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# DECAPOD CRUSTACEA OF THE CALIFORNIAN AND OREGONIAN ZOOGEOGRAPHIC PROVINCES

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## a. General introduction

Approximately 280 species of decapod crustaceans live along the west coast of North America between Puget Sound and Magdalena Bay, Baja California, Mexico. Species of the shrimp families Crangonidae, Hippolytidae and Pandalidae and crabs of the Cancridae, Lithodidae, Majidae and Paguridae are particularly abundant. Many of the genera and species either are unique to the North Pacific or are found only along the west coast of North America.

The last major guide to the decapods of California or Oregon was Marine Decapod Crustacea of California, by W.L. Schmitt (1921). Schmitt's pioneering book, largely based on collections of the U.S. Fisheries steamer Albatross, now is badly out of date and difficult to obtain. Shallow-water species are mentioned in guidebooks to intertidal animals, such as those by Morris et al. (1980), Ricketts et al. (1985), and Smith and Carlton (1975). Good color photographs of shallow-water species, along with information on range and identifying features, can be found in the book by Jensen (1995). These works do not provide citations for the original descriptions or type localities, synonymies or other information needed by the specialist. There are no recent summaries or reviews of species of deeper benthic habitats and only one (Wicksten, 2002) listing of pelagic species. Revisions of the nomenclature, new systematic interpretations of families and higher taxa, descriptions of new species, range extensions and natural history information published since 1921 are scattered in the literature of at least seven nations and four languages. Many valuable works on decapods are old and unavailable except through major university libraries. Little is available on the internet. Even today, only the most meager details of anatomy and natural history are available for many species.

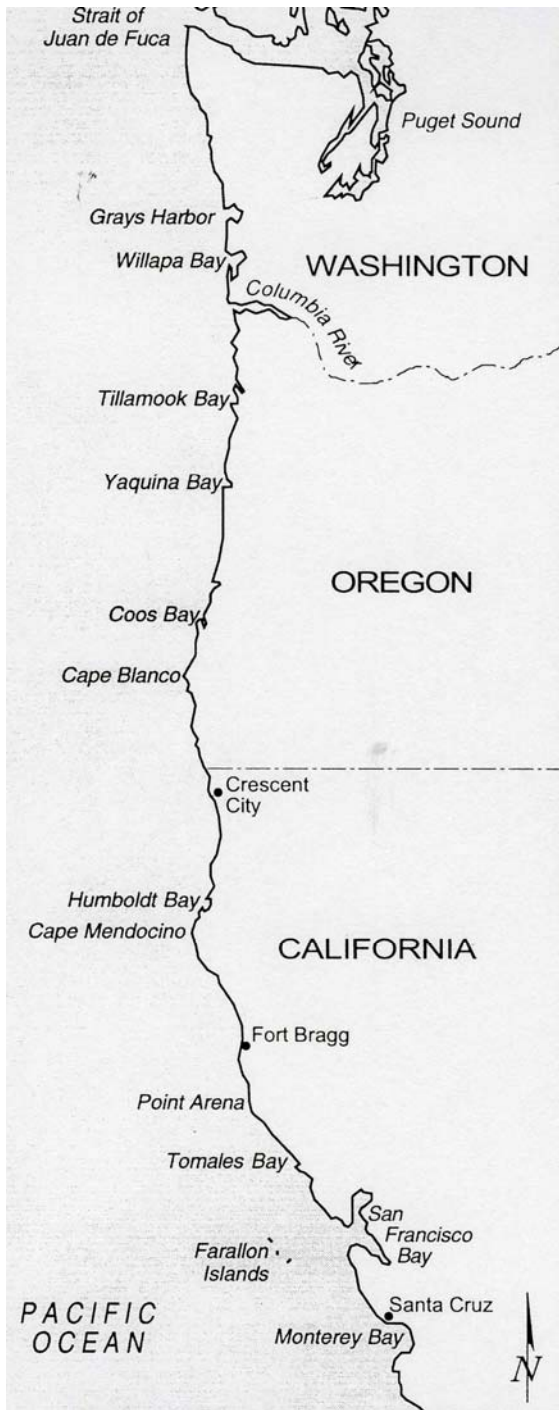
Compared to other marine invertebrates, decapods tend to be large and recognizable. Larger crabs, shrimp and lobsters are fished commercially for food or bait. Many species are important in food webs, feeding on small mollusks, worms, crustaceans or detritus and in turn being eaten by fishes, birds, seals or sea lions. Intertidal species have been used in behavioral or physiological research on regeneration, color changes, respiration and symbiotic relationships. Interested visitors to kelp beds and tide pools photograph and observe decapods.

One must identify a species in order to study it or label its photograph. Without the needed literature or training in the anatomy of decapod crustaceans, the interested biologist must seek out the few specialists who can identify northeastern Pacific decapods. The fauna of the northeastern Pacific differs greatly at the level of genera from that of tropical regions or the western Atlantic. A person familiar with decapods of other regions may have no idea where to find information on the fauna of the northeastern Pacific, especially if the pertinent literature is in Russian.

It is my hope to remedy the lack of a technical guide to decapods of the warm and cold temperate regions of the northeastern Pacific. The format of the text follows that of Shrimps, Lobsters and Crabs of the Atlantic Coast, by A. Williams (1984). The work is focused on nomenclature and natural history of the species. Literature on mariculture, fisheries and

physiology is not included. The text is directed to the biologist or advanced university student.

## b. Methods and Coverage

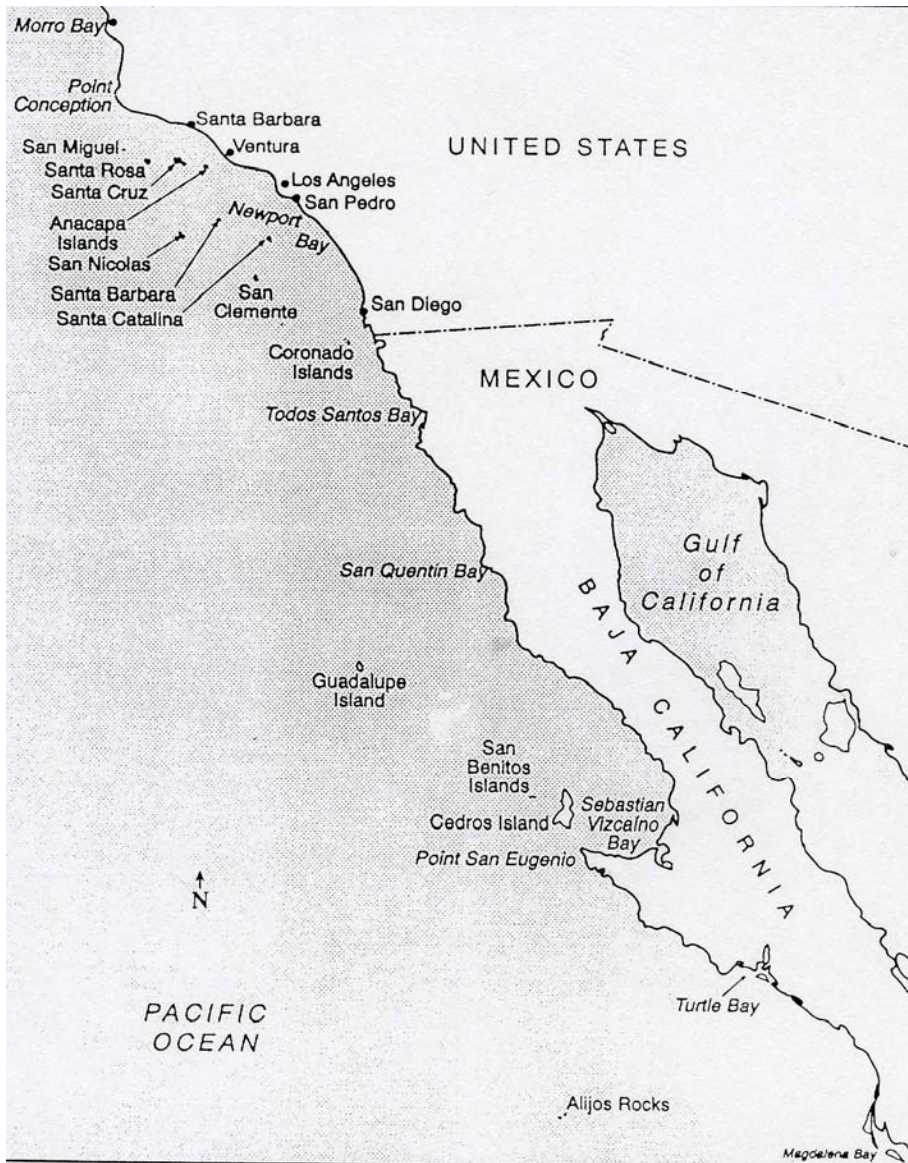


The present work provides information on all decapods that have been reported from Puget Sound to Magdalena Bay, Baja California; including fresh water species. Coverage extends from the intertidal zone to the continental slopes and lower mesopelagic zone. For purposes of this book, pelagic species are included that might be collected within the territorial waters of the United States, northern Mexico and southwestern Canada and not in the open sea. Species that are known from only a single record, misidentifications, non-reproducing introductions and questionable or unverified records are included in the accounts of each family.

The geographic area covered encompasses the Oregonian Zoogeographic Province, from Puget Sound to Point Conception, California; and the Californian Zoogeographic Province, from Point Conception to roughly Magdalena Bay (Brusca and Wallerstein, 1979). For species found in Puget Sound and to the north, consult the works of Kozloff (1974), Butler (1980) and Hart (1982). Species of western Mexico and the tropical eastern Pacific are covered by Hendrickx (1996, 1997), Hendrickx and Estrada-Navarrete (1996) and Wicksten and Hendrickx (2003).

Keys are provided for all families, and species if more than one species belongs to that family. The keys are based on identification features that can be used to distinguish between the families and species in the area of coverage. Classification follows Bowman and Abele (1982), Hendrickx (1996) and Martin and Davis (2001) except as noted. For a world-wide key to genera of caridean and stenopodidean shrimp, consult Holthuis (1993). Common names for many shrimp species have been compiled by McLaughlin and Camp, 2005, but are not included here.

Major synonymies are provided for each species. These include the citation of the original description and citations from major systematic works, widely-used checklists, textbooks and guidebooks, and shorter papers containing information on range, natural history or first records of occurrence in the area. The reader is referred to more extensive synonymies presented in systematic works where such exist. No new synonyms or descriptions of undescribed species are provided in this work.



Descriptions are based on published works as mentioned in the synonymies and also examination of specimens in the collections of the United States Museum of Natural History, Smithsonian Institution; California Academy of Sciences, Scripps Institution of Oceanography and Los Angeles County Museum of Natural History (repository of the collections of the Allan Hancock Foundation of the University of Southern California). The descriptions present recognition characters that are useful for identification without dissection. The systematist interested in minute details of setae, mouthparts, etc. is advised to examine actual specimens to see these features. Some of the species are known from a few specimens in poor condition; others are known only from short and old descriptions, so the descriptions presented here vary in their length and degree of complexity.

Drawings were based on actual specimens as much as possible. Where the drawing is based on a previous illustration, the source is cited. Color in life is based on published color plates, photographs and notes as well as field notes of living specimens. Range, depth and habitat are based on published information, field note and records from the collections mentioned previously. Latitude and longitude are given for locations away from easily located shore features. Any previously unpublished records include a station or collection catalogue number.

Collections and descriptions of northeastern Pacific decapods go back to the early 1800's. Some of the early biologists, such as Brandt and Owen, reported collecting localities that are easy to locate on a map today. Others were vague, giving locations such as "California". I have given the type locality as was written in the original description. I also have indicated where a type locality was not specified.

I have included remarks on taxonomy and natural history where such information will aid the reader in identifying a species. A few species have undergone extensive taxonomic revision; others have peculiar habits, morphological features or ecological relationships that are characteristic.

Every effort was exerted to insure that this work was up-to-date at the time of publication. Most of the illustrations either were newly prepared for this work or were derived from recent

and authoritative works. However, the reader is warned that many species, as mentioned in the text, can be variable in such features such as the number of spines, length of the rostrum, and size and shape of the chelipeds. The specific designation of some remains in question. The diligent biologist may find unknown variants within a species, previously unknown species, or synonyms. At present, few biologists have applied molecular or enzymatic techniques to the study of northeastern Pacific species. Such techniques could clarify the systematic relationships of many species-rich groups. The fauna of the continental slopes is largely unstudied between southern California and Oregon.

### c. Geographic distributions

Before widespread human activities, freshwater decapods ranged from California to Washington, U.S.A. There are no records of freshwater decapods from northern Baja California prior to the twentieth century. Two species of Syncaris, freshwater shrimp endemic to California, occurred in coastal streams. Native crayfish belonged to four species of Pacifastacus. The crayfish ranged into streams and rivers of the Coast, Sierra Nevada and Cascade Ranges as far east as Idaho. These cold-water decapods have their nearest relatives in Eurasia.

Marine species of the area under consideration tend to have extensive ranges. The most wide-ranging decapods are pelagic shrimp of the families Benthesicymidae, Sergestidae, Oplophoridae and Pasiphaeidae. Twelve species of these families occur almost world-wide; eight species range widely across the Indo-Pacific and eastern Pacific, and another twelve have extensive ranges in the northern or eastern Pacific. Hymenodora gracilis seems to be circumpolar and circumboreal in the northern hemisphere; H. glacialis is circumpolar and circumboreal in both hemispheres. Deep benthic decapods also tend to have extensive ranges, with at least eight species ranging from California to Peru or Chile.

Twelve decapod species, mostly caridean shrimp, range from northern Japan and the coast of Russia to southern California and western Mexico. More than 70 species range from Alaska or Canada south to California or western Mexico. The distributions of many species follow the Kuroshio and California currents, which flow eastward from Asia across the Aleutian Islands and then south to Point Conception, California. South of Point Conception, cold-water species may inhabit greater depths or remain in areas of upwelling. Other species follow the eddies of the California current and live on surf-swept sides of the outer and northern islands of the coast of southern California.

The Oregonian Province tends to have cooler summer waters, often about 9-10°C. Surf action is strong; coasts contain wave-swept beaches and rocky coasts. Surf-tolerant kelp such as Nereocystis lutkeana and Postelsia palmaeformis are characteristic. The crabs Oregonia gracilis and Metacarcinus magister and the shrimp Heptacarpus brevirostris are characteristic of the Oregonian province. A few species, such as Argis levior and Pagurus aleuticus, rarely are found south of Cape Mendocino, California. Some of the cold-water decapods rarely may be found south of Point Conception in deep water or in areas with strong upwelling. The shrimp Eualus barbatus and Spirontocaris lamellicornis usually are reported from north of Point Conception, but both have been found in canyons in Santa Monica Bay. Pagurus hemphilli and a few other northern decapods rarely are found regularly along the coasts of San Miguel Island and in areas of strong surf along other islands.

The Californian Province tends to be warmer, up to 15° or even more at the surface in summer. Beaches may be more gradual in slope; bays containing salt marshes and sand flats were abundant before human destruction. Beds of the kelp Macrocystis pyrifera are common while Nereocystis is rare. The spiny lobster, Panulirus interruptus, reaches its normal northern limit here, as do crabs of the families Goneplacidae, Ocypodidae and Portunidae. The shrimp

Heptacarpus brevirostris and crabs Petrolisthes cinctipes and Pagurus hirsutiusculus, common north of Point Conception, are replaced by Heptacarpus palpator, Petrolisthes cabrilloi and Pagurus venturensis, which occupy much the same intertidal habitats. During years of unusually warm currents (“El Niño years”), southern California is subject to short-term colonization by species characteristic of the tropical eastern Pacific, such as the pelagic crab Pleuroncodes planipes, the arrow crab Stenorhynchus debilis and the shrimp Plesionika mexicana and Solenocera mutator. See Engle and Richards (2001) and Montagne and Cadien (2001) for an account of warm-water species recently found in California.

Ranges of decapods may be interrupted by geographic or oceanographic barriers. Monterey Bay is unusually protected from incoming ocean swell and has protected coves and the estuary of Elkhorn Slough. Numerous species, such as the shrimp Heptacarpus palpator, Alpheus bellimanus and Alpheopsis equidactylus and the crab Cycloxanthops novemdentatus, have been found in Monterey Bay, but not been reported from areas between there and Point Conception. There have been few studies to determine which of these southern species are permanent residents with reproducing populations and which arrive and die out from time to time.

The fauna of southern California is influenced by substrate type and water temperature. Usually, one finds the shrimp Argis californiensis and the crab Erileptus spinosus along the islands, but they may be found off Point Dume and in rocky areas off Palos Verdes Point or La Jolla on the mainland. These species seem to prefer steep rocky areas with coarse sand. Sand-dwelling or silt-tolerant species such as Sicyonia ingentis and Crangon alaskensis usually occur along the mainland. Only one shrimp, Heptacarpus fuscimaculatus, is known only from the offshore islands of California and Baja California, but other species such as the shrimp Palaemonella holmesi and the crab Epialtoides hiltoni may be more common there than along the mainland.

It is difficult to place an exact southern limit to the Californian Zoogeographic Province, for the coast does not show an abrupt discontinuity in geography like Point Conception. Most coastal temperate species range to Punta Eugenia or Magdalena Bay, where rocky shores may experience upwelling. One finds patches of kelp beds and their associated cool-water species intermingled with sandy bays with more tropical groups along the central coast of Baja California, and a mixture of Californian and tropical species as far south as the Alijos Rocks (Wicksten, 1996). The fauna and associated algal flora can change dramatically from year to year according to current patterns and upwelling. See Garth, 1955, for a review of the southern limit of the warm-temperate fauna. There is a less well-defined change in the deep benthic fauna along the Pacific coast of Baja California, with the cold-water fauna of shrimp such as Spirontocaris sica and Pandalus jordani being replaced by various penaeid shrimp and species of Heterocarpus. See Wicksten (1989) for an account of ranges of deeper benthic decapods of the entire eastern Pacific.

#### **d. Habitats**

Most decapods occupy characteristic habitat and depth ranges. The visitor to the tidepools is most likely to encounter the shrimp Heptacarpus sitchensis, the shore crabs Hemigrapsus nudus and Pachygrapsus crassipes, and the hermit crab Pagurus samuelis. In the lower intertidal zone and in channels and deep pools, the shrimp Heptacarpus brevirostris, H. taylori and H. palpator may be common. The crabs Romaleon antennarius, Metacarcinus anthonyi and Cancer productus enter the tide pools. The kelp crab Pugettia producta commonly is found among algae, especially Egregia spp., while other species of Pugettia are common among red algae at the lowest tide zone. Porcelain crabs (Petrolisthes spp.) and pebble crabs (Lophopanopeus spp.) are very common under cobble in the intertidal zone. In southern California, the shrimp Betaeus

longidactylus is especially common in the intertidal zone under rocks. Other shrimp species, such as Alpheus clamator and Lysmata californica, may be exposed under rocks during the lowest tides. In central California, the hermit crab Pagurus hemphilli is characteristic of the lowest intertidal zone and upper subtidal zone.

Shallow rocky reefs abound in decapods. The shrimp Pandalus danae, Lebbeus lagunae, various species of Heptacarpus and Eualus, and Alpheus bellimanus may be common among rocks. The large crabs Cancer productus, Loxorhynchus crispatus and L. grandis forage among the rocks. The crab Mimulus foliatus usually is found concealed among red algae. Well-aerated rocky reefs north of Point Conception also are inhabited by various crabs of the family Lithodidae, such as Cryptolithodes sitchensis. The shrimp Lissocrangon handi, well camouflaged, rests in shelly sand near rocky reefs. Paguristes ulreyi, largest hermit crab of the subtidal zone, wanders across rocks and reefs. The shrimp Hippolyte clarki, Eualus lineatus and Heptacarpus fuscimaculatus often occur among kelp, especially south of Point Conception. The southern kelp crab Taliepus nuttalli ranges from kelp beds into the lowest intertidal zone. Where it has not been heavily collected, one may find groups of spiny lobsters, Panulirus interruptus, in cracks.

Wave-swept sandy beaches are the habitat for mole crabs and their relatives (Emerita analoga, Blepharipoda occidentalis and others). In southern and central California, a burrowing hermit crab, Isocheles pilosus, lives in the sand. In bays and along shore in southern California, the crabs Portunus xantusii and Randallia ornata dig into the sand. The hermit crabs Pagurus venturensis and P. hirsutiusculus often live among rocks in muddy sand, as does the shore crab Hemigrapsus oregonensis. In muddy sand, burrowing ghost shrimp (families Callianassidae and Upogebiidae) are abundant, as well as pea crabs, family Pinnotheridae, that live in the burrows of large burrowing mollusks, worms and ghost shrimp. One species of fiddler crab, Uca crenulata, inhabits salt marshes in southern California. Although many common nearshore decapods range into beds of eelgrass (Zostera sp.), only one shrimp, Hippolyte californiensis, usually is confined to this habitat. Species of Heptacarpus, especially H. paludicola, often live in sea grass beds. Shrimp of the family Crangonidae commonly live in protected sandy areas, often near sea grass beds. Commensal species of the shrimp Betaeus may live in the burrows of ghost shrimp (Neotrypaea spp.).

Subtidal sandy areas beyond the surf zone are characterized by numerous shrimp of the family Crangonidae. Other shrimp, such as Spirontocaris snyderi and Heptacarpus stimpsoni, and the crab Metacarcinus gracilis are abundant in subtidal sandy areas. Spirontocaris lamellicornis, Pagurus armatus and Metacarcinus magister are found on sand north of Point Conception. In southern California, Pagurus spilocarpus ranges across subtidal sand. In deeper areas with more mud, Pandalus jordani and Sicyonia ingentis become abundant. Argis californiensis usually occurs at the shelf break in southern California. Deeper on the shelf, the shrimp Spirontocaris sica and the spider crab Chorilia longipes are among the common species.

The continental slopes are inhabited by the shrimp Spirontocaris holmesi, Pandalus platyceros, and other species of the Pandalidae, Hippolytidae and Crangonidae. Tanner crabs Chionoecetes tanneri, are the deepest brachyuran crabs in the area. Crabs of the families Lithodidae and Galatheididae, such as Paralithodes californiensis, Janetogalatea californiensis and Munida quadrispina, live along walls of canyons or deep-water rocky areas. Species of the shrimp Glyphocrangon are characteristic of depths of over 1000 m, as well as the hermit crabs Pagurus tanneri and Parapagurus benedicti, the flatback lobster Stereomastic pacifica, and crabs of the family Lithodidae, such as Paralomis multispina. The shrimp Lebbeus washingtonianus and L. vicinus and the blind galatheids of the genus Munidopsis are among the deepest species of the continental slope. Members of the anomuran family Chirostylidae tend to associate with deep-

water colonial corals (orders Antipatharia and Gorgonacea).

Midwater areas typically are inhabited by shrimp of the families Benthesicymidae, Oplophoridae, Pasiphaeidae and Sergestidae. These shrimp sometimes are caught in baited traps as they attempted to scavenge on food being raised to or lowered from the surface. Many of these species migrate vertically, being found at lesser depths by night than by day. The crab Planes cyaneus is found in offshore water where it clings to driftwood or to the backs of sea turtles. Ebeling et al. (1969) classified assemblages of midwater shrimp and fishes by depth in basins off southern California. Percy and Forss (1966), Wasmer (1972b) and Krygier and Wasmer (1975) published accounts on the vertical and horizontal distribution of midwater decapods, especially species collected off Oregon.

Cool temperate regions usually do not have as many species of symbiotic crustaceans as do tropical areas. Pontonia californica lives inside the branchial basket of large ascidians. Betaeus spp. may associate with sea urchins, large gastropod mollusks, porcelain crabs or ghost shrimp. Lysmata californica often lives in the hole of a moray eel and cleans the fish. Members of the crab family Pinnotheridae are symbionts of mollusks, echinoderms, burrowing decapods and worm-shaped invertebrates.

Bays and harbors receive introduced species, either deliberate attempts by fishermen or bait gatherers to produce useful harvests or the result of careless disposal of left-over catches or shipments. The Oriental shrimp Palaemon macrodactylus has been found repeatedly over decades in San Francisco Bay, and seems to be the most well established of these introductions. The green crab Carcinus maenas seems to be spreading from a point of introduction in San Francisco Bay northward. Freshwater streams abound in the introduced crayfish Procambarus clarkii, native to the eastern United States, but a native species, Pacifastacus leniusculus, also has been spread far outside of its native range.

#### **e. Acknowledgements**

Originally, this work was conceived as being an up-to-date version of Schmitt's work of 1921. John S. Garth and Janet Haig of the University of Southern California contributed greatly to the development of the work, but did not live to provide text for their proposed sections on the Brachyura and Anomura.

Many others helped with the loan of specimens, contribution of new records or provision of photographs and field notes. Dustin Chivers, Christopher Mah and Robert Van Syoc of the California Academy of Sciences helped with many loans and records. Joel Martin and George Davis of the Los Angeles County Museum of Natural History, Gilbert Rowe of Texas A&M University, Brian Kensley and his assistants at the United States National Museum of Natural History and Spencer Luke and Lawrence Lovell of Scripps Institution of Oceanography sent specimens on loan. Don Cadien, Los Angeles County Sanitation District, and other members of the Southern California Association of Marine Invertebrate Taxonomists searched their collections for anything unusual and provided field notes. John Yaldwyn, Dominion Museum, Wellington, New Zealand, prepared a field key to pelagic crustaceans of the San Pedro Basin, California. Michel Hendrickx of the Estación Mazatlán, Universidad Autónoma de Mexico, helped with information on midwater species. I thank John Moore, Dick Turner and many gracious underwater photographers for providing excellent digital photographs of living decapods in their natural habitat. I owe a great debt of gratitude to Peter Brueggeman of Scripps Institution of Oceanography Library, University of California San Diego Libraries, for helping assemble this large work and bringing the computer formatting up to date.

Works on decapods of the northeastern Pacific depend largely on the descriptions of Fedor Brandt, William Stimpson and especially Mary Jane Rathbun. These pioneering biologists tried



to make sense of a bewildering number of undescribed species. See Garth and Wicksten (1993) for an account of the history of crustacean studies in the area. Modern biologists owe these forerunners a debt of gratitude.

**f. Revision History**

July 2008: revised genera in Sergestidae.

April 2009: Enigmatheres canfieldi, formerly Fabia canfieldi

January 2011: revision of Parapontophilus; range extension of Synalpheus lockingtoni

# THE SHRIMP

Older works classified all shrimp-shaped decapod crustaceans into a single suborder, the Natantia (meaning "swimmers"). More recent studies of larval stages, gill types and enzymatic structure indicate that the three major groups of shrimp are not so closely related. The suborder Dendrobranchiata contains animals with dendrobranchiate gills (Fig. 3). The first three pereopods are chelate; the pereopods may bear exopods. The second abdominal somite does not overlap the first along the anterior margin. The male bears a copulatory organ, the petasma; the female has a distinct genital area, the thelycum (see fig. 6, for example). A nauplius larval stage is present. The female does not brood the eggs below the abdomen. Most dendrobranchiates in California and Oregon are midwater or deep benthic species, but three species occur near shore or on the continental shelf.

The suborder Pleocyemata contains shrimp-, lobster- and crab-shaped species. None have dendrobranchiate gills. The female broods the eggs beneath the abdomen. The nauplius stage is passed in the developing egg. Although copulatory structures may be present, they are not in the form of a thelycum or petasma. Most shrimp and other decapods of California and Oregon belong to this suborder, which inhabits both marine and freshwater habitats.

Shrimp of the suborder Pleocyemata are further divided into two infraorders. Only one species of the infraorder Stenopodidea has been found off California. In the stenopodids, the gills are trichobranchiate (fig. 3). The first three pairs of pereopods are chelate, but without exopods. The third pereopods are large and lobster-like. The second abdominal somite does not overlap the first. The carapace has a row of spines along the dorsal surface. The species in California inhabits deep-sea sponges.

The most common shrimp in the Californian and Oregonian Provinces belong to the infraorder Caridea. These shrimp have phyllobranchiate gills (fig. 3). In all but a few rare species (not found in the area), only the first and second pereopods bear chelae. Exopods are found on the pereopods of some deep-sea species, but are absent on most common coastal carideans. The second abdominal somite overlaps the first; the third often forms a sharp bend or hump along the posterior margin. In California, freshwater shrimps of the family Atyidae can occur in coastal streams, but the majority of carideans are marine. For a key to all the known families and genera of the Caridea and Stenopodidea world-wide, see Holthuis (1993).

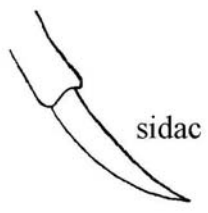
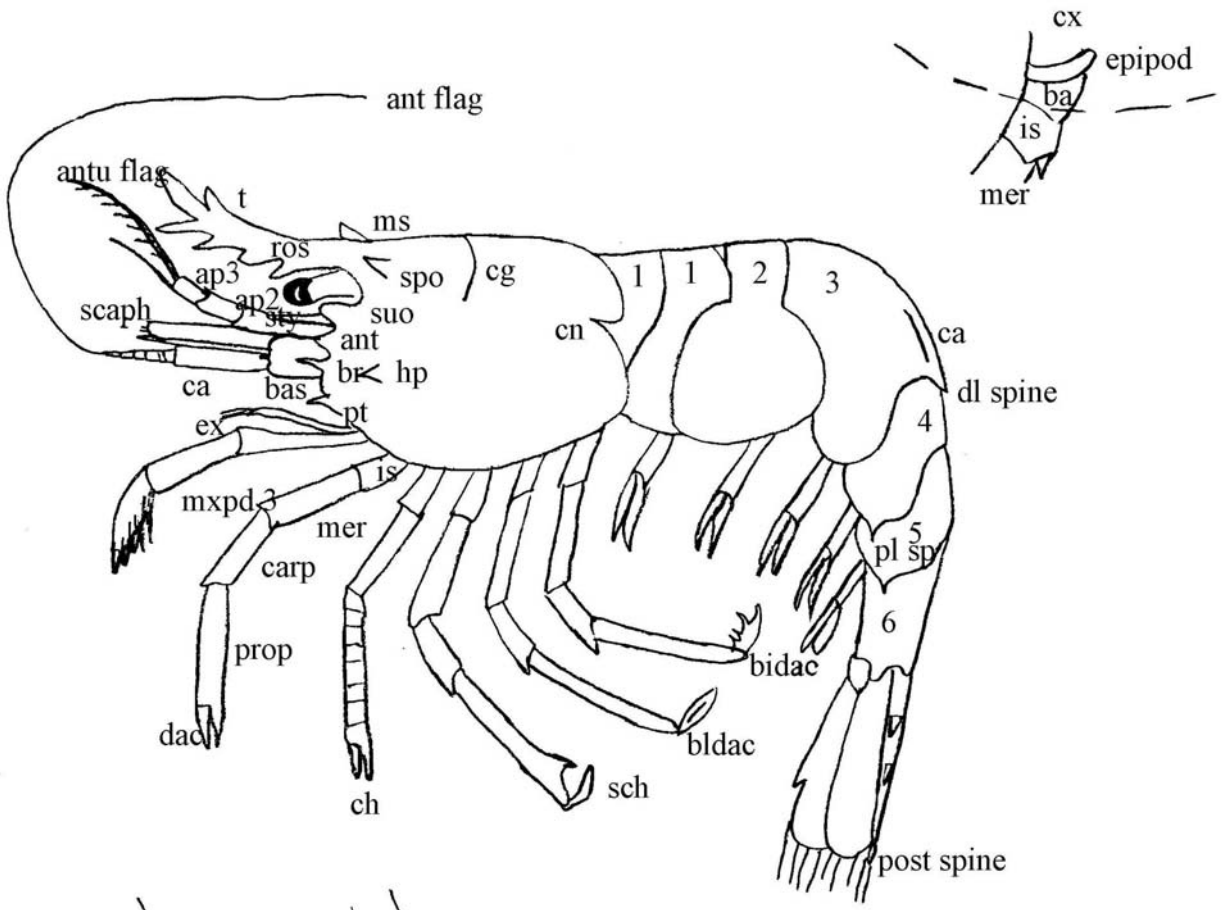
# KEY TO THE FAMILIES OF SHRIMP

1. Pleura of second abdominal somite not overlapping those of first and third pleura. Third pereopod chelate -----2  
Pleura of second abdominal somite overlapping those of first and third pleura. Third pereopod not chelate-----7
2. Male with petasma, female with thelycum. Third pereopods not larger than first or second-----3  
Male without petasma, female without thelycum. Third pereopods larger than first or second----- family Stenopodidae
3. First to third pereopods chelate, fourth and fifth pereopods well developed, male without antennular flagellum modified as clasping organ-----4  
First pereopod not chelate, fourth and fifth pereopods reduced, male with antennular flagellum modified as clasping organ-----family Sergestidae
4. Rostrum with ventral teeth. No postorbital spine, abdominal somites without prominent dorsal carinae-----family Penaeidae  
Rostrum without ventral teeth. Postorbital spine present or absent, abdominal somites with or without prominent dorsal carinae-----5
5. Postorbital spine present, abdominal somites without prominent carinae----- family Solenoceridae  
Postorbital spine absent, abdominal somites with or without prominent carinae-----6
6. Abdominal somites and carapace with prominent carinae, often with enlarged teeth, exoskeleton well calcified. (Nearshore sandy or muddy bottoms or continental shelf)----- family Sicyonidae  
Abdominal somites and carapace without prominent carinae, usually without teeth, exoskeleton thin. (Continental slopes and pelagic habitats)-----family Benthescymidae
7. Fingers of chelae with conspicuous terminal brushes of setae. Inhabiting freshwater streams----- family Atyidae  
Fingers of chelae without conspicuous terminal brushes of setae. Marine or estuarine-----8
8. Pereopods with exopods-----9  
Pereopods without exopods-----11

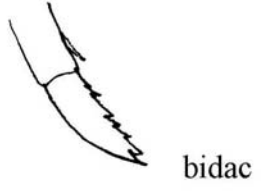
9. Chelae with slender fingers lined with comb-like spinules; rostrum absent or represented by small, short spine-----family Pasiphaeidae
- Chelae with fingers stout to slender, but not lined with comb-like spinules; rostrum short to long and toothed-----10
10. Last three pair of pereopods not conspicuously lengthened, carpus of these legs distinctly shorter than propodus-----family Oplophoridae
- Last three pair of pereopods conspicuously lengthened, carpus of these legs several times longer than propodus----- family Nematocarcinidae
11. First pereopods subchelate. Benthic species, capable of digging into substrate-----12
- First pereopods chelate. Usually epibenthic species-----13
12. Second pereopod with carpus subdivided into articles. Carapace with prominent spines and ridges. Continental slopes only-----family Glyphocrangonidae
- Second pereopod with carpus not divided into articles. Carapace with smaller spines and ridges (if any). Intertidal to continental slopes-----family Crangonidae
13. Carpus of second pereopod not divided into articles-----14
- Carpus of second pereopod divided into 3-many articles -----15
14. First and second pereopods nearly equal in size and shape; fingers of chelae long and slender, without teeth but with long setae. (Known in area of coverage only from deep slopes or abyssal plains )-----family Stylodactylidae
- Second pereopod often larger and heavier than first; fingers of chelae not particularly long and slender, teeth may be present, without long setae. (In area of coverage, in fresh water and shallow marine habitats)-----family Palaemonidae
15. First pereopods heavy, strongly chelate. Carapace with posterior notch. Rostrum absent or reduced to small spine-----family Alpheidae
- First pereopods not as heavy, chelae smaller. Carapace without posterior notch. Rostrum usually toothed and elongated-----16
16. Eyestalks elongate, anterior dorsal part of carapace with numerous small spines----- family Ogyrididae
- Eyestalks not as long, anterior dorsal part of carapace with at most few pair supraorbital spines-----17
17. Rostrum with movable spines, often long and curved upward-----family Pandalidae

|   |                     |
|---|---------------------|
| Rostrum without movable spines, length and shape variable-----  | 18                  |
| 18. Rostrum very short, at most barely as long as eye, with no dorsal or ventral teeth. (San Diego, California southward; living in sand or mud)----- | family Processidae  |
| Rostrum short to long, with dorsal and/or ventral teeth. (Throughout area of coverage; living on or in diverse substrates)-----                       | 19                  |
| 19. Carpus of second pereopod with more than 20 articles. Antennular flagella long, as long as body or more when intact-----                          | family Lysmatidae   |
| Carpus of second pereopod with seven or fewer articles. Antennular flagella short and setose-----   | 20                  |
| 20. Carpus of second pereopod with three articles. (One supraorbital spine)---  | family Hippolytidae |
| Carpus of second pereopod with seven articles. (Zero to four supraorbital spines)-----  | family Thoridae     |

# The Complete Shrimp



sidac



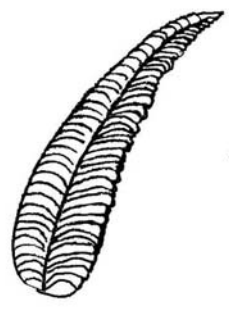
bidac



Dendro



Tricho



Phyllo



## **The carapace and rostrum:**

ros=rostrum (usually attached, but can be movable if hinge at base as in Pantomus)

t =tooth (no socket), ms=movable spine.

cg=cardiac groove (note: a groove may be called a sulcus).

cn=cardiac notch

spo=superorbital spine, suo=suborbital spine, ant=antennal spine, br=branchiostegal spine,

pt=pterygostomian spine, hp=hepatic spine.

Note: peneids have additional spines and grooves; other families have carinae on the carapace.

The carinae are named according to the region of the carapace where they occur.

## **Segments of the legs:**

cx=coxa, ba=basis, is=ischium, mer=merus, carp=carpus, prop= propodus, dac=dactyl

Upper right: epipod

## **The antennae:**

sty=stylocerite (long spine or scale lateral to first segment of first antenna).

apl=first segment of peduncle of 1st antenna; ap2=second, ap3=third.

antu flag= flagellum of 1st antenna; atn flag=flagellum of second antenna

scaph=scaphocerite (=antennal scale), ca= carpocerite (thickened base of flagellum),

bas=basicerite

## **The thoracic appendages:**

ex=exopod (usually short)

mxdp 3=third maxilliped (often with setose terminal segment)

sch=subchela, ch=chela, bidac=biunguiculate dactyl (ends in 2 large hooks or claws),

sidac=simple dactyl, bldac=bladed (or spatulate) dactyl.

## **The abdomen and tail fan:**

Segments are numbered from anterior to posterior.

can=carina, pl sp =pleural spine, dl spine =dorsolateral spine, post spine=posterior spine.

Gill types: dendro= dendrobranchiate; tricho=trichobranchiate; phyllo=phyllobranchiate.

## SUBORDER DENDROBRANCHIATA

Until recently, all dendrobranchiates were included in two families: the Penaeidae and the Sergestidae. Recent revision has split what once were subfamilies into families in their own right. The interested reader should consult the authoritative work by Pérez Farfante and Kensley (1997) for a detailed consideration of the group.

The key given here is modified from Pérez Farfante and Kensley (1997) to facilitate identification of species in the geographic area of coverage. For species found in the southwestern Pacific coast of Baja California, the reader should refer to the work by Hendrickx (1996).

### Key to the Families of the Dendrobranchiata

1. Fifth pereopod considerably shorter than other pereopods. Never more than 7 or 8 branchiae present on each side. (Strictly pelagic, rostrum shorter than eyestalk)-----family Sergestidae

Fifth pereopod similar in size at least to fourth pereopod. At least 11 branchiae present on each side. (Pelagic or benthic, rostrum shorter than or longer than eyestalk)-----2

2. Only one or two rostral or postrostral teeth. Exoskeleton often thin. (Usually found at greater than 500 m)-----family Benthescymidae

More than two rostral or postrostral teeth. Exoskeleton firm. (Usually found at less than 200 m)-----3

3. Integument very rigid. Abdomen with obvious sharp dorsal carina-----family Sicyoniidae

Integument not as rigid. Abdomen without sharp dorsal carina-----4

4. Carapace with postorbital tooth. Rostrum without ventral teeth-----family Solenoceridae

Carapace without postorbital tooth. Rostrum with ventral teeth-----family Penaeidae



## Family Penaeidae

The family Penaeidae includes many of the large, edible shrimp and prawns taken commercially by trawling. These species are most abundant on sand and mud bottoms of warm-temperate and tropical waters. In the eastern Pacific, they are common from the Gulf of California to Peru.

Only one species, Farfantepenaeus californiensis, occurs in California. Although it is large and edible, it rarely occurs in California in sufficient quantities to support a fishery.

Genus Farfantepenaeus Pérez Farfante and Kensley, 1997

Farfantepenaeus californiensis (Holmes)

Penaeus californiensis Holmes, 1900: 218, pl. 4, figs. 64-69.--Anderson and Lindner, 1943: 307.--Kerstitch, 1989: 82, fig. 201.

