

**The taxonomy and
biogeography of
macrofaunal ostracod
crustaceans, with focus on
the abyssal benthic Pacific
fauna relevant to the CCFZ**

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Few words about myself



Serbia (Novi Sad, born)



Italy (Salerno, 2 years)



Australia (Perth & Hobart, 10 years)



Germany (Hamburg, 2 years)



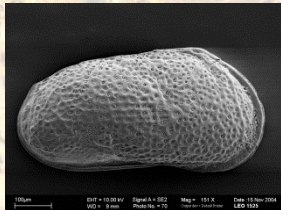
South Korea (Seoul, 3.5 years)

- Started working on ostracods 15 years ago
- Worked on faunas from all continents (including Antarctica)
- and from all environments: from freshwater puddles to deep sea
- I don't particularly like ostracods
- I like the fact that ostracods give insight into many aspects of biology

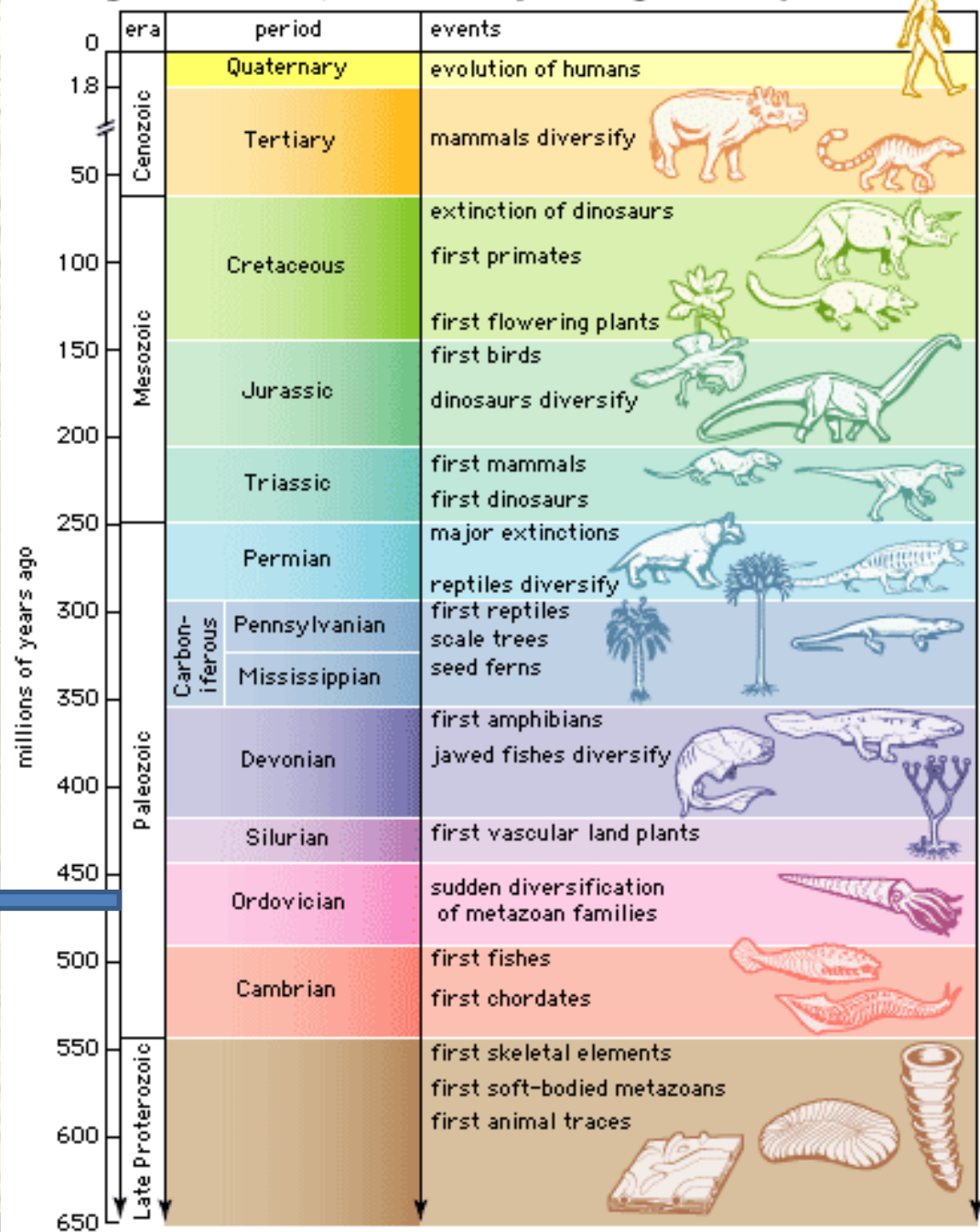
General information on ostracods

- Named in 1802 by Latreille
- Name comes from the Greek *óstrakon*, meaning shell or tile
- Common name in English: “mussel shrimp” or “seed shrimp”
- In German it is “Muschelkrebse”
- Live in all aquatic habitats on the planet

Fossil record



Geologic time scale, 650 million years ago to the present



Systematics

- Previously in the class Maxillopoda
- Currently recognized as one of the 7 classes of the phylum Crustacea
 - Currently divided into two subclasses
 1. Myodocopa
 2. Podocopa

Systematics cont.

- Subclass Myodocopa
 - 1. Order Myodocopina
 - 2. Order Halocyprida
 - a) Suborder Halocypridina
 - b) Suborder Cladocopina
- Subclass Podocopa
 - 3. Order Platycopida
 - 4. Order Podocopida
 - a) Suborder Bairdiocopina
 - b) Suborder Cytherocopina
 - c) Suborder Darwinulocopina
 - d) Suborder Cypridocopina
 - e) Suborder Sigilliocopina

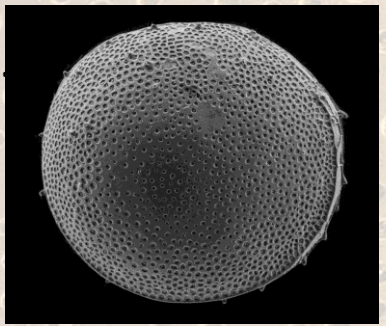
1.



2a.



2b.



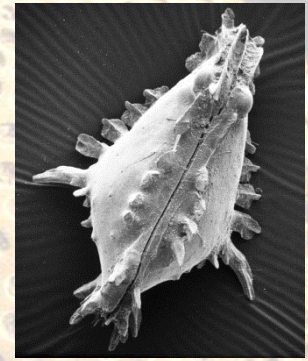
3.



4a.



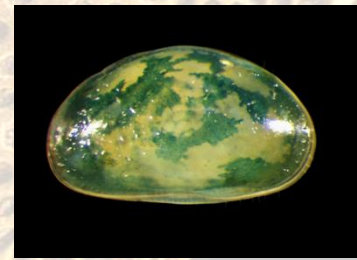
4b.



4c.



4d.



4e.

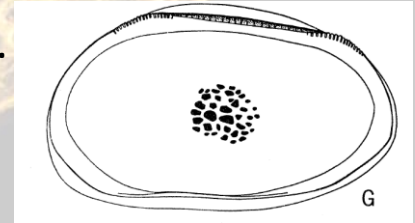
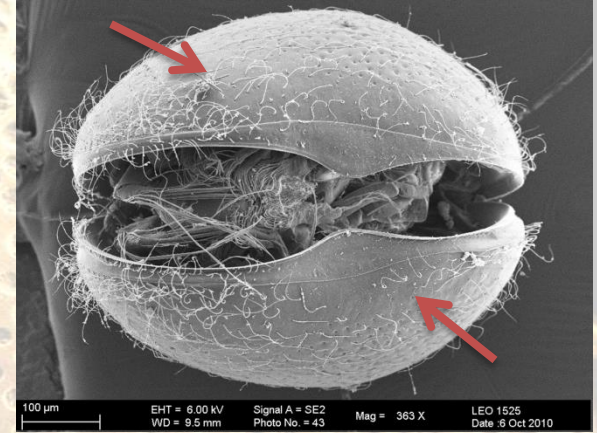


Photo credits:
 1, 2: S.N. Brandao
 3: Brandao & Yasuhara
 4b, c: D. Keyser
 4e: From Maddocks (1972)

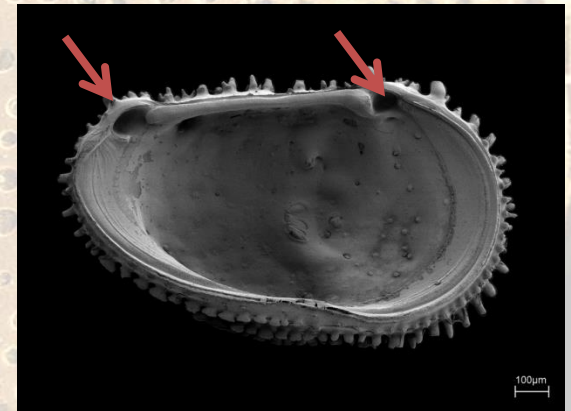
Morphology

1. Body enclosed between two (strongly) calcified valves
2. Dorsally hinged
3. (Almost) No body segmentation

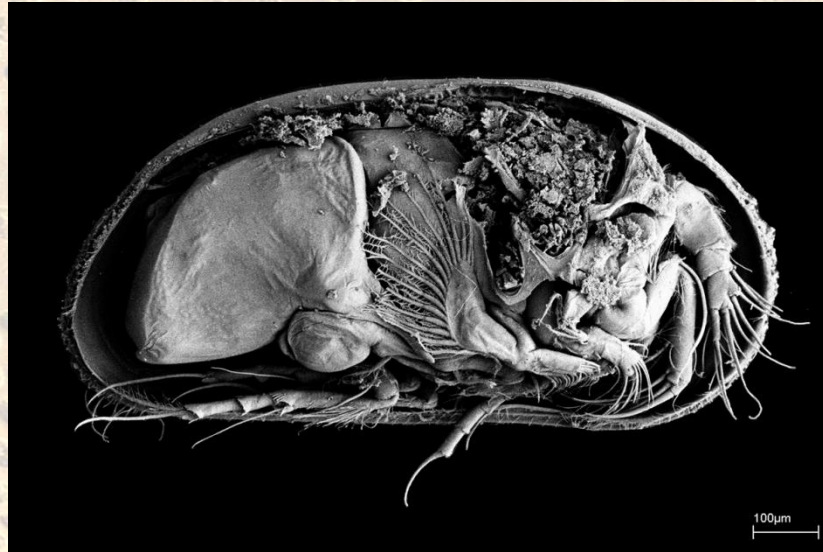
a.



b.

