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New majoid crab (Brachyura: Majoidea: Macrocheiridae) from the Eocene Lookingglass Formation, Oregon, USA

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Abstract

A new species of *Macrocheira*, *M. enoptra* from the Lookingglass Formation of Oregon, appears to be a smaller, younger individual than those from previously described extinct species. Fossil species of *Macrocheira* from west coastal North America fall into three categories: older, Eocene-Oligocene, strongly ornamented forms; younger, Oligocene-Miocene forms with subdued ornamentation; and the comparatively small form described here. Macrocheiridae is a small but well-represented family in the North Pacific from the Eocene through Holocene. Ontogenetic changes in carapace shape and ornamentation are observable in both extinct and extant species of *Macrocheira*.

Key words: Crustacea, Decapoda, Pancrustacea, spider crab, Ypresian

1. Introduction

The Eocene Lookingglass Formation of Oregon has yielded nine species of brachyuran crab, one achelatan lobster, and one axiidean shrimp (Feldmann and Schweitzer, 2017; Gustafson, 2023). Brachyurans are arrayed across Raninoida and Eubrachyura, a typical faunal composition for the Eocene (Schweitzer and Feldmann, 2015; Hartzell et al., 2022; Schweitzer and Feldmann, 2023). It is a fossiliferous unit, preserving numerous species of molluscs, echinoderms, and vertebrates in addition to the decapod crustaceans (Gustafson, 2023). The Lookingglass Formation has been constrained in age based upon microfossils and paleomagnetic data to about 50 mya, early Eocene (Ypresian) (Prothero, 2009; Cohen et al., 2013) and is interpreted to have been deposited in a shallow shelf environment (Feldmann and Schweitzer, 2017; Gustafson, 2023). Herein a new species of majoid crab from the unit is described.

2. Materials and methods

Imaging was done with a Leica Z6 APO macroscope with PLANOPO 0.5xWD lens and SPOTFLEX digital camera or a Nikon D7200 with Tamron 28x105 mm lens. Fossil specimens of *Macrocheira* spp. were whitened with ammonium chloride. Images were toned in Adobe Photoshop 23.1.0 prior to composing figures in Adobe Illustrator 26.0.2. Measurements were taken with Mitutoyo analog calipers to the nearest tenth of a millimeter.

Repositories and institutional abbreviations: The holotype specimen is deposited in the United States National Museum, Smithsonian Institution, Department of Paleobiology, Washington, DC, USA (USNM). Material examined includes specimens

deposited in the Carnegie Museum of Natural History, Pittsburgh, PA, USA (CM) as well as USNM.

3. Systematic Paleontology

Order Decapoda Latreille, 1802
Infraorder Brachyura Latreille, 1802
Section Eubrachyura de Saint Laurent, 1980
Superfamily Majoidea Samouelle, 1819

Family Macrocheiridae Dana, 1851
(Figs. 1, 2)

Included genus: *Macrocheira* De Haan, 1839.

Diagnosis: Carapace ovate, pyriform, widening posteriorly; rostrum bifid, short in extant species, can be quite long in extinct species; supraorbital eave narrow with well-developed antorbital spine, followed by short intercalated spine or blunt projection, and subsequently by long postorbital spine (Fig. 2.2); regions well defined, ornamented with tubercles of varying sizes; muscle scars along urogastric and cardiac regions often well-marked; chelipeds isochelous (adapted from Schweitzer et al., 2020; Poore and Ahyong, 2023; detailed description in Guinot et al., 2022; morphological terminology following Poore and Ahyong, 2023; Schweitzer et al., 2024).

Material examined: *Macrocheira kaempferi* (Temminck, 1836), USNM 18047, Holocene, Japan. *Macrocheira longirostra* Schweitzer and Feldmann, 1999, holotype CM 39683, paratype CM 39685, Quimper Sandstone, Eocene, Washington. *Macrocheira teglandi* Rathbun, 1926, USNM PAL 508590, Makah Formation, Oligocene, Washington. *Macrocheira* sp., USNM PAL 795913, Keasey Formation, Oligocene, Oregon.

Discussion: *Macrocheira* had been variously placed within Inachidae (i.e., Ng et al., 2008; Schweitzer et al., 2020) and Oregoniidae (i.e., Poore and Ahyong, 2023) because of its characteristics exhibiting a combination of features of those two families (Guinot et al., 2022). This was resolved by placement within a monotypic family that can accommodate the unusual morphology of *Macrocheira* (Guinot et al., 2022). *Macrocheira kaempferi* (Temminck, 1836) is very well known due to its enormous size, apparently making it the largest extant arthropod (Guinot et al., 2022) (Figs. 1.4, 2.2). Extinct taxa have been recognized since 1926 from the Eocene through Miocene of western North America (Rathbun, 1926; Schweitzer and Feldmann, 1999) (Figs. 1.1–1.3, 2.3) and fossils of *M. kaempferi* were reported from the Miocene of Japan (Imaizumi, 1965; Karasawa and Ohara, 2012). Specimens in the fossil record are much smaller than those of the extant species as far as is known (Fig. 1).

Genus *Macrocheira* De Haan, 1839

Type species: *Maja kaempferi* Temminck, 1836, by monotypy.

Included species: *Macrocheira columbiaensis* Nyborg et al., 2016; *M. enoptra* new species; *M. jayi* Nyborg et al., 2016; *M. kaempferi*; *M. longirostra* Schweitzer and Feldmann, 1999; *M. sullivani* Nyborg et al., 2016; *M. teglandi* Rathbun, 1926. The three species of Nyborg et al. (2016) are considered unavailable on Decanet (accessed May 23, 2025), but the ISSN listing for the journal indicates that the publication is print medium (portal.issn.org, accessed May 27, 2025). The three species were published without registration of nomenclatural acts in ZooBank (amendment to ICZN articles 8.5, 78.2.4). As it is unclear at this time whether the species names are valid, they are listed here for completeness, in hopes that the issue will soon be resolved.

Diagnosis: as for family.

Discussion: The new specimen is referred to *Macrocheira* based upon its possession of a supraorbital eave, a short intercalated spine, and a postorbital spine (Figs. 1.1, 2.1); a bifid rostrum (Fig. 1.1); a pyriform carapace; and regions of the same overall shape and arrangement as the type species. The reduced regional development and ornamentation compared to the extinct species from the west coast of North America differentiate the new species from all others. *Macrocheira jayi*, *M. longirostra*, and *M. sullivani* have very large globose swellings on most carapace regions that are not evident on the new species; for example, *M. longirostra* has four large swellings on the mesogastric region whereas there is no evidence of any swelling on that region of the new species (Fig. 1.3). The rostrum of *M. longirostra* is much longer than that of the new species

(Fig. 2.3), accounting for about 27% of the total length of the carapace, whereas in the new species, the rostrum accounts for about 11% of the total length. *Macrocheira columbiaensis* and *M. teglandi* are much more densely granular, and the mesogastric region is much more inflated, than seen in the new species.

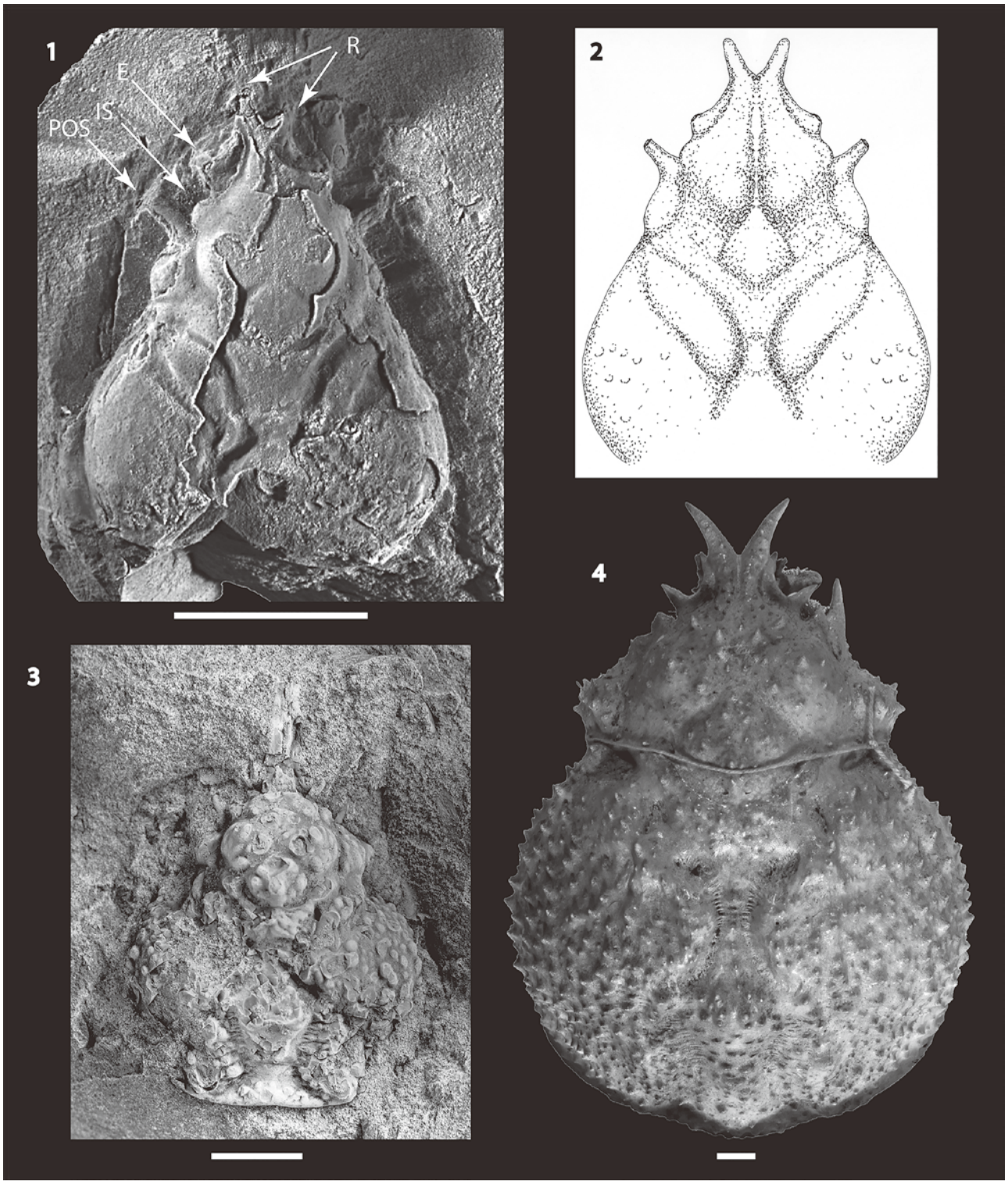

Fig. 1. ***Macrocheira*** **spp. 1,** ***Macrocheira enoptra*** **new species**, holotype USNM PAL 801580, dorsal carapace. **2,** line drawing. **3,** ***Macrocheira longirostra***, holotype CM 39683, Eocene, Washington, USA. **4,** ***Macrocheira kaempferi***, USNM 18047, dried specimen, Holocene, Japan. R = rostrum, E = supraorbital eave; IS = intercalated spine; POS = postorbital spine. Scale bar 1 = 5 mm; scale bars 3, 4 = 1 cm.

The specimen described here is very small compared to other species and specimens of *Macrocheira* (Fig. 1). Other extinct species range in size from about 3–5 cm wide, whereas the new specimen is only about 1 cm wide. The new specimen exhibits some of the features described for smaller specimens of extant *Macrocheira kaempferi* (Guinot et al., 2022). The carapace is more elongate-pyriform and less ovate posteriorly in the new specimen than in other species of *Macrocheira,* and this shape is typical of smaller individuals of *M. kaempferi* (Guinot et al., 2022, fig. 5D). The rostrum appears to have been relatively long in the new specimen, as described for smaller individuals of *M. kaempferi*, whereas the rostrum is short in larger individuals. The postorbital spine of the new species is directed laterally, the condition seen in smaller individuals, whereas it is directed anteriorly in larger specimens (Guinot et al., 2022). The cuticle is not well preserved in the new specimen, although setal pits are noted where it is present. Smaller specimens of extant *M. kaempferi* are reported to be densely covered with setae, which become sparse or absent in larger specimens. The metagastric region is long axially and extends laterally into epibranchial ridges, which are clearly defined on smaller specimens and less clear on larger specimens (Guinot et al., 2022). Thus, the specimen exhibits clear characteristics similar to those described for smaller, presumably younger, individuals of *Macrocheira kaempferi*. Note that the specimen is probably a younger adult form, as discussed in Guinot et al. (2022), not a larval form. Distinguishing between younger, smaller adults and older, larger adults, and the types of features that might be used to recognize them as such, has received recent attention in other extinct crab taxa (Schweitzer et al., 2025). This paper adds to this growing knowledge of recognizing ontogenetic change in extinct brachyuran crabs.

