Amphipoda of the Northeast Pacific (Equator to Aleutians, intertidal to abyss): XIX.
Liljeborgioidea - a review Donald B. Cadien, LACSD
22July2004 (revised 9Dec2014)

Preface

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

Introduction to the Liljeborgioidea

The superfamily, as constituted here, is a construct of Bousfield and Shih (1994) and Bousfield (2001). Subsequent authors (and some earlier authors as well) have placed the families differently. Udekem d'Acoz (2010), for instance, restricts the superfamily to only the family Liljeborgiidae, excluding other families included here by Bousfield and Shih. Jaume et al (2009) suggest that the Sebidae are closer to and belong with the Leucothoidea rather than the Liljeborgioidea. This was supported by the analysis of Berge et al (2000), where both the Colomastigidae and Sebidae fell in their Clade 5 along with the Leucothoidea. Both of the included listriellid taxa were placed in their Clade 4, which seemed to be a largely artificial grouping lacking close ties to the other clades and not united by numerous synapomorphies. We follow the placement of Bousfield and Shih here, and treat the superfamily as having three families in the NEP; the Liljeborgiidae, the Sebidae, and the Colomastigidae.

Diagnosis of the Liljeborgioidea

"*Plesiomorphic, weakly rostrate and weakly abdominally processiferous benthonic gammarideans, lacking a pelagic terminal male stage; antennae lacking brush setae but antenna 1 flagellum often with elongate aesthetascs; accessory flagellum present, occasionally very large; antenna 2 peduncle stout; eyes (when present) subrotund, lateral; mouthparts modified; upper lip with median notch; lower lip broad, inner lobes variously developed or fused; mandibular molar vestigial or lacking, incisor strong, palp slender, terminal segment often small; maxillae inner plates weakly setose, maxilla 1 outer plate with 7-9 apical spine teeth, palp normal; maxilliped inner plate small, outer normal, palp strong; coxal plates medium deep, 4th excavate behind; coxae 5-7 posteriorly lobate; peraeon segments normal; abdomen large; gnathopods 1 and 2 variable, weakly to strongly amplexing, subsimilar but occasionally markedly unlike (Sebidae); peraeopods 5-7 homopodous, basis strongly expanded; brood plates linear; coxal gill lacking on peraeopod 7; pleopods normal or reduced; uropods 1 and 2 lanceolate, subapically notched, rami unequal; uropod 3 lanceolate, non-foliaceous, outer ramus 2-segmented or fused, inner ramus occasionally short or lacking; telson lobes distally separated (narrowly) or fused, apices with notch and spine*." (Bousfield 1978).

Ecological Commentary

Feeding in liljeborgiids was observed to be primarily on detrital aggregates. These were not captured by filter feeding, but by direct gathering (Enequist 1949). These observations were on animals moving freely on the bottom, not in association with other taxa in tubes. In the latter case nutrition might be opportunistic; based on gathering of particulates dropped by the host. Given the positive response to mucus mentioned below, some liljeborgiids may function as kleptoparasites, stealing mucus captured nutrients from the host.

Most liljeborgioids are associated in symbiotic relationships with other invertebrates. Polychaete worms of the family Maldanidae seem the most frequent hosts of members of the liljeborgiid genus *Listriella*, but terebellid polychaetes are also reported as hosts (Bousfield 1973), and Batcheler and Mills (1965) report positive responses of *L. clymenellae* to pectinariid polychaete mucus. Associations of other *Listriella* are reported with holothurians (Fox and Bynum 1975, Vader 1978) and with thalassinid decapods. Members of the liljeborgiid genus *Liljeborgia* are known to be repeatably found within the shells of hermit crabs (Vader 1995). Taylor (1979) reported an association between an undescribed *Liljeborgia* and the hermit crab *Pagurus hemphilli* in the NEP. This appears to be a specific association, since attempts by the amphipod to enter shells of the co-occurring *P. granosimanus* led to attempts at predation, while *P. hemphilli* ignore the amphipods. Further support for a specific association is that the coloration of the amphipod matches both that of the hermit crab legs, and of the coralline alga on which the hermit crab is normally found (Taylor 1979). This is described as dark red by McLaughlin (1974). The identity of this animal remains unknown, but is unlikely to be the same as *L. geminata*, which also occurs in the intertidal zone in the NEP. It's range may be considerably greater than currently known, as the host ranges north to British Columbia (McLaughlin 1974). None of the other members of the genus in the NEP are known to be strongly pigmented in life. Without additional morphological detail the species cannot be included in the key below.