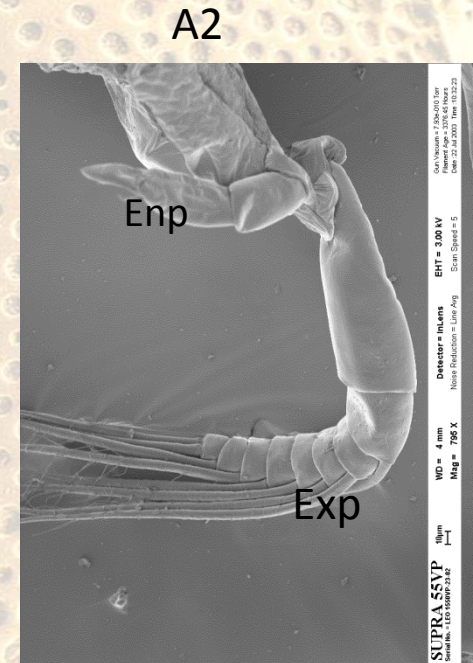
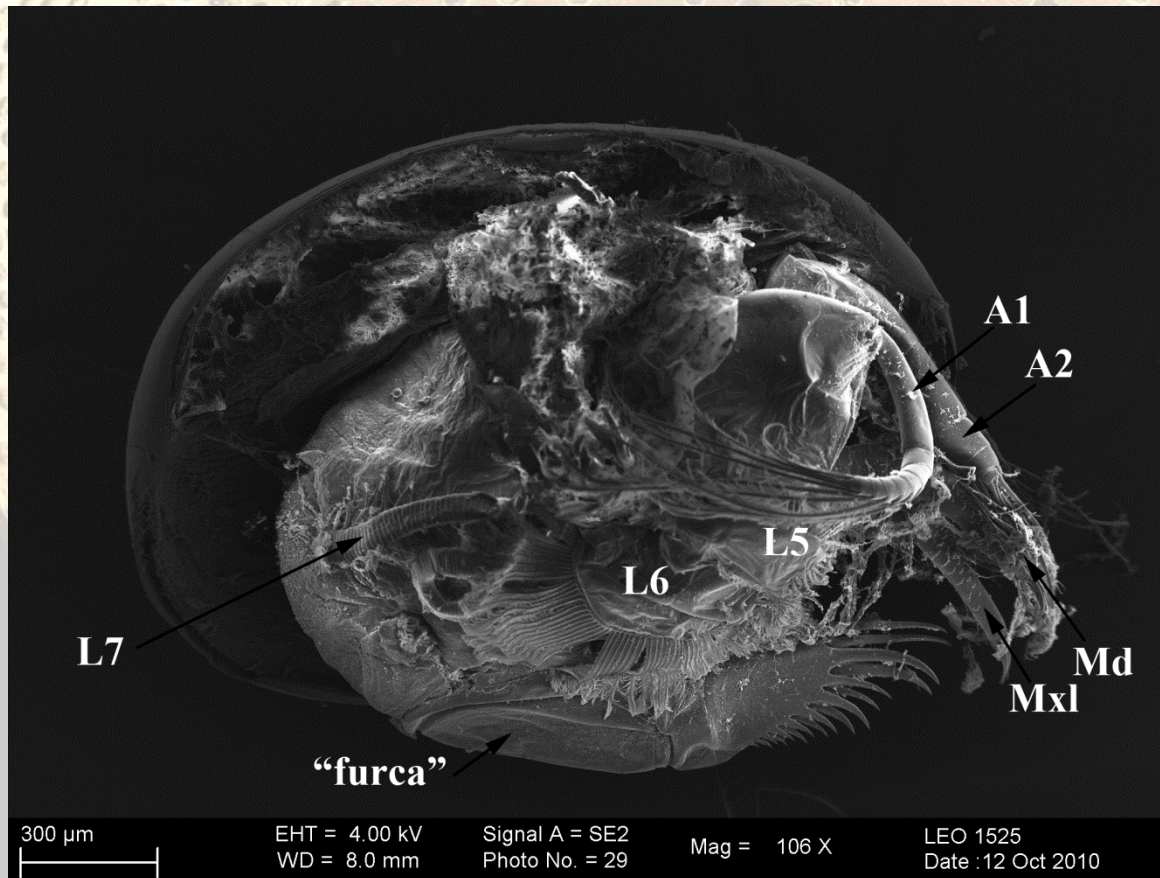


c.



Myodocopa: morphology

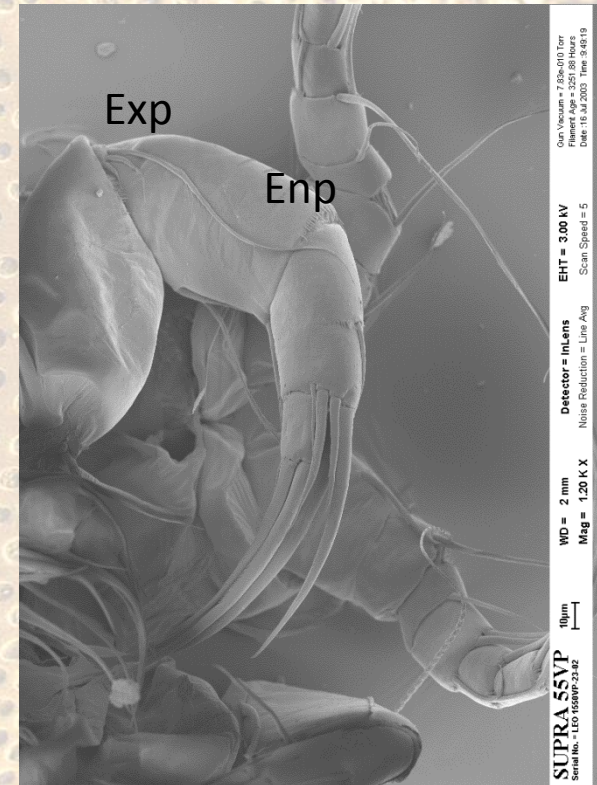
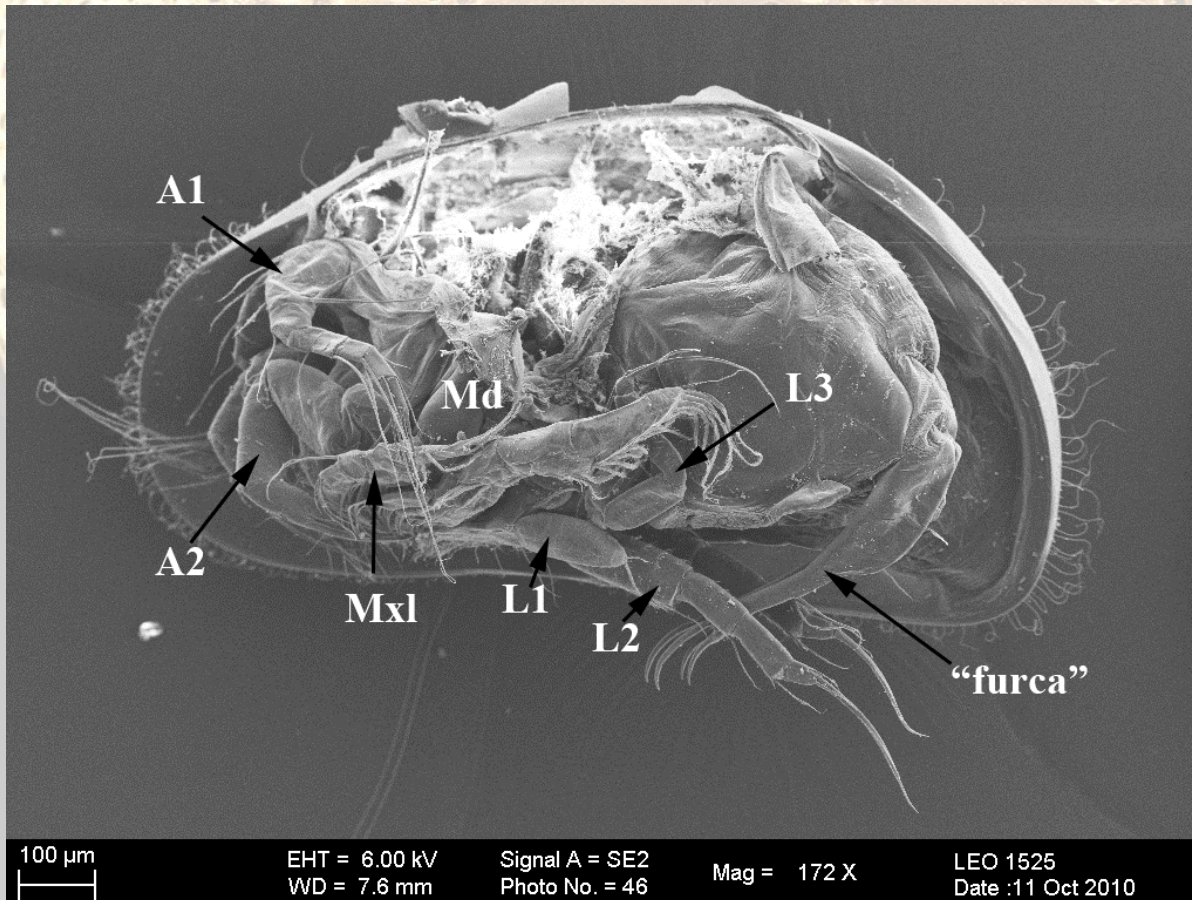
- up to seven appendages, huge differences in morphology between orders
- weaker calcification



