipitation. These changes are putting increasing pressure on the Greenland Ice Sheet and surrounding aquatic-terrestrial habitats. Søndre Strømfjord (Kangerlussuaq) is the widest ice- free margin of Greenland and exhibits a strong climatic gradient from the continental ice-margin to maritime conditions at the coast. Closed-basin lakes within this region are saline due to a combination of low precipitation, high rates of evaporation, and locally derived salts (primarily an aeolian input). Lake sediment cores from this area provide an important archive for understanding the changing environment between the Greenland Ice Sheet and the Baffin Bay-Davis Strait. Greenland ice core records suggest relatively stable conditions over the Holocene, but more recent evidence suggests a more variable seasonal climate. Lake sediment records afford the ability to reconstruct high resolution records of precipitation and evaporation derived from oxygen-isotopes ($\delta^{18}O$). More crucially, the combination of $\delta^{18}O$ analyses on the fine-grained carbonate component of lacustrine sediments and ostracod shells (*Candona candida*) in some circumstances can enable the reconstruction of climatic conditions in different seasons. Results from a 1500-year multi-proxy record from Braya Sø provide evidence for more unstable climatic conditions with $\delta^{18}O$*C.candida* reflecting changes in lake level and temperature. Throughout the 1500-year record, ostracod species *Limnocythere inopinata, Candona candida* and, endemic species, *Potamocypris parva* are dominant. Recent warming of the Arctic is evident through the disappearance of *Limnocythere suessenbornensis* in 1948 CE and the appearance of *Heterocypris incongruens* in 2022 CE. Accompanying this warming, alternations between assemblages dominated by the oligosaline-tolerant species *Limnocythere*

*inopinata* and the freshwater species *Cypris pubera* suggest varying salinity driven by changes in precipitation-evaporation. This presentation will highlight the potential of ostracod faunal assemblages and shell chemistry to elucidate seasonal controls in Arctic lakes whilst exploring the remaining unknowns in habitat controls in these environments.

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Lucy R. Roberts & Thomas A. Davidson

# OSTRACOD SHELL CHEMISTRY AS AN INDEPENDENT MEASURE OF SHALLOW LAKE EUTROPHICATION?

Since ostracod shells calcify using elements taken from the lake water, providing a direct reflection of lake-water concentrations, ostracod shell chemistry is used to reconstruct a range of environmental conditions. For some elements, such as Mg and Sr, there is a known, and often quantified, relationship between concentration and temperature and salinity. Here, we present results of a P/Ca calibration that can be used to quantitatively reconstruct the P concentrations of lake waters. Nutrient (P and N) pollution from agricultural fertilizers and other sources remains one of the most significant threats to water quality, despite recent improvements in catchment management, in Europe. Elevated external loading of nutrients leads to the increased productivity (eutrophication) of lakes, particularly in lowland shallow lakes, where agriculture is generally more intensive. In shallow lakes, eutrophication often leads to the replacement of aquatic plants by planktonic algae and ultimately a decline in overall biodiversity. The restoration of these environments is critical for future biodiversity, resilience to climate change, the provision of ecosystem services, and is legally binding under the EU Water Framework Directive (WFD). Palaeolimnology offers a method to define reference conditions for effective restoration. However, existing approaches (e.g. diatom transfer functions) for reconstructing nutrient enrichment are problematic due to their indirect approach that involves major assumptions. Robust independent palaeo-P concentrations, derived from ostracod shell chemistry, are a potentially significant advancement in the ability to 1) set reference condition P concentrations for shallow lake restoration targets under the WFD and 2) to predict the effects of future climate change on freshwater biodiversity.

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# COMPARING THE TRANSPOSON LANDSCAPES OF A PUTATIVE ANCIENT ASEXUAL AND A SEXUAL NON-MARINE OSTRACOD (CRUSTACEA, ARTHROPODA)

Ostracods have the best fossil record of all living arthropods which makes them fascinating evolutionary model organisms. In the absence of high-quality ostracod reference genomes, we here compare transposon landscapes between two Illumina genome assemblies from the putative ancient asexual *Darwinula stevensoni* and the fully sexual ostracod *Notodromas monacha*. Both assemblies have around 60,000 contigs, sizes of 360-380 Mb, more than 100X coverage and BUSCO scores of 93 and 94%, respectively. Because homology-based programs are not sensitive enough to detect families of transposable elements (TEs) in species missing from Repbase or Dfam, we used three different pipelines for de novo analyses: REPET, RepeatMasker2 (RM2) and EarlGrey (RM2-based, with automated curation).

TE diversity between the two genomes differs substantially regardless which pipeline was used. The Illumina assembly of *N. monacha* is dominated by LTR retrotransposons (6.5%) with some DNA transposons (3.7%), whereas DNA (15.5%), LINE-like (5.9%) and rolling circle Helitron elements (1.5%) were most abundant in the assembly of *D. stevensoni*. Our results on the dominance of DNA (Tc/mar, hAT) and LINE-like (CR1, RTE) TEs in *D. stevensoni* parallel earlier findings from a partial genomic library, and differ from those of other asexuals. TE copies with a low number of nucleotide substitutions are only observed with REPET ("L" shape landscape) in both genomes.

Although the presented results may underestimate TE abundance, they indicate pronounced differences of the transposon landscapes and diversity between these two ostracod species. Analysis of related species should determine whether the differences are correlated with the repro-

ductive mode or are lineage specific. We are currently curating TEs in an Oxford Nanopore draft assembly of *D. stevensoni* to further confirm our initial results.

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# REVERSE VALVE OVERLAP AS A POSSIBLE TRIGGER FOR SYMPATRIC OSTRACOD SPECIATION: A CASE FROM THE *CYPRIDEIS* SPECIES FLOCK OF WESTERN AMAZONIA (MIOCENE)

During the Miocene, Western Amazonia was covered by an extensive (~1 million km$^2$) and long-lived (~23–10 Ma) wetland called the Pebas system, which contrasts with the modern river-dominated Amazon River and its rainforest (Hoorn *et al*., 2010). Within this aquatic ecosystem, molluscs (Wesselingh, 2006) and ostracods experienced a large radiation. As a result, dozens of endemic species assigned to the genus *Cyprideis* (Purper, 1979; Whatley *et al*. 1998; Gross *et al*., 2014) were identified. Earlier taxonomic work enabled the clustering of the Amazonian *Cyprideis* species into two main groups, the 'smooth' and 'ornate' group (Whatley *et al*., 1998) and each of them was subsequently divided into several subgroups (Gross *et al*., 2014). However, the biological or environmental (e.g. climatic, tectonic, paleohydrological) mechanisms that triggered this speciation are still unclear.