Key to NEP Liljeborgiidae – D. Cadien 23 Mar 2006 (adapted from Barnard 1959, and other sources). Note: characters used in this key apply to both juveniles, and adults of both sexes

1. Carpus of G1 and G2 with strongly produced slender ventral lobe extending along hind margin of propodus.....*Liljeborgia* 2
   Carpus of G1 and G2 lacking produced ventral lobe.....*Listriella* 6
2. Telson cleft nearly to base, lobes with imbedded terminal spine; basis of P5-7 only 1-1.5x as long as wide; with eyes.....3
   Telson cleft only ¼ to 1/3, lacking terminal spines on telsonic lobes; basis of P5-7 more than twice as long as wide; blind.....5
3. Epimeron 1 concave above posterio-ventral tooth.....*Liljeborgia pallida* Bate 1857
   Epimeron 1 convex above posterio-ventral tooth.....4
4. Cusps of telsonic lobes longer medially than laterally; eyes reniform.....
   .....*Liljeborgia marcinabrio* Barnard 1969
   Cusps of telsonic lobes subequal to longer laterally than medially; eyes oval to subquadrate..... *Liljeborgia geminata* Barnard 1969

5. Pleonal segments 1-3 and urosomal segments 1 and 2 with large spine, dactyl of G2 not serrate.....*Liljeborgia* sp CS1 Cadien 2004§
   Pleonal segment 1 with small spine or spine absent, other pleonal and urosomal segments with spines large, small, or absent; dactyl of G2 serrate.....*Liljeborgia cota* Barnard 1962
6. Lacking bands or spots of pigment; blind.....*Listriella albina* Barnard 1959
   With stripes, spots, or bars of pigment on pereonites, antennae, coxae, or legs, or some combination of these; eyed.....7
7. With pigment on the top of the head.....8
   Without pigment on the top of the head.....9
8. A band of pigment on article 2 of antenna 1.....*Listriella goleta* Barnard 1959
   No pigmented band on article 2 of antenna 1.....*Listriella eriopisa* Barnard 1959
9. Epimeron 3 subquadrate, with a small posterio-ventral tooth.....*Listriella* sp A SCAMIT 1987§
   Epimeron 3 rounded, with posterior notch, but lacking posterio-ventral tooth.....10
10. A band of pigment on article 2 of antenna 1.....*Listriella melanica* Barnard 1959
    No pigmented band on article 2 of antenna 1.....*Listriella diffusa* Barnard 1959

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

Family Liljeborgiidae

*__Liljeborgia cota__ Barnard 1962b – Gulf of Alaska to northern Baja California, Mexico: 366-2000m

*__Liljeborgia geminata__ Barnard 1969b –Goleta to northern Baja California: 3-70m

Liljeborgia kinahani Bate 1862 (Barnard ID=L. geminata)

Liljeborgia marcinabrio Barnard 1979b – Bahia de Los Angeles, Gulf of California, 46m

Liljeborgia pallida Bate 1857 – NE Atlantic to Mediterranean, Central California, off Pt. Buchon and Pt. San Luis: 40-611m

Liljeborgia sp **CS1** Cadien 2004§ - Oregon: 2818m

Liljeborgia sp Taylor 1979§ - Central California: intertidal, commensal with Pagurus hemphilli

*__Listriella albina__ Barnard 1959a – Oregon to northern Baja California Mexico: 16-830m

*__Listriella diffusa__ Barnard 1959a – Pt. Conception to northern Baja California, Mexico: 12-172

*__Listriella eriopisa__ Barnard 1959a – Pt Conception to Bahia Tortugas, northern Baja California, Mexico: 11-560m

*__Listriella goleta__ Barnard 1959a – Oregon to Bahia San Cristobal, northern Baja California, Mexico: 12-459m

*__Listriella melanica__ Barnard 1959a –Pt Conception to Bahia de Los Angeles, Gulf of California, Mexico: 11-200m

*__Listriella sp A__ SCAMIT 1987§ - Palos Verdes to San Diego in the SCB: 5-61m

Family Sebidae

Seba bathybia Larsen 2007 – Juan de Fuca hydrothermal vents: 2656m

Seba profunda Shaw 1989 – Off Vancouver Island : 1797-1825m

Family Colomastigidae

***Colomastix sp A** SCAMIT 2012§. – SCB: intertidal to shallow sublittoral

Colomastix pusilla Grube 1861 (of Barnard cites in NEP = C. sp)

Comments by Family

Family Liljeborgiidae – The most difficult thing about liljeborgiids may be their pronunciation (lily bor gee ids) named after distinguished Swedish carcinologist Wilhelm Liljeborg. The family contains but few genera, two of which are represented in the NEP. The first of these is the type *Liljeborgia*, the second is *Listriella*.