Penaeus (Farfantepenaeus) californiensis.-- Méndez, 1981: 50, pl. 14, figs. 111-113.-- Von Sternberg and Motoh, 1995: 146.-- Hendrickx, 1996: 35, fig. 17.

Farfantepenaeus californiensis.-- Pérez Farfante and Kensley 1997: 79. —Debelius 1999: 114.-- Wicksten and Hendrickx 2003: 57.

Penaeus brevirostris: Rathbun, 1904: 146; Schmitt, 1921: 21, fig. 9 (not

Penaeus brevirostris Kingsley, 1878b).

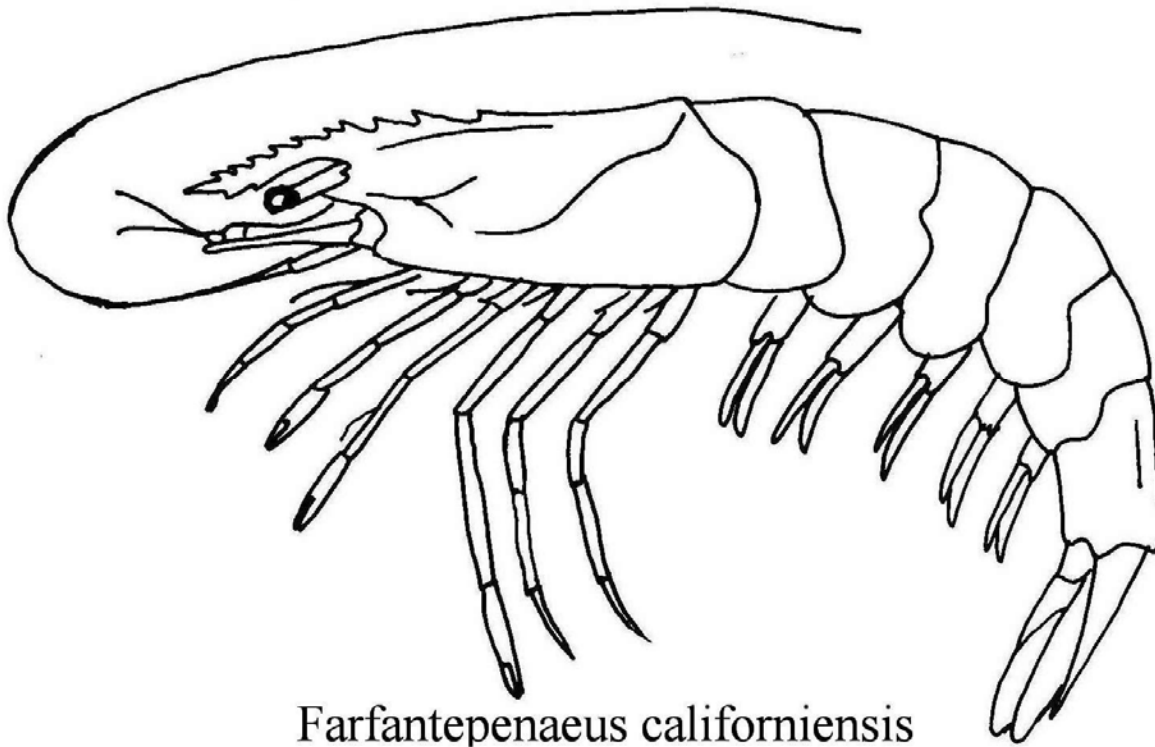
Recognition characters: Rostrum longer than eye, with 9-11 dorsal and 2-3 ventral teeth, extending posteriorly as carina along dorsal midline of carapace, grooves parallel to rostrum and carina. Carapace with antennal tooth, pterygostomial margin produced forward into blunt knob, carina running posteriorly from antennal tooth, grooves posterior to orbit and near hepatic spine. Stylocerite longer than eye. Scaphocerite with tapered tip. Third maxilliped with long exopod, pereopods with exopods. First to third pereopods chelate, fourth and fifth with simple dactyls. First to fifth abdominal pleura blunt, sixth with posterodorsal and posterolateral points; part of fourth and all of fifth and sixth abdominal somites with dorsal carina. Telson shorter than uropods, with dorsal groove. Total length 88-201 mm.

Color in life: Rose brown, sometimes with dull brown vertical stripes on abdominal somites.

Habitat and depth: Sand and mud bottoms of bays to continental shelf, 2-180 m.

Range: San Francisco Bay, California to Callao, Peru, but uncommon in California. Type locality not specified, type material came from Anaheim and San Francisco Bays, California.

Natural history remarks: Farfantepenaeus californiensis usually occurs north of Point Conception in years of particularly warm currents. The species has been found in channels of cooling waters from steam-generating power plants.



*Farfantepenaeus californiensis*

## Family Solenoceridae

Species of this family bear a unique postorbital spine. They usually are found on sand or mud on the continental shelf. In life, the flagella of the antenna are as long as the body. Only one species occasionally occurs in California.

Genus Solenocera Lucas, 1850

Solenocera mutator Burkenroad

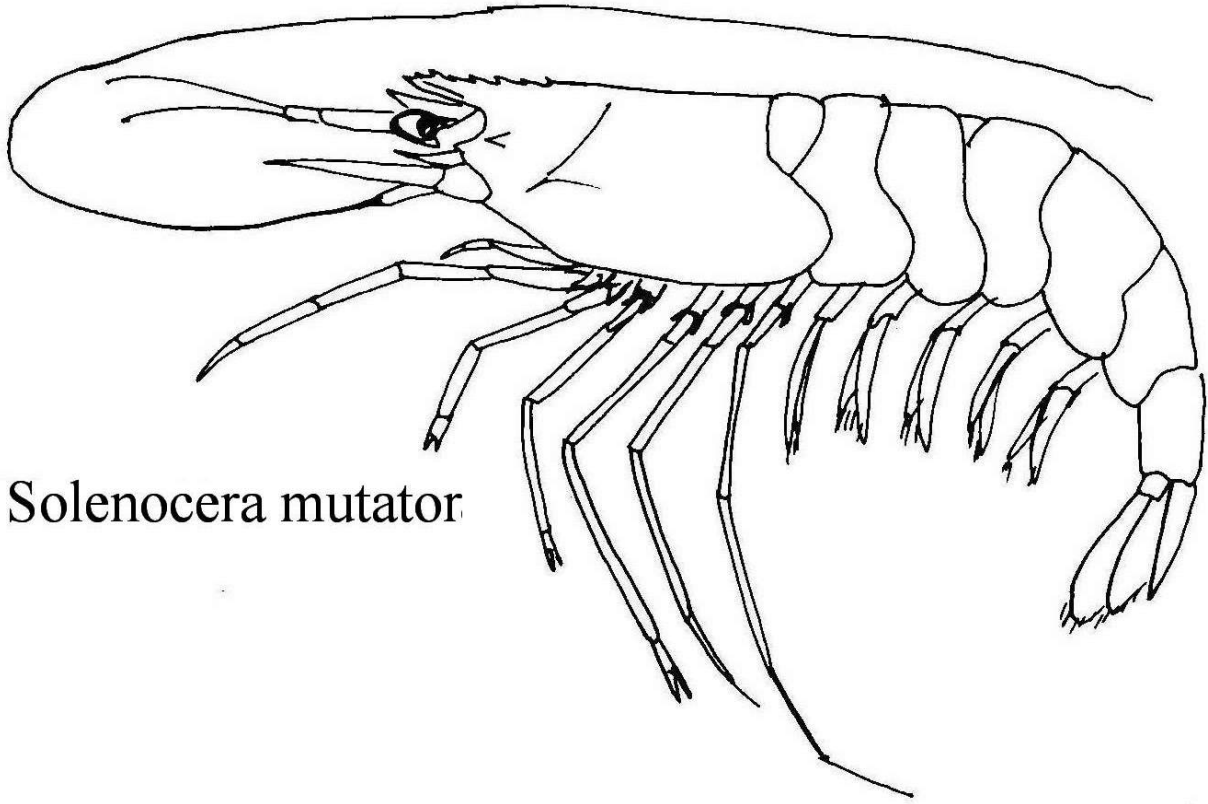
Solenocera mutator Burkenroad, 1938: 6, figs. 2-5.-- Anderson and Lindner, 1943: 288.-- Méndez, 1981: 57, pl. 21, figs. 169-171.-- Wicksten, 1988: 241.-- Hendrickx, 1996: 126, fig. 64.—Pérez Farfante and Kensley 1997: 182.—Wicksten and Hendrickx 2003: 59.

Recognition characters: Rostrum about as long as eye, with 7 dorsal and no ventral teeth, acute tip. Carapace with postorbital, antennal and pterygostomian teeth, grooves near base of rostrum and cervical groove. Stylocerite about as long as eye. Antennular flagellum flattened. Stylocerite with tapered tip. Third maxillipeds long and slender. All pereopods with exopods. First to third shorter than fourth and fifth, chelate; fourth and fifth very slender with simple dactyls. Pleura of abdominal somites 1-3 rounded, fourth and fifth with acute distolateral margins, sixth ending in small distolateral spine. Telson shorter than uropods. Total length 42.5-61 mm.

Color in life: Not recorded.

Habitat and depth: Sand or mud, 11-190 m.

Range: Off Santa Barbara Point, California to Lobos de Tierra Island, Peru. Type locality southern Baja California, Mexico.



*Solenocera mutator*

## Family Sicyonidae

Sometimes called rock shrimp, members of this family usually have a well-calcified exoskeleton. The dorsal midline of the carapace and abdomen bear a carina, often with prominent spines. The rostrum is conspicuous. In life, these shrimp bury into sand or shelly sand. They are edible, and are fished commercially in many warm-temperate areas world-wide.

The only species of this family native to the area is Sicyonia ingentis. Two other species, however, have been seen off southern California in recent years. Sicyonia penicillata Lockington, 1879 has been collected rarely in Santa Monica Bay and in the vicinity of Los Angeles-Long Beach Harbors (D. Cadien, pers. comm.) This species has a large dark spot on the branchial region of the carapace. Hendrickx (1996, fig. 56) provided a good illustration of this species. Divers have photographed occasional individuals of S. picta Faxon, 1893, off Santa Catalina Island, California. This species has a large eye-like marking on the posterolateral part of the carapace. Unlike S. penicillata, it has no tooth on the dorsal midpoint of the carapace. See Hendrickx (1996, fig. 58) for an illustration. Both of these species usually range from the Gulf of California and the southern end of Baja California, Mexico southward. Should global warming continue, either or both of these species might establish a breeding population in southern California.

Genus Sicyonia H. Milne Edwards, 1830

Sicyonia ingentis (Burkenroad)

Eusicyonia ingentis Burkenroad, 1938: 88, fig. 31-34.-- Anderson and Lindner, 1945: 318.

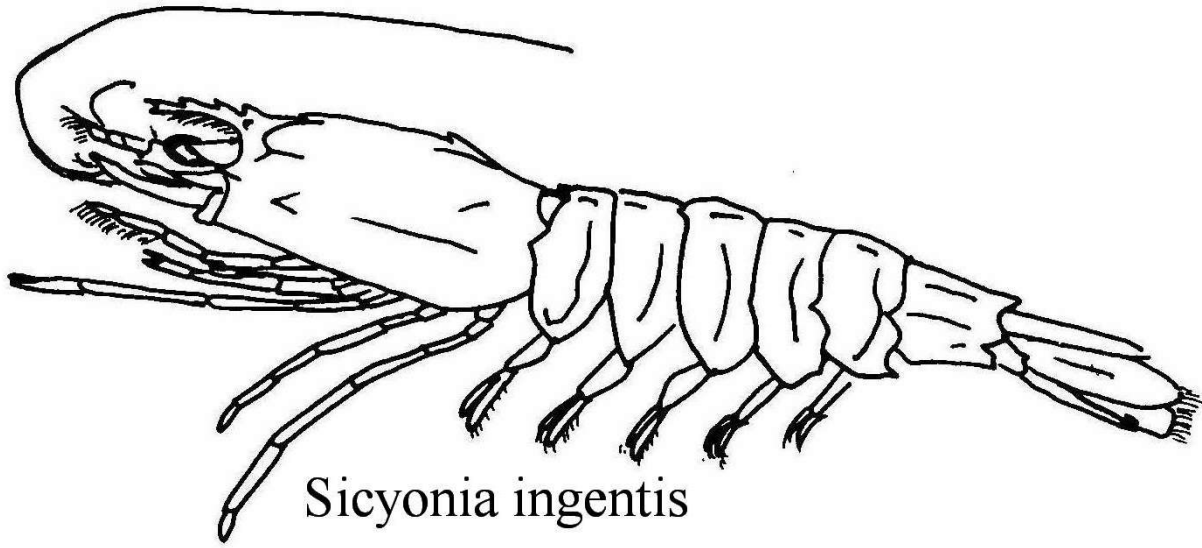
Sicyonia ingentis: Pérez Farfante, 1985: 69, figs. 52, 57-60.-- Hendrickx, 1996: 94, fig.48, pl. 2B.-- Pérez Farfante and Kensley 1997: 156.-- Wicksten and Hendrickx 2003: 58.

Recognition characters: Rostrum longer than cornea of eye, with 3 dorsal and 2-3 apical teeth. Carapace with dorsomedial carina bearing small tooth posterior to mid-carapace, with antennal tooth and hepatic spine; postorbital and hepatic grooves, and hepatic and branchiocardiac carinae. Stylocerite longer than eye., Scaphocerite with lateral tooth exceeding blade, blade rounded. Third maxilliped slender and setose. First to third pereopods chelate, third longest of the three; fourth and fifth pereopods with simple dactyls. First abdominal somite with small dorsal tooth on anterior margin, all abdominal somites with vertical grooves and dorsomedian carina. First to third abdominal pleura rounded to slightly pointed, fourth to sixth ending in sharp posterolateral spines. Sixth abdominal somite with carina ending in sharp point. Telson shorter than uropods, with deep median groove, pair small subterminal spines. Total length 157-180 mm.

Color in life: Reddish-brown, bases of pereopods banded with brick red, distal parts of pereopods yellow; light vertical yellow lines along margins of first to fourth abdominal pleura.

Habitat and depth: Usually sandy bottoms, but also on shell or mud, 5-307 m, in California, most abundant at 55-82 m.

Range: Monterey Bay, California to Isla Maria Madre, Nayarit, Mexico, including central and southern Gulf of California. Type locality off east coast of Cedros Island, Baja California.



*Sicyonia ingentis*



*Sicyonia ingentis*

## Family Benthescymidae

Species of this family occur on the continental slopes and in the offshore water column. These species are poorly known, and may be much more common than their records indicate. The exoskeleton is thin and membranous. Many species are colored orange to dark red. Although features of the telson and carapace may be characteristic of certain species, the soft exoskeleton often is torn or twisted during collection. Definitive identification relies on examination of the genital apparatus, especially among midwater species.

Species of Benthescymus are the largest members of this family in California. These benthic shrimp inhabit muddy areas of the continental slopes and abyssal plains. Species of Gennadas and Bentheogennema live in midwater. Species of Gennadas are very similar in appearance, and must be identified by comparison of the copulatory structures. The key follows a key given by Wasmer (1972b) for identification of species of Gennadas.

Midwater benthescymids undergo vertical migrations. They feed primarily on copepods, ostracods, and other small crustaceans (Heffernan and Hopkins, 1981). Information included here from the San Pedro Basin is based on unpublished records and color notes by John C. Yaldwyn, University of Wellington, New Zealand.

### Key to the Species of the Family Benthescymidae

1. Endopodites of second maxillipeds slender. (Usually benthic)-----2  
Endopodites of second maxillipeds with merus thin, broad and compressed. (Usually pelagic)----  
-----4
2. Posterior margin of fourth abdominal somite armed with comb-like denticles and teeth-----  
-----Benthescymus laciniatus Rathbun  
Posterior margin of fourth abdominal somite not armed with comb-like denticles and teeth----3
3. Median carina of fifth and sixth abdominal somites terminating posteriorly in small acute tooth-----Benthescymus tanneri Faxon  
Median carina of fifth and sixth abdominal somites not terminating in teeth; sixth somite ending in upturned transverse ridge-----Benthescymus altus Bate
4. Podobranchs absent on pereopods 1-3. Telson with single pair mobile lateral spines-----5  
Podobranchs present on pereopods 1-3. Telson with more than single pair mobile lateral spines-----8
5. Female with orifices of seminal receptacles opening independently, not included in common atrium. Male with distolateral lobe of petasma undivided-----6  
Female with orifices of seminal receptacles lying within common atrium. Male with distolateral lobe of petasma divided-----7

6. Female with subtriangular structure present on sternite XIII, between fourth pereopods; two symmetrical protuberances transversely located just in front of this structure from posterior margin of fifth thoracic sternite, male with external lobe of petasma undivided; distoventral lobe of petasma divided-----Gennadas tinayrei Bouvier

Female without such structure, male with external distoventral lobe of petasma undivided-----Gennadas sordidus Kemp

7. Female with thelycum provided with subrectangular, tong-shaped projection extending forward from sternite XIV and reaching to posterior edge of sternite XIII; male with external lobe of petasma much longer than median lobe-----Gennadas incertus (Balss)

Female without such subrectangular structure, but subtriangular structure on sternite XIII, between the second pereopods and with strong transverse crest on anterior part of sternite XIV. Male with external lobe of petasma shorter than median lobe----Gennadas propinquus Rathbun

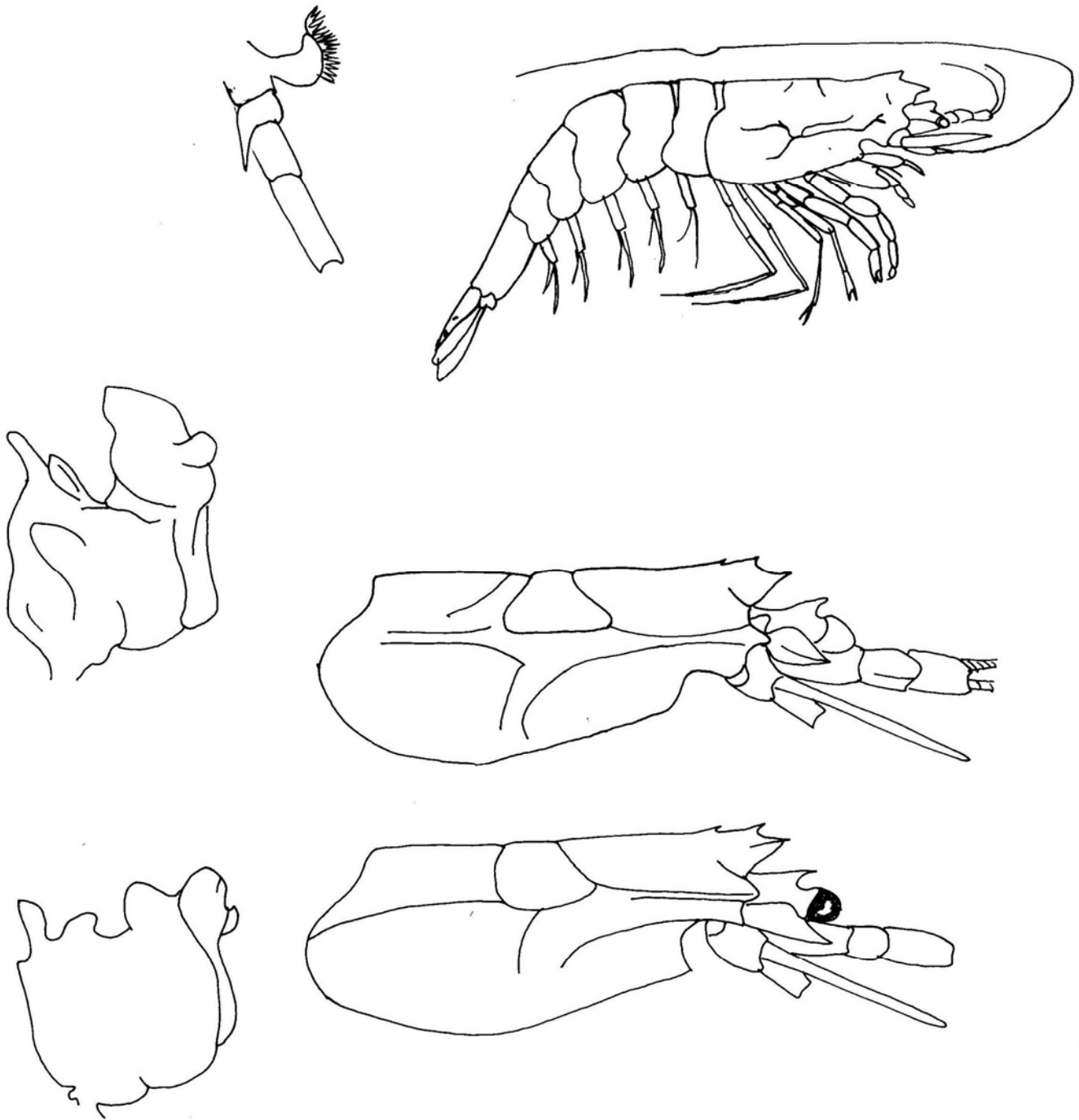
8. Cervical and post-cervical sutures not closely approaching each other on dorsal midline-----Bentheogennema borealis (Rathbun).

Cervical and post-cervical sutures closely approaching each other on dorsal midline-----9

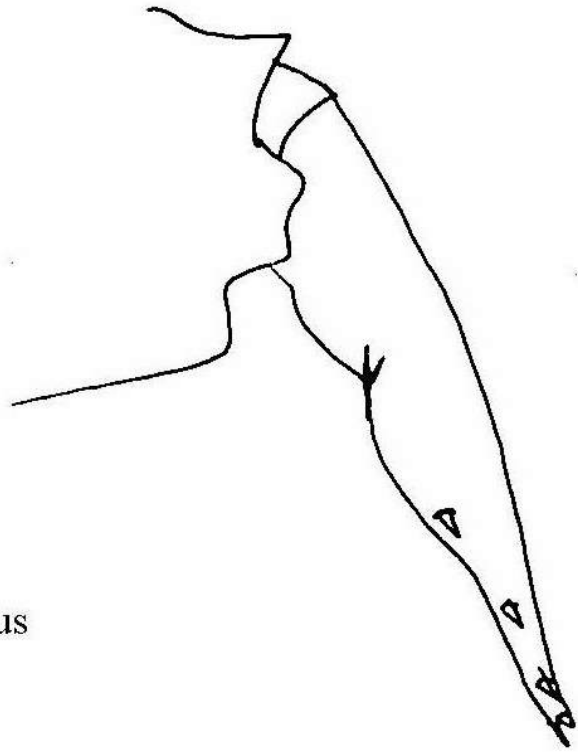
9. Petasma with large accessory lobe; in mature male, with terminal hook; thelycum with elevated triangular plate on sixth sternite. (Telson with only 1 pair terminal-lateral spines)-----Bentheogennema burkenroadi Krygier and Wasmer

Petasma with smaller accessory lobe, without terminal hook; thelycum without elevated triangular plate on sixth sternite. (Telson with 1-3 pairs terminal-lateral spines)-----Bentheogennema pasithea (de Man)

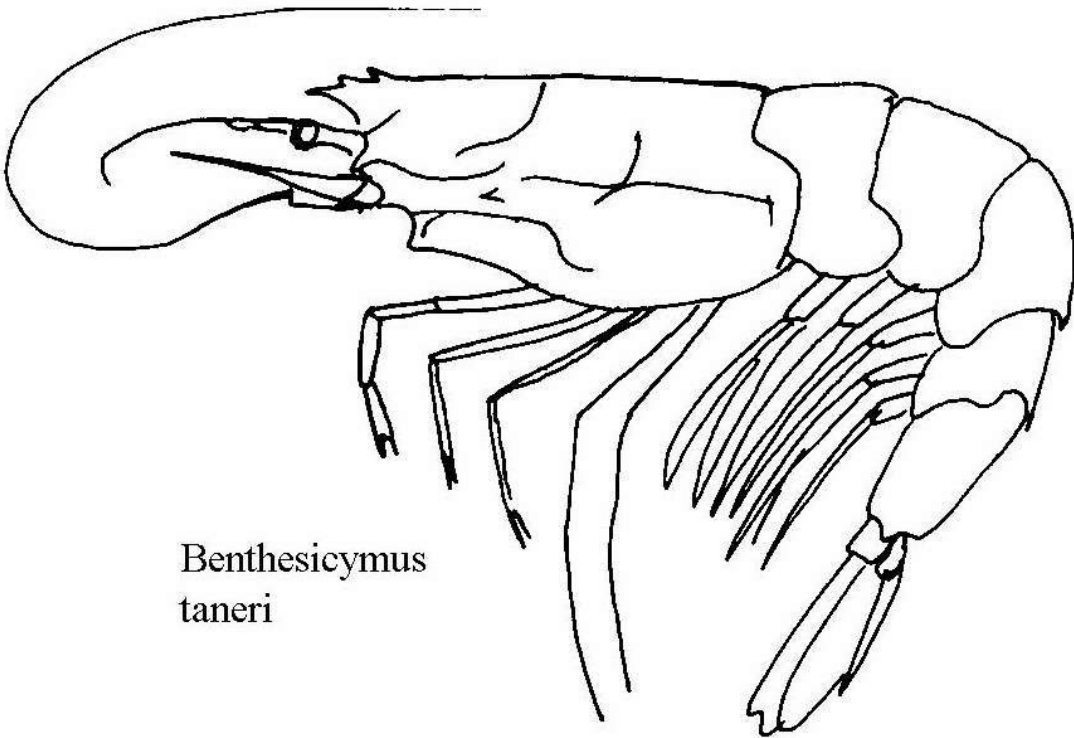




Bentheogennema species: top, *B. borealis* with podobranch; middle, *B. pasithea* with petasma on left; lower, *B. burkenroadi* with petasma on left. Lower two figures after Hendrickx and Estrada-Navarrete, 1996.



Benthescyrmus altus



Benthescyrmus  
taneri

Genus Benthesicymus Bate, 1881

Benthesicymus laciniatus Rathbun

Benthesicymus laciniatus Rathbun, 1906: 906, fig. 59, pl. XIX, fig. 3.—Hayashi 1983: 441, fig. 62.—Kikuchi and Nemoto 1991: 65.—Pérez Farfante and Kensley 1997: 61.—Wicksten 2004: 93. (See last reference for a more complete synonymy).

Gennadas pectinatus Schmitt, 1921: 25, fig. 12; pl. 11, fig. 1.—Pérez Farfante and Kensley 1997: 66.—Wicksten 2002: 128.

Recognition characters: Rostrum slightly ascending, with 1-2 dorsal teeth and sharp apex, continuing posteriorly as dorsal carina to cervical groove. Carapace with antennal and branchiostegal teeth, cervical groove and Y-shaped lateral groove running posteriorly. Eyes without pigment, eyestalk with tubercle. Scaphocerite with rounded blade, exceeding spine. Second maxilliped broad and flattened. First to third pereopods short and strong, chelate, fourth and fifth pereopods long and slender. Pleopods with exceptionally long endopods and exopods. Abdominal somites 1-4 rounded, fourth with comb-like structure of teeth and spinules along posterior margin. Somites 5 and 6 with dorsal carina and small posterolateral spine, carina of fifth ending in sharp spine. Telson shorter than uropods, with 4 pair lateral spines. Carapace length to 42 mm.

Color in life: Not recorded.

Habitat and depth: Lower continental slope, and abyssal plains, 1471-4028 m.

Range: Cosmopolitan: Azores, Canary Islands, Madagascar, Reunion, Saya de Malha Bank, Japan, Hawaii, off Santa Catalina Island, California; off Baja California, Mexico. Type locality off Kauai, Hawaiian Islands.

Benthesicymus tanneri Faxon

Benthesicymus tanneri Faxon, 1893: 215.-- Rathbun, 1904.--147; Schmitt, 1921: 23, fig. 10.-- Anderson and Lindner, 1943: 298.-- Méndez, 1981: 31, pl. 8, figs. 61, 61a, 62a-b.-- Wicksten, 1989b: 311.-- Kikuchi and Nemoto, 1991: 65.-- 2.-- Hendrickx, 1996: 12, fig. 5. (See this reference for a more extensive synonymy).—Pérez Farfante and Kensley 1997: 61.—Guzmán and Wicksten 2000: 926.—Wicksten and Hendrickx 2003: 57.

Recognition characters: Exoskeleton smooth and membranous. Rostrum short, raised into crest with 2 dorsal and no ventral teeth, continued on carapace as dorsal carina to cervical groove. Carapace with lower orbital angle prominent but blunt, prominent branchiostegal tooth continuing into carina, sharp pterygostomial angle without tooth; hepatic spine, gastro-hepatic and cervical grooves and ridge along branchial region. Eyes pigmented. Stylocerite shorter than first segment of antennular peduncle, with tooth at distal external angle. Scaphocerite tapered. Last segment of third maxilliped with 4 spines, exopod present. Pereopods slender, without exopods. First three abdominal somites without carina, fourth with faint dorsal carina, fifth and sixth with dorsal carina armed with posterior tooth. Telson short, convex above, with 3 pair lateral spines. Total length 112 mm.

Color in life: Deep red, sometimes with patch of blue on second-fourth abdominal segments.

Habitat and depth: Continental slopes, usually benthic, 484-1300 m

Range: San Diego, California to northern Chile. Type locality 75 mi. SW of Guaymas, middle of Gulf of California (Albatross sta. 3436).

Benthesicymus altus Bate

Benthesicymus altus Bate, 1881: 191.-- Faxon, 1895: 203.-- Schmitt, 1921: 22, pl. 11, fig. 2.-- Anderson and Lindner, 1943: 298.-- Wicksten, 1989b: 311.-- Kikuchi and Nemoto, 1991: 85, figs. 14-15.-- 2; Hendrickx, 1996: 9, fig. 10. (See this reference for a more extensive synonymy).—Pérez Farfante and Kensley 1997: 60.—Guzmán and Wicksten 2000: 927, fig. 2.—Hendrickx and Wicksten 2003: 57.

Recognition characters: Similar to B. tanneri. Carapace without hepatic spine. Last segment of third maxilliped with one strong spine and 4-5 spinules. Fourth abdominal somite with slight dorsal carina, fifth with posterior dorsal carina, sixth with strong dorsal carina ending in upturned margin. Telson with 4 pair lateral spines. Total length 120 mm.

Color in life: Not recorded.

Habitat and depth: Continental slopes, usually benthic, 923-4120 m.

Range: Western Pacific from Japan to Fiji, eastern Pacific from San Nicolas Island to Chile, south Atlantic, Indian Ocean off Maldiva and Comoro Islands. Type locality "between Australia and New Guinea" (Challenger sta. 184).

Genus Gennadas Bate, 1881

Gennadas incertus (Balss)

Amalopenaeus incertus Balss, 1927: 265, figs. 24-29.

Gennadas incertus: Anderson and Lindner, 1943: 294.-- Percy and Forss, 1966: 1137.-- Ebeling et al., 1969: 12.-- Kensley, 1972: 12, 14, figs. 4i, 5j.-- Crosnier, 1978: 37, figs. 15b, 19a.-- Krygier and Percy. 1981: 78.-- Hendrickx and Estrada-Navarrete, 1989: 107.-- Hendrickx and Estrada-Navarrete, 1996: 27, fig. 13. (See this reference for a more extensive synonymy).—Pérez Farfante and Kensley 1997: 66.—Guzmán and Wicksten 2000: 928.—Wicksten 2002: 129.

Recognition characters: Carapace with branchiostegal tooth. Median carina of carapace extending to posterior margin. Sixth abdominal segment with dorsal carina. Petasma characteristic, with external lobe in two parts, forming 2 long points; of the two parts of the median lobe the outer one is small and narrow, the inner part more broad. The accessory lobe is well developed. The hooks on the inner border are equally shaped and of the same length. Total length 25 mm. (Translated from Balss, 1927).

Color in life: Bright red, with blue spots on appendages.

Habitat and depth: Pelagic, by day, 400-900 m, by night, 100-200 m; usually at 500-1000 m off Oregon.

Range: Off Oregon to Baja California, Chile, Indo-Pacific. Type locality not specified, near Seychelles Islands in Indian Ocean (40° 34'S, 53° 42'E and 40° 45'S, 48° 58'E).

### Gennadas propinquus Rathbun

Gennadas propinquus Rathbun, 1906: 907.-- fig. 61a-b; Anderson and Lindner, 1943: 295.-- Percy and Forss, 1966: 1137.-- Ebeling et al., 1969: 12.-- Crosnier, 1978: 38, figs. 16b, 18d-e.-- Krygier and Percy, 1981: 77.-- Hendrickx and Estrada-Navarrete, 1989: 107.-- Hendrickx and Estrada-Navarrete, 1996: 29, fig. 15. (See this reference for a more extensive synonymy).—Pérez Farfante and Kensley 1997: 66.—Guzmán and Wicksten 2000: 927.—Wicksten 2002: 130.

Recognition characters: Rostrum and gastric tooth slender. Stylocerite slender. Antennular peduncle pubescent. Thelycum with large subtriangular shield between bases of third pereopods, followed by narrow transverse plate and then subcordate disk between fifth pereopods. Total length 32 mm.

Color in life: Bright red, with blue spots on appendages.

Habitat and depth: Pelagic, surface to 1200m, by day, above 100 m and below 500 m at night, usually at 200-1000 m off Oregon.

Range: Oregon to Baja California, Chile, Indo-Pacific. Common in southern California. Type locality between Erben Bank and Kaiwi Channel, Hawaii.

### Gennadas sordidus Kemp

Gennadas sordidus Kemp, 1910: 177, pl. 13, figs. 1-3.-- Anderson and Lindner, 1943: 291.-- Ebeling et al., 1969: 12.-- Hendrickx and Estrada-Navarrete, 1989: 107.-- Hendrickx and Estrada-Navarrete, 1996: 34, fig. 19.—Pérez Farfante and Kensley 1997: 66.—Guzmán and Wicksten 2000: 929.—Wicksten 2002: 130.

Recognition characters: Rostrum short, with one dorsal tooth and acute apex. Carapace with blunt antennal angle and sharp infra-antennal angle, small branchiostegal tooth. Cervical and postcervical grooves separated on dorsal midline by distance equal to 0.2X distance from postcervical groove to posterior margin of carapace. Mid-dorsal carina inconspicuous posterior to postcervical groove. Scaphocerite 3X long as wide and terminating in small tooth, blade exceeding lateral tooth. Chela of first pereopod as long as carpus, chela of second pereopods 0.66X length of carpus, chela of third pereopods 0.5X length of carpus. Sixth abdominal somite with dorsal carina. Apex of telson truncate, with 4-5 pair plumose setae. Petasma with distinctive spoon-shaped portion directed forward from middle of distal margin of each lobe. Male total length to 24 mm.

Color in life: Bright red, with blue spots on appendages.

Habitat and depth: Pelagic, 0-915 m.

Range: San Pedro Basin, California to Revillagigedo Islands, Gulf of California, Chile, Indian Ocean. Type locality not specified; type specimens came from off Laccadive Islands and northeast of Ceylon.

### Gennadas tinayrei Bouvier

Gennadas tinayrei Bouvier, 1906.-- Anderson and Lindner, 1943: 293.-- Kensley, 1972: 12, figs. 4b, 5c.-- Crosnier and Forest, 1973: 281.-- Crosnier, 1978: 44, figs. 17b, 19d.-- Krygier and Percy, 1981: 78.-- Hendrickx and Estrada-Navarrete, 1989: 107.-- Hendrickx and Estrada-Navarrete,

1996: 36, fig. 9, 21, 23A.—Pérez Farfante and Kensley 1997: 66.—Guzmán and Wicksten 2000: 929.—Wicksten 2002: 130.

Recognition characters: Similar to G. sordidus. Thelycum with posteriorly directed tongue-like process on fifth thoracic sternite. Petasma with median lobe undivided, convex; external lobe divided with division marked by closely approximated blunt lobules.

Color in life: Not recorded.

Habitat and depth: Pelagic, 90-1400 m.

Range: Off Oregon to Baja California, Chile, Atlantic and Indian Oceans. Type locality Cape Verde Islands.

### Genus Bentheogennema Burkenroad, 1936

#### Bentheogennema borealis (Rathbun)

Gennadas borealis Rathbun, 1902: 24.-- Rathbun, 1904: 147, figs. 88-89.-- Schmitt, 1921: 24, fig. 11.-- Kobyakova, 1937: 141, fig. 9.-- Goodwin, 1952: 393.-- Kozloff, 1974: 162.

Bentheogennema borealis: Anderson and Lindner, 1943: 295.-- Percy and Forss, 1966: 1137.-- Butler, 1980: 41.-- Krygier and Percy, 1981: 77.-- Hendrickx and Estrada-Navarrete, 1989: 106.-- Hendrickx and Estrada-Navarrete, 1996: 13, fig. 3. (See this reference for a more extensive synonymy).—Pérez Farfante and Kensley 1997: 58.—Wicksten 2002: 129.

Recognition characters: Exoskeleton membranous and smooth. Rostrum short, with dorsal tooth and acute tip, extending posteriorly as middorsal carina. Carapace with suborbital tooth rounded, low antennal tooth, branchiostegal tooth strong and extending posteriorly into carina, pterygostomial margin rounded, cervical and postcervical grooves widely separated on dorsal midline, antennal and branchial carinae extending posteriorly and meeting hepatic carina. Eyes pigmented, with tubercle on eyestalk. Stylocerite short, with wide base. Scaphocerite rounded, scale exceeding lateral tooth. Kink in flagellum of antenna. Second maxilliped flattened and setose. Third maxilliped longer than second, flattened and setose, dactyl flat and twisted, with exopod and podobranch. Pereopods 1-3 chelate, sturdy, with epipods and podobranchs. Pereopods 4 and 5 slender, with simple dactyls. Abdominal somites with small grooves, pleura blunt to rounded. Sixth somite with dorsal carina. Telson shorter than uropods, narrow, truncate, with 2 pair movable spines and dorsal groove. Total length 58-64 mm.

Color in life: Red.

Habitat and depth: Pelagic, 100-2560 m, maximum density at 600-1000 m.

Range: Japan and Bering Sea to Coronado Islands, Baja California. Type locality off Copper Island, Kamchatka.

#### Bentheogennema burkenroadi Krygier and Wasmer

Bentheogennema burkenroadi Krygier and Wasmer, 1975: 737, figs. 1-3.-- Butler, 1980: 43.-- Krygier and Percy, 1981: 76.-- Hendrickx and Estrada-Navarrete, 1989: 106.—Hendrickx and Estrada-Navarrete 1996: 16, fig. 5. (See this reference for a more extensive synonymy).—Pérez Farfante and Kensley 1997: 58.—Wicksten 2002: 129.

Recognition characters: Similar to B. borealis. Small tubercle on dorsal carina posterior to rostrum. Cervical and postcervical grooves approaching each other closely on middorsal midline and interrupting middorsal carina. Third maxilliped with strong spine on last segment. Petasma with characteristic large accessory lobe, with terminal hook in adult. Thelycum with pentagonal plate on eighth thoracic sternite, elevated triangular plate on sixth sternite. Telson with 1 pair movable spines. Total length 59-66 mm.

Color in life: Deep to medium red, small flecks of purple on third maxilliped, pereopods, ventral surfaces of abdominal somites and bases of pleopods.

Habitat and depth: Pelagic, 0-2000 m, most abundant between 100-500 m.

Range: British Columbia to Baja California and mid-northern Pacific. Type locality west of British Columbia (51° 26'N, 128° 28'W).

### Bentheogennema pasithea (de Man)

Gennadas pasithea de Man, 1907: 146.

Bentheogennema pasithea: Anderson and Lindner, 1943: 295.-- Ebeling et al., 1969: 12.-- Crosnier, 1978: 31, figs. 13c-d.-- Hendrickx and Estrada-Navarrete, 1989: 106.-- Hendrickx and Estrada-Navarrete, 1996: 18, fig. 6.—Pérez Farfante and Kensley 1997: 129.—Guzmán and Wicksten 2000: 927.—Wicksten 2002: 129.

Recognition characters: Similar to B. burkenroadi. Small tubercle on dorsal midline posterior to rostrum. Cervical and postcervical grooves approaching each other on dorsal surface, interrupting mid-dorsal carina. Petasma with smaller accessory lobe, without terminal hook. Thelycum with rectangular-rounded plates on sixth and eighth thoracic sternites. Telson with 1-3 pair terminal-lateral spines. Total length 41 mm.

Color in life: Red with blue spots on appendages.

Habitat and depth: Pelagic, below 1000 m.

Range: Off Santa Catalina Island, California (Velero IV sta. 10696-65) south to Baja California, Chile, Indo-Pacific. Type locality off Indonesia.

## Family Sergestidae

Sergestids are a widespread family of pelagic shrimp. The second abdominal segment that does not overlap the first. Males have a petasma, females have a sperm receptacle between the third or third and fourth pereopods. In the male, the inner antennular flagellum is modified as a prehensile clasping organ used in copulation. The rostrum is short. Neither the third maxilliped nor the pereopods bear exopods. The fourth and fifth pereopods are shorter than the anterior pereopods.

