

Amphipoda of the Northeast Pacific (Equator to Aleutians, intertidal to abyss): VII.
Caprelloidea – a review Donald B. Cadien, LACSD 22July04 (revised 20Apr15)

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.

Anthropogenic transport is also constantly introducing exotic species into our area, particularly in this superfamily.

Introduction to the Caprelloidea

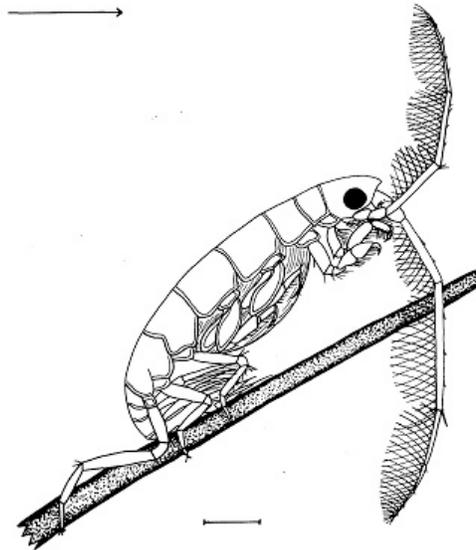
Until recent years the caprellids were viewed as a separate suborder of the order Amphipoda, equivalent to the gammarids and the hyperiids. The discovery of the caprogammarids (Kudrjashov & Vassilenko 1966) began to call this into question (McCain 1968, 1970; Laubitz 1976, J. L. Barnard & Karaman 1983), and, following the revisionary work of Myers and Lowry (2003), they are fully nested into the gammaroids based on morphologically based cladistic analysis of their phylogeny. This position was retained in the larger analysis of Lowry & Myers (2013) which established the senticaudates, to which all of the caprellidians belong. Not all workers are willing to accept the revisions of Myers and Lowry, particularly Stella Vassilenko, who feels that it is inappropriate and based on the wrong evidence (Vassilenko 2006). She feels that caprellids should retain their own separate suborder as Caprellidea, and that Cyamida and Caprellida both should retain infraordinal rank.

Diagnosis of the Caprelloidea

“Head partially or completely coalesced with pereonite 1, triangular, rectangular, or round, with distinct neck region, or free, not coalesced with pereonite 1; lateral cephalic lobe weakly or not extended; eye, if present, situated proximal to lobe; anterior ventral margin not recessed, weakly recessed and moderately excavate, or moderately to strongly recessed and moderately excavate. Antenna 1 peduncular article 3 more than half, usually much more than half, length of article 2 or (secondarily) short, half or less length of article 2. Mandible molar present or absent. Pereonites 6-7 free and orientated ventrally, or fused and orientated posteriorly. Pereonite 7 posterior distal margin not rotated posteriorly, or weakly to strongly rotated posteriorly (Pereopod 7 directed posteriorly). Pereopods 3-4 well developed, reduced to 1 or 2 articles, or absent; bases glandular or nonglandular. Pereopods 5-7 prehensile or not prehensile, dactylus elongated and closing along most of posterior margin of propodus, without accessory spines on anterior margin. Pereopod 7 longer than, subequal to, or shorter than pereopod 6. Pleonite 3 not expanded, or expanded ventrally to form epimeron. Urosomites 1 or 1 and 2 extremely long, urosomite 1 coalesced with urosomite 2 or free; urosomite 2 coalesced with urosomite 3 or free. Uropod 3 peduncle short, length 2 times or less breadth, and parallel sided, or vestigial or absent; uniramous, or without rami. Telson without hooks or denticles.” (Myers and Lowry 2003).

Ecological Commentary

Caprellloideans have a number of important interrelationships with other organisms. The cyamids are pre-eminently ectoparasites of marine mammals, and cannot live separately from their hosts (Martin & Haney 2007). Other groups have relationships that are less close, but may be equally constant. The dulichiid *Dulichia rhabdoplastis* is an obligate associate of red sea urchins. This is a phoretic association, with no apparent trophic linkage; the amphipod living attached to the spines of the host (McCloskey 1970a). He provides extensive observation on the amphipods *in situ*, and their association with the spines is relatively specialized. They construct “rods” of their own fecal matter and detritus which are attached at one end to the tip of a sea urchin spine. The animals lengthen these over time until they extend well beyond the spines themselves. The amphipods live on the rods rather than the spines. Mattson & Cedhagen (1989) note similar rod formation in two *Dyopedos* species, but these were bottom attached, not placed on another organism. They also suggest that *Dulichia tuberculata* builds rods, but is not confined to them, being able to feed from a position sitting on the bottom.



Dyopedos porrectus female in feeding position near the end of her self-constructed rod. Current direction is indicated by the arrow; scale bar = 1mm (from Mattson & Cedhagen 1989)

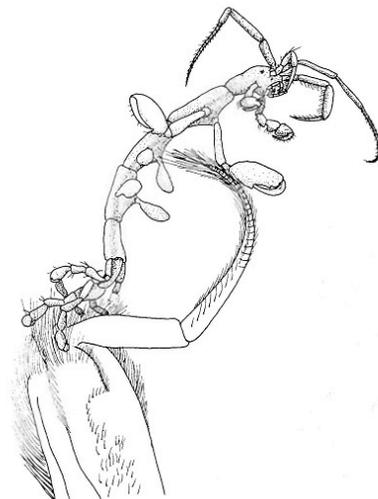
A further phoretic relationship is that of the podocericid *Podocerus cheloniphilus* with the loggerhead sea-turtle *Caretta caretta*. While there is no equivalent behavioral modification here to those seen in *Dulichia rhabdoplastis*, the amphipod seems only to be found on the carapaces of these turtles (Mateus & Afonso 1974, Thomas & Barnard 1992a). As they are very widely distributed (Uetz 2015) its amphipod associate may prove to have a wider distribution than currently known in the Atlantic. They are taken on turtle carapaces, sometimes in high abundance (Chevreux & de Guerne 1888), with no trophic connection to the host. Three amphipods have been described from a turtle phoresy; *Podocerus cheloniae* Stebbing 1888, *P. cheloniphilus* Chevreux & de Guerne 1888, and *P. umigame* Yamato 1992. All three are retained on the current list of valid species in the genus (Lowry 2015a), but all three may actually be the same species. The latter two were taken from loggerhead turtles, and the first from a hawksbill turtle. The

first two have been treated as synonyms, with *P. cheloniae* viewed as immature (Thomas & J. L. Barnard 1992a), and *P. umigame* is scarcely differentiable from *P. cheloniphilus*. Baldinger (2001) and Kilgallen (2009) both follow this synonymy, and I agree that the three species are one.

Caprellids themselves are often carried about on the shells of turtles (*i.e.* *Caprella andreae* on the shell of *C. caretta*; Aoki & Kikuchi 1995), as well as on floating debris, rafting kelp, ships hulls, and logs. Such relationships are adventitious, however, and are non-specific, although both *C. andreae* and *Podocerus cheloniphilus* are much more abundant on carapaces than any other epibiont (Caine 1986). Guerra-García & Figueroa (2009) reported *C. andreae* guts to contain only detritus, demonstrating no trophic connection to the phorant.

The amphipods are highly thigmotactic, and clasp relentlessly whatever substrate they find themselves on. This strong grip has allowed a number of caprellid species to be introduced into broader ranges by human intervention, spreading widely within the ranges of sea-water temperatures they tolerate (Ashton et al 2007). Several have become pests in Europe or here in the NEP, perhaps most notably *Caprella mutica* (Ashton 2006, Ashton et al 2008, Buschbaum & Gutow 2005, Cook et al 2007, Frey et al 2009, Willis et al 2009). Caprellids are often found on hydroid or bryozoan growth, and in some cases these attachment substrates provide food (Alarcón-Ortega et al 2012). They also settle readily on newly exposed surfaces, grow rapidly, and form a suitable substrate for caprellids during distribution by surface rafting.

The caprellid *Caprella unguina* is reported to occur on the carapace of lithodid crabs (Wicksten 1982). The observations of Takeuchi et al (1989) and Baldinger (1992), would suggest that the real point of attachment is the mouthparts, suggesting a kleptoparasitic relationship. The relationship of *Caprella bathytatos* to the majid crab *Macroregonia macrochira* also involves food kleptoparasitism by the amphipod. The caprellids have only been seen on the mouthparts of this crab, clinging to the setae (Martin & Petit 1998). In that position they can steal bits of food as it is consumed by the crab. There seems to be no mutualist benefit for the crab, only a nutritional benefit to the amphipod.



Caprella bathytatos clinging to the 3rd maxilliped of the crab *Macroregonia macrochira*
(from Martin & Petit 1998)

Caprella unguolina and *C. bathytatos* are reasonably close morphologically, and the former has been observed subject to a good deal of morphological variability over its large range (Takeuchi et al 1989). Verdi & Celentano (2008) raise the issue of their possible synonymy. The case for such an action is considerably aided by the report of *C. bathytatos* from a lithodid rather than a majid crab host in the Southwest Atlantic by those authors.

A similar obligate relationship is exhibited by *Caprella grahami*, which lives on the sea star *Asterias rubens*. It is very common on that host, but also is occasionally found on the predatory sea star which feeds on *Asterias*, *Crossaster papposus* (Patton 1968). Caine (1978) reports *Caprella gracilior* as being found on the seastar *Luidia foliolata* in Puget Sound. That observation has not been repeated in the SCB, where the host only occurs in offshore waters sampled by trawling. In the NEP *Caprella greenleyi* was also described from a sea star, and was initially thought to be an obligate associate (McCain 1969). Subsequent collections have demonstrated that there is no association, with the original collection being accidental (Martin 1977). While asteroids are the most common echinoderm associates of caprellids (Jankowski & Vassilenko 1973, Vader 1978, Wirtz & Vader 1996), they have also been recorded in association with holothurians (Wirtz 1998), and the echinoid *Spatangus californicus* (Hendrickx & Ayón-Parente 2014). The host of *Caprella astericola* is *Asterias amurensis*, an invasive seastar in the NEP. As yet no records of the commensal amphipod have come from seastars collected outside the home range in the NWP. The only association documented for the enigmatic Caprogammaridae is between *Caprogammarus gurjanovae* and large busyconid whelks (Takeuchi & Ishimaru 1991).

Associations with cnidarians are common (Vader 1983), but not often specific or exclusive. *Caprella gorgona* is recorded as occurring in association with gorgonian octocorals (Laubitz & Lewbel 1974). While a few specimens have been taken around gorgonians on the bottom, nearly all known specimens have come from gorgonians: primarily *Leptogorgia chilensis*, or *Muricea californica* or *M. fruticosa*. Caprellids have also been reported to occur on ahermatypic corals (McCloskey 1970b).

A single mutualist relationship has been reported between a caprellid and a hydroid (Caine 1998). In this case the caprellid *Paracaprella tenuis* aggressively removes the predatory nudibranch *Tenellia pallida* from the hydroid *Bougainvillia rugosa*. Although this behavior is restricted to only one body length from where the amphipod sits on the hydroid, it still provides protection from predation to the hydroid.

Feeding in caprellids is reportedly through a variety of nutritive modes. The cyamids are true parasites, feeding on the tissues of their host cetaceans. Leung (1976), while noting feeding on host tissues during development, suggests that cyamids also consume the algae growing on the skin surface of the host. Other caprellid groups are more variable in feeding. Podocerids lack spinning glands, and if seen in tubes, have borrowed those of others (Barnard et al 1988). They seem to be all filter feeders, and compete for locations relative to current. The largest individuals seem able to occupy the highest, most exposed, and prime feeding positions (Barnard et al 1988). McCloskey (1970a) reports that *Dulichia rhabdoplastis* also filter-feeds at the end of its self-constructed spine extension. Given that mouthparts are very similar in all members of the genus (Laubitz 1977), it is likely that other species also filter-feed with their setose antennae and gnathopods (see Mattson & Cedhagen 1989). At least during summer

months, however, *D. rhabdoplastis* adopts the “farming” of pennate diatoms which grow on the fecal rods they inhabit. These are groomed and harvested by the amphipods, whose guts are crammed with the diatoms (McCloskey 1970a). So even in seemingly clear cases of filter-feeding, behavioral plasticity probably allows use of other atypical nutrients as available.

Feeding in the caprellids themselves is more diverse than reported for other caprellid groups. Caine (1974, 1977) reports browsing, filter feeding, predation, scavenging, and scraping are all separate nutritive modes which occur among the caprellids. His observations were personally made on live individuals of a number of different species, and his classifications were verified by analysis of stomach contents. The most comprehensive dietary investigation to date is that of Guerra-García & Figueroa (2009) which examined 62 taxa. While the great majority of species were primarily detritivores, a few were specialized predators which fed on one or more groups of animals. Even when evidence of multiple feeding modes for a given species was found, detritivory seemed almost invariantly to be the dominant mode. Detritivory would fall within Caine’s class of scavenging. The characterizations of *C. californica* feeding reported by Keith (1969) and Guerra-García & Figueroa (2009) differ. Keith found a more complex diet among his specimens, while 100% detritivory was reported by the latter workers. The two sources agreed, however, on the diet of *C. equilibra*.

Subsequent investigators have also used analysis of stomach contents for positive identification of nutritive mode (Navarro-Barranco et al 2013). They found the two caprellids examined to be in different categories; *Periambus typicus* was a detritivore, while *Phtisica marina* was an omnivore whose guts contained detritus, algal fragments, and microcrustaceans, combining elements of several of Caine’s categories. Caine (1977) characterized the same species as strictly predatory, while listing most species as having multiple feeding modes. Based on such evidence Ros et al (2014) showed *Caprella scaura* to be a detritivore, while *Paracaprella pusilla* is a predator on microcrustaceans. Both these are invasive species, and variation in diet in different environmental conditions within their broad ranges were also evaluated. It was found to be limited. Patton (1968) investigated the gut contents of the obligate commensal *C. grahmi*, and found it was a detritivore feeding on settled particles caught in the surface secretions of the host sea star. It showed no evidence of feeding on host tissues.

Gut analysis of *Aciconula acanthosoma* showed it to be a scraper/browser, and apparently only of animal substrates (tunicates and sponges) (Chess 1989). Similar scraping activity was observed for *Metaprotella sandalensis* on octocoral cnidarians (Scinto et al 2008). Caprellid activities are normally not harmful to larger animals, but at least one case in which a bloom of amphipods led to catastrophic death in seafans has been reported in the literature (Scinto et al 2008). The amphipods were classed as scraper/grazers, and their feeding removed enough of the coenenchyme of the octocorals to lead to their deaths. The infestation of amphipods was just too dense for the cnidarians to tolerate. This is a very unusual, possibly unique, occurrence. Observations of severely damaged octocorals with much of their tissue removed are not uncommon, even in local waters, so perhaps involvement of caprellids may not be as rare as current reports suggest.