The number of genera in the family is in dispute. The genera *Listriella* and *Idunella*, for instance are either both viewed as valid (i.e. J. L. Barnard 1959, J. L. Barnard and Karaman 1991, Lincoln, 1979) , or *Listriella* is viewed as synonymous (i.e. Karaman 1980, Udekem d'Acoz 2010). The controversy concerns which characters define the two genera. J. L. Barnard (1959) erected *Listriella* to house those members of *Idunella* with gnathopod 2 dominant (and proposed a number of additional species). Only the type of *Idunella* remained in the genus (one other species was later added). These forms had gnathopod 1 dominant. Karaman (1980) remarked that there was a continuum in that character, with no clear dividing line, only extremes, and suggested that *Listriella* be synonymized. Perhaps in response to this, J. L. Barnard and Karaman (1991) revised the definition of *Listriella* and *Idunella*, concentrating on the relative lengths of the first article of the mandibular palp; short in *Idunella*, long in *Listriella*. This redefinition is still being evaluated, although Udekem d'Acoz (2010), remarking that the situation was as yet unresolved, recombined the two genera – essentially rejecting the redefinition.

The redefinition was, no doubt, an attempt to "save" *Listriella*. Alternatively, the recombination could have been accepted, with *Listriella* dropping into synonymy, and a new genus, based on the revised character set, erected to divide *Idunella*. This pathway is more disruptive to nomenclature than the redefinitions proposed by J. L. Barnard and Karaman in 1991. Consequently, I feel it is better to accept the redefinitions and retain *Listriella* as a valid genus separate from *Idunella.* As Udekem d'Acoz points out (2010) better and more detailed descriptions are needed for many taxa in this complex of genera, and more generic level entities may yet emerge.

WoRMS (Horton & De Broyer 2015) has followed Udekem d'Acoz's lead, and currently treats *Listriella* as a synonym of *Idunella*, contrary to the practice here in the NEP. WoRMs currently lists only two valid genera, while J. L. Barnard and Karaman 1991 list five. The difference comes from the combination of *Listriella* with *Idunella* mentioned above, along with the treatment of *Isipingus* as a synonym of *Liljeborgia*, and the rejection of *Sextonia* as a valid generic taxon. Both *Isipingus* and *Sextonia* have single species, so they can be viewed as just aberrant members of a larger, more diverse genus, or as separate entities. Udekem d'Acoz (2010) agrees that *Sextonia* is well-enough supported to be retained at generic level, while retaining *Isipingus* at subgeneric level within *Liljeborgia*.

Description: "**Head** free, not coalesced with peraeonite 1; exposed; as long as deep, or longer than deep; rostrum present or absent, short; eyes present, well developed or obsolescent, or absent; not coalesced; 1 pair; not bulging. Body laterally compressed; cuticle smooth.

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

Mouthparts well developed. *Mandible* incisor dentate, or minutely serrate; lacinia mobilis present on both sides; accessory setal row without distal tuft; molar present or absent, medium, non-triturative; palp present. *Maxilla 1* present; inner plate present, weakly setose apically; 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 or reduced, separate; outer plates present, small or vestigial; 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, overlapping, coxae not acuminate. *Coxae 1-3* not successively smaller, none vestigial. *Coxae 2-4* none immensely broadened.

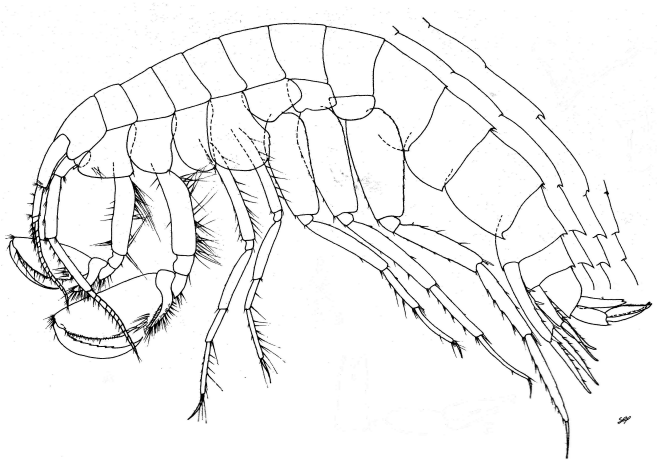
Gnathopod 1 sexually dimorphic; subequal to gnathopod 2, or larger (or stouter) than gnathopod 2; larger than coxa 2; gnathopod 1 merus and carpus not rotated; gnathopod 1 carpus/propodus not cantilevered; shorter than propodus; gnathopod 1 strongly produced along posterior margin of propodus, or slightly produced along posterior margin of propodus, or not produced along posterior margin of propodus; dactylus large. *Gnathopod 2* sexually dimorphic, or not sexually dimorphic; carpochelate, or subchelate; coxa 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, shorter than propodus, strongly produced along posterior margin of propodus or slightly produced along posterior margin of propodus or not produced along posterior margin of propodus.