Two color patterns are common among the species: partly pigmented, with red pigment in the anterior body and translucent appendages and abdomen with small pigment spots; and solid bright red. Usually, the partly pigmented species occur at lesser depths than the bright red ones, which often live at depths of 500 m or more. Many species carry on daily vertical migrations, and occur at lesser depths during the night than by day.

Sergestids have extremely long antennal flagella in life. In Eusergestes similis, the antennae are extended during swimming. These flagella bear a kink at about half their length. The antennae are well supplied with small sensory endings, which may detect prey by vibration or chemosensation, or may provide early warning of approaching predators (Cowles, 1994).

Sergestids are primarily predators, especially on copepods. Ostracods, euphausiids, pteropods, chaetognaths and cnidarians also are eaten (Flock and Hopkins, 1992).

Much of the classification of sergestids is based on the shape of the copulatory structures. (See Judkins and Kensley, 2008, fig. 1 for illustrations of the characteristic petasma of the genera formerly united in the genus Sergestes, now divided into six genera). The key given here follows that of Wasmer (1972) and Judkins and Kensley (2008).

### Key to the Species of the Family Sergestidae

1. Arthrobranchs of up to 13 rami, lamellae relatively large and independent in appearance; petasma with processus ventral forked-----Petalidium suspiriosum Burkenroad

Arthrobranchs with more than 13 rami, lamellae small and closely spaced; petasma with processus ventralis not forked-----2

2. Organs of Pesta present; without dermal photophores. Ovary confined to cephalothorax. Supraorbital and hepatic spines present or absent-----3

Organs of Pesta absent, with or without dermal photophores. Ovary may extend into abdomen. Supraorbital and hepatic spines absent-----6

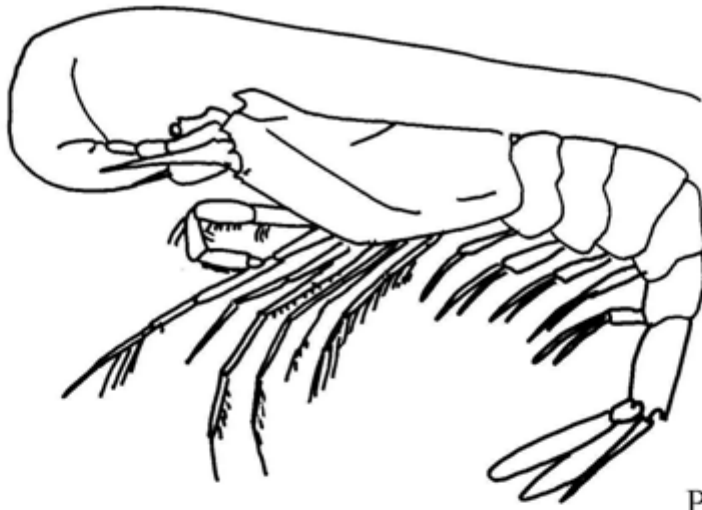
3. Third maxilliped longer than third pereopod-----4

Third maxilliped not as long as third pereopod-----Eusergestes similis Hansen

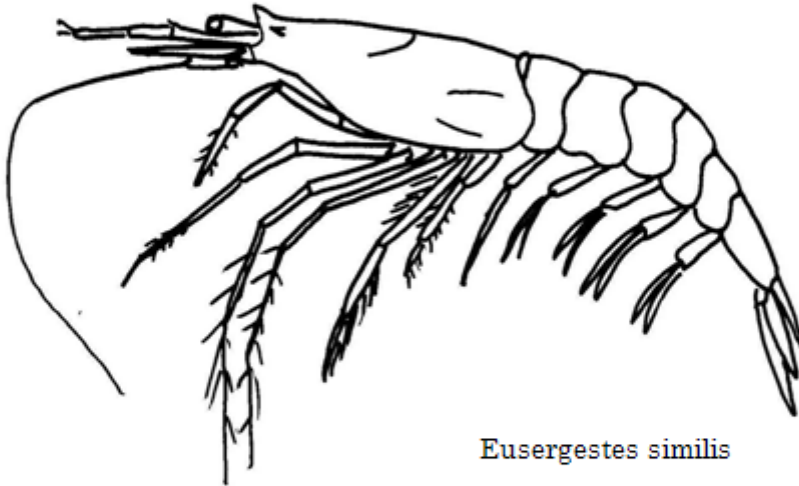
4 Third maxilliped as long as entire body anterior to posterior half of sixth abdominal somite-----Parasergestes halia Faxon



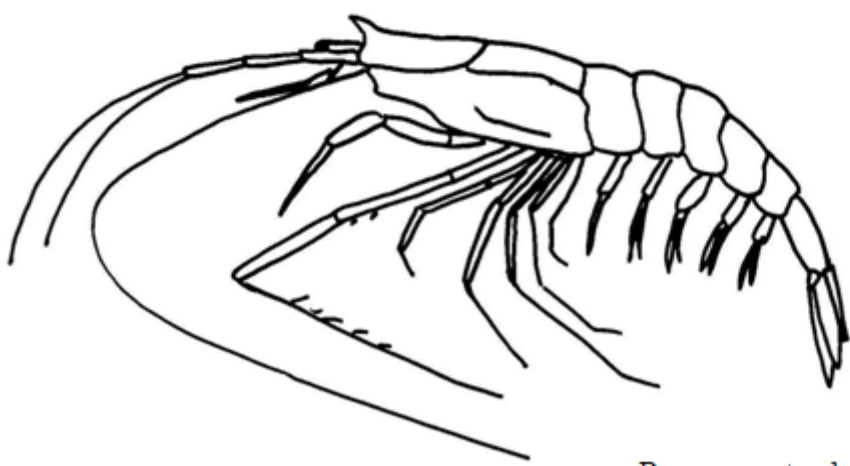
- Third maxilliped not as long as entire body anterior to posterior half of sixth abdominal somite-----5
5. Basal segment of third maxilliped swollen. Inner uropod without setose margin -----  
-----Allosergestes pestafer Burkenroad
- Basal segment of third maxilliped slender. Inner uropod with setose margin-----  
-----Neosergestes consobrinus Milne
6. Dermal photophores absent-----7
- Dermal photophores present-----8
7. Posterior to cervical groove, lateral groove of carapace having dorsal branch. Cornea of eye not much wider than eyestalk-----Sergia japonica (Bate)
- Posterior to cervical groove, lateral groove of carapace without dorsal branch. Cornea of eye wider than eyestalk-----Sergia laminata (Burkenroad)
8. Body slender. Second and third segments of antennular peduncle not short and thick-----  
-----Sergia tenuiremis (Kröyer)
- Body compact. Second and third segments of antennular peduncle short and thick-----  
-----Sergia phorca (Faxon)



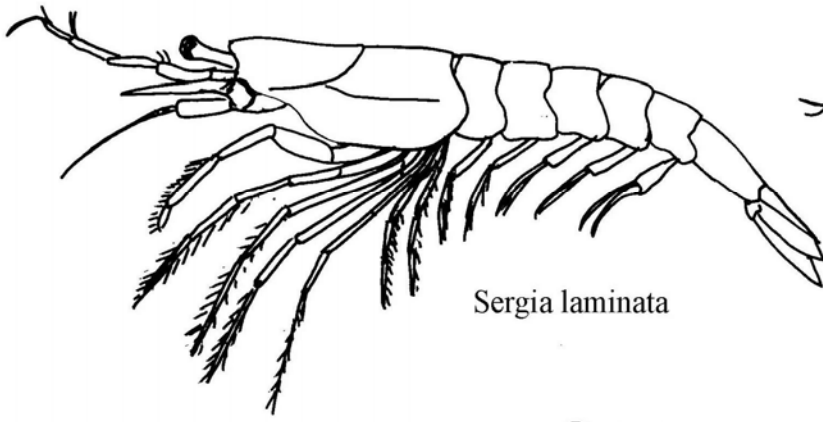
Petalidium  
suspiriosum



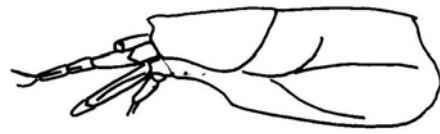
Eusergestes similis



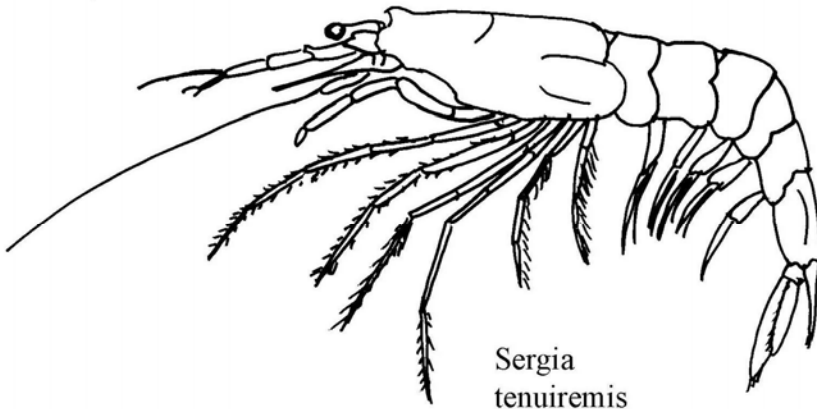
Parasergestes halia



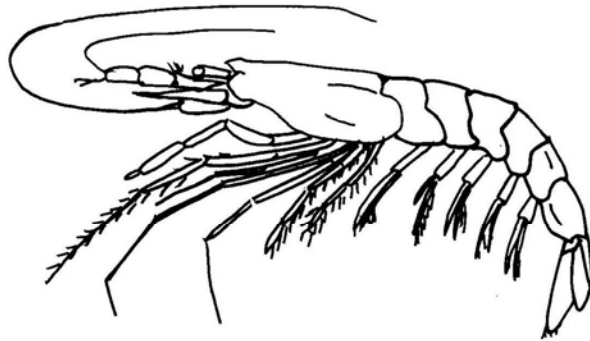
Sergia laminata



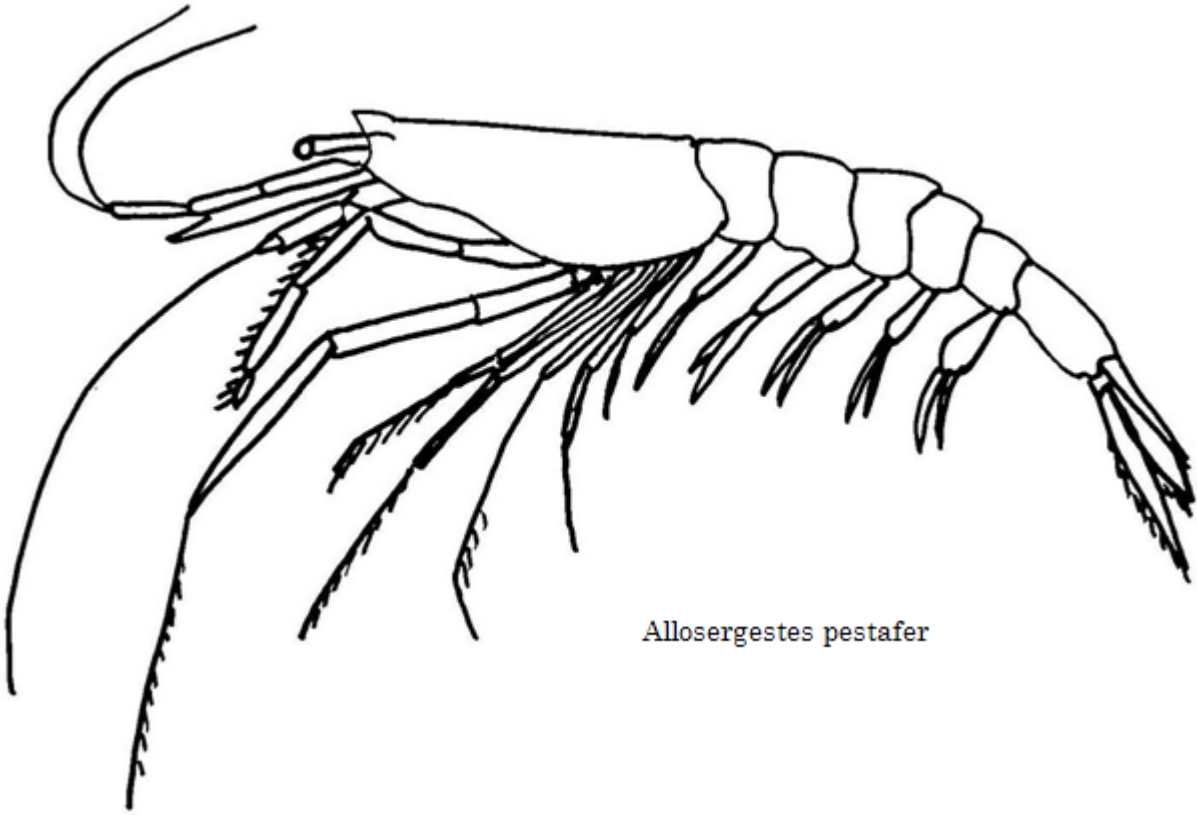
Sergia japonica



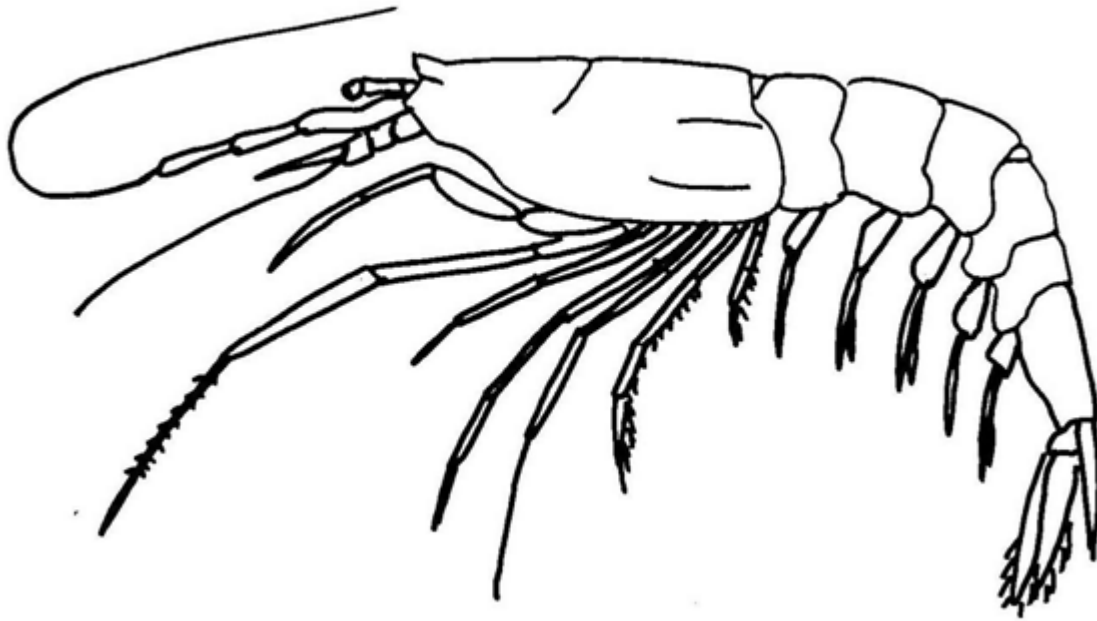
Sergia  
tenuiremis



Sergia phorca



*Allosergestes pestafer*



*Neosergestes consobrinus*

Genus Petalidium Bate, 1881

Petalidium suspiriosum Burkenroad

Petalidium suspiriosum Burkenroad, 1937: 325, figs. 8-12.-- Ebeling et al., 1969:12.-- Krygier and Percy, 1981: 76.-- Hendrickx and Estrada-Navarrete, 1989: 110.-- Hendrickx and Estrada-Navarrete, 1996: 75, fig. 47.—Pérez Farfante and Kensley 1997: 193.—Wicksten 2002: 131.

Recognition characters: Rostrum short, with 1-2 terminal teeth, rising abruptly from plane of carapace. Carapace with hepatic spine, points at antennal, branchiostegal and pterygostomial angles; strong carina running posteriorly from eyestalk toward posterior margin; cervical and gastro-cardiac grooves present. Eye pigmented. First segment of antennular peduncle concave, male with hooked antennular flagellum. Scaphocerite with blade exceeding blunt spine. Antennular flagellum long. Second maxilliped with strong, dense, dark setae along margin of last two segments. Third maxilliped and pereopods with very long setae. Sixth abdominal somite ending in terminal point, another point on ventrolateral margin. Telson with pair lateral points near acute apex. Outer uropod without setae on outer margin.

Color in life: Red to purplish red; a black pigment fleck present in dorsal view on ocular segment between eyes.

Habitat and depth: Pelagic, 150-1750 m, maximum population density off Oregon at 600-1000 m.

Range: Oregon to Clarion Island, Hawaiian Islands, northwestern Pacific Ocean. Type locality north of Clarion Island, Mexico: 20° 36'N, 115° 07'W.

Taxonomic remarks.--This may be the species reported as "Sergestes sp. indet." by Rathbun (1904) and Schmitt (1921).

Genus Eusergestes Judkins and Kensley, 2008

Eusergestes similis Hansen

Sergestes similis Hansen, 1903: 60, pl. 11, figs. 6a-d.-- Schmitt, 1921: 19, fig. 8.-- Burkenroad, 1937: 321.-- Ebeling et al., 1969: 12.-- Butler, 1980: 47.-- Krygier and Percy, 1981: 73.-- Hendrickx and Estrada-Navarrete, 1989: 109.-- Hendrickx and Estrada-Navarrete, 1996: 61, fig. 39.—Pérez Farfante and Kensley 1997: 197.—Wicksten 2002: 131.

Recognition characters: Rostrum sharply pointed, angled upward obliquely. Carapace with prominent supraorbital tooth and moderate hepatic spine. Five organs of Pesta present: prominent anteriolateral pair, lateral midgastric pair and single posterolateral organ. Antennular peduncle slender. Antennular scale not reaching end of third segment of antennular peduncle. Second maxilliped short and stout. Third maxilliped barely longer than third pereopod; dactyl of third maxilliped with 8 subsegments. Pereopods slender, third pereopod longer than others. Fourth and fifth pereopods setose, each without dactyl. Abdominal somites with lateral sulci (difficult to see in preserved material). Telson shorter than uropods, with acute tip. Outer uropod without setae on outer margin. Total length 57-61 mm.

Color in life: Transparent with orange-red spots over carapace and abdomen, telson, uropods and bases of appendages. (See color plate 1, Butler, 1980).

Habitat and depth: Pelagic, 50-2400 m, usually above 1000 m, between 200-600 m by day and 50-200 m by night.

Range: Japan, Bering Sea to Gulf of California, off Chile; eastern South Atlantic in Benguela Current. Type locality off Japan.

Natural history remarks: This is one of the most common sergestids in California and Oregon. Cowles (1994) provided a detailed account of its swimming behavior.

Genus Parasergestes Judkins and Kensley, 2008

Parasergestes halia Faxon

Sergestes halia Faxon, 1893: 217.-- Burkenroad, 1937: 320, text-figs. 4,5.--Hendrickx and Estrada-Navarrete, 1989: 108.-- Hendrickx and Estrada-Navarrete, 1996: 49, fig. 32.—Pérez Farfante and Kensley 1997: 197.

Sergestes edwardsii: Faxon 1895: 212, pl. 51, fig. 1 (not Sergestes edwardsi Kröyer, Atlantic species).

Parasergestes halia.—Judkins and Kensley 2008: 77.

Recognition characters: Body slender, smooth. Rostrum short, obliquely pointed, ending in tiny tooth. Carapace with supraorbital tooth and hepatic spine, antennal and branchial carinae; gastro-hepatic groove faint on dorsal part of carapace, dorsal part of cervical groove faint. Eyes pigmented. Scaphocerite narrow, elongate, spine slightly longer than very narrow distal end of blade. Second and third maxillipeds robust, third especially long, greatly exceeding pereopods. First to third pereopods slender and chelate, pereopods 4 and 5 slender, fifth pereopod very short. Abdominal somites rounded. Telson with dorsal groove, blunt apex. No setae on outer margin of outer uropod. Total length 37 mm.

Color in life: Not recorded.

Habitat and depth: Pelagic, surface to 1617 m.

Range: Southern California (Natural History Museum of Los Angeles County, unpublished checklist) to Gulf of Panama, Gulf of California. Type locality Gulf of Panama.

Taxonomic remarks: The illustration given by Faxon (1895) shows a blunt rostrum, but both the figure by Burkenroad (1937) and a specimen examined (from off Socorro Island, Mexico) had a rostrum ending in a small tooth.

Genus Allosergestes Judkins and Kensley, 2008

Allosergestes pestafer Burkenroad

Sergestes pestafer Burkenroad, 1937: 318, figs. 1-3.-- Ebeling et al., 1969: 12.-- Hendrickx and Navarrete, 1989: 109.-- Hendricks and Estrada-Navarrete, 1996: 56, fig. 36.—Pérez Farfante and Kensey 1997: 197.

Allosergestes pestafer.—Judkins and Kensley 2008: 75.

Recognition characters: Carapace with supraorbital tooth and hepatic spine. Distal articles of antennular peduncle long and slender, shorter than basal segment. Third maxilliped long, basally swollen, ultimate segment shorter than penultimate, both with many spines on 1 side but few on other; ultimate segment (dactyl) with 5 subsegments, inner margin of antepenultimate subsegment with 8 spines in male and 11-12 in female. Ischium of first and

second pereopods with spine on outer margin. Carpus of first legs shorter than propodus. Second and third pereopods minutely chelate, fixed finger shorter than mobile finger, palm with longitudinal series of long setae. Precoxa of third pereopods of female with spur. Fifth pereopods with distal 2 segments setose on both margins. Telson with terminal point, 1 pair dorsolateral spinules. External uropods with setose margin 1.5X length of area without setae, without tooth or spinule. Total length 37 mm.

Color in life: Partly transparent, with red chromatophores mostly on cephalothorax.

Habitat: Pelagic, to 1100 m.

Range: Off Santa Catalina Island, California (Velero IV sta. 8031-62), outer coast of Baja California, to Galapagos Islands. Type locality north of Clarion Island, Mexico (20° 36'N, 115° 7'W).

#### Genus Neosergestes Judkins and Kensley, 2008

##### Neosergestes consobrinus Milne

Sergestes consobrinus Milne, 1968: 26, figs. 5-9.-- Judkins, 1978: 16, figs. 9-11.-- Hendrickx and Estrada-Navarrete, 1989: 108.-- Hendrickx and Estrada-Navarrete, 1996: 45, fig. 27.—Pérez Farfante and Kensley 1997: 196.—Wicksten 2002: 131.

Neosergestes pestafer.—Judkins and Kensley 2008: 76.

Recognition characters: Exoskeleton fragile. Rostrum short, with single terminal tooth barely reaching beyond base of eyestalk. Carapace with hepatic spine and surpaorbital tooth, branchial, hepatic and anterior ridges, weak cervical and postcervical grooves. Eyes pigmented.

Antennular peduncle long and slender, basal segment wider than other segments. Scaphocerite long and tapering, with small terminal point. Third maxilliped longer and stouter than pereopod 3, propodus with 2 subsegments, dactyl with 6 subsegments. Pereopods 1-3 slender, increasing in size posteriorly, with weak chelae. Pereopods 4 and 5 laterally flattened, setose. Organs of Pesta consisting of single anterior midventral organ and 3 pairs located anterolaterally, midlaterally and posterolaterally. Abdominal pleura with rounded margins bearing setae, sixth somite ending in weak point. Telson shorter than uropods, without spines and with rounded tip. Outer uropod with setae along entire outer margin. Total length 18 mm.

Color in life: Partly pigmented with red, especially on cephalothorax, and partly transparent.

Habitat and depth: Pelagic, 20-400 m, maximal abundance at 120 m.

Range: California Current and central Pacific between 41° (northern California) and 17° N (state of Michoacan, Mexico); northwestern Pacific. Type locality off southern California (33° 44'N, 124° 53'W).

Taxonomic remarks: Judkins (1978) originally emended the "Sergestes edwardsi" group in California, and distinguished between N. edwardsii (as S. edwardsii, now considered to inhabit the Atlantic) and related species. See Judkins and Kensley, 2008, fig. 1E for an illustration of the characteristic petasma of this and related species.

#### Genus Sergia Stimpson, 1860

##### Sergia japonica (Bate)

Sergestes japonicus Bate, 1881: 194.

Sergestes (Sergia) japonicus: Crosnier and Forest, 1973: 341, figs. 113c, 117 (see this reference for an extensive synonymy).

Sergia japonicus: Krygier and Percy, 1981: 76.-- Flock and Hopkins, 1992: 214.

Sergia japonica: Pérez Farfante and Kensley 1997: 200.—Wicksten 2002: 131.

Recognition characters: Rostrum very short and blunt. Eyestalks long, overreaching stylocerite; corneas small. Carapace with cervical groove reaching from middorsal surface to lateral groove; lateral groove divided posterior to cervical groove with dorsal section extending nearly to posterior of carapace and ventral groove ending short of ventral margin. Telson as long as endopod of uropods. Female total length about 75 mm.

Color in life: Not recorded.

Habitat: Pelagic, 0-1000 m but usually deeper than 500 m. Taken at 850-1000 m off Oregon.

Range: Japan to the Philippines, New Zealand, off British Columbia and Oregon, Newfoundland to Gulf of Mexico, west of Scotland to off Angola, Mediterranean. Type locality south of Japan.

### Sergia laminata (Burkenroad)

Sergestes laminatus Burkenroad, 1940: 53.-- Ebeling et al., 1969: 12.-- Kensley, 1971: 251, figs. 18a-f.

Sergia laminata: Hendrickx and Estrada-Navarrete, 1989: 109.-- Hendrickx and Estrada-Navarrete, 1996: 69, fig. 43.—Pérez Farfante and Kensley 1997: 200.—Wicksten 2002: 132.

Sergia laminatus: Wasmer, 1993: 60, fig. 10.

Recognition characters: Dermal photophores absent. Rostrum blunt. Cornea of eye wider than eyestalk. Carapace with small hepatic spine in juvenile, no supraorbital tooth. Cervical groove extending across dorsal surface of carapace. Anterolateral groove of carapace not quite meeting cervical groove, posterolateral groove ascending gradually toward posterior margin of carapace, without any branches; faint ventrolateral groove. Antennular peduncle slender. Scaphocerite not reaching end of third segment of antennular peduncle. Third maxilliped slender, not as long as third pereopod. Posterior pereopods slender and setose. Telson almost as long as inner uropod. Total length 36.2 mm.

Color in life: Red to purplish red, without black pigment fleck on ocular segment.

Habitat: Pelagic, 0-1416 m.

Range: San Pedro Basin, California to Baja California; Indo-Pacific, Japan, Tasman Sea, south of Australia, off west coast of Africa. Type locality off Baja California (Dana station 3933I).

### Sergia tenuiremis (Kröyer)

Sergestes tenuiremis Kröyer, 1855: 30; Illig, 1927: 283, figs. 6-10.

Sergestes kroyeri Bate, 1881: 193.

Sergia kroyeri: Krygier and Wasmer, 1988: 72.-- Hendrickx and Estrada-Navarrete, 1989: 110.

Sergia tenuiremis .--Percy and Forss 1966: 1137.--Butler 1980: 49.--Krygier and Percy 1981: 75.—Pérez Farfante and Kensley 1997: 200.

Recognition characters: Body slender and compressed. Rostrum short, barely projecting beyond



frontal margin, with apex blunt to acute, at times with small tooth on posterior dorsal surface. Carapace with lateral carina extending from branchiostegal to hepatic region, suprbranchial carina extending almost to posterior margin, sometimes branching ventrally and posteriorly above ventral margin of carapace, cervical sulcus conspicuous. Ventral margin of carapace concave. Eye moderately large, cornea well developed, with tubercle on inner margin of stalk. Peduncle of first antenna exceeding scaphocerite, stout, dorsal tubercle on first segment. Stylocerite short. Scaphocerite narrow, lateral tooth exceeding blade, basicerite with upper rounded lobe. Third maxilliped with setae on propodus and dactyl, dactyl with about 8 short, tapering segments. First pereopod shorter than third maxilliped, slender, propodus and dactyl with setae on both margins, dactyl with 1-2 distal setae. Second pereopod slender but longer than first, propodus slender, with about 13 segments, minutely chelate. Third pereopod slightly longer than second, slender, propodus with setae and about 12 segments, minutely chelate; fourth shorter than third, slender, with setae, propodus with blunt tip, no dactyl; fifth shorter than fourth, as slender, setose; propodus with blunt tip, no dactyl. First abdominal somite with oblique lateral carina; second with short lateral carina and faint transverse sulcus; third with dorsoventral carina and transverse sulcus; fourth with v-shaped sulcus; fifth with arched lateral carina and oblique sulcus; sixth with dorsal posterior spine and slight carina, lateral carina and carina along ventral margin. Telson shorter than uropods, narrowing, with acute tip and 2-3 pair dorsal spines, tip of inner uropod not reaching distolateral spine of outer uropod. Male total length about 63 mm, female total 75 mm.

Color in life: Vermillion, darker red over most of telson and uropods.

Habitat and depth: Pelagic, 570-1000 m.

Range: West coast of Vancouver Island, off Oregon south to off Point Loma Light, San Diego County, California (Velero IV sta. 10996-66), Hawaiian Islands, northeast of New Zealand, Indian Ocean and Atlantic Ocean. Type locality Greenland.

### Sergia phorca (Faxon, 1893)

Sergestes phorcus Faxon, 1893: 217; Burkenroad, 1937: 323, figs. 6-7.-- Ebeling et al., 1969: 12.-- Méndez, 1981: 59, pl. 22, figs. 172-176.

Sergestes bisulcatus: Faxon, 1895: 210, pl. 52 (not S. bisulcatus Wood-Mason).

Sergia phorca: Hendrickx and Estrada-Navarrete, 1989: 110.-- Hendrickx and Estrada-Navarrete, 1996: 73, fig. 45.

Recognition characters: Exoskeleton smooth and membranous. Rostrum short, with tiny apical tooth. Carapace without supraorbital tooth and hepatic spine, with cervical and gastro-hepatic grooves, suprbranchial carina. Antennular peduncle stout, male with inner flagellum modified as prehensile organ. Scaphocerite with spine exceeding blade. Third maxilliped longer than first pereopod but shorter than third, dactyl with 8 subsegments. First to third pereopods chelate, slender and setose, fourth and fifth pereopods flattened, heavily setose. No organs of Pesta, but photophores on ventral surface of body. Ovary of female extending into abdomen. Faint carinae and grooves on lateral surfaces of abdominal somites, sixth somite with dorsal carina ending in small spine. Telson shorter than uropods, with dorsal groove and triangular tip, 2-3 pair dorsolateral spines. Outer margin of outer exopod without setae. Total length 82 mm.

Color in life: Red with purple photophores.

Habitat and depth: Pelagic, 0-1100 m.

Range: Off Santa Catalina Island, California (Velero IV sta. 7299-61) to Peru. Type locality not

specified: type material came from five stations between east of Galapagos Islands (0° 59'0"S, 86° 46'0"W. Albatross sta. 3401) to south of Guaymas, Gulf of California (Albatross sta. 3437).

## SUBORDER PLEOCYEMATA

### INFRAORDER STENOPODIDEA

#### Family Stenopodidae

The family Stenopodidae includes the brightly colored coral shrimp (Stenopus spp.) of tropical reefs. Related species occur in the eastern Pacific from the southern Gulf of California to the Galapagos. However, only one member of the family has been found along the west coast of the United States.

In stenopodids, the third pereopods are unusually large and heavily chelate. At first glance, the animals can be mistaken for small lobsters. The body often has rows of spines. The rostrum is toothed. Stenopodids often live in pairs, with a male and female occupying the same host sponge or hole.

Genus Odontozona Holthuis, 1946

Odontozona spongicola (Alcock and Anderson)

?Richardina spongicola Alcock and Anderson, 1899: 291.

Richardina spongicola: Alcock, 1899: pl. 42, figs. 4, 4a.

Odontozona spongicola: Holthuis, 1946: 40.-- Wicksten, 1982c: 134.-- Goy, 1992: 2, fig. 1C.

Odontozona ? spongicola: Wicksten, 1989b: 311.

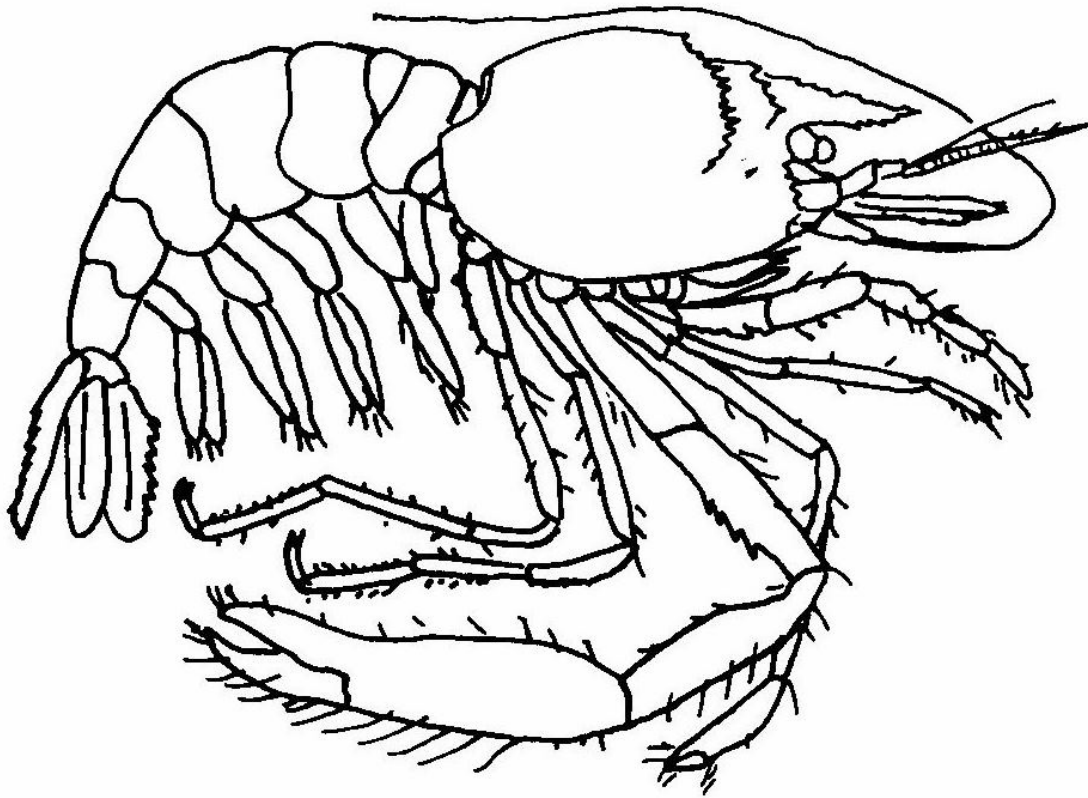
Recognition characters: Rostrum reaching end of antennular peduncle, with 6 dorsal and 4 ventral spines. Carapace with 3 spines on anterior border, spines at base of rostrum, row of spines at cervical groove and 2 hepatic spines. Eyes without pigment, eyestalks with spinules. Scaphocerite with spinules. Third maxillipeds about as long as first pereopods. First to third pereopods chelate, the third stronger and heavier than anterior two pair. Pereopods without spines except for spinules on merus and carpus of third pereopods. Fourth and fifth pereopods with biunguiculate dactyls. Abdominal somites smooth, rounded. Telson and outer uropod with spinules. Total length 17.2 mm.

Color in life: Not recorded, but fresh specimens were white to yellowish.

Habitat and depth: Commensal in deep-sea hexactinellid sponges, 496-900 m.

Range: Indian Ocean, northern Australia, Santa Catalina Island, California. Type locality Andaman Sea.

Natural history remarks: Odontozona spongicola is known from California from a single dredged specimen. Because the species apparently lives only among sponges of the continental slope, it is difficult to collect. The host sponge species is not reported.



*Odontozona spongicola*

## Family Pasiphaeidae

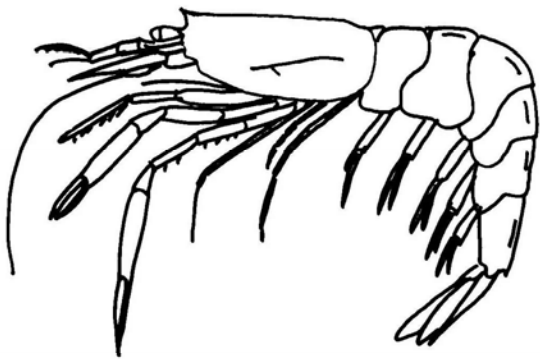
Members of the family Pasiphaeidae are primarily pelagic, although some have been captured in benthic traps. Their peculiar slender chelae, lined with minute teeth, give them the common name of "comb shrimp" in some publications. The rostrum is short or absent. The carapace bears carinae and may have a branchiostegal tooth. The eyes are of moderate size and are pigmented. The third maxilliped and all pereopods bear exopods, but only the third maxilliped may bear an epipod. Some are partly pigmented, others are colored red to carrot-red. Many reach large sizes. Several species have been reported to eat euphausiids.

The key below presents all species of this family reported from California and Oregon to date. However, Ebeling et al. (1969) reported finding a "Glyphus-like" pasiphaeid from the San Pedro Basin, California. Species of Glyphus have a rostrum with a ventral teeth, small teeth on the dorsal surface of the carapace and antennal and branchiostegal teeth. (See Holthuis 1993, p. 25, fig. 6 for an illustration).