Metaprotella sandalensis swarming on the octocoral *Mellithea* sp. Feeding activities of the scraping grazer amphipods led to the death of large numbers of seafans (from Scinto et al 2008)

Predation on caprelloids is primarily due to fishes (Caine 1989), although Mattson & Cedhagen (1989) also report predation by a polychaete. Chess (1989) reports finding *Aciconula acanthosoma* in the guts of cottids, embiotocids, clinids, labrids, pomocentrids, and gobiids, but not as a preferred prey. Mattson & Cedhagen (1989) report that *Dyopedos* were found in the guts of 12 of 16 trawled fishes taken in their study area. They made up 9% of the identifiable food items in the examined guts. The only species not feeding on them were pelagic rather than demersal. They also reported well developed escape response of amphipod flight to the base of their rods in response to fish approach.

All caprelloids are dependent on the ability to maintain position; on a host, on a specially constructed feeding structure, or on a substrate. This thigmotaxis is exercised by all pereopods in the more compact families Cyamidae, Podoceridae and Dulichiidae, but by the last two or three in Caprellidae. A number of genera have the fifth leg strongly reduced or even absent, and thigmotaxis is performed by the 6th and 7th pereopods. In some deep living caprellids the posterior pereopods are spread umbrella fashion to provide more diffuse attachment in the soft bottom sediments (Corbari et al 2005). Most shallow water caprellids have robust dactyls on the last three pereopods, which close between one or more pairs of “grasping spines” (Laubitz 1970) preventing lateral sliding and forming a lock for the closed dactyl. Once the dactyl is closed over an object, usually a thin algal portion, or part of a cnidarian or branching ectoproct, a very strong holding ability is exercised. Dislodgement by currents in shallow wave-swept habitat, which the majority of species occupy, becomes very difficult giving the animal positional stability (Caine 1978, 1989). The nature of this has been examined by Takeuchi & Hirano (1995).

Caprellids can swim, albeit in a jerky ungainly fashion, by flexion of their long slender bodies. This is aided by the setosity of the antennae in many, but not all, caprellids. In the rare instances of dislodgement, swimming is rapid and vigorous, and

designed to return the animal to its initial position. Not all animals in the water column are swimming, however. Thiel (1998) reported on collections of pelagic *Dyopedos monacanthos* that were passive drifters in currents. The make-up of this drifting contingent varied over the year. During spring most were new recruiting juveniles leaving the whips of their mother; later in the year larger individuals adopted the drift method of finding a new location. In cases where the hold on the substrate is intentionally relinquished, swimming may be more protracted as the animal seeks a better feeding position, or one more protected from predators.

A similar escape from predators may be the impetus for the single report of mimicry in a podoceric amphipod. *Podocerus cristatus* is reputed to mimic the sea slug *Flabellina trilineata*, which is protected by the stolen cnidoblasts of its hydroid prey (Goddard 1984). This Batesian mimicry may deter some visual predators that have learned to avoid the protected nudibranch.

List of NEP caprelloids based on McLaughlin et al (2005) with addition of newly described and known provisional taxa *= taxa included in Edition 9 of the SCAMIT Taxonomic Listing (Cadien & Lovell 2014). Valid taxa are **bolded**, synonyms not

Family Caprellidae

Subfamily Caprellinae

Abyssicaprella galathea McCain 1966 – Costa Rica to Peru: 3501-4004m

Abyssicaprella sp B of Benedict 1978§ - SCB: depth?

***Abyssicaprella sp LA1** Cadien 2014§ - Off Palos Verdes: 151m

***Aciconula acanthosoma** Chess 1989 – SCB to Nyarit, Mexico: 1-25m

Aeginella hirsuta La Follette 1915 (see *Tritella pilimana*)

Cancer linearis Linnaeus 1767 (see *Caprella linearis*)

Caprella acanthogaster humboldtiensis Martin 1977 (= *Caprella mutica*)

Caprella acutifrons of La Follette 1915 (see *Caprella penantis*)

***Caprella alaskana** Mayer 1903 – Alaska to Central California: depth?

Caprella alaskensis Holmes 1904 – (see *C. borealis*)

Caprella angusta of authors NEP, not Mayer 1903 (see *C. natalensis*)

Caprella anomala Mayer 1903 – Japan; SE Alaska to Monterey, California: 0-100m

Caprella bathytatos Martin and Pettit 1998 – British Columbia, Uruguay: 600-2201m

Caprella borealis Mayer 1903 – Japan, Kamchatka to Washington: 0m

***Caprella brevirostris** Mayer 1903 – SCB to Gulf of California, Mexico: 0m

Caprella calderoni Hendrickx & Ayon-Parente 2014 – Northern Gulf of California, Mexico: 270-415m

***Caprella californica** Stimpson 1857 – Iceland, Denmark, Sweden, Norway, South Africa, Hong Kong, Korea, Japan; Alaska to Cabo San Lucas, Baja California, Mexico; Chile: 1.1-111m

Caprella ciliata G. O. Sars 1883 – Iceland, Denmark, Sweden, Norway; Alaska: 957-1838m

Caprella constantina Mayer 1903: Aleutians: 15-73m

Caprella cristibrachium Mayer 1903 – Kuriles , Okhotsk and Kamchatka;
Bering Sea to Bristol Bay, Alaska: 16-38m

Caprella drepanochir Mayer 1890 – Russia, Japan, China; Bering Id to San Francisco Bay, Central California: 0-4m

***Caprella equilibra** Say 1818 – nearly cosmopolitan in temperate and tropical seas, NEP western Canada to Chile: 0-145m

Caprella ferrea Mayer 1903- Alaska to Central California: depth?
Caprella geometrica of La Follette 1914 (see Caprella penantis)

***Caprella gorgonia** Laubitz & Lewbel 1974 – La Jolla, California: 20-23m

***Caprella gracilior** Mayer 1903 – Russia, Arctic Ocean; Alaska to SCB: 0-1750m

Caprella greenleyi McCain 1969 – Boiler Bay Oregon to Trinidad, Northern California: 0-2m

***Caprella incisa** Mayer 1903 – Southern Alaska to California: 0-15m

Caprella irregularis Mayer 1890 – Korea; Alaska to Washington: 11-183m

***Caprella kennerlyi** Stimpson 1864- Alaska to SCB : 0-20m

***Caprella laeviuscula** Mayer 1903 – Japan; Alaska to SCB: 0-61m

Caprella linearis (Linnaeus 1767) – NE Atlantic, NW Atlantic, Arctic Atlantic and Pacific, Russia, sea of Japan; Aleutians to Gulf of Alaska: 1-360m

***Caprella mendax** Mayer 1903 – British Columbia to SCB: 3-172m

Caprella mercedesae Hendrickx & Ayon-Parente 2014 – Northern Gulf of California, Mexico: 260-309m

***Caprella mutica** Schurin 1935 – Europe, western Atlantic, Russia, Japan, New Zealand; Humboldt Bay to SCB: 0-152m

***Caprella natalensis** Mayer 1903 – Circumglobal?; British Columbia to SCB: 0-123m

Caprella paulina Mayer 1903 – Bering Sea, Aleutians: 0-23m

Caprella penantis Leach 1814 – Eastern and Western Atlantic, Australia, New Zealand, Japan, Hong Kong; Bering Sea to Monterey, Central California: 0m

***Caprella pilidigita** Laubitz 1970 – British Columbia to the SCB: 0m

Caprella pilipalma Dougherty and Steinberg 1953- Monterey, Central California: 0m

Caprella pitu Sánchez-Moyano et al 2014 – Central West Mexico: 3-25m

Caprella pustulata Laubitz 1970 – Prince William Sound, Alaska to Washington: depth ?

Caprella rudiuscula Laubitz 1970 – Yakutat Bay, Alaska to Vancouver Id., British Columbia, Canada: depth ?

Caprella scabra Holmes 1904 – Prince William Sound, Alaska: depth?

***Caprella scauroides** Mayer 1903 – China, Japan, Australia; SCB (introduced): depth?

Caprella septentrionalis La Follette 1914 not Krøyer 1838 (see Caprella brevirostris)

***Caprella simia** Mayer 1903 – Japan; San Francisco to San Diego; 0-4m

Caprella striata Mayer 1903 – Alaska to Washington: 13-275m

- Caprella unguina** Mayer 1903 – British Columbia to Tierra del Fuego: 500-1000m [on lithodid crabs]
 Caprella uniforma La Follette 1915 (=Caprella natalensis)
- ***Caprella verrucosa** Boeck 1872 – Japan; British Columbia, Canada to Coquimbo, Chile: 0-6.9m
- ***Caprella sp E** Benedict 1978§ - SCB: 30m
- Caprella sp LA1** Haney 200?§ - off Palos Verdes: 23m
- ***Deutella californica** Mayer 1890 – Prince William Sound, Alaska to Northern Gulf of California, Mexico: 15-60m
- ***Deutella venenosa** Mayer 1890 – SCB; Coquimbo, Chile: 0-5m
- Liropus isabelensis** Sánchez-Moyano et al 2014 – Central West Mexico: 25m
- Liropus minusculus** Guerra-García & Hendrycks 2013 -
- ***Mayerella acanthopoda** B. R. Benedict 1977 – SCB: 2-17m (?107m)
- ***Mayerella banksia** Laubitz 1970 – Alaska to SCB: 3-333m
- Metacaprella anomala (Mayer 1903) (see Caprella anomala)
- Metacaprella ferrea (Mayer 1903) (see Caprella ferrea)
- Metacaprella kennerlyi (Stimpson 1864) (see Caprella kennerlyi)
- Paracaprella barnardi** McCain 1967 – Panama: 0-1m
- Paracaprella carballoi** Sánchez-Moyano et al 2014 – Central West Mexico: 1-25m
- Paracaprella isabelae** Sánchez-Moyano et al 2014 – Central West Mexico: 3-6m
- ***Paracaprella sp SD1** Pasko 2000§ - Off La Jolla: 88m
- Paracaprella sp SPARWAR1 Phillips 2015§ - San Diego Bay: 2-5m
- Pseudoliropus vanus** Laubitz 1970 – Queen Charlotte Ids., Canada: 1200m
- Triantella sp A Haney 2005§ (= Tritella tenuissima)
- Tritella laevis** Mayer 1903 – Vancouver Id., British Columbia, Canada to SCB: 0-96m
- ***Tritella pilimana** Mayer 1890 – Alaska to SCB: 0-188m
- ***Tritella tenuissima** Dougherty and Steinberg 1952 – Monterey Bay, Central California to the SCB: 169-1166m
- “Tritellopsis” sp A of Benedict 1978§ - SCB: depth ?
- “**Urilops**” sp B of Benedict 1978§ - Cascadia Slope, Oregon to off Pt. Loma: 378-952m
- Subfamily Paracercropinae
- Cercops compactus** Laubitz 1970: Alaska to Cape Arago, Oregon: 0m
- Paracercops setifer** Vassilenko 1972:NEP: depth?
- Subfamily Phtisicinae
- ***Hemiproto sp A** Benedict 1978§- Central California to SCB – 7-151m
- Hemiproto wigleyi of Watling 1995 not McCain 1968 (see Hemiproto sp A)
- Paedaridium breve La Follette 1915 (see Perotripus brevis)
- ***Perotripus brevis** (La Follette 1915) – Alaska to Laguna Beach, California: 0-109m
- Phtisica marina** Slabber 1769 – Northeast, Northwest, and Southeast Atlantic, Caribbean, Brazil; SCB: 0-888m
- Family Caprogammaridae – no NEP representatives

Family Cyamidae [distributional data on this family is not provided, as it is completely dependent on the hosts, which are in most cases found in several oceans if not worldwide]

Cyamus bahamondei Buzeta 1963 – West Coast of Baja California to Iquique, Chile; on sperm whales

Cyamus balaenopterae K. H. Barnard 1931 – World-wide, except in polar oceans: on blue, Minke and fin whales

Cyamus boopis Lütken 1870 – World-wide: on sperm and humpback whales

Cyamus catodontis Margolis 1954 – World-wide, except in polar oceans: on sperm whales

Cyamus ceti (Linnaeus 1758)

Cyamus delphinii Guérin-Méneville 1836 (see *Isocyamus delphinii*)

Cyamus erraticus Roussel de Vauzème 1834

Cyamus eschrichtii Margolis, McDonald, and Bousfield 2000

Cyamus gracilis Roussel de Vauzème 1834

Cyamus kessleri Brandt 1872

Cyamus mesorubraedon Margolis, McDonald, and Bousfield 2000

Cyamus monodontis Lütken 1870

Cyamus nodosus Lütken 1860

Cyamus orubraedon Waller 1989

Cyamus ovalis Roussel de Vauzème 1834

Cyamus physeteris Pouchet 1888 (see *Neocyamus physeteris*)

Cyamus scammoni Dall 1872

Isocyamus delphinii (Guérin-Méneville 1836)

Isocyamus kogiae Sedlak-Weinstein 1992

Neocyamus physeteris (Pouchet 1888)

Oniscus ceti Linnaeus 1758 (see *Cyamus ceti*)

Platycyamus flaviscutatus Waller 1989

Family Dulichiidae

Dulichia arctica Murdoch 1884 (see *Dyopedos arcticus*)

Dulichia bispina Gurjanova 1930 (see *Dyopedos bispinis*)

Dulichia falcata (Bate 1857) – North Atlantic, Arctic, Beaufort Sea, Japan; Aleutians: 16-682m

Dulichia monacantha Metzger 1875 (see *Dyopedos monacanthus*)

Dulichia remis J. L. Barnard 1965 (see *Dulichiosis remis*)

****Dulichia rhabdoplastis*** McCloskey 1970- Prince William Sound, Alaska to Monterey Bay, Central California: 0-25m

Dulichia unispina Gurjanova 1951 (see *Dyopedos unispinis*)

***Dulichia* sp.** of Chapman 2007 – San Francisco Bay (introduced): 1-3m

Dulichiosis abyssii (Stephenson 1944) – Arctic Basin to Cascadia Abyssal Plain, Oregon: 763-2820m

Dulichiosis barnardi Laubitz 1977 – Alaska: 882m

****Dulichiosis remis*** (J. L. Barnard 1964) – Near Islands, Alaska to SCB: 586-881m

Dyopedos arcticus (Murdoch 1884)- Western North Atlantic, Arctic, Beaufort Sea; Alaska to SCB: 3-410m

Dyopedos bispinis (Gurjanova 1930) – North Atlantic, Arctic, Bering Sea, Gulf of Alaska, British Columbia: 10-75m

***Dyopedos monacanthus** (Metzger 1875) - NE and NW Atlantic; Alaska to Pt. Conception, California: 20-326m

Dyopedos unispinis (Gurjanova 1951) –Bering Sea: 25m

Dyopedos sp 1 of Thomas & McCann 1995 – off Purissima Point, Central California: 410m

Paradulichia typica Boeck 1870 – North Atlantic, Arctic, Chukchi & Berents Seas, Bering Sea, Aleutians?:60-1102m

Family Podoceridae

Cyrtophium cristatum Thompson 1879 (see *Podocerus cristatus*)

Platophium brasiliense Dana 1853 (see *Podocerus brasiliensis*)

***Podocerus brasiliensis** (Dana 1853) –“Cosmopolitan” in temperate and tropic waters: 0-24m

***Podocerus cristatus** (Thompson 1879) – Australia, New Zealand, West Africa; California south to Magdalena Bay, Baja California, Mexico: 0-100m

***Podocerus fulanus** J. L. Barnard 1959 – SCB: 1.1-5.5m

Podocerus spongicolus Alderman 1936 – Northern California: 4m

Comments by Family

Family Caprellidae – A very large family of amphipods, divided into three subfamilies, all of which are represented in the NEP fauna (De Broyer 2015). The largest of these, the Caprellinae, contains 58 genera worldwide. Of these ten occur in our region; *Abyssicaprella*, *Aciconula*, *Caprella*, *Deutella*, *Liropus*, *Mayerella*, *Metacaprella*, *Paracaprella*, *Pseudoliropus*, and *Tritella*. The genus *Triliropus* may also be present if a potential species reassignment is followed. In addition, several provisional species erected by Bruce Benedict in the 70’s based on the Bureau of Land Management collections in the SCB probably represent new genera. The second subfamily, Paracercopinae, has only a single regional species in each of two genera. The third, the Phtisicinae, is more diverse in our area, with representatives of *Hemiproto*, *Phtisica*, and *Perotripus*. By far the greatest regional diversity is in the genus *Caprella*, which has 40 species (including 2 provisionals) reported as occurring in the NEP.