Peraeopods heteropodous (3-4 directed posteriorly, 5-7 directed anteriorly), none prehensile. *Peraeopod 3* well developed. *Peraeopod 4* well developed. 3-4 not glandular; 3-7 without hooded dactyli, 3-7 propodi without distal spurs. Coxa well developed, longer than broad; carpus shorter than propodus or subequal to propodus, not produced; dactylus well developed. **Coxa larger than coxa 3**, not acuminate, with well developed 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; coxa smaller than coxa 4, without posterior lobe; basis expanded, subrectangular, with 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;

longer than peraeopod 5; similar in structure to peraeopod 6; with 7 articles; basis 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. *Epimeron 2* without setae.

Urosome not dorsoventrally flattened; urosomites 1 to 3 free; urosomite 1 subequal to urosomite 2, or longer than urosomite 2; urosome urosomite 1 carinate, or urosomites not carinate, or urosomite 3 carinate; urosomites 1-2 without transverse dorsal serrations. *Uropods 1-2* apices of rami without robust setae. *Uropods 1-3* similar in structure and size. *Uropod 1* peduncle without long plumose setae, without basofacial robust seta, with ventromedial spur. **Uropod 2** well developed; **with ventromedial spur**, without dorsal flange; inner ramus subequal to outer ramus. *Uropod 3* not sexually dimorphic; peduncle short; outer ramus subequal to peduncle or longer than peduncle, 1-articulate or 2-articulate, without recurved spines. *Telson* laminar; deeply cleft, or moderately cleft; longer than broad; apical robust setae present." (Lowry and Springthorpe2001).



Liljeborgia cota, showing variants of pereon and pleon ornament
(From J. L. Barnard 1962)

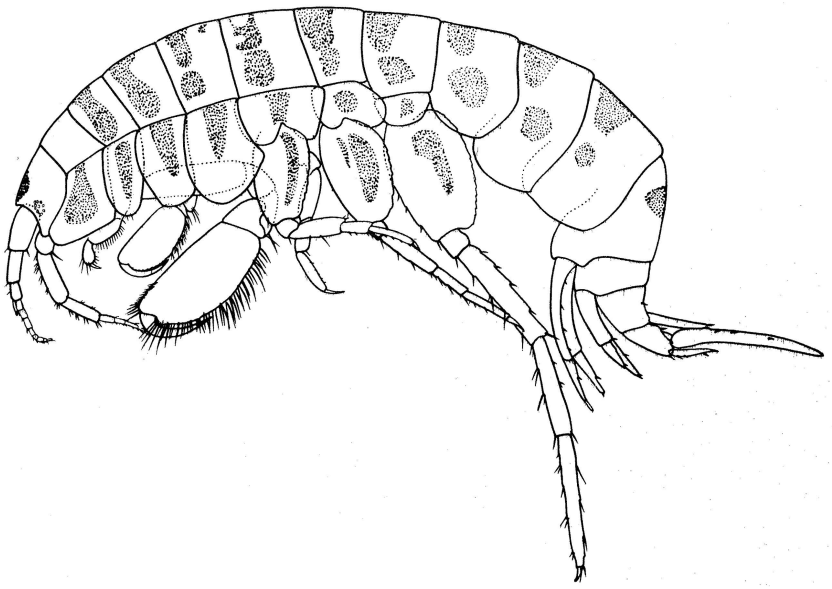
Liljeborgia – The genus has two alternative spellings, both reflecting the name of the dedicatee Wilhelm Liljeborg. According to Udekem d'Acoz (2008), this worthy moved to the United States from Sweden around 1860, and changed his name at that time to William Lilljeborg. Udekem d'Acoz (loc. cit.) lays out the arguments for handling this, and supports the use of *Liljeborgia* rather than *Lilljeborgia* on the basis of ICZN rules. The genus is a rather large one, with 72 species world-wide. Many of these are from the southern hemisphere (Udekem d'Acoz 2008, 2009) although the type is northeast Atlantic.

Liljeborgia has four described species in the NEO, two occurring in the SCB, *Liljeborgia cota* and *L. geminata*. Edition 9 of the SCAMIT list, reports both, but not an undescribed species of *Liljeborgia* known from abyssal depths off Oregon. An additional undescribed species occurs intertidally in Central California in association with hermit crabs. The record of *Liljeborgia kinahani* Bate in Barnard 1962b was later placed in the synonymy of *Liljeborgia geminata* (Barnard, 1969b). *Liljeborgia pallida* was reported from the Santa Maria Basin area of Central California off Pt. Buchon and Pt.

San Luis by Thomas and McCann (1995). It is not known to occur in the SCB. Description of *L. pallida* is in Lincoln (1979), and Thomas and McCann (loc. cit.) reproduce Sars 1895 figures of the species. It is included in the key above, as is *Liljeborgia marcinabrio* Barnard 1969a, known only from the Gulf of California.