In this study we provide a taxonomic revision of three poorly known species from the Miocene Amazonian *Cyprideis* species flock (*Cyprideis caraionae* Purper and Pinto, 1985, *Cyprideis krsticae* Purper and Pinto, 1985 and *Cyprideis retrobispinosa* Purper and Pinto, 1983), which were placed in the 'smooth group'. The material comes from several outcrops from the Iquitos region (Peru) and a core representing the type locality of one of these species (1-AS-33-AM, ~220 km SW of Benjamin Constant, Amazonas, Brazil). The abundance of ostracods, their good preservation, and the co-occurrence of the studied species with female and male specimens together with several larval stages in the same layers permits us to investigate intra- and interspecific variations of valve traits over time and space. One of the most significant interspecific characters is the development of inverse valve hinges and reverse valve overlap. We also investigate other fossil '*Cyprideis* species flocks' (e.g., from the Caribbean and Central European Lake Pannon; Sand-

BERG, 1964; BOLD, 1976; GROSS *et al*., 2008) as well as recent *Cyprideis* material with a large geographic coverage (WROZYNA *et al*., 2022) to elucidate whether this change in carapace asymmetry is unique to the Pebas system and as a possible mechanism of speciation. According to our observations, the emergence of 'inverse populations' (with reverse valve overlap/'inverse' hinges) could be a driver for reproductive isolation and thus of sympatric speciation among 'Pebasian' ostracods.

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# OSTRACOD BIOSTRATIGRAPHY AND ITS INTEGRATION WITH OTHER INDEX FOSSILS IN THE MIOCENE OF WESTERN AMAZONIA. PRELIMINARY RESULTS AND PERSPECTIVES

The Amazon tropical rainforest is one of the most biodiverse areas on the planet (Mutke & Barthlott, 2005; Jenkins *et al.*, 2013). This vast biotic richness has its roots throughout the Cenozoic due to the influence of several climatic, tectonic, and biological migration events, especially in the Neogene, when several animal and plant taxa diversified considerably (Wesselingh & Salo, 2006; Hoorn *et al.*, 2010).

Thus, Miocene fossils of Amazonia contain crucial evidence for the understanding of these evolutionary processes. However, the stratigraphy of Neogene deposits in Amazonia is a challenge due to several factors. The lack of infrastructure and the dense vegetation limit access of the outcrops over large areas. In addition, there are no volcanic layers suitable for radiometric dating of these deposits, except for the maximum depositional ages provided by detrital zircon geochronology (e.g. Kern *et al.*, 2020). Therefore, the key element for dating these rocks remains palynostratigraphy with regional biozones (Hoorn, 1994). These biozonations were subsequently underpinned using molluscs (Wesselingh *et al.*, 2006) and ostracods (Muñoz-torres *et al.*, 2006). The faster evolution of these biota and their wide distribution throughout the Western Amazonian basins are assumed to offer a higher temporal resolution than the pollen zonation.

In this report, we cross-check the biostratigraphic indication of these three groups of index fossils by means of micropaleontological analyses of 73 samples in 13 stratigraphic sections from the Iquitos region (Peru). Based on the existing mollusc biostratigraphy (Wesselingh *et al.*, 2006) and new palynological data, our preliminary results point to a temporal range expansion of several ostracod species such as *Cyprideis* aff. *Graciosa* (Purper, 1979), *Cyprideis caraionae* Purper & Pinto, 1985 and *Cyprideis cyrtoma* Muñoz-Tor-

res, Whatley & van Harten, 1998 (the last two species are of great interest as they are indicators of an ostracod biozone). In addition, we add to the updated stratigraphic distribution some *Cyprideis* species with a previously unknown range (e.g., *C. krsticae* Purper & Pinto, 1985 and *C. retrobispinosa* Purper & Pinto, 1983) as well as species of marine origin (e.g., *Pellucistoma curupira* Gross, Ramos & Piller, 2015).

Currently, the use of ostracods as index fossils appears to be limited due to the detected extension of the temporal range of several species. However, a clearer chronologic record of species could provide important clues for paleoecological reconstructions and/or the understanding of unique adaptations to the particular aquatic environments of Western Amazonia in the Miocene.

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# LIVING BENTHIC OSTRACODS FROM SUB-ANTARCTIC SOUTH GEORGIA FJORDS: A KEY TO MONITORING RECENT CLIMATE CHANGE

Antarctic fjords are among the environments most affected by recent climate change. In our rapidly climate changing world, it is essential to monitor changes in these vulnerable settings. Here, I present a baseline study of "living" benthic ostracods from fjords of South Georgia, including fjords with and without tidewater glaciers. Their distribution is analyzed in the light of new fjord water and sediment property data, including grain size and sorting, total organic carbon, total sulfur, and 13C of bulk organic matter (Majewski *et al*., 2023). Five well-defined ostracod assemblages by statistical analysis are recognized. *Paracytherois suedgeorgensis* dominates in the mid, outer-fjord areas, *Argilloecia antarctica* is dominant mainly in mid, inner-fjord areas, *Cytheropteron acuticaudatum* is found in the mid-outer parts of the fjords and *Cytheropteron antarcticum* is dominant in the most restricted, near- shore and glacier-proximal habitats. Finally, *Pseudocythere spinifera* together with *Copytus elongatus* are found in the outer parts of the fjords. *Cytheropteron antarcticum* founded in several Antarctic areas including the outer Ross Sea shelf area seems to be the most tolerant species to strong glacial influence, including high sedimentation rates in fjord heads and sediment anoxia, as inferred from sediment color and total organic carbon = sulfur ratios. This opportunistic species thrives in both the food-poor inner reaches of fjords that receive mainly refractory petrogenic organic matter from glacial meltwater and in shallow-water coves, where it benefits from an abundant supply of fresh, terrestrial, and marine organic matter. *Cytheropteron acuticaudatum*, previously recorded by Hartman in South Georgia, is also known as most abundant species from Admiralty Bay, King George Island. This species founded in the mid-outer parts of the fjords well fits mainly with total organic carbon and salinity probably influenced by meltwater from the tidewater

Neumayer Glacier, and in bays supplied with freshwater snowmelt by streams and small rivers. *Argilloecia antarctica,* as recorded by BRANDÃO *et al.*, 2022 did not correlate with any environmental variable so probably recording its ability to tolerate wide environmental changes (SALVI *et al.*, 2022). The outer parts of fjords with clear, well-oxygenated bottom water are inhabited by *Pseudocythere spinifera* together with *Copytus elongatus* dominating in the deepest water settings, with water salinities ≥33.9 PSU and temperatures 0.2–1.4 ºC, characteristic of winter water and Upper Circumpolar Deep Water. The inner- and mid-fjord ostracod assemblages, in the absence of previous bibliography, appear to be specific to South Georgia, although with continued warming and deglaciation, they may become more widespread in the Southern Ocean.