Description: “**Head** free, not coalesced with peraeonite 1, or partially or completely coalesced with peraeonite 1; exposed; as long as deep, or longer than deep; anteroventral margin straight or concave, anteroventral corner subquadrate; rostrum present or absent, short; eyes present, well developed or obsolescent, or absent; not coalesced; 1 pair; bulging, or not bulging. Body cylindrical; cuticle smooth, or processiferous.

Antenna 1 subequal to antenna 2, or longer than antenna 2; peduncle with sparse robust and slender setae; 3-articulate; peduncular article 1 shorter than article 2, or subequal to article 2; antenna 1 article 2 subequal to article 3, or longer than article 3; peduncular articles 1-2 not geniculate; accessory flagellum present, or absent; antenna 1 callynophore absent. *Antenna 2* present; short; articles not folded in zigzag fashion;

without hook-like process; flagellum shorter than peduncle; less than 5-articulate; not clavate; calceoli absent.

Mouthparts well developed. Mandible incisor dentate; lacinia mobilis present on both sides; accessory setal row without distal tuft; molar present, medium, triturtative; palp present. Maxilla 1 present; inner plate absent; palp present, not clavate, 2-articulate. Maxilla 2 inner plate present; outer plate present. Maxilliped inner and outer plates well developed or reduced, palps present, well developed or reduced; inner plates well developed, separate; outer plates present, small; palp 4-articulate, article 3 without rugosities. Labium smooth.

Peraeon. Peraeonites 1-7 separate; complete; sternal gills absent; pleurae absent.

Coxae 1-7 vestigial or absent, none fused with peraeonites. Coxae not acuminate. Coxae 1-3 not successively smaller, none vestigial. Coxae 2-4 none immensely broadened.

Gnathopod 1 not sexually dimorphic; smaller (or weaker) than gnathopod 2; gnathopod 1 merus and carpus not rotated; gnathopod 1 carpus/propodus not cantilevered; shorter than propodus; gnathopod 1 not produced along posterior margin of propodus; dactylus large. Gnathopod 2 not sexually dimorphic; subchelate; ischium short; merus not fused along posterior margin of carpus or produced away from it; carpus/propodus not cantilevered, carpus short, shorter than propodus, not produced along posterior margin of propodus.

Peraeopods 3-4 absent, 5-7 directed anteriorly, some or all prehensile. Peraeopod 3 small, or absent. Peraeopod 4 small, or absent. 3-4 not glandular; 3-7 without hooded dactyli, 3-7 propodi without distal spurs. Coxa well developed. Not acuminate. Peraeopods 5-7 with few robust or slender setae; dactyli without slender or robust setae. Peraeopod 5 well developed; subequal in length to peraeopod 6; basis slightly expanded or linear, subrectangular, without posteroventral lobe; merus/carpus free; carpus weakly expanded; setae absent. Peraeopod 6 shorter than peraeopod 7; merus/carpus free; dactylus without setae. Peraeopod 7 with 6-7 well developed articles; longer than peraeopod 5; similar in structure to peraeopod 6; with 7 articles; basis expanded or slightly expanded, without dense slender setae; dactylus without setae.

Peraeopods 3-4 absent, 5-7 directed anteriorly, some or all prehensile. Peraeopod 3 small, or absent. Peraeopod 4 small, or absent. 3-4 not glandular; 3-7 without hooded dactyli, 3-7 propodi without distal spurs. Coxa well developed. Not acuminate. Peraeopods 5-7 with few robust or slender setae; dactyli without slender or robust setae. Peraeopod 5 well developed; subequal in length to peraeopod 6; basis slightly expanded or linear, subrectangular, without posteroventral lobe; merus/carpus free; carpus weakly expanded; setae absent. Peraeopod 6 shorter than peraeopod 7; merus/carpus free; dactylus without setae. Peraeopod 7 with 6-7 well developed articles; longer than peraeopod 5; similar in structure to peraeopod 6; with 7 articles; basis expanded or slightly expanded, without dense slender setae; dactylus without setae.

Pleon. Pleonites 1-3 without transverse dorsal serrations, without dorsal carina; without slender or robust dorsal setae. Epimera 1-3 absent.

Urosome not dorsoventrally flattened; urosomites 1 to 3 coalesced; urosomites 1-2 without transverse dorsal serrations. **Uropods 1-3 reduced to one vestigial pair.** Uropod 2 absent.” (Lowry and Springthorpe 2001).

Key to NEP Caprellid genera – dbcadien 17Apr2015 (based on Laubitz 1970)

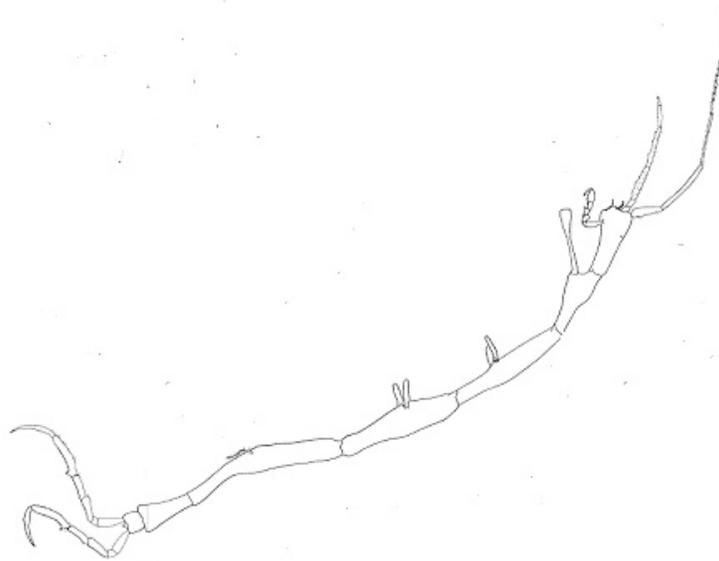
1. Gills on pereonites II, III, and IV; mandibular molar absent.....2♦
Gills on pereonites III and IV; mandibular molar present.....Caprellinae 6
2. Pereopod 3 one-segmented; abdomen five segmented.....Paracercopinae 3
Pereopod 3 of three or more segments, abdomen minute.....Phtisicinae 4
3. With two pairs of uropods.....Cercops
With only a single pair of uropods.....Paracercops
4. Pereopods 3 and 5 of 3 segments, pereopod 4 of 1 segment.....Perotriopus
Pereopod 3 and 4 six-segmented, pereopod 5 of 5 segments.....5
5. Male abdomen with 2 pair long biarticulate appendages.....Phtisica
Male abdomen with 2 pair short uniarticulate appendages.....Hemiproto
6. Rudimentary pereopods present on pereopods 3 & 4.....7
No rudimentary pereopods present on pereopods 3 & 4.....Caprella
7. Antenna 2 bearing swimming setae.....Tritella*
Antenna 2 lacking swimming setae.....8
8. Pereopods 3 & 4 one-segmented.....9
Pereopods 3 & 4 two-segmented.....12*
9. Pereopod 5 one-segmented.....”Tritellopsis”
Pereopod 5 with 2-3 segments.....10*
10. Antenna 1 & 2 with tuberculate peduncles.....”Urilops”
Antennal peduncles smooth, lacking tubercles or knobs.....11
11. Mandibular palp article 3 setation pattern $x+y+1$Pseudoliropus♦
Mandibular palp article 3 setation pattern $1+X+1$Liropus
12. Pereopod 5 of two or three articles.....Mayerella*
Pereopod 5 of 5-6 articles.....13
13. Pereopod 5 of five articles.....Abyssicaprella
Pereopod 5 of six articles.....14
14. Pereopod 5 full sized, robust, like 6 & 7.....Paracaprella
Pereopod 5 reduced, smaller and more delicate than 6 & 7.....15
15. Pereopod 5 soft, flexible, setose, nearly the length of 6 & 7.....Aciconula
Pereopod 5 like 6 & 7, but much smaller.....Deutella*

*- These three genera have variability in the cited character. For *Tritella*, all members of the genus have swimming setae except *T. tenuissima*, which probably needs to be transferred to the genus *Triliropus* in consequence. For *Mayerella*, all members of the genus have three articles in Pereopod 5 except *M. acanthopoda*. If the number of articles is allowed to fluctuate here, *M. acanthopoda*, which otherwise conforms to *Mayerella*, can be retained. Otherwise a new genus will be required for that species. In *Deutella*, all members have two articles to the Pereopods 3 & 4, except *D. venenosa*. During his 2003 review of the genus Guerra-García reexamined Mayer’s species, and found it to have only a single article in P3 and P4. Mayer’s original description recorded two, but the redescription reported one. Since all other aspects of the species matched Mayer’s species, this makes the biarticulate vestigial legs of *Deutella* variable, and includes uniarticulate ones. It is difficult to imagine that Mayer, who otherwise was very precise in his descriptions, got this wrong. The animals described were from the same locality,

and those used in the redescription included hundreds of specimens of both sexes. We can only conclude that article number is not definitive for the genus as a whole after all. This also appears to be true of *Liropus*, where all members have 2 articles in P5, except *L. nelsonae*, which has 3, and *L. minusculus*, which has 1. It would appear that within the Caprellinae, the number of articles in the pereopods cannot be used as a criterion character to define the genus, but can summarize the tendency within the genus.

◆- The genus *Pseudoliropus* in the Caprellinae is reputed to lack a molar. It was based on very limited material, and the description may be in error. It lacks gills on pereonite 2, and otherwise more closely resembles Caprellinae than Phtiscinae.

Subfamily Caprellinae -



Abyssicaprella galathea (from McCain 1965)

Abyssicaprella – The monotypic type and two additional provisional taxa all occur within the NEP, making this a regionally endemic genus. While the type is abyssal, the two provisional forms have been taken at shelf and upper slope depths. Individuals of this genus appear either to be rare, or to occupy difficult to sample habitats. The three species can be distinguished on the basis of the position of attachment and nature of fifth leg development.

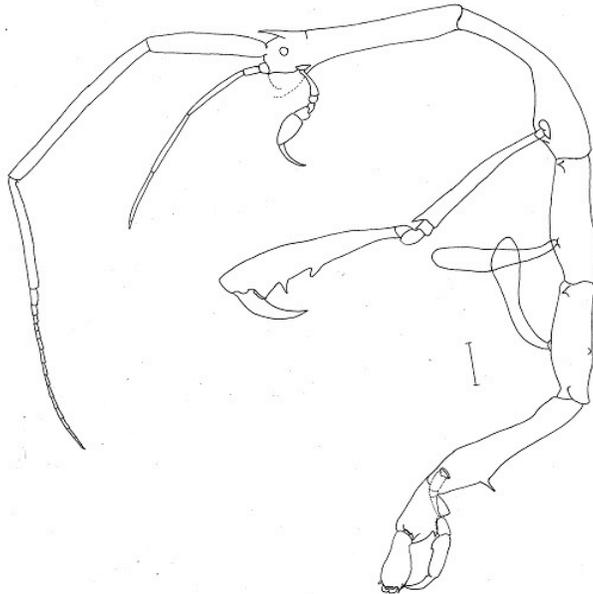
Diagnosis: “Swimming setae absent; mandible with 3-jointed palp, setal formula for terminal article $I-x-y-I$; inner lobe of maxilliped half as long as outer; gills on pereonites 3 and 4; pereopod 3 2-jointed; pereopod 4 2-jointed; pereopod 5 5-jointed (= Mayer's 4 1/2); abdomen of male with 1 pair of appendages and a pair of raised knobs (= Mayer's 11/2 pair) female with 1 pair of appendages.” (from McCain 1965)



Aciconula acanthosoma female and male. Scale bar = 1mm (from Sánchez-Moyano et al 2009)

Aciconula – A small genus of four species widely distributed in the world ocean, with a single representative known from the NEP. The other three are from the southwest Atlantic, the western Pacific, and Australia. The presence of well-developed male abdominal lobes separates *A. acanthosoma* from the remaining species, although Guerra-García (2004) retained it (apparently with some misgivings) in the genus. All members are from shallow water, typically occurring on hydroids or other branching substrates in or on turfs.

Diagnosis: “Flagellum of antenna 2, 2-segmented; pereopods 3-4, 2-segmented, pereopod 5 abnormal for caprellids, being long, soft and flexible, and 6-segmented; gills on pereonites III and IV; mandibular palp 3-segmented; abdominal appendages of female 1 with a pair of simple lobes.” (from Arimoto 1976)



Caprella californica male. Scale =1mm (from Laubitz 1970)

Caprella – An immense world-wide genus containing 183 taxa currently viewed as valid (Lowry 2015c). This number is approximate for several reasons: 1) description of

new taxa in the genus is nearly continuous; 2) it takes time to fully evaluate older species for synonymy with the newly diagnosed forms; 3) some species remain listed under several genera, and 4) some generic distinctions are under debate, such as whether or not *Metacaprella* is a valid generic taxon. If it is rejected, its members would revert to *Caprella*. In the NEP, where both *Metacaprella* and *Caprella* occur together, this issue affects the fauna attributed to *Caprella*. Currently we follow Watling & Carlton (2007) rather than Lowry (2015b), synonymizing *Metacaprella*. We have records of 2 provisional species, as well as 38 described species of *Caprella* from the NEP. There is no comprehensive key to all these taxa available, although that of Watling & Carlton (2007) covers the majority of the species from the NEP. For some of the northern species the keys of Laubitz (1972) or of Vassilenko (2006), are useful, but each is focused on areas outside the NEP. A number of forms from the Arctic and subarctic NEP are included in one or both of these works. No substantiation for the occurrence of *C. septentrionalis* in the North Pacific (suggested by McLaughlin et al 2005) could be found, and the species is not considered part of the NEP fauna here.