Variation in dorsal spine formulas is documented for *L. cota* in J. L. Barnard 1962 (see figure above). He also illustrates variability in configuration of the G2 palm in males in the same paper. It may be that *L. cota* has reduced host specificity, and consequently displays a number of morphs associated with host selection. It may also be that *L.* sp CS1 is merely an extreme variant of the variable *L. cota* from the deepest portion of its bathymetric range, but characters of the gnathopods suggest otherwise.

Diagnosis: *Articulation between articles 1 and 2 of Md palp rectilinear. Article three of Md palp not flattened, without D3-setae in a comb-like disposition on posterior border. Hinge articulating Md with carapace in lateral position. Outer distal part of Md not pointed. Molar process always reduced, non-triturative, and bearing strong setae. Article two of the palp of Mx1 with 1 or several anterior setae. Outer plate of Mx1 with 7 to 10 spines. Inner plate of Mx1 with 1 (more rarely several) long setae [accessory short setae only present in teratological specimens]. Inner marginal border of the outer plate of the maxilliped with marginal spines and margino-facial setae. Coxa 1 usually with anterior tooth or notch. Gn2 dominant (except in male Liljeborgia prionota d'Udekem d'Acoz, 2008, in which the reverse is true). Gn1 and Gn2 always fairly similar in females and often also in males. Carpus of Gn1-Gn2 with long posterior process. Palm of Gn1 without outer setae, with a long outer row of hooked spines, never with a row of medial hooked spines, and with medial spinose medial setae apparently forming two loose rows. Palm of Gn2 with outer setae (sometimes just a few, sometimes many; usually more numerous and longer in males than in females), with a long outer row of hooked spines, never with a medial row of hooked spines, and with medial spinose setae apparently forming two loose rows. Dactylus of Gn2 with some strong setae on medial surface (in addition to proximal anterior short seta). Margino-medial setae of palm of Gn1-Gn2 almost always with 2 anterior spinules and no posterior spinules. Dactylus of pereiopods 3 and 4 without unguis, spinules or setules. Posterodistal border of urosomites 1 and 2 with 0-1 teeth, without spinules. Urosomite 1 with or without ventrofacial spines. Peduncle of U1 without ventrofacial spines. Tip of dorsolateral border of the peduncle of U1 with a long spine pointing backwards not paired with a short spine pointing upwards. Rami of U1-2 tapering distally, with tip pointed and narrow, without spines or with trace of a spine fused with tip. Outer ramus of uropod 3 entire. Outer ramus of U3 almost always with spines on outer margin only. Ventral proximal spine never present on inner ramus of U3. Rami of U3 with spines only, never with setae*." (from Udekem d'Acoz 2010)

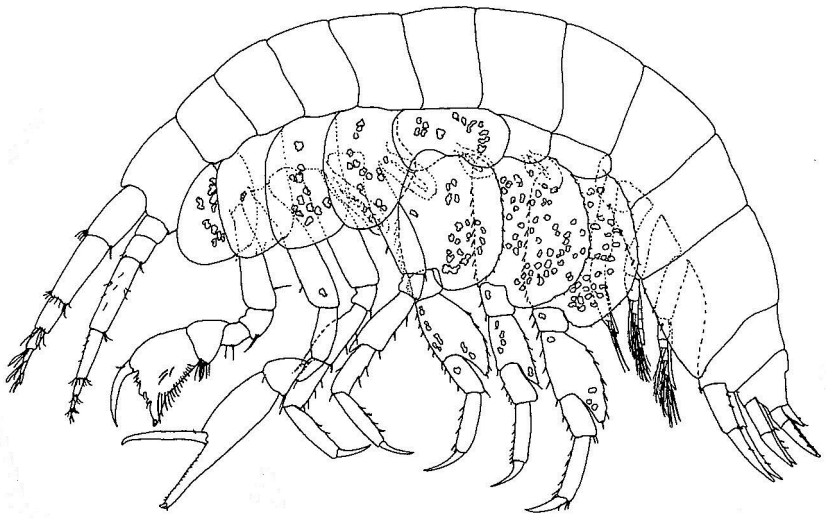


Listriella eriopisa female (From J. L. Barnard 1959)

Listriella -The genus *Listriella* is commonly taken in the SCB, and widely in the NEP. A genus of good size, with 33 species; one with two subspecies. Outside the NEP the genus is known from the NWP, the Caribbean and NW Atlantic, the NE and SE Atlantic, the Mediterranean, and the Indian Ocean, but not from polar seas. The distribution is circumtropical to temperate, with limited incursions into the boreal zone. It is known to live as a symbiont with polychaetous annelids in their tubes. J. L. Barnard and Karaman (1991) comment that they are associated with maldanid polychaetes inside their mud tubes, but other families may also harbor these amphipods. Other associations are reported with decapods, and echinoderms (Fox and Bynum 1975). SCAMIT member agencies take all six reported species of *Listriella*, but three are regularly encountered; *L. eriopisa*, *L. goleta*, and *L. melanica*. *Listriella albina* is occasionally taken at slope depths, and only occurs in deeper water. The apparently introduced *Listriella* sp A has been encountered a few times off Palos Verdes, but is very uncommon. *Listriella diffusa* occurs once in a while, but is also very uncommon. Members of *Listriella* occur predominantly at shelf depths in the NEP (with the exception of *L. albina*, which is bathyal), but several species seem to undergo antitropical submergence, occurring deeper further north in the NEP (J.L. Barnard 1971).

