Amphipoda of the Northeast Pacific (Equator to Aleutians, intertidal to abyss): XI. Calliopioidea – a review Donald B. Cadien, LACSD 13Mar 2015

Preface

The purpose of this review is to bring together information on all of the species reported to occur in the NEP fauna. It is not a straight path to the identification of your unknown animal. It is a resource guide to assist you in making the required identification in full knowledge of what the possibilities are. Never forget that there are other, as yet unreported species from the coverage area; some described, some new to science. The natural world is wonderfully diverse, and we have just scratched its surface.

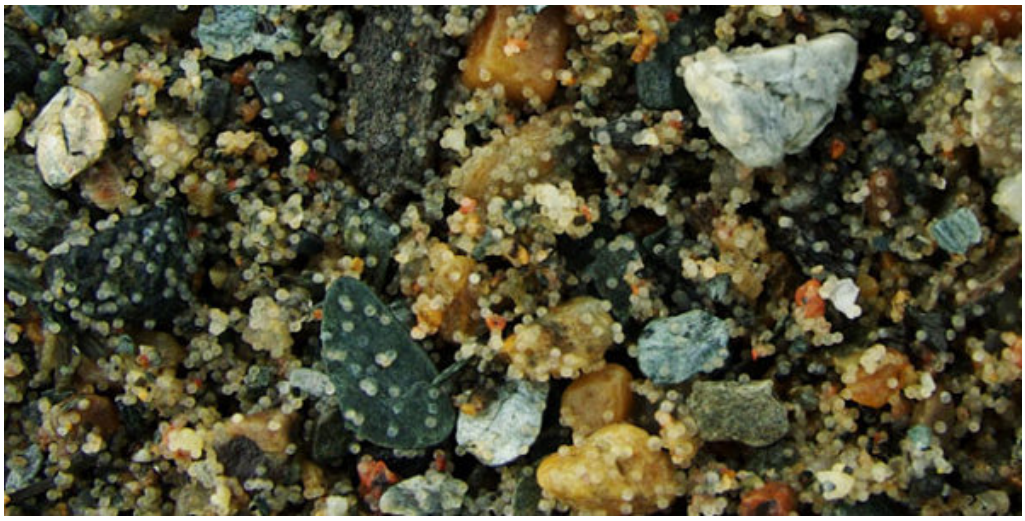
Introduction to the Superfamily Calliopioidea

When Bousfield began to conceptualize the amphipods at the superfamily level (1979) he did not identify the calliopiids as a group above family level. This did not change over time, and in 2001 he still considered them to fall within the superfamily Eusiroidea. Lowry and Myers, in their cladistic analysis of the gammaroids based on new character states (2013) identified the group as of superfamily status, and erected the Calliopioidea. They placed it within the Infraorder Hadziida in their new subclass Senticaudata. One of the major benefits of their analysis is that they applied cladistic methodology to examination of the relationship of both marine and freshwater families. Much of their Senticaudata belongs in the latter category, although there are minor elements of marine affinity scattered within it. The diagnosis they provided for the superfamily is basically that provided by Sars for the family Calliopiidae, with a new point of view and a new assessment of status. The group was not successfully retrieved in the phyletic analysis of Berge et al (2000), falling in their clade 4 with a number of disparate forms including pleustids, eusirids, and synopiids. Englisch et al (2003) while basing their analysis on DNA rather than morphology, had taxon sampling which did not allow the position and relationships of the Calliopioidea to be addressed.

Diagnosis of the Superfamily Calliopioidea – "*Antenna 1 shorter than antenna 2. Uropod 1 peduncle without basofacial robust seta.*" (From Lowry & Myers 2013)

Ecological Commentary

One of the more intriguing instances of amphipod interaction with fishes involves the calliopiid *Calliopius laeviusculus*. This small amphipod has a broad range in the boreal Pacific, and Atlantic. In northeast Atlantic waters it tends to feed on unicellular algae (Hudon 1983), but in the Northwest Atlantic it feeds mostly on the eggs of the capelin, *Mallotus villosus* (DeBlois & Leggett 2001, 2003a,b). This small fish spawns, like grunion, in the intertidal zone. Spawning is synchronous, massive, and conducted on the surface rather than below it (as grunion do). Release of roe is tremendous, and animals from amphipods to birds and bears, gorge on the nutrient rich eggs. The roe is used in sushi in several guises. In the northwest Atlantic the fish do not only spawn intertidally, but also pelagically. This is apparently the result of behavioral evolution in the NW Atlantic capelin, who were denied access to intertidal spawning by glaciation (Stergiou 1989). Since the glacial retreat a portion of the population has resumed intertidal spawning, providing added trophic pathways for local *Calliopius*. Even the pelagic eggs may eventually end up on the beach, if conditions are good, since they are both buoyant and adhesive



Capelin eggs coating the gravel of an intertidal beach (from ArcticBiodiversity.com)

Bousfield & Hendrycks (1997) refer to the calliopiids in general as detritivores, although detailed study of some members find different strategies. For instance, *Dolobrotus*, a pontogeneid, is reportedly a bait attracted scavenger (Bowman 1974). The oophagy of *Calliopius* is another non-detritus food source. Aquarium observations on a series of species tend to confirm the contention of Bousfield & Hendrycks that detritivory is the norm. Observations of feeding activity show feeding on surface resuspended by vigorous pleopod action, and examination of guts reveal mineral particles from the sediment (Enequist 1949). The pontogeneid *Paramoera mohri* is described as feeding primarily by antennal filtration augmented by opportunistic feeding on algal fragments, live copepods, and detritus (Staude 1995). The calliopiid *Apherusa glacialis* has proven to have a flexible set of feeding strategies. This sympagic species feeds on algae growing on the underside of the ice pack as well as being a detritivore feeding on phytodetritus (Arndt et al 2005). Bousfield & Hendrycks (1997) suggest the calliopiid *Oradarea longimana* is an obligate associate of decapod crustaceans, possibly as a scavenger. Specimens in the NEP have been taken either among algal drift, or off the large spider crab *Macroregonia macrochira* near vents in the deep sea.

Leptamphopus fragilis is the first member of the genus reported from vent associated habitat (Larsen & Krapp-Schickel 2007). It was taken on wood blocks deployed and recovered from deep water adjacent to vent sites on the Juan de Fuca Ridge off Oregon. Nutrition was not discussed by the authors, but seems potentially interesting. Given the extreme fragility of the species it could not be predatory. It's occurrence on wood suggests feeding on the blocks themselves, probably on bacterial film covering the surface. The mouthparts of this species are not particularly suited to any nutritive mode, although the maxillipedal plates are relatively well armed and could serve as an adequate bacterial scraper. My supposition is that this species feeds as a micrograzer on bacterial films in chemically reduced venting areas; a common strategy for small invertebrates in those communities.

Hornellia, and thus the Hornelliidae, would appear to be filter feeders much like the melphidippoids and megaluropids . The upside-down cradle position which was noted for several members of the subgenus *Metaceradocus* in the western Atlantic (Thomas & J. L. Barnard 1986) implies that the heavily setose second antennae and anterior legs are used for filter feeding.

These amphipods are apparently readily consumed by predators when the opportunity arises. It is highly probable, though undocumented, that *Calliopius laeviusculus* are consumed by other larger organisms, along with the capelin roe on which they are feeding. Fish certainly consume the pontogeneid *Apherusa glacialis* (arctic cod, Barnard 1959).

Calliopioids swim, especially the lighter forms. Saint-Marie & Brunel (1985) report *Calliopius laeviusculus* to be a member of the lowermost hyperbenthos in their investigation of swimming behavior. Steele and Steele (1973) report swarms of this species extending "far out to sea" during reproduction in late summer. Conlan (1991) in her consideration of precopulatory behavior in amphipods characterized *Paramoera mohri* as a "Non-mate guarder: pelagic". This implies at least some degree of swimming in males of the population, confirmed by Staude (1995). Bernard (1959) reports collections of *Apherusa glacialis*, a calliopiid, from vertical plankton tows under arctic ice. This obviously indicates swimming, well off the bottom most likely, of at least a portion of the population. It was not clear if the specimens were coming from the bottom, or were sympagic, living on the underside of the ice but Arndt et al (2005) provide evidence of the latter.