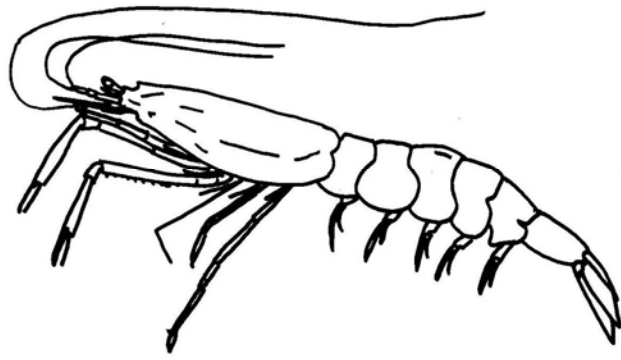
### Key to the Species of the Family Pasiphaeidae

1. Rostrum in form of postfrontal or epigastric tooth, carapace with branchiostegal tooth-----2  
Rostrum arising from frontal margin of carapace, carapace without branchiostegal tooth-----8
2. Carapace with middorsal carina not reaching posterior half-----Pasiphaea affinis Rathbun  
Carapace with middorsal carina extending at least to posterior 2/3 of carapace-----3
3. Telson truncate, not forked or notched-----4  
Telson forked or notched-----5
4. Second to fifth abdominal somites with dorsal carina-----Pasiphaea magna Faxon  
Second to fifth abdominal somites without dorsal carina-----Pasiphaea chacei Yaldwyn
5. Branchiostegal tooth over angle of anterolateral sinus, not on or near anterior margin of carapace-----Pasiphaea pacifica Rathbun  
Branchiostegal tooth near or on anterior margin of carapace and extending beyond it----- 6
6. Knob-like projection anterior to postfrontal tooth of carapace---Pasiphaea emarginata Rathbun  
No knob-like projection anterior to postfrontal tooth of carapace ----- 7
7. Dorsal and ventral margins of carapace convex, postfrontal tooth horizontal-----  
-----Pasiphaea tarda Kröyer

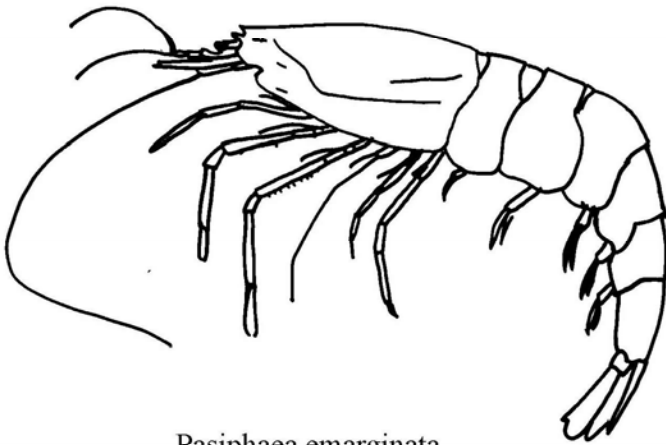
- Dorsal and ventral margins of carapace straight and angled, postfrontal tooth almost vertical --  
 ----- Pasiphaea corteziana Rathbun
8. Carapace with small teeth along entire dorsal midline-----Eupasiphae serrata (Rathbun)
- Carapace without small teeth along entire dorsal midline-----9
9. Dorsal carina of carapace with at most 1-2 teeth, fingers of second chela distinctly longer than palm-----Parapasiphae cristata Smith
- Dorsal carina of carapace without teeth, fingers of second chela not longer than palm-----  
 -----Parapasiphae sulcatifrons Smith



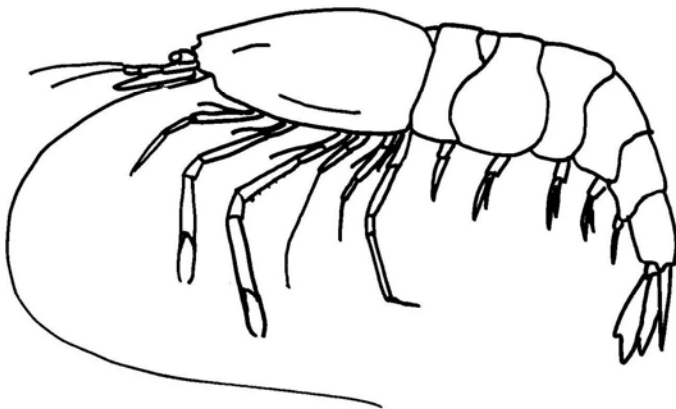
*Pasiphaea affinis*



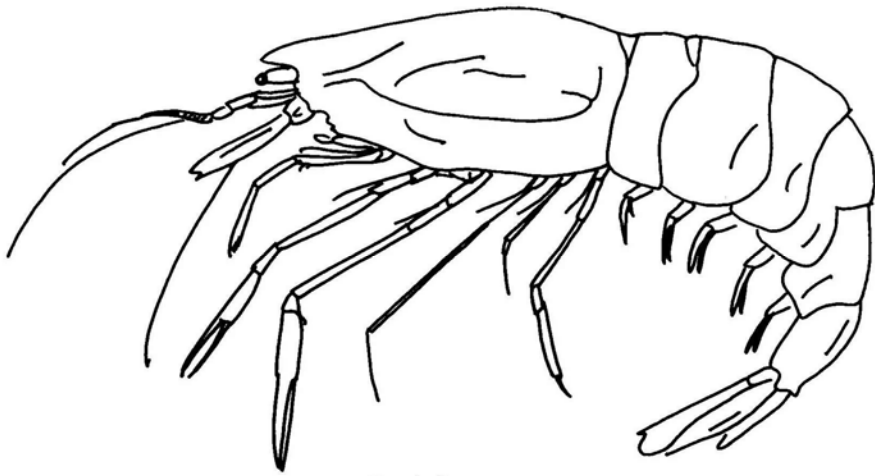
*Pasiphaea pacifica*



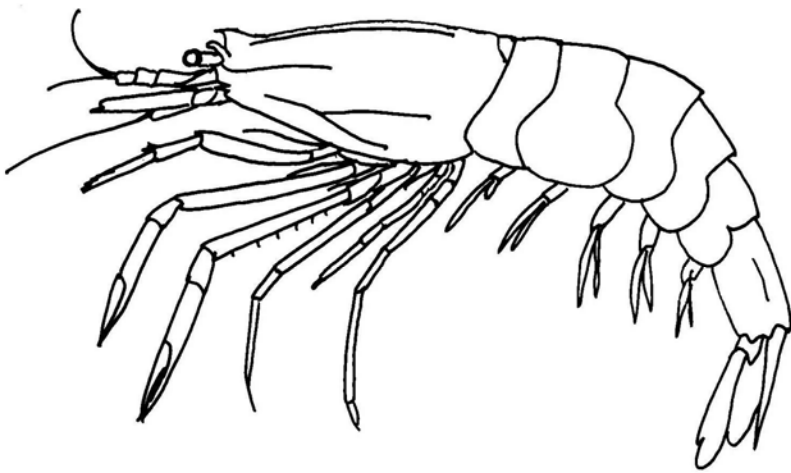
*Pasiphaea emarginata*



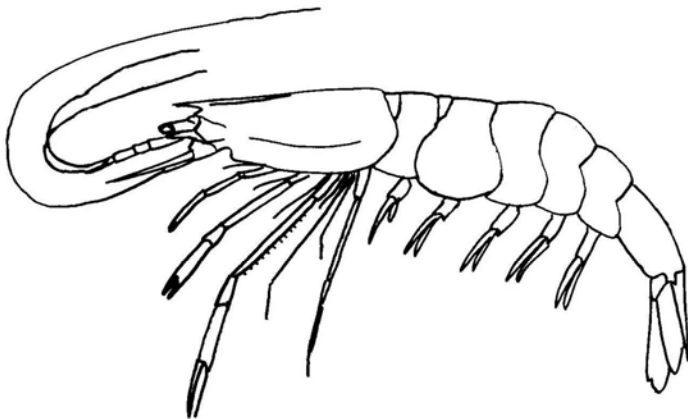
*Pasiphaea tarda*



*Pasiphaea magna*

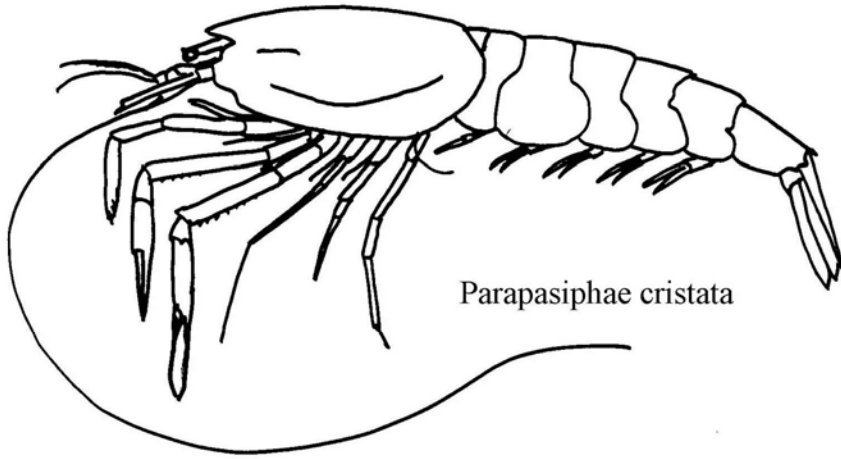


*Pasiphaea corteziana*

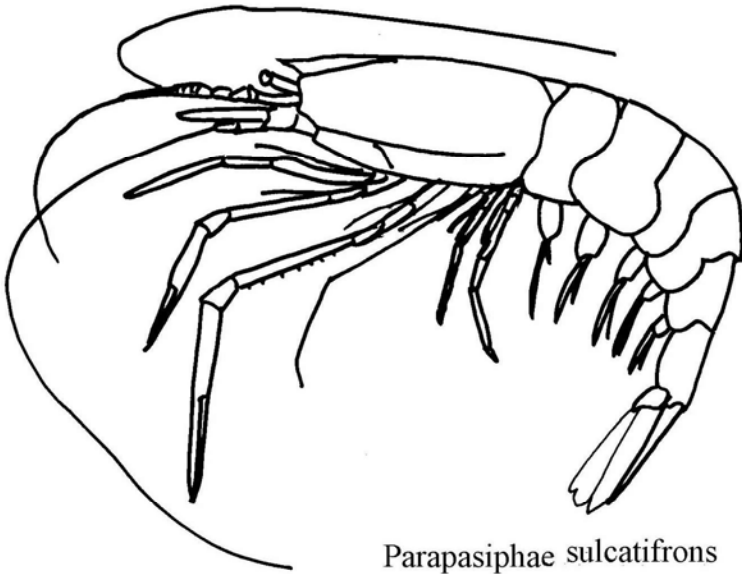


*Pasiphaea chacei*

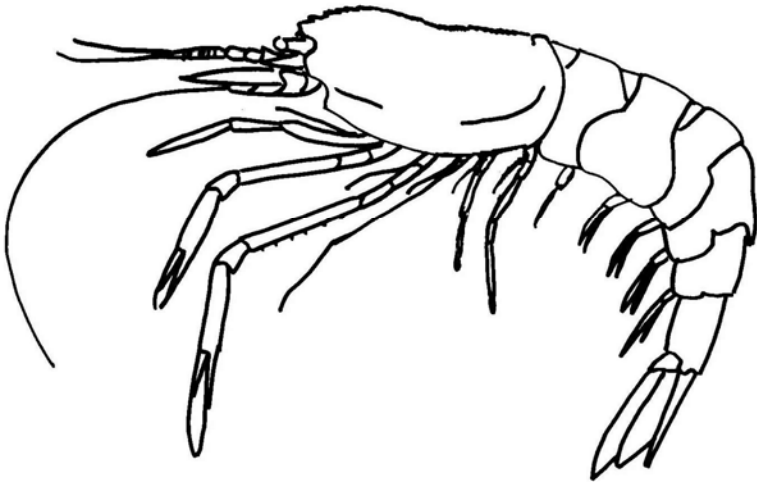




*Parapasiphae cristata*



*Parapasiphae sulcatifrons*



*Eupasiphae serrata*

Genus Pasiphaea Savigny, 1816

Pasiphaea affinis Rathbun

Pasiphaea affinis Rathbun, 1902: 905.-- Rathbun, 1904: 24, fig. 6.--Schmitt, 1921: 31, fig. 17.-- Hendrickx and Estrada-Navarrete, 1989: 111.--Wicksten 2002: 133.

Recognition characters: Postfrontal tooth nearly vertical to angled upward. Carapace not carinated beyond gastric tooth, branchiostegal tooth present, carina extending horizontally posteriorly from antennal region and another Y-shaped carina running posteriorly along branchial regions. Eyes large and rounded. Stylocerite reaching cornea of eye, not as long as first segment of antennular peduncle. Antennal scale exceeding antennular peduncle. Third maxilliped and all pereopods with large and obvious exopods. First and second pereopods heavy and chelate, tips of fingers of second chela crossing. Merus and ischium of second pereopod with sharp spines. Third pereopod slender, fourth pereopod reduced, fifth short. Second to sixth abdominal somites with dorsal carina, sixth somite ending in distal point. Telson with V-shaped notch, with dorsal groove. Male total length 67 mm, female 55.

Color in life: Not recorded.

Habitat and depth: Pelagic, 1800 m.

Range: Known only from type locality, near Cortez Bank, California.

Pasiphaea magna Faxon

Pasiphaea magna Faxon, 1893: 209.-- Faxon, 1895: 176, pl. 45, figs. 2-2c.-- Méndez, 1981: 64, figs. 190-192.-- Krygier and Percy, 1981: 81.-- Hendrickx and Estrada-Navarrete, 1989: 11.-- Hendrickx and Estrada-Navarrete, 1996: 91, figs. 56, 57.-- Wehrtmann and Carvacho, 1997: 50.-- Guzmán and Wicksten, 1998: 205.-- Wicksten 2002: 134.

Recognition characters: Anterior margin of carapace forming blade-shaped tooth. Carapace with dorsal carina extending along entire midline, small knob above eyestalk, small branchiostegal tooth, Y-shaped carina running horizontally from antennal region nearly to posterior margin. Stylocerite longer than eye. Scaphocerite with lateral tooth exceeding blade. Third maxilliped shorter than first pereopod, setose. First and second pereopods chelate, long, first pereopod shorter than second; chelae slender, carpus of second pereopods with distal spine. Third pereopods slender and thread-like, fourth pereopods very short, with blade-shaped dactyl, fifth pereopods longer than fourth but shorter than third, with blade-shaped dactyl. All abdominal somites with dorsal carina, but carina faint on first somite. Telson with truncate margin ending in spinules, with dorsal groove, shorter than uropods. Total length 145 mm.

Color in life: Bright red.

Habitat and depth: Pelagic, 700-1000 m, rarely taken in benthic trawls.

Range: Oregon to northern Chile. Type locality Gulf of Panama.

### Pasiphaea chacei Yaldwyn

Pasiphaea chacei Yaldwyn, 1962: 18, fig. 1-19.-- Ebeling et al., 1969: 12.-- Krygier and Percy, 1981: 79.-- Hendrickx and Estrada-Navarrete, 1989: 111.-- Hendrickx and Estrada-Navarrete, 1996: 87, fig. 53.-- Guzmán and Wicksten, 1998: 204.--Wicksten 2002: 133.

Recognition characters: Postfrontal tooth prominent, long, slender and acute. Carapace with dorsal carina on anterior 2/3 of surface, with suprabranchial carina; anterior margin produced dorsally into blunt, convex lobe and then sinuous ventrally; branchiostegal tooth prominent. Eyes well developed and pigmented. Antennular peduncle with narrow stylocerite. Basicerite with strong lateral tooth, scaphocerite reaching beyond antennular peduncle, with lateral tooth longer than blade. Third maxilliped reaching beyond scaphocerite, with exopod. All pereopods with exopods. First pereopod with 0-12 meral spines, carpus with distoventral spine, slender chela. Second pereopod with 6-23 meral spines, carpus with distoventral spine, chela with fingers elongate, tips curved and capable of crossing one another. Third pereopod slender, fourth pereopod short and slender, fifth pereopod longer than fourth, with broad dactyl. Abdominal somites without dorsal carina. Abdominal pleura rounded to concave. Telson somewhat shorter than sixth abdominal somite, with longitudinal groove and truncate distal margin armed with 4 pairs spinules. Total length about 55 mm.

Color in life: Transparent with lightly scattered red chromatophores.

Habitat and depth: Pelagic, 0-1236 m, usually at 100-850 m.

Range: Oregon to Baja California, Mexico; northern Chile. Type locality San Pedro Basin, California.

### Pasiphaea pacifica Rathbun

Pasiphaea pacifica Rathbun, 1902: 905.-- Rathbun, 1904: 20, fig. 2.-- Schmitt, 1921: 29, fig. 14.-- Kobyakova, 1937: 97, fig. 1.-- Goodwin, 1952: 393.-- Kobyakova, 1967: 20.-- Kozloff, 1974: 162.-- Butler, 1980: 55.-- Krygier and Percy, 1981: 79.-- Wicksten, 1982b: 245.-- Hendrickx and Estrada-Navarrete, 1989: 111.-- Hendrickx and Estrada-Navarrete, 1996: 93, fig. 59.--Wicksten 2002: 134.

Recognition characters: Rostrum thin. Postfrontal tooth directed anteriorly, acute. Carapace with dorsal carina extending nearly to posterior margin, with strong branchiostegal tooth and supporting carina, lateral carina extending from antennal region posteriorly. Stylocerite longer than eye. Scaphocerite with lateral tooth exceeding blade. Flagella of both pair antennae very long when intact. Third maxilliped setose, shorter than first pereopod. First and second pereopods chelate, chelae slender. Fingers of chela of first pereopod crossing. Second pereopod with spine on carpus, row of spinules on merus. Third pereopods slender, thread-like, Fourth pereopods short, with flat dactyl. Fifth pereopods longer than fourth, with flat, setose dactyl. Second to sixth abdominal somites with dorsal carina, pleura rounded to blunt. Telson with dorsal groove, deep posterior notch, shorter than uropods. Male total length 81 mm, female total 73 mm.

Color in life: Translucent, with scattered red chromatophores, especially on gastric region, dorsal midline of abdominal somites 3-6 and telson and uropods.

Habitat and depth: Epipelagic, 0-1076 m but usually between 75-500 m, may be caught in bottom trawls.

Range: Siberia; Alaska to Gulf of California, Australia, South Africa. Type locality off Point Sur, California.

Pasiphaea emarginata Rathbun

Pasiphaea emarginata Rathbun, 1902: 905.-- Rathbun, 1904: 22, fig. 4.-- Schmitt, 1921: 30, fig. 15.-- Ebeling et al., 1969: 12.-- Hendrickx and Estrada-Navarrete, 1989: 11.-- Hendrickx and Estrada-Navarrete, 1996: 89, fig. 55.

Recognition characters: Postfrontal projection spine-like, directed obliquely upward. Carapace with small knob anterior to postfrontal tooth, small branchiostegal tooth supported by carina, dorsal carina extending to posterior margin, lateral H-shaped carina extending posteriorly along branchial region, also two smaller carina parallel to this carina but dorsal to it and small Y-shaped carina near antennal region. Appendages similar to those of P. pacifica. First to fifth abdominal somites slightly carinate, sixth somite with faint carina, telson with dorsal groove, V-shaped posterior notch. Total length 81 mm.

Color in life: Translucent, scattered red chromatophores on much of body; telson, uropods, antennae and maxillipeds with red tint.

Habitat and depth: Pelagic, 0-1600 m. Rarely taken in bottom trawls.

Range: Santa Barbara Channel, California to Gulf of California (Concepcion Bay). Type locality off Concepcion Bay, Gulf of California.

Pasiphaea tarda Kröyer

Pasiphaea tarda Kröyer, 1845: 434.-- Butler, 1980: 56.-- Krygier and Percy, 1981: 79.-- Hendrickx and Estrada-Navarrete, 1989.—112.-- Hendrickx and Estrada-Navarrete, 1996: 96, fig. 60.--Wicksten 2002: 134.

Recognition characters: Exoskeleton thin. Postfrontal tooth extending forward as blade-like extension of carapace. Carapace with middorsal carina extending along entire dorsal midline, with small branchiostegal tooth supported by short carina, Y-shaped carina along branchial region but not reaching posterior margin, slight carina dorsal to Y-shaped carina. Stylocerite longer than eye. Scaphocerite with lateral tooth exceeding blade. First and second pereopods particularly stout and heavy, both with spinules on merus. All abdominal somites with distinct dorsal carina. Telson with dorsal groove, V-shaped posterior notch, not as long as uropods. Male total length 152 mm, female total 215 mm.

Color in life: Crimson.

Habitat and depth: Pelagic, 0-2400 m, usually at 200-2000 m.

Range: Unalaska to Ecuador; Atlantic Ocean. Type locality off Greenland.

Pasiphaea corteziana Rathbun

Pasiphaea corteziana Rathbun, 1902: 905.-- Rathbun, 1904: 24, fig. 5.-- Schmitt, 1921: 30, fig. 16.-- Hendrickx and Estrada-Navarrete, 1921: 111.--Wicksten 2002: 133.

Recognition characters: Postfrontal tooth nearly vertical. Carapace with blunt middorsal carina, small branchiostegal tooth (may be blunt or reduced in larger specimens), Y-shaped horizontal carina along branchial region and carina extending posteriorly from antennal region. First and second pereopods with long, slender chelae. Second pereopod with row of spinules along merus. Third pereopod slender, fourth short, with blunt dactyl; fifth longer and also with blunt dactyl. Abdominal somites without middorsal carina. Sixth abdominal somite with small tooth on posterodorsal margin. Telson with dorsal groove, deep posterior notch. Outer uropod longer than inner. Total length to 105 mm. (Description and illustrations based on specimens from off San Nicolas Island, California; Velero IV station 11965).

Color in life: Not reported.

Habitat and depth: Pelagic, 1400-1630 m.

Range: Santa Cruz Island, San Nicolas Island to Cortez Bank, California. Type locality near Cortez Bank.

Genus Eupasiphae Wood-Mason and Alcock, 1893

Eupasiphae serrata (Rathbun)

Parapasiphae serrata Rathbun, 1902: 904.-- Rathbun, 1904: 25, fig. 7.-- Schmitt, 1921: 31, fig. 18.  
Eupasiphae serrata: Crosnier, 1988: 788, fig. 2b.-- Hendrickx and Estrada-Navarrete, 1989: 112.-  
-Wicksten 2002: 133.

Recognition characters: Rostrum short, not exceeding eyestalk. Dorsal margin of carapace carinate to posterior 1/5 of its length, with 16 small spinules; with posterior dorsal groove, lateral carina running posteriorly from branchiostegal region and nearly joining another carina running horizontally along branchial region. Stylocerite much longer than eye. Scaphocerite with lateral tooth longer than blade. Third maxillipeds stout, shorter than first pereopod. First and second pereopods stout, chelate, with spinules on propodus and merus. Third pereopods thread-like, fourth and fifth pereopods short and with flat dactyls. First three abdominal somites not carinate, fourth somite with carina, notch above strong posterodorsal tooth. Fifth somite not carinate, sixth not carinate but with longitudinal groove. Telson shorter than uropods, apex truncate. Total length 65 mm.

Color in life: Not recorded.

Habitat and depth: Pelagic, 970-1800 m.

Range: Off Cortez Bank, California; southeast Atlantic. Type locality off Cortez Bank, California.

Genus Parapasiphae Smith, 1884

Parapasiphae cristata Smith

Parapasiphae cristata Smith, 1884: 388, pl. V, fig. 3.-- Krygier and Percy, 1981: 81.-- Hendrickx and Estrada-Navarrete, 1989: 112.--Wicksten 2002: 133.

Recognition characters: Rostrum extending to cornea of eye. Dorsal carina of carapace with at most 1-2 teeth. Groove along branchial region. Cornea of eye lightly pigmented, with distinct tubercle. Exopods of maxillipeds and pereopods heavy and prominent. First and second

pereopods chelate, merus of each with minute spinules. Fingers of chela of second pereopod longer than palm. Third to fifth pereopods reduced. Most abdominal somites without carina, fourth somite with dorsal carina ending in posterior tooth. Telson slightly shorter than inner uropod. Total length 86.9 mm. (Description based on specimen from Velero IV station 10675, off Guadalupe Island, Mexico).

Color in life: Not recorded.

Habitat and depth: Pelagic, 400-2870 m.

Range: Oregon to Baja California, Mexico; North Atlantic. Type locality off New Jersey.

### Parapasiphae sulcatifrons Smith

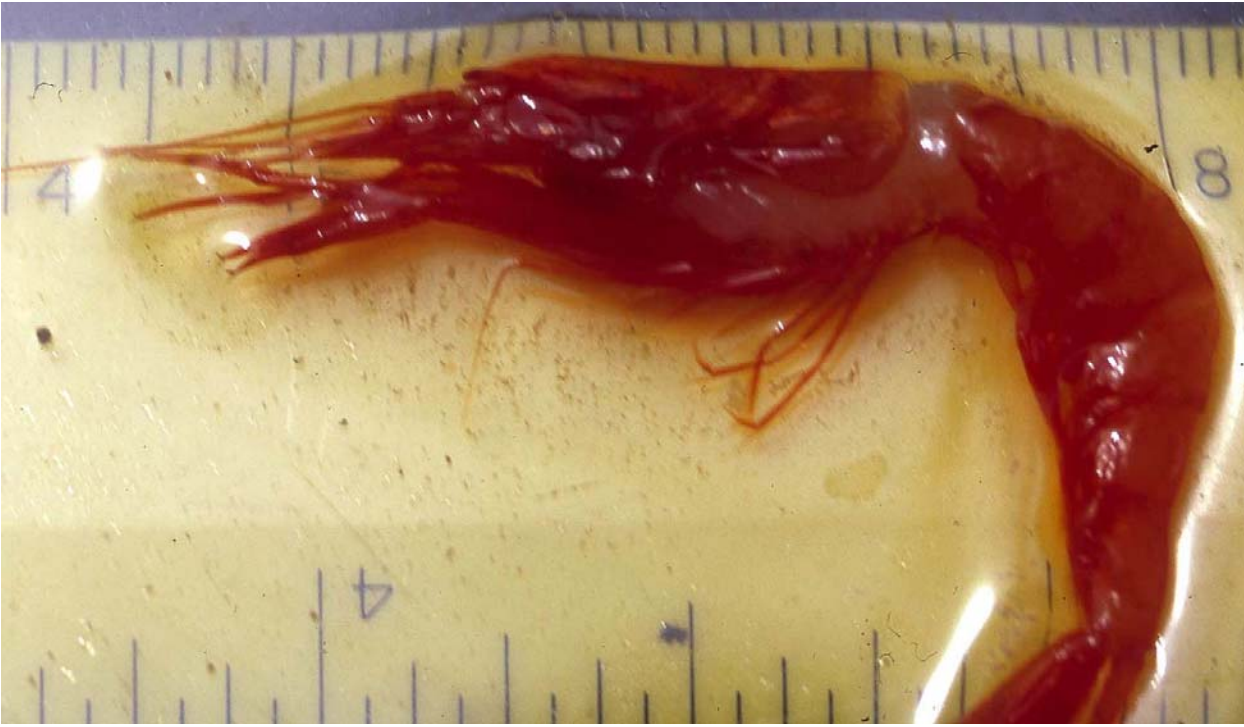
Parapasiphae sulcatifrons Smith, 1884: 384, pl. 5, fig. 4; pl. 6, figs. 1-7.-- Ebeling et al., 1969: 12.-  
- Crosnier and Forest, 1973: 142, fig. 41.-- Butler, 1980: 58.-- Krygier and Pearcy, 1981: 81.--  
Hendrickx and Estrada-Navarrete, 1989: 112.-- Hendrickx and Estrada-Navarrete, 1996: 99, fig.  
62.-- Guzmán and Wicksten, 1998: 205.--Wicksten 2002: 133.

Recognition characters: Exoskeleton rather thin. Rostrum shorter than eyestalk, slightly ascending, apex acute. Carapace with middorsal carina not quite extending to posterior margin, with Y-shaped carina running along branchial region and carina running posterior and ventrally from orbital region. Stylocerite acute, longer than eye. Base of thickened flagellum of antennule particularly broad. Scaphocerite with lateral tooth exceeding blade. Third maxilliped setose. First and second pereopods chelate, first setose, second with strong spines on carpus, merus and ischium; fingers of chela shorter than palm, crossing at tip. Third pereopod thread-like, fourth and fifth pereopods short, with blade-shaped dactyls. Only fourth abdominal somite with dorsal carina, extending into posterior tooth. Telson with dorsal groove, rounded apex armed with 6-9 spines, shorter than uropods. Male total length 70 mm, female total to 93 mm.

Color in life: Scarlet, eye amber to bronze.

Habitat and depth: Pelagic, 500-1300 m.

Range: Canada to Baja California, northern Chile, Atlantic and Indo-Pacific Oceans. Type locality east coast of United States.



Parapasiphae sulcatifrons

# Family Oplophoridae

Oplophorids are pelagic shrimp, often with a thin carapace and a bright orange to red color. The rostrum varies from very short to long and toothed. The carapace may bear teeth and carinae. Some species also have teeth on the dorsal midline of the abdominal somites. Eyes may be pigmented or not. The first two pairs of pereopods are chelate and shorter than the last three pairs. The maxillipeds and pereopods bear exopods.

Little is known about most oplophorids of California and Oregon. Systellaspis debilis produces a luminous cloud. Other species have photophores. Oplophorids have been captured by traps being brought up to the surface, suggesting that they were scavenging on the bait. Species of Notostomus and Systellaspis may feed on pelagic cnidarians such as jellyfishes of the genus Atolla (Moore et al., 1993).

Oplophorids occur world-wide in pelagic zones. At present, many of the species are thought to occur more or less world-wide or in both the Atlantic and Pacific Oceans. The work by Chace (1986) provides keys and descriptions, especially of Indo-Pacific species.

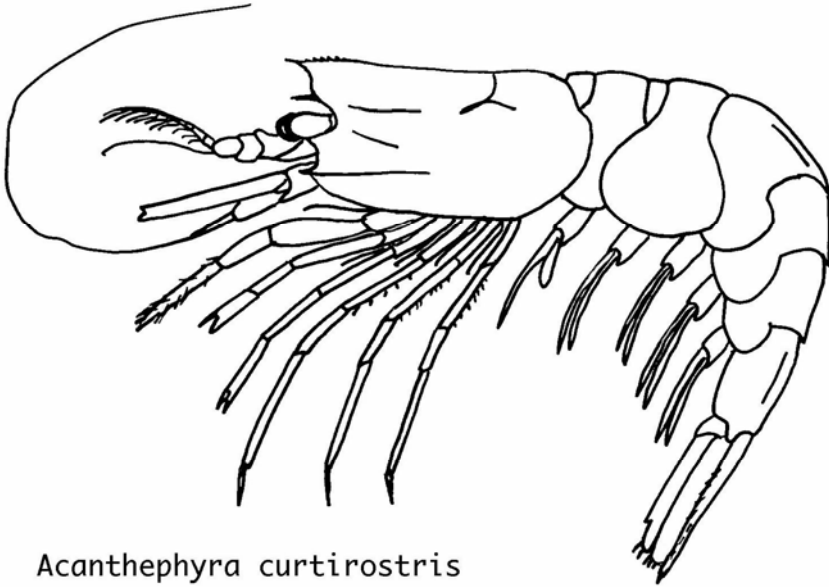
The key includes all species reported to date from California and Oregon. Ebeling et al. (1969) reported Notostomus patentissimus Bate, 1888 from the San Pedro Basin, California, but this is believed to be an Indo-Pacific species (Crosnier and Forest, 1973).

## Key to the Species of the Family Oplophoridae

1. Abdomen with carina present at least on dorsal midline of posterior 4 abdominal somites; eggs small to medium-sized and numerous-----2  
Abdomen without carina on dorsal midline of posterior 4 abdominal somites; eggs large and few-----7
2. Carapace without lateral carina extending from near orbit to near posterior margin, posterior margin of hepatic groove usually not abruptly delimited by oblique carina-----3  
Carapace with lateral carina extending from near orbit to near posterior margin, posterior margin of hepatic groove abruptly delimited by oblique carina-----6
3. Carapace with prominent carina on posterior 1/3 of dorsal midline-----Acanthephyra eximia Smith  
Carapace without prominent carina on posterior 1/3 of dorsal midline-----4
4. Rostrum armed ventrally with 1-2 teeth-----5  
Rostrum armed ventrally with 3-7 teeth-----Acanthephyra quadrispinosa Kemp
5. Carapace with strong carina extending from branchiostegal tooth posteriorly to hepatic groove, no ridge on posterior half of lateral surface-----Acanthephyra curtirostris Wood-Mason



- Carapace without strong carina extending from branchiostegal tooth, with well-marked ridge on posterior half of lateral surface-----Acenthephyra chacei Krygier and Forss
6. Carapace with single lateral longitudinal carina, abdomen without median dorsal carina on first somite-----Meningodora mollis Smith
- Carapace with more than one lateral longitudinal carina, abdomen with median dorsal carina on first somite-----Notostomus japonicus Bate
7. Eyes large and pigmented, anterior margin of first abdominal somite armed with distinct lobe or tooth overlapping posterior margin of carapace, telson with acute apex-----8
- Eyes small and weakly pigmented, anterior margin of first abdominal somite not armed with distinct lobe or tooth, telson with truncate and spinose apex-----10
8. Carapace without sinuous lateral ridge extending posteriorly from orbital region nearly to posterior margin; telson armed laterally with single row of small spines totally at most 10 spines on each side-----Systellaspis debilis (A. Milne-Edwards)
- Carapace with sinuous lateral ridge extending posteriorly from orbital region nearly to posterior margin; telson armed laterally with 2 or more rows of small spines totalling at least 20 on each side-----9
9. Rostrum triangular in lateral aspect, dorsal posterior margin of fifth abdominal somite without median tooth-----Systellaspis braueri (Balss)
- Rostrum slender, dorsal posterior margin of third abdominal somite with median tooth-----Systellaspis cristata (Faxon)
10. Rostrum reaching to or beyond distal end of antennular peduncle-----Hymenodora frontalis Rathbun
- Rostrum reaching little beyond cornea of eye -----11
11. Anterior part of carapace near rostrum swollen-----Hymenodora glacialis (Buchholz)
- Anterior part of carapace near rostrum not swollen-----12
12. Anterior margin of first abdominal somite forming lobe overlapping posterior margin of carapace-----Hymenodora acanthitelsonis Wasmer
- Anterior margin of first abdominal somite not forming lobe overlapping posterior margin of carapace -----Hymenodora gracilis Smith



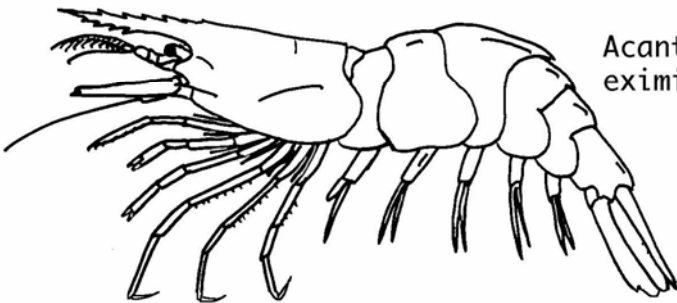
*Acanthephyra curtirostris*



*Acanthephyra quadrispinosa*



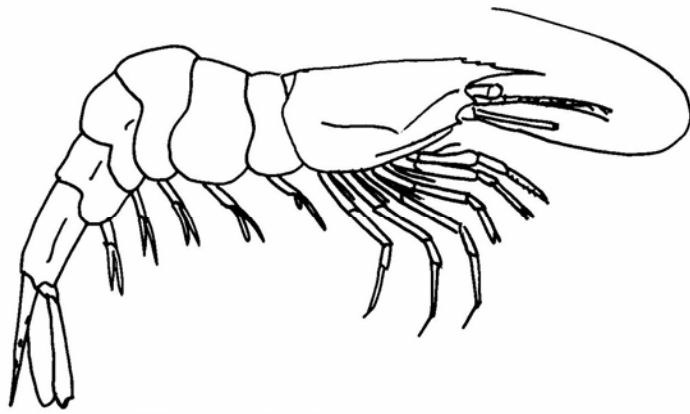
*Meningodora mollis*



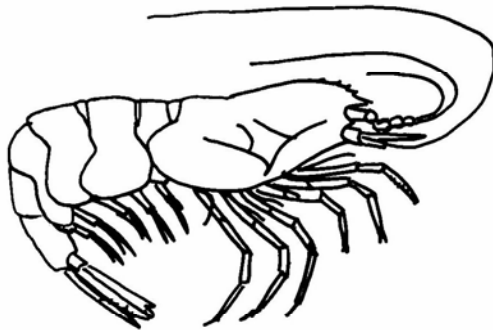
*Acanthephyra eximia*



*Hymenodora gracilis*



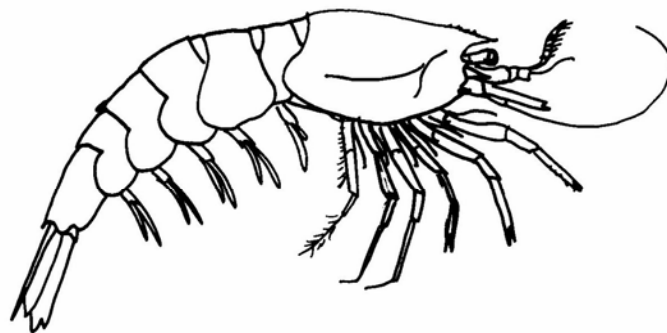
*Hymenodora frontalis*



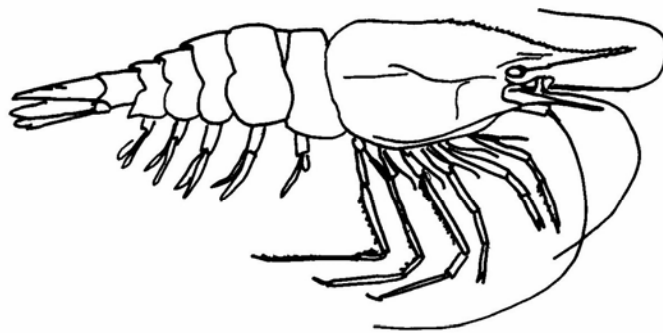
*Hymenodora glacialis*



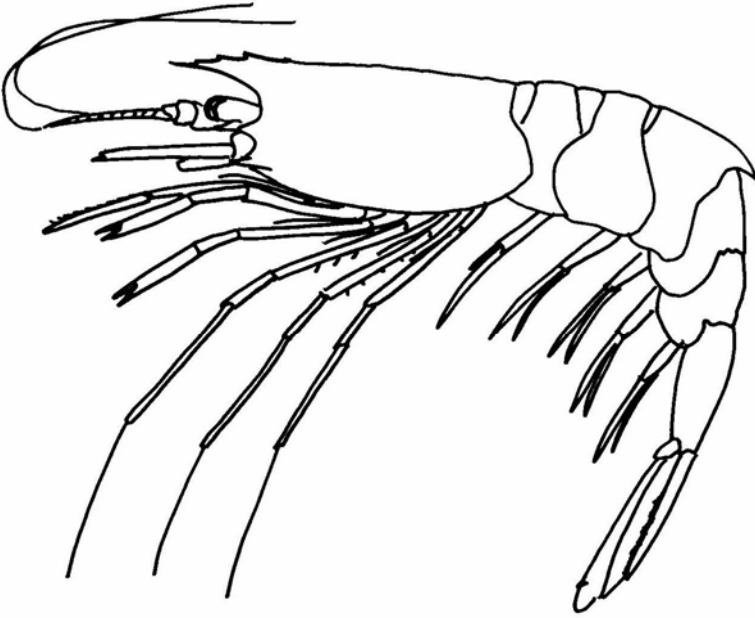
*Hymenodora acanthitelsonis*



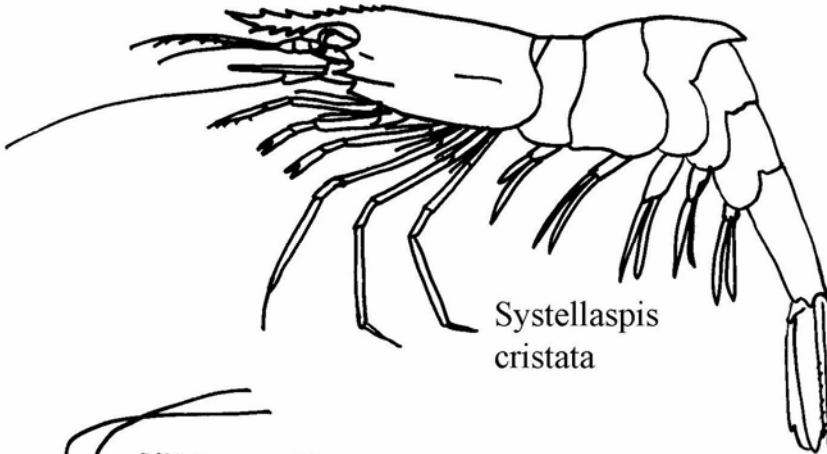
*Meningodora mollis*



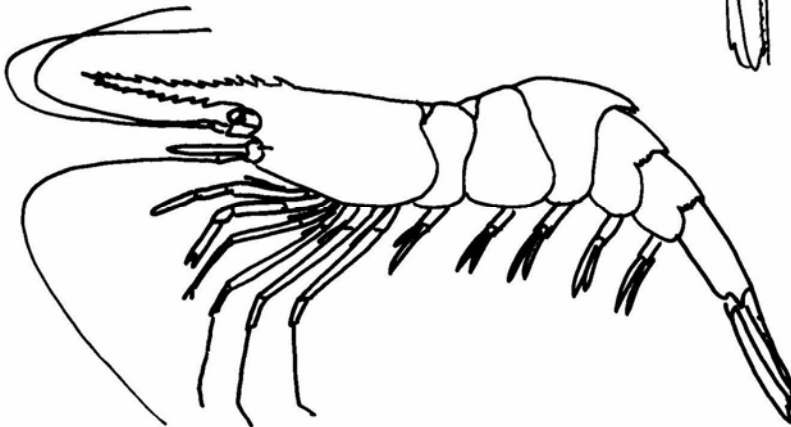
*Notostomus japonicus*



*Systellaspis braueri paucispinosa*



*Systellaspis cristata*



*Systellaspis debilis*

Genus Acanthephyra A. Milne-Edwards, 1881

Acanthephyra eximia Smith

Acanthephyra eximia Smith, 1884: 376.-- Chace, 1940: 147, fig. 24.-- Crosnier and Forest, 197: 34, fig. 7c.-- Chace, 1986: 18, figs. 2j, 4j, 5j, 6h, 9a.-- Hendrickx and Estrada-Navarrete, 1989: 114.—Wicksten 2002: 135.

Recognition characters: Exoskeleton firm, not hard. Rostrum as long as scaphocerite, narrow, with 8 dorsal teeth and space devoid of teeth between them and apex of rostrum, 4 ventral teeth. Carapace with dorsomedian carina, antennal and branchiostegal teeth. Eye pigmented. Antennular peduncle short. Scaphocerite with narrow blade exceeding lateral tooth. Third maxilliped and all pereopods with prominent exopods. First and second pereopods with slender chelate, third to fifth pereopods with simple dactyls and row of spinules along merus. All but first abdominal somite with dorsomedian carina, with posterior median tooth on third-sixth somites, tooth of third somite the largest. Telson with faint dorsal carina, 3-5 pair lateral spines. Carapace length to 41 mm.

Color in life: Crimson.

Habitat and depth: Pelagic or benthic, 200-4700 m.

Range: Offshore of southern California, Indo-Pacific and Atlantic Oceans, Gulf of Mexico. Type locality off Cape Hatteras, North Carolina.