Most members of the genus in NEP waters have identifying color patterning which persists in preservation. There is a tabular key to all six species in the SCAMIT voucher sheet for *Listriella* sp A (SCAMIT NL 6#7) prepared by Sue Garner of MEC. This modifies the original tabular key provided by Barnard (1959) to include the new provisional.

Diagnosis: "*Accessory flagellum usually 2- (rarely 4) articulate. Epistome poorly produced. Article 1 of mandibular palp elongate, molar simple. Coxae 1-4 ordinary. Gnathopods variable, either dominant; propodus and carpus not setose anteriorly; carpus of gnathopods 1-2 moderately to poorly produced. Outer ramus of uropod 3 1- or 2-articulate. Each lobe of telson with 2 apical spines*." (from J. L. Barnard & Karaman 1991).



Seba profunda (From Shaw 1989)

Family Sebidae – A small family, but widely distributed, with representatives from abyssal depths to hypogean freshwaters (Jaume et al 2009). All marine species are in the genus *Seba*, while the hypogean species are in the genera *Seborgia* or *Relictoseborgia*. The family origin is apparently fairly early, since the invasion of hypogean freshwaters by sebids must have occurred no later than the Cretaceous (Holsinger 1986). Needless to say, only *Seba* has been reported from the marine areas of the NEP. In recent years investigations of coral reef areas have added numerous species in the genus *Seba* (i.e. Yerman and Coleman 2009). Like the colomastigids, they are often found in association with sponges, but a number of species are known from rubble areas with no specific host association. One has been taken in association with larger hydrothermal vent animals such as vestimentiferans and gastropods. That species, *S. profunda*, does not seem to have the mouthpart structure needed for filter feeding, but the facial setal brush on G2 may serve in harvesting bacterial aggregations from surfaces. Such relationships with larger organisms may represent actual predation, utilization of host provided water movement for filter feeding, or mere inquilinism (Shaw 1989).

Description: "**Head** free, not coalesced with peraeonite 1; exposed; as long as deep; rostrum present, moderate; **eyes absent**. Body laterally compressed; cuticle smooth and dorsally carinate.

Antenna 1 subequal to antenna 2; peduncle with sparse robust and slender setae; 3-articulate; **peduncular article 1 shorter than article 2**; antenna 1 article 2 longer than article 3; peduncular articles 1-2 not geniculate; accessory flagellum present; 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, non-triturative; palp present. *Maxilla 1* present; inner plate present, weakly setose apically; palp present, not clavate, 1 -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, overlapping, coxae not acuminate. *Coxae 1-3* not successively smaller, none vestigial. *Coxae 2-4* none immensely broadened.

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

Peraeopods heteropodous (3-4 directed posteriorly, 5-7 directed anteriorly), none prehensile. *Peraeopod 3* well developed. *Peraeopod 4* well developed. 3-4 not glandular; 3-7 without hooded dactyli, 3-7 propodi without distal spurs. Coxa well developed, longer than broad; carpus subequal to propodus, not produced; dactylus well developed. Coxa subequal to coxa 3, not acuminate, with well developed 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; **coxa** smaller than coxa 4, **with ventrally produced posterior lobe or equilobate**; basis expanded or slightly expanded, subrectangular or subovate, with posteroventral lobe; merus/carpus free; carpus linear; setae absent. *Peraeopod 6* subequal in length to peraeopod 7, or longer than peraeopod 7; merus/carpus free; 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, 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.