Sainte-Marie (1991) compiled the available information on reproductive patterns in amphipods, and provides information on a number of calliopioid taxa. Both pontogeneids and calliopiids are well represented, although no information was found for hornelliids. Much of the information was from antarctic or arctic species, since the groups are largely bipolar. In cases where it could be determined, the number of broods per year was 1, except for *Calliopius laeviusculus* which has several broods/yr (Steele & Steele 1973). One reason for this might be the protracted maturation period of the eggs. Thurston (1968) reporting on the Antarctic pontogeneid *Bovallia*, found eggs to require 7 months to mature in the brood pouch. Appearance of young *Apherusa glacialis* was observed in July, after observation of gravid females in May (Węsławski & Legeżyńska 2002). A differing annual pattern was reported for this species by Poltermann et al (2000), who report mating in the fall and release of brood in March. They found females took a year to reach maturity and become reproductive, and that they only bore a single brood in their two year life-span. In the Antarctic *Paramoera walkeri* Sagar (1980) found females were not mature until their second year, and some did not reproduce until their third, dying soon thereafter.

Calliopioids are shallow water animals, usually associated with either cobble, gravel, or shell debris in beaches or shallow nearshore waters, or with algae on rocky shores. Some, like *Paramoera mohri*, which lives within gravel and cobble beaches intertidally, migrating up and down with the tide, can be present at very high density (100,000/m2, Staude 1995). A few species, like *Bouvierella carcinophila* and *Leptamphopus fragilis* come from deep water, but this is atypical for the superfamily.

Key to genera of Northeast Pacific Calliopioidea

NEP Calliopioidea from McLaughlin *et al.* (2005) augmented by known provisional taxa.
*= Taxa on the SCAMIT Ed 9 list (Cadien and Lovell 2014).
Valid taxa **bolded**, synonyms not.

Family Calliopiidae

Amphithopsis longimana Boeck 1871 (see Oradarea longimana)
Bouvierella carcinophila Chevreux 1889 – North Atlantic; Alaska to British Columbia: 68-1386m
Callaska pratti (see Paracalliopiella pratti)
Calliopius carinatus Bousfield & Hendrycks 1997 – Prince William Sound, Alaska to Central Oregon: 0-10m
Calliopius columbianus Bousfield & Hendrycks 1997 – SE Alaska to Oregon: 0-160m
Calliopius pacificus Bousfield & Hendrycks 1997 – Prince William Sound, Alaska to Central Oregon:0-15m
Leptamphopus fragilis Larsen & Krapp-Schickel 2007 – Juan de Fuca Ridge, off Oregon: 2656m
Oligochinus lighti J. L. Barnard 1969 – Aleutians to Pt. Conception; 0m
Oligochinus sp IS1 Cadien 2010§ - San Francisco Bay; 0m
***Oradarea longimana** (Boeck 1871) – Japan to SCB: 54-2000m
Paracalliopiella haliragoides Bousfield & Hendrycks 1997 – SE Alaska; 0m
Paracalliopiella kudrjaschovi Bousfield & Hendrycks 1997 – Bering Sea to Prince William Sound, Alaska: 0-20m
Paracalliopiella pratti J. L. Barnard 1954 – Alaska to Central California; 0m
Paracalliopiella slatteryi Bousfield & Hendrycks 1997 – Bering Sea to Prince William Sound, Alaska: 0m
Paracalliopiella tzvetkovae Bousfield & Hendrycks 1997 – Bering Sea to Prince William Sound, Alaska: 0m

Family Hornelliidae

***Hornellia occidentalis (**J. L. Barnard 1959) – Pt. Conception, California, to Ensenada, Baja California: 2-31m
Metaceradocus occidentalis J. L. Barnard 1959 (see Hornellia occidentalis)

Family Pontogeneidae

Accedomoera melanophthalma of Chapman 2007 (see Pontogeneia melanophthalma)
Accedomoera vagor Barnard 1969 – Central California: 0m
Amphithoe inermis Krøyer 1838 (see Pontogeneia inermis)
***Nasageneia quinsana** (Barnard 1964) – SCB to Gulf of California: 0-21m
Nasageneia nasa (Barnard 1969) – Gulf of California: 0-1m
Paramoera (Humilomoera) crassicauda Staude 1995 – Alaska: 0m
Paramoera (Humilomoera) leucophthalma Staude 1995) – British Columbia: 0m
Paramoera (Paramoera) bousfieldi Staude 1995 – SE Alaska to N. Oregon: 0m
Paramoera (Paramoera) columbiana Bousfield 1958 – Aleutians to Puget Sound: 0m
Paramoera (Paramoera) mohri Barnard 1952 – Washington to Central Calif.: 0-10m
Paramoera (Paramoera) serrata Staude 1995 – Washington to Central Calif.: 0m
Paramoera (Paramoera) serrata escofetae Staude 1995 – Baja California: 0m
Paramoera (Paramoera) suchaneki Staude 1995 – SE Alaska to N. Calif.: 0m

Paramoera (Rhithromoera) bucki Staude 1995 – SE Alaska to Washington: 0m
Paramoera (Rhithromoera) carlottensis Staude 1995 – SE Alaska to British Columbia (Queen Charlotte Ids.): 0m
Pontogeneia inermis (Krøyer 1838) – Boreal Atlantic and Pacific to SCB: 0-220m
Pontogeneia intermedia Gurjanova 1938 – NWP, Central California to SCB: 0-6m
Pontogeneia melanophthalma Gurjanova 1938 – NWP to California: 0-80m
Pontogeneia minuta of J. L. Barnard 1959 (see Tethygeneia opata)
Pontogeneia nasa J. L. Barnard 1969 (see Nasageneia nasa)
Pontogeneia opata J. L. Barnard 1979 (see Tethygeneia opata)
Pontogeneia quinsana J. L. Barnard 1964 (see Nasageneia quinsana)
Pontogeneia rostrata Gurjanova 1938 – NWP, Central California to SCB: 0-100m
Pontogeneia sp Harty 1979 – Southern Oregon:0-1m, on sea urchins
Tethygeneia nasa (J. L. Barnard 1969) (see Nasageneia nasa)
Tethygeneia opata (J. L. Barnard 1979) – SCB to Costa Rica: 0-7m
Tethygeneia quinsana (J. L. Barnard 1964)(see Nasageneia quinsana)

Comments by Family

Family Calliopiidae – While a number of species in the family are known from the NEP, only a single species makes it into the Southern California Bight, *Oradarea longimana*. Two others come as far south as central California, but the majority of these animals are boreal or arctic. The group in the NEP was monographed in 1997 by Bousfield and Hendrycks, who provide both a generic key, and keys to individual multi-species genera. The family was treated by some previous authors (including J. L. Barnard & Karaman 1991) as a subfamily of Eusiridae, as were the pontogeneids. They are currently viewed as valid at family status.

Diagnosis: "*Body often dorsally carinated on pleon, occasionally on peraeon. Rostrum short to medium. Eyes large, well pigmented. Head lobe truncated or narrowly incised; inferior antennal sinus sharply incised. Antennae (of males often, and females occasionally) calceolate; peduncular segments short. Antenna 1 usually shorter than antenna 2; accessory flagellum small, often minute, occasionally lacking; callynophore usually lacking, rarely weakly developed.*

Mouthparts basic. Upper lip simple, apex rounded or slightly incised. Lower lip, inner lobes lacking or weakly developed. Mandible normally developed; molar strong, triturative, with distal flagellum; palp segment 3 normal or shorter than 2. Maxilla 1 regular, inner plate setose; outer plate with 9-11 apical spines; palp 2-segmented, occasionally reduced. Maxilla 2, inner plate, facial row of setae variously reduced. Maxilliped normal, strong; outer plate often large or modified.