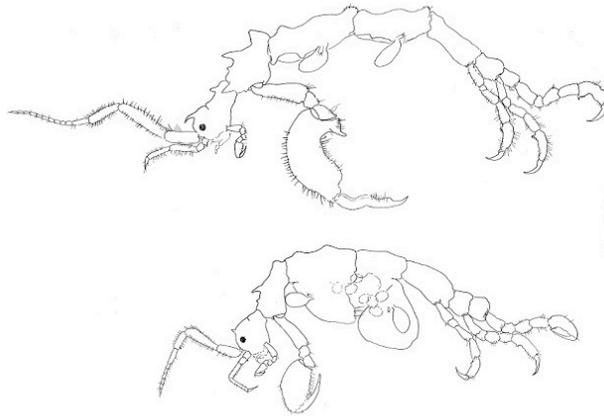
A number of *Caprella* species approach each other quite closely, and are variable in many characters, leading to frequent confusion and unreliable distributional information. Case in point is the identification of *C. californica* and *C. scauroides* (Takeuchi & Oyamada 2013). While *C. californica* is usually viewed as relatively easy to identify, it has been confused in the past with *C. scauroides*, which was not viewed as a valid species for many years. Reinvestigation showed the two to co-occur in parts of their overlapping ranges, calling into question many previous identifications of only *C. californica* from those areas. During a recent SCAMIT meeting specimens identified as *C. scauroides* from San Diego were reviewed. They corresponded well to the redescription provided by Takeuchi & Oyamada in many respects, while differing in others. The examined specimens seemed to represent a “mosaic” of character states of the two taxa, throwing their separability further into doubt when based solely on morphology. Ontogenic change also leads to confusion. Laubitz (1970) for instance, views the *C. alaskensis* of Holmes 1904 as only a large male of *C. borealis* Mayer 1903. Given the unavailability of Holmes’ specimen for further examination, some, including Lowry (2015c), retain the species as separate. We find Laubitz’ arguments sufficient and synonymize the two.

Some invasive species which have been widely distributed by man are also not readily separable from local taxa, and are overlooked for many years following their introduction. *Caprella mutica* is sufficiently different from the most other caprellids that it is recognized as non-native, although perhaps not as *C. mutica*. When encountered in Northern California it was described as a new subspecies of *C. acanthogaster* (Martin 1977). The first specimens I encountered of this animal in southern California (in 2003) were also tentatively referred to as *Caprella cf. acanthogaster*. It was included as a new record for the area in Bruce Benedicts draft caprellid key (1978), but never published by Bruce. The first published record of the species in the NEP is that of Carlton (1979) from San Francisco Bay. Marelli (1981) recognized Martin’s 1977 subspecies as *C. mutica*, and provided a description of the species.

Other species are not so blatantly different. *Caprella simia* is similar to *C. californica* in a number of respects, and went unnoticed among them for some time after their first penetration of the SCB. Both these invaders are treated in Watling & Carlton

(2007), and can be distinguished from native forms using their key. Similarly confusion still persists about the boundaries between *Caprella penantis*, *C. acutifrons*, *C. natalensis*, and *C. drepanochir*, all of which share a variety of characters. Their separation remains an area of active debate. As some are both introduced, and variable in their morphology, species described from points within their range are often later synonymized. These decisions are, however, often reversed once more information and/or material becomes available. Eventually molecular investigations will begin to tease apart some of these species complexes and allow reliable characterization of their members (i.e. Cabezas et al 2013)

Diagnosis: “*Antenna 2 usually with swimming setae, flagellum biarticulate; mandibular palp absent; molar present; outer lobe of maxilliped larger than, or equal to, inner lobe; gills on pereonites III and IV; pereopods 3 and 4 absent; pereopod 5 six-segmented; abdomen of male with one pair of appendages and one pair of lobes, of female with one pair of lobes.*” (from Laubitz 1970)



Deutella venenosa female and male (from Guerra-García 2003)

Deutella – A widely distributed genus of 12 described species. A generic revision was recently published by Guerra-García (2003), which contained a key to the known species. Unfortunately only eight of the twelve species are included in his key, as three species descriptions were in press, and an additional taxon was discovered in 2006 (Guerra-García et al 2006). Both of the forms known from the Northeast Pacific are included in the key, however, which can be used for their separation. It is worth noting that in his redescription of Mayer’s 1903 species *D. venenosa*, Guerra-García found different numbers of articles in Pereopods 3 and 4 than described by Mayer. Normally these article counts are invariable within a species, but the other aspects of the specimens convinced Guerra-García that this was indeed Mayer’s taxon, especially as his specimens were taken from the type locality. The article count did not vary in the several hundred specimens he examined.

The most frequently occurring NEP species is *Deutella californica*, which can be relatively abundant on occasion. The second species, *D. venenosa*, is much less common, and tends to be taken around the islands rather than on the mainland shelf of the Southern California Bight. Its range into California waters, with no intervening records between them and Coquimbo, Chile (type locality) remains puzzling. A photograph of a recently collected male specimen identified as *D. venenosa* was sent to Dr. Guerra-García, who

found it to match well with that species, especially in the unusual configuration of lateral flanges on pereonites 2, 3 and 4 (pers comm, 7 February 2015). Some species of *Paracaprella* also bear lateral tubercles and/or flanges on these segments, but have the mandibular palp strongly reduced or absent altogether. The palp in *D. venenosa* is robust and three segmented, and it was so in the photographed specimen. Both the local forms are colorful, with brown pigment blotches on a lighter ground. The pigmentation of *D. venenosa* is typically both darker and denser than that of *D. californica*. The head spine of both these species exhibit variability in size, in acuteness, and in orientation. Those of most *D. californica* are sharp, slightly curved, and point slightly forward rather than being vertical. Variability does not extend to number, and all specimens examined to date had a single rather than a double spine.

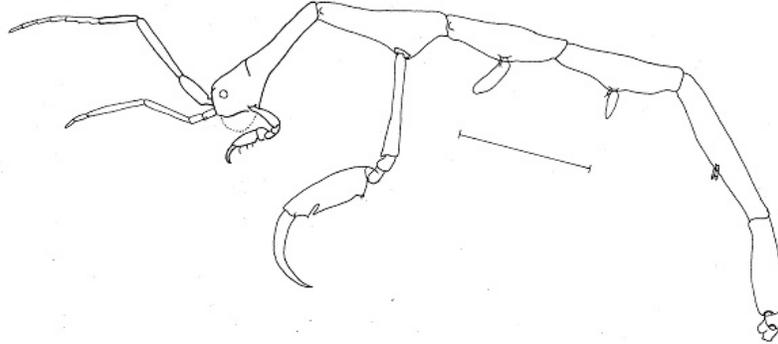
Diagnosis: “Antenna 2 without swimming setae, flagellum biarticulate; mandibular palp triarticulate, setal formula for terminal article 1 +X +1 ; molar present; outer lobe of maxilliped larger than inner lobe; gills on pereonites III and IV; pereopods 3 and 4 two-segmented, pereopod 5 six-segmented, inserted at posterior end of pereonite V; abdomen of male with one pair of non-segmented appendages and one pair of setose lobes, of female with one pair setose lobes.” (from Laubitz 1970)

Liropus – A ten member genus which until recently was not known from the NEP. There are now two described species from the region; *L. isabelensis* from central West Mexico, and *L. minusculus* from southern California. The remaining forms are distributed in the NWP (Japan), Brazil, and the temperate/subtropical Eastern Atlantic/Mediterranean. A key to the genus is presented by Guerra-García & Hendrycks (2013), which includes all but one species. All are included in a comparative character table presented by Sánchez-Moyano et al 2014, which allows differentiation of the two regional species. Unfortunately no character is listed for females of the two species, although males can be separated by the presence of anterolateral spines on Pereonite 3 and 4 in *L. minusculus* and their absence in *L. isabelensis*.



Liropus minusculus female and male (from Guerra-Garcia & Hendrycks 2013)

Diagnosis: *A2 flagellum with 2 arts. Mandibular palp with 3 arts. Mxp inner plate = 1/3 of outer. Anterior oostegites ciliated. P3-4 reduced to a little l-articulate prominence at the base of gills. P5 with 2 arts. P6-7 normal. Posterior pleopods rudimentary in both sexes.*” (from Krapp-Schickel 1993)



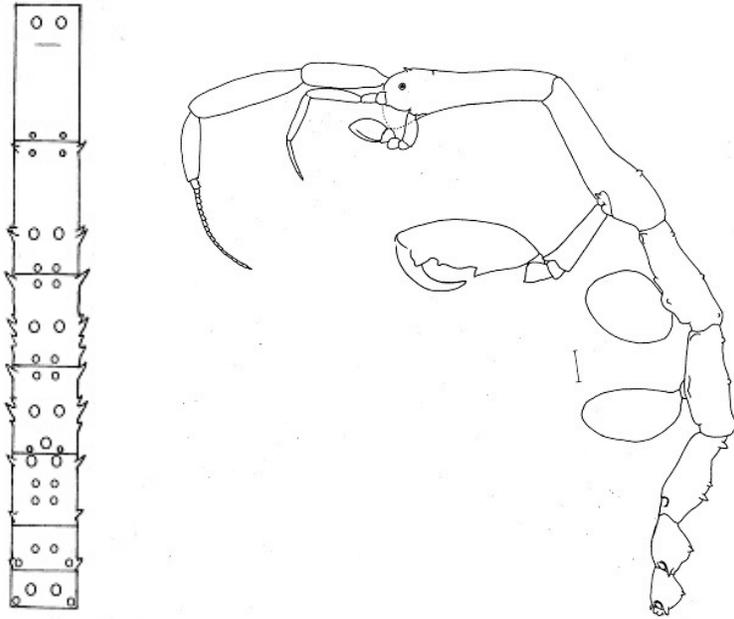
Mayerella banksia male - scale = 1mm. (from Laubitz 1970)

Mayerella – The five described members of the genus are distributed in the NEP (2), the Caribbean/Gulf of Mexico (2), and the Antarctic (1). There may be one or more additional species to be recognized in the NEP, but these materials need additional study before firm generic allocation can be made. The four northern hemisphere species can be separated using the character table presented by Benedict (1977). It is interesting to note that *M. acanthopoda* is indicated as having a 2-articulate P5, while all other members of the genus have a 3-articulate P5. The number of articles in P5 is normally an important generic level character, and one that usually does not vary among members. The species seems to correspond to other generic level characters of *Mayerella*.

Diagnosis: “*Antenna 2 without swimming setae, flagellum biarticulate; mandibular palp triarticulate with one seta on terminal article; molar present; outer lobe of maxilliped larger than inner lobe; gills on pereonites III and IV; pereopods 3 and 4 two-segmented, pereopod 5 three-segmented; abdomen of male with one pair of appendages and one pair of lobes, of female with one pair of lobes.*” (from Laubitz 1970)

[Metacaprella] – Although Lowry (2015b) has retained the genus as valid in WoRMS, its validity has been questioned on more than one occasion (Laubitz, 1970, Mori 1999, Guerra-García & Ros 2012). Laubitz decided to let sleeping dogs lie while noting that the presence of female abdominal appendages in *Metacaprella* and their absence in *Caprella* was the only feature separating the two. Both Mori, and Guerra-García & Ros, also noted this limited differentiation, but both their papers concluded that *Metacaprella* was not valid because the character on which it was based was too variable in expression. The rationale for the present retention is uncertain, as no notes are presented by Lowry (2015b) to explain his position. He lists four species as comprising the genus, three being endemic to the NEP (he also lists Mayer’s 1903 species *ferrea* as valid in both *Metacaprella* and *Caprella*). One of these, *Metacaprella ferrea*, was treated as a *Caprella* by Laubitz (1970), while she left the other two as *Metacaprella*. All are included in her key, which can thus be used for NEP members of the genus. SCAMIT is currently rejecting this taxon as not differentiable from *Caprella* based on the variability of the female abdomen, thus following Mori 1999 and Guerra-García & Ros 2012, rather than Lowry (2015b) in WoRMS. The NEP species referred to *Metacaprella* by Lowry are

included as *Caprella* species in the key of Watling & Carlton (2007), which can be used for their recognition as can the key of Laubitz (1970).



Metacaprella kennealyi dorsal spine diagram and male – scale=1mm (from Laubitz 1970)

Diagnosis: “Antenna 2 with swimming setae, flagellum biarticulate, mandibular palp absent; molar present; outer lobe of maxilliped larger than inner lobe; gills on pereonites III and IV; pereopods 3 and 4 absent; pereopod 5 six-segmented; abdomen of male with one pair of appendages and one pair of lobes, of female with one pair of appendages.” (from Laubitz 1970)



Paracaprella carballoi female and male – scale bar=1mm (from Sánchez-Moyano et al 2014)

Paracaprella – An eleven member genus, with an undescribed provisional in the NEP. Four other described species are also known from the region. A sixth species occurs in San Diego Bay which may be either described or new has also been examined. More detailed investigation of that form is needed to determine if it is a provisional, or identical to *Paracaprella tenuis* from the Atlantic, which it resembles closely (especially the mandibular palp). *P. tenuis* has also been reported from Japan (Arimoto 1976), and is apparently subject to anthropogenic transport. It was recorded from *Undaria* cultivation areas in Japan, and that alga has since proven invasive in the NEP. It is keyed below as *P.* sp SPAWAR1, pending more precise determination of its relationship to *P. tenuis*.

Unlike other genera in the family with reduced pereopod 3 and 4, the pereopod 5 in *Paracaprella* is full sized, with six articles, and a robust dactyl like P6 and P7. The genus is known mostly from the tropical Atlantic, the NEP, and the NWP. Lacerda & Masunari (2014) provide a key to the genus and illustrate many of the species. They do not include *P. insolita* Arimoto 1980, or the two species described by Sánchez-Moyano et al (2014). These latter authors do not provide a more comprehensive key, opting for a character table comparing a number (but not all) of the described species. They do textually describe the differences between their new species and other related forms. These will be used to construct a key to the six species reported from the NEP.