Acanthephyra eximia

Acanthephyra curtirostris Wood-Mason

Acanthephyra curtirostris Wood-Mason, 1891: 195.-- Faxon, 1895: 164, pl. 43, figs. 2-5.---

Rathbun 1904: 27.—Schmitt 1921: 33, fig. 19.--Goodwin, 1952: 394.-- Crosnier and Forest, 1973: 39, fig. 8a.-- Butler, 1980: 61.-- Méndez, 1981: 89, fig. 273-275.-- Krygier and Percy 1981: 81.-- Chace, 1986: 17, figs. 2i, 4i, 5i, 6g, 8h.-- Hendrickx and Estrada-Navarrete, 1989: 114.-- Hendrickx and Estrada-Navarrete, 1996: 113, fig. 70.—Wicksten 2002: 135.

Recognition characters: Rostrum triangular in lateral view, as long as antennular peduncle, with 6-9 small dorsal and 1-2 ventral teeth, extending posteriorly as carina on anterior 2/3 of carapace. Carapace with prominent carina extending posteriorly from branchiostegal tooth, grooves extending posteriorly from orbit and antennal region, also y-shaped groove on posterior lateral region. Eye small and pigmented. Antennular peduncle short, scaphocerite long, with lateral tooth exceeding blade. Third maxilliped stout, distal segment with longitudinal ridge. First two pereopods short and chelate, third to fifth with simple dactyls. Second to sixth abdominal somites with strong dorsal carina, third to fifth ending in posterior dorsal spine; third spine the strongest. Telson with truncate tip, 8-12 lateral spines, 4 pair distal spines. Male total length 69 mm, female to 79 mm.

Color in life: Crimson.

Habitat and depth: Bathypelagic, 300-2000 m, greatest catches at 600-900 m, does not seem to migrate daily.

Range: Vancouver Island to Peru, Indo-Pacific and Atlantic Oceans. Gulf of Mexico. Type locality Bay of Bengal.

#### Acanthephyra quadrispinosa Kemp

Acanthephyra quadrispinosa Kemp, 1939: 571.-- Krygier and Percy, 1981: 83.--Chace, 1986: 26, figs. 3h, 4t, 7g, 10c, 14.-- Hendrickx and Estrada-Navarrete, 1989: 114.—Wicksten 2002: 135.

Recognition characters: Exoskeleton firm. Rostrum longer than carapace, with 3-7 dorsal and 6 ventral teeth. Carapace with blunt carina near rostrum, small antennal tooth, branchiostegal tooth with short posterior carina. Third maxilliped longer than first or second pereopods. Third to fifth pereopods setose, with few spines on merus and ischium. Abdominal somites 2-6 with dorsomedian carina, median spines on somites 3-6, sixth somite with distolateral tooth. Telson with dorsal groove, 4 pair lateral spines and terminal spines. Total length 40 mm.

Color in life: Not recorded.

Habitat and depth: Pelagic, 250-5040 m; may migrate between 180-1500 m.

Range: Oregon, Indo-Pacific and Atlantic Oceans. Type locality south and eastern Africa.

#### Acanthephyra chacei Krygier and Forss

Acanthephyra chacei Krygier and Forss, 1981: 96, figs. 1-2.-- Chace, 1986: 9.—Wicksten 2002: 135.

Recognition characters: Exoskeleton membranous. Rostrum with 5-9 dorsal teeth, usually one ventral tooth, triangular in shape, descending from gastric region and then ascending past cornea of eye. Eye pigmented. Carapace dorsally carinate, without cervical groove, with strong lateral ridge bifurcating at anterior margin; deep depression marking branchial cavity. Branchiostegal tooth on short rise, not on carina. Antennular peduncle less than half length of

antennal scale, stylocerite short. Antennal scale with lateral tooth exceeding blade, blade with midlongitudinal ridge. Third maxilliped setose, with exopod. All pereopods with exopods. First pereopod chelate, short; merus with 1-2 spines. Second pereopod chelate, longer than first, merus with 1-6 spines, ischium with 0-7 spines. Third pereopod extremely long, dactyl small and simple, with numerous spines on carpus, merus and ischium. Fourth pereopod slender, with 5-17 spines on ischium. Fifth pereopod shorter, dactyl simple, with numerous spines on carpus, merus and ischium. Abdominal somites 3-6 dorsally carinate, each ending in spine. Telson about as long as uropod, sulcate dorsally and usually armed with 3 pair dorsolateral spines; with terminal spine flanked by 3 pair lateral spines. Male carapace length 37 mm, female to 36.7.

Color in life: Scarlet.

Habitat and depth: Bathypelagic, 1,500-2,400 m.

Range: Southern tip of Alaskan peninsula to off the coast of Oregon. Type locality 44°45.2'N, 127°44.0'W.

### Genus Meningodora Smith, 1882

#### Meningodora mollis Smith

Meningodora mollis Smith, 1882: 74, pl. 11, figs. 8, 8a, 9, pl. 12, figs. 5, 5a, 6-9.-- Crosnier and Forest, 1973: 44, fig. 10c.-- Krygier and Percy, 1981: 83.-- Chace, 1986: 50, figs. 26a-k.-- Hendrickx and Estrada-Navarrete, 1989: 115.-- Hendrickx and Estrada-Navarrete, 1996: 122, fig. 75.—Wicksten 2002: 136.

Notostomus fragilis Faxon, 1893: 207; Faxon 1895: 170, pl. 44, figs. 2a-b.

Notostomus mollis: Chace, 1940: 164, fig. 38.

Recognition characters: Exoskeleton soft and fragile. Rostrum with 7-9 small dorsal and no ventral teeth, barely exceeding eye. Carapace somewhat inflated, with antennal tooth, branchiostegal tooth with short carina, lateral carina extending from orbit nearly to posterior margin. Eye small and pigmented. Antennular peduncle short. Scaphocerite with blade exceeding lateral tooth. Third maxilliped shorter than first and second pereopods, setose. Second and third pereopods chelate, third to fifth pereopods with simple dactyls, fifth pereopod especially setose. Third to sixth abdominal somites with dorsomedian carina, posterior dorsal tooth on fourth-sixth somites. Telson without lateral spines. Total length 70 mm.

Color in life: Cephalothorax maroon tinged with black, abdomen and appendages red.

Habitat and depth: Pelagic, surface-2000 m, usually 500-1150 m.

Range: Oregon to Galapagos Islands, Indian and Atlantic oceans., Gulf of Mexico. Type locality east of Cape Lookout, North Carolina.

### Genus Notostomus A. Milne-Edwards, 1881

#### Notostomus japonicus Bate

Notostomus japonicus Bate, 1888: 830, pl. 135, fig. 1.-- Kozloff, 1974: 163.-- Butler, 1980: 63.-- Krygier and Percy 1981: 83.-- Chace, 1986: 53, figs. 28j-l, 29 h-i.-- Hendrickx and Estrada-Navarrete, 1989: 115.—Wicksten 2002: 136.

Recognition characters: Exoskeleton thin. Rostrum longer than scaphocerite, slender, with 55-83 small teeth extending posteriorly on most of carapace, 10-18 ventral teeth. Carapace arched in anterior portion, with antennal and branchiostegal teeth, two lateral carinae running posteriorly from rostrum, along anterior lateral carina and two posterior carinae running length of carapace from orbit to posterior margin, branchial carina extending from branchiostegal spine to posterior margin, vertical carina between anterior part of branchial carina and carina posterior to eye. Antennular peduncle short. Scaphocerite with broad blade, lateral tooth exceeding blade. Third maxilliped longer than first pereopod. First and second pereopods shorter than posterior 3 pereopods, which have simple dactyls, fifth pereopods with more setose dactyl than anterior two pair pereopods. Abdominal somites all with dorsomedian carina, 3-6 with posterior dorsal spine. Telson with dorsal groove, 3-4 pair dorsolateral spines, blunt tip with 5 distal spines. Male total length 151 mm, female 153.

Color in life: Crimson, carinae darker.

Habitat and depth: Pelagic, 450-5380 m.

Range: Oregon, Hawaii, Japan. Type locality off Honshu Island, Japan.

### Genus Systellaspis Bate, 1888

#### Systellaspis debilis (A. Milne-Edwards)

Acanthephyra debilis A. Milne-Edwards, 1881: 13.

Systellaspis debilis: Chace, 1940: 181, fig. 51.--Crosnier and Forest, 1973: 87, figs. 26b, 27b.--Krygier and Percy, 1981: 89.--Chace, 1986: 65, figs. 34g-i, 35e, f.--Hendrickx and Estrada-Navarrete, 1989: 116.—Wicksten 2002: 137.

Recognition characters: Rostrum elongate, much longer than scaphocerite, with 14 dorsal and 9 ventral teeth, acute tip. Carapace with antennal and branchiostegal teeth. Eye pigmented. Stylocerite about as long as eye. Scaphocerite with lateral tooth longer than blade. Third maxilliped about as long as first pereopod. Exopods of third maxilliped and all pereopods about same length. First and second pereopods short and chelate, pereopods 3-4 longer, with simple dactyls, pereopod 5 shorter, with paddle-like dactyl, pereopods 3-5 with spinules on propodus, merus and ischium. Abdominal somites with rounded to blunt pleura. Third abdominal somite with large posterior dorsal tooth and carina, fourth somite with smaller spine and carina. Posterior margins of somites 3 and 4 armed with spinules. Sixth somite with posterolateral spout. Telson nearly as long as uropods, with 5-6 pair lateral spinules. Carapace length to 17 mm.

Color in life: Adult scarlet-red, appendages tinged with salmon-orange. Hardy (1970, pl. 17-7) illustrated a juvenile with the anterior part of the body scarlet and the rostrum and posterior parts fading to translucent.

Habitat and depth: Pelagic, 0-1500 m, concentrated at 150 m by night and 650-800 m by day.

Range: Oregon, Indo-Pacific and Atlantic oceans, Gulf of Mexico, Caribbean Sea. Type locality Bahamas Channel.

Natural history remarks: Systellaspis debilis has been reported to produce a secretion that creates a luminous cloud. This is one of the most common midwater shrimp.



Systellaspis braueri paucispinosa Crosnier

Systellaspis braueri paucispinosa Crosnier, 1987: 954, fig. 3-b.-- Hendrickx and Estrada-Navarrete, 1989: 116.-- Hendrickx and Estrada-Navarrete, 1996: 125, fig. 77.—Wicksten 2002: 137.

Systellaspis braueri: Butler, 1980: 65.-- Krygier and Percy, 1981: 87.

Recognition characters: Exoskeleton thin and smooth. Rostrum short, triangular, with 11-12 dorsal and 1-4 ventral teeth, anterior third without teeth. Carapace with moderate antennal and branchiostegal teeth, the latter with supporting carina; orbito-hepatic and branchial carinae; groove below branchial carina. Eye small, pigmented. Stylocerite shorter than eye. Scaphocerite with lateral tooth and blade about equal in length. Third maxilliped setose, longer than first pereopod. Exopod of third maxilliped and pereopods about same length and size. First two pereopods short and chelate; third and fourth long, with simple, slender dactyls, fifth very short, with blunt dactyl; propodus, merus and ischium of each of last three pereopods with spinules. Third abdominal somite with strong posterior dorsal tooth and carina, fourth somite with smaller spine and carina. Abdominal pleura blunt to rounded. Posterolateral margins of fourth and fifth somites with small notch, fifth somite with posterolateral tooth. Telson with 20-30 lateral spines. Telson slightly longer than uropods. Male total length 110 mm. female total 138 mm.

Color in life: Deep red to red-brown.

Habitat and depth: Pelagic, 500-2000 m, maximum concentration at 900-2000 m.

Range: Oregon to Central America; North and South Pacific, Indonesia. Type locality east of Japan, 31° 59'08"N, 158° 04'04'E.

Systellaspis cristata (Faxon)

Acanthephyra cristata Faxon, 1893: 206.-- Faxon, 1895: 162, pl. 43, fig. 1.-- Goodwin, 1952: 394.

Systellaspis cristata: Butler, 1980: 67.-- Crosnier and Forest, 1973: 94, figs. 26d, 27d.-- Méndez, 1981: 84, figs. 258-262.-- Krygier and Percy, 1981: 89.--Chace, 1986: 64, figs. 34d-f, 35c.-- Hendrickx and Estrada-Navarrete, 1989: 116.—Wicksten 2002: 137.

Recognition characters: Exoskeleton thin, minutely pitted. Rostrum about as long as blade of scaphocerite, with 10-14 dorsal and 4-8 ventral teeth, tip acute; may be raised into convex crest posterior to orbit. Carapace with weak suborbital, moderate antennal and strong branchiostegal teeth, the latter with supporting carina; gastro-orbital and submarginal carinae. Eyes pigmented. Stylocerite slightly longer than eye. Scaphocerite with lateral tooth longer than blade. Third maxilliped longer than first or second pereopod, setose. Third maxilliped and all pereopods with exopods of similar size. First and second pereopods short, chelate; third to fifth longer, third and fourth with long dactyls, fifth with short, broad dactyl; propodus, merus and ischium of each bearing spinules. Abdominal pleura rounded or bluntly angular, dorsal surface of third somite with strong posterior tooth and carina, fourth with smaller tooth; small lateral spinules on pleura of fourth and fifth somites. Sixth somite longer than telson. Telson with 7-9 pair spines on dorsal surface, 18-21 pair small lateral spines as well as 1 pair strong lateral spines. Uropods slightly shorter than telson. Male total length 81 mm, female total length 169.

Color in life: Crimson.

Habitat and depth: Pelagic, 0-2500 m; usually below 200 m.

Range: Canada to Gulf of Panama, Atlantic Ocean, Indian Ocean. Type locality south of Panama.

Genus Hymenodora Sars, 1877

Hymenodora frontalis Rathbun

Hymenodora frontalis Rathbun, 1902: 904.—Rathbun, 1904: 28, fig. 8.--Schmitt, 1921: 34, fig. 20.-- Kobyakova, 1937: 98, fig. 2.-- Goodwin, 1952: 394.-- Ebeling et al., 1969: 12.-- Kozloff, 1974: 163.-- Butler, 1980: 70.-- Krygier and Percy, 1981: 83.-- Chace, 1986: 42, figs. 21 f-j.-- Hendrickx and Estrada-Navarrete, 1989: 115.—Wicksten 2002: 136.

Recognition characters: Exoskeleton thin, not pitted. Rostrum shorter than scaphocerite, with 3-6 dorsal and no ventral teeth, tip acute. Carapace with suborbital and antennal spines fused into lobe, moderate branchiostegal tooth merging into carina which extends nearly to posterior margin of carapace, orbital carina running obliquely posteriorly to v-shaped notch, then running horizontally toward posterior margin. Eye without pigment or pale amber. Stylocerite shorter than eye. Scaphocerite with lateral tooth longer than blade. Third maxilliped with proximal segment somewhat concave, setose; longer than first pereopod. Exopods of third maxilliped and pereopods about same length. First and second pereopods chelate, short. Third and fourth pereopods with simple dactyls, spinules on merus and ischium. Fifth pereopod shorter than fourth, with very short dactyl. Abdominal somites rounded, no lateral or dorsal teeth. Telson longer than uropods, with 6-9 pairs posterolateral spines and 6 distal spines near apex, truncate distally. Male total length 58 mm, female total 53 mm.

Color in life: Orange-red.

Habitat and depth: Pelagic, 200-2400 m, maximum abundance at 600-1300 m. Very common in its depth range.

Range: Sea of Okhotsk and Bering Sea to southern California. Type locality west of Unalaska.

Hymenodora glacialis (Buchholz)

Pasiphae glacialis Buchholz, 1874: 279, pl. 1, fig. 2.

Hymenodora glacialis: Kobyakova, 1937: 99, fig. 3.-- Havens and Rork, 1969: 19.-- Crosnier and Forest, 1973: 84, fig. 25b.-- Butler, 1980: 72.-- Krygier and Percy, 1981: 86.-- Chace, 1986: 42, figs. 21k-o.-- Hendrickx and Estrada-Navarrete, 1989: 115.-- Hendrickx and Estrada-Navarrete, 1996: 117, fig. 72.—Wicksten 2002: 136.

Recognition characters: Very similar to H. frontalis. Exoskeleton membranous, finely pitted. Anterior part of carapace swollen, rostrum barely longer than eye, lower margin convex, with 2-5 dorsal and 0-1 ventral teeth. Carpus of first pereopod with conspicuous distal tubercle. Telson with 5-6 pair dorsolateral spines. Male total length 48 mm, female total 45 mm. See Havens and Rork, 1969 for a comparison of H. glacialis and H. gracilis.

Color in life: Blood red.

Habitat and depth: Pelagic, rarely near surface in polar seas but more common at 350-1000 m; at 2000-5610 m off Oregon.

Range: Sea of Okhotsk and Bering Sea to Gulf of Panama, Arctic region, North Atlantic; western

South Atlantic, Chile and subantarctic Pacific, southwestern Indian Ocean. Type locality eastern Greenland, 74 ° N, near edge of pack ice.

Hymenodora acanthitelsonis Wasmer

Hymenodora acanthitelsonis Wasmer, 1972a: 87, figs. 1-8.--Krygier and Pearcy, 1981: 87.—Wicksten 2002: 136.

Recognition characters: Exoskeleton rather firm. Rostrum about equal to eye, with 6 dorsal teeth and continuing posteriorly as carina of carapace. Anterior carapace not inflated; carapace with weak cervical groove, also supra-branchial and subhepatic grooves and small pterygostomial tooth. Eye with tubercle at base of cornea. Scaphocerite with tapered blade, lateral tooth exceeding blade. First abdominal somite with anterolateral lobe overlapping posterior margin of carapace. Telson with 6-7 pair dorsolateral spines, lobate end with numerous small spines. Total length about 50 mm.

Color in life: Not recorded.

Habitat and depth: Pelagic, 2400-3000 m.

Range: Off coast of Oregon. Type locality 45° 18.0'N, 125° 43.2'W-45° 17.2'N, 125° 48.3'W.

Hymenodora gracilis Smith

Hymenodora gracilis Smith, 1887: 680, pl. 12, fig. 6.-- Chace, 1940: 175, fig. 46.-- Crosnier and Forest, 1973: 83, fig. 25a.-- Butler, 1980: 69.-- Chace, 1986: 43, figs. 21 p-t.-- Hendrickx and Estrada-Navarrete, 1989: 115.--Hendrickx and Estrada-Navarrete, 1996: 119, fig. 73.—Wicksten 2002: 136.

Recognition characters: Similar to H. frontalis. Exoskeleton soft and membranous. Rostrum slightly longer than eye, with 4 dorsal and no ventral teeth, apex acute. Carapace with groove running obliquely posteriorly from orbit, with hepatic and branchial branches. Scaphocerite with blade and lateral tooth of same length. Telson with 3 pairs anterolateral spines. Total length about 50 mm.

Color in life: Bright scarlet to red.

Habitat and depth: Pelagic, 300-4730 m, maximal abundance at 1250-2000 m.

Range: Oregon to Baja California; off Chile and subantarctic waters of South Pacific, Indian and Atlantic Oceans; Gulf of Mexico. Type locality not specified, off New Jersey-Maryland; 40° 26' 40"N, 67° 05' 15"W-37° 12' 20, 69° 36' 00"W.

## Family Nematocarinidae

Sometimes called thread-leg shrimp, these deep-sea crustaceans are characterized by their very long and thin pereopods, which often break off when the shrimp is collected. Studies on Atlantic species suggest that they are generalistic feeders on benthic organisms. Females produce enormous numbers of eggs (2,400-15,500 per female) (Wenner, 1979).

Species of the family are widespread in tropical to temperate seas. However, there is only one record of a single species of the family off Oregon.

Genus Nematocarcinus A. Milne-Edwards, 1881

Nematocarcinus exilis (Bate)

Stochasmus exilis Bate, 1888: 823, pl. 132, fig. 14.

Nematocarcinus ensifer var. exilis: de Man, 1920: 75.

Nematocarcinus exilis: Crosnier and Forest, 1973: 116, figs. 32d, e; 33d-f.-- Krygier and Percy, 1981: 89.

Recognition characters: Rostrum about 0.4-0.5X as long as carapace, more or less straight, with 20-25 dorsal and no ventral teeth. Carapace relatively smooth, with sharp antennal and pterygostomian teeth. Stylocerite shorter than first segment of antennular peduncle. Bascierite with sharp lateral tooth, scaphocerite with lateral tooth slightly exceeding blade. Third maxilliped elongate, with exopod and straplike epipod. Anterior 4 pairs pereopods with exopods and straplike epipods, 2 anterior pairs chelate and without divided carpus, 3 posterior legs very long and with simple dactyls. Third abdominal segment overlapping fourth on posterodorsal end, pleura of fifth abdominal somite with point. Telson not longer than uropods. Carapace length 11-23 mm.

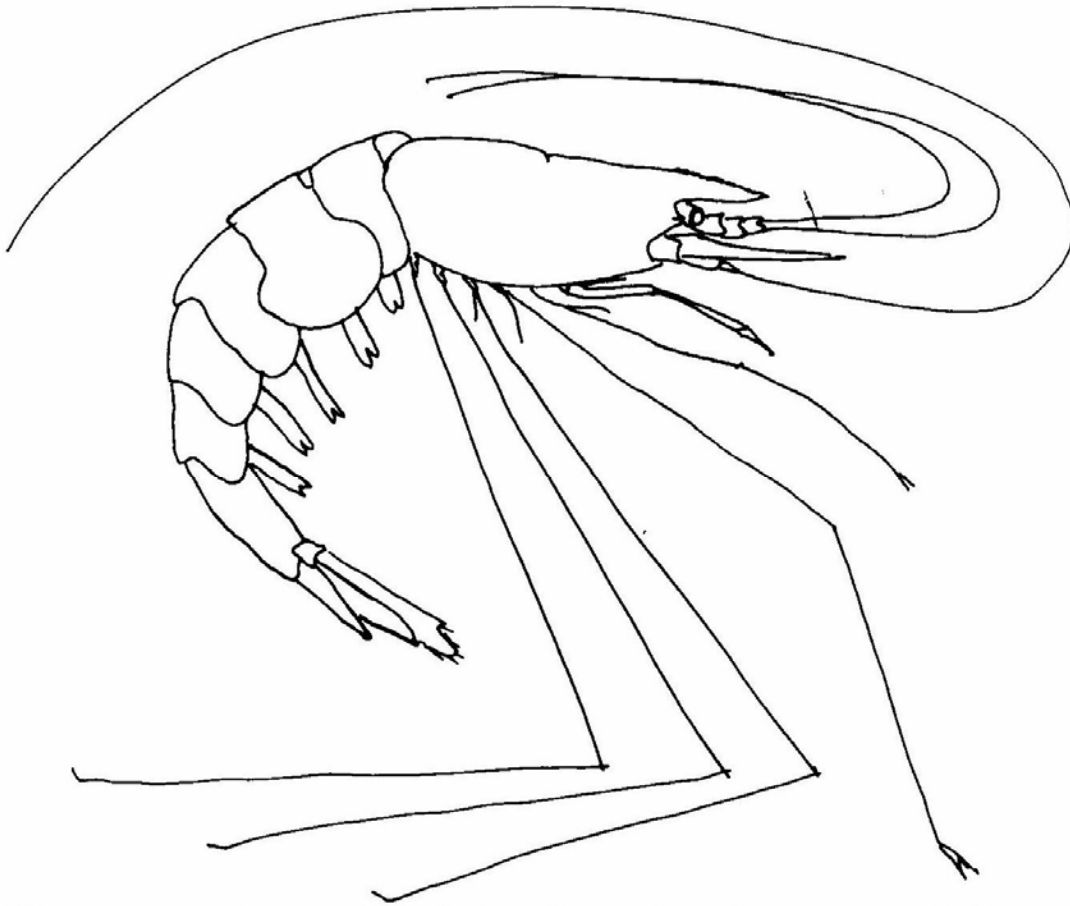
Color in life: Not reported, but other species are either entirely crimson or spotted with red.

Habitat and depth: Epibenthic, 1200-4000 m.

Range: Eastern Atlantic from southeast of Ireland to Morocco and Mediterranean; off Oregon.

Type locality off Canary Islands (30 °, 38' N, 18 °, 38'N).

Taxonomic remarks: Krygier and Percy (1981) based their identification of N. exilis on the features presented by Crosnier and Forest (1973) in differentiating N. exilis from N. ensifer Smith. However, N. ensifer is the species reported previously from the eastern Pacific by Faxon (1895) and Burukovsky (2001). Further study of these two polymorphic species is needed to determine the American distributions of the species, especially in the northeastern Pacific.



*Nematocarcinus exilis* (after Crosnier & Forest, 1973)

## Family Stylodactylidae

Bathystylodactylus echinus Wicksten and Martin, 2004

Bathystylodactylus echinus Wicksten and Martin, 2004: 377-384.

Recognition characters.—Rostrum nearly straight, nearly 2X length of carapace or more, with 23-27 dorsal and 18-25 ventral spines; series of 7-9 minute spinules on carapace just posterior to rostrum proper. Carapace and abdomen with small spinules along dorsal and lateral surfaces. Stylocerite slender, not reaching middle of first segment of antennular peduncle. Basicerite bearing strong lateral tooth. Scaphocerite covered by minute spinules, reaching second segment of antennular peduncle. Third maxilliped setose, with arthropod but without exopod. Pereopods all lacking exopods or epipods. First and second pereopods, chelate, similar in size and shape. Fingers of chelae elongate, without teeth, with long setae and shorter spine-like setae along cutting edges. Third to fifth pereopods elongate with few scattered setae. Third abdominal somite weakly carinate dorsally, pleura of somites 4 and 5 with sharp poststyroventral spine. Telson with 11-13 pairs of dorsolateral spines located on weak ridges. Carapace length to 41.4 mm.

Color in life.—Not recorded.

Habitat and depth.—Abyssal plains, 3427-3689 m.

Range.—Patton Escarpment off California to basin off Magdalena Bay, Baja California, Mexico. Type locality basin off Magdalena Bay (24°35'N, 113° 25'W).

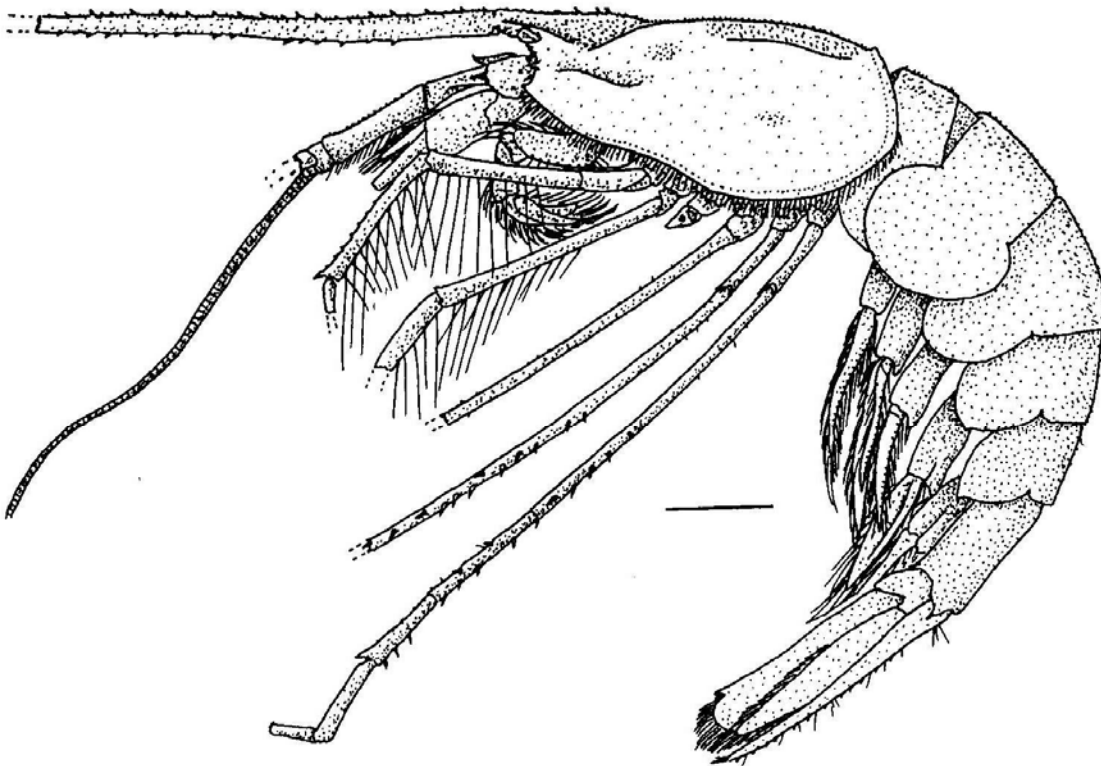


Fig. 1. *Bathystylodactylus echinus*, new species, male holotype, Scripps Institution of Oceanography C3188. Scale bar = 10.0 mm.

# SUBORDER PLEOCYEMATA

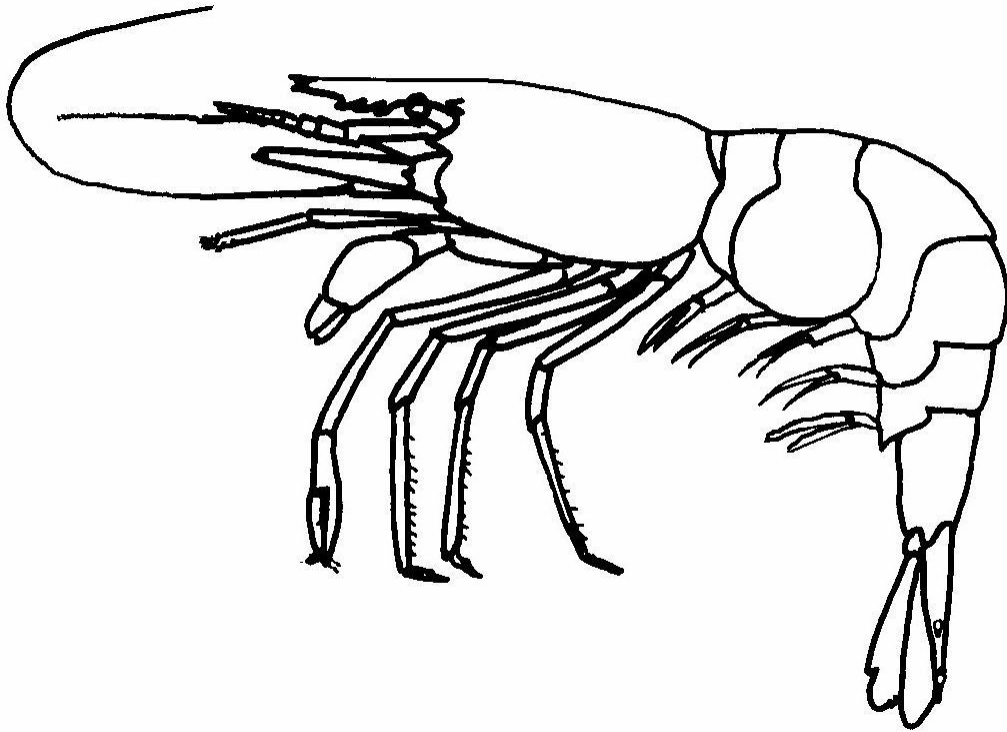
## INFRAORDER CARIDEA

### Family Atyidae

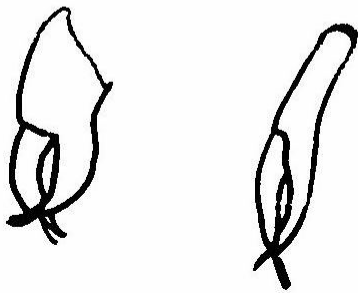
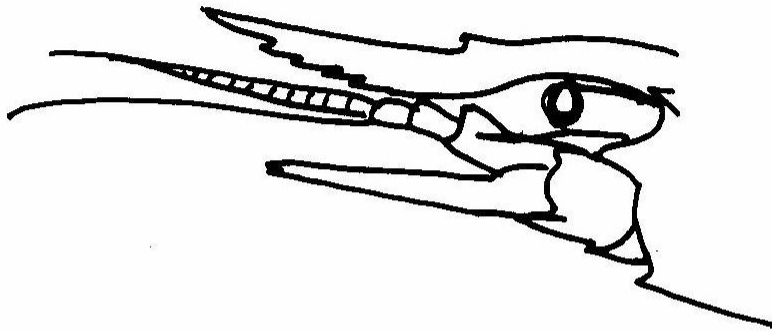
The Atyidae are freshwater shrimp, usually found in flowing water. The fingers of the chelae end in brushes of setae, which are used to scrape food particles from rocks and sand. Although there are numerous tropical species of this family, only two species of Syncaris have been found in California.

#### Key to the Species of the Family Atyidae

1. Rostrum with 1-2 teeth on upper margin of rostrum. Marin, Napa and Sonoma counties, California-----Syncaris pacifica Holmes  
Rostrum without teeth on upper margin of rostrum. Los Angeles County, California-----  
-----Syncaris pasadenae (Kingsley)



*Syncaris pasadenae* and chelae



*Syncaris pacifica*



Genus Syncaris Holmes, 1900

Syncaris pacifica (Holmes)

Miersia pacifica Holmes, 1895: 577.

Syncaris pacifica: Holmes, 1900: 211; Hedgpeth 1968: 511, figs. 1,2; Carlton and Kuris 1975: 390, pl. 93, fig. 15; Eng 1981: 1, fig. 1. Martin and Wicksten 2004: 447, figs. 6-9. (See last reference for a more complete synonymy).

Recognition characters: Body slender. Rostrum with 1-2 dorsal and 5-9 ventral teeth, slender and about as long as carapace. Carapace with supraorbital, antennal and pterygostomial teeth. Stylocerite longer than first segment of antennular peduncle. Scaphocerite about as long as rostrum. Pereopods 1-4 with exopods, and epipods pereopod 5 without exopods. First pereopods short, carpus short and distally widened, concave; chela when flexed folding against concavity of carpus. Second pereopods longer than first, carpus shorter than chela. Pereopods 3-5 subequal, dactyls short, with spinules; merus of third pereopod with 3 spines, merus of fourth and fifth pereopod with 2 spines each. Abdominal somites rounded. Telson with truncate or broadly rounded apex, with 2 short dorsolateral spines and 2 pair terminal spines. Total length 50 mm.

Color in life: Transparent to rust-colored, with scattered chromatophores and pale band at base of tail fan.

Habitat and depth: Coastal streams of Napa, Sonoma and Marin counties, shallow water.

Range: Napa, Sonoma and Marin counties, California. (See Martin and Wicksten, 2004 for map).

Type locality Sonoma County, California.

Remarks: Syncaris pacifica, the California freshwater shrimp, is endangered due to habitat destruction and introduction of predatory fishes into the streams in which it lives. The shrimp usually occur in slower reaches of streams, where they cling to aquatic vegetation and roots (Hedgpeth, 1968; Eng, 1981).

Syncaris pasadenae Kingsley

Fig. 11A-C

Caridina pasadenae Kingsley, 1897: 98, pl. 3, figs. 1-7; Holmes, 1900: 214.

Syncaris trewi Holmes, 1900: 213.

Syncaris pasadenae: Hedgpeth 1968: 516; Holthuis 1993:63, fig.50. Martin and Wicksten 2004: 447. (See last reference for a more complete synonymy).

Recognition characters: More robust than S. pacifica. Rostrum without dorsal teeth, bifid at apex, with 3-5 ventral teeth. Carapace with supraorbital, antennal and pterygostomial teeth. Stylocerite longer than first segment of antennular peduncle. Scaphocerite rounded, blade exceeding lateral tooth, not as long as rostrum. First to fourth pereopods with exopods and epipods. First pereopod with chela, fingers gaping and ending in tufts of setae. Second pereopods with carpus longer than chela, fingers of chela ending in tufts of setae.. Third to fifth pereopods elongate, with slender dactyls, dactyls with spinules. Merus of third pereopod with 1 spine. First to fourth adominal pleura rounded, fifth pleuron with spine or point. Telson tapering to round or truncate apex, with 2 pair dorsolateral spines. and 2 pair terminal spines. Uropods longer than telson. Total length 32-40 mm.

Color in life: Not recorded.

Habitat and depth: Streams of Los Angeles and San Bernardino Counties, especially Los Angeles River drainage; shallow. See Hedgpeth, 1968 for map.

Range: Los Angeles River drainage, streams near San Gabriel and Pasadena, and Warm Creek, San Bernardino County, California. Type locality streams near Pasadena.

Remarks: The last verified collection of this species was in 1933. Despite extensive searching, it has not been found again. The streams in which it lived have undergone extensive habitat destruction, which probably contributed to the extinction of the species.

## Family Palaemonidae

The family Palaemonidae includes a diverse array of tropical species inhabiting coral reefs, estuaries, rivers and caves. Many are specialized and are commensals of cnidarians, mollusks, echinoderms or tunicates. Being primarily inhabitants of warmer regions, few range as far north as California. One species has been introduced into bays of California and Oregon from the Orient. All of the other resident species in California are marine. For a key to all species of the eastern Pacific and nearby freshwater drainages, consult Wicksten (1989a).

In palaemonids, both the first and second pereopods bear chelae. The carpus of the second pereopod is entire, not divided into three or more articles. The second pereopods are especially large and heavy in adult males.

Three additional introduced species have been found California. As of this writing, it is uncertain whether any of them has established a breeding population in the area. Exopalaemon carinicauda (Holthuis, 1950) has been collected in southern San Francisco Bay. This large estuarine species is native to China and Korea. See Wicksten, 1997 for an illustration. Macrobrachium rosenbergii (De Man, 1879), widely raised in aquaculture, has been found in tributaries of San Francisco Bay. It is widespread in freshwater areas of the Indo-Pacific region, and can tolerate salt water for short periods of time. Palaemonetes kadiakensis Rathbun, 1902, has been found in freshwater streams draining into San Diego Bay, California. It is native to the eastern United States. See Holthuis, 1952 for illustrations of this species.

### Key to the Species of the Family Palaemonidae

1. Posterior margin of telson with 2 pairs spines. Pleurobranch on third maxilliped. (Rostrum always with spines)-----2  
  
Posterior margin of telson with 3 pairs spines. No pleurobranch on third maxilliped. (Rostrum with or without spines)-----4
2. Carpus of second pereopod distinctly shorter than chela. (San Diego, California south)-----  
-----Palaemon ritteri Holmes  
  
Carpus of second pereopod longer than chela. (San Francisco Bay south)-----3
3. Rostrum with subapical tooth, mandible with palp. (Introduced into bays of California)-----  
-----Palaemon macrodactylus Rathbun  
  
Rostrum without subapical tooth, mandible without palp. (San Pedro, California south)-----  
-----Palaemonetes hiltoni Schmitt
4. Rostrum without teeth dorsal teeth-----5  
  
Rostrum with dorsal teeth-----6
5. Body stout, major chelipeds heavy and lobster-like. Commensal with ascidians-----  
-----Pontonia californiensis Lockington

Body and major chelipeds slender. Not commensal with ascidians-----

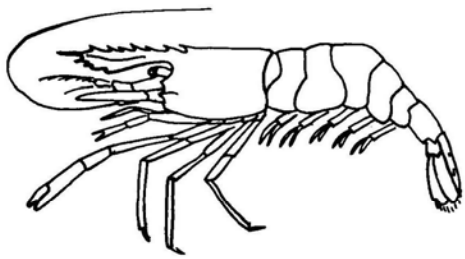
-----Pseudocoutierea elegans Holthuis

6. Rostrum arched over eye, carapace without supraorbital teeth-----

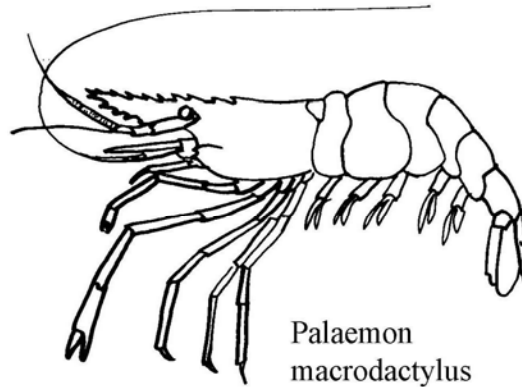
-----Periclimenes infraspinis (Rathbun)

Rostrum not arched over eye, carapace with supraorbital teeth-----

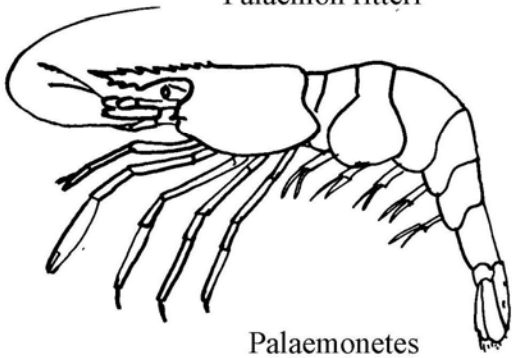
-----Palaemonella holmesi (Nobili)



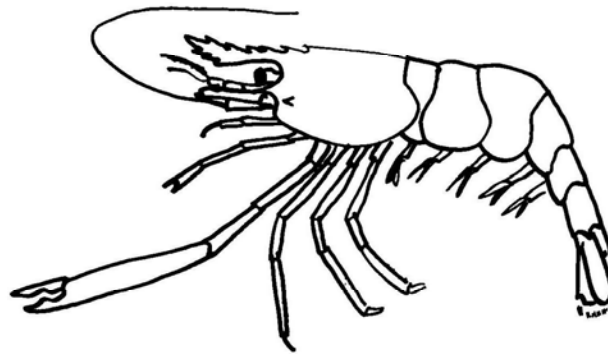
Palaemon ritteri



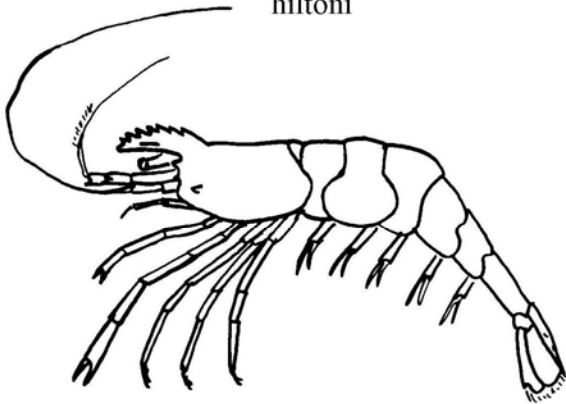
Palaemon  
macrodactylus



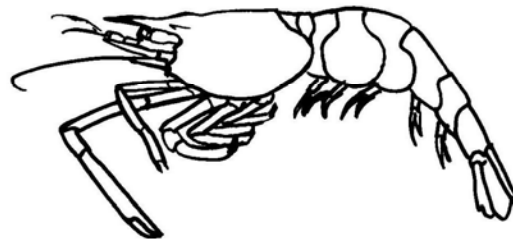
Palaemonetes  
hiltoni



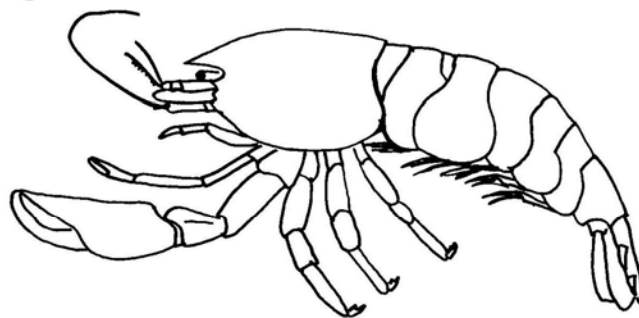
Palaemonella holmesi



Periclimenes infraspinis



Pseudocoutierea elegans



Pontonia californiensis

Genus Palaemon Weber, 1795

Palaemon ritteri Holmes

Palaemon ritteri Holmes, 1895: 579, pl. 21, figs. 29-35.--Holmes, 1900: 216.-- Rathbun, 1904: 29.-- Schmitt, 1921: 35, fig. 21.-- Holthuis, 1952a: 173, pl. 44, figs. a-g.-- Méndez, 1981: 73, fig. 252.-- Wicksten, 1983b: 10.-- Kerstitch, 1989: 76, fig. 184.-- Wicksten, 1989a: 14.-- Wicksten and Hendrickx, 2003: 60.