Podocopa: morphology

- up to seven appendages, more conservative
- more strongly calcified

A2



Polyphyletic?

1. Different ontogeny:
 - Myodocopa 5-6 appendages (metanauplius), most usually only 5 instars
 - Podocopa 3-4 appendages most often 8 instars
2. Position of the most posterior appendage “furca”:
 - Myodocopa dorsal to anus
 - Podocopa ventral to anus
3. Some molecular studies (but very limited)
4. Strikingly different morphology

Size

- From 0.2 mm



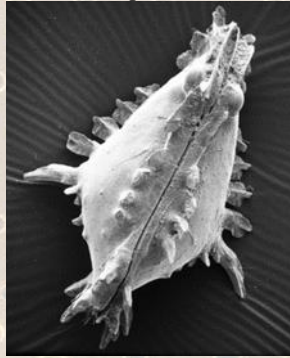
- To 3 cm



Image: <http://www.whoi.edu/page.do?pid=83676&tid=4142&cid=58133&i=22>

Diversity

- 65.000 Fossil Species
- 8.000 Recent (?living) **living = shell + soft parts**
- Majority of fossil species belong to the order Cytherocopina



- Cytherocopina is also 2/3 of the entire diversity of living ostracods

Trends in ostracodology and application of ostracod study



- Indicators of palaeoclimate

- Mg/Ca ratio, indicator of palaeotemperature;
- Sr/Ca ratio, indicator of salinity

- Indicators of past human activity

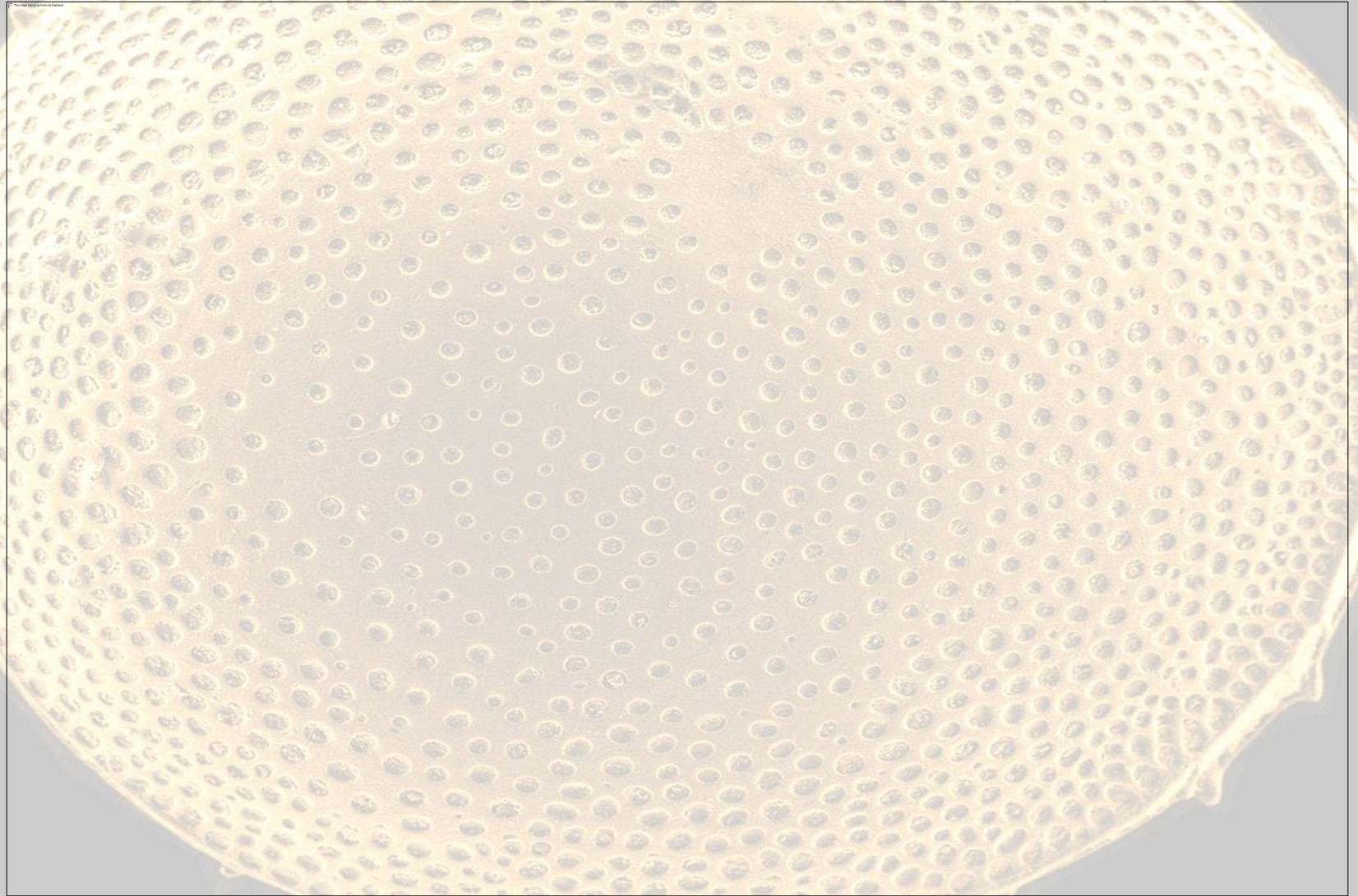
- Indicators of pollution or seasonal changes

Shell – this is where taxonomic problems start



- lots of taxonomic information:
 1. ornamentation
 2. coloration
 3. level of calcification
 4. general morphology
 5. HINGE
- So, why fussing?
 1. **Too many homoplastic characters**
 2. **Shell often mirrors the environmental condition**
- Most of the ostracodologists are **paleontologists**
- even among neontologists there is a clear trend to just take a look at the shell
- result: current systematics of most abundant group (Cytherocopina) is not based on phylogeny but rather on phenetics (and sometimes stratigraphy)
- the paleontological and neontological classifications are rarely in accordance

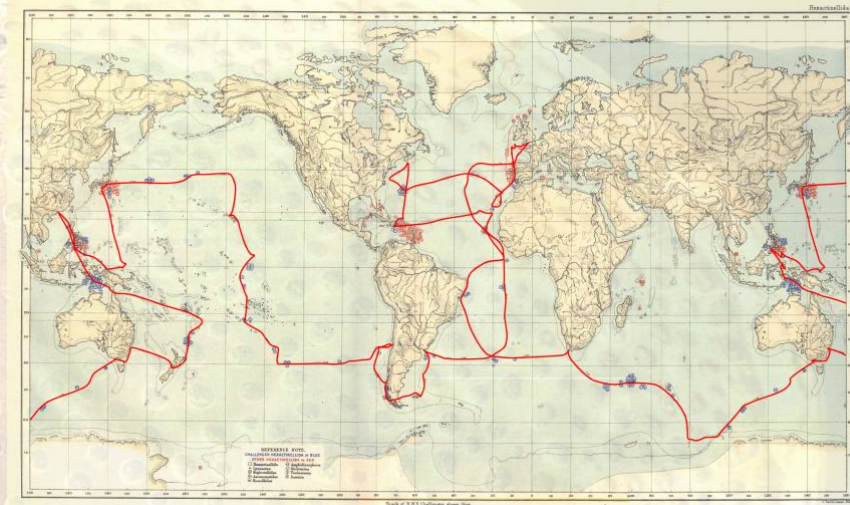
Shell – this is where taxonomic problems start cont.