Key to the NEP species of *Paracaprella* – (based on Sánchez-Moyano et al 2014)
 dbcadien (15Apr2015)

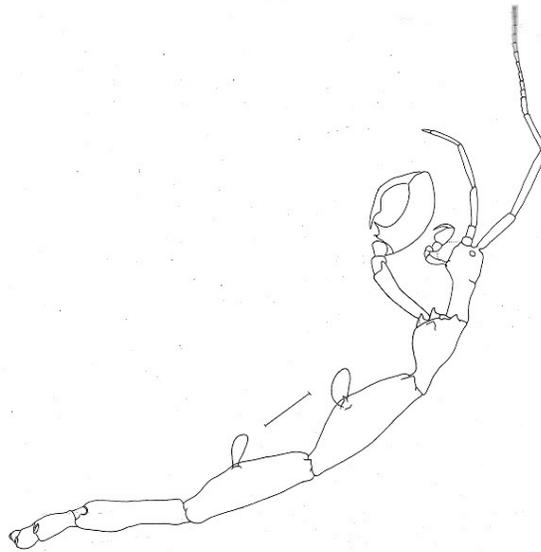
1. Mandibular palp absent, anterolateral projections on pereonite 2 bifid and pointed*Paracaprella isabelae*
 Mandibular palp reduced, stubby, 3-articled, much shorter than the width of the mandible.....*Paracaprella* sp SPAWAR1(=*P. tenuis*?)
 Mandibular palp reduced to a single seta, anterolateral projections on pereonite 2 not bifid, either pointed or rounded.....2
2. Male abdomen with posteriorly serrate appendage.....3
 Male abdominal appendage lacking posterior serrations.....4
3. Male G2 palm with two deep sinuses.....*Paracaprella* sp SD1
 Male G2 palm concave, but lacking sinuses..... *Paracaprella barnardi*
4. Basis of male G2 lacking proximal knob.....*Paracaprella carballoi*
 Basis of male G2 with rounded proximal knob.....*Paracaprella pusilla*

Diagnosis: “*Flagellum of antenna 2, 2-segmented; pereopods 3 and 4, 2-segmented, pereopod 5, 6-segmented; gills on pereonites III and IV; mandibular palp with 0-2 segments; abdominal appendages of male with a pair of single jointed appendages and a pair of lobes, female with a pair of lobes.*” (from Arimoto 1976)

Pseudoliropus – A monotypic genus endemic to the NEP. Laubitz (1970) provided a complete description of *P. vanus*, but did not illustrate the species. I don’t believe it has been reported outside the original description. Bruce Benedict, in illustrating his animals from the BLM survey of the SCB, labeled several *Pseudoliropus vanus?*. These were later crossed out and replaced with MS names of intended new genera.

Diagnosis: “Antenna 2 without swimming setae, flagellum biarticulate; mandibular palp three-segmented, setal formula for terminal article $X + y + 1$, molar absent (?); outer lobe of maxilliped larger than inner lobe; gills on pereonites III and IV; pereopods 3 and 4 one-segmented; pereopod 5 two-segmented; abdomen of female with one pair of setose lobes and one pair of appendages.” (from Laubitz 1970)

[*Triliropus*] – The genus is not currently recorded from the NEP, with representatives in the Red Sea and Thailand. It is, however, likely that *Tritella tenuissima* will eventually be moved here from its current placement. Since *T. tenuissima* is much more elongate and deeper dwelling (typically bathyal) than either of the two current members, it may actually prove to deserve a new genus entirely, a position espoused by Benedict in his draft key (1978). The species, as pointed out by Dougherty & Steinberg (1953) has affinities to both *Triliropus* and *Tritella*. It does not fit easily into either, however. It is here retained in *Tritella* pending further investigation of the issue.



Tritella pilipalma male. The dense setation of the G2 dactyl and palm are omitted here, as are the long dense swimming setae of A2 - scale = 1mm (from Laubitz 1970)

Tritella – a genus similar in several respects to *Triliropus*. It currently contains five described taxa, three of which are known from the NEP. One of these, *Tritella tenuissima*, is probably better placed in *Triliropus*, as it lacks swimming setae on antenna 2, a primary diagnostic character for *Tritella* (Arimoto 1970, McCain 1968). The species is retained in *Tritella* by Lowry (2015d), but this requires further evaluation given the setation of antenna 2. The characters listed by Dougherty & Steinberg (1953) as their reason for placing *tenuissima* in *Tritella* rather than *Triliropus* seem less important than the nature of the antennal setation. Because of the lack of swimming setae on A2, *T. tenuissima* is easily separated from the other two regional taxa. They are keyed in both Laubitz (1970) and in Watling & Carlton (2007), while *T. tenuissima* is not keyed in either.

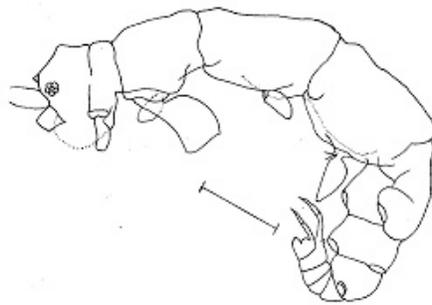
Diagnosis: “Antenna 2 with swimming setae, flagellum biarticulate; mandibular palp triarticulate, setal formula for terminal article $1 + X + 1$; molar present; outer lobe of maxilliped larger than inner lobe; gills on pereonites III and IV; pereopods 3 and 4

one-segmented, pereopod 5 six-segmented; abdomen of male and female with 1 pair of setose lobes.” (from Laubitz 1970)

“**Tritelopsis**” – A provisional genus used by Bruce Benedict in his 1978 key for a new species of small caprellid taken off-shore in the SCB. He never promulgated a diagnosis of the genus, and it is thus a placeholder for the provisional species, and without nomenclatural standing. He considered it close to *Pseudoprotella* based on annotations on his figure of the animal. The single provisional is “*Tritelopsis*” sp A Benedict 1978§. In the key provided above *Liropus minusculus* actually has a single P5 article, and would key to “*Tritelopsis*”. The two differ strongly in antennal configuration, with *Tritelopsis* having antenna 1 as longer than the first 3 pereonites (almost ½ body length). *Liropus* has antenna 1 only slightly longer than the first 2 pereonites. In both antennae 1 and 2 the peduncular articles are much longer in *Tritelopsis* than in *Liropus*. The gnathopod 2 propod is also very different in *T. sp A* and *L. minusculus*. These distinctions apply to both males and females.

“**Urilops**” – A provisional genus which Bruce Benedict intended to create for a provisional species discovered by him in materials collected in the Southern California Borderland by the Bureau of Land Management in the late 1970’s. He unfortunately died prior to completion of either the specific or generic description, so the genus is only a placeholder for the species assignment. It is not yet clear if a new genus is needed, or if the taxon can fit within the bounds of an existing genus. Specimens of this animal have been occasionally taken off southern California and off Oregon, if the key and drawing left by Benedict are being correctly interpreted. He made no extended description, so it is a bit difficult to fully evaluate details of his provisional genus and species. There is a large rounded knob on the dorsal side of the Antenna 1 peduncle in his *Urilops* sp B which separates it from all other local caprellids. Based on the annotations of his figures for this animal, Benedict initially thought it might be *Pseudoliropus vanus*, but he later added NO, and indicated correspondence with Laubitz on 13 Dec 1974 confirming that this was not her species.

Subfamily Paracercropinae



Cercops compactus male. Scale bar = 1mm (from Laubitz 1970)

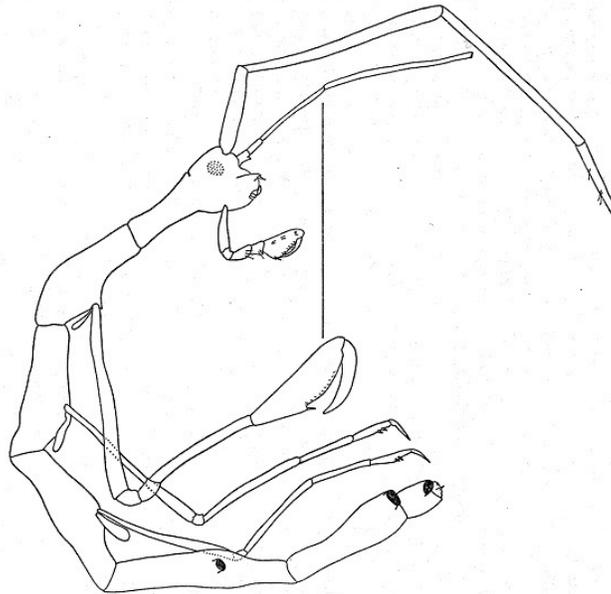
Cercops – A five member genus known primarily from the North Pacific, but with a single species also known from the North Atlantic and Arctic. Only a single species, *C. compactus*, is currently known from the NEP, with three taxa from the NWP.

Diagnosis: “*Antenna 2 without swimming setae, flagellum bi- or tri-articulate; mandibular palp triarticulate, with three terminal bristles; molar absent; maxilliped lobes very small, outer larger than inner; gills on pereonites II, III, and IV; pereopods*

3 and 4 one-segmented, pereopod 5 six-segmented; abdomen five-segmented, male with two pairs of well-developed biarticulate limbs on segments 4 and 5, plus two pairs of very rudimentary limbs on segments 1 and 2; female with two pairs of biarticulate limbs on abdominal segments 4 and 5.” (from Laubitz 1970)

Paracercops – A monotypic North Pacific endemic genus. While better known from the NWP, *Paracercops setifer* has been listed as occurring in the northern NEP (McLaughlin et al 2005) without detailed location information. The only generic diagnosis is in Russian, and is omitted here. The species is well illustrated in Vassilenko (1974), although not discussed in her later work in English.

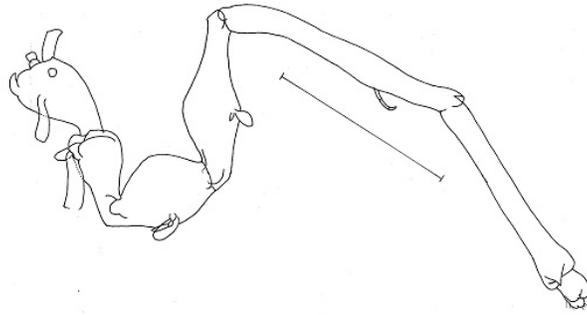
Subfamily Phtisicinae



male *Hemiproto wigleyi*, an Atlantic species –scale bar=1mm (from McCain 1968)

Hemiproto – A single species is described in this genus, *H. wigleyi* from the southwest Atlantic. This species was reported in California waters by Watling (1995), who could not find differences between locally collected specimens and *H. wigleyi*. Local taxonomists had been using a provisional designation of this animal as *Hemiproto* sp *A* for many years, and were dismayed when Watling proposed that it was indeed the Atlantic species. I recently considered this issue in putting together a voucher sheet for *H. sp A*, and found a series of morphological discrepancies between local and Atlantic specimens I feel prevent their synonymy. The two are similar, and are perhaps another cognate species pair on opposite sides of the Panamanian land bridge separating the Pacific from the Atlantic since the Miocene.

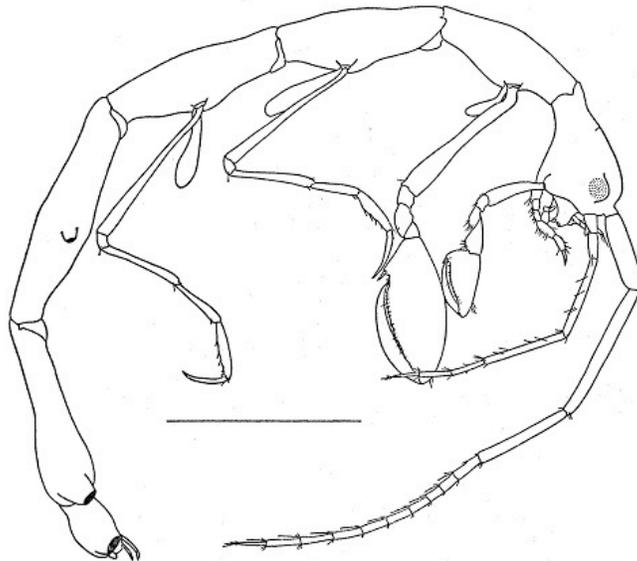
Diagnosis: “Flagellum of antenna 2, 2- to 4-segmented, swimming setae absent; mandibular palp 3-segmented, setal formula for terminal article 1-1 or 1-X-1, molar absent; outer lobe of maxilliped equal to inner lobe; gills on pereonites 2-4; pereopods 3 and 4, 6-segmented, pereopod 5, 5-segmented; abdomen of male with 2 pairs of small uniarticulate appendages and pair of nonsetose lobes, female with 1 pair of uniarticulate appendages.” (from McCain 1968)



Perotripus brevis male. Scale=1mm. The sigmoid body position is characteristic of the genus, although more pronounced in males (from Laubitz 1970)

Perotripus – *Perotripus brevis*, the type from the NEP, has been joined by two other species *P. keeblei* from Australia (Guerra-García 2006), and *P. koreanus* from Korea (Lee & Hong 2010). All three seem to have the peculiar sigmoid body stance which apparently is a generic level character here. It renders them very easily separable from other small caprelloids in the areas where the genus is found. Although the body configuration is more prominent in males it is also present in the female. Little is known about their biology, although all three species seem to come from shallow sublittoral sandy bottoms.

Diagnosis: “Antenna 2 without swimming setae, flagellum biarticulate; mandibular palp triarticulate with one terminal seta, molar absent; outer lobe of maxilliped equal to or larger than inner lobe, both minute; gills on pereonites 11, 111, and IV; pereopod 3 three-segmented, 4 one-segmented, 5 three-segmented; abdomen of male with one pair one-segmented appendages plus one pair setose lobes, of female with one pair of setose lobes.” (from Laubitz 1970)



Phtisica marina male. Scale bar 1mm (from McCain 1968)

Phtisica – A small genus of only three described taxa, known primarily from the Tropical West Atlantic. One of the members, *Phtisica marina*, is much more widely

distributed, and occurs in both the Northwest and Northeast Pacific. It has been described as “pelagic” in occurrence, and is likely a rafter on floating objects.

Diagnosis: “*Flagellum of antenna 2, 2- to 5-segmented, swimming setae absent; mandibular palp 3-segmented, setal formula for terminal article 1-X-1 or 1, molar absent; outer lobe of maxilliped equal to inner lobe; gills on pereonites 2-4; pereopods 3 and 4, 6-segmented, pereopod 5, 5-segmented; abdomen of male with 3 pairs of appendages, female with 2 pairs of appendages, pair of lobes and raised anterior projection.*” (from McCain 1968)

Family Caprogammaridae – The family is not known to have representatives in the NEP, although it is represented both in the NWP and in the Arctic. Perhaps members of the family will be found in future within the region.