Recognition characters: Rostrum as long as or longer than scaphocerite, with 8-10 dorsal and 3-4 ventral teeth, distal part unarmed. Carapace with antennal and branchiostegal teeth. Basal segment of antennular peduncle with anterolateral tooth and small distolateral tooth. Scaphocerite with blade overreaching lateral tooth. First pereopods chelate, shorter than second pereopods. Carpus of second pereopod shorter than chela proper. Third to fifth pereopods with simple dactyls. Pleura of abdominal somites 1-4 rounded, fifth with anterolateral spine. Telson with 2 pairs anterolateral spines. Total length 40 mm.

Color in life: Translucent with scattered dark chromatophores or banded with brown.

Habitat and depth: Usually intertidal, tidepools, bays.

Range: San Diego, California to Galapagos Islands. Type locality San Diego.

Natural history remarks: No specimens of this species have been found in California since the type was collected. The species is an abundant tidepool shrimp of the Gulf of California.

Palaemon macrodactylus (Rathbun)

Leander macrodactylus Rathbun, 1902: 52, fig. 24.

Leander macrodactyla: Kobayakova, 1937:99.

Palaemon macrodactylus: Newman, 1963:119.-- Kobayakova, 1967: 238.-- Carlton and Kuris, 1975: 390, pl. 93, fig. 17.—Chace and Abbott, 1980: 570, fig. 23.1.-- Wicksten, 1989a: 14.-- Jensen, 1995: 52, fig. 95.

Recognition characters: Similar to P. ritteri. Rostrum as long as scaphocerite, with 9-15 dorsal teeth, bare space near apex, 3-4 ventral teeth including subapical tooth. Carapace with antennal and branchiostegal teeth. First segment of antennular peduncle broad and flattened, with prominent distolateral spine and small proximal spine. Basicerite with distolateral tooth, carapacerite shorter than antennular peduncle. Third maxilliped slender and setose. First pereopods slender and chelate. Second pereopods longer than first, carpus about as long as merus, carpus nearly as long as entire chela. Third-fifth pereopods slender, with simple dactyls. Abdominal pleura 1-4 rounded, fifth with distolateral point, sixth with distolateral and ventrolateral points. Telson shorter than uropods, with 2 pair dorsolateral spines. Total length 58 mm.

Color in life: Translucent brown to greenish or olive.

Habitat and depth: Docks, pilings and shores of bays, intertidal to 1 m .

Range: Native to coast of Korea, China and Japan; introduced into San Francisco Bay, Malibu Lagoon, Long Beach Harbor and San Diego county, California. Type locality Aomiri, Rikuoku, Japan.

Natural history remarks: This large shrimp can be common among rocks and cobble along the coast of San Francisco Bay. Although it can inhabit estuarine areas, it also occurs in normal

ocean salinities (35 o/oo) in San Francisco Bay.



Palaemon macrodactylus

Genus Palaemonetes Heller, 1869

Palaemonetes hiltoni Schmitt

Palaemonetes hiltoni Schmitt, 1921: 36, pl. 12, fig. 5.--Holthuis, 1952a: 227, pl. 53, figs. n-s.--Wicksten, 1983b: 11.--Wicksten, 1989a : 15.--Wicksten and Hendrickx, 2003: 62.

Recognition characters: Rostrum as long as scaphocerite, with 8-11 dorsal and 2-3 ventral teeth. Carapace with antennal and branchiostegal teeth. Basal segment of antennular peduncle with lateral tooth and small subapical tooth. Scaphocerite with scale exceeding lateral tooth. First pereopod chelate, shorter than second pereopod. Carpus of second pereopod as long as palm of chela. Third to fifth pereopods slender, with simple dactyls. Pleura of abdominal somites 1-4 rounded, fifth with posterolateral spine. Telson with 2 pair spines on posterior margin. Total length 24 mm.

Color in life: Translucent.

Habitat and depth: Bays and estuaries, shallow water.

Range: San Pedro and Del Mar, California; Gulf of California in Sonora and Sinaloa states. Type locality San Pedro, California.

Natural history remarks: Palaemonetes hiltoni has not been reported in California since its original description. It is abundant in bays in the Gulf of California.

Genus Pontonia Latreille, 1829

Pontonia californiensis Rathbun

Pontonia californiensis Rathbun, 1902: 902.--Rathbun, 1904: 33, fig. 11.--Schmitt, 1921: 38, fig. 23.--Holthuis, 1951: 145, pl. 46, figs. a-i, pl. 47, figs. a-c.--Wicksten, 1989a: 18.

Recognition characters: Rostrum about as long as first segment of antennular peduncle, flattened and without teeth. Carapace without teeth. Stylocerite short and blunt, first segment of antennular peduncle with very small distolateral spine. Scaphocerite oval in shape, blade about as long as inwardly curved lateral tooth. First pereopods short, slender and chelate, second pereopods more robust, unequal in size and shape. Larger second pereopod with two teeth closing against each other on dactyl and propodus, smaller chela without teeth, fingers slender and gaping. Third to fifth pereopods with hooked, biunguiculate dactyls. Abdominal pleura rounded, may be widely spread in ovigerous female. Telson with two pair large dorsolateral spines, three pair small terminal spines. Total length to 29 mm.

Color in life: Yellowish white or dull orange brown.

Habitat and depth: Subtidal, commensal in ascidians, to 55 m.

Range: Carmel, Santa Cruz and Santa Rosa Islands, off Palos Verdes Point, California. Type locality off Santa Cruz Island, California.

Natural history remarks: Species of Pontonia usually occur in pairs, but so far, records of P. californiensis are of single specimens from a host. There are few records of this commensal shrimp, probably because it is necessary to pluck the ascidian from its rocky substrate in order to extract the shrimp.

Genus Pseudocoutierea Holthuis, 1951

Pseudocoutierea elegans Holthuis

Pseudocoutierea elegans Holthuis, 1952: 183, pl. 57, figs. a-r.--Wicksten, 1983b: 19.--Wicksten, 1989a: 15.—Wicksten and Hernández, 2000: 96. Wicksten and Hendrickx, 2003: 62.

Recognition characters: Rostrum reaching or exceeding antennular peduncle, without teeth. Carapace with enlarged supraocular teeth which partially cover eyestalks, also antennal tooth and branchiostegal groove. Stylocerite sharp and slender, reaching middle of basal segment of antennular peduncle, which bears anterolateral tooth. Scaphocerite with lateral tooth longer than blade. First pereopod slender and chelate. Second pereopods larger than first, chelate, unequal in size. Larger cheliped bearing one tooth in larger specimens, smaller cheliped without tooth and with more elongate fingers. Pereopods 3-5 with hooked dactyls. First and second abdominal pleura rounded, third to sixth with sharp posterolateral points. Telson with 2 pair dorsolateral spines, 3 pair posterolateral spines. Total length 16 mm.

Color in life: Orange-red.

Habitat and depth: Subtidal rocky substrates, usually with gorgonians, to 92 m.

Range: Santa Catalina Island, California to Punta Sal, Peru and Galapagos Islands. Type locality off Santa Catalina Island.

Natural history remarks: A specimen from Santa Catalina Island was found with the gorgonian Lophogorgia chilensis, which also is colored orange-red. Other related members of the



Palaemonidae are camouflaged by having the same color as the gorgonians on which they live.

Genus Periclimenes Costa, 1844

Periclimenes infraspinis (Rathbun)

Urocaris infraspinis Rathbun, 1902: 903.--Rathbun, 1904: 31, fig. 10.--Schmitt, 1921: 37, fig. 22.  
Periclimenes infraspinis: Holthuis, 1951: 46, pl. 13, figs. a-l.--Wicksten, 1983b: 14.--Wicksten, 1989a: 17.--Wicksten and Hendrickx, 2003: 62.

Recognition characters: Rostrum reaching third segment of antennular peduncle, arched over eye, with 5-7 dorsal and 1-2 ventral teeth. Carapace with antennal and hepatic teeth. Stylocerite slender, reaching middle of basal segment of antennular peduncle, this segment with distolateral tooth. Scaphocerite with blade exceeding tooth. First pereopods slender and chelate, second pereopods longer, chelate, unequal in size and shape in adults. Larger second pereopod with 2 teeth on dactyl, smaller chelipeds without teeth on dactyl. Third to fifth pereopods slender, with biunguiculate dactyls. Abdominal pleura rounded or ending in blunt points. Telson with two pair dorsolateral spines, 3 pair terminal spines. Total length 23 mm.

Color in life: Translucent, pale brown.

Habitat and depth: Subtidal among rock, sand, algae or cnidarians, to 150 m.

Range: San Diego, California to Galapagos Islands. Type locality Concepcion Bay, Baja California, Mexico.

Genus Palaemonella Dana, 1852

Palaemonella holmesi (Nobili)

Periclimenes holmesi Nobili, 1907: 5.

Anchista tenuipes Holmes, 1900: 216.

Periclimenes tenuipes: Rathbun, 1904: 34, fig. 12.--Schmitt, 1921: 39, fig. 24.

Palaemonella holmesi: Holthuis, 1951: 13, pl. 3, figs. a-h; pl. 4, figs. a-i.--Wicksten, 1983b: 13.--Wicksten, 1989a: 16.--Kerstitch, 1989: 78, fig. 190.--Jensen, 1995: 53, fig. 96.—Wicksten and Hendrickx 2003: 61.

Recognition characters: Rostrum exceeding scaphocerite, with 6-9 dorsal and 2-4 ventral teeth. Carapace with supraorbital, antennal and hepatic teeth. Stylocerite strong and pointed, reaching middle of basal segment of antennular peduncle, which bears anterolateral tooth. Scaphocerite with tooth exceeding blade. First pereopods slender and chelate. Second pereopods sexually dimorphic: in mature males, very elongate, with one large tooth and 4 smaller teeth on fingers of chelae (but may be worn in old animals), gape present; more slender and shorter in females. Third to fifth pereopods slender, with simple dactyls. Abdominal somites rounded. Telson with 2 pair dorsolateral spines, 3 pair posterior spines. Total length to 50 mm.

Color in life: Translucent golden-brown.

Habitat and depth: Subtidal sandy or rocky bottoms, 2-90 m.

Range: Santa Catalina Island, California to Ecuador. Type locality Santa Catalina Island, California.



Palaemonella holmes

## Family Lysmatidae

Until recently, members of the families Lysmatidae, Thoridae and Hippolytidae all were lumped into a single family, the Hippolytidae. Christoffersen (1988a) split the family. I follow his system in this account. Species of the Lysmatidae are recognizable by their extremely long antennular flagella and having 22 or more carpal articles in the second pereopods.

The only representative of the family Lysmatidae in California is Lysmata californica. Species of the family usually are temperate or tropical in distribution, and live among rocks or corals. They are active at night. Many are colored red or red with white stripes. Many species are protandrous hermaphrodites. The males are smaller than the females.

Many species of the Lysmatidae are cleaners: they remove debris, dead tissue, parasites and mucus from fishes. Lysmata californica associates with the green moray eel Gymnothorax mordax (Limbaugh, 1961). However, L. californica also lives by itself under rocks and in cracks.

Species of Lysmata are well known for their ability to disperse across wide distances. Adults can cling to drifting kelp and other objects. The larvae have peculiar flattened areas that may provide buoyancy.

Genus Lysmata Risso, 1816

Lysmata californica (Stimpson)

Hippolysmata californica Stimpson, 1866: 48.--Holmes 1900: 180, pl. 2, fig. 38.--Rathbun 1904: 56.--Schmitt 1921: 49, fig. 27.--Johnson and Snook 1927: 304, fig. 258.--Holthuis 1947: 19.--MacGinitie and MacGinitie 1968: 274, fig. 125.

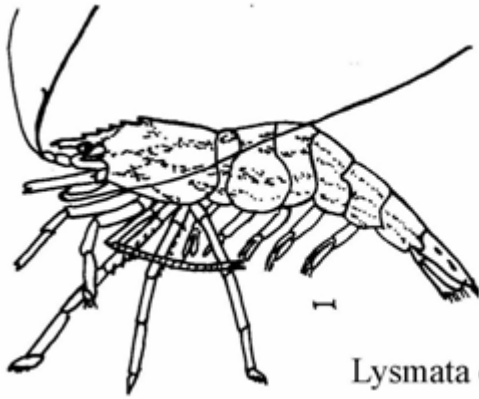
Lysmata californica: Chace and Abbott 1980: 569, fig. 23.8--Standing 1981: 780.--Wicksten 1983b: 27.--Ricketts et al. 1985: 173, fig. 144.--Kerstitch 1989: 81, fig. 198.--Wicksten 1990b: 596.--Jensen 1995: 51, fig. 90.--Chace 1997: 73. --Debelius 1999: 125.—Wicksten 2000: 3, fig. 4A.—Wicksten and Hendrickx 2003: 67.

Recognition characters: Rostrum slender, strongly ridged on sides, bent downward near base, reaching at most end of second segment of antennular peduncle, with 5-7 dorsal and 2-3 ventral teeth. Carapace with sharp antennal tooth, no branchiostegal tooth, pterygostomial tooth absent or minute. First segment of antennular peduncle with closely set spinules on distal margin, second and third segments without spines or spinules, stylocerite not reaching end of first segment of peduncle. Flagella of first antenna subequal, longer than body. Accessory branch of outer flagellum completely fused or free for only one segment. Flagella of second antenna also longer than body. Third maxillipeds with exopod and epipod. Pereopods 1-4 with epipods. Second pereopods long and slender, carpus with 25-32 articles (usually 27-29). Third to fifth pereopods with stout, spinose dactyls; merus of third pereopod with 6-7 spines, pereopod 4, with 5-6 spines; pereopod 5, with 3 spines. Pleura of abdominal somites 1-4 rounded, 5-6 with spines. Telson subacute, shorter than uropods, with 2 pair dorsolateral spines. Male carapace length to 12.7, female to 18.2 mm.

Color in life: Banded with longitudinal red stripes. At night, the corneas of the eyes reflect a golden color.

Habitat and depth: Tidepools, kelp beds and rocky reefs; intertidal to 83 m.

Range: Usually south of Point Conception, California; rarely as far north as Tomales Bay ; south to Magdalena Bay, Baja California; Gulf of California at Puerto Peñasco, Consag Rock and Guaymas, Sonora. Type locality San Diego, California.



*Lysmata californica*

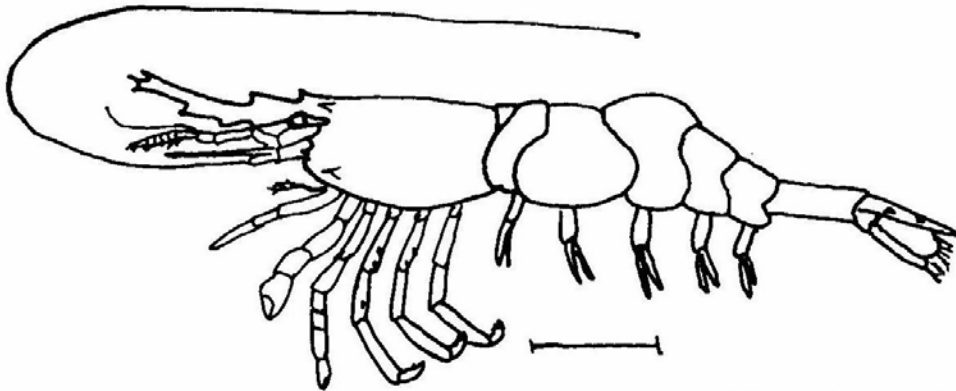
## Family Hippolytidae

Following the classification by Christoffersen, only two species found in California or Oregon now are included in this family. These two species each have one pair of supraorbital spines and three carpal articles in the second pereopod. Both usually are associated with plants. In life, they are well camouflaged, colored brown, green, splotched, or otherwise like the plants among which they live. Often, they also rest parallel to the long axis of the plant on which they live. The animals are sexually dimorphic. Males usually are smaller than females and have subchelate third pereopods and a very short rostrum.

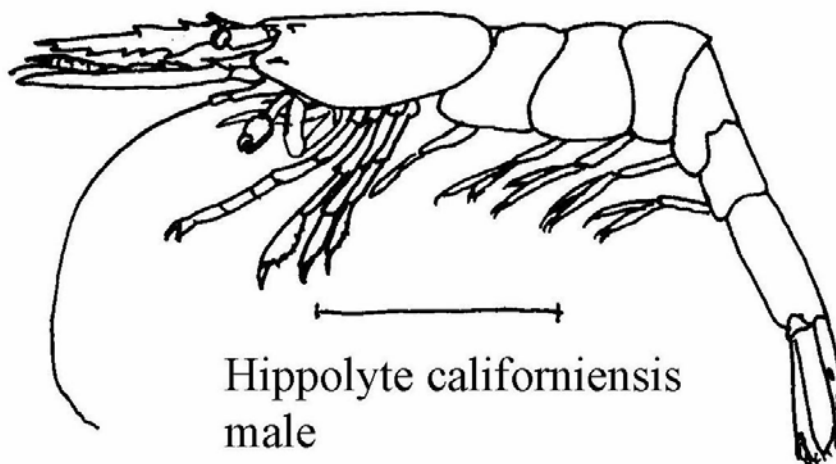
### Key to the Species of the Family Hippolytidae

1. No spines on first segment of antennular peduncle, tip of rostrum trifid. (Usually among algae, particularly giant kelp) ----- Hippolyte clarki Chace

1-2 spines on first segment of antennular peduncle, tip of rostrum bifid. (Usually among sea grasses, Zostera sp.)----- Hippolyte californiensis Holmes



Hippolyte clarki female



Hippolyte californiensis  
male

Genus Hippolyte Leach, 1814

Hippolyte clarki Chace

Hippolyte clarki Chace, 1951: 37, fig. 1.--Kozloff 1974: 165.--Butler 1980: 156, pl. 3A.--Chace and Abbott 1980: 573.--Wicksten 1983b: 25.-- Ricketts et al. 1985: 348.--Wicksten 1990b: 589.--Jensen 1995: 49, fig. 85.

Recognition characters: Female: rostrum exceeding antennular peduncle and scaphocerite, with 2-5 dorsal and 1-5 ventral teeth, tip trifid. No spines on first segment of antennular peduncle, stylocerite not reaching end of first segment, peduncle shorter than scaphocerite. Carapace with supraorbital, antennal and branchiostegal teeth. Third maxilliped with exopod, no epipod. No epipods on pereopods. First pereopod particularly short and stout. Pereopods 3-5 with short, spinose dactyls. Merus of third pereopod with 2-5 spines, merus of fourth with up to 5 spines, and merus of fifth with up to 4 spines. Pleura of abdominal somites 1-4 rounded, of 5 and 6 obtusely pointed. Telson shorter than sixth abdominal segment, with 2 pair dorsolateral spines. Male similar to female but with shorter, slender rostrum, propodi of Pereopods 3-5 subchelate. Total length of female to 31 mm, male to 18 mm .

Color in life: Camouflaged like algae: green, mottled or striped brown and tan, yellow brown.

Habitat and depth: Usually among algae, Macrocystis or Nereocystis, usually shallow or near surface, as deep as 30.5 m.

Range: Sheep Bay, Alaska to Santa Catalina Island, California. Type locality Friday Harbor, Washington.



Hippolyte clarki

Hippolyte californiensis Holmes

Hippolyte californiensis Holmes, 1895: 576, fig. 21-26.-Holmes 1900: 193.--Rathbun 1904: 56.--Schmitt 1921: 48, fig. 26.--Holthuis 1947: 14; Chace 1951: 35, fig. 1 (in part).--MacGinitie and MacGinitie 1968: 273.--Carlton and Kuris 1975: 390, pl. 95, figs. 39A, B, C.--Chace and Abbott 1980: 573, fig. 23.9.--Wicksten 1983b: 23, fig. 3.--Ricketts et al. 1985: 305.--Wicksten 1990b: 589.--Jensen 1995: 49, fig. 86.—Wicksten and Hendrickx 2003: 201.—Quiroz-Vásquez et al. 2005: 100.

Recognition characters: Very similar to H. clarki. Female: rostrum exceeding scaphocerite, with 3-4 dorsal and 3-5 ventral teeth, tip bifid. First segment of antennular peduncle with 1-2 spines. Merus of third pereopod with 3-5 spines, merus of fourth with 3 spines and merus of fifth with 1 spine. Male similar to H. clarki, but with 1-2 spines on first segment of antennular peduncle. Total length to 40 mm .

Color in life: Camouflaged like plants: bright green, striped with tan, mottled brown, etc.

Habitat and depth: In shallow areas of sandy bays, usually among sea grasses, Zostera spp.

Range: Humboldt Bay, California to San Quintin Bay, Baja California, Mexico; Gulf of California. Reports of H. californiensis from north of Humboldt Bay probably refer to H. clarki. Type locality Bodega Bay, California.

## Family Thoridae

The most diverse and common shrimp of the coasts of California and Oregon are species of the Thoridae. All species have a rostrum, which can range from a sharp single spine to an elaborately toothed blade. The eyes are large and not hidden beneath the carapace. The carapace bears two or more supraorbital spines in Spirontocaris, one in Lebbeus, and none in other genera found in California and Oregon. Suborbital, antennal, and pterygostomial spines often are present on the carapace, although the pterygostomial spine may be small or absent in some species. The carapace does not have a cardiac notch. The antennules are short; one flagellum always is densely setose. The third maxilliped is setose and bears small claws at the end of the terminal segment; it bears in exopod in species of Eualus and always also an epipod in species of Spirontocaris, Lebbeus and Eualus. Species of Heptacarpus also usually, but not always, have an epipod on the third maxilliped. The first pereopod is stout and chelate. The second pereopod is slender and chelate, and has a multiarticulated carpus. There are seven carpal articles in species of Eualus, Heptacarpus, Lebbeus and Spirontocaris. The third to fifth pereopods are ambulatory, and end in curved and simple or stout, spinose dactyls. The pleura of the abdomen can be evenly rounded or bear sharp spines. The telson bears dorsolateral and terminal spines.

Best known members of this family are the coastal shrimp, genus Heptacarpus, which can be found in tidepools, under docks, in kelp beds or on nearshore sandy bottoms. Coastal shrimp often have camouflaging or disruptive coloration, with stripes, bands, spots, saddle markings, etc. of green, brown, black, tan or white. These color patterns, usually seen in adult females, aid in camouflage (Bauer, 1981).

Of the other three genera found in California, less is known. Species of Lebbeus range from the lowest intertidal region to the continental slope. Species of Eualus live in kelp beds and in offshore areas. Spirontocaris truncata and S. prionota live subtidally in kelp beds or on rocky reefs. Spirontocaris lamellicornis, S. sica and S. holmesi are characteristic of muddy and sandy bottoms of the continental shelf.

An additional species, Eualus suckleyi (Stimpson, 1864) has been reported once from off Grays Harbor, Washington. It has a rostrum slightly longer than the scaphocerite, with spines on the dorsal distal half. It usually lacks an epipod on the second pereopod. See Butler (1980: 204) for more information and an illustration.

Owen (1839) described two additional hippolytids, Hippolyte affinis and H. layi from Monterey, California. The latter was reported again from Vancouver Island (Bate, 1866, in Schmitt, 1921). According to Owen's description and illustration, the former should be designated as Spirontocaris affinis and the latter as Heptacarpus layi. However, the type material of each species has been lost, and no further specimens have been found.

MacGinitie and MacGinitie (1968, p. 273) mentioned that a "new species" of Spirontocaris fed on tunicates. However, they used the generic name Spirontocaris for species now included in Spirontocaris, Eualus, Lebbeus or Heptacarpus. Because they usually studied shallow-water and intertidal species, it is likely that their animals belonged to a species of Heptacarpus. I have been unable to find specimens of this unknown species among the material that they donated to the Allan Hancock Foundation or the California Academy of Sciences. No species of Heptacarpus



described since 1921 is known to eat tunicates, but H. palpator often lives on wharves and pilings where tunicates may occur.

Species of Spirontocaris are found primarily in the northern Pacific Ocean, but three species occur in the Arctic and northern Atlantic. Species of Lebbeus also are most abundant in the northern Pacific, but also occur in the northern Atlantic, very deep areas of the central Pacific and in the southeastern Pacific. Species of Eualus are most diverse in body form and number of species in the northern Pacific, but also occur in the northern Atlantic and in the southern hemisphere. Species of Heptacarpus range from the coast of Asia to southwestern Mexico, but usually are found in temperate and boreal waters of the north Pacific. Although three species of Thor live in the tropical eastern Pacific, none are found in the Oregonian or Californian Provinces.

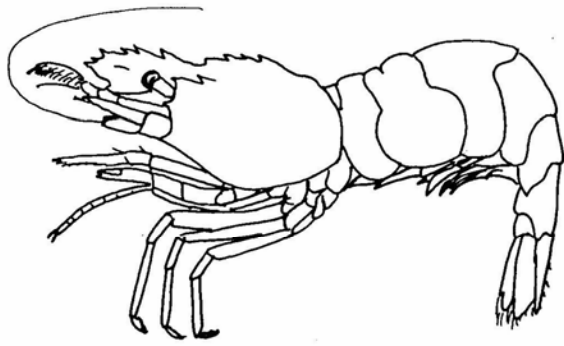
### Key to Species of the Family Thoridae

1. Supraorbital teeth present-----2
  - Supraorbital teeth absent-----12
2. Two or more supraorbital teeth, third maxilliped with exopod-----3
  - One supraorbital tooth, no exopod on third maxilliped-----8
3. Carapace with 3-4 supraorbital teeth-----4
  - Carapace with 2 supraorbital teeth-----5
4. Rostrum deep, with 10-26 dorsal teeth on rostrum proper, ventral margin of pleuron of third abdominal segment acute or pointed-----Spirontocaris prionota (Stimpson)
  - Rostrum moderately deep, with 1-3 large dorsal teeth on rostrum proper, ventral margin of pleuron of third abdominal segment broadly rounded-----Spirontocaris truncata Rathbun
5. Pleura of first to third abdominal segments ventrally acute to pointed-----Spirontocaris lamellicornis (Dana)
  - Pleura of first to third abdominal segments broadly rounded ventrally-----6
6. Rostrum without distinct terminal projection, dactyls of pereopods 3-5 short and stout, tips bifid-----Spirontocaris snyderi Rathbun
  - Rostrum with distinct terminal projection, dactyls of pereopods 3-5 long, slender and simple-----7
7. Distal projection of rostrum with 1 ventral tooth, dorsal teeth extending to or past middle of carapace-----Spirontocaris holmesi Holthuis
  - Distal projection of rostrum without ventral tooth, dorsal teeth not extending as far as middle of carapace-----Spirontocaris sica Rathbun

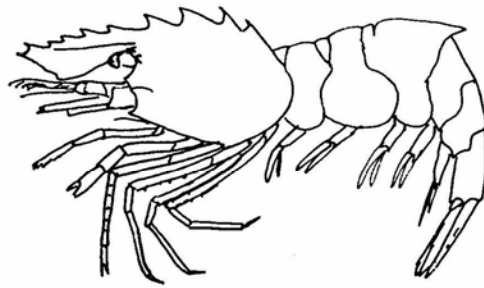
8. Rostrum reduced to spine on frontal margin of carapace. 3 teeth on anterior dorsal midline of carapace-----Lebbeus lagunae (Schmitt)
- Rostrum prominent, not reduced to spine. 1-2 teeth on anterior dorsal midline of carapace----9
9. Epipods on only first pereopods. (Living only at 950 m and deeper)-----  
-----Lebbeus vicinus montereyensis Wicksten and Méndez
- Epipods on first to third pereopods. (Shallow subtidal to 1808 m)----- 10
10. Antennular peduncle extending nearly to end of scaphocerite. Inhabiting continental slope----  
-----Lebbeus washingtonianus (Rathbun)
- Antennular peduncle extending to near middle of scaphocerite. Inhabiting subtidal rocky areas-----11
11. Rostrum shorter than eye. Dorsal surface of second abdominal segment without furrow and fold-----Lebbeus fasciatus (Kobyakova)
- Rostrum longer than eye. Dorsal surface of second abdominal segment with furrow and fold-----  
-----Lebbeus speciosus (Urita)
12. Exopod on third maxilliped-----13
- No exopod on third maxilliped-----19
13. No epipod on any pereopod-----14
- Epipod at least on first pereopod-----16
14. Rostrum deep, shorter than carapace, eyes large-----Eualus macrophthalmus (Rathbun)
- Rostrum slender, as long as or longer than carapace, eyes smaller-----15
15. Posterior margin of third to sixth abdominal segments each bearing median dorsal tooth-----  
-----Eualus barbatus (Rathbun)
- Posterior margin of third to sixth abdominal segments unarmed-----Eualus biunguis (Rathbun)
16. Rostrum with dorsal margin markedly convex over eyes, 7-14 spines-----  
-----Eualus avinus (Rathbun)
- Rostrum nearly straight over eye, fewer (2-9) spines-----17
17. Pleuron of fourth abdominal segment without ventral tooth. Rostrum with 8-11 dorsal teeth-----  
-----Eualus berkeleyorum Butler

|  |   |
|--|---|
| Pleuron of fourth abdominal segment with ventral tooth. Rostrum with 3-6 dorsal teeth-----   | 18.   |
| 18. First segment of antennular peduncle with multiple dorsal, distal spines. (Usually found north of Point Conception, California)----- | <u>Eualus lineatus</u> Wicksten and Butler  |
| First segment of antennular peduncle with single distolateral spine. (Found from Monterey Bay south to Baja California)-----             | <u>Eualus subtilis</u> Carvacho and Olson   |
| 19. Ventral margin of fourth pleuron without tooth-----  | 20  |
| Ventral margin of fourth pleuron with tooth-----   | 26  |
| 20. Epipod absent on third maxilliped-----   | <u>Heptacarpus tenuissimus</u> Holmes       |
| Epipod present on third maxilliped-----  | 21  |
| 21. Epipods present on at least first and second pereopods. Dorsal surface of third abdominal segment forming conspicuous hump-----      | 22  |
| Epipods absent from all pereopods. Dorsal surface of third abdominal segment evenly rounded, not forming conspicuous hump-----           | 23  |
| 22. Epipods present on first to third pereopods. Rostrum deep, with 3-7 dorsal teeth, 2-6 ventral teeth-----                             | <u>Heptacarpus carinatus</u> Holmes         |
| Epipods present on first and second pereopods only. Rostrum narrow, with 4-5 dorsal teeth, 5-8 ventral teeth-----                        | <u>Heptacarpus flexus</u> (Rathbun)         |
| 23. Pterygostomian tooth absent-----   | 24  |
| Pterygostomian tooth present-----  | 25  |
| 24. Rostrum shorter than carapace, distal ventral half convex-----   | <u>Heptacarpus brachydactylus</u> (Rathbun) |
| Rostrum longer than carapace, distal ventral half not convex or only slightly so-----  | <u>Heptacarpus franciscanus</u> (Schmitt)   |
| 25. Scaphocerite shorter than carapace, sixth abdominal segment longer than telson-----  | <u>Heptacarpus decorus</u> (Rathbun)        |
| Scaphocerite as long as or longer than carapace, sixth abdominal segment shorter than telson-----  | <u>Heptacarpus kincaidi</u> (Rathbun)       |
| 26. Rostrum deep. Epipod on first pereopod only. (Usually on continental shelf, Oregon and northward)-----                               | <u>Heptacarpus moseri</u> (Rathbun)         |

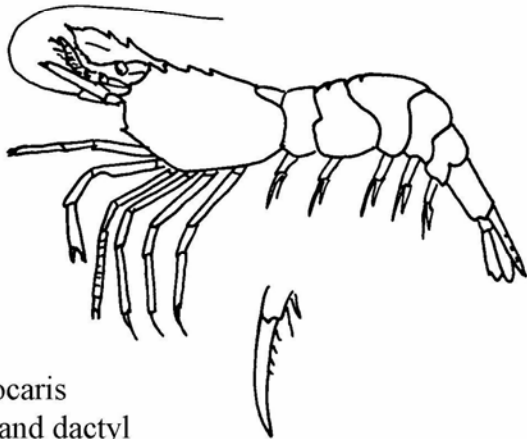
|   |    |
|---|----|
| Rostrum shallow. Epipods on at least first ,and often also second pereopods. (Usually intertidal to subtidal, Alaska to Baja California)-----                 | 27 |
| 27. Epipods on first and second pereopods at most-----  | 28 |
| Epipods on first to third pereopods-----  | 30 |
| 28. Rostrum barely reaching end of first segment of antennular peduncle-----  |    |
| ----- <u>Heptacarpus pugettensis</u> Jensen   |    |
| Rostrum extending beyond end of first segment of antennular peduncle-----   | 29 |
| 29.    Rostrum reaching to end of antennular peduncle or beyond. (Often in sea grass beds or tidepools of northern California)-----                           |    |
| ----- <u>Heptacarpus paludicola</u> Holmes  |    |
| Rostrum not reaching end of antennular peduncle. (Common in tidepools of northern Oregon and Marin County, California southward)-----                         |    |
| ----- <u>Heptacarpus sitchensis</u> (Brandt)  |    |
| 30. Dactyls of pereopods 3-5 simple and curved, rostrum slightly ascending over eye and with dorsal teeth most thickly set in proximal half-----              |    |
| ----- <u>Heptacarpus stimpsoni</u> Holthuis   |    |
| Dactyls of pereopods 3-5 bifid and with small spines on flexor margin, rostrum not slightly ascending over eye and with ventral teeth more widely spaced----- | 31 |
| 31. Rostrum not reaching as far as cornea of eye, with series of teeth descending from anterior margin of carapace to apex-----                               |    |
| ----- <u>Heptacarpus taylori</u> (Stimpson)   |    |
| Rostrum exceeding cornea of eye, rostral teeth more widely space and not as clearly descending--  |    |
| -----   | 32 |
| 32. Spine on distal ventral flexor margin of merus of first pereopod-----   |    |
| ----- <u>Heptacarpus fuscimaculatus</u> Wicksten  |    |
| No spine on distal ventral flexor margin of merus of first pereopod-----  | 33 |
| 33. Rostrum usually with bifid or trifid apex, exceeding cornea, merus of third and fourth pereopods with 2 spines-----                                       |    |
| ----- <u>Heptacarpus palpator</u> (Owen)  |    |
| Rostrum usually with simple apex, not exceeding cornea, merus of third and fourth pereopods with 1 spine-----   |    |
| ----- <u>Heptacarpus brevirostris</u> (Dana)  |    |