Macrocheira was already known from the Eocene through Miocene of west coastal North America, so although not previously reported from the Lookingglass Formation, the new occurrence does not extend the geographic or geologic range of the genus. The new specimen is, however, by far the smallest of the fossils known. Because no species of *Macrocheira* have been collected from the Lookingglass Formation, and the other known extinct species are clearly morphologically different from the new specimen, even taking into account ontogenetic differences, the new species is warranted.

Macrocheira enoptra new species
(Figs. 1.1, 1.2, 2.1)

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Diagnosis: Carapace pyriform, rostrum bifid, rostrum about 11% total length of carapace; orbital eave widens posteriorly, not cup-shaped, followed by a short, blunt intercalated spine, followed by a long post-orbital spine; carapace ornamentation subdued, setal pits covering surface; regional development evident but not deeply marked, regions not strongly inflated.

Description: Carapace pyriform, small, longer than wide, maximum width about 88% length of carapace excluding rostrum, widest in posterior 10% of length; moderately vaulted transversely and longitudinally. Rostrum bifid, length of rostrum about 11% carapace length. Orbital area composed of an eave that widens posteriorly but is not cup-shaped, followed by a short, blunt intercalated spine, followed by a long post-orbital spine, carapace width about 45% maximum width between post-orbital spines. Hepatic segment of anterolateral margin posterior to post-orbital spine short, convex; posterolateral margin long, weakly convex; posterior margin unknown.

Mesogastric region with very narrow, long anterior process, widened posteriorly, triangular. Protogastric regions long, obovate, possibly with large swelling centrally. Hepatic region circular. Metagastric region long axially, narrowing laterally into long, narrow, keel-like oblique epibranchial ridge. Urogastric region narrow and long, with a few tubercles; cardiac region widening but otherwise broken. Oblique, ovate mesobranchial region just posterior and parallel to epibranchial keel. Metabranchial region broadly inflated, appearing to be ornamented with evenly spaced tubercles.

Measurements: Measurements (in mm) taken on the dorsal carapace of *Macrocheira enoptra* new species: carapace length including rostrum, 12.7; carapace length excluding rostrum, 11.3; maximum carapace width, 9.9; length to position of maximum width, 10.0; width of base of rostrum, 3.8; width between post-orbital spines, 4.5.