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# A NEW GENUS AND SPECIES OF THE TRIBE POTAMOCYPRIDINI (CRUSTACEA: OSTRACODA) FROM THAILAND

A new genus and species belonging to the subfamily Cpridopsinae is described from Thailand. The new taxon is similar to *Potamocypris* in several aspects, especially the presence of a spatula shaped terminal segment of the maxillular palp. It is thus unequivocally lodged in Potamocypridini (Jacobs & Martens, 2022; Savatenalinton, 2023) which results that the tribe is no longer monogeneric. The new genus can be distinguished from *Potamocypris* mainly by the undivided penultimate segment of the second thoracopod (T2), the absence of the d1 seta on the third thoracopod (T3) and the morphology of mandibula (Md), maxillula (Mx1) and female genital hook. The undivided penultimate segment of the T2 is outstanding feature of the new genus which makes it significantly different from all genera of Cypridopsinae, except for the members of Cyprettadopsini: *Cyprettadopsis* and *Pseudocypretta* (Savatenalinton, 2020; Savatenalinton *et al*., 2022). The first segment of the T3 usually carries d1, d2 and dp setae in Notodromadidae and Cyprididae, including cypridopsine genera, whereas the absence of either of d setae commonly occurs in Ilyocypridinae and Candonidae. Nevertheless, some species of Cyprididae have exceptions, such as the new species and genus (lack d1 seta) and *Martensina thailandica* (lacks d2 seta) (Savatenalinton, 2022). The new genus also shows the following remarkable features. The  seta on Md-palp is small with flagellum-like tip and  seta is markedly long bearing few setules sparsely and with flagellum-like apex. The medial subapical seta on the basal segment of Mx1-palp is exceptional as it is robust and densely set with very long setules on the apical part resulting in the long brush-like ending. The reinforcement of the new genus is also indicated by the female genital hook which apparently differs between the new genus and *Potamocypris*. In *Potamocypris*, it is slender with slightly curved ending (Meisch, 1984,

1985; HORNE *et al*., 2011; SMITH, 2023) whereas it is stubby with strongly curved tip in the new genus. The discovery of the new genus and species most likely suggests the divergent evolution of morphology within the tribe.

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# OSTRACODA (CRUSTACEA) AS INDICATORS OF ANTHROPOGENIC IMPACTS – A REVIEW

The impact of human activities on aquatic ecosystems has been a growing concern, requiring reliable bioindicators for monitoring environmental changes. Ostracods, a group of small crustaceans, have shown great potential in this role due to their sensitivity to various pollutants and environmental conditions. We review all studied responses of Ostracoda to anthropogenic environmental stresses, covering different types of water bodies worldwide. The review is intended to summarize and highlight benefits of ostracods as anthropogenic indicators for potential implementation in water quality and other studies related to human impacts, including palaeo- research. We document the high value of ostracods for indicating anthropogenic pressure on aquatic ecosystems such as nutrients input, pollution by heavy metals, fertilizers, oil spills and even nuclear pollution with steadily increasing publication output since 1969. Most studies focus on eutrophication so far, but results on metalloids, pesticides, and hydrocarbons look very promising for further exploration. We expect future applications in the field of thermal pollution, where almost no information exists so far. Analytical methods in use involve indicator species approaches, including toxicity tests, association analysis, morphological variability, and shell chemistry with a recent trend of increasing numbers of papers on ecotoxicity.

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# MICROFAUNISTIC RECORD OF MARINE PLIOCENE SANDS FROM COSTA BAUSA (BUCCHERI, SOUTHEASTERN SICILY), INCLUDING NEW OSTRACOD SPECIES

At Costa Bausa, a countryside along the left side of the Torrente Mazzarino (NE Buccheri, SE Sicily), marine sands crop out unconformably above the Miocene carbonate succession. Due to their stratigraphic position and the recorded fossil fauna, they are referable to Pliocene s.l. The ostracod and foraminifer associations of these sands are analysed and described for the first time in the present study. The ostracod fauna is composed by specimens belonging mostly to marine shallow water genera such as *Aurila, Neonesidea, Bosquetina, Callistocythere, Carynocythereis, Cistacythereis, Cytherelloidea, Cytheretta, Costa, Graptocythere, Grinioneis, Loxoconcha, Mutilus, Caudites, Pontocythere, Semicytherura, Tenedocythere, Urocythereis, Verrucocythereis* and *Xestoleberis.* Among them, some species are here proposed as new, they are: *Perissocytheridea (Kroemmelbeinella)* n. sp., *Aurila* n. sp., *Aurila* n. sp., *Aurila* sp. nov., *Aurila* n. sp., *Tenedocythere* n. sp., *Cytheretta* n. sp., *Verrucocythereis* n. sp. The remaining species are known or left in open nomenclature.

Plancktonic foraminifera are very rare: only few specimens of *Orbulina universa* and *O. suturalis, Trilobatus trilobus,* and *T. sacculifer* occur. Benthic foraminifer assemblage is characterized by common *Amphistegina lobifera* and *A. lessonii*, and by abundant *Elphidium crispum*, *E. macellum, Ammonia beccarii, A. parkinsoniana* and *Lobatula lobatula* and rare *Cancris auricula, Patellina corrugata, Quinqueloculina seminulum, Massilina oblonga, Oolina exagona* and *O. lineata.*

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# OSTRACODS FROM PANTANI CUBA AND LONGARINI (SE SICILY)

Cuba and Longarini are swamp lakes situated on the SE coast of Sicily. They are both coastal lagoons, which are semi-enclosed bodies of shallow water separated from the open sea by a narrow dune ridge and a sandy beach and linked to the sea by one restricted ephemeral channel. Pantano Longarini has approximately a total water surface of about 150 hectares and has a total volume of 1.1x106 $m^3$. The two parts of the water body, which are called Pantano Longarini 1 (Ragusa) and Pantano Longarini 2 (Syracuse) respectively, are separated by a NE-SW oriented canal at the border between the two provinces and between the municipalities of Ispica and Pachino (ARPA, 2019). This swamp lake is characterised by a muddy-silty bottom devoid of hard substrates (with occasional anoxia phenomena of bottom water) and never reaches a depth greather than one meter (ARPA, 2019). The average salinity of the water is <30 psu (20-27 psu) (euryhaline waters). Pantano Cuba has a water surface of about 50 hectares with a total volume of about 35x106 $m^3$ and reaches a maximum depth of three metres during periods of maximum rainfall (Arpa, 2019). It is categorised in mesohaline waters of intermediate salinity (between 5 and 20 psu) (Galasso *et al.*, 2023).

For the first time, bottom samples and water samples were taken with the aim of acquiring knowledge of the biodiversity of living ostracods in the two lagoons of Longarini and Cuba. Four sampling stations were made in Cuba lagoon and six in Longarini lagoon in July 2022 and December 2022. Bottom samples were carried out by a small bottom dredging with a 63-micron net. Ostracods were picked up under a stereomicroscope, therefore adult living and dead specimens were counted and identified, juveniles are only reported but not counted. The distinction between live and dead specimens was made on the basis of the presence of soft parts. A total of 15 ostracod species were identified:

*Cyprideis torosa* (Jones, 1850*), Prionocypris zenkeri* (Chyzer & Toth, 1858*), Heterocypris salina* (Brady, 1868*), Plesiocypridopsis aculeata* (Costa, 1852), *Candona* (?)*, Cytheridea neapolitana* Kollmann, 1960*, Aurila convexa* (Baird, 1850)*, Aurila prasina* Barbeito-Gonzalez, 1971*, Cytheretta adriatica* Ruggieri, 1952*, Loxoconcha elliptica* Brady, 1868*, Paracytheridea* sp.*, Pontocythere turbida* (Müller, 1894)*, Pterigocythereis jonesii* (Baird, 1850)*, Xestoleberis communis* Müller, 1894*, Semicytherura incongruens* (Müller, 1894)*;* the first five species, almost all collected in December 2022, are known as non-marine ostracods and already reported in inland water of Sicily (PIERI *et al.*, 2020) except for *P. aculeata* reported here for the first time; the remaining 10 species, also collected in December 2022, are commonly known as living in shallow marine environments and they were all found only in the PL1 sample taken near the coast except for *A. prasina* which is represented by very few specimens and it was also found in the samples distant from the coast. The euryhaline ostracod *C. torosa* appears to be the most abundant species predominantly in July and subordinately in December. All other non-marine species are represented by a few specimens. The presence of marine species in sample PL1 in December is related to the increased connection between the swamp and the sea right in the area of the sampling station due to the greater amount of water in the swamp during the winter period. This would allow a greater faunal exchange between the two environments.

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Naturalista sicil., S. IV, XLVIII, 2024, pp. 111-112

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# PRESERVED APPENDAGES IN A SILURIAN BINODICOPE: IMPLICATIONS FOR THE EVOLUTIONARY HISTORY OF OSTRACODS

Ostracod crustaceans originated at least 500 Mya ago. Their tiny bivalved shells represent the most species-abundant fossil arthropods and ostracods are omnipresent in a wide array of freshwater and marine environments today and in the past. *Derima paparme* from the Herefordshire Silurian Lagerstätte (~430 Mya) in the Welsh Borderland, UK, is one of only a handful of exceptionally preserved ostracods (with soft parts as well as the shell), known from the Palaeozoic. A male specimen provides the first evidence of the appendages of Binodicopina, a major group of Palaeozoic ostracods comprising some 135 Ordovician to Permian genera. The appendage morphology of *D. paparme*, but not its shell, indicates that binodicopes belong to Podocopa. The discovery that the soft-part morphology of binodicopes allies them with podocopes affirms that using the shell alone is an unreliable basis for classifying certain fossil ostracods and knowledge of soft-part morphology is critical for the task. Current assignment of many fossil ostracods to higher taxa, and therefore the evolutionary history of the group, may require reconsideration (Siveter *et al.*, 2024).

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Giovanni Surdi, Carolina d'Arpa & Alessandro Incarbona

# RUGGIERI'S OSTRACOD COLLECTION DIGITISATION

Giuliano Ruggieri (1912-2002) was one of the most valued international paleontologists and devoted much of his scientific career to the study of Ostracods. He contributed to increase the knowledge on fossil and recent ostracofaunas, publishing over 70 scientific papers and the describing more than 250 new species and subspecies. The Ruggieri Ostracod Collection (O.C.R.) is one of the most important collections in the world and is stored at the "G.G. Gemmellaro" Geological Museum of the University of Palermo.

The collection consists of over 4.700 slides from more than 400 national and foreign localities, including Paleozoic, Neogene, Quaternary, and living ostracod species from his own personal sampling and from colleagues' collection. The O.C.R. collection is a benchmark point for specialists, as evidenced by the frequent demand for photographic documentation. To date, there is a digital catalogue, including basic information on collected specimens, not publicly available, and a published printed catalogue (Buccheri et al., 2004).

The museum has been launching a digital cataloguing initiative, aimed at enhancing the collection visibility and access to a wider public, funded by the PNRR National Biodiversity Future Center (NBFC). The digitization campaign will start focussing on the types (Holotypes and Paratypes). The adopted cataloguing system is from the Central Institute for Cataloguing and Documentation (ICCD) of the Italian Ministry of Cultural Heritage, that follows international standards, among others on information accuracy, image resolution and ease of reference, through the web-based platform SIGECweb (http://www.iccd.beniculturali.it/it/sigecweb).

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# VARIATION IN THE CARAPACE ORNAMENTATION OF A NEW SPECIES OF PSEUDOCYPRIS DADAY, 1910 (CRUSTACEA, OSTRACODA) FROM SOUTH AFRICA

The genus *Pseudocypris* Daday, 1910 has an Afrotropical distribution, with only one species extending beyond this region (Meisch et al., 2019). A newly identified species, *Pseudocypris* sp. nov., was collected from five temporary waterbodies in the North West Province of South Africa, marking the fifth species of this genus recorded from this country (Methuen, 1910; SARS, 1924a, b). The new species can be distinguished primarily based on the shape of hemipenis and the prehensile palps. In addition, the new species is characterized by phenotypic variation in the carapace ornamentation, which consists of numerous sharply pointed spines. However, such spines occur on certain specimens only, i.e. individuals from four of the sampling sites possessed nearly smooth carapaces or had the spines only weakly developed, varying even on the two valves, yet maintained an outline identical to that of spinose specimens. This morphological variation may be attributable to the site-specific environmental conditions or differential predation pressures combined with a genetic component. Notably, the spined carapace appears to develop only during the last juvenile stage, as younger stages from all studied sites exhibit smooth carapaces.

Given its broad distribution in southern Africa, the genus *Pseudocypris* requires a thorough taxonomic revision. This should encompass detailed morphological descriptions of the soft parts of both male and female specimens, coupled with extensive ecological investigations to elucidate the environmental factors influencing the distribution and variability of the representatives of this genus, and supplemented (whenever possible) with a molecular component, leading to integrative taxonomy.

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# REEFAL OSTRACOD ASSEMBLAGES FROM THE ZANZIBAR ARCHIPELAGO (TANZANIA)

The enormous biodiversity of tropical reef ecosystems has long fascinated ecologists and evolutionary biologists alike, yet it is under threat of increasing natural and anthropogenic disturbances worldwide. Meiobenthic biotas on coral reefs, including ostracods, are poorly understood in terms of their diversity and compositional patterns (Leray & Knowlton, 2015; Plaisance *et al*., 2011). Here we conducted the first large- scale assessment of shallow-marine ostracods from three islands of the Zanzibar Archipelago (Zanzibar, Pemba, Mafia) in Tanzania, where the reef ecosystem is highly diverse and productive. We characterized four ecologically distinct ostracod faunas each inhabiting different benthic environments, which were deep fore reef, shallow fringing reef, degraded fringing reef and intertidal algal bed. We identified typical ostracod associations, i.e., Bairdiidae versus Loxoconchidae-Xestoleberididae, that showed affinity to hard corals or algae on the reef platforms, respectively. Highest diversity was found on shallow fringing reefs where reefal and algal taxa exhibited maximum overlap of their distributional ranges, while the pristine fore reefs accommodated predominantly reefal taxa with moderate levels of diversity. All remaining sites of sand flats, mangrove and marginal reefs within the intertidal zone had much lower diversity with high abundance of euryhaline taxa. Furthermore, the detriment of human activities to overall reef health is evident as shown by the diversity loss and compositional changes of ostracod assemblages near the Zanzibar Town, where the coastal development has been the most intense during past decades (Thissen & Langer, 2017). We conclude that water depth, habitat type, and anthropogenic disturbances are likely the most important environmental factors determining the diversity and faunal structure of reefal ostracod assemblages in a tropical, shallow- marine setting. This study therefore highlights

the ecological significance of ostracods on coral reefs and indicates the usefulness of ostracods as a model proxy for (paleo)environmental assessment.