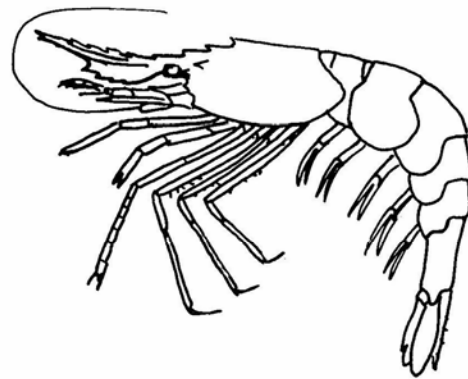
*Spirontocaris truncata*



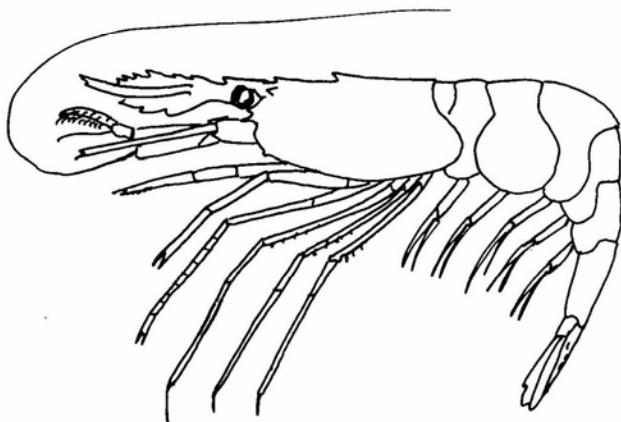
*Spirontocaris lamellicornis*



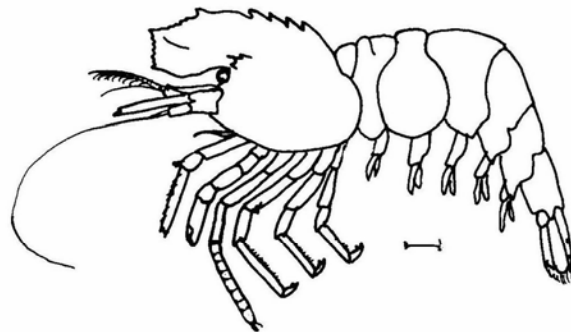
*Spirontocaris  
snyderi and dactyl*



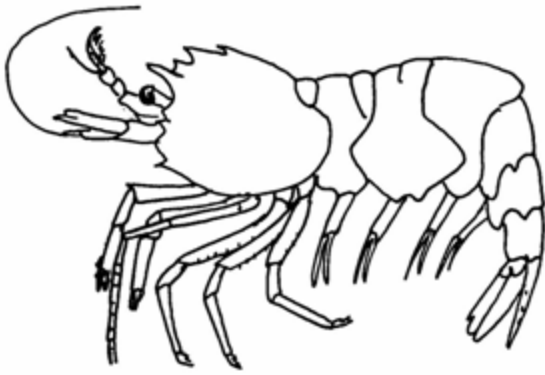
*Spirontocaris holmesi*



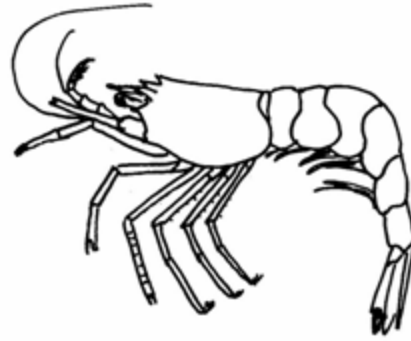
*Spirontocaris sica*



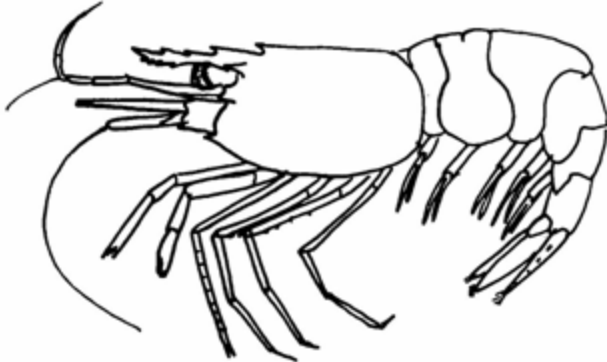
*Spirontocaris prionota*



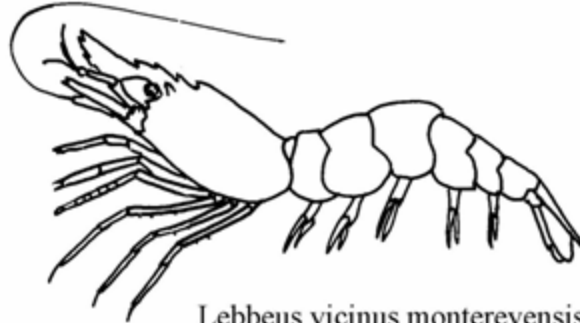
*Lebbeus lagunae*



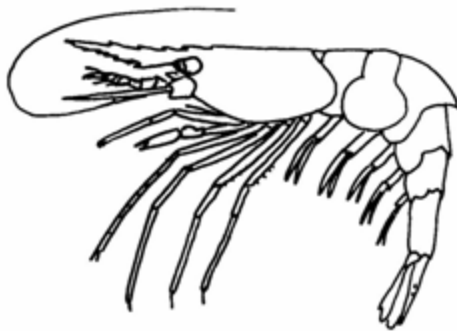
*Lebbeus fasciatus*



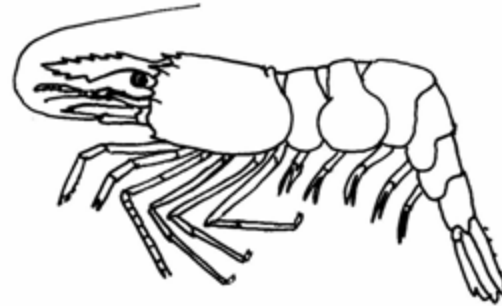
*Lebbeus washingtonianus*



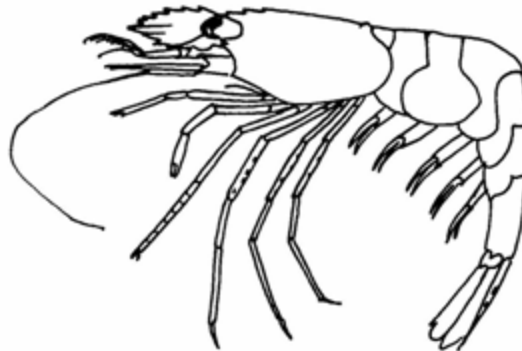
*Lebbeus vicinus montereyensis*



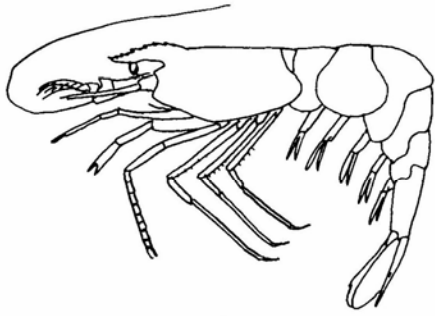
*Eualus barbatus*



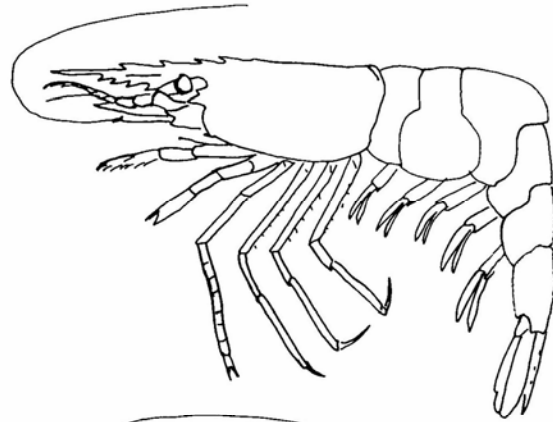
*Lebbeus speciosus* (after  
Kobyakova, 1937)



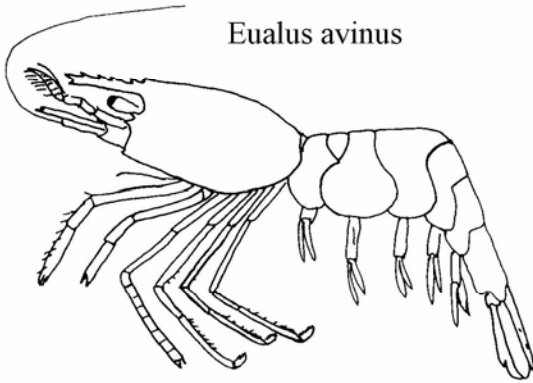
*Eualus macrophthalmus*



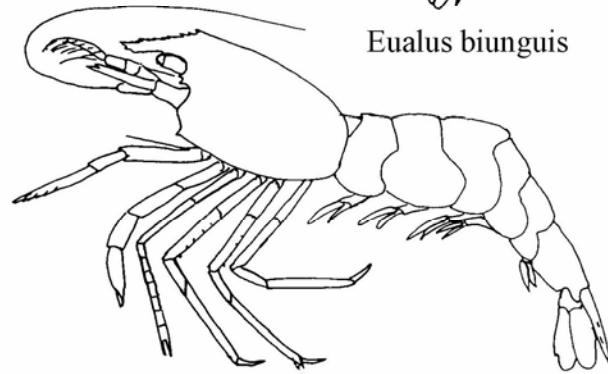
*Eualus avinus*



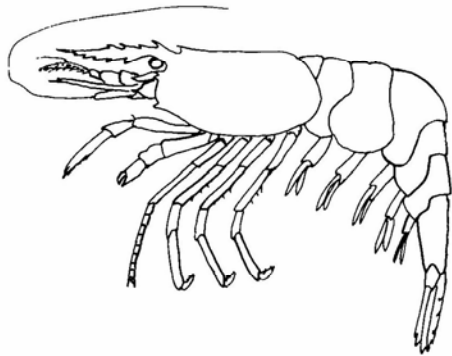
*Eualus biunguis*



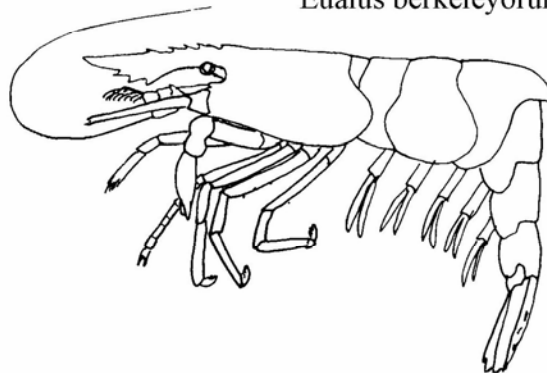
*Eualus lineatus*



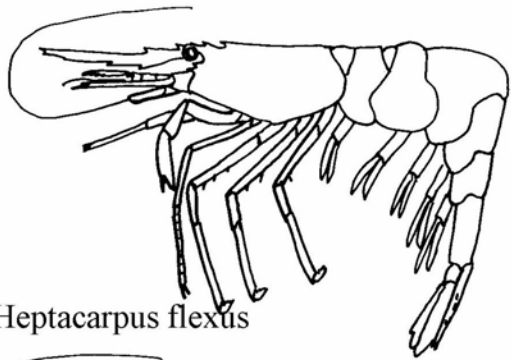
*Eualus berkeleyorum*



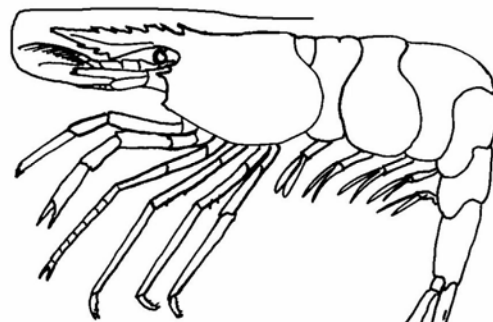
*Heptacarpus tenuissimus*



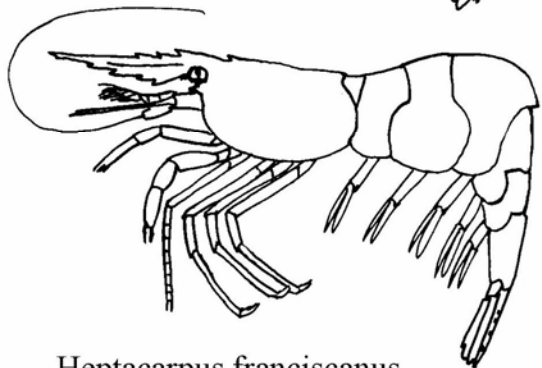
*Heptacarpus carinatus*



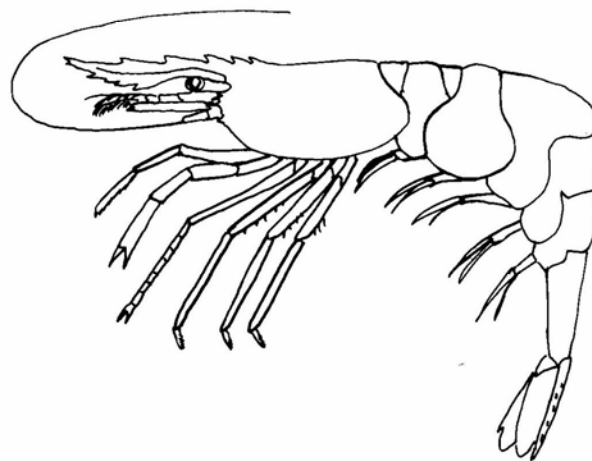
*Heptacarpus flexus*



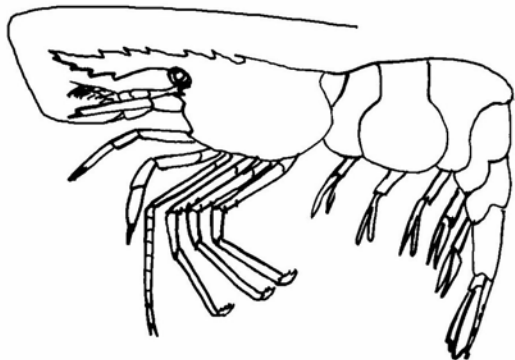
*Heptacarpus brachydactylus*



*Heptacarpus franciscanus*

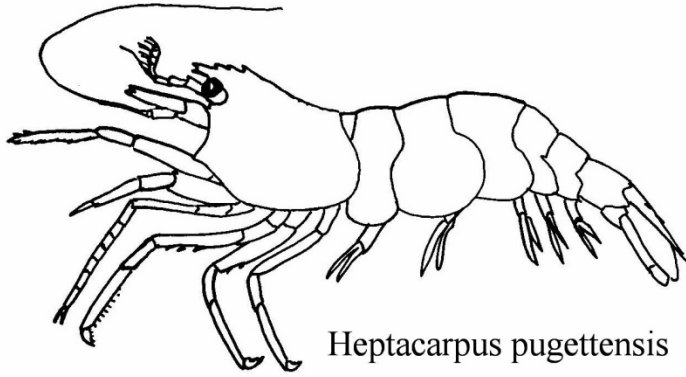


*Heptacarpus kincaidi*

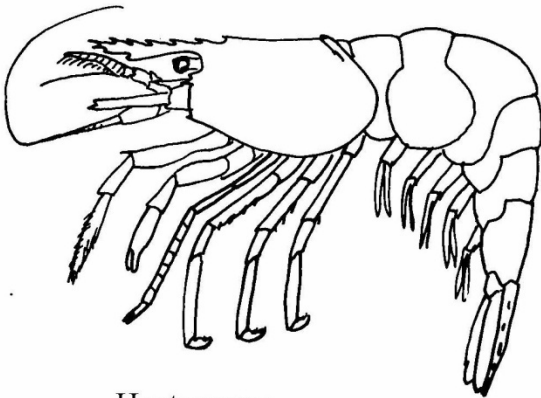


*Heptacarpus decorus*

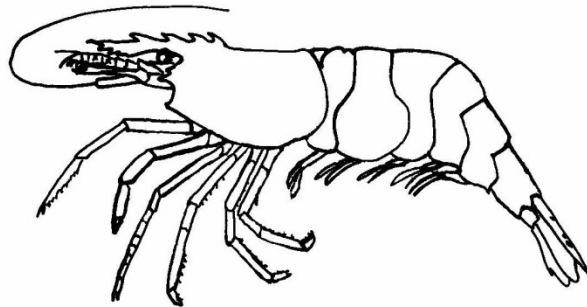




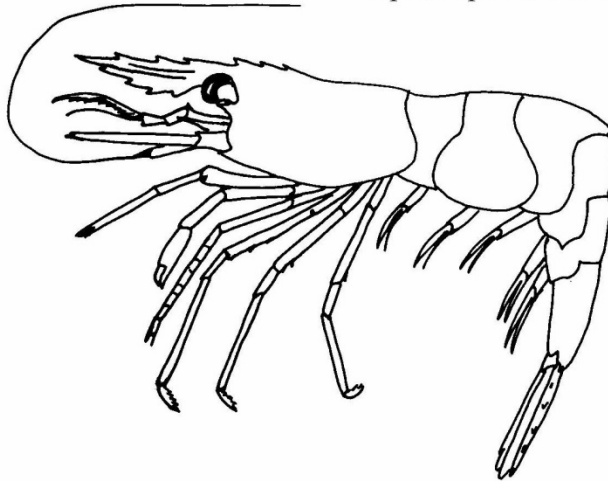
Heptacarpus pugettensis



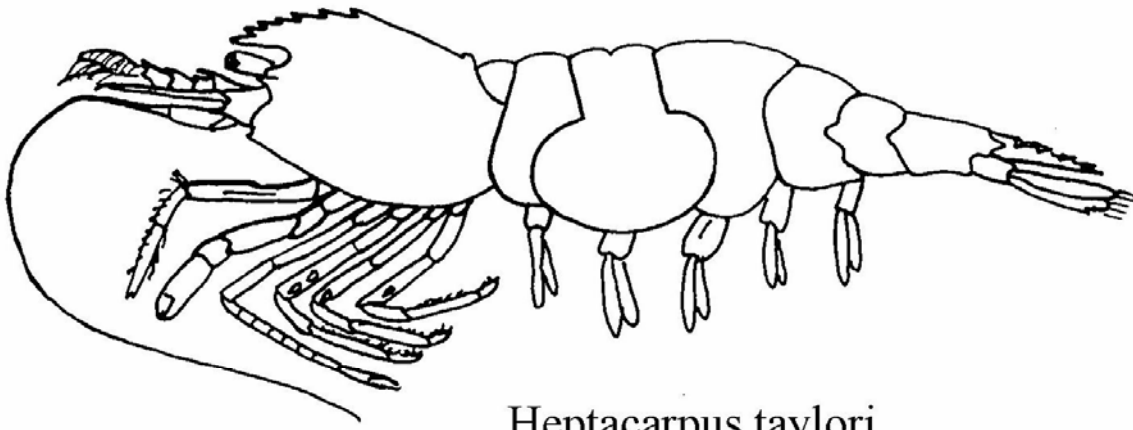
Heptacarpus  
paludicola



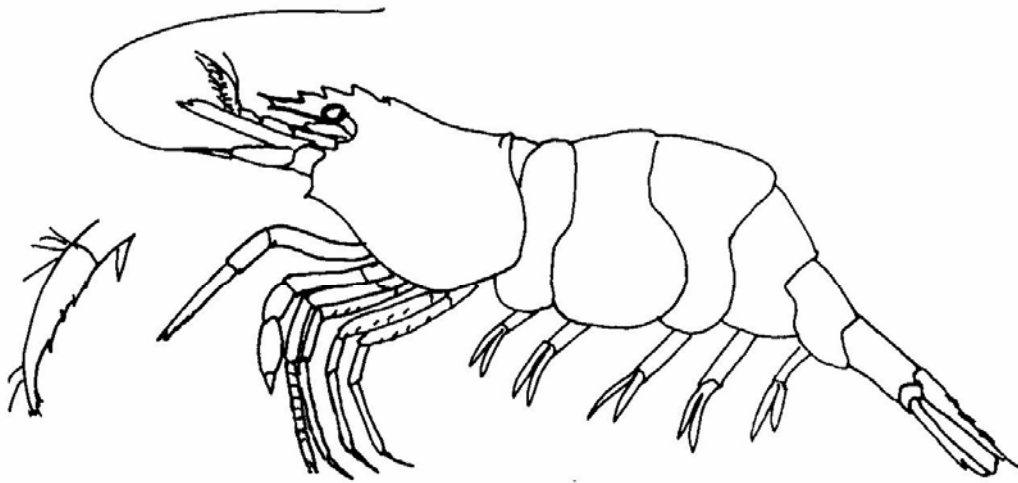
Heptacarpus sitchensis



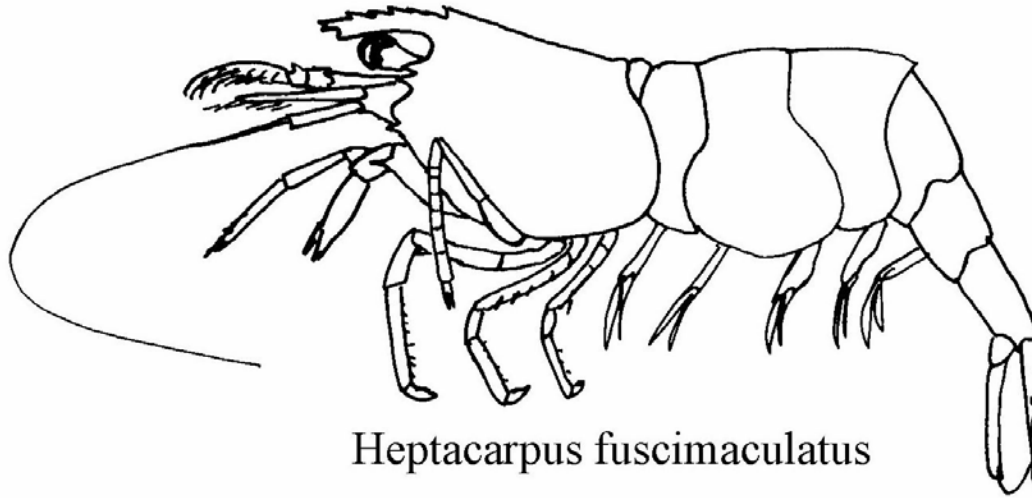
Heptacarpus moseri



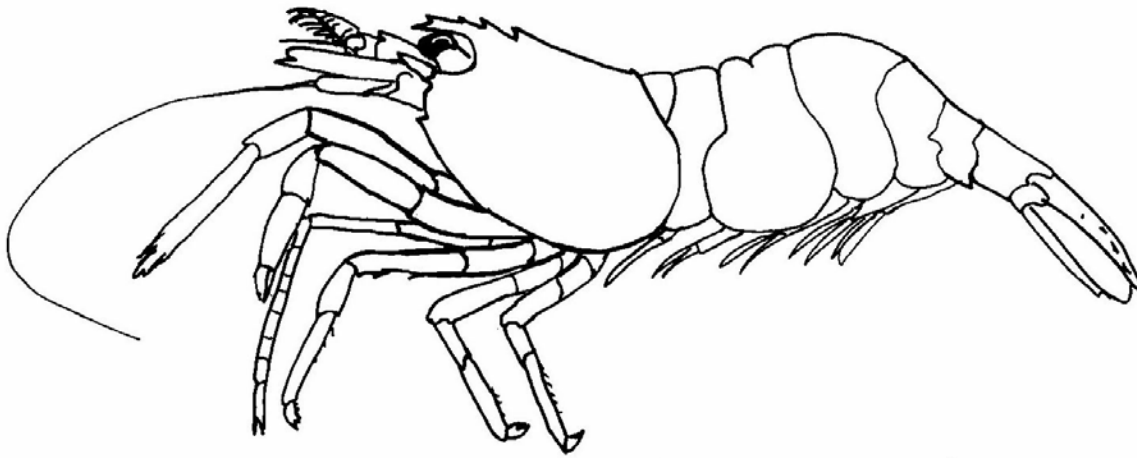
*Heptacarpus taylori*



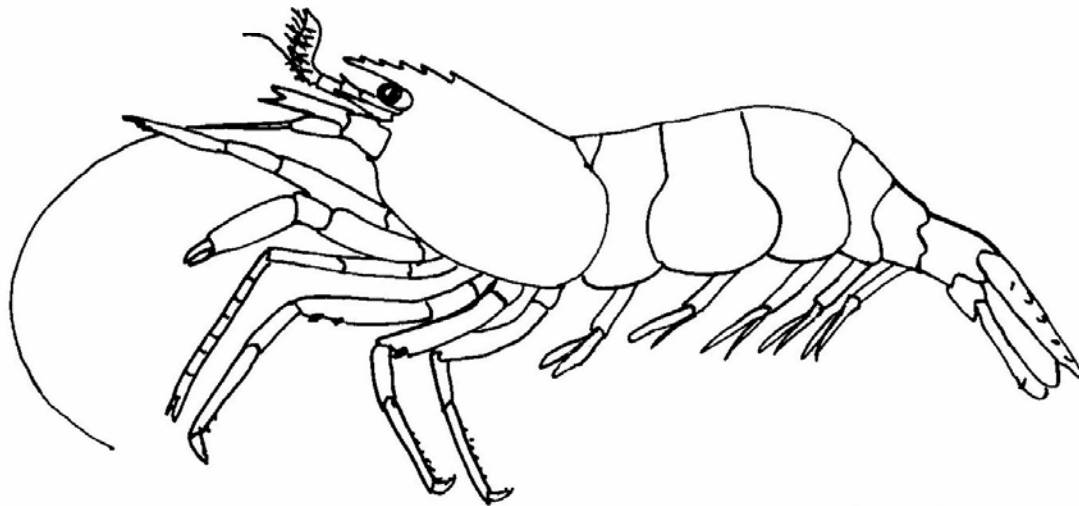
*Heptacarpus stimpsoni*, with dactyl



*Heptacarpus fuscimaculatus*



*Heptacarpus palpator*



*Heptacarpus brevirostris*

Genus Spirontocaris Bate, 1888

Spirontocaris prionota (Stimpson)

Hippolyte prionota Stimpson, 1864: 153.

Spirontocaris prionota: Holmes, 1900: 206.-- Rathbun, 1904: 61.-- Schmitt, 1921: 52, fig. 28.  
—Kobyakova, 1937: 129.-- Holthuis, 1947: 8.-- Kozloff, 1974: 166.-- Carlton and Kuris,  
1975: 390.-- Butler, 1980: 161.-- Chace and Abbott, 1980: 574, fig. 23.10.-- Carvacho and Olson,  
1984: 64.-- Ricketts et al., 1985: 197, fig. 109.-- Wicksten, 1990b: 590.-- Jensen, 1995: 51, fig. 92.

Recognition characters: Rostrum deep, extending beyond end of antennular peduncle, with 10-15 dorsal and 6-7 ventral teeth in male; 12-26 dorsal and 3-8 ventral teeth in female, 3-4 large serrate teeth on dorsal midline of carapace proper. Second and third segments of antennular peduncle each bearing spine. Stylocerite reaching third segment of antennular peduncle. Carapace with 3-4 supraorbital teeth. Pereopods 1-3 with epipods. Pereopods 3-5 stout, dactyls spinose and bifid; merus of pereopod 3 with 1-2 spines, pereopod 4, with 0-2 spines, pereopod 5, 0-1 spine. Pleura of abdominal somites 1-3 rounded, 4-5 pointed to sharp-tipped. Telson with 4 pair dorsolateral spines and acute tip. Male total length to 19 mm, female to 28.  
Color in life: Variable. Red-spotted with blue steaks; carapace and uropods olive, rest of body rufous (Butler, 1980). Carapace and rostrum china white, rest of body rusty red or green (color photographs by H. Cheney, Santa Barbara Museum of Natural History, and Jensen, 1995).  
Habitat and depth: Eelgrass beds, lower rocky intertidal zone, rocky subtidal areas, low subtidal areas to 163 m. Specimens from California usually were collected at depths of 30 m or less.  
Range: Nunivak Island and Bering Island, Bering Sea to Todos Santos Bay, Baja California, Mexico. Type locality Puget Sound.

Spirontocaris truncata Rathbun

Spirontocaris truncata Rathbun, 1902: 284.-- Rathbun, 1904: 67, fig. 22.-- Holthuis, 1947: 9.  
-- Butler, 1980: 163, pl. 3C.-- Wicksten, 1984b: 246, fig. 4.-- Wicksten, 1990b: 590.

Recognition characters: Rostrum moderately deep, extending beyond antennular peduncle, with truncated apex, 7-9 dorsal and 3-4 ventral teeth. Carapace with 3 supraorbital teeth. Pereopods 1-3 with epipods. Pereopods 3-5 with spinose, bifid dactyls; merus of pereopod 3, with 2-3 spines, pereopod 4, with 2 spines, pereopod 5, with no spines. Pleura of abdominal somites 1-3 broadly rounded, fourth and fifth sharp-tipped. Telson with 4-5 dorsolateral spines, tapering to acute tip. Male total length to 14 mm, female to 20.

Color in life: Carapace yellow-orange, with red-orange to deep red dots, posterior dorsal spines of carapace dark brown, red dots on appendages and antennae, abdomen milkish with faint red dots on dorsal surface of third segment (Butler, 1980).

Habitat and depth: Rocky reefs, in sponges, 44-92 m.

Range: Gabriola Island, Strait of Georgia to SW of San Carlos Point, Baja California, Mexico. Type locality Hecata Bank, Oregon.

Natural history remarks: All records of this species come from rocky subtidal reefs and banks. One was hand-collected by a SCUBA diver between 37-55 m on a reef off Point Sur, California.

Spirontocaris lamellicornis (Dana)

Hippolyte lamellicornis: Dana, 1852a: 24.-- Dana, 1852b: 576, pl. 1, fig. 6.

Spirontocaris lamellicornis: Holmes, 1900: 208.-- Rathbun, 1904: 62.-- Schmitt, 1921: 53, fig. 29.-- Holthuis, 1947: 8.-- Zarenkov, 1960: 346.-- Kozloff, 1974: 166.-- Butler, 1980: 169, pls. 2B, 6D.-- Standing, 1981: 780.-- Wicksten, 1980: 134.-- Wicksten, 1990b: 590.-- Jensen, 1995: 51, fig. 91.

Recognition characters: Rostrum deep, extending beyond antennular peduncle, with midrib extending as strong tooth, 9-23 dorsal and 1-3 ventral teeth including 4-5 large teeth on dorsal surface of carapace. Each segment of antennular peduncle with distal spine, stylocerite exceeding length of peduncle. Carapace with 2 supraorbital teeth. Pereopods 1-3 with epipods, Pereopods 3-5 with simple, curved dactyls; merus of pereopod 3, with 5-7 spines, pereopod 4, with 4 spines, pereopod 5, with 1-2 spines. Pleura of abdominal somites 1-5 with sharp spines in most specimens, but becoming rounded in animals larger than 10 mm in carapace length. Telson with 4 pair dorsolateral spines and acute tip. Male total length to 42 mm, female to 63.

Color in life: Variable. Dark brown, pereopods dark red to colorless, tail fan banded; milkish overlaid with fine red mottling interspersed with yellow and brown to black spots; milkish with sixth abdominal somite red to purplish (Butler, 1980).

Habitat: Sand to mud bottoms, 3-192 m. In California, most specimens were taken by trawling at 50-70 m.

Range: Commander Islands and Bering Sea to Santa Monica Bay, California. Rarely collected south of Point Conception, California. Type locality Dungeness, Straits of Juan de Fuca.

Spirontocaris snyderi Rathbun

Spirontocaris snyderi Rathbun, 1902: 894.-- Rathbun, 1904: 69, fig. 24.-- Schmitt, 1921: 54, fig. 31.-- Holthuis, 1947: 8.-- Kozloff, 1974: 166.-- Butler, 1980: 171.-- Wicksten, 1990b: 590.— Jensen, 1995: 52, fig. 94.

Recognition characters: Rostrum deep, reaching end of antennular peduncle, with 8-10 dorsal and 3-5 ventral teeth, 3-4 dorsal teeth on carapace proper. Dorsal spine on each of segments of antennular peduncle, stylocerite reaching end of first segment. Carapace with 2 supraorbital teeth. Pereopods 1-2 with epipods. Pereopods 3-5 slender, dactyls slender but spinose; merus of pereopod 3, with 3 spines, pereopod 4, with 3-4 spines, pereopod 5, with 3-4 spines. Pleura of abdominal somites 1-3 rounded, 4 and 5 with weak tooth. Telson with 4 pair dorsolateral spines and acute tip. Male total length 18 mm, female to 24 .

Color in life: Reddish brown, mottled with white, pink and silvery bands and spots (Jensen, 1995).

Habitat and depth: Usually on sand, or sand mixed with mud and rock, 4-355 m. Most specimens from California were taken at 50-100 m.

Range: Tasu Sound, Queen Charlotte Islands to Cedros Island, Baja California, Mexico. Type locality Monterey Bay, California.

### Spirontocaris holmesi Holthuis

Spirontocaris bispinosa Holmes, 1900: 207.--Rathbun, 1904: 68, fig. 23.-- Schmitt, 1921: 54, fig. 30.--(not Hippolyte bispinosa De Haan, 1841).

Spirontocaris holmesi Holthuis, 1947: 38.-- Kozloff, 1974: 166.-- Butler, 1980: 165, pl. 6E.— Wicksten, 1984b: 135.-- Wicksten, 1989b: 313.-- Wicksten, 1990b: 590.

Recognition characters: Rostrum moderately deep, with distal styliform process bearing one subapical ventral tooth, 8-16 dorsal, 3-7 ventral teeth, 2 on carapace proper. Each segment of antennular peduncle with dorsal spine, stylocerite reaching second segment. Carapace with 2 supraorbital teeth. Pereopods 1-2 with epipods. Pereopods 3-5 long and slender, with long, simple dactyls, 0.5-0.6X length of propodi; merus of pereopod 3, with 6-7 spines, pereopod 4, with 5-8 spines, pereopod 5, with 4-5 spines. Pleura of abdominal somites 1-4 rounded, 5 with small tooth. Telson with 3-4 pair dorsolateral spines, tip rounded. Male total length to 44 m, female to 62 .

Color in life: Body yellowish, with lines, bars, dots and patches of red (Butler, 1980).

Habitat and depth: 24-485 m. Specimens from California come from mud or sand bottoms, usually at 150-300 m.

Range: Yes Bay, Alaska to San Diego, California. Type locality Puget Sound.

### Spirontocaris sica Rathbun

Spirontocaris sica Rathbun, 1902: 894.-- Rathbun, 1904: 69, fig. 25.-- Schmitt, 1921: 55, fig. 32.-- Holthuis, 1947: 8.-- Kozloff, 1974: 166.-- Butler, 1980: 167.-- Wicksten, 1987: 54.-- Wicksten, 1989b: 313.-- Wicksten, 1990b: 590.

Recognition characters: Very similar to S. holmesi. Rostrum somewhat shorter, without subapical ventral tooth; 9-15 dorsal and 3-8 ventral teeth, 2 closely spaced teeth on dorsal surface of carapace proper. Pereopods 3-5 long and slender, with long, simple dactyls, about 0.3-0.4X length of propodi; merus of pereopod 3, with 5-9 spines, pereopod 4, with 5-8 spines, pereopod 5, with 3-7 spines. Telson narrow, with 4 pairs dorsolateral spines, acute tip. Male total length 42 mm, female to 65.

Color in life: Background milkish to dull yellow, marked by red dots, bands and blotches (Butler, 1980).

Habitat and depth: 88-849 m (Butler, 1980). Most specimens from California were taken on rock, mud or gravel at 150-550 m.

Range: Restoration Bay, Burke Channel to between San Benito Islands and Cedros Island, Baja California, Mexico. Type locality Santa Barbara Channel, California.

### Genus Lebbeus White, 1847

#### Lebbeus lagunae (Schmitt)

Spirontocaris lagunae Schmitt, 1921: 57, fig. 35, pl. 12, figs. 10-11.

Lebbeus lagunae : Holthuis, 1947: 9.-- Carlton and Kuris, 1975: 403.-- Wicksten, 1978:a 2, figs. 1, 4.-- Wicksten and Méndez, 1982: 117.—Carvacho and Olson 1984: 60.-- Wicksten, 1990b: 592. -- Debelius 1999: 130.

Recognition characters: Rostrum reduced to spiniform tooth. Second segment of antennular peduncle with large spine, stylocerite reaching end of first segment. Carapace with 3 large teeth on dorsal margin, large supraorbital tooth. Pereopods 1-3 with epipods. Pereopods 3-5 stout, dactyls spinose; merus of each without spine. Pleura of abdominal somites 1-3 in female rounded, 4 pointed and 5 with tooth; in male, somites narrow, all bluntly to acutely pointed. Telson with 3 pair dorsolateral spines. Females with more deeply inflated carapace and rounded abdominal pleura than males. Total length 20 mm.

Color in life: Camouflaged like algae: "kelp color", body light, legs darker, red and black on appendages (Schmitt, 1921); mottled with white, rose-red, dark rose-red, tan and brick red (Wicksten, 1978a).

Habitat and depth: Rocky reefs and kelp beds, tidepools to 55m.

Range: Dark Gulch, Mendocino County, California to south of Punta Banda, Baja California. Type locality Laguna Beach, California.

### Lebbeus vicinus montereyensis Wicksten and Méndez

Lebbeus polaris: Wicksten, 1978a: 6, fig. 6 (not Alpheus polaris Sabine, 1821).

Lebbeus vicinus montereyensis Wicksten and Méndez, 1982: 114, pl. 6.-- Wicksten, 1989b: 313.-- Wicksten, 1990b: 591.-- Wicksten and Hendrickx, 2003: 67.

Recognition characters: Rostrum of female long and slender, reaching end of scaphocerite, of male not reaching end of scaphocerite, with 3-4 dorsal teeth, 2-3 of them on carapace proper, and 4 ventral teeth. First segment of antennular peduncle with sharp spine, stylocerite reaching end of first segment. Carapace with supraorbital tooth. First pereopod with epipod. Pereopods 3-5 slender, dactyls with spines; merus of pereopod 3, with 1 large distolateral and 4-6 smaller lateral spines.-- pereopod 4, with 4 meral spines, pereopod 5, with 3 lateral meral spines. Pleura of abdominal somites 1-4 rounded, 5 with sharp tooth. Telson with 2 pair dorsolateral spines. Total length 50-65 mm.

Color in life: Not recorded.

Habitat and depth: 954-2086 m.

Range: Monterey Bay, California to Gulf of California, Mexico. Type locality west of Punta Banda, Baja California, Mexico.

### Lebbeus washingtonianus (Rathbun)

Spirontocaris washingtoniana Rathbun, 1902: 895.-- Rathbun, 1904: 76, fig. 30.-- Schmitt 1921: 55, fig. 33.

Lebbeus washingtonianus: Holthuis, 1947: 10.-- Kozloff, 1974: 165.-- Wicksten, 1978: 3, fig. 5.-- Butler, 1980: 183.-- Wicksten and Méndez, 1982: 119.-- Wicksten, 1989b: 31.-- Wicksten, 1990b: 592.-- Kikuchi and Ohta, 1995: 779, figs. 8-13.—Wicksten and Hendrickx 2003: 67.

Recognition characters: Rostrum slender, reaching end of first segment of antennular peduncle, with 4-5 dorsal and 2-3 ventral teeth. Dorsal spine on each segment of antennular peduncle, stylocerite not reaching end of first segment, flagella each twice length of carapace. Carapace

with supraorbital, suborbital, antennal and weak pterygostomial teeth. Pereopods 1-3 with epipods. Pereopods 3-5 long and slender, dactyls slender and spinose; merus of pereopod 3, with 5 spines, pereopod 4, with 4 spines, pereopod 5, with 1 spine. Pleura of abdominal somites 1-3 rounded, somite 4 with weak ventral teeth, somite 5 with strong tooth. Telson with 4-6 pair dorsolateral spines and acute tip. Male total length 43 mm, female 39.

Color in life: Not recorded.

Habitat and depth: Steep areas and trenches of the continental slope, 820-1808 m.

Range: Iheya Ridge, north of Naha, Okinawa; Anthony Island, Queen Charlotte Islands to Guaymas Basin, Gulf of California. Type locality off Sea Lion Rock, Washington.

### Lebbeus fasciatus (Kobyakova)

Hetairus zebra Makarov, 1935: 319, fig. 1.

Hetairus fasciatus Kobyakova, 1936: 116.

Lebbeus zebra: Butler, 1980: 186.-- Wicksten and Méndez, 1982: 118.-- Wicksten, 1990b: 592.  
Not Lebbeus zebra (Leim, 1921)(North Atlantic species)

Recognition characters: Rostrum narrow, reaching at most to end of first segment of antennular peduncle, with 2-5 dorsal teeth, 1-2 on carapace proper, no ventral teeth. First segment of antennular peduncle with 2-4 on dorsal margin and appressed mesioventral spine, second and third segments with dorsal spines, stylocerite not reaching end of spine of second article. Carapace with strong supraorbital tooth and small pterygostomial tooth. Pereopods 1-3 with epipods. Pereopods 3-5 slender, with stout spinose dactyls; merus of pereopods 3-5 without spines. Pleura of abdominal somites 1-3 rounded, 4 and 5 with small teeth. Telson with 4-5 pair dorsolateral spines, blunt tip. Total length 49 mm.

Color in life: Conspicuously banded with brownish red to orange stripes on body and appendages (Leim, 1921).

Habitat and depth: Rocky subtidal areas, 10-140 m.

Range: Gulf of St. Lawrence to Isles of Shoals, Bering Sea, Kamchatka, Vancouver Island to off Santa Rosa Island, California. Type locality not specified: Passamaquoddy Bay, St. Croix River and Campobello Island, New Brunswick.-- St. Mary's Bay, Nova Scotia.

Remarks: Lebbeus fasciatus of the northern Pacific is extremely similar to the north Atlantic L. zebra. Apparently unaware of the name given to the Atlantic species, Makarov (1935) created a homonym when describing the northern Pacific species. Kobyakova (1936) changed the name of the Pacific species, but did not designate distinctive features of it. Future molecular analyses will be needed to better distinguish between these two species.

### Lebbeus speciosus (Urita)

Spirontocaris makarofi speciosa Urita, 1942: 19, fig. 4.

Lebbeus possjeticus Kobyakova, 1967: 235, fig. 4.-- Wicksten and Méndez, 1982: 118.—  
Wicksten, 1990b: 592.

Lebbeus speciosus: Hayashi, 1992: 132, figs. 13, 14.

Recognition characters: Rostrum moderately deep, exceeding tip of antennular peduncle, with 5-7 dorsal teeth, 2 on carapace proper, and 3-4 ventral teeth. First segment of antennular



peduncle with 3-4 terminal spines, stylocerite reaching second segment. Carapace with strong supraorbital tooth. Pereopods 1-3 with epipods. Pereopods 3-5 slender, with short, spinose dactyls; merus of pereopod 3, with 4 spines, pereopod 4, with 3-4 spines, pereopod 5, with 1-2 spines. Pleura of abdominal somites 1-3 rounded, 4 and 5 with small teeth. Telson with 4-5 pair dorsolateral spines. Total length 32 mm.

Color in life: Carapace and abdomen with dark brown bands, telson dark brown, appendages brown and white (Hayashi, 1992).

Habitat and depth: Rocky shore and subtidal areas, 0-57 m

Range: Hokkaido, coast of Siberia, Bering Island, and off San Nicolas Island, California. Type locality Sakhalin.

## Genus Eualus Thallwitz, 1892

### Eualus macrophthalmus (Rathbun)

Spirontocaris macrophthalma Rathbun, 1902: 900.-- Rathbun, 1904: 105, fig. 48.-- Schmitt, 1921: 72, fig. 49.

Eualus macrophthalmus: Holthuis, 1947: 11.-- Kozloff, 1974: 166.-- Butler, 1980: 189, pl. 8A.-- Wicksten, 1989b: 312.-- Wicksten, 1990b: 593.—Wicksten 2002: 137.—Jensen 2004: 468.

Recognition characters: Rostrum deep, reaching beyond antennular peduncle, with 10-14 dorsal and 1-4 ventral teeth, tip acute. Second and third segments of antennular peduncle with terminal spines, stylocerite not reaching end of first segment. Carapace with pterygostomial spine minute or absent. Pereopods lacking epipods. First pereopod moderately large, second pereopod slender. Pereopods 3-5 long and slender, with slender, simple dactyls; merus of pereopod 3, with 5-6 spines, pereopod 4, with 5-6 spines, pereopod 5, with 4 spines. Pleura of abdominal somites 1-4 rounded, 5 with ventral tooth. Telson with 5-6 pair dorsolateral spines. Male total length to 43 mm, female to 71.