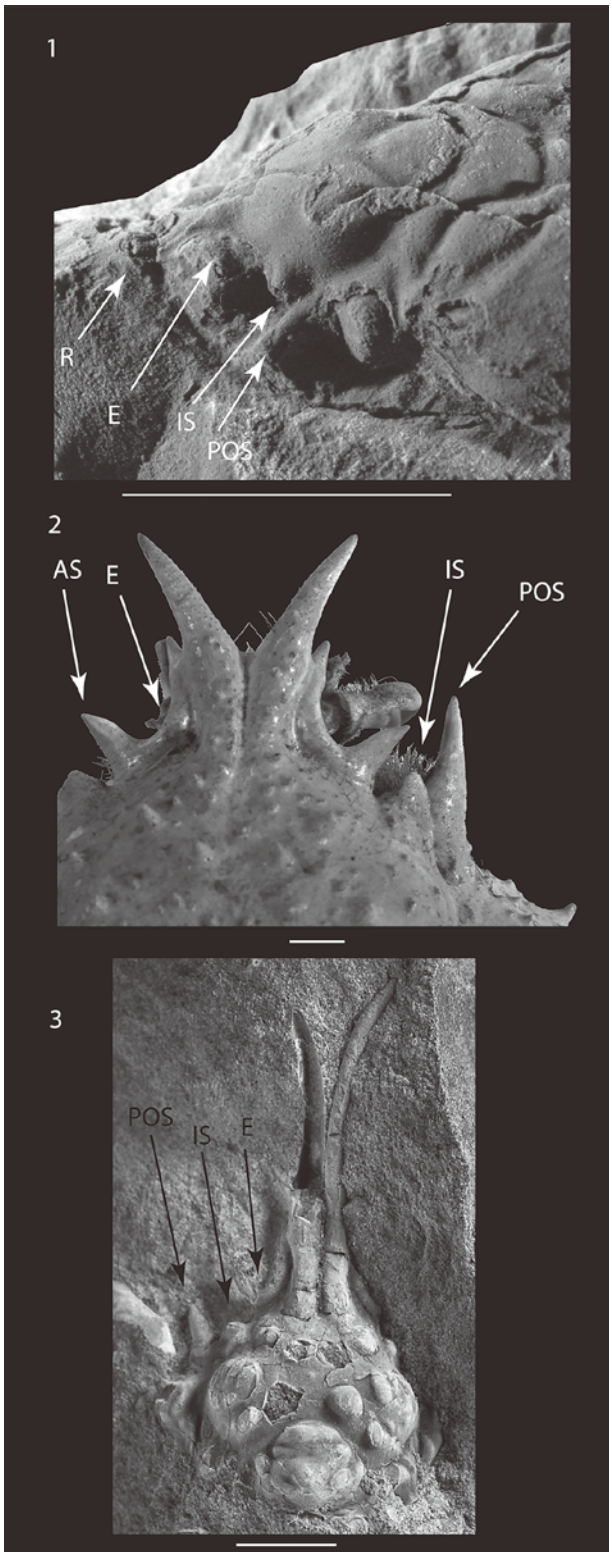

Fig. 2. ***Macrocheira*** **spp. 1,** ***Macrocheira enoptra*** **new species**, oblique view of left orbit. **2,** ***Macrocheira kaempferi***, USNM 18047, dried specimen orbits and rostrum, Holocene, Japan. **3,** ***Macrocheira longirostra***, paratype, CM 39685, orbits and rostrum, Eocene, Washington, USA. R = rostrum, AS = antorbital spine, E = supraorbital eave, IS = intercalated spine, POS = postorbital spine. Scale bar 1 = 5 mm; scale bars 2, 3 = 1 cm.

Holotype: USNM PAL 801580.

Etymology: The species names is derived from the Greek *enoptron*, meaning mirror, recognizing the formation of origin as the Lookingglass Formation.

Occurrence: The holotype was collected from the Lookingglass Formation, near N42°33.604', W124° 01.262', locality UO 2593, three miles east from Agness, Curry County, Oregon, on the south side of Road 3406 (Feldmann and Schweitzer, 2017).

Discussion: The specimen is preserved as a mold of the interior with small areas of cuticle along the left margin. Where cuticle is preserved, it shows evidence of setal pits and broadly spaced tubercles.

Including the species named by Nyborg et al. (2016), six species of *Macrocheira* are now reported from the west coast of North America. Excluding the small, possibly young specimen described here, they fall into two morphological groups. The Eocene or Eocene-Oligocene species *M. jayi*, *M. longirostra* and *M. sullivani*, are quite similar and all have long bifid rostra and very swollen and ornamented carapace regions. The broadly swollen and heavily ornamented regions are very different from those seen in *M. enoptra*. The Oligocene-Miocene *Macrocheira teglandi* and Miocene *M. columbiaensis* are much more densely ornamented than the new species and are similar to one another in their less coarse ornamentation as compared to the Eocene species. Such dramatic changes in ornamentation with growth do not characterize extant *Macrocheira* (Guinot et al., 2022). Thus, *M. enoptra* differs substantially from the Eocene species in its rostrum and ornamentation and while more similar in ornamentation to the Oligocene-Miocene species, it is substantially geologically older than them. For these reasons, a new species seems warranted for the new specimen.

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