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# PALAEOENVIRONMENTAL INSIGHTS FROM CAVE OSTRACODS IN GREECE: THE CAVE OF THE LAKES, KASTRIA, GREECE

Ostracods inhabit a wide range of aquatic environments, including groundwater and caves. Despite their prevalence, systematic studies on cave ostracods remain limited, resulting in fragmented knowledge about their biodiversity and distribution. For central Europe, general information on cave ostracods is given by Meisch (2000). In Greece, the relevant work is significantly reduced when it comes to groundwater species (e.g. Karanovic, 2003) and almost non-existent when it comes to species in cave environments (the only extensively known work is that of Popa *et al.*, 2019). However, these organisms are crucial for palaeoecology, offering valuable insights for interdisciplinary research in fields such as archaeology and palaeoclimatology. Consequently, studying cave ostracods presents significant potential for groundbreaking discoveries. The collaborative project "Cave Ostracoda from Greece and Germany: A Pilot Study for (Palaeo)Ecological and Biogeographical Collaboration" in the frame of the "Program for the Promotion of the Exchange and Scientific Cooperation between Greece and Germany IKYDA 2022" exemplifies how scientific research between academic institutions can be synergistically combined with the cooperation of two UNESCO Global Geoparks (Chelmos Vouraikos UGGp and Thüringen Inselsberg - Drei Gleichen UGGp). This research aims to comprehensively analyze ostracods and their ecology in selected caves within these geoparks, laying the groundwork for future paleoenvironmental studies. This investigation contributes novel insights to the understudied field of cave ostracod research, advancing our understanding of freshwater ostracods. Sampling has been conducted in the Kastria Cave of the Lakes and Ladon River springs within the Chelmos Vouraikos UGGp, as well as in Altensteiner Höhle, Marienglas Höhle, and Kittelsthaler Tropfsteinhöhle: Grafsche Kammern within the

Thüringen Inselsberg - Drei Gleichen UGGp. Among these, the Cave of the Lakes has yielded the most promising results. In October 2022, sediment samples were collected from five different locations on the cave floor and two box core samples from the bottoms of lakes 1 and 2. Short cores were also taken from two of the five sampling sites. These samples were wet sieved using 125 μm and 63 μm sieves. Three distinct species of freshwater ostracods were identified across all samples, with the core samples being particularly rich in findings. These species belong to the genera *Neglecandona, Trapezicandona* and *Schellencandona*. Additionally, two gastropod species and various micro-mammal bones were discovered. Notably, microplastics were detected in numerous specimens. This multidisciplinary research is unprecedented for the Cave of the Lakes and Greece in general. We plan to extend our preliminary research through subsequent project aimed at reconstructing the late Quaternary environmental evolution and anthropogenic impacts within the Cave of the Lakes.

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# ENVIRONMENTAL FACTORS AND UV EXPOSURE AFFECT GENE ACTIVITY IN THE PUTATIVE ANCIENT ASEXUAL OSTRACOD *DARWINULA STEVENSONI*

The non-marine ostracod *Darwinula stevensoni* (Ostracoda, Crustaceae) is one of the last remaining examples of an ancient asexual (Schön *et al.*, 2009) and has probably abandoned sexual reproduction approximately 20 million years ago (Straub, 1952). In spite of the limited genetic diversity of *D. stevensoni*, its cosmopolitan distribution in different aquatic habitats indicates that this species can survive asexually in the long-term, possibly because it developed a general purpose genotype (Van Doninck *et al.*, 2002). To unravel the genetic background of this general purpose genotype, we have studied gene activity of *D. stevensoni* via the RNA sequencing of transcriptomes. The transcriptome is the collection of all active genes which have been transcribed from DNA to RNA under certain conditions. Statistically comparing the genetic composition of transcriptomes allows us to identify differences in active (or expressed) genes, which inform on host adaptations to specific conditions (Tran Van *et al.*, 2021). We characterised transcriptomes of *D. stevensoni* from natural populations in Spain, England and Belgium. To summarize results in our multi-gene approach, the "gene ontology" (GO) classification system was used which divides genes across groups ("terms") in accordance to the biological function, molecular pathway or cellular component they affect. Of the 5013 terms which were assessed regarding biological function, 49 were found to have significantly different gene expression between the three different populations. However, none of these terms could be directly linked to temperature-related functions, suggesting that differences in gene expression between natural *D. stevensoni* populations are more complex and do not only reflect adaptation to varying temperature ranges. Living *D. stevensoni* individuals from the Belgian population were also exposed to UV-radiation in the lab. In this experiment, we expected to find

an increased activity of genes being related to the repair and preservation of DNA countering the effects of UV-radiation. Of the same 5013 analysed gene terms, only 9 showed a significant change in gene expression in response to UV-radiation. None of these gene terms had known repair functions, potentially highlighting again more complex gene expression patterns in *D. stevensoni* than initially expected. More analyses are currently ongoing to unravel the functionality of the activated genes in more detail. We are also planning an experimental set up to directly study gene expression differences of *D. stevensoni* under different temperatures.

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# ASSIGNMENT OF OSTRACOD TAXA TO ECOLOGICAL GROUPS: A PROOF OF CONCEPT TO DEVELOP THE OSTRA-AMBI INDEX IN THE ADRIATIC SEA

Multiple biotic indices have been developed to assess the Ecological Quality Status (EcoQS) of marine and transitional environments. These ecological indices rely on assignment of species to Ecological Groups (EGs) based on their sensitivity/tolerance to organic-matter (OM) enrichment (e.g., Borja *et al.,* 2000). This, in turn, opens the opportunity to use fossilizable organisms, such as benthic foraminifers to assess the EcoQS and to reconstruct Paleo-EcoQS highlighting natural or human-induced pollution trends within sedimentary successions. Despite the well-known potentiality of ostracods as ecological and (paleo)environmental proxy, the assignment of taxa to EGs has not been carried out yet.

The wide availability of a modern database (Breman, 1975) encompassing abiotic and biotic data (i.e., water depth, sand, calcium carbonate and OM), allowed us to better determine the level of sensitivity/tolerance of ostracod taxa to OM. Indeed, the high degree of knowledge of seafloor morphology, water circulation and transport of river-derived detritus in the Adriatic Sea, enabled to disentangle the complex interplay of co-occurring parameters on ostracod distribution and OM ranges preferences.

Statistical analyses (i.e., weighted-averaging optimum and tolerance range and nonlinear regression) on 298 grab samples enabled the assignment of 115 species to EGs.

The SSE-directed sediment routing system, mainly fueled by the Po River, leads to distinct organic enrichment gradients on the Adriatic shelf, supporting the identification of key ostracod species from sensitive (EG I) to third- order opportunists (EG III) for the evaluation of the EcoQS in shallow-water settings. Shelf species of *Semicytherura* were commonly assigned to EG I, while *Aurila convexa* and *A. speyeri* to EG II. Differently, *Leptocythere*

*bacescoi* and *Cytheridea acuminata neapolitana* were assigned to EG III. Several second-order opportunists (EG IV) occur only under deep-water settings (ca. >160m) in the Mid and South Adriatic Depressions (i.e., *Pedicythere phryne* and *Bythocypris obtusata*, the latter recorded only in the South Adriatic Depression).