Color in life: Pale yellow with red speckling (Butler, 1980).

Habitat and depth: 110-1163 m. The species may be pelagic.

Range: Unalaska to Point Sur, California. Type locality off Tawhit Head, Washington. A report of this species from Tanner Bank, California was in error due to a misinterpretation of the locality.

### Eualus barbatus (Rathbun)

Spirontocaris barbata Rathbun, 1899: 556.-- Rathbun, 1904: 82, fig. 35.

Eualus barbatus: Holthuis, 1947: 10.-- Kozloff, 1974: 165.-- Butler, 1980: 190, pl. 5C.

-- Wicksten, 1984b: 246.-- Wicksten, 1989b: 312.-- Wicksten, 1990b: 593.—Jensen 2004: 468.

Recognition characters: Rostrum moderately deep, reaching beyond antennular peduncle, with 5-8 dorsal and 3-4 ventral teeth. Stylocerite of antennular peduncle reaching about to end of first segment. Carapace with weak suborbital, strong antennal and pterygostomial teeth. Pereopods lacking epipods. Pereopods 3-5 slender, with spinose dactyls; merus of pereopod 3, with 3-4 spines, pereopod 4, with 4-5 spines, pereopod 5, with 4-5 spines. Pleura of abdominal somites 3-5 rounded, somites 3-5 each with dorsal carina and spine, somites 4-5 with ventral

teeth. Telson with 3 pair dorsolateral spines. Male total length 76 mm, female 95.

Color in life: Body with bands and spots of light orange (Butler, 1980).

Habitat: Soft mud, 82-507 m .

Range: Pribilof Islands to Santa Monica Bay, California. Type locality off St. George Island, Pribilof Islands.

### Eualus biunguis (Rathbun)

Spirontocaris biunguis Rathbun, 1902: 899.-- Rathbun, 1904: 97, fig. 44.

Eualus biunguis: Kobyakova, 1937: 120.-- Holthuis, 1947: 10.—Miyake and Hayashi 1967: 248, fig. 1.--Birshtein and Zarenkov, 1972: 440.-- Kozloff, 1974: 165.-- Butler, 1980: 192, color plate 6C.-- Miyake and Hayashi, 1967: 248, fig. 1.-- Wicksten, 1989b: 312.-- Wicksten, 1990b: 593.

—Jensen 2004: 468.

Recognition characters: Rostrum long and slender, reaching almost to end of antennular flagella, with 5-7 dorsal and 4-7 ventral teeth, dorsal half of rostrum without teeth. First and second segments of antennular peduncle with dorsal spine each, stylocerite nearly reaching end of first segment. Carapace with weak pterygostomial tooth. Pereopods lacking epipods. First pereopod stout and chelate, other pereopods slender; pereopods 3-5 with long, slender dactyls bearing minute spinules, each merus of pereopods 3-5 with 4-6 spines.. Pleura of abdominal somites 1-4 rounded, fifth somite with posterolateral tooth, sixth elongate; none with dorsal carinae. Telson with 5-6 pair dorsolateral spines. Male total length 49 mm, female to 99.

Color in life: Mostly red with yellow background, white patches on first 3 pleura of abdomen and on pereopods (Butler, 1980, color plate 6C).

Habitat and depth: Possibly semipelagic, usually lower continental slope, 90-2090 m .

Range: Bering Sea to Oregon, Sea of Japan, Siberian coast. Type locality off Cape St. James, Queen Charlotte Islands.

### Eualus avinus (Rathbun)

Spirontocaris avina Rathbun, 1898: 557.-- Rathbun ,1904: 103, fig. 47.

Eualus avinus: Holthuis ,1947: 10.-- Kozloff, 1974: 166.-- Butler, 1980: 193, color plate 8E.

-- Wicksten, 1990b: 593.—Jensen 2004: 468.

Recognition characters: Rostrum short, not reaching end of second antennular segment, arched over eye, with 12-14 dorsal and 1-2 ventral teeth. First and second segments of antennular peduncle each with spine. Carapace with weak pterygostomial tooth. Pereopods 1-3 with epipods. Pereopods 3-5 slender, with long and slender dactyls; each merus of pereopod 3-5 with 5-7 spines. Abdominal somites 1-3 rounded, 4-5 with posterolateral teeth, somite 6 elongate. Telson with 3 pair dorsolateral spines. Male total length 29 mm, female 44.

Color in life: Translucent with blotches of orange on body and appendages (Butler, color plate 8E).

Habitat and depth: Muddy and sandy bottoms of continental shelf, 46- 642 m.

Range: Pribilof Islands to off Depoe Bay, Oregon. Type locality north of Unalaska, Aleutian Islands.

Eualus lineatus Wicksten and Butler

Eualus lineatus Wicksten and Butler, 1983: 3, figs. 1-2.-- Wicksten, 1990b: 593.-- Wicksten and Hendrickx, 1992: 7.—Jensen and Johnson 1999: 133.--Jensen 2004: 468.

Spirontocaris herdmani: Rathbun, 1904: 100 (in part, not Spirontocaris herdmani Walker, 1898).

Eualus herdmani: Holthuis, 1947 : 11 (in part).-- Kozloff, 1974: 166.-- Butler, 1980: 197, pl. 1C (in part).

Recognition characters: Rostrum slender, not reaching end of second segment of antennular peduncle, with 3-6 dorsal and 1-3 ventral teeth. First segment of antennular peduncle with 3 spines, other two segments with 2 spines each, stylocerite reaching or surpassing end of first segment; with curved, dorsal spine near base. Carapace with small suborbital tooth, strong antennal tooth, moderate pterygostomial tooth. Pereopods 1-3 with epipods. First pereopod stout. Pereopods 3-5 slender, with spinose dactyls; merus of pereopod 3, with 3 spines, pereopod 4, with 2-3 spines, pereopod 5, with 0-1 spine. Pleura of abdominal somites 1-3 rounded, 4-5 with teeth. Telson with 3 pair dorsolateral spines. Male total length 20 mm, female 25.

Color in life: Carapace and abdomen marked with broad orange bands against translucent background (Jensen and Johnson, Fig. 5).

Habitat and depth: Rocks, reefs; often among sponges; 12 to 232 m .

Range: Naha Bay, Alaska to Santa Cruz Island, California. Type locality SW of Gull Island, off Santa Cruz Island, California.

Taxonomic remarks: This species was long confused with Heptacarpus herdmani Walker, despite Walker's original description stating that the species lacked an exopod on the third maxilliped. At present, H. herdmani is known only from the type specimen from Puget Sound.

Eualus subtilis Carvacho and Olson, 1984

Eualus subtilis Carvacho and Olson, 1984:59.—Jensen 2004: 468.

Eualus herdmani.—Butler 1980: 197, pl. 1C (in part).

Recognition characters.— Rostrum with 3-4 dorsal, 0-2 ventral teeth, reaching cornea of eye. Carapace without supraorbital teeth, no suborbital tooth but strong antennal tooth and small but acute pterygostomial tooth. First segment of antennular peduncle with one small spinule. Stylocerite without curved dorsal tooth near base. Basicerite with one lateral tooth.. Third maxilliped with exopod. Pereopods 1 and 2 with epipods. Third pereopod with 2-5 distal spines on merus; fourth pereopod, with 2-3, fifth pereopod with 1 meral spine. Third pereopod of male sexually dimorphic: propodus enlarged on flexor margin, dactyl with 8 spines. Abdominal pleura 1-3 rounded, pleura of somites 4 and 5 each with posterolateral spine. Carapace length of male to 2.1 mm,,female to 3.8.

Color in life.—Translucent with lines of dark chromatophores.

Habitat and depth.—Kelp beds, wrecks, reefs, intertidal to 74 m.

Range.—Barkley Sound, British Columbia to Punta Banda, Todos Santos Bay, Baja California, Mexico. Type locality Punta Banda.

Taxonomic remarks.—This species can be confused easily with E. lineatus. In the field, the color pattern is useful in identification: E. lineatus has bold stripes, E. subtilis is more transparent.

Eualus subtilis is much smaller than E. lineatus.

### Eualus berkeleyorum Butler

Eualus berkeleyorum Butler, 1971: 1616, figs. 1-2.-- Butler, 1980: 199, pl. 5A.-- Coyle and Mueller, 1981: 17.-- Wicksten, 1984b: 246.-- Wicksten, 1990b: 593.—Jensen 2004: 468.

Recognition characters: Rostrum short, reaching end of first segment of antennular peduncle, with 8-11 dorsal and 2-5 ventral teeth. Second and third segments of antennular peduncle bearing spines, stylocerite not reaching end of first segment. Carapace with strong suborbital and antennal teeth, weak pterygostomial tooth. Pereopods 1-3 with exopods. Pereopods 3-5 slender, with long, simple dactyls; merus of pereopods 3-5 each with 4-5 spines. Pleura of abdominal somites 1-4 rounded, 5 with tooth. Telson with 3 pair dorsolateral spines. Female total length 38 mm.

Color in life: Background white to cream, with red to orange patches on rostrum, body and appendages, and saddle-like bands on abdominal somites (Butler, 1980, color plate 5A).

Habitat and depth: Soft mud bottoms, 46-384 m (Butler, 1980).

Range: Unakwick Inlet, Alaska to off Trinidad Harbor, Humboldt County, California. Type locality Strait of Georgia.

### Genus Heptacarpus Holmes, 1900

#### Heptacarpus tenuissimus Holmes

Hippolyte gracilis Stimpson, 1864: 155 (not Hippolyte gracilis Lilljeborg, 1850).

Heptacarpus tenuissimus Holmes, 1900: 203.-- Holthuis, 1947: 13, 43.-- Holthuis, 1969: 3, fig. 1.-- Kozloff, 1974: 167.-- Butler, 1980: 208.-- Wicksten, 1990b: 593.-- Jensen, 1995: 49, fig. 84.

Spirontocaris gracilis: Rathbun, 1904: 77, fig. 31.-- Schmitt, 1921: 59, fig. 37.

Heptacarpus gracilis: Carlton and Kuris, 1975: 391, pl. 95, fig. 33.

Recognition characters: Rostrum exceeding antennular peduncle, with 4-5 dorsal and 4-8 ventral teeth, anteriormost dorsal tooth near middle of rostrum. Second and third segments of antennular peduncle with spine each, stylocerite reaching past first segment. Third maxilliped without epipod. No epipods on pereopods. Pereopods 3-5 slender, with spinose dactyls; merus of pereopod 3, with 3-4 spines, pereopod 4, with 4 spines, pereopod 5, with 2-3 spines. Pleura of abdominal somites 1-4 rounded, 5 with strong tooth. Telson with 4 pair dorsolateral spines. Male total length 36 mm, female 43.

Color in life: Mostly translucent, with horizontal red line running from antennal scale to tip of tail fan; appendages marked with red (Jensen, 1995).

Habitat and depth: 2-137 m. Off San Francisco, California, the species was taken at 54-74 m on fine dark green sand.

Range: Bird Island, Alaska to Santa Catalina Island, California. Type locality Puget Sound.

## Heptacarpus carinatus Holmes

Heptacarpus carinatus Holmes, 1900: 202, pl. 3, fig. 60.-- Holthuis, 1947: 12.-- Carlton and Kuris, 1975: 391, pl. 93, fig. 16.-- Butler, 1980: 210.-- Wicksten, 1990b: 594.-- Jensen, 1995: 46, fig. 77.

Spirontocaris carinata: Rathbun, 1904: 84.-- Schmitt, 1921: 62, fig. 39.-- Johnson and Snook, 1927: 305, fig. 259a.

Recognition characters: Rostrum exceeding antennular peduncle, with 3-7 dorsal and 2-6 ventral teeth. Second and third segments of antennular peduncle with spine each, stylocerite not reaching end of first segment. Pereopods 1-3 with epipods. Pereopods 3-5 stout, with spinose dactyls; merus of pereopod 3, with 1-3 spines, pereopod 4, with 0-2 spines, pereopod 5, with 1 spine. Distal dorsal margin of abdominal somite 3 with pronounced hump. Telson with 2-5 pair dorsolateral spines. Male total length 38 mm, female 51.

Color in life: Variable: translucent, apple green with red rostrum and stripes on carapace and abdomen, bright green, or red.

Habitat and depth: Tidepools, among eelgrass and algae, intertidal to 27 m .

Range: Dixon Harbor, Alaska to Point Loma, California. Type locality Monterey Bay, California.

## Heptacarpus flexus (Rathbun)

Spirontocaris camtschatica Rathbun, 1899: 557 (not Hippolyte camtschatica Stimpson, 1860).

Spirontocaris flexa Rathbun, 1904: 78, fig. 32.-- Schmitt, 1921: 58, fig. 36.

Heptacarpus flexus: Holthuis, 1947: 12.-- Kozloff, 1974: 167.-- Butler, 1980: 206.-- Wicksten, 1989b: 312.-- Wicksten, 1990b: 594.

Recognition characters: Very similar to H. tenuissimus. Rostrum exceeding antennular peduncle, with 4-5 dorsal and 5-8 ventral teeth, anteriormost dorsal tooth near to or behind middle of rostrum. Stylocerite exceeding first segment of antennular peduncle. Third maxilliped and pereopods 1 and 2 with epipods. Pereopods 3-5 slender, dactyls slender and weakly bifid; merus of pereopod 3, with 2 spines, pereopod 4, with 2 spines, merus 5, with 1 spine. Pleura of abdominal Somites 1-4 rounded, 5 with ventral tooth. Somite 3 with dorsal hump. Telson with 4 pair dorsolateral spines. Female total length to 54 mm .

Color in life: Not recorded.

Habitat and depth: 37-172 m .

Range: Bering Sea to Farallon Islands, California. Type locality north of Bird Island, Shumagins, Alaska.

## Heptacarpus brachydactylus (Rathbun)

Spirontocaris brachydactyla Rathbun, 1902: 898.-- Rathbun, 1904: 93, fig. 41.-- Schmitt 1921: 72, fig. 48.

Heptacarpus brachydactylus: Holthuis, 1947: 12.-- Standing, 1981: 779.-- Wicksten, 1990b: 594.

Recognition characters: Rostrum with 6 dorsal and 2-3 ventral teeth. First and second segments of antennular peduncle with small spines or knobs, stylocerite exceeding first segment. Carapace

with suborbital and antennal teeth. Third maxilliped with epipod. No epipods on pereopods. Pereopods 3-5 slender, with long and bifid dactyls; merus of pereopod 3 and 4 with 2 spines apiece, pereopod 5 with 1 spine. Pleura of abdominal somites 1-4 rounded, 5 with spine; sternite of abdominal somite 5 with tooth. Telson with 3-4 pair dorsolateral spines. Female total length 33 mm.

Color in life: Not recorded.

Habitat and depth: Rocky areas, 486-695 m .

Range: Monterey Bay to San Diego. Type locality off Santa Cruz Island, California.

### Heptacarpus franciscanus (Schmitt)

Spirontocaris franciscana Schmitt, 1921: 60, pl. 12, figs. 8-9.

Heptacarpus franciscanus: Holthuis, 1947: 12.-- Carlton and Kuris, 1975: 403.-- Carvacho and Olson, 1984: 59.-- Wicksten, 1990b: 594.

Recognition characters: Rostrum exceeding antennular peduncle, with 5-6 dorsal and 5-7 ventral teeth. Each segment of antennular peduncle with spine, stylocerite not exceeding first segment of antennular peduncle. Carapace with suborbital and antennal spines, no pterygostomial spine. Third maxilliped with epipod. No epipods on pereopods. Pereopods 3-5 with short, spinose dactyls; merus of pereopod 3, with 2 spines, pereopod 4, with 2 spines, pereopod 5, 1 spine.. Pleura of abdominal somites 1-4 rounded, 5 with tooth. Telson with 4-6 pair dorsolateral spines. Female total length to 46 mm.

Color in life: Pale reddish brown (Schmitt, 1921).

Habitat and depth: On rocks or sand, 4-23 m.

Range: San Francisco Bay to Todos Santos Bay, Baja California, Mexico. Type locality San Francisco Bay, California.

### Heptacarpus decorus (Rathbun)

Spirontocaris decora Rathbun, 1902: 896.-- Rathbun, 1904: 79, fig. 33.-- Schmitt, 1921: 61, fig. 38.

Heptacarpus decorus: Holthuis, 1947: 12.-- Kozloff, 1974: 167.-- Butler, 1980: 214, p.. 7C.

-- Standing, 1981: 779.-- Wicksten, 1990b: 594.

Recognition characters: Rostrum exceeding antennular peduncle, with 4-5 dorsal and 4-8 ventral teeth. Second and third segments of antennular peduncle with spine each, stylocerite reaching at most to end of first segment. Third maxilliped with epipod. Pereopods without epipods. First pereopod with particularly stout chela. Pereopods 3-5 slender, with spinose dactyls; merus of pereopod 3, with 3-5 spines, pereopod 4, with 4 spines, pereopod 5, with 3-4 spines. Pleura of abdominal somites 1-4 rounded, 5 with ventral tooth. Telson with 4-7 pair dorsolateral spines. Male total length 33 mm, female 60.

Color in life: Watery pink, with patterns of small red spots on body and appendages (Butler, 1980).

Habitat and depth: 22-313 m.

Range: Gabriola Island, Strait of Georgia to San Diego, California. Type locality off Santa Cruz Island, California.

### Heptacarpus kincaidi (Rathbun)

Spirontocaris kincaidi Rathbun, 1902: 899.-- Rathbun, 1904: 95, fig. 43.-- Schmitt, 1921: 63, fig. 40.

Heptacarpus kincaidi: Holthuis, 1947: 12.-- Kozloff, 1974: 167.-- Butler, 1980: 218.-- Wicksten, 1990b: 594.-- Jensen, 1995: 47, fig. 78. --Debelius 1999: 131.

Recognition characters: Rostrum moderately deep, exceeding antennular peduncle, with 5-6 dorsal and 5-6 ventral teeth; apex usually bifid. Second and third segments of antennular peduncle with 1 spine each, stylocerite reaching end of second segment. Third maxilliped with epipod. No epipods on pereopods. Pereopods 3-5 slender, with spinose dactyls; merus of pereopod 3 with 2-4 spines, pereopod 4, with 2-3 spines, pereopod 5, with 2-3 spines. Pleura of abdominal somites 1-4 rounded, 5 with sharpventral tooth. Dorsal posterior margin of third somite forming cap-like lobe. Telson with 4 pair dorsolateral spines. Female total length 35 mm.

Color in life: Mostly transparent, with spots and bands of red on body and appendages (Butler, 1980). Rostrum with yellowish stripe running its length, body marked with red streaked with white and with gray-green patches (color photograph by Jensen, 1995).

Habitat and depth: 10-183 m. In British Columbia, the shrimp associates with the sea anemone Cribrinopsis fernaldi. It also may associate with Urticina crassicornis.

Range: Discovery Passage, E. coast of Vancouver Island to San Pedro, California. Type locality Santa Cruz, California.

### Heptacarpus moseri (Rathbun)

Spirontocaris moseri Rathbun, 1902: 897.-- Rathbun, 1904: 91, fig. 39.

Heptacarpus moseri: Holthuis, 1947: 12.-- Kozloff, 1974: 167.-- Butler, 1980: 223, color plate 6A.-- Wicksten, 1989b: 312.-- Wicksten, 1990b: 595.

Recognition characters: Rostrum long, exceeding antennular peduncle, with 5-8 dorsal and 1-7 ventral spines. Each segment of antennular peduncle with spine, stylocerite reaching end of first segment. Third maxilliped and first pereopod with epipods. Pereopods 3-5 slender, with spinose, bifid dactyls; merus of pereopod 3, with 0-3 spines, pereopod 4, with 3 spines, pereopod 5, with 0-3 spines. Pleura of abdominal somites 1-3 rounded, 4-5 ending in posterolateral teeth. Telson with 4-5 pair lateral spines. Female total length 43 mm.

Color in life: Translucent, banded and patched with red to red-orange or transparent striped with blue (Butler, color plate 6A).

Habitat and depth: Intertidal, among algae to 1100 m.

Range: Pribilof Islands to off Columbia River, Oregon. Type locality off Segouam, Aleutian Islands.

### Heptacarpus sitchensis (Brandt)

Hippolyte sitchensis Brandt, 1851: 116, fig. 18.

Hippolyte picta Stimpson, 1871: 125.

Heptacarpus pictus: Holmes, 1900: 200, pl. 3, figs. 54, 55.-- Holthuis, 1947: 13.-- Carlton and Kuris, 1975: 391, pl. 95, fig. 36A,B.-- Chace and Abbott, 1980: 572, Fig. 23.7.-- Bauer 1981: 141.-- Ricketts et al., 1985: 85.-- Wicksten, 1990b: 595.

Spirontocaris picta: Rathbun, 1904: 101.-- Schmitt, 1921: 68, Fig. 46.-- Johnson and Snook, 1927: 308, fig. 259e.

Spirontocaris sitchensis: Rathbun, 1904: 102.

Heptacarpus sitchensis: Holthuis, 1947: 13.-- Kozloff, 1974: 167.-- Butler, 1980: 225.-- Wicksten, 1990b: 595.-- Wicksten, Flynn and Fagarason, 1996: 71.-- Jensen, 1995: 47, fig. 80.

Recognition characters: Rostrum barely exceeding length of antennular peduncle, with 4-8 dorsal teeth and 0-5 ventral teeth. Each segment of antennular peduncle with sharp spine, stylocerite reaching or exceeding end of first segment. Third maxilliped and pereopod 1-2 with epipods. Pereopods 3-5 stout, with spinose, bifid dactyls, merus of pereopod 3, with 0-9 spines, pereopod 4, with 0-5 spines, pereopod 5, with 0-5 spines. Pleura of abdominal somites 1-3 rounded, 4 and 5 with posterolateral tooth. Telson with 4-5 pairs dorsolateral spines. Male total length 16 mm, female 28.

Color in life: Variable: translucent, striped with brown and white, longitudinally striped with tan along dorsal midline, green, green with white carapace, or nearly black. For a discussion of the color patterns of this species, see Bauer, 1981.

Habitat and depth: Tidepools, docks, among algae and rocks, rarely to 12 m

Range: Resurrection Bay, Alaska to Yaquina Bay, Oregon; Duxbury Reef, Marin County, California to Punta Banda, Baja California, Mexico. Type locality Sitka, Alaska.

Taxonomic remarks: Until recently, H. sitchensis and H. pictus (Stimpson) were considered to be separate species on the basis of the epipods. Unlike the former, H. pictus was thought to have epipods on both the first and second pereopods as well as on the third maxillipeds. However, individuals can be found with an epipod on only the left or right first pereopod but not on both. Individuals with various arrangements of epipods can be collected in the same tidepool. In the absence of any other distinguishing features, these individuals must be considered to be variants of the same species.



Heptacarpus sitchensis



### Heptacarpus pugettensis Jensen

Heptacarpus pugettensis Jensen, 1983: 314, figs. 1-3.-- Wicksten, 1888: 242.-- Wicksten, 1990b: 595.-- Jensen, 1995: 47, fig. 79.

Recognition characters: Rostrum rarely overreaching eye, not reaching end of first segment of antennular peduncle, with 3-5 dorsal and 0-2 ventral teeth. First segment of antennular peduncle with ventromesial and dorsolateral spines, second and third segments also with spine each. Stylocerite extending past first segment. Third maxilliped and pereopods 1 and 2 with epipods. Pereopods 3-5 strong, with spinose dactyls; merus of pereopod 3, with 3 spines, pereopod 4, with 2 spines, 5 with 1-0 spines. Pleura of abdominal somites 1-3 rounded, fourth pleuron with weak to moderate tooth, fifth with point. Telson with 3-5 pair dorsolateral spines. Total length to 21 mm.

Color in life: Carapace with alternating green and red bands, appendages with reddish brown bands, appearing overall dark green with white transverse bands and 3 large yellowish oval markings on abdomen (Jensen, 1983).

Habitat and depth: Low intertidal zone, clinging to undersides of large rock .

Range: Alki Point, Seattle, Washington to Hazard Reef, near Morro Bay, California. Type locality Alki Point, Washington.

### Heptacarpus paludicola Holmes

Heptacarpus paludicola Holmes, 1900: 201, pl. 3, figs. 56, 57.-- Holthuis, 1947: 12.-- Kozloff, 1974: 167.-- Carlton and Kuris, 1975: 390, pl. 95, fig. 37.-- Butler, 1980: 227.-- Bauer, 1981: 141.-- Ricketts et al., 1985: 85, fig. 66.-- Wicksten, 1990b: 595.

Spirontocaris paludicola: Rathbun, 1904: 101.-- Schmitt, 1921: 64, fig. 42.-- Johnson and Snook, 1927: 306, fig. 259f.

Recognition characters: Rostrum extending beyond antennular peduncle, with 6-8 dorsal and 2-4 ventral teeth. Spine on each of three segments of antennular peduncle, stylocerite not reaching end of first segment. Third maxilliped and pereopods 1 and 2 with epipods. Pereopods 3-5 with spinose bifid dactyls; merus of pereopod 3, with 5 spines, pereopod 4, with 4 spines, pereopod 5, with 2-4 spines. Pleura of abdominal somites 1-3 rounded, fourth with weak tooth, fifth with spine. Telson with 4-5 pairs dorsolateral spines. Male total length 20 mm, female 32.

Color in life: Highly variable: green, banded, striped, speckled and transparent; color dependent on size and substrate. At night, colored blue to aquamarine (Bauer, 1981).

Habitat and depth: Tidepools and eelgrass beds, intertidal to 10 m.

Range: Tava Island, Alaska to San Diego, California. There are few records of the species south of Monterey Bay. Type locality Humboldt Bay, California.

### Heptacarpus stimpsoni Holthuis

Hippolyte cristata Stimpson, 1860: 33 (not Hippolyte cristatus De Haan, 1849).

Heptacarpus cristatus: Holmes, 1900: 202, pl. 3, figs. 58, 59.-- Carlton and Kuris, 1975: 391,

figs. 34A, 34B.

Spirontocaris cristata: Rathbun, 1904: 102, fig. 45.-- Schmitt, 1921: 69, fig. 47.-- Johnson and Snook, 1927: 308, fig. 259g.-- Goodwin, 1952: 394.

Heptacarpus stimpsoni Holthuis, 1947: 13, 44.-- Kozloff, 1974: 167.-- Butler, 1980: 229.— Carvacho and Olson, 1984: 60.-- Ricketts et al., 1985.-- Wicksten, 1988a: 243.-- Wicksten 1990b: 595.-- Jensen, 1995: 48, fig. 81.

Recognition characters: Rostrum not reaching end of antennular peduncle, with 5-8 dorsal teeth away from apex and 1-4 ventral teeth. Second and third segments of antennular peduncle with spine each, first segment with dorsal spinules, stylocerite reaching at least to second segment. Third maxilliped, pereopods 1-3 with epipods. Pereopods 3-5 slender, with simple, slender dactyls; merus of pereopod 3, with 4-5 spines, pereopod 4, with 4 spines, pereopod 5, with 2-4 spines. Pleura of abdominal somites 1-3 rounded, 4 and 5 with posterolateral teeth. Telson with acute tip, 3 pair dorsolateral spines. Male total length 23 mm, female 32.

Color in life: Drab brown or gray, with pale bands (Jensen, 1995).

Habitat and depth: Low intertidal to 104 m (Velero III station 1131-40). Almost all specimens from California occur at depths of 10-100 m, usually on sand.

Range: Sheep Bay, Alaska to Todos Santos Bay, Point Abreojos and Rosario Bay, Baja California. Specimens also have been collected at Melpomene Cove, Guadalupe Island, Mexico. Type locality San Francisco, California.

#### Heptacarpus taylori (Stimpson)

Hippolyte taylori Stimpson, 1857b: 500.

Heptacarpus taylori: Holmes, 1900: 199, pl. 3, figs. 52, 53.-- Holthuis, 1947: 13.-- Kozloff, 1974: 167.-- Carlton and Kuris, 1975: 391, pl. 95, fig. 35.-- Ricketts et al., 1985: 198.-- Green and Butler, 1988: 4, fig. 2.-- Wicksten, 1988a: 242.-- Wicksten, 1990b: 595.

Spirontocaris taylori: Rathbun, 1904: 101.-- Schmitt, 1921: 67, fig. 45.-- Johnson and Snook, 1927: 307, fig. 259d.

Recognition characters: Rostrum very short, not reaching cornea of eye, with 5-6 dorsal and no ventral teeth. Second and third segments of antennular peduncle each with spine, first segment with 3 spinules, stylocerite reaching to end of first segment. Third maxilliped and pereopods 1-3 with epipods. Pereopods 3-5 sturdy, with spinose bifid dactyls; merus of pereopods 3-5 with 1 spine each. Pleura of abdominal somites 1-3 rounded, 4 and 5 with posterolateral teeth. Telson with rounded tip, 3 pair dorsolateral spines. Males with heavier third maxillipeds than females. Male total length 25 mm, female 32.

Color in life: Highly variable, including red-brown, greenish with white carapace or mottled colors (Carlton and Kuris, 1975). Animals observed in San Mateo County, California included mottled brown ones, animals with a white carapace and a reddish brown abdomen, green ones with a mid-dorsal white stripe, and solid green ones. Johnson and Snook (1927) photographed one with a saddle-like mark on the carapace. The shrimp are camouflaged like algae or sea grasses in their natural habitat.

Habitat and depth: Among algae, intertidal to 13 m.

Range: Queen Charlotte Sound, British Columbia.-- Dillon Beach, California to Magdalena Bay, Baja California. Type locality Monterey, California.



Heptacarpus taylori

Heptacarpus fuscimaculatus Wicksten

Heptacarpus fuscimaculatus Wicksten, 1986: 47, figs. 1-2.-- Wicksten, 1988a: 243.-- Wicksten, 1990b: 595.

Recognition characters: Rostrum short, slightly exceeding first segment of antennular peduncle, with 3-6 dorsal and 1-0 ventral spines. All segments of antennular peduncle with 1 spine each, stylocerite reaching end of first segment. Third maxilliped and pereopods 1-3 with epipods. Merus of first pereopod with spine. Pereopods 3-5 with spinose, bifid dactyls; merus of pereopod 3 with 2-3 spines, pereopod 4, with 1-2 spines, pereopod 5, with 0-1 spine. Pleura of abdominal somites 1-3 rounded, 4-5 with posterolateral tooth each. Abdominal somite 5 with spine on ventral midline. Telson with 3-5 pair dorsolateral spines. Female total length 12 mm.

Color in life: Translucent with lines of brown chromatophores to pale green (Wicksten, 1986).

Habitat and depth: On floating docks, in kelp holdfasts and among sand, gravel and algae, 0-295 m but usually at 50 m or less.

Range: Santa Rosa Island to off Thurloe Head, Baja California. Type locality Big Fisherman's Cove, Santa Catalina Island, California.

Heptacarpus palpator (Owen)

Hippolyte palpator Owen, 1839: 89, pl. 28, fig. 3.-- Stimpson, 1856: 97.

Heptacarpus palpator: Holmes, 1900: 196, pl. 3, figs. 48, 49.-- Holthuis, 1947: 12.-- Carlton and Kuris, 1975: 391, pl. 95, figs. 31A, 31B.-- Ricketts et al., 1985: 197, fig. 167.-- Wicksten, 1986: 51, figs. 3, 4.-- Wicksten, 1990b: 596.-- Wicksten and Hendrickx, 1992: 7.-- Jensen, 1995: 46, fig. 76.

Spirontocaris palpator: Rathbun, 1904: 98.-- Schmitt, 1921: 65, fig. 43.-- Johnson and Snook, 1927: 307, fig. 259b.

Recognition characters: Similar to *H. fuscimaculatus*, but considerably larger. Rostrum reaching at least to end of cornea, often to end of first segment of antennular peduncle or slightly beyond, with 4-7 dorsal and 0-2 ventral teeth. First segment of antennular peduncle with 2-3 dorsal spinules and 1 lateral spine. Third maxilliped long and heavy, especially in males. No spine on merus of first pereopod. Pereopods 3-5 with short, spinose dactyls, 1-2 meral spines apiece. All abdominal somites with tubercles on ventral midline, somites 1-2 with 2 tubercles each, other somites with 1 ventral tubercle. Pleura of somites 4-5 ending in small, sharp points. Sixth abdominal somite longer than fifth, with 2 sharp lateral points. Telson shorter than uropods, with 4-5 pairs dorsolateral spines, apex acute. Total length 46.6 mm.

Color: Translucent to dark brown. Individuals from San Pedro, California had the anterior part of the body colored translucent with brown mottled bands, similar markings on the appendages, and dark brown bands on the abdomen and tail fan. The species is well camouflaged among algae.

Habitat and depth: Tidepools, shallow rocky areas and wharf pilings, 0-37 m.

Range: San Francisco Bay to Magdalena Bay, Baja California; one record from Isla Epiritu Santo, Gulf of California. In California, rarely north of Monterey Bay, most common south of Point Conception along the mainland. The record from San Francisco Bay was by Stimpson (1856). Type locality Monterey, California.



Heptacarpus palpator

Heptacarpus brevirostris (Dana)

Hippolyte brevirostris Dana, 1852: 566.-- Dana 1855: pl. 36, fig. 5.-- Stimpson, 1856: 97.

Heptacarpus brevirostris: Holmes, 1900: 198, pl. 3, figs. 50, 51.-- Holthuis, 1947: 12.-- Kozloff, 1974: 167.-- Carlton and Kuris, 1975: 391, pl. 95, figs. 32A, 32B.-- Chace and Abbott, 1980: 572, fig. 23.6.-- Butler, 1980: 231.-- Ricketts et al., 1995: 198.-- Wicksten, 1986: 54, fig. 5.-- Wicksten ,

1990b: 596.-- Jensen, 1995: 46, fig. 75.

Spirontocaris brevirostris: Rathbun, 1904: 99.-- Schmitt, 1921: 66, fig. 44.-- Johnson and Snook, 1927: 307, fig. 259c.

Recognition characters: Similar to H. palpator. Rostrum short, usually with simple apex, reaching cornea or beyond but not exceeding first segment of antennular peduncle, with 2-6 dorsal and no ventral teeth. First segment of antennular peduncle with 3-4 spinules, second and third segments with spine each, stylocerite reaching end of second segment. Third maxilliped long and heavy, especially in male. Pereopods 3-5 with short, spinose dactyls, merus with 1 spine each. Fifth abdominal somite with strong posterolateral spine; sixth somite, with strong posteroventral tooth. Telson with acute tip and 4 pairs dorsolateral spines, uropods exceeding telson. Male total length 49 mm, female 62.

Color in life: Variable: translucent, kelp-brown, opaque pinkish white with green abdomen, red (Butler, 1980). Animals observed alive in northern California and Oregon were chocolate brown, greenish, or mottled with rose pink and white. All were well camouflaged among algae.

Habitat and depth: Rocky intertidal areas, rocky subtidal areas with algae, 0-128 m.

Range: Attu, Aleutian Islands to Santa Cruz County, California. There are unverified reports of the species from offshore islands of southern California. Type locality Dungeness, Straits of Juan de Fuca.

Taxonomic remarks: There may be an additional species of Heptacarpus similar to H. palpator and H. brevirostris present in southern California. Three specimens from San Nicolas Island had a rostrum with 7 dorsal teeth and a shape different from that typical of H. palpator and H. brevirostris. At the time of this writing, no further specimens of this type have been found. I am uncertain as to whether this should be designated as a separate species or considered to be a variant of a described species. There have been no molecular studies on Heptacarpus spp. to date.



Heptacarpus brevirostris

## Family Processidae

Processids, known as night shrimp, resemble the lysmatids in having slender second pereopods with a multiarticulated carpus. The rostrum, however, is always short and slender, without teeth or with a bifid apex. The eyes are large. At least one of the first pereopods is chelate. The third to fifth pereopods are long and slender. Processids are most common on sandy or muddy bottoms off beaches or in deeper areas.

Only one species, Ambidexter panamensis, has been reported more than once from California. Schmitt (1921) reported this species as Processa canaliculata Leach. However, he included specimens belonging to two species in his account. Some of the specimens reported by Schmitt belong to Processa peruviana Wicksten, which usually ranges from the Gulf of California to Peru (Wicksten, 1983b). Processa peruviana is known from California from a single specimen taken off the Palos Verdes Peninsula, Los Angeles County, California.

### Key to the Species of the Family Processidae

1. Only one of first pair of pereopods chelate, other simple. First pereopods extending beyond scaphocerite-----Processa spp.  
  
Both of first pair of pereopods chelate. First pereopods extending to distal half of scaphocerite-----Ambidexter panamensis Abele

Genus Ambidexter Manning and Chace, 1971

Ambidexter panamensis Abele

Processa canaliculata: Rathbun, 1904:110 (in part).-- Schmitt, 1921: 81 (in part); not pl. 12, fig. 6 (photograph of Processa peruviana. See Wicksten, 1983b for information on Processa peruviana; not Processa canaliculata Leach, European species; see Manning and Chace, 1971, for further information).

Ambidexter panamensis Abele, 1972: 373, figs. 4-5.--Wicksten, 1983b: 31.--Wicksten and Hendrickx, 2003:68.

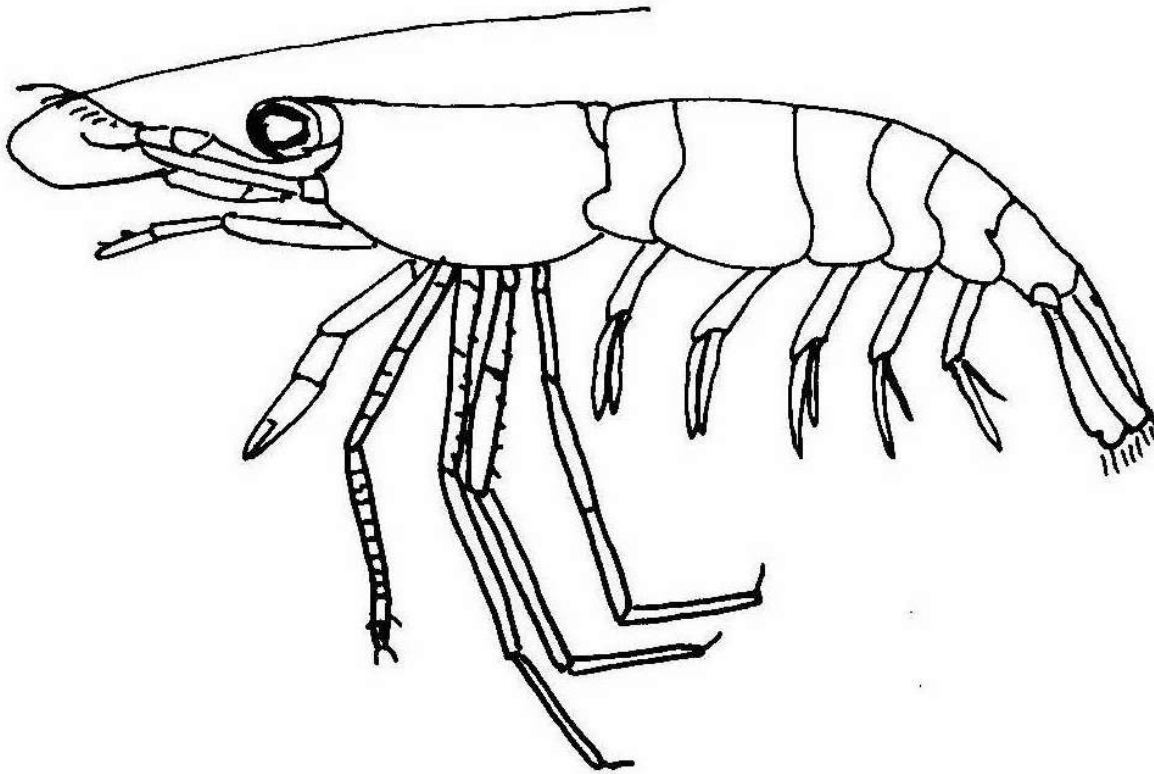
Recognition characters: Rostrum with simple apex, not extending to midpoint of eyestalk. First segment of antennular peduncle with small tooth on ventral surface, other segments unarmed; stylocerite round and not exceeding first segment. Scaphocerite reaching distal margin of last segment of antennular peduncle, rounded and with strong anterolateral tooth. Anterior margin of carapace with strong antennal tooth, no other spines. First pereopods subequal and chelate. Second pereopods equal, carpus with 12-13 articles. Pereopods 3-5 slender, with simple dactyls. Pleura of abdominal somites 1-4 rounded, fifth pleura rounded to bluntly angled; sixth pleuron with acute posterolateral tooth. Telson with two pair strong dorsal spines and two pair terminal spines flanking sharp point. Male total length 12 mm, female 17.

Color in life: Transparent.

Habitat and depth: Intertidal to 65 m, on mud or rock.

Range: San Diego, California; Gulