Deep seafloor imagery from the Weddell Sea document natural food falls and octopod diversity and distribution

Julian B. Stauffer[1], Richard Schwarz[2], Autun Purser[3], Laura Hehemann[3], Louise Allcock[4], Henk-Jan T. Hoving[1]

[1]GEOMAR Helmholtz Centre for Ocean Research Kiel (Germany), [2]Universidade Do Vale Do Itajaí, Laboratório de Estudos Marinhos Aplicados (Brasil), [3]Alfred-Wegener-Institut Helmholtz-Zentrum fuer Polar- und Meeresforschung, Helmholtz Centre for Polar and Marine Research, Bremerhaven (AWI) (Germany), [4]Ryan Institute and School of Natural Sciences, National University of Ireland Galway (Ireland)
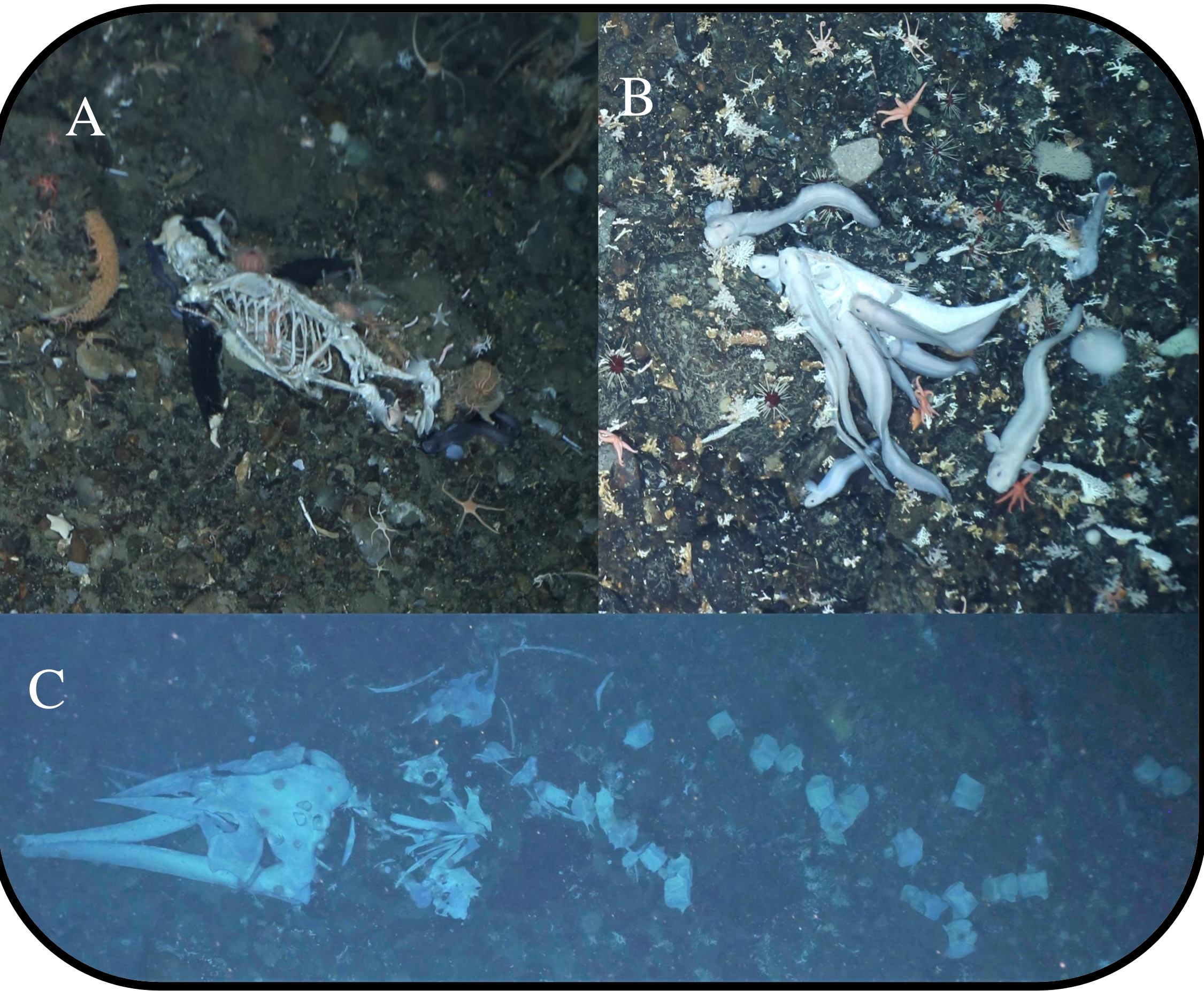
Figure 1 | Three of the six observed food falls. A) Penguin carcass found at 613m, B) fish remains observed at 2112m and C) a whale fall at 613m water depth.