Exclusively brackish and freshwater species, mainly inhabiting the transitional environments of the Po River Delta, were potentially assigned to the first-order opportunists (EG V) being associated to highly organic marine sediments. These species were considered transported on the shelf by river floods, which are commonly OM-enriched.

Although the complicated relationships between species, depositional settings and OM gradient are still to be fully understood, the proposed results support the development of an ostracod-based index (i.e., Ostra-AMBI) for EcoQS and Paleo-EcoQS assessment.

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# EXCEPTIONALLY PRESERVED OSTRACODS FROM THE MID-CRETACEOUS AMBER

As a famous fossil Lagerstätte, the mid-Cretaceous (ca. 100 Ma) amber from Kachin, northern Myanmar, harbors one of the most diverse Mesozoic palaeobiotas yet discovered. Over the past few years, reports of organisms trapped in Kachin amber have increased exponentially. However, ostracods, as fully aquatic animals, are so far represented in Kachin amber by 43 specimens including marine and non-marine ostracods. Here, we focus on these non-marine ostracods which have 42 specimens from two pieces of amber. The bivalved crustacean ostracods have the richest fossil record of any arthropod group and display complex reproductive strategies contributing to their evolutionary success. Sexual reproduction involving giant sperm, shared by three superfamilies of living ostracod crustaceans, is among the most fascinating behaviours. However, the origin and evolution of this reproductive mechanism has remained largely unexplored because fossil preservation of such features is extremely rare. Here, we report exceptionally preserved ostracods with soft parts (appendages and reproductive organs) in a single piece of mid-Cretaceous Kachin amber (approximately 100 Myr old). The ostracod assemblage is composed of 39 individuals. Thirty-one individuals belong to a new species and genus, *Myanmarcypris hui* gen. et sp. nov., exhibiting an ontogenetic sequence from juveniles to adults (male and female). Seven individuals are assigned to a new species and genus *Electrocypria burmitei* gen. et sp. nov. and one to *Sanyuania* sp. Our micro-CT reconstruction provides direct evidence of the male clasper, sperm pumps (Zenker organs), hemipenes, eggs and female seminal receptacles with giant sperm. Our results reveal that the reproduction behavioural repertoire, which is associated with considerable morphological adaptations, has remained unchanged over at least 100 million years — a paramount example of evolu-

tionary stasis. These results also double the age of the oldest unequivocal fossil animal sperm. This discovery highlights the capacity of amber to document invertebrate soft parts that are rarely recorded by other depositional environments. We further describe taphonomic traits indicating that the studied ostracods were quickly surrounded by resin and instantly immobilized. The palaeoenvironment is considered to be a vegetated brackish (mesohaline-oligohaline) lagoon.

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Qianwei Wang & Peter Frenzel

# THE PLEISTOCENE-HOLOCENE CLIMATE CHANGE IN CENTRAL EUROPE REFLECTED BY OSTRACOD SUCCESSIONS FROM PLINZ, THURINGIA

The transition between the Pleistocene and the Holocene in Thuringia, Central Europe, represents a unique period characterized by significant environmental and climatic changes (Boettger *et al*., 2009). The present study focuses on the analysis of palaeoclimate dynamics by examining the ostracod successions in the Plinz area between approximately 11,600 and 9,100 years cal BP. We have selected ostracods, a taxon highly sensitive to ecological variations, as our subject of study and analyzed their community changes across the Pleistocene/Holocene boundary.

A total of eleven ostracod species were identified and their associations were divided into three successive zones. Zone A exhibits cooler marshy conditions characteristic of the Late Glacial to Early Holocene transition marked by the presence of *Cavernocypris subterranea* and *Potamocypris zschokkei*, which thrive in cold environments (Horne & Mezquita, 2008; Fuhrmann, 2012), indicating the commencement of postglacial environmental shifts. Progressing to Zone B, the ostracod evidence, particularly the abundance of *Cyclocypris laevis*, suggests warmer and more humid conditions (Frenzel, 2018) during a period that fostered the formation of small ponds indicative of more ecological stability during the early Holocene. Lastly, Zone C, captures a return to cooler and drier climates, with *Eucypris pigra* and *Potamocypris pallida* indicating a decrease in water availability. Punctuated by significant climatic oscillations consistent with the Preboreal oscillation (Bos *et al*., 2007), denoting a period of increased environmental variability.

The study of these palaeoecological zones highlights the intricate relationship between ostracod communities and climatic changes during the Pleistocene-Holocene transition. The resulting palaeoenvironmental model

illustrates the evolution of local paleoclimate and associated hydrological conditions over this period.

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Qianwei Wang, Dayou Zhai & Peter Frenzel

# DORMANT OSTRACODS IN DESICCATED RICE FIELDS OF YUNNAN, CHINA: INSIGHTS INTO LIFE STRATEGIES AND COMMUNITY DYNAMICS

Ostracods are commonly documented as active members of rice field ecosystems (Smith *et al*., 2018), yet little is known about their dormant communities during the dry periods of the rice cycle, impeding a holistic comprehension of their life strategy and adaptive mechanisms to the rice field environment. Such information, however, is especially interesting considering rice fields as anthropogenic ecosystems with implications for environmental management, geoarchaeology, and our knowledge on invasive species.

Our data provide evidence for the dormant ostracod community in 43 desiccated rice fields of Yunnan, southwestern China, studied here. The samples cover at least the upper 0 2 cm of the surface sediment. By culturing soil samples from these rice fields, we identified 11 ostracod species. These are dominated by species of the family Cyprididae, accompanied by members of Candonidae and Ilyocyprididae. A notable variance in species of the dormant communities suggest adaptive ecological strategies for survival during the dry phase (Rosa *et al*., 2020, 2021a, b, 2023).

This investigation provides new insights into the biodiversity of non-marine ostracods from rice fields focusing on ostracods with dormant phases, thus contributing to biogeographical mapping and conservation efforts. The findings indicate that current perspectives on ostracod communities could be revised, encouraging a re-evaluation of existing conservation strategies. This new approach may lead to a more refined understanding of the role these ostracods play as bioindicators.

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YAQIONG WANG & BYUNG-DO CHOI

# APPLICATION OF OSTRACODA FROM THE EARLY CRETACEOUS LIUPANSHAN GROUP AT PINGLIANG (NW CHINA) – BIOSTRATIGRAPHY AND PALAEOECOLOGY

The Liupanshan Basin is one of the small-scale Mesozoic-Cenozoic rift basins, which situated in the northern part of the North-South tectonic belt and bounded by the Ordos Block, the Alxa Block, the Hexi Corridor belt, and the Qinling-Qilian orogenic belt. Within this basin, the Lower Cretaceous Liupanshan Group comprises five formations: Sanqiao, Heshangpu, Liwaxia, Madongshan, and Naijiahe formations, arranged in ascending stratigraphic order. This study investigates a non-marine ostracod fauna recovered from the Liwaxia and Madongshan formations, encompassing eight species belonging to seven genera: *Lycopterocypris infantilis*, *Ziziphocypris costata*, *Bisulcocypridea gaodianensis*, *Cypridea astuta*, *C. puncticulata*, *Mongolocypris liupanshanensis*, *Liupanshania typica* and *Limnocythere* sp. A. Among these, the genus *Bisulcocypridea* has been reported from Aptian to lower Paleocene deposits in the United States, Mongolia, and China (WANG, 2024).