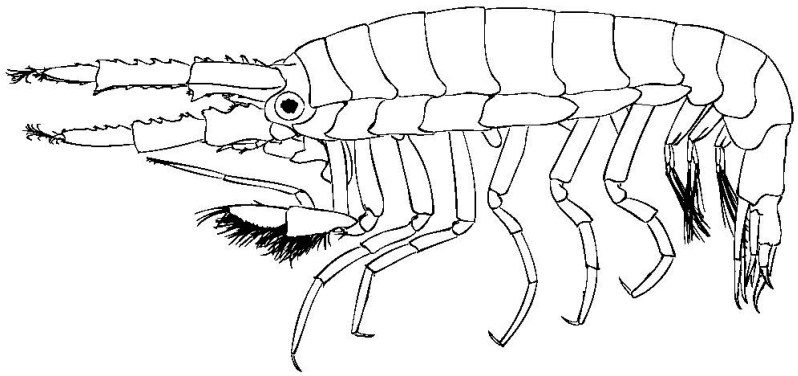
Urosome not dorsoventrally flattened; urosomites 1 to 3 free, or 1 free, 2 and 3 coalesced; urosomite 1 longer than urosomite 2, or much longer than urosomite 2; urosome urosomites not carinate; urosomites 1-2 without transverse dorsal serrations. *Uropods 1-2* apices of rami without robust setae. *Uropods 1-3* similar in structure and size. *Uropod 1* peduncle without long plumose setae, without basofacial robust seta, without ventromedial spur. *Uropod 2* well developed; without ventromedial spur, without dorsal flange; inner ramus longer than outer ramus. *Uropod 3* not sexually dimorphic; peduncle short; without recurved spines. *Telson* laminar; entire; longer than broad; apical robust setae absent." (Lowry and Springthorpe 2001).

Seba - Sebids are represented in the NEP by two species from bathyal depths off British Columbia on the Endeavor Seamount – *Seba profunda* Shaw 1989, or from abyssal depths off Oregon – *Seba bathybia* Larsen 2007. Larsen distinguishes his species from that of Shaw by possession of an enlarged posteriorly excavate coxa 4 (among other points). While not taken directly from hydrothermal vents, *S. bathybia* came from wood blocks deployed in an active venting area. It was the most abundant species taken. Mouthparts and general setation of this species do not suggest a filter-feeding diet, but it

also has the G2 ventral setal brush shown in *S. profunda*. The decapod *Glyptolithodes*, which lives in association with decaying wood – another sulfide source, has been observed to use the setal brushes on its chelipeds to harvest *Sulfobacter* growth from the wood. I suspect that these amphipods feed similarly.

We have never taken them, and never expect to, given their minimum depths and apparent rarity. There is a tendency for vent associated animals to be more strongly restricted by presence of vents and sulfides than depth. Even so, it seems unlikely that these animals might show up at our local vent site (LACSD Station 0C) in 150m of water, or other vent locations in the SCB. In *Seba* the G1 and G2 are both chelate, with the G2 long and slender, and the G1 robust with a broad propod. This is well illustrated in Barnard and Karaman (1991) (and see above).

Diagnosis: "*Labium with inner lobes indistinct and fused to outer lobes. Palp of maxilla 1 l-articulate. Maxilla 2 ordinary, with 2 plates. Coxa 4 scarcely the largest or not the largest, not orthodox, all posterior margin excavate, therefore posteroventral lobe feeble. Gnathopods diverse, gnathopod 1 much the larger, subchelate or chelate, propodus broad, gnathopod 2 strongly chelate with elongate, article 3, carpus and propodus very slender. Urosomites 2-3 fused together. Oostegites moderately expanded, generally with 5-7apical and subapical setae."* (from J. L. Barnard & Karaman 1991)



Colomastix denticornis (From LeCroy 2004)

Family Colomastigidae – Colomastigids are very small amphipods usually found in close association with sponges. Even when the association is not evident, they are recovered from habitats where sponges also occur. Close examination of a good sized sponge can provide hundreds of specimens of some colomastigid species. LeCroy (1995) reported that of 35 potential host taxa, 26 had associated colomastigids. These hosts included both sponges and corals. Host specificity was relatively low for most species of amphipods, with occupation of a variety of hosts by each, and most host housing more than one species of *Colomastix*. Typically members of the family are found at shelf depths, with few reaching 100m or greater (LeCroy 1995). Geographic distribution of the genus is broad, with representatives in most waters other than the Arctic. *Colomastix* is the only genus known from the northern hemisphere, but an additional genus, *Yulmara*, is found in Australia.

Description: "**Head** free, not coalesced with peraeonite 1; exposed; as long as deep, or deeper than long; anteroventral margin weakly recessed or straight or oblique, anteroventral corner rounded; rostrum present or absent, short; eyes present, well

developed or obsolescent, or absent; not coalesced; 1 pair; not bulging. **Body subcylindrical**; cuticle smooth.

Antenna 1 subequal to antenna 2, or longer than antenna 2; peduncle with sparse robust and slender setae; 3-articulate; peduncular article 1 subequal to article 2, or longer than article 2; antenna 1 article 2 longer than article 3; peduncular articles 1-2 geniculate, or 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; accessory setal row without distal tuft; molar present or absent, medium, non-triturative; ***palp absent***. *Maxilla 1* present; inner plate present, weakly setose apically; palp present, not clavate, 1 - 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 reduced, 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 broader than long, overlapping, coxae not acuminate. *Coxae 1-3* not successively smaller, none vestigial. *Coxae 2-4* none immensely broadened.