Coxal plates 1-4 medium, increasing posteriorly, lacking hind cusp. Gnathopods subsimilar, subchelate, trending to sexual dimorphism (propod more powerful in male); carpus (especially of gnathopod 2) variable, often elongate.

Peraeopods 3 & 4 regular, dactyls short to medium. Peraeopods 5-7 regular, homopodous; coxae posterolobate; postero-distal angles of segments 4 & 5 weakly produced.

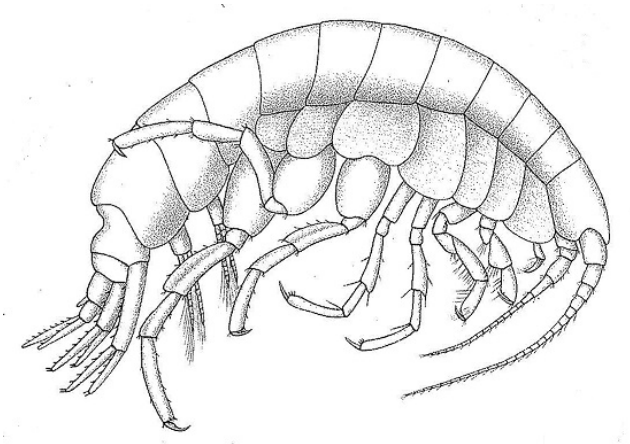
Pleon segments large, uncoalesced. Pleopods strongly developed, especially in male. Pleon plates regular, hind corners variable. Urosome segments separate. Uropods 1 & 2, rami sublanceolate or sublinear, outer ramus the shorter, margins serially spinose, apices unequally

spinose. Uropod 3, rami lanceolate, subequal, margins serially spinose, plesiomorphically setose.

Telson plate-like, apex acute, rounded, or variously notched; penicillate setae in two pairs, inner member of distal pair often spine-like.

Coxal gills usually strongly pleated, especially in male. Brood plates very broad and strongly marginally setose; occasionally slender, weakly setose on peraeopod 5.

Males usually slightly smaller than females, and having more slender body form, more strongly calceolate antennae, larger eyes, and stronger gnathopods." (Bousfield and Hendrycks 1997).



Bouvierella carcinophila (from Chevreux1900)

Bouvierella - Only two members are known in the genus, *B. carcinophila* from the North Atlantic and NEP, and *B. curtirama* from the Mid-Atlantic ridge around hydrothermal vents. The former species, as its name suggests, is found associated with decapods and living on their carapaces (Shaw 1988). The pereopodal dactyl is long, slender, and closes against several large robust setae on the palm to form a grasping organ probably used with hairs on the host. NEP host crabs are as yet unspecified, but the types were collected from *Geryon affinis* off the Azores. The two, while extremely similar, can be separated by the shortened inner ramus of U3 in *B. curtirama* . Bellan-Santini & Thurston (1996) provide a comparison table to assist with the separation of *Bouvierella* from similar long-wristed calliopiids.

Diagnosis: "*Body smooth, without dorsal processes or carina. Rostrum short; anterior head lobe subacute. Pigmented eyes lacking. Antenna **1** slightly longer than 2. Antenna1 peduncles short; accessory flagellum very short or lacking; callynophore and calceoli lacking.*

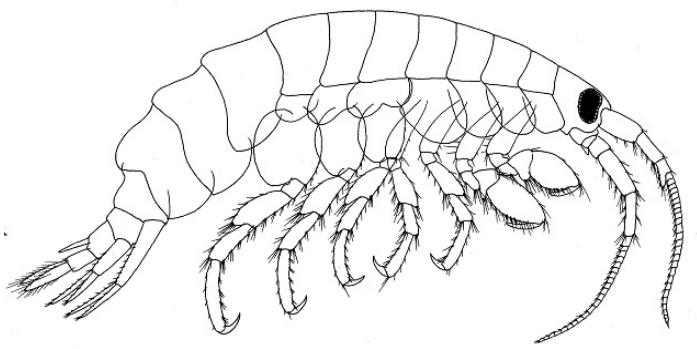
Mouthparts basic. Upper lip slightly notched. Lower lip simple. Mandible, palp normal, left lacinia 7-dentate. Maxilla 1 normal, inner plate with numerous marginal setae. Maxilla 2, inner facial setae numerous, regular. Maxilliped, inner plate short; outer plate broadened.

Coxae 1-4 large, deep. Gnathopods 1 & 2 slender, weakly subchelate, sexually alike; carpus of gnathopod 2 elongate.

Peraeopods 3-7 regular, weakly subchelate, dactyls short. Peraeopods 5-7 closely homopodous; bases broad.

Pleon large; plates 2 & 3, hind corners obtuse ; pleopods powerful. Uropods 1 & 2, rami sublinear, serially spinose, with weak apical spines, outer ramus shorter. Uropod 3, rami narrowly lanceolate, margins spinose. Telson plate like, apex with V-cleft.

Coxal gills plate-like, simple, on peraeopods 2-7. Brood plates moderately broad to narrow." (from Bousfield & Hendrycks 1997)



Calliopius laeviusculus (from Lincoln 1979)

Calliopius – A genus of eight valid species distributed in the subarctic-boreal areas of the NEP and North Atlantic. The genus is most diversified in the North Pacific. According to Bousfield & Hendrycks (1997) there are no authentic records of *C. laeviusculus* in the North Pacific; previous records referring to recently described siblings. Three species occur in the NEP, all described as new in Bousfield & Hendrycks (loc. cit.), none extending further south than Oregon. A key to species is provided by the above authors.

Diagnosis: " *Body medium, robust, weakly to strongly middorsally carinated or tuberculated, especially on the pleon; cuticle often highly pigmented in mottled or banded patterns. Head, rostrum short but distinct; inferior head lobe not produced. Eyes large, subrectangular, strongly pigmented. Antennae stout, not elongate; antenna 1 shorter than 2; distal peduncular and flagellar segments calceolate (both sexes); calceoli simple (pontogeniid type). Antenna 1, peduncular segment 3 with variously developed posterodistal process; accessory flagellum minute, variously fused with segment 3; flagellum faintly (or not) basally callynophorate.*

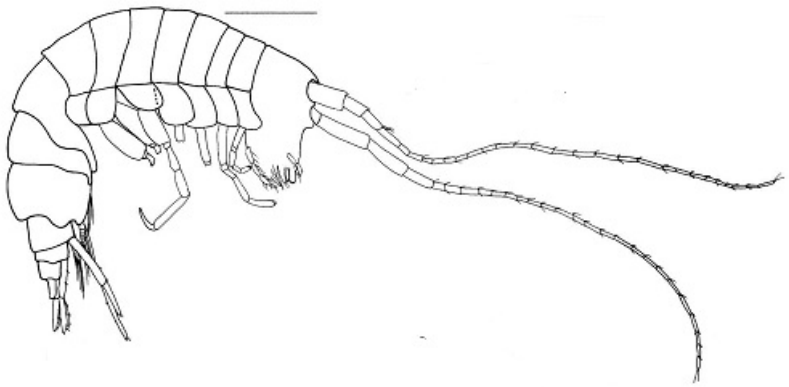
Mouthparts regular. Lower lip with weak inner lobes. Mandible, palp segment 3 large, falciform, with 1-3 basofacial groups of "A" setae; segments 1 & 2 with inner marginal setae; left lacinia 5-7 dentate, right lacinia 3-4 cuspate; spine row medium strong. Maxilla 1 normal; right palp broadly 2-segmented; inner plate with 2-6 apical setae; outer plate with 11 apical spines. Maxilla 2, inner plate narrowed, with 1-2 facial seta, one often strong. Maxilliped plates regular, not enlarged; palp strong.

Coxae 1-4 medium deep. Gnathopods I & 2 powerfully subchelate, raptorial, subsimilar, slightly sexually dimorphic; propod palms oblique, with 3-5 spines near posterodistal angle; dactyls minutely setulose behind; carpus short, deep; merus small.