*Bisulcocypridea gaodianensis* has been also found in the Albian to Cenomanian Baruunbayan Formation of Mongolia (NEUSTRUEVA *et al.*, 2005). The stratigraphic range of the genus *Mongolocypris* spans from Aptian to Paleocene, but it is predominantly Albian to Paleocene (CHOI *et al.*, 2020). The distribution pattern of *L. infantilis* was documented and summarized by WANG *et al.* (2016), and this species is widely distributed in Hauterivian to Albian non-marine strata in East Asia (WANG *et al.*, 2016). Consequently, based on the aforementioned information, the Liwaxia Formation is mainly Aptian but may extend into the Albian, and the Madongshan Formation is an Albian in age at the Pingliang area.

In this ostracod fauna, the endemic-dominated extinct genus *Liupanshania* is most closely related to the living genus *Cyprois* of the family Notodromadidae. All living species from the family Notodromadidae possess

swimming ability, and most feed on the neuston. Additionally, notodromadidae are known to inhabit mostly lentic habitats (SMITH *et al.,* 2022). Furthermore, based on our previous findings, the other ostracod genera from this fauna may indicate a fresh to slightly saline lacustrine to fluvial environment. Therefore, we interpret the Liwaxia and Madongshan formations in the Pingliang area of the Liupanshan Basin as having been deposited in a fresh to slightly saline lacustrine environment.

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YAQIONG WANG, PING YANG & YANHONG PAN

# MARINE OSTRACODS FOUND IN LACUSTRINE DEPOSITS OF THE QAIDAM BASIN SUGGESTS LONG-DISTANCE DISPERSAL DURING PLEISTOCENE

Ostracoda thrive in most inland waters but are also found in marine, interstitial, and occasionally (semi-)terrestrial environments. While the majority of living ostracods exhibit restricted geographic distributions, a small number transcend two or more zoogeographical regions, even marine ecoregions. The mechanisms behind the dispersal of these widely distributed ostracod species are still under discussion. A large number of studies have focused on the long-distance dispersal of freshwater ostracod species (e.g. HORNE & SMITH, 2004). In contrast, the long-distance dispersal of brackish to marine ostracods (intercontinental, intraoceanic, and interoceanic transports) has been minimally explored by a few authors, discussing potential passive dispersal through rafting seaweeds, anthropogenic activities (global shipping, mariculture), shellfish (oysters), and even tsunamis (e.g. TANAKA *et al.,* 2018).

In this study, four ostracod specimens from the Pleistocene lacustrine deposits of the Qaidam Basin are re-assigned to the brackish to marine species *B. bisanensis* s.l. and

*P. bradyformis*, previously misclassified under the freshwater ostracod genus *Cytherissa* by YANG *et al.* (2020). These two marine ostracod species are benthic forms found in modern mud to fine-grained sand substrates along the coasts of China, Japan, Korea, Russia, and Vietnam, within latitudes approximately 20°N to 43°N , with fossil records concentrated along the Eastern Pacific Ocean coast. The Qaidam Basin, a terrestrial sedimentary basin since the Early Jurassic, presents an intriguing case wherein these marine ostracod species likely traversed over 2,000 kilometers from coastal areas of the Eastern Pacific Ocean to the Qaidam palaeo-lake during the Pleistocene. For many marine microscopic organisms, movement within and between habitats poses significant challenges due to limited self-dispersal capabilities.

Nonetheless, certain microscopic marine organisms have successfully dispersed over long distances facilitated by vectors, including wind, water currents, sea plants, animals, and anthropogenic activities. While wind dispersal may be relatively inefficient over longer distances, water currents, fish, mollusks, and floating algae are potential agents facilitating passive migration of marine ostracods between interconnected habitats. However, the absence of a direct hydrological connection between the Qaidam palaeo-lake and the Eastern Pacific Ocean coastal areas discounts these vectors as significant agents in the passive migration of the discovered marine ostracods. Comparatively, bird-mediated transport emerges as one of the most effective forms of passive dispersal for ostracods, especially over long distances and between disconnected habitats. Consequently, this study presents potential evidence for the long-distance dispersal of marine ostracods via water birds from the west coast area of the Pacific Ocean to the the Qaidam palaeo-lake during the Pleistocene. It is also implied that the existence or formation of the East Asian Flyway or East Asia/Australasia Flyway during the Pleistocene period.

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Mark T. Warne

# *BRADLEYA* AND ALLIED GENERA FROM NEOGENE NERITIC STRATA OF SOUTHEASTERN AUSTRALIA: A HIGH DIVERSITY OF SPECIES-GROUPS FROM CONTINENTAL SHELF SETTINGS

*Bradleya* Hornibrook, 1952 is an iconic global ostracod genus extensively studied from deep- sea environments (e.g. Benson, 1972, Jellinek & Swanson, 2003, Mazzini, 2004, Brandão & Päplow, 2021, Bergue & Coimbra, 2023). The heritage of Cenozoic deep-sea *Bradleya* species (and allied taxa) is generally thought to involve passive migration of shallow marine clades into deep marine realms, as new seas and oceans formed between rifted fragments of Gondwana (e.g. Whatley 1983, 1996). Unusually diverse shallow marine species-groups of *Bradleya* (and allied genera) also occur in Neogene continental shelf strata of southeastern Australia. It is argued that these shallow marine taxa provide an expanded perspective relevant to bradleyine systematics, particularly generic classification. During the Neogene, short-lived migrations on upwelling currents onto the southeast Australian continental shelf are apparent for some deep-sea bradleyine species. However, it is also noted that some late Cenozoic upwelling currents in this region may have been associated with cascading undercurrents of relatively saline, dense continental shelf waters that flowed down the continental slope into the Tasman Sea. The latter may have been an additional pathway or conduit for the migration and subsequent adaptation of former shallow marine clades to deep-sea realms. Also of note, archaic bradleyine species persist into the Neogene of southeastern Australia; these forms possessing transitional carapace morphologies between the genera *Limburgina* Deroo, 1966 and *Bradleya.* Paedomorphosis appears to be an important mechanism involved in the evolution of Bradleyinae species-groups of the Southwest Pacific and Southern oceans.