Diagnosis: “Head rectangular, not recessed, free, not coalesced with pereonite 1. Mandible molar present. Pereopods 3+4 greatly reduced. Urosomites 1+2 not coalesced.” (Myers and Lowry 2003).



Cyamus ovalis female and male (Photo Vicky Rowntree)

Family Cyamidae – The whale lice. While this group was once considered as a suborder of the amphipods equivalent to the gammarids, recent phylogenetic analyses have placed them as a very derived group within the Caprelloidea (Lowry & Myers 2013). These parasites of large marine mammals are distributed throughout the world ocean, frequently being found wherever their hosts choose to go. While a degree of host specificity is often evident, some cyamids occur on multiple hosts, and hosts frequently have several different cyamid parasites. Where this occurs there is generally a difference in body location on the host, so that the different parasites are not actively competing for space. Sexual dimorphism is relatively strong in most cyamids. They are obligate parasites, so cyamids are never taken except attached to the host, and will never be seen in monitoring collections. A recent review of the group (and key to genera and species) in the NEP was provided by Margolis et al (2000). They are also discussed by Martin & Haney (2007), and Leung (1965, 1967, 1970, 1976). Those associated with the California Gray Whale were discussed by Hurley & Mohr (1957).

Description: “**Head** partially or completely coalesced with pereonite 1; exposed; as long as deep, or longer than deep; rostrum absent; eyes present, well developed or

obsolescent; not coalesced; 1 pair; not bulging. Body dorsoventrally flattened; cuticle smooth, or processiferous.

Antenna 1 longer than antenna 2; peduncle with sparse robust and slender setae; 3-articulate; peduncular article 1 subequal to article 2; antenna 1 article 2 shorter than article 3, or subequal to article 3; peduncular articles 1-2 not geniculate; accessory flagellum absent; antenna 1 calynophore absent. *Antenna 2* present; short; articles not folded in zigzag fashion; without hook-like process; flagellum absent.

Mouthparts reduced. *Mandible* incisor dentate; lacinia mobilis present on both sides; accessory setal row without distal tuft; molar present or absent, vestigial or medium, non-triturative; palp absent. *Maxilla 1* present; inner plate absent; palp present, not clavate, 1-articulate. *Maxilla 2* inner plate present; outer plate present, or absent. *Maxilliped* inner and outer plates well developed or reduced, palps present, well developed or reduced, or forming small triangular lobes, palps absent, or inner and outer plates well developed or reduced, palps absent; inner plates reduced, fused medially or separate; outer plates absent; palp 4-articulate, article 3 without rugosities. *Labium* smooth.

Peraeon. Peraeonites 1-7 separate; complete; sternal gills absent; pleurae present, or absent.

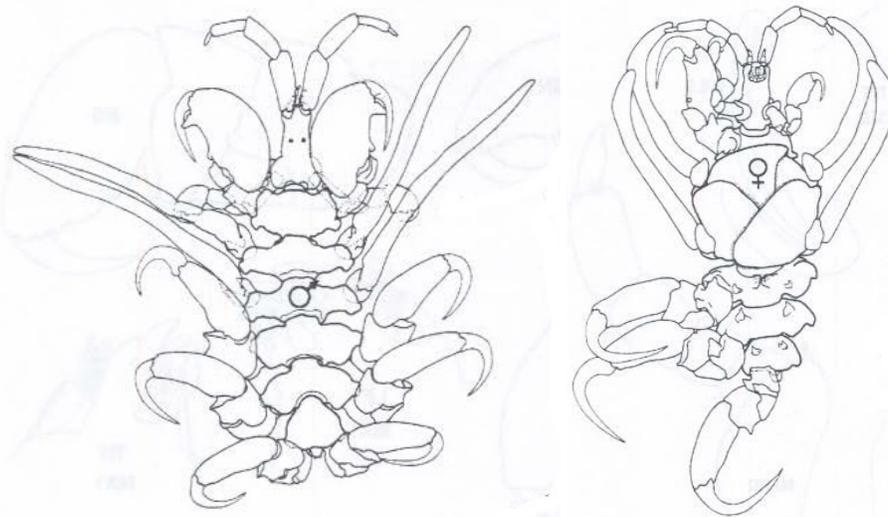
Coxae 1-7 vestigial or absent, none fused with peraeonites. Coxae not acuminate. *Coxae 1-3* not successively smaller, none vestigial. *Coxae 2-4* none immensely broadened.

Gnathopod 1 not sexually dimorphic; smaller (or weaker) than gnathopod 2, or subequal to gnathopod 2; gnathopod 1 merus and carpus not rotated; gnathopod 1 carpus/propodus not cantilevered; shorter than propodus; gnathopod 1 not produced along posterior margin of propodus; dactylus large. *Gnathopod 2* not sexually dimorphic; subchelate; ischium short; merus not fused along posterior margin of carpus or produced away from it; carpus/propodus not cantilevered, carpus short, shorter than propodus, not produced along posterior margin of propodus.

Peraeopods 3-4 absent, 5-7 directed posteriorly, some or all prehensile. *Peraeopod 3* absent. *Peraeopod 4* small. 3-7 without hooded dactyli, 3-7 propodi without distal spurs. Not acuminate. *Peraeopods 5-7* with few robust or slender setae; dactyli without slender or robust setae. *Peraeopod 5* well developed; subequal in length to peraeopod 6; basis expanded or slightly expanded, subrectangular, without posteroventral lobe; merus/carpus fused; setae absent. **Peraeopod 6** subequal in length to peraeopod 7; **merus/carpus fused**; dactylus without setae. *Peraeopod 7* with 6-7 well developed articles; subequal to peraeopod 5; similar in structure to peraeopod 6; with 7 articles; basis expanded or slightly expanded, without dense slender setae; dactylus without setae.

Pleon. Pleonites 1-3 without transverse dorsal serrations, without dorsal carina; without slender or robust dorsal setae. *Epimera 1-3* present. *Epimeron 1* well developed.

Urosome not dorsoventrally flattened; urosomites 1 to 3 coalesced; urosomites 1-2 without transverse dorsal serrations. *Uropods 1-3* reduced to one vestigial pair. *Uropod 2* absent.” (Lowry and Springthorpe 2001).



Cyamus ceti male and female (from Margolis et al 2000)

Cyamus – A medium sized genus with eighteen species currently considered valid (De Broyer 2015b). Most of these (14 species) occur in the NEP and are usually associated with wide-ranging hosts.

Diagnosis: “*Mostly relatively large animals, ectoparasitic on large whales, mainly Mysticeti, Ziphiidac, Monodontidae, and Physeteridae.*

Body variable, often slender in males; lateral lobes of peraeon segments separate, not contiguous or overlapping. Peraeon segments 5-7 with Ventral adhesion spines.

Antenna 1 large, 4-segmented. Antenna 2 medium small, 4-segmented.

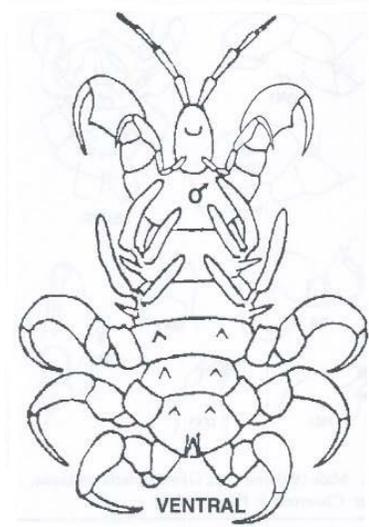
Mouthparts: Upper lip shallowly incised apically, lobes variously asymmetrical; epistome variously developed often strongly. Lower lip, inner lobes. separated distally, small; outer lobes broad, moderately to widely separated. Mandibular molar flat . weakly triturative. With proximal molar seta; incisor typically 5-dentate: left lacinia basically 5 dentate, right lacinia trifold: blade spines present in spine row. Maxilla 1, body short, broad; outer plate with 6 (7) short apical spine-teeth; palp short, 1 segmented. Maxilla 2 short, outer plate distinctly set off from inner plate. Maxilliped: basal plates separated, segment 3(ischium) not exceeding segment 2 (basis); palp 4-segmented, present in early life stages, often persisting in adult.

Gnathopod 1 medium, 6-segmented (ischium distinct); propodal palm distinct, dactyl short, with fused unguis; carpus large; basis slender. Gnathopod 2 large; 5-segmented (ischium fused with basis): propod elongate, palm oblique, bidentate; carpus small, cryptic; basis short, broad, with distinct anterior "flange"; Coxal gills usually simple, slender; accessory gills present, variously developed, 2-4 lobate.

Peraeopods 5-7 similar. 5-segmented; carpus large, propod large, elongate; dactyl large: merus small, subcryptic; ischium variously fused to short basis having large anterior flange.

Abdomen narrow. Male pleopod. variously cleft distally. apices rounded, finely setulose.

Female: body size smaller and peraeon typically broader than in male: brood plates with marginal setae.” (from Margolis et al 2000)



Isocyamus delphinii (from Margolis et al 2000)

Isocyamus – A small genus of only four described members, two occurring in the NEP. These amphipods parasitize smaller cetaceans, and have been recovered from common dolphins, pilot whales, pygmy sperm whales, and false killer whales (Margolis et al 2000)

Diagnosis: “Body medium broad. Peraeon segment 1 broadest, shield-shaped, and may be notched anterolaterally. Peraeon segments 3 & 4 narrowed, each with paired latero-ventral adhesion spines; peraeon segments 5-7 separated, each with pair of stout ventral adhesion spines.

Head medium. Antenna 1 medium, 4-segmented, basal segments thickened. Antenna 2 short, 3-segmented.

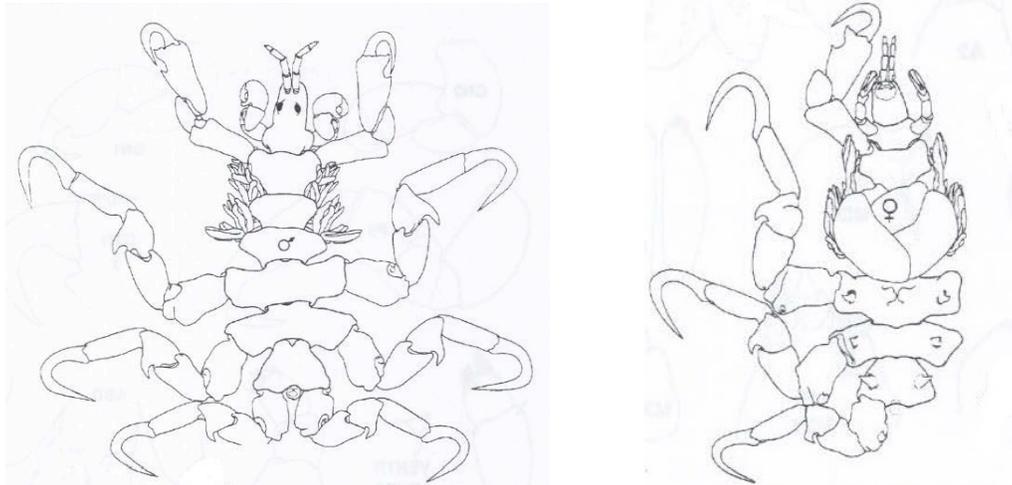
Mouthparts modified. Upper lip large, notched apically, lobes asymmetrical. Lower lip, outer lobes narrowly separated; inner lobes fused. Mandibular molar forming a rounded setulose knob, surface with short blades but lacking proximal seta; incisor 5-6 cusped; left lacinia 5-dentate, right lacinia trifid?; 0-2 blades in spine row. Maxilla 1, outer plate with 6 or 7 apical spines. Maxilla 2, inner plate obsolete, fused with outer plate. Maxilliped, basis small, weakly setulose apically, segment 3 and palp lacking.

Gnathopod 1 medium, 5-segmented; dactyl distally pectinate, unguis distinct. Gnathopod 2 stout, appearing 4-segmented.

Coxal gills single, short, stout, on each of peraeon segments 3 & 4, each with a single large, variously shaped accessory gill.

Peraeopods 5-7 short, stout, strongly raptorial, 5-segmented.

Male pleopods deeply separated distally. Penes relatively large. (from Margolis et al 2000)



Neocyamus physeteris male and female (from Margolis et al 2000)

Neocyamus – A monotypic genus known from the sperm whale, and therefore of world-wide distribution.

Diagnosis: “Body slender, widest at peraeon segments 5 & 6. Peraeon 2-4, lateral lobes small. Peraeon 5-7 each ventrally with pair of stout adhesion spines.

Head elongate, widest posteriorly. Antenna 1 short, 4-segmented. Antenna 2 very small, 2-segmented.

Mouthparts modified: lower lip, inner lobes fused to medium tall plate.

Mandible: incisors 5-toothed; molar obsolete; left lacinia 5-dentate, right lacinia tridentate, 1-3 blades in each spine row. Maxilla 1, outer plate with 7 pectinate spine-teeth. Maxilla 2 tall, inner plate fused with outer plate. Maxilliped palp lacking in adults, 4-segmented in juveniles; basis small, fused $\frac{1}{2}$ with opposite member; segment 3 extending beyond basis in adults.

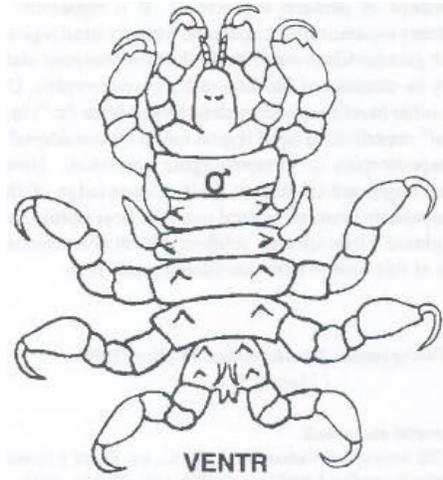
Gnathopod 1 6-segmented; segment 3 distinct; dactyl pectinate, unguis distinct. Gnathopod 2 appearing 4-segmented; segment 2 (basis) elongate; segment 4 lacking anterior margin, convex behind; propod elongate, broadening distally, palm sharply concave, with strong hinge tooth; dactyl strongly curved.

Coxal gills single, multi-filamentous (fasciculate); accessory gills lacking in males.

Peraeopods 5-segmented; basis with small adhesion spine; segment 4 elongate, anterior margin with distal tooth; segment 5 with strong posterior adhesion tooth; propod slender, elongate; dactyl strong.

Male penes strong, curving medially.

Female (ov.) (to 6.0mm); posterior brood lamellae large, margins unlined.” (from Margolis et al 2000)



Platycyamus thompsoni (from Margolis et al 2000)

Platycyamus – Another small genus of only two species, one from the NEP and one from the Atlantic. The Pacific species, *P. flaviscutatus* is known from Baird's beaked whales, while it's Atlantic congener is known from bottle-nosed whales (Margolis et al 2000).