Figure 2 | Depth profile of images taken along station "39_1". Points indicate images where octopods were identified to species level. The color code indicates the different species. Deployment track map: Laura Hehemann, AWI.

Main Findings

- Octopods are dominant players of the benthic megafauna of the Weddell Sea over large depth ranges

- Largest database of Southern Ocean Octopods *in situ* observations allows distribution, behavioural and diversity studies

- The slopes of the Weddell Sea receive organic input by various types of food falls

- Differences in octopod abundance and species composition between different sampling locations

Materials & Methods

- Polarstern cruise PS118 from 2019 to the Weddell Sea
- 7900 images were captured with the Ocean Floor Observation and Bathymetry System (OFOBS) along three transects between 400m and 2200m [3]
- Image annotations of food falls and octopods were done in BIIGLE 2.0 [4]
- Octopods were identified by experts from the field, unidentifiable octopods were left as "Octopoda"
- Graphical representations from this poster were done in R [5]

Background

- Carcasses of pelagic organisms ("food falls") provide energy to benthic scavenging communities and are largely unquantified pathways in the global carbon flux [1]
- Observations of natural food falls are very scarce, hindering accurate flux estimations [1]
- Type and role of food falls in the Southern Ocean is largely unknown.
- Benthic octopods are a major cephalopod group of the Southern Ocean but ecological data is largely known from trawling data, often limited to shallower depths [2]
- Here we applied seafloor observations to document food falls and octopods in the Southern Ocean

Results

Station "39_1" with 3936 images
- 342 octopods between 455 and 1402m, 95 identified to species and 34 to Genera level
- Three food falls, one baleen whale at 613m, one penguin at 613m, and one fish carcass at 647m

Station "69_01_02" with 2722 images
- 161 octopods between 1670 and 2213m, 19 identified to species and 15 to Genera level
- Three fish food falls at 2137, 2165, and 2112m

Station "6_9b" with 1490 images
- Seven octopods between 430 and 436m, two identified to species and two to Genera level

Scavenging Fauna
- Whale fall: unidentified Echinoderms
- Penguin: zoarcids, Asteroidea, Ophiuroidea, and Echinoidea
- Fish: zoarcids, Asteroidea, Echinoderms, Amphipoda, unidentified fish

Figure 3 | Boxplots of the depth distributions of 343 cephalopods found at station "39_1" from 3936 images with water depth in m on the x-axis and taxonomic identification on the y-axis.

Figure 4 | Boxplots of the depth distributions of 161 cephalopods found at station "69_01_02" from 2722 images with water depth in m on the x-axis and taxonomic identification on the y-axis.

Discussion

Food Falls
- To the best to our knowledge, we report here only the third whale fall observed in the Southern Ocean and the first observed penguin food fall [6,7]
- The successional stage of the whale fall is advanced, there is no visible tissue left and there are no fish scavengers near the carcass, this is comparable to another observed whale fall from the Southern Ocean [6]
- The penguin carcass had still remaining tissue mostly on the head and flippers as well as associated mobile scavengers indicating recent deposition
- Three of the fish carcasses seem to belong to Macrouridae, most of the remains look very fresh, are accompanied by mobile fish scavenger and were observed within short time intervals (1h 30min), thus they may be fisheries discards
- Observations of amphipods arriving first at one of the fish falls is in line with food fall experiments in Arctic/Norwegian waters [8]