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# SEASONAL DYNAMICS OF THE STABLE ISOTOPE ($\delta^{18}O$, $\delta^{13}C$) COMPOSITION OF MODERN OSTRACODES IN A LARGE TROPICAL LAKE (LAGO ENRIQUILLO, DOMINICAN REPUBLIC)

Stable oxygen (O) and carbon (C) isotope records are widely used for paleoenvironmental reconstructions based on the bulk carbonate values. This approach ignores, however, information of seasonal environmental variability that is implied by the short and variable life history of ostracodes. Consequently, there are only few studies that highlight the potential of ostracodes for high-resolution (e.g., seasonal) paleoenvironmental reconstructions, based on their stable isotope composition.

Seasonal weather patterns of tropical areas such as the Caribbean region are broadly divided into dry and rainy seasons with often profound effects on hydrological and ecological conditions. How this hydrological seasonality is archived by ostracode stable isotopes ($\delta^{18}O$, $\delta^{13}C$) is, however, poorly documented. In the present study, variation of lake water isotopes ($\delta^{18}O$, $\delta^{2}H$) and $\delta^{13}C_{DIC}$ together with hydrochemical composition (anions, cations) of the hyperhaline Lago Enriquillo have been sampled together with living ostracodes in March and September 2022. Stable oxygen and carbon isotopic signatures of single ostracode valves were analysed of different ostracode species (*Cyprideis similis, C. edentata*, *Perissocytheridea cribrosa, Thalassocypria* cf. *sarbui*) which have been shown to provide differences in their temporal-spatial distribution in the lake (Berndt *et al.*, under review). Results are further complemented, by the stable C and N isotope composition of organic matter, and the stable C and O isotope composition of bulk carbonate.

Preliminary results show that species display differences in their isotopic composition and variation ranges. Different isotope compositions could result from seasonal and spatial differences in e.g., freshwater input, evaporation, and microhabitat preferences within the lake. Within-sample variability may reflect differences of timing of calcification and/or adult-life span as

well as differences in vital effects of the species. *C. similis* shows similar seasonal variation and relatively small variation ranges in their $\delta^{18}O$ values similar to the lake water. Larger variation ranges and lack of seasonal differentiation of *P. cribrosa* and *C. edentata* could result from differences in the timing of calcification from e.g., longer adult life span and represent therefore interannual hydrological changes.

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Moriaki Yasuhara

# TIME MACHINE BIOLOGY: PALEOBIOLOGY DISCOVERS DEEP-TIME BIODIVERSITY

Direct observations of marine ecosystems are inherently limited in their temporal scope. Yet, ongoing global anthropogenic change urgently requires improved understanding of long-term baselines, greater insight into the relationship between climate/environment and biodiversity, and knowledge of the long-term consequences of our actions. Small fossils, so called microfossils (including various taxonomic groups of photosynthetic plankton such as coccolithophores and diatoms, various mixo- to heterotrophic protists such as planktonic and benthic foraminifera and radiolarians, and small metazoans such as benthic ostracods as well as parts of larger organisms, such as the scales and teeth of fish and shark denticles), can provide this understanding by linking data on the responses of marine biota to reconstructions of past environmental and climatic change. Given the continuous, abundant, ubiquitous preservation of microfossils in sediment cores and outcrops, studies of microfossils have the potential to constrain the state and dynamics of past climates/environments and biodiversity on timescales of centuries to millions of years. Here, I will overview the development and recent advances in this line of research that I dubbed "Time Machine Biology"—a synthetic science with the potential to illuminate the interplay and relative importance of ecological and evolutionary factors during times of global change. I will showcase several examples from recent studies from our group, especially focusing on microfossil ostracods, and give an outlook on ongoing and future anthropogenic changes.

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# PERISSOCYTHERIDEA FROM THE NEOGENE OF WESTERN AMAZONIA

The genus *Perissocytheridea* is assumed to be Gondwanan origin and has an extensive paleobiogeographic and stratigraphic record (North and South America, Africa and Europe; Cretaceous to recent; e.g., Zabert, 1978; Purper, 1979; Nogueira & Ramos, 2016).

Neogene sediments of western Amazonia are known for their high paleobiodiversity among the so-called 'Pebasian' molluscs (Wesselingh, 2006). But also 'Pebasian' ostracods exhibit a high degree of diversity and endemicity, which has led to the establishment of several new genera and species (Purper, 1979; Sheppard & Bate, 1980). Over the last four decades, these ostracods have been thoroughly studied, although the focus has been on the genus *Cyprideis*, which usually makes up the bulk of the ostracod fauna (Purper, 1979; Muñoz-Torres et al., 1998; Gross et al., 2014).

Our aim is to revise the taxonomy of *Perissocytheridea* species of western Amazonia and to explore their paleobiogeographic and paleoecological significance. We investigated specimens from six localities in the Iquitos region (Peru), which yielded abundant and well-preserved material, including females, males, juvenile valves some specimens with reverse valves overlap and "inverse" hinges.

So far, we have identified five species (*Perissocytheridea ornellasae, Perissocytheridea aff. akistron, Perissocytheridea? elongata and, less frequently, Perissocytheridea acuminata* and *Perissocytheridea* sp.1), which appear to be endemic to western Amazonia.

Like Cyprideis, it is assumed that *Perissocytheridea* typically occurs in mixohaline environments (e.g., Keyser, 1977; Babinot, 1988; Nicolaidis & Coimbra, 2008).

Geochemical analyses (O/C-isotopy) are in progress to contribute to the

question of the influx of saline water either via marine ingressions or subterranean waters into the mainly freshwater 'Pebas mega-wetland' (GROSS & PILLER, 2020).

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# LATE ORDOVICIAN OSTRACODS OF VALCOUR ISLAND, NEW YORK STATE, USA

Ordovician ostracods in New York State had been preliminarily reported (SWAIN, 1957, 1962; COPELAND, 1982), but have not been revised since. In this study, new materials are collected from the early Sandbian (Late Ordovician) Crown Point Formation of Valcour Island, northeastern New York State, for systematic revision, diversity analysis as well as discussion on paleogeography and paleoecology. A total of 52 species of 43 genera are identified from the fauna, with podocopid *Krausella variata* Kraft, 1962, beyrichiocopid *Cryptophyllus oboloides* (Ulrich & Bassler, 1923), and podocopid *Elliptocyprites longula* Swain, 1962 being dominant. Diversity analysis using Hill number for each sample reveals a significant increase through the studied section. Global faunal comparison and diversity analysis show close relationships between Laurentia and Baltica, as well as Avalonia and Siberia during this time interval, with frequent faunal exchange and migration. Compared to the macroevolutionary pattern of Ordovician ostracod in Baltica that has the diversity climax of the Great Ordovician Biodiversification Events during the Katian (BRADDY *et al.*, 2004), Laurentian records indicate that its diversity climax occurred earlier in the Sandbian. Additionally, well-preserved materials of the palaeocopid *Eurychilina placida* Swain, 1962 with moult retention are collected. The phenomenon of moult retention has been observed in a few genera of Paleozoic ostracod empirically assigned to the Suborder Eridostracina Adamczak, 1961. Previous research has indicated that the eridostracines might be a polyphyletic group (OLEMPSKA, 2012), and the new materials challenge the present classification scheme for taxa with moult retention by suggesting that the feature may not be reliable for defining the suborder, thus implying the need for revision.

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