Peraeopods 3-4 regular; segment 5 not shortened; dactyls stout, curved. Peraeopods 5-7 homopodous, increasing posteriorly; bases broadly rounding, hind lobes distinct. Pleon plates 2-3 broad, hind margins smooth, lower margins (and often facially) spinose; hind corners acuminate, not produced.

Pleopods strong, slightly sexually dimorphic. Uropods 1 & 2, rami sublinear, apices truncate, spinose, outer ramus shorter. Uropod ***3;*** *rami subequal, margins variously setose and short-spinose, inner ramus broadly lanceolate.*

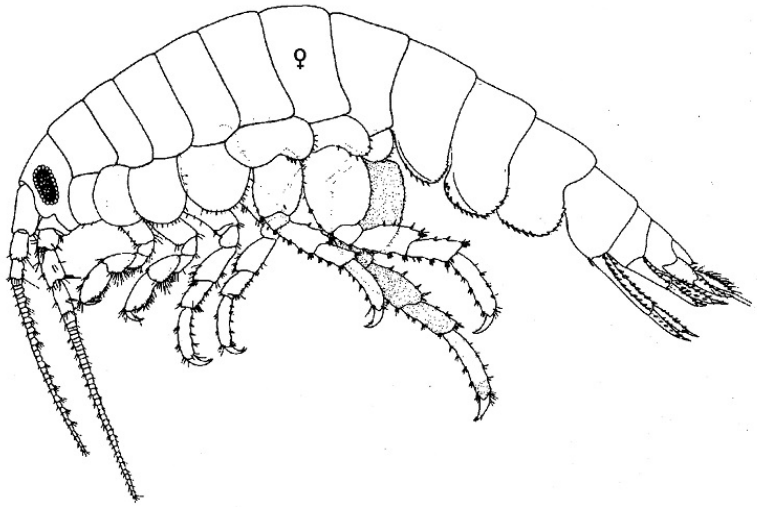
Telson linguiform, apex rounded; penicillate setae median. Coxal gills on peraeopods 3 & 4 strongly pleated, especially in male. Brood plates large, margins strongly setose." (from Bousfield & Hendrycks 1997)



Leptamphopus fragilis; scale bar 0.5mm (from Larsen & Krapp-Schickel 2007)

Leptamphopus – A small genus of only four species, three from the Northeast Atlantic and Mediterranean, and the fourth from the NEP. This species L. fragilis, lives deeper than any of the others, which range from shelf to mid-slope depths, being from abyssal depths in the vicinity of hydrothermal vents on the Juan de Fuca Ridge off Oregon. Larsen & Krapp-Schickel (2007) do not provide a key, but do differentiate their new species from others in the genus based on a series of characters.

Diagnosis: "*Body smooth or not sharply spinose. Rostrum small or absent. Coxae moderate, C4 excavated. Antennae elongate, subequal. Accessory flagellum reduced or absent. Labium without inner lobes. Mandibular incisor protruding; molar robust and triturative; palp 3-articulate. Mx1 palp 2-articulate. Maxilliped inner plate maximally reaching midlength on palp article 3; outer plate reaching 2/3 to end of palp article 3. Gnathopods elongate; G2 longer and somewhat thinner than G1. U3 rami unequal. Telson notched or weakly cleft*." (from Larsen & Krapp-Schickel 2007)



Oligochinus lighti (from Bousfield & Hendrycks 1997)

Oligochinus – Although currently monotypic, a second as yet undescribed species was encountered in fouling samples from San Francisco Bay (Treasure Island). This species, *O*. sp IS1, differs in several ways from *O. lighti*, but the easiest to see is the structure of the hind margin of epimeron 3; serrate in *lighti*, smooth in IS1.

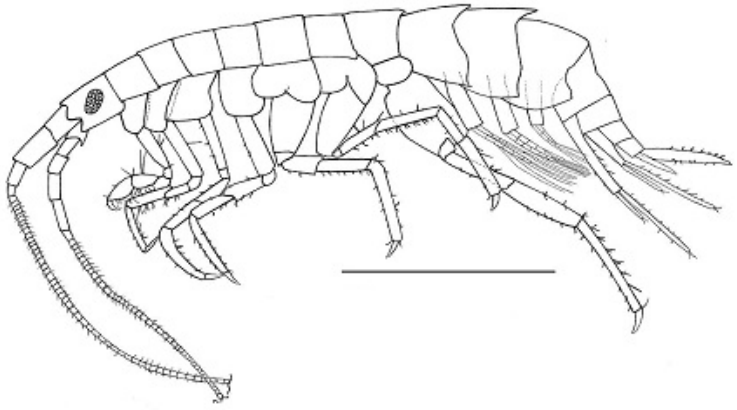
Diagnosis: "*Body smooth. Rostrum short. Eyes medium, narrow, rectangular. Anterior head margin rounded, broadly notched below. Antennae medium; peduncles short, lacking calceoli and/or callynophore. Antenna 1 shorter than 2; accessory flagellum scale-like, with single large stiff apical seta; clusters of aesthetascs posteriorly on alternate flagellar segments*

Lower lip lacking inner lobes. Mandible normal; palp segment 3 subfalciform, shorter than 2; left lacinia5-dentate?; right lacinia slender. Maxilla 1, palp normal, inner plate 4-setose. Maxilla 2, inner plate with submarginal and single large facial setae. Maxilliped, outer plate small, palp ordinary, not raptorial.

Coxae 1-4 medium, deeper than wide. Gnathopods weakly subchelate, subsimilar; propod and carpus short; palm oblique, posterior angular spines stout.

Peraeopods 3 & 4 short, stout, spinose; segment 5 shorter than 4; dactyls short. Peraeopods 5-7 regularly homopodous, increasing slightly posteriorly.

Pleon plates 2 & 3 shallow, rounded below, lower margin spinose, hind margin serrate. Uropods 1 & 2 short, stout, rami much shorter than peduncles, marginally and apically spinose. Uropod 1, rami subequal. Uropod2, outer ramus the shorter. Uropod 3 short, rami broad-lanceolate, margins spinose and setose Telson short, broad, apex notched. Coxal gills simple, not pleated." (from Bousfield & Hendrycks 1997)



Oradarea surera, a southwest Atlantic species; scale bar 3mm (from Alonso di Pina 2012)

Oradarea – Currently consisting of seventeen species (Lowry & De Broyer 2014), is primarily distributed in the southern hemisphere, with a few representatives in the North Atlantic and North Pacific. The species known from the NEP, *O. longimana* is distributed towards the east through the Arctic and into the Northeast Atlantic. Bousfield & Hendrycks (1997) illustrate *O. longimana*. Note the extremely elongate linear propods of G2 in this species. These render it quite easily recognizable. It tends to be taken in outer shelf and upper slope collections, in association with drifting kelp on the bottom. When encountered, it is often present in considerable numbers.

Diagnosis: "*Body weakly mucronate on pleon and peraeon segment 7. Rostrum short. Eye small. Lower head process acute. Antennae slender, elongate. Antenna 1, peduncle short; accessory flagellum short, apex setose; flagellum weakly callynophorate, but lacking calceoli.*

Mouthparts modified. Lower lip with distinct inner lobes. Mandibular palp segment 3 short, apex blunt; lacinia mobilis 5-dentate. Maxilla 1, inner plate multisetose. Maxilla 2, inner plate with facial setae. Maxilliped, inner plate broad; outer plate normal; palp, dactyl short.