Diagnosis: "Body slender, widest at peraeon segment 5; segments 3&4 narrowed, each with single ventro-lateral adhesion spines; peraeon segments 1 & 2 distinct; segments 6&7 not fused; segments 5-7 each with single pair of ventral adhesion spines.

Head short, broad. Antenna 1 short, 4-segmented. Antenna 2 small, 4-segmented, sexually dimorphic.

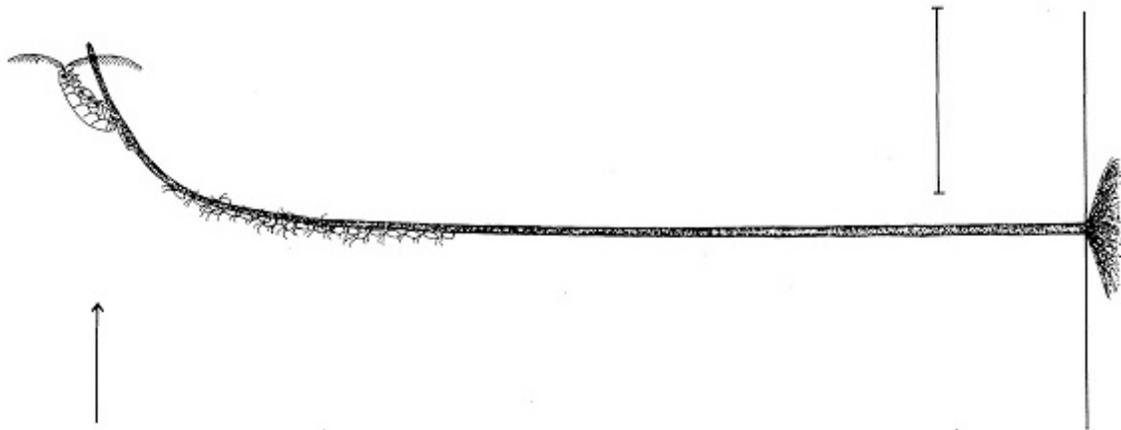
Mouthparts modified. Upper lip apically rounded. Lower lip, outer lobes broadly separated; inner lobes fused. Mandibular molar a rounded mound, lacking proximal seta; left lacinia 5-dentate, right lacinia trifid, incisor 5-cusped; 1-3 blades on each side. Maxilla 1, outer plate with 6-7 apical spine-teeth. Maxilla 2, inner plate fused within outer plate. Maxilliped small, lacking palp; segment 3 exceeding basis, apex setulose.

Gnathopod 1 6-segmented; palm short, vertical; dactyl strongly curved, unguis not clearly demarcated. Gnathopod 2 medium strong, appearing 5-segmented; propodal palm short, vertical.

Coxal gills short, double, on peraeon segments 3 & 4; accessory gills lacking.

Peraeopods 5-7 stout, 6-segmented, segments long; basis and segment 3 with spinose anteroventral process; dactyls large, strongly curved.

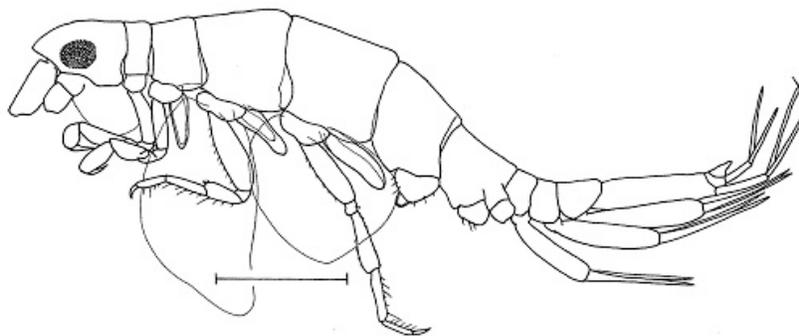
Male penes large, curved. Pleopods markedly separated distally." (from Margolis et al 2000)



Female *Dulichia* on her rod, her young behind her. Scale bar = 10mm, arrow=current
(from Mattson & Cedhagen 1989)

Family Dulichiidae – In previous evaluations of this group of taxa they were allocated to the Podoceridae in the subfamily Dulichiinae on morphological grounds (Laubitz 1983). Currently the two families are viewed as separate and distinct (Lowry & De Broyer 2015). Among the characters which separate this group from the Podoceridae is the presence of spinning glands in the dactyls of the pereopods, which are used in the construction of feeding rods. These are not present in podocerids, and members of that family do not have the same rod-based feeding strategy as dulichiids. In general the dulichiids are Arctic to Boreal in the northern hemisphere, while podocerids are temperate to tropical world-wide. The members of the family were revised by Laubitz (1977), except for two additional genera proposed in 1990 (Andres & Rauschert 1990, Rauschert 1990). All four genera represented in the NEP were covered in Laubitz’ review, and dulichiid genera can be separated using her key.

Diagnosis: “Head triangular; anterior ventral margin moderately excavate. Pereopods 3+4 basis glandular. Pereonites 6 and 7 fused, oriented posteriorly.” (Myers and Lowry 2003).



Dulichia tuberculata female (from Laubitz 1977)

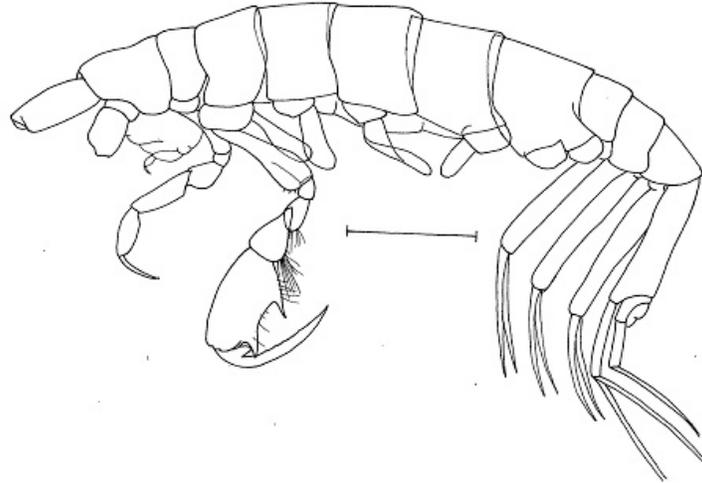
Dulichia – A small genus of six accepted species, two of which are reported from the NEP; *D. falcata*, and *D. rhabdoplastis*. These two, while quite similar in appearance, represent the two behavioral approaches to feeding in the genus. *Dulichia falcata* does not construct a fecal rod, feeding instead from a position on the bottom, and exhibiting the longer antennae such strategy requires (Mattson & Cedhagen 1989). *Dulichia rhabdoplastis* constructs fecal rods which it attaches to the spines of red sea urchins, and from which it feeds well off the bottom (McCloskey 1970). The two species can be distinguished from each other, and the other genus members by the key in Laubitz (1977). The record of *D. tuberculata* from the NEP (McLaughlin et al 2005) is viewed as unsubstantiated. They also do not list *D. falcata* as occurring on the Pacific coast, despite valid records from the Aleutians.

Diagnosis: “Head in lateral view triangular anteriorly; rostrum well developed. Eyes lateral, large, prominently convex. Antenna I setose, longer or shorter than body; accessory flagellum of three articles, length less than half basal article of primary flagellum.

Upper lip broad and fleshy, indented and setose at apex. Mandibles well developed with large molar; incisor strongly toothed, left lacinia mobilis toothed, right lacinia mobilis denticulate; palp with three articles, article 2 longest. Maxilla 1 with rudimentary inner plate, outer plate with nine terminal spines, palp with terminal spines and some setae. Maxilla 2 with terminal setae on both plates, inner plate with subapical setal row. Maxilliped palp with short stout dactylus; inner plate with three apical spines; outer plate inner margin smooth and bearing many slender spines. Lower lip well developed, inner lobes rectangular, outer lobes with lateral projections.

Pereon slender, last two segments coalesced; coxae small and distinct, sometimes spiniform; four pairs coxal gills; three pairs brood plates at least as broad as length of pereonite to which attached. Gnathopods subequal in female; gnathopod 1 dactylus with strongly serrate setose inner margin; female gnathopod 2 propodus broader medially than basally; male gnathopod 2 powerfully developed. Pereopods 3 and 4 bases not expanded and usually of equal length, pereopod 4 longer than 3; propodus and dactylus very weak. Pereopods 5 to 7 greatly elongated, increasing in length posteriorly; articles 5 and 6 strongly spinose anteriorly, propodus without palm, dactylus no more than half length of propodus and with weak or no denticulation on inner margin.

Pleopods large with strongly developed basal article. Urosome segment 1 longer than pleosome. Peduncle of both uropods with median spines. Uropod 1 peduncle twice length of uropod 2 peduncle, inner ramus longer than outer ramus, apical spines usually very long and slender. Uropod 2 shorter than uropod 1, inner ramus longer than outer ramus. Telson ovate and small.” (from Laubitz 1977)



Dulichiopsis remis male. Scale bar = 1mm (from Laubitz 1977)

Dulichiopsis – Laubitz (1977) created this genus, splitting off six species which had previously been part of *Dulichia*. Three of these species are reported from the northern portion of the NEP, only one of which (*Dulichiopsis remis*) is distributed south into the waters of the SCB. One other species now placed in the genus she placed in *Dyopedos* (*D. bispinis*) where it clearly belongs. *Dulichiopsis brevidactyla* from the Western Indian Ocean abyssal was not yet described. All of the NEP reported species are included in her key to the genus (Laubitz 1977). Members of the genus are typically cold water, and/or from bathyal to abyssal depths. All are blind or have only the most rudimentary eyes. The duplicate placement of *Dyopedos bispinis* in *Dulichiopsis* in WoRMS is an error, and the genus thus contains only seven species.

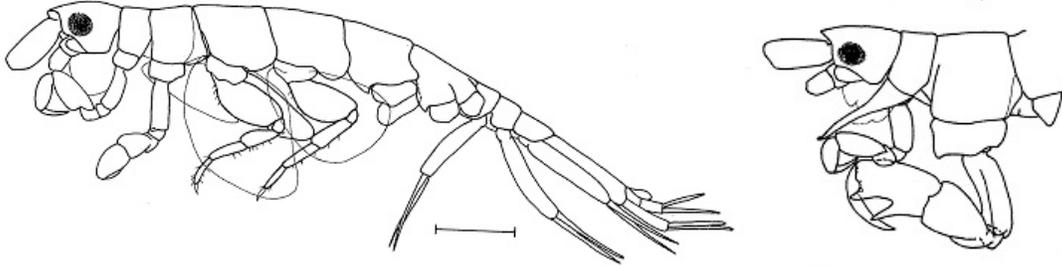
Diagnosis: “Head in lateral view more or less rectangular fused, poorly developed or absent. Antenna 1 setose, as long as body; accessory flagellum of three or four articles and length at least half basal article of primary flagellum.

Upper lip broad and fleshy, bilobed at apex. Mandibles well developed with large molar; incisor strongly toothed, left lacinia mobilis toothed, right lacinia mobilis finely denticulate; palp with three articles, article 2 the longest, and with many long setae. Maxilla 1 with rudimentary inner plate, outer plate with nine terminal spines, palp with terminal spines and some setae. Maxilla 2 with terminal setae on both with subapical row of setae. Maxilliped palp with long slender dactylus; inner plate with two apical spines; outer plate broad apically and with notched inner margin bearing spines and strong, apical setae. Lower lip well developed, inner lobes rounded, outer lobes with winglike lateral projections, both lobes apically setose.

Pereon smooth, very long and slender, last two segments coalesced; coxae small and distinct, not spiniform; four pairs of coxal gills; three pairs brood plates, narrower than length of pereonite to which attached. Gnathopods subequal in female; gnathopod 1 with very long slender nonserrate dactylus; female gnathopod 2 propodus broader distally than at point of attachment to carpus; in male gnathopod 2 powerfully developed. Pereopods 3 and 4 with slender basis, very weak propodus and dactylus; pereopod 3 with longer basis and shorter articles 4 and 5 than pereopod 4. Pereopods 5 to 7 greatly elongated, pereopod 5 being longer or shorter than pereopod 6; article 5 weakly spinose anteriorly, propodus with palm, dactylus approximately half length of propodus and with

denticulate inner margin.

Pleopods large, with strongly developed basal article. Urosome segment 1 shorter than pleosome. Uropods very long and slender. Peduncle of both uropods with median spines. Uropod 1 peduncle one and a half times length uropod 2 peduncle, inner ramus longer than outer ramus, rami with minute or no apical spines. Uropod 2 shorter than uropod 1, inner ramus longer than outer ramus. Telson oval and very small.” (from Laubitz 1977)



Dyopedos monacanthus female, and male showing acuminate coxa 1. Scale = 1mm (from Laubitz 1977)

Dyopedos – As mentioned above *Dyopedos bispinis* clearly belongs here based on its morphology, not in *Dulichlopsis*. It is listed in both genera in WoRMS, correctly under *Dyopedos* (Lowry & De Broyer 2015b). Including that species the genus contains nine taxa distributed in the Arctic and the cold waters of the North Atlantic and North Pacific. Four of these are reported from the waters of the NEP. The descriptions and key provided by Laubitz (1977) can be used to separate specimens of these taxa.

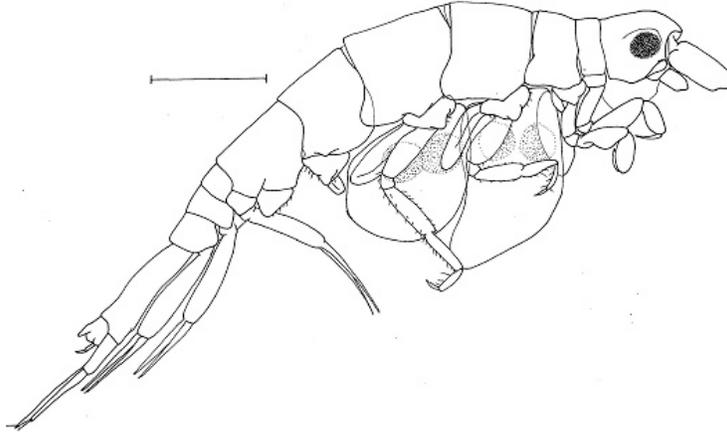
Diagnosis: “Head in lateral view usually anteriorly triangular in male, rectangular in female; rostrum poorly developed. Eyes well developed and obvious, but of variable size. Antenna I variously setose, longer or shorter than body; accessory flagellum of one to three (rarely four) articles, length less than one-third basal article of primary flagellum.