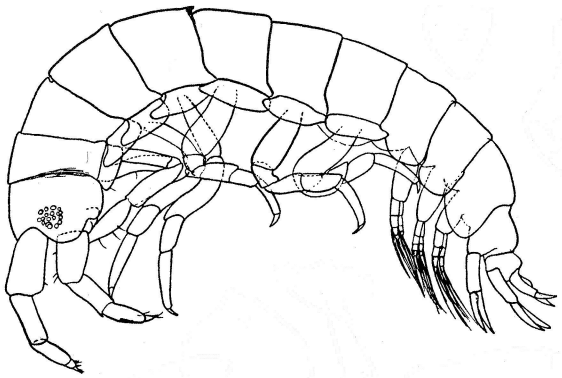
Gnathopod 1 not sexually dimorphic; smaller (or weaker) than gnathopod 2; subequal to coxa 2; gnathopod 1 merus and carpus not rotated; gnathopod 1 carpus/propodus not cantilevered; subequal to propodus, or longer than propodus; gnathopod 1 not produced along posterior margin of propodus; dactylus large, or minute. *Gnathopod 2* sexually dimorphic; simple, or carpochelate, or subchelate; coxa 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), none prehensile. *Peraeopod 3* well developed. *Peraeopod 4* well developed. 3-4 not glandular; 3-7 without hooded dactyli, 3-7 propodi without distal spurs. Coxa well developed, longer than broad or broader than long; carpus shorter than propodus, not produced; dactylus well developed. Coxa subequal to coxa 3, 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; **longer than peraeopod 6**; coxa subequal to coxa 4, without posterior lobe; basis slightly expanded or linear, subrectangular, without posteroventral lobe; merus/carpus free; carpus linear; setae absent. *Peraeopod 6* subequal in length to peraeopod 7; merus/carpus free; 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 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 not dorsoventrally flattened; urosomites 1 free, 2 and 3 coalesced; urosome urosomites not carinate; urosomites 1-2 without transverse dorsal serrations. *Uropods 1-2* apices of rami without robust setae. *Uropods 1-3* similar in structure and size. *Uropod 1* peduncle without long plumose setae, without basofacial robust seta, without ventromedial spur. *Uropod 2* well developed; without ventromedial spur, without dorsal flange; inner ramus subequal to outer ramus, or longer than outer ramus. *Uropod 3* not sexually dimorphic; peduncle short; outer ramus shorter than peduncle or subequal to peduncle or longer than peduncle, 1-articulate, without recurved spines. *Telson* laminar; entire; longer than broad, or as long as broad; apical robust setae absent." (Lowry and Springthorpe 2001).

Colomastix - A single species in the family is reported in California waters. It has been identified as *Colomastix pusilla* Grube 1861 in previous literature for the area (Barnard 1955, 1969a). The local form is now recognized as different from Grube's species (Barnard & Karaman 1991), and is referred to as *Colomastix* sp A SCAMIT 2012 on the SCAMIT list. It is probably not the same species described by Barnard (1955) from Hawaii.



Colomastix "pusilla" from Hawaii (From J. L. Barnard 1955)

It may be that here, as in other areas, a more discriminating look will find several colomastigid species unseparated in the past. The number of different forms is difficult to resolve at present, as no males have yet been recovered from the area. Species level characters have grown much more exacting in recent decades, with recognition of additional character states of the antennae, the head, the epistome, and other areas needed for species recognition. In earlier descriptions these were often either not recorded or imprecise, leaving the identity of early described species equivocal. Reexamination of either types or topotypic material will be required to adequately represent the condition of these species with regard to the additional character states.

Colomastigids are quite small, and *Colomastix* species appear to be associated with sponges or tunicates. In our waters they are usually reported from sponges. They have subequal, relatively short, antennae; a reduced urosome, simple G1, an enlarged G2 with inflated propod; small linear coxae, and eyes composed of multiple separated ommatidea; body is cylindrical or subcylindrical. In life several of the tropical western Atlantic species have distinctive color patterns (LeCroy 1995, 2004) lost in preservation.

Specimens of *Colomastix* sp A from California waters typically come from scrapings of fouling communities, settling plates, or similar sources. To my knowledge none have been gleaned from solitary sponges. It may be that the local representative(s)

Colomastix processa (From australian museum.net.au)

favor encrusting sponges rather than the larger free standing balls, antlers and vases found in more tropical regions. As yet none have been taken from areas north of Pt. Conception, but they probably occur further north within the NEP, as they penetrate into boreal waters in the Atlantic.

Diagnosis: "*Head large and free. Antennae 1 and 2 subequal in size, peduncles thick· but not immensely enlarged, not geniculate. Coxae 1-7 all very short and alike, much broader than long, strongly overlapping. Urosomite 1 without pleuron. Uropod 3 biramous though outer ramus often vestigial, main ramus not palmate*." (from J. L. Barnard & Karaman 1991

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