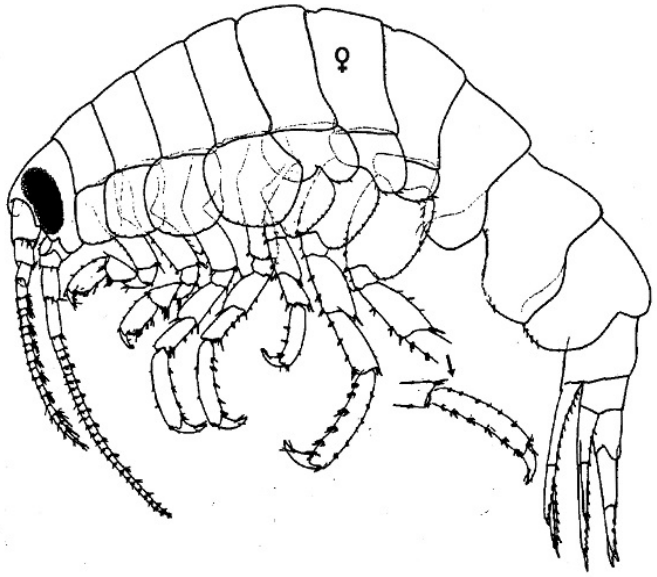
Coxae 1-4 regular, deeper than broad. Gnathopods weakly subchelate, slender, very unequal. Gnathopod 2 much the longer, carpus and propod elongate (both sexes).

Peraeopods regular, slender, dactyls small. Peraeopods 5-7 elongate, homopodous; dactyls short.

Pleon plates 2 & 3 lacking facial spines, hind corners not acuminate. Uropods 1 & 2, rami slender, elongate, weakly spinose, outer ramus much the shorter. Uropod 3, rami very unequal (inner longer), margins spinose only.

Telson short, length slightly greater than width, apex very weakly notched.

Coxal gills plate-like, not pleated." (from Bousfield & Hendrycks 1997)



Paracalliopiella pratti (from Bousfield & Hendrycks 1997)

Paracalliopiella – A moderately sized genus of 10 species which is endemic to the North Pacific, and represented relatively equally in the NWP and the NEP. Of the four regional species, only *P. pratti* extends south to Central California. Members of the genus are keyed in Bousfield & Hendrycks (1997).

Diagnosis: "*Body smooth to strongly carinated mid-dorsally on posterior peraeonal segments and pleon. Rostrum short to medium strong. Eyes large, pigmented, larger in male. Inferior antennal sinus shallow, notch small, inferior head lobe little or not produced anteriorly. Antenna 1 shorter than 2; calceoli lacking. Antenna 1, peduncle short; accessory flagellum minute; aesthetascs clustering posteriorly on alternate flagellar segments. Upper lip broadly rounded. Lower lip, inner lobes weak or lacking. Mandible, palp segment 3 usually shorter than 2, with basofacial cluster of "A" or "B" setae; left lacinia 5- **6** dentate, right lacinia trifid. Maxilla 1, inner plate with 2- 8 apical setae; outer plate with 11 apical spines, innermost slender, finely pectinate, outermost heavy, coarsely pectinate; palp segment 1 elongate, right palp segment 2 not broadly expanded. Maxilla 2, inner plate narrow, with 3-6 marginal or submarginal facial setae. Maxilliped, inner plate tall, inner margin setose, apex with 2(3) conical spines; outer plate broad, inner margin angled distally and apex medially incised; palp strong, not raptorial in form.*

Coxae 1-4 broad, medium deep, increasing posteriorly. Gnathopods 1 & 2 subsimilar; in female weakly subchelate, propods narrow; carpus slender not longer than propod, hind lobe shallow; in male: gnathopods strongly subchelate, gnathopod 1 usually larger; propods large, deep, with strong palmar spines; carpus short, deep, lobate behind.

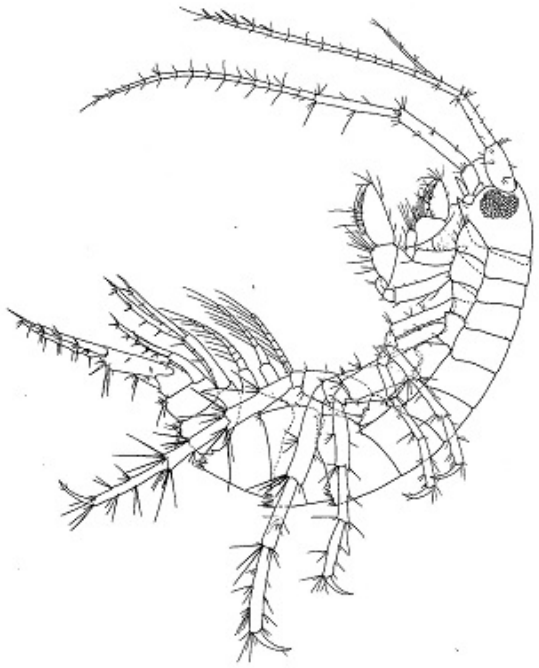
Peraeopods 3 & 4 regular, segment 5 often slightly shorter than 4; dactyls medium. Peraeopods 5-7 regularly homopodous, increasing posteriorly; bases intermediate, rounded behind and distally lobate; segment 4 variously broadened; dactyls medium.

Pleon plate 3, hind margin smooth, rounded, lower margin spinose, hind corner obtuse. Uropods 1 & 2, rami narrowly lanceolate-linear, margins strongly serially spinose; outer ramus distinctly the shorter. Uropod 3, rami lanceolate, attenuating distally, usually longer than peduncle; inner ramus slightly the larger, margins spinose and/or weakly setose. Telson entire, narrowing distally, apex narrowly rounded or truncate.

Coxal gills plate-like, not pleated in male. Brood plates very broad, marginally setose." (from Bousfield & Hendrycks 1997)

Family Hornellidae

Diagnostic description: "*Body laterally compressed or subcylindrical. Eyes well developed, round, reniform or subrectangular.* ***Antennae 1–2 calceoli absent****. Antenna 1 shorter than, subequal in length to, or longer than antenna 2; peduncular article 1 shorter than or subequal to article 2; article 2 longer than article 3; article 3 shorter than article 1; peduncular articles 1–2 not geniculate; accessory flagellum short.* ***Antenna 2 peduncular article 1not enlarged****. Mandible molar triturative; palp symmetrical.* ***Maxilla 1 basal endite setose along medial margin****; palps symmetrical. Maxilla 2 basal endite with oblique setal row.* ***Coxal gills*** *on pereopods 2–6,* ***not stalked****; sternal gills absent; sternal blisters absent; oostegites fringing setae simple.* ***Gnathopod 1*** *subchelate; subchelate; similar in males and females (not sexually dimorphic);* ***smaller (or weaker) than gnathopod 2****; propodus palm without robust setae along palmar margin. Gnathopod 2 similar or in males and females (not sexually dimorphic); carpus not produced along posterior margin of propodus, projecting between merus and propodus.* ***Pereopods 3–4 not sexually dimorphic. Pereopod 4 without posteroventral lobe****. Pereopod 5 shorter than pereopod 6; coxa with large anteroventral lobe. Pereopod 7 longer than pereopod 5. Pleonites 1–3 without dorsal carinae. Urosomites 1–3 free; with or without slender or robust dorsal setae (check). Urosomite 1 without large distoventral robust seta. Urosomite 2 without dorsal setae. Uropod 1 with or without basofacial robust setae.* ***Uropod 3*** *sexually dimorphic or not;* ***biramous****, with or without plumose setae;* ***endopod subequal in length to exopod****.* ***Telson deeply to weakly cleft****; dorsal or lateral robust setae present or absent; apical robust setae present or absent*." (from Lowry & Myers 2013)



Hornellia tequestae (from Thomas & J. L. Barnard 1986)

Hornellia – The genus is divided into two subgenera, *Hornellia* s.s., and *Hornellia* (*Metaceradocus*). Four species fall in *Hornellia* s. s., and the remaining nine into *H.* (*Metaceradocus*). Only a single species *H. (Metaceradocus) occidentalis* is known from the NEP. The description of this form (as *Metaceradocus*) is in J. L. Barnard & Reish (1959). This shallow water form is usually taken on bottoms with either drift or attached algal cover. If the local species follows the same trophic path as its Caribbean cognate (*H. atlanticus*) and congener (*H. tequestae*), it is a surface dweller in cradle configuration; suspension feeding in the benthic boundary layer.