Upper lip broad and fleshy, bilobed and setose at apex. Mandibles well developed with large molar; incisor strongly toothed, left lacinia mobilis toothed, right lacinia mobilis finely denticulate; palp with three articles, article 2 longest. Maxilla I with rudimentary inner plate, outer plate with nine terminal spines, palp with terminal spines and surface setae. Maxilla 2 with apical setae on both plates. Maxilliped palp with short, stout dactylus; inner plate with three apical spines; outer plate inner margin smooth and bearing many slender spines. Lower lip well developed, inner lobes circular or rectangular, outer lobes with lateral projections.

Pereon slender, last two segments coalesced; coxae small and distinct, sometimes spiniform; three pairs coxal gills; three pairs brood plates about as broad as pereonites to which attached. Gnathopods subequal in female; gnathopod I carpus longer than propodus, dactylus quite long and slender with setose and strongly denticulate inner margin; female gnathopod 2 propodus with no median swelling or palmar development, dactylus usually very short gnathopod 2 powerfully developed in male. Pereopods 3 and 4 of increasing length, with greatly inflated bases, that of 3 usually longer and less inflated than that of 4; propodus and dactylus very weak. Pereopods 5 to 7 not elongated, pereopod 6 usually shorter than 5 and with a broader basis than 5 and 7; propodus

without obvious palm; dactylus less than one third length of propodus and without denticulation on inner margin.

Pleopods large with strongly developed basal article. Urosome segment 1 equal to or longer than pleosome (except *D. spinosus*). Peduncle of uropod 2 with median setae. Uropod 1 peduncle two to three times length of uropod 2 peduncle, inner ramus longer than outer, apical spines small to medium length. Uropod 2 shorter than uropod 1, inner ramus longer than outer ramus. Rami and sometimes peduncle of both uropods with denticulate margins. Telson ovate and small.” (from Laubitz 1977)



Paradulichia typica female. Scale bar = 1mm (from Laubitz 1977)

Paradulichia – A small two-species genus, with one member in the North Atlantic, and a second in the North Pacific and Arctic. A third species was proposed, but has been synonymized with *P. typica*, the North Pacific species. Laubitz (1977) describes and illustrates *P. typica*, but does not provide a key. She felt that *P. secunda* was too poorly described to be accurately placed, considering it essentially a nomen inquirendum, and leaving *Paradulichia* with a single member. The tiny vestigial third uropod of this genus easily distinguishes it from other dulichiids in the NEP.

Diagnosis: “Head in lateral view more or less rectangular anteriorly; rostrum well developed. Eyes large and strongly convex. Antennae shorter than body, setose; accessory flagellum of three to five articles, length half basal article of primary flagellum.

Upper lip bilobed and setose at apex. Mandibles well developed with large molar; incisor strongly toothed, left lacinia mobilis toothed, right lacinia mobilis denticulate; palp with few setae and of three articles, article 2 longest. Maxilla 1 inner plate rudimentary, outer plate with nine terminal spines, palp with terminal spines and some setae. Maxilla 2 with terminal setae on both plates, inner plate broader than outer. Maxilliped palp with short stout dactylus; inner plate with three apical spines; outer plate inner margin smooth and bearing many slender spines. Lower lip well developed, inner lobes ovate, outer lobes with lateral fleshy projections.

Pereon slender, last two segments coalesced; coxae small and distinct, sometimes spiniform; four pairs coxal gills; three pairs brood plates about as broad as pereonite to which attached. Gnathopods subequal in male and female; gnathopod 1 carpus longer than propodus, dactylus long and slender with setose and denticulate inner margin;

gnathopod 2 propodus similar in male and female, broader medially than basally. Pereopods 3 and 4 with sturdy bit not inflated basis, very weak propodus and dactylus; pereopod 3 shorter than pereopod 4. Pereopods 5 to 7 elongate, pereopod 6 being shorter than 5; article 5 weakly spinose, propodus without palm, dactylus approximately half length of propodus and without denticulations.

Pleopods large with strongly developed basal article. Urosome segment 1 longer than pleosome. Uropod 1 peduncle with median setae, inner ramus longer than outer, apical spines long. Uropod 2 shorter than peduncle of uropod 1, single ramus of varying size or absent. Telson ovate and small.” (from Laubitz 1977)



Podocerus cristatus sitting on a sponge. The blue coloration is the result of a mutation which produces a protein combining with astraxanthin, a reddish pigment, to produce crustacyanin, the blue seen above (Photo Matt Segal)

Family Podoceridae – The family currently contains eight recognized genera (De Broyer 2015c), only one of which is represented in the NEP. All are discussed and a key to them (also including dulichiids) presented in Laubitz (1983).

Description: “**Head** free, not coalesced with peraeonite 1; exposed; longer than deep; anteroventral margin weakly recessed or moderately recessed or strongly recessed, anteroventral margin deeply excavate or shallowly excavate; rostrum present or absent, short or long; eyes present, well developed or obsolescent, or absent; coalesced, or not coalesced; 1 pair; bulging, or not bulging. Body cylindrical, or subcylindrical; cuticle smooth, or processiferous and dorsally carinate.

Antenna 1 shorter than antenna 2, or subequal to antenna 2, or longer than antenna 2; peduncle with sparse robust and slender setae; 3-articulate; peduncular article 1 shorter than article 2; antenna 1 article 2 shorter than article 3, or subequal to article 3; peduncular articles 1-2 not geniculate; accessory flagellum present, or absent; antenna 1 calynophore absent. Antenna 2 present; medium length, or long; articles not folded in zigzag fashion; without hook-like process; flagellum shorter than peduncle; less than 5-articulate, or 5 or more articulate; not clavate; calceoli absent.

Mouthparts well developed. Mandible incisor dentate; lacinia mobilis present on both sides; accessory setal row without distal tuft; molar present, medium, triturative; palp present. Maxilla 1 present; inner plate present or absent, strongly setose along medial margin or weakly setose apically or without setae; palp present, not clavate, 2 -

articulate. Maxilla 2 inner plate present; outer plate present. Maxilliped inner and outer plates well developed or reduced, palps present, well developed or reduced; inner plates well developed, separate; outer plates present, small; palp 4-articulate, article 3 without rugosities. Labium smooth.

Peraeon. Peraeonites 1-7 separate; complete; sternal gills absent; pleurae absent.

Coxae 1-7 well developed, none fused with peraeonites. Coxae 1-4 longer than broad or as long as broad or broader than long, discontinuous, coxa 1 anteroventrally acuminate or coxae not acuminate. Coxae 1-3 not successively smaller, none vestigial. Coxae 2-4 none immensely broadened.

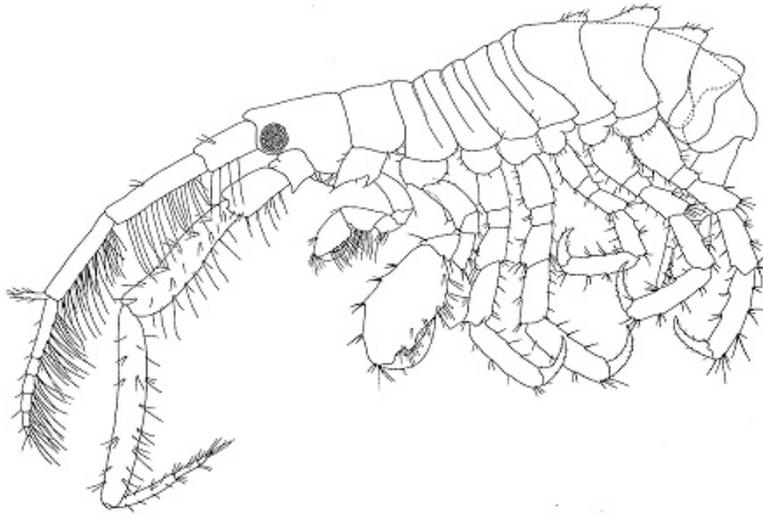
Gnathopod 1 sexually dimorphic, or not sexually dimorphic; smaller (or weaker) than gnathopod 2, or subequal to gnathopod 2; smaller than coxa 2, or subequal to coxa 2, or larger than coxa 2; gnathopod 1 merus and carpus not rotated; gnathopod 1 carpus/propodus not cantilevered; subequal to propodus, or longer than propodus; gnathopod 1 not produced along posterior margin of propodus; dactylus large. Gnathopod 2 sexually dimorphic, or not sexually dimorphic; simple, or subchelate; coxa smaller than but not hidden by coxa 3, or subequal to but not hidden by coxa 3; ischium short; merus not fused along posterior margin of carpus or produced away from it; carpus/propodus not cantilevered, carpus short or elongate, shorter than propodus or subequal to propodus or longer than propodus, not produced along posterior margin of propodus.

Peraeopods heteropodous (3-4 directed posteriorly, 5-7 directed anteriorly), some or all prehensile or none prehensile. Peraeopod 3 well developed, or small. Peraeopod 4 well developed, or small. 3-4 with glandular basis, or 3-4 not glandular; 3-7 without hooded dactyli, 3-7 propodi without distal spurs. **Coxa** well developed, **broader than long**; carpus shorter than propodus or subequal to propodus or longer than propodus, not produced; dactylus well developed. Coxa smaller than coxa 3 or subequal to coxa 3, acuminate ventrally or not acuminate, without posteroventral lobe; carpus not produced. Peraeopods 5-7 with few robust or slender setae; dactyli without slender or robust setae. Peraeopod 5 well developed; shorter than peraeopod 6, or subequal in length to peraeopod 6; coxa smaller than coxa 4 or subequal to coxa 4 or larger than coxa 4, without posterior lobe; basis linear, subrectangular, without posteroventral lobe; merus/carpus free; carpus linear; setae absent. Peraeopod 6 shorter than peraeopod 7, or subequal in length to peraeopod 7; merus/carpus free; dactylus without setae. Peraeopod 7 with 6-7 well developed articles; subequal to peraeopod 5, or longer than peraeopod 5; similar in structure to peraeopod 6; with 7 articles; basis expanded or slightly expanded or linear, without dense slender setae; dactylus without setae.

Pleon. Pleonites 1-3 without transverse dorsal serrations, without dorsal carina; without slender or robust dorsal setae. Epimera 1-3 present. Epimeron 1 well developed. Epimeron 2 without setae.

Urosome dorsoventrally flattened; urosomites 1 to 3 free, or 1 and 2 free, urosomite 3 absent, or 1 free, 2 and 3 coalesced; urosomite 1 much longer than urosomite 2; urosome urosomites not carinate; urosomites 1-2 without transverse dorsal serrations. Uropods 1-2 apices of rami with robust setae. **Uropods 1-3 radically dissimilar in structure and size.** Uropod 1 peduncle without long plumose setae, without basofacial robust seta, with ventromedial spur or without ventromedial spur. Uropod 2

well developed, or absent; with ventromedial spur or without ventromedial spur, without dorsal flange; inner ramus subequal to outer ramus, or longer than outer ramus. Uropod 3 not sexually dimorphic; peduncle short or vestigial. Telson thickened dorsoventrally; entire; longer than broad, or as long as broad, or broader than long; apical robust setae present, or absent.” (Lowry and Springthorpe 2001).



Podocerus kleidus, a species from the Florida keys (from Thomas & Barnard 1992)

Podocerus - Although a number of genera are placed in this family, only *Podocerus* is represented in the fauna of the NEP. This is a large genus of 52 recognized species, of world-wide distribution, primarily from shallow waters, but reaching onto the middle slope (J. L. Barnard & Karaman 1991). As this includes the three cheloniphilous species, which are probable synonyms, as separate species, it should have a few less species. Four species are reported from the NEP, all from very shallow situations typically in bays and estuaries, although they are also taken in shallow coastal waters (Alderman 1936). The large setose antennae of these species are easily deciduous, and normally are not present in remotely collected specimens. A representation of their size relative to the body is provided above. A key to the species known world-wide at the time, which includes all four forms reported from the NEP, is provided by J. L. Barnard (1962b).

Diagnosis: “*Body often dorsally corrugated or provided with elevations, teeth, humps, or carinate or smooth, depressed, last 2-3 pereonal segments often fused, urosomite 1 elongate. Rostrum short, ocular lobes short, blunt, antennal sinus deep. Eyes large to weak, often bulging laterally. Antennae of medium to great length, 1 shorter than 2, 1 slender, antenna 2 stout; peduncular article 3 of antenna 1 longer than 1, article 2 longest, accessory flagellum 1 to 2-articulate, main flagellar articles very few. Antenna 2 peduncular article 3 scarcely elongate, peduncle moderately stout, flagellum short, poorly articulate. Epistome produced anteriorly. Labrum incised, bilobed. Mandible normal, palp strong, article 3 clavate, shorter than 2. Labium with entire outer lobes, with well-developed inner lobes, mandibular lobes long, pointed or blunt. Inner plate of maxilla 1 short to vestigial, with or without 1 seta, outer plate with 9 (?11) spines, palp 2-articulate. Outer plates of maxilla 2 rather broad, inner plate with only sparse*

mediomarginal setae. Inner plate of maxilliped with distal spines, outer plate normal, reaching halfway to apex of palp article 2, with spines on medial margin, palp with 4 articles, article 2 long, article 3 unlobed, article 4 short, with long nail and setae.

Coxae very small, short, weakly discontinuous, of various sizes and shapes, not progressively elongate from 1 to 4, often spiniform, coxa 1 dilated, produced forward, coxa 2 shorter or longer than 1, often produced, coxa 4 not longer than coxa 1, not lobed, coxa 5 as long as 4, coxae 6-7 not much smaller than anterior coxae. Gnathopods 1-2 diverse, gnathopod 2 greatly larger than 1, gnathopod 1 in male poorly subchelate, article 5 shorter than or as long as 6, weakly lobed. Gnathopod 2 enlarged, weakly subchelate or essentially simple, very setose, with article 2 barely dilated, with article 4 enlarged, incipiently merochelate, extended and fused distally along posterior margin of article 5, article 5 much shorter than 6, mostly fused to 4 or cryptic, article 6 dilated, dactyl long.

Pereopods 3-4 longer than gnathopods, similar, with slender article 2, article 4 dilated, dactyls medium. Pereopods 5-7 similar to each other, progressively slightly longer or pereopod 6 longer, pereopods 5-7 with narrow to broad unlobed or barely lobed article 2, dactyl of pereopods 5-7 medium, curved. Sternal processes of thorax absent. Coxal gills undescribed, present on segments ?2-6. Pleopods normal. Epimeron 3 not bisinuate. Uropods 1-2 biramous, rami grossly unequal, inner much longer than (2) or as long as (1) peduncle, peduncle of uropods 1-2 with or without ventrodiscal process, that of uropod 2 smaller. Uropod 3 forming small leaf lacking rami, very short, obtuse distally, with few armaments. Telson entire, short,

Female. Gnathopod 2 smaller, merochelate, carpus distinct but subcryptic, propodus short and inflated. Oostegites broad, present on segments 2-5 or 2-4.” (from J. L. Barnard & Karaman 1991)

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