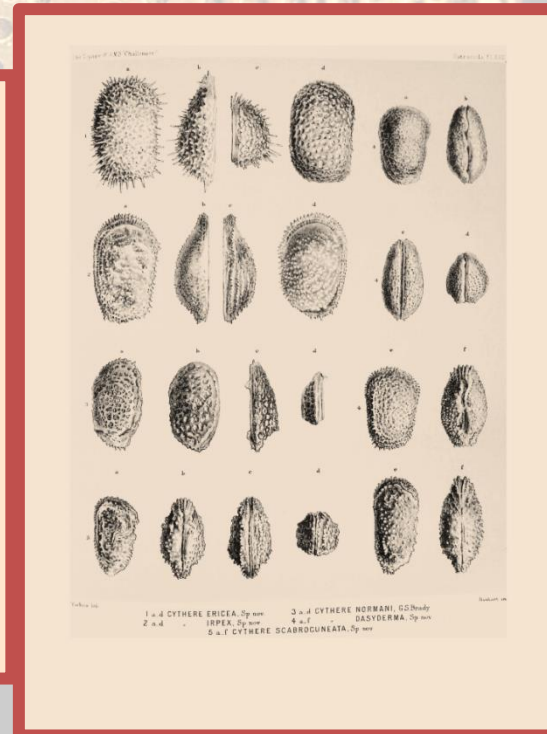
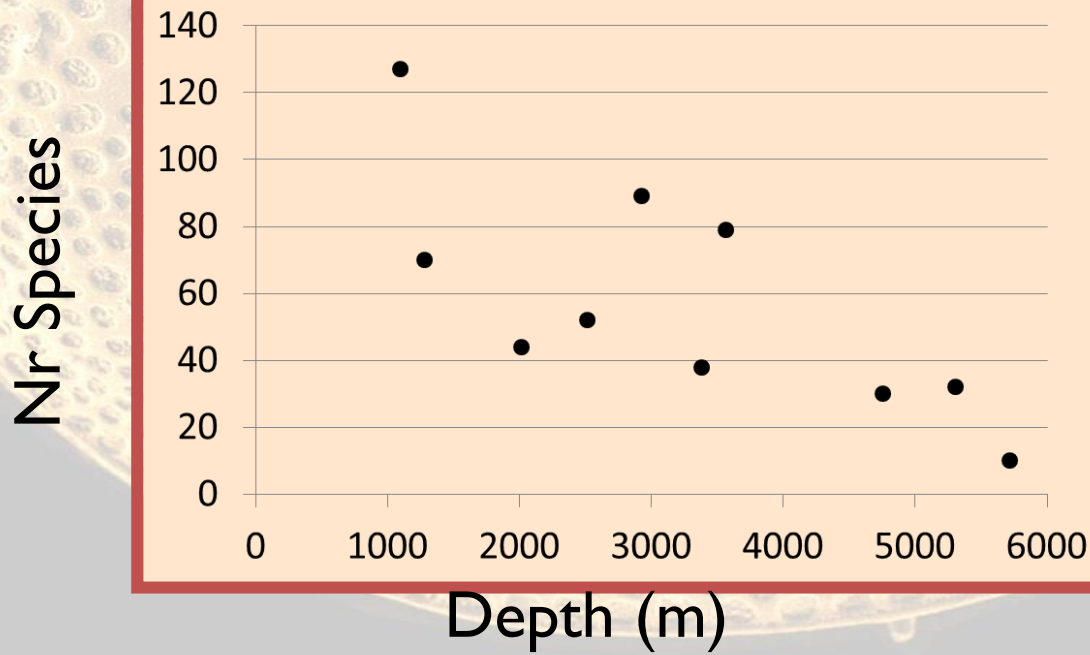
From Keyser & Aladin (2004): Noding in *Cyprideis torosa* and its causes

Birth of deep-sea Ostracodology (Brady, 1880)

- Challenger expedition (1870)
- 150 new sp. and genera
- Cosmopolitanism
- Low diversity



Challenger summary (Murray, 1895)



Deep sea Ostracoda

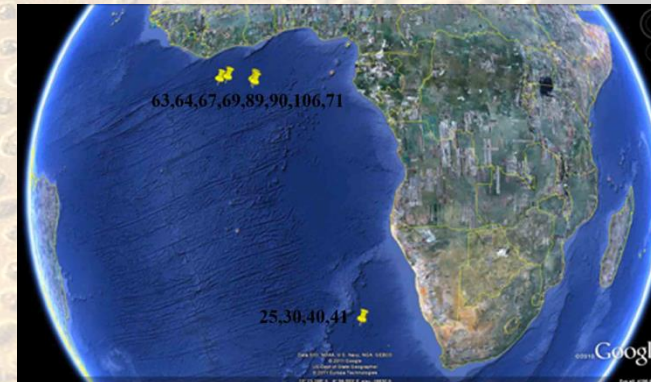
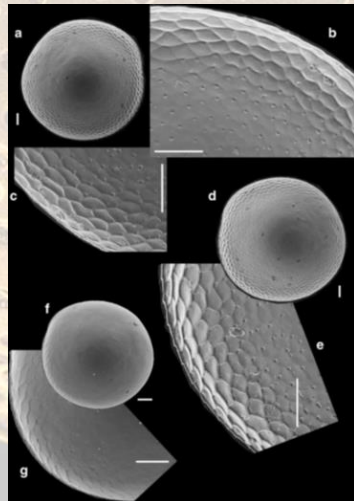
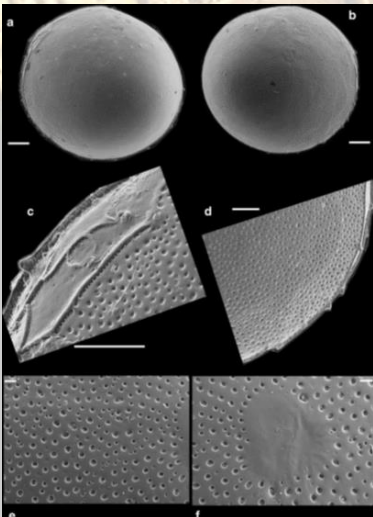
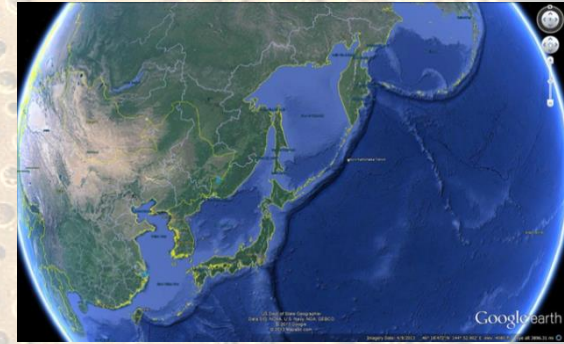
- Ostracods – important components of deep sea meiofauna
- Studies relatively abundant date from late 70's
- Based mostly on the shells obtained from sediments
- In many cases the species were considered as Recent
- soft parts were rarely considered:
 1. low abundance (i.e. number of living specimens per m²)
 2. inadequacy of the sampling techniques
- Generally, deep-sea ostracod assemblages are composed of several **podocopid** lineages, with predominance of the suborder **Cytherocopina**.

living = shell + soft parts

Recent studies based on living deep-sea ostracods: example 1

• Suborder Cladocopina (family Polycopidae)

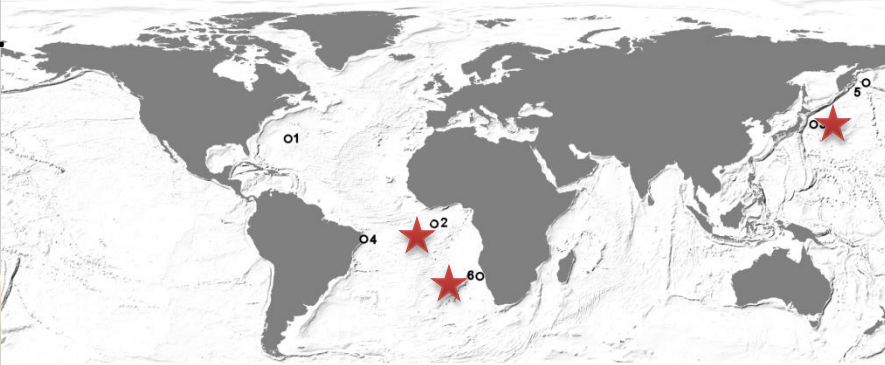
- The most abundant deep-sea ostracod group in the palaeontol. and palaeoecol. studies
- Constitute more than 50% of all ostracod taxa
- Identified only as *Polycope* spp.
- first living deep sea polycopid species described in the late 70's;
- only 9 species known from the depths of more than 2500 m.
- all from the Kuril-Kamchatka trench
- Expedition of **DIVA II** ("RV Meteor")
- 14 new species collected – **11 new taxa described** (9 n. sp., 1 n. gen., 1 n. sub. gen.)



Recent studies based on living deep-sea ostracods: example 1

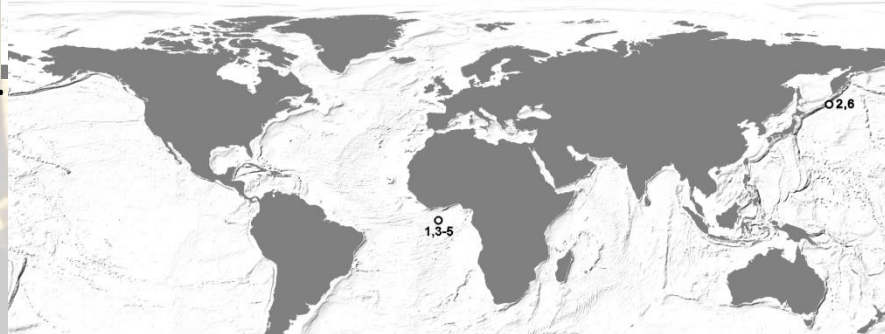
Zoogeography of the genera from the deep South Atlantic

A.



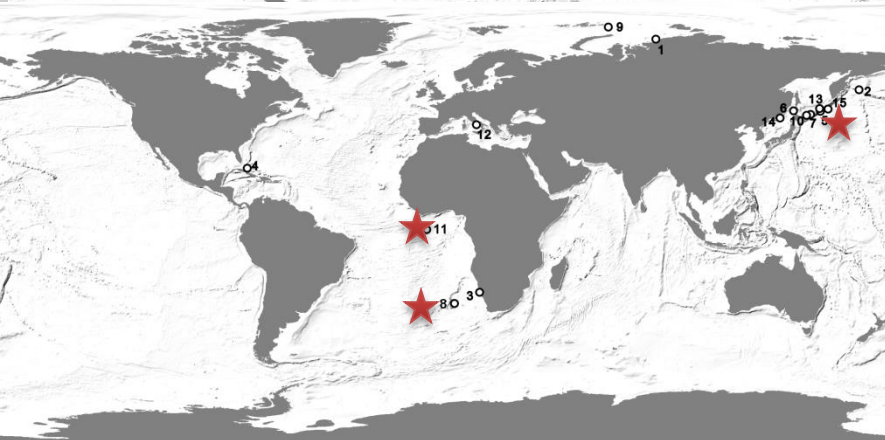
A. *Metapolycope* Kornicker & Markhoven: 3 out of six

B.



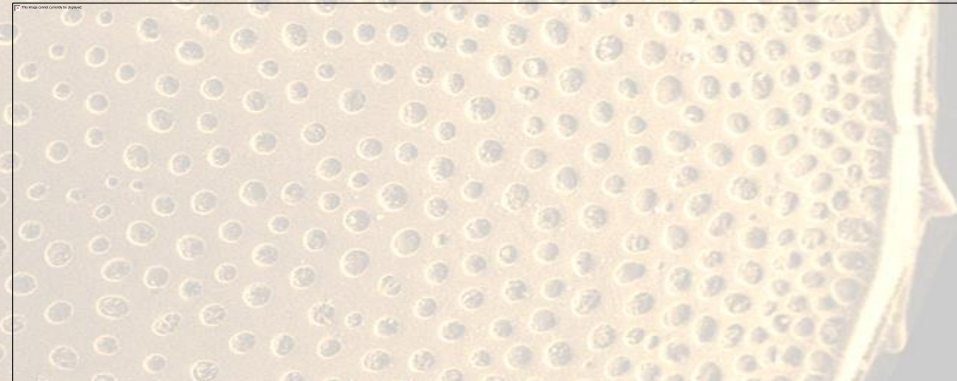
B. *Archypolycope* Chavtur: all deep sea

C.

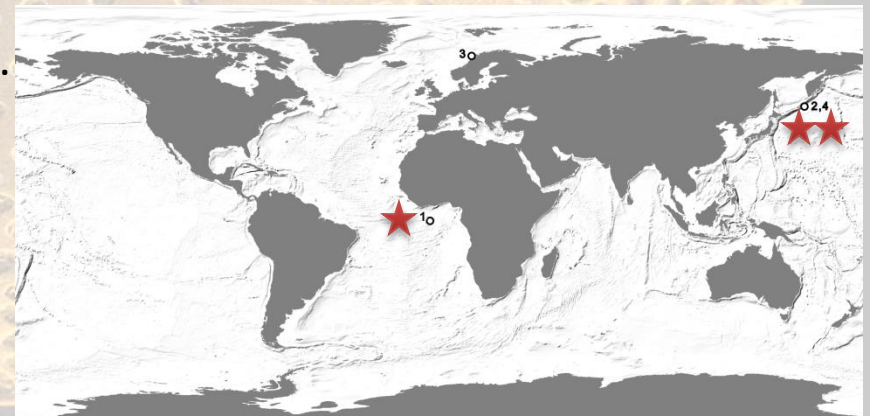


C. *Pseudopolycope* s.str. Chavtur: 3 out of 15

D. *P. Divacope* Karanovic & Brandao: 3 out of 4



D.



Recent studies based on living deep-sea ostracods: example 2

- Suborder Cytherocopina (family Keyseridae)

- collected during the KURAMBIO cruise on board the German Research Vessel Sonne (SO-223)
- abyss east to the Kuril-Kamchatka Trench, Northwestern Pacific
- The driftwood was collected on with the Agassiz trawl, from 5217 m.
- many wood peaces collected, but only one contained high number of taxa
- fresh-looking piece (birch tree) (E)



Recent studies based on living deep-sea ostracods: example 2

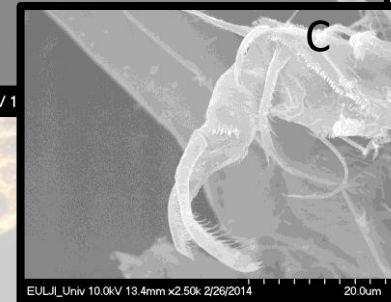
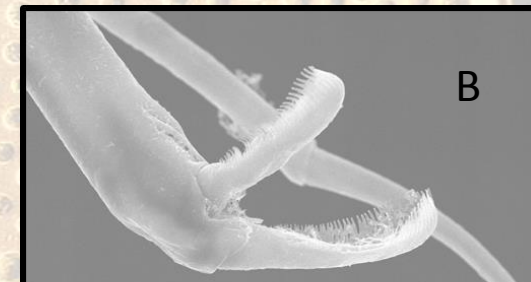
Deep-sea driftwood ostracods

- have already been reported and majority of them also belong to Cytheroidea
- The first deep-sea wood-dwelling ostracod assemblage Described from the experimental pieces of wood (Bahamas and Panama Basin, 2000 to 4000 m) (Maddocks and Steineck, 1987)
- several species found on the same wood piece and many of the same species found on different wood pieces placed 1000 km apart
- ostracod fauna similar to communities found living on shallow water algae and marine grass
- endemic to deep sea habitats
- transported from one wood island to another by currents and/or other animals
- wood dwelling ostracods may be able to reach new wood pieces through their hosts
- **Wood on the sea floor represents a great food source and it is not strange that many animals find their refuge here**

Recent studies based on living deep-sea ostracods: example 2

Keyseridae

- tiny species (A) (~0.4 mm)
- special adaptations of claws on A2 (B), and Md (C)
- new family described
- includes one more genus described 50 years ago living commensally on *Limnoria lignorum*
- convergent characters with interstitial ostracods



Author's Accepted Manuscript

Biogeography of deep-sea wood fall, cold seep and Hydrothermal vent Ostracoda (Crustacea), with the description of a new family and a taxonomic key to living Cytheroidea


Ivana Karanovic, Simone Nunes Brandão



www.elsevier.com/locate/dsr2

PII: S0967-0645(14)00261-6
DOI: <http://dx.doi.org/10.1016/j.dsr2.2014.09.008>
Reference: DSR113718

Other recent publications on the living deep sea ostracods

 Zootaxa 1866: 373–452 (2008)
www.mapress.com/zootaxa/
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ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

New species of Bairdioidea (Crustacea, Ostracoda) from the Southern Ocean and discussions on *Bairdoppilata simplex* (Brady, 1880), *?Bairdoppilata labiata* (Müller, 1908) and *Bythopussella aculeata* (Müller, 1908)*


SIMONE N. BRANDÃO

Helgol Mar Res
DOI 10.1007/s10152-011-0269-9

ORIGINAL ARTICLE

On the genus *Thaumatoconcha* Kornicker and Sohn (Halocyprida) with description of two new species from Southern Ocean deep sea

Ivana Karanovic · Simone Nunes Brandão

 Zootaxa 3692 (1): 123–135
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Article

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<http://zoobank.org/urn:lsid:zoobank.org:pub:E9B40A5C-8854-4178-8D02-27119835CB80>

***Pseudopolycope (P.) andeep* sp. nov. from the deep Southern Ocean (Crustacea, Ostracoda, Cladocopina)**

IVANA KARANOVIC¹ & SIMONE NUNES BRANDÃO²

 **ZOOLOGICAL**
Journal of the Linnean Society



Zoological Journal of the Linnean Society, 2010, 159, 567–672. With 65 figures

Macrocyprididae (Ostracoda) from the Southern Ocean: taxonomic revision, macroecological patterns, and biogeographical implications

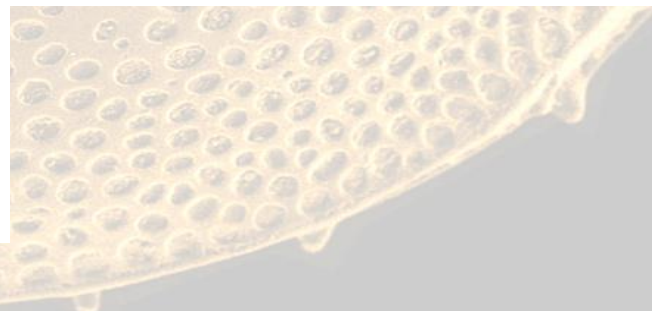
SIMONE N. BRANDÃO*

Journal of Micropalaeontology

New species and occurrences of *Bradleya* Benson, 1972, *Harleya* Jellinek & Swanson, 2003 and *Poseidonamicus* Benson, 1972 (Ostracoda: Cytheroidea) from the Atlantic Sector of the Southern Ocean

SIMONE N. BRANDÃO and OLINGA PÄPLOW

Journal of Micropalaeontology 2011; v. 30; p. 141-166
doi: 10.1144/0262-821X10-017

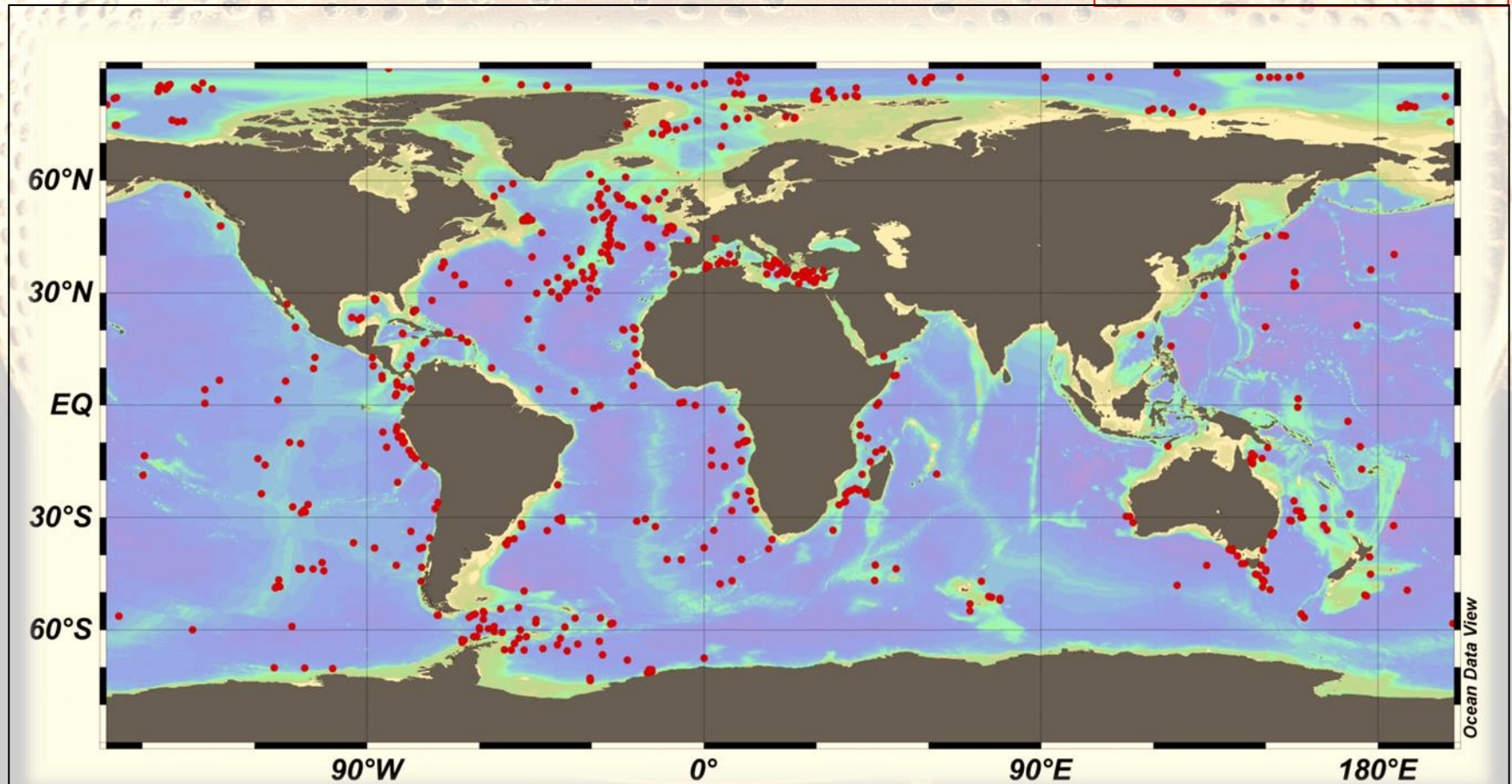


Recent deep-sea ostracods (>2000 m): all published data

- 3681 records
- 700 stations

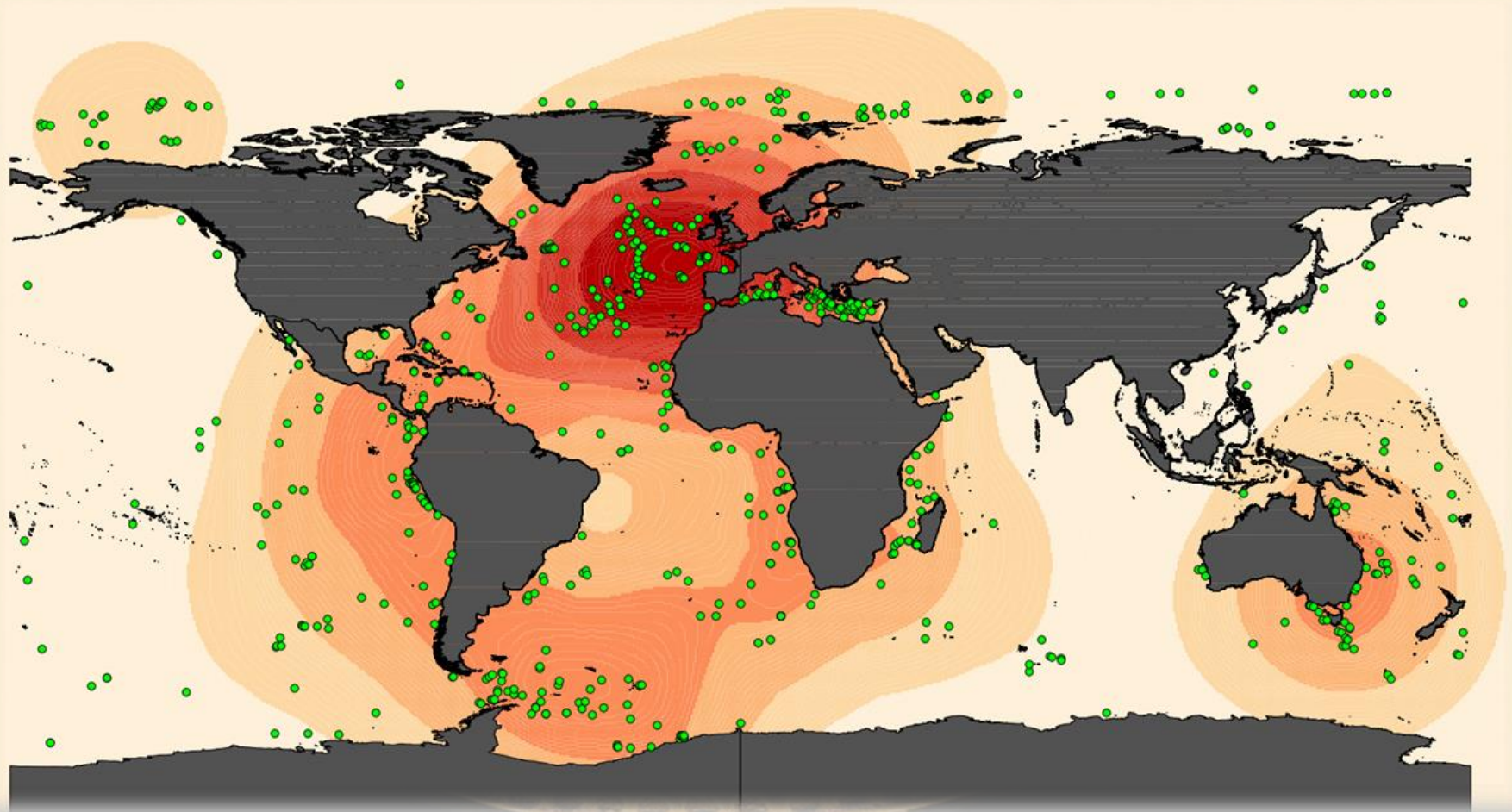
Almost NO data from Clarion-Clipperton Fracture Zone