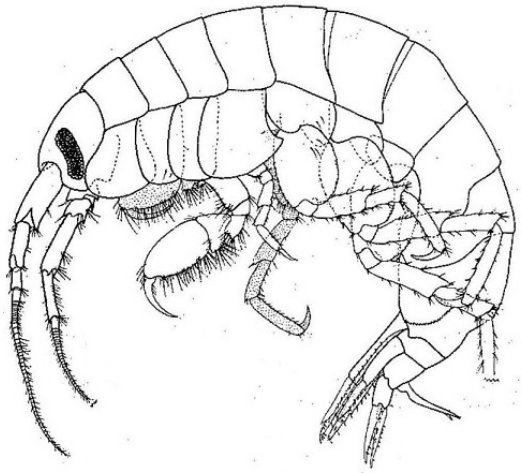
Diagnosis: "*Body rather tumid. Segments of pleon and urns with postero-dorsal teeth. Head not rostrate or vaulted in front. Eyes distinct, not coalescent. Upper antenna with an appendage ; flagellum slender, much longer than the peduncle. Mandibles with well-developed molar tubercle, spine-row, and toothed cutting edges; palp long, 3-jointed, 2nd and 3rd joints subequal (fig. 27. m.). First maxillae with the 2nd joint of the palp widened towards the obliquely truncate end. which is crowned with spine-teeth and seta; alternately (fig. 27. mx1). Maxillipeds well developed in all parts ; 4th joint of palp dactyliform (fig. 27. mxp.). Gnathopods subequal and similar, like those in Halimedon. Third uropods of moderate length, with subequal rami. Telson long and deeply cleft*." (from Walker 1904)

Family Pontogeneidae - The Pontogeneidae is represented by several genera in the NEP, but neither *Accedomoera* nor *Paramoera* penetrate south of Pt. Conception. Members of *Nasageneia* and *Pontogeneia* do occur in the SCB, and are in the SCAMIT Ed. 9 list. The two genera can be separated in the generic key, but all members of these two genera will be keyed together to species level below. The disjunct subspecies *Paramoera serrata escofetae*, which is known only from the outer coast of Baja California, is also included. There is currently no review of the family in the region which is comprehensive.

Diagnosis: " *Body laterally compressed. Eyes well developed, round, ovoid, reniform or occupying most of lateral surface of head.* ***Antennae 1–2 calceoli pontogeneiid (type 4)****. Antenna 1 shorter than, subequal in length to, or longer than antenna 2; peduncular article 1 subequal to, or longer than article 2; article 2 longer than article 3; article 3 shorter than article 1; peduncular articles 1–2 not geniculate; accessory flagellum present or absent; if present minute or scale-like. Antenna 2 peduncular article 1 not enlarged. Mandible molar triturative; palp symmetrical. Maxilla 1 basal endite setose along medial margin or apically setose; palps symmetrical. Maxilla 2 basal endite with or without oblique setal row. Labium inner lobes present. Coxal gills on pereopods 2–6, not stalked; sternal gills present or sternal gills absent, simple; sternal blisters absent; oostegites fringing setae simple. Gnathopod 1 subchelate; similar in males and females (not sexually dimorphic); smaller (or weaker) than or similar in size to gnathopod 2; propodus palm without robust setae along palmar margin. Gnathopod 2 subchelate; similar in males and females (not sexually dimorphic); carpus slightly produced or not produced along posterior margin of propodus, projecting between merus and propodus. Pereopods 3–4 not sexually dimorphic. Pereopod 4 with well developed or small posteroventral lobe or without posteroventral lobe. Pereopod 5 shorter than pereopod 6; coxa equilobate or with posteroventral lobe or with large anteroventral lobe or with small anteroventral lobe or without lobes. Pereopod 7 longer than pereopod 5. Pleonites 1–3 each with dorsal carina or carinae or without dorsal carinae. Urosomites 1–3 free; without slender or robust dorsal setae. Urosomite 1 with or without large distoventral robust seta. Urosomite 2 without dorsal setae. Uropod 1 without basofacial robust setae. Uropod 3 biramous, with or without plumose setae; endopod shorter than or subequal to exopod.* ***Telson deeply to weakly cleft****; dorsal or lateral robust setae absent; apical robust setae absent*." (from Lowry & Myers 2013)

Accedomoera – An endemic North Pacific genus of two members; *A. tricuspidata* from the NWP, and *A. vagor* from the NEP. This latter is known only from Central California in the intertidal zone, associated with red algae. Chapman (2007, pp 602-604) provides a key to eusiroideans (including Eusiridae, Calliopiidae, Bateidae, and Pontogeneidae) from California which includes this species, and other related forms. He also includes in his key *Accedomoera melanophthalma*, which is currently placed in *Pontogeneia*. Eastern Pacific records of this are questionable, and the species is included herein based on Chapman's reference to it occurring here.

Diagnosis: "Gnathopods not eusirid, sixth article longer than broad and not attached to a produced apex of the fifth article, fifth articles somewhat lobate behind, fifth and sixth articles not linear, sixth as broad as fifth, palms distinct; palp of maxilla 1 long, article 2 longer than article 1; articles 4-6 of pereopods 3-5 longer than article 2; epistome apparently lacking an anterior process; accessory flagellum a short, distinctly articulated piece; inner plate of maxilla 1 with less than 4 principal setae; lower lip with small inner lobes; telson deeply cleft." (from J. L. Barnard 1964c)



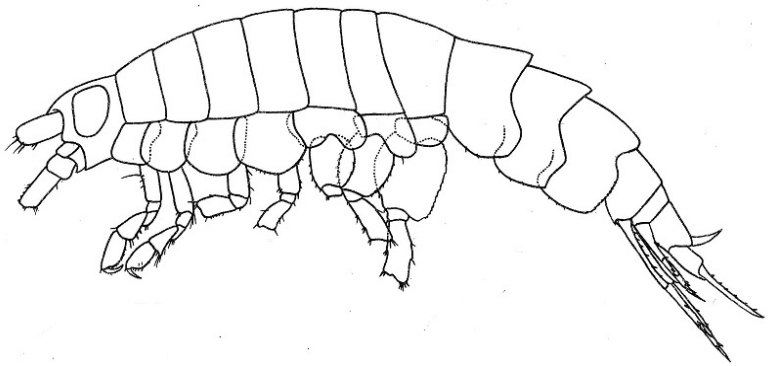
Eusiroides sp A SCAMIT 2015§ (from J. L. Barnard 1964a)

Eusiroides – The genus has 16 described members world-wide, although several of these have been placed in synonymy at one time or another. Only a single species occurs in the NEP.

Eusiroides monoculoides is a shallow water species which is reef, turf, or algal associated. It has been reported from the NEP on several occasions (J. L. Barnard 1964a & 1969, Garcia Madrigal 2007). The local form is, however, almost certainly not the same as Haswell's *E. monoculoides* from Australia. This species, like some others (i.e. *Colomastix pusilla*) are known to differ in some respects from their exotic nominate congeners. Consequently a provisional, *Eusiroides sp A* SCAMIT 2015§, was erected for the specimens previously identified as *E. monoculoides* in both regional literature reports and agency collections. *Eusiroides sp A* is illustrated in Barnard 1964a , and the characters which distinguish it are summarized in the voucher sheet on the SCAMIT website. Until fairly recently this genus was treated as a eusirid rather than as a pontogeneid, where it currently resides (Lowry 2014a).