Octopods
- Our data show that octopods are dominating the benthic megafauna of the Weddell Sea on hard bottom substrate
- We identified octopods from six species, seven genera, and three families
- *In situ* observations allow to document interactions with other organisms, substrate, but also behaviour like brooding
- The database will enable density calculations of the observed octopod taxa
- Possible new depth record for *Muusoctopus rigbyae* at 2123m but there is noteworthy confusion potential with other species from the same genus
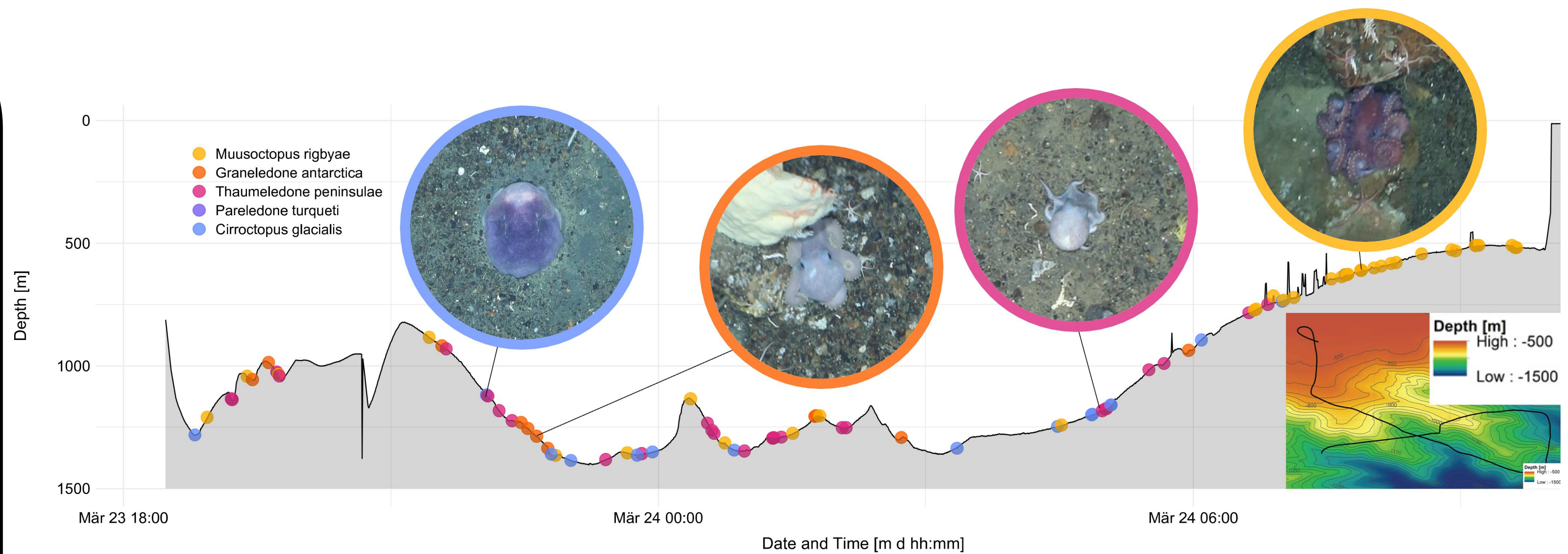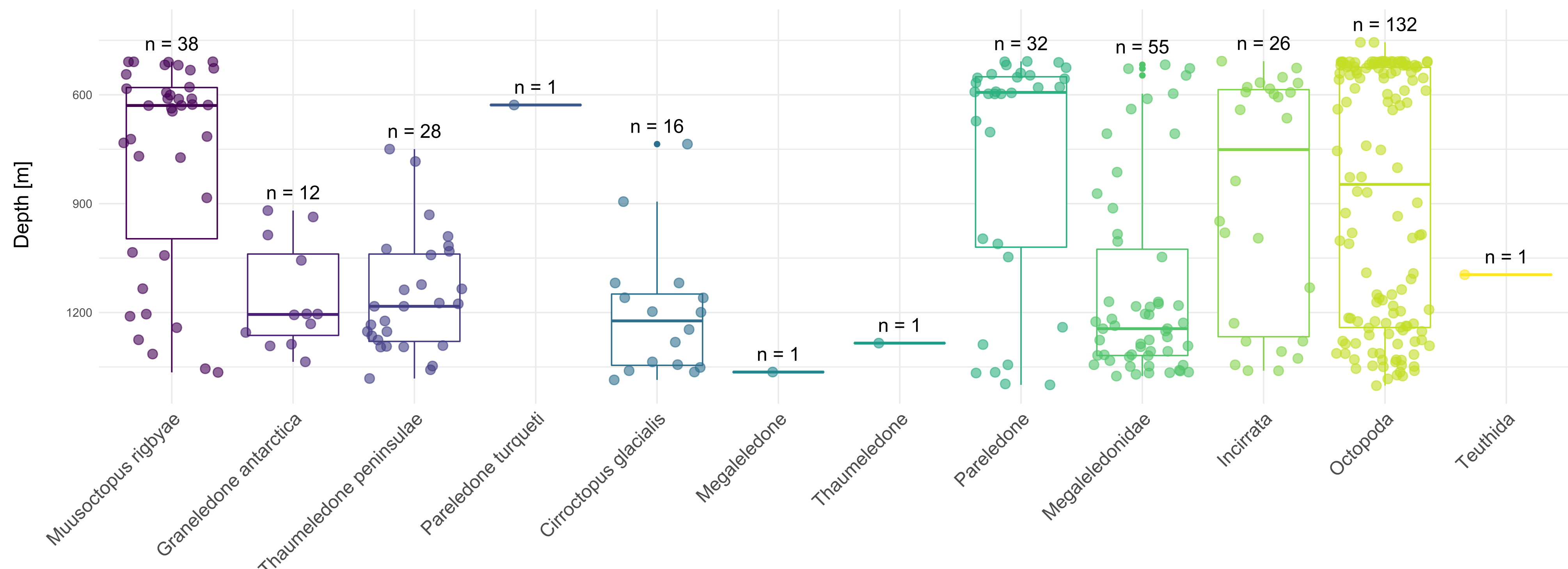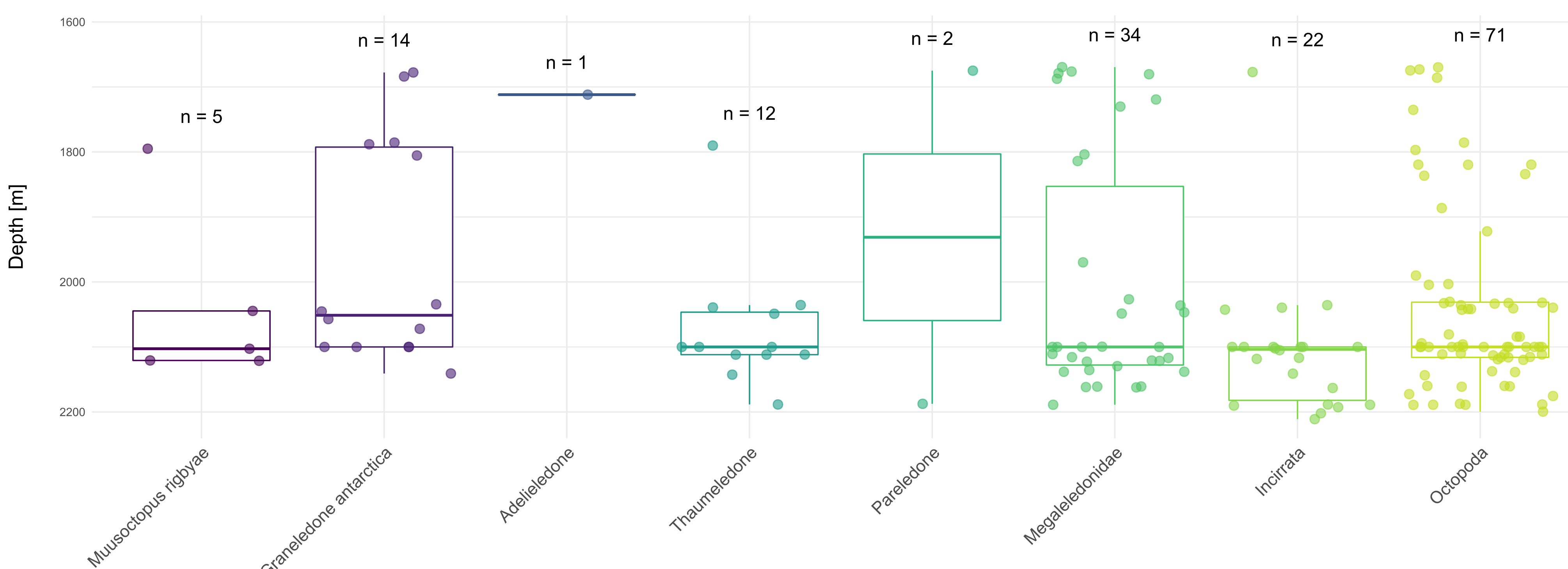
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