map: S. N. Brandao

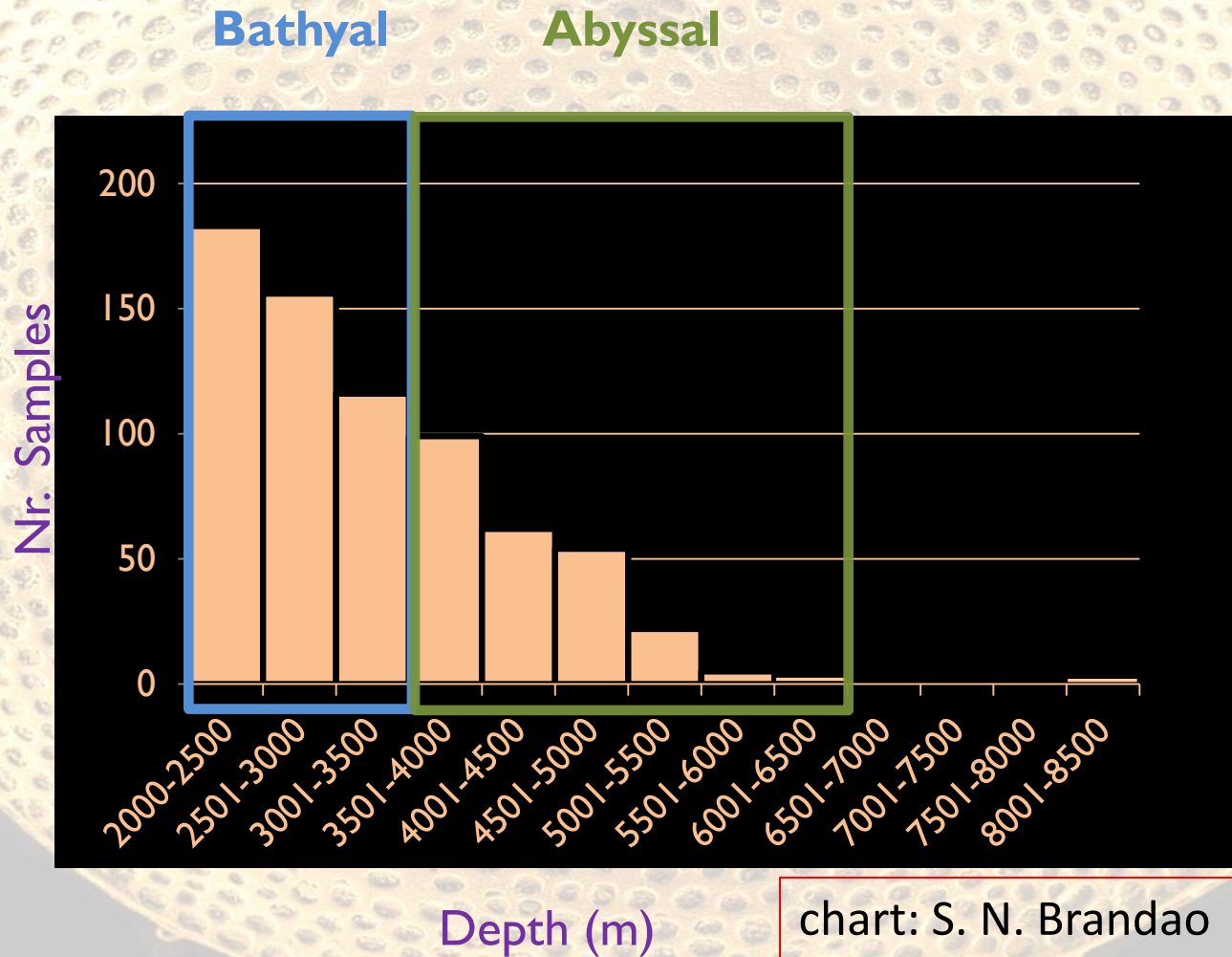


Recent deep-sea ostracods (>2000 m): all published data: geographical bias

map: S. N. Brandao



Recent deep-sea ostracods (>2000 m): all published data: bathymetrical bias



Recent deep-sea ostracods (>2000 m): all published data: diversity

- 37 families
- ~ 200 genera
- ~ 500 species (~5% of all Recent ostracods)

➤ PROBLEMS

- 40% described in 19th/beginning of 20th Century
- 20% smooth shells
- many cosmopolitan

Cosmopolitanism at species level?

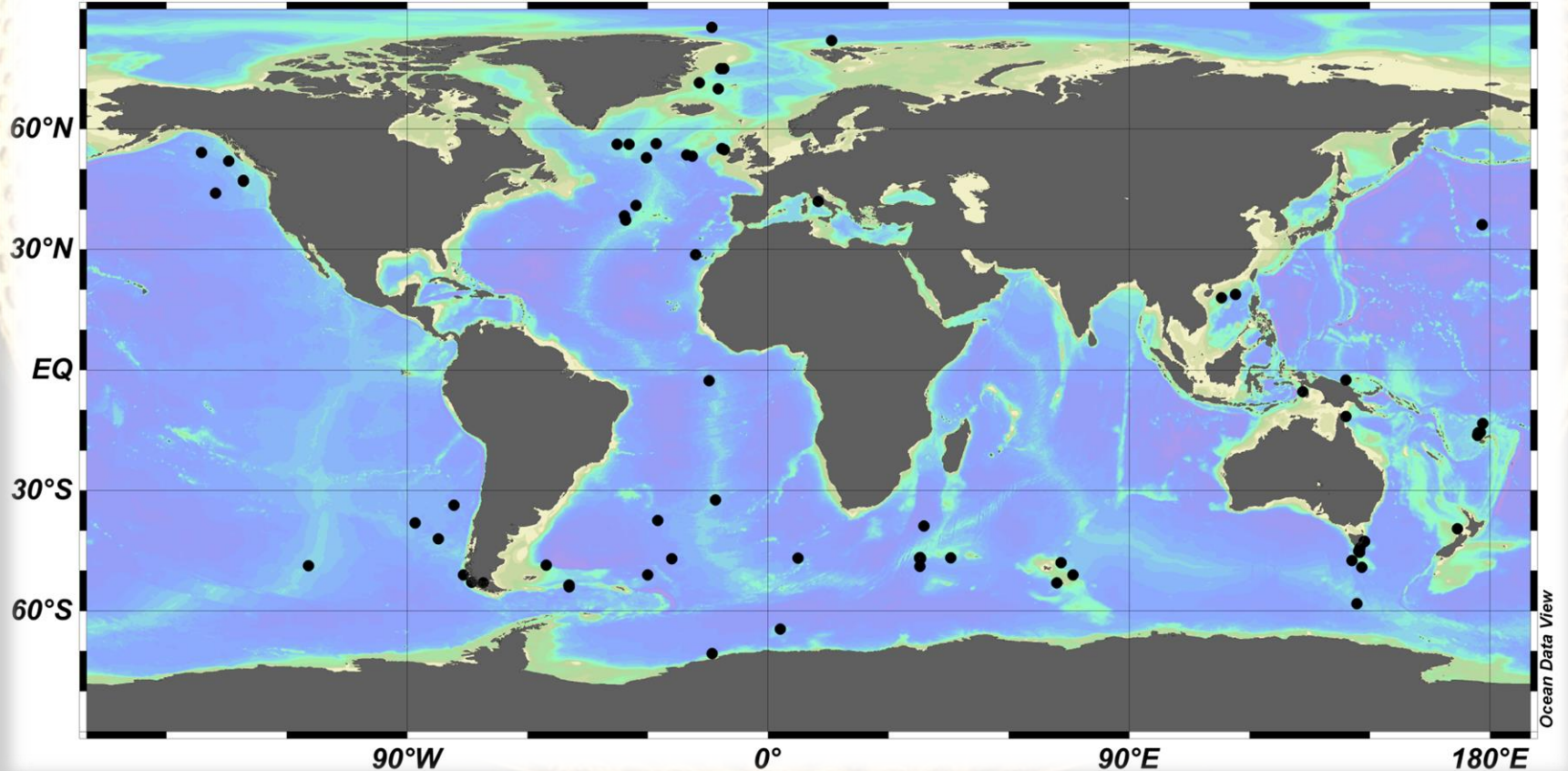


Henryhowella dasyderma

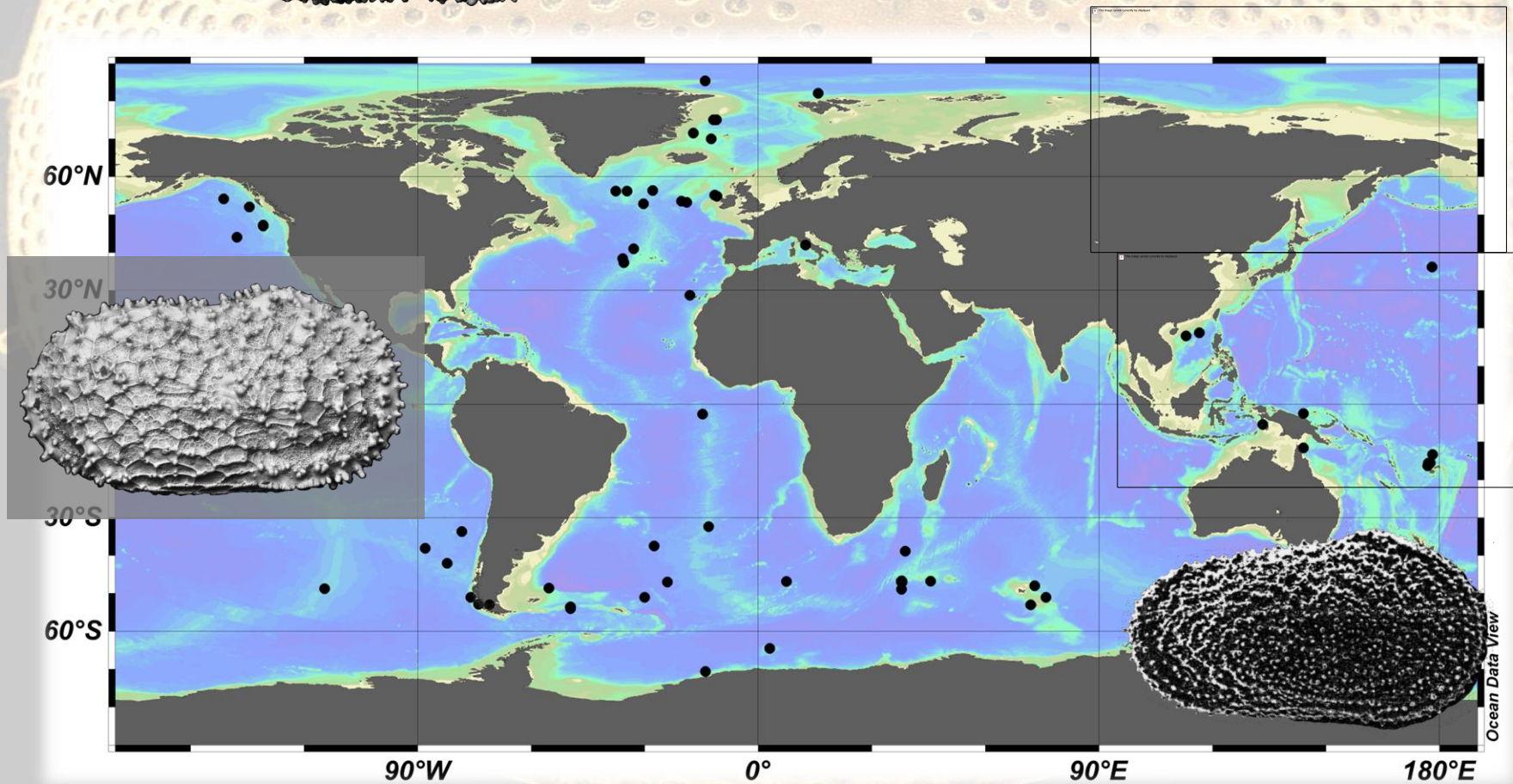
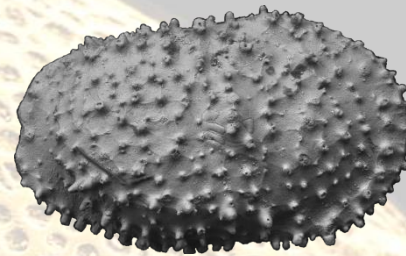
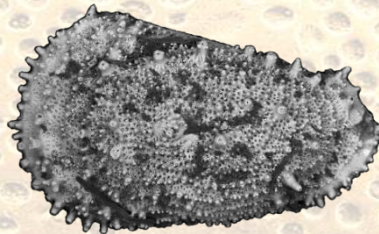
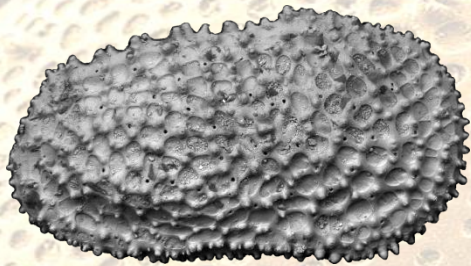
200 to 5100 m