Diagnosis: "*Body ordinary compressed, smooth or weakly carinate and toothed. Rostrum small to medium, lateral cephalic lobes ordinary; anteroventral margin of head not produced. Eyes reniform. Antenna· 1 longer than 2, article 1 almost as long as head, article 2 almost as long as article 1; article 3 short, not produced; article 1 of primary flagellum, short, accessory flagellum 1articulate, elongate. Labrum weakly incised, emarginate, broader than long; epistome unproduced. Molar triturative, columnar, article 2 of mandibular palp unlobed, article 3 as long as or longer than 2. Labium: inner lobes small, forcing gape between outer lobes. Maxilla 1: inner plate with 1 medial and 1 apical setae or fewer, palp long, article 1 short. Maxilla 2: inner plate much broader but not longer than outer, outer plate narrow, inner plate without facial row of setae and no other basomedial setae. Maxilliped: inner plates not relatively long, outer plate slightly longer than inner; palp of 4 articles, 4 slightly shorter than 3, 3 weakly lobed, 4 not spinose along inferior margin. Coxae ordinary, coxa 1 produced anteriorly, expanded ventrally, coxa 4 with posterior lobe, excavate, not twice·· as long as coxa 1. Gnathopods alike, medium to large, subchelate, not· eusirid, carpus of both, much shorter than propodus, with strong posterior lobe extending distad, carpus with numerous long posterior setae, propodus broadly ovate, swollen, palms very oblique and usually bearing thick spines. Pereopods 3-7 ordinary, simple, dactyls simple, article 2 not anteriorly lobate. Epimeron 3 smooth or serrate (type). Outer rami of uropods 1-2 slightly shortened; rami with lateral and dorsal spines. Uropod 3 ordinary, not extended beyond uropod 1, peduncle without large*

process, rami lanceolate. Telson elongate, cleft, lobes notched, without long apical armaments." (from J. L. Barnard and Karaman 1991) –

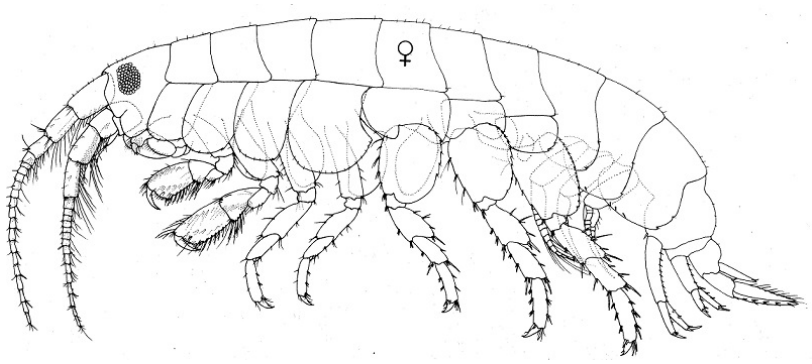


Nasageneia quinsana (from J. L. Barnard 1964b)

Nasageneia – A five member genus from American temperate and tropical waters. Two species have been described from the Caribbean and one from the eastern coast of Mexico in the Yucatan. The two forms from the NEP are very similar, and I doubt are specifically distinct. They are currently maintained as valid, however (Lowry 2014b). They can be distinguished based on the key provided below to pontogeneid species.

Diagnosis: "*Body slender, compressed, smooth. Rostrum large, lateral cephalic lobes ordinary, anteroventral margin of .head scarcely produced. Eyes reniform. Antennae subequal, peduncular articles of antenna 1 progressively shorter, article 1 shorter than head, article 3 weakly produced; article 1 of primary flagellum ordinary to short, accessory flagellum absent. Labrum entire, subrounded, broader than long; epistome unproduced. Molar triturative, columnar, article 2 of mandibular palp unlobed, article 3 shorter than 2. Labium: inner lobes absent. Maxilla 1: inner plate with 1 medial and 2 apical setae, palp long, article 1 short. Maxilla 2: inner plate not broader but slightly longer than outer, inner plate without facial row of setae but with other medial setae, few, large, at least one slightly submarginal. Maxilliped: inner plate not relatively long, outer plate slightly shorter than inner; palp of 4 articles, 4 slightly shorter than 3, 3 unlobed, 4 not spinose along inferior margin.*

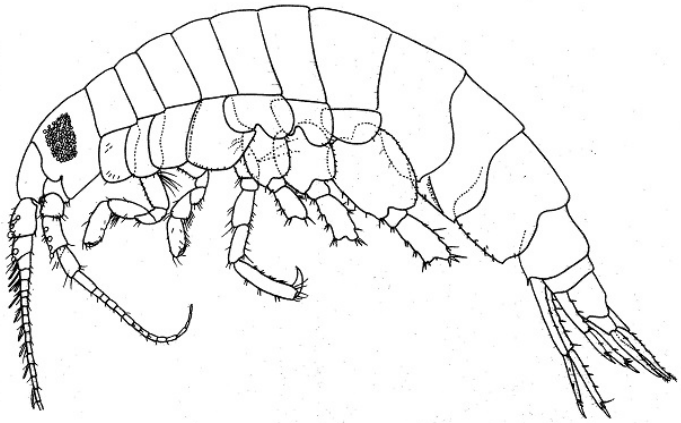
Coxae ordinary to short, coxa 1 not produced anteriorly nor expanded ventrally, coxa 4 without posterior lobe, excavate. Gnathopods diverse, medium, of similar size, subchelate, not eusirid, medium, carpus of both shorter than propodus, only gnathopod2· with strong posterior lobe extending distad, carpus without numerous long posterior setae, propodus rectangular in female, inflated in male, in latter with posterior spines outside limits of oblique palm. Pereopods 3-7 ordinary, simple, dactyls simple; article 2 not anteriorly lobate. Epimeron 3 serrate. Outer rami of uropods 1-2 shortened; rami with lateral and dorsal spines. Uropod 3 ordinary, not extended beyond uropod 1, peduncle with small process, rami lanceolate, subequal. Telson ordinary, weakly cleft, apices without long armaments." (from J. L. Barnard & Karaman 1991)



Paramoera serrata (from Staude 1995)

Paramoera – A large 50 member genus which J. L. Barnard & Karaman (1991) characterize as cosmopolitan, but dominantly austral. A number of species, including several in the NEP, are typically found in either hyposaline or freshwaters adjacent to the marine environment. Regionally the genus was monographed by Staude (1995), who provides keys to separate the local representatives. Of the nine species known regionally, a single member, *Paramoera mohri* penetrates south into Central California, where it occurs in gravel beaches with or without freshwater input. A disjunct subspecies of P. serrata is also found to the south, in Baja California, where it seems restricted to a shallow subtidal sandbar habitat (Staude 1995). The subgenera erected by Staude, *Humilomoera* and *Rhithromoera* are not currently being recognized by WoRMS (Lowry 2014c), although another subgenus *Ganigamoera*, is.

Diagnosis: "*Rostrum vestigial or absent; antenna 1 usually longer than antenna 2; accessory flagellum I-segmented, scale-like, with 2 long apical setae and a shorter seta to either side; gland cone projecting ventrally, bearing spines or setae; discoid calceoli present in male. upper lip symmetrical and evenly rounded; mandibular incisor with 6 teeth, left lacinia mobilis with 5 teeth, right lacinia with 2-3 major teeth, with a blunt tooth at the base of the mandibular palp; segments 2 and 3 of mandibular palp subequal in length; lower lip with inner lobes indistinct or absent; inner plates of maxilla 1 and 2 generally with numerous plumose setae (reduced in apomorphic subgenera), setae of maxilla 2 in a submarginal diagonal row; inner plate of maxilliped with 3 stout apical spine teeth. Coxae 1-4 without articulated spines along the posterior margins; gnathopods subchelate (not eusirid), with oblique palms, propodus with groups of finely pectinate comb-setae in parallel arrangements along the ventral, medial, and anteromedial margins; carpus of gnathopod 2 lengthened in female (often exceeding the length of the propodus). Lobes of telson rarely fused more than half its length, with prominent setae or spines near the apices*." (from Staude 1995)

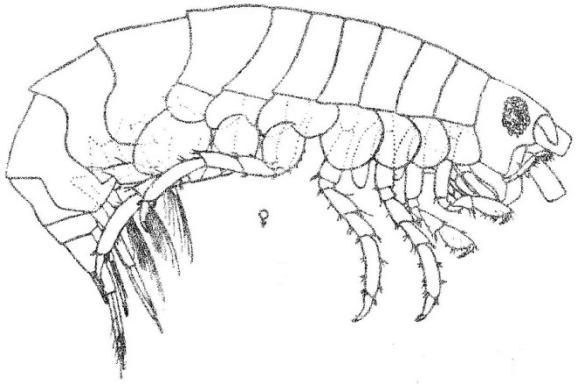


Pontogeneia rostrata (from J. L. Barnard 1964b)

Pontogeneia – A moderate sized genus of 13 described species, of which five occur in the NEP Distributed in both the North Pacific and North Atlantic boreal regions, and penetrating south to Cocos Island Costa Rica in the Pacific, and to Cuba in the Atlantic. Off the four NEP forms, one is widely distributed in both the Atlantic and Pacific, although Chapman (2007) suggests that Eastern Pacific records need to be reviewed. Except for *P. melanophthalma*, which is northern and is not often recorded in the NEP (mostly NWP), the genus is well represented in the SCB, with *P. inermis*, *P. intermedia*, and *P. rostrata* all occurring in appropriate habitat. A provisional species, *Pontogeneia* sp, occurs in the intertidal of southern Oregon in association with the purple sea urchin (Harty 1979). She points out that a previous report of pontogeneids being taken from purple sea urchins in Oregon existed (J. L. Barnard 1954), although he had identified them as *P. inermis*. This is perhaps the source for Chapman's comment on the need for review of earlier *P. inermis* records (i.e. J. L. Barnard 1952). It may also be the source of his statement that *P. inermis* is "a possible echinoderm and coelenterate commensal". I prefer to think that Harty's provisional, although not adequately characterized, differs from *P. inermis*. I have encountered the latter numerous times in the SCB, and never in association with a defined host. It has never been purple in color, as the provisional is described to be, and does not have pereopodal dactyls fit for spine grasping, as do other sea urchin commensals. I prefer to view J. L. Barnard's early report as a failure to recognize a new sibling form, and differentiate it from the broadly distributed *P. inermis*. The fact that, while other local *Pontogeneia* are intertidal to at most shallow subtidal, *P. inermis* has a reported bathymetric range down to 220m, is suggestive of as yet undifferentiated congeners buried in identifications of that species. The described forms are keyed in the SCB pontogeneid key below.

Diagnosis: " *Body ordinary, compressed, smooth. Rostrum small to large; lateral cephalic lobes ordinary; anteroventral margin of head often weakly produced. Eyes reniform. Antennae subequal, peduncular article 1 of antenna 1 shorter than head, article 2 shorter than article 1; article 3 not or weakly produced; article 1 of primary flagellum ordinary, accessory flagellum absent; calceoli tympanic. Labrum entire, subrounded, as long as broad; epistome unproduced. Molar triturative, columnar, article 2 of mandibular palp unlobed, article 3 scarcely shorter than 2. Labium: inner lobes small. Maxilla 1: inner plate with medial and distal setae, palp long, article 1 short. Maxilla 2: inner plate not broader nor longer than outer, plates narrow, inner plate with facial row of 3 setae .and several other medial setae. Maxilliped: inner*

plate not relatively long, outer plate as long as inner; palp of 4 articles, 4 shorter than 3, 3 weakly lobed, 4 not spinose along inferior margin. Coxae ordinary, coxa 1 not produced anteriorly nor expanded ventrally, coxa 4 with posterior lobe, excavate. Gnathopods alike, small, subchelate, not eusirid, small carpus of both longer than propodus, without posterior lobe, with numerous posterior setae, gnathopods 1-2 slender and slightly elongate in type. Pereopods 3-7 ordinary, simple, dactyls simple, article 2 not anteriorly lobate. Epimeron 3 smooth. Outer rami of uropods 1-2 shortened; rami with lateral and dorsal spines. Uropod 3 ordinary, not extended beyond uropod 1, peduncle without large process, rami lanceolate, subequal or unequal. Telson slightly elongate, cleft, apices without long armaments." (from J. L. Barnard & Karaman 1991)



Tethygeneia longleyi (from Shoemaker 1933)

Tethygeneia – A broadly distributed genus with twelve described species, only one of which occurs in the NEP. Although two other regional species were placed in *Tethygeneia* at one time, they have been transferred to *Nasageneia*, leaving only *T. opata*. The genus is found in more southern waters than most pontogeneids, favoring temperate to tropical climes. Another genus found shallow, with species taken only 0-20m (J. L. Barnard & Karaman 1991). *Tethygeneia opata* is predominantly found in bays, but may occur offshore if flushed from more protected habitus. It is keyed in the SCB pontogeneid key provided below.

Diagnosis: "*Body ordinary, compressed, smooth. Rostrum large, lateral cephalic lobes ordinary, anteroventral margin of head scarcely produced. Eyes reniform. Antennae subequal or 1 shorter than 2, peduncular articles of antenna 1 progressively shorter, article 1 shorter than head, article 3 weakly or not produced; article 1 of primary flagellum ordinary or short, accessory flagellum I-articulate, scale-like or absent; calceoli anthurial. Labrum entire, subrounded, broader than long, epistome unproduced. Molar triturative, columnar, article 2 of mandibular palp unlobed, article 3 shorter than 2. Labium: inner lobes absent. Maxilla 1: inner plate with 5 (4-7) medial-apical setae, palp long, article 1 short. Maxilla 2: inner plate not broader nor longer than outer, inner plate without facial row of setae but with other medial setae, often few, enlarged and weakly submarginal. Maxilliped: inner plate not relatively long, outer plate slightly shorter than inner; palp of 4 articles, 4 slightly shorter than 3, 3 unlobed, 4 not spinose along inferior margin, coxae" ordinary, coxa 1 not or scarcely produced anteriorly nor expanded ventrally, coxa 4 with posterior lobe, excavate.*

Gnathopods diverse, medium, of same size, subchelate, not eusirid, carpus of both much shorter than propodus, only gnathopod2 with strong posterior lobe extending distad, carpus without numerous long posterior setae, propodus rectangular. Pereopods 3-7 ordinary, simple, dactyls simple, article 2 not anteriorly lobate. Epimeron 3 smooth. Outer rami of uropods 1-2.

shortened; rami with lateral and dorsal spines. Uropod 3 ordinary, slightly, extended beyond uropod 1, peduncle without large process, rami lanceolate. Telson ordinary, cleft, without long apical armaments." (from J. L. Barnard & Karaman 1991)

Key to NEP pontogeniid species known from south of Pt. Conception – D. Cadien 17Apr06

1. Epimeron 3 posterior margin serrate.....*Nasageneia* 2
   Epimeron 3 posterior margin sinuous or convex, smooth.....3
2. Anterioventral head corner acute.....*N. nasa* Barnard 1969*
   Anterioventral head corner subacute.....*N. quinsana* Barnard 1964b*
3. Coxae 1-3 bearing small posterioventral tooth; epimera 1-2 lacking oblique ridge extending from anterior margin along ventral margin.....
   .....*Paramoera serrata escofetae* Staude 1995
   Coxae 1-3 lacking posterioventral teeth; epimera 1-2 with oblique ridge extending from anterior margin along ventral margin.....*Pontogeneia* 4
4. Telson lobes rounded, with no definite corner at the cleft.....5
   Telson lobes obliquely truncate, with distinct corner at the cleft.....
   .....*Pontogeneia rostrata* Gurjanova 1938
5. Coxae 1-3 bearing a single large posterior spine; G2 carpus with narrow ventral lobe in both sexes.....*Pontogeneia* (*Tethygeneia*) *opata* Barnard 1959
   Coxae 1-3 lacking posterior spines; G2 carpus lacking narrow ventral lobe.....6
6. Epimeron 3 strongly sinuous with posterioventral corner quadrate, lacking a tooth.....
   .....*Pontogeneia* (*Pontogeneia*) *inermis* (Krøyer 1838)
   Epimeron 3 convex with posterioventral corner bearing a small tooth.....
   .....*Pontogeneia* (*Pontogeneia*) *intermedia* Gurjanova 1938

* in my opinion these two forms cannot be reliably separated, and *N. nasa* should be synonymized with *N. quinsana*. The differences mentioned by Barnard 1979 between them do not seem substantiated by the descriptions and illustrations of the species available. His assertion that one is an embayment form and the other an offshore form when both occur intertidally is absurd.

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