Eocene to recent

(Brandão & Yasuhara, 2013)



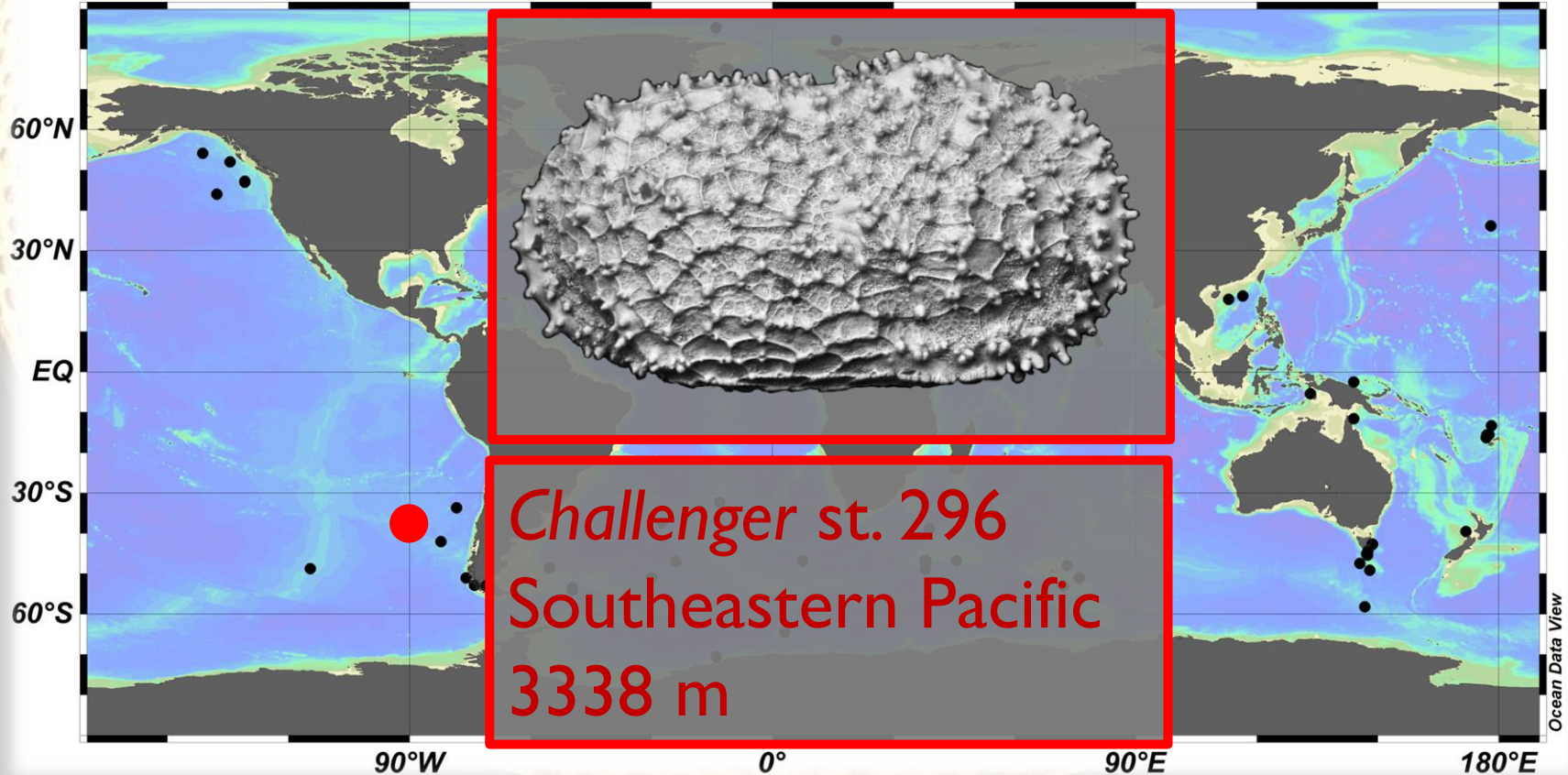
Henryhowella dasyderma



Ayressoleberis dasyderma gen. nov.

Only Recent and abyssal

Endemic to SE Pacific



Cosmopolitism: conclusion

- Only of Family level
- to some extent on the genus level
- (probably) not on species level
- very few molecular studies (confirm no cosmopolitism)
- more detailed studies on soft parts

How to study deep-sea ostracods?

- pay attention when sorting (often look like rocks)
- **take a photo before dissecting**
- use all available information on morphology (shell + soft parts)
- extract DNA (if possible)
- use available keys to ID down to Family level
- consult literature for more detailed ID
- if not sure ask a specialist

Key literature for ID ostracods (to the family/subfamily level)

1. Karanovic I. (2012): Recent freshwater ostracods of the world. Springer.
information on ostracod morphology, methods for studying ostracods, key to ostracod subclasses, orders, and suborders
+online keys to ostracod orders: http://species-identification.org/species.php?species_group=Ostracods&menuentry=inleiding
2. Karanovic I. & Brandao S. N. (2012): Review and phylogeny of the Recent Polycopidae (Ostracoda, Cladocopina)...Marine Biodiversity.
key to all living species of the family Polycopidae (the most abundant Myodocopa in the deep-sea)
3. Karanovic I. & Brandao S. N. (2014): Biogeography of deep-sea wood fall, cold seep and Hydrothermal vent Ostracoda (Crustacea), with the description of a new family and a taxonomic key to living Cytheroidea. Deep-Sea Research II. (in press)
key to all families (with living representatives) of the suborder Cytherocopina (the most abundant and diverse ostracods in general)
4. Web site by Kasia Blachowiak-Samolyk and Martin Angel: <http://ocean.iopan.gda.pl/ostracoda/index.php>
good for general information on the suborder Halocypridina (from Southern Ocean) with illustrations
5. Kornicker. L. S. (1975): Antarctic Ostracoda (in two parts). Smithsonian Contribution to Zoology.
detailed information on subclass Myodocopa with keys to almost all taxonomic levels (be aware this is an old publication)
6. Maddocks, R. F. (1969): Revision of Recent Bairdidae. US National Museum Bulletin.
No keys but good for general orientation in the family Bairdidae (also often present in deep-sea). (be aware this is an old publication)
7. Maddocks, R. F. (1990): Living and Fossil Macrocyprididae. The University of Kansas Paleontological Contributions Monograph 2.
8. Maddocks, R. F. (1991): Revision of the family Pontocyprididae (Ostracoda), with new anchialine species and genera from Galapagos Islands. Zoological J. of the Linnean Society
9. Jellinek T., & Swanson K. M. (2003): Report on the taxonomy, biogeography and phylogeny of mostly living benthic Ostracoda (Crustacea) from deep-sea samples (Intermediate Water depths) from the Challenger Plateau (Tasman Sea) and Campbell Plateau (Southern Ocean), New Zealand. Abhandlungen der Senck. Naturforsch....Frankfurt am Main.
this sounds good, but only shells and photos (very bad) of soft parts
10. Mazzini, I. (2005): taxonomy, biogeography and ecology of Quaternary benthic Ostracoda (Crustacea) from circumpolar deep water of the Emerald Basin (Southern Ocean) and the S Tasman Rise (Tasman Sea). Senckenbergian maritima.
only shells

Acknowledgments

- All organizers of the Macrofauna workshop in Uljin
- Dr Simone Nunes Brandao (Federal University of Rio Grande do Norte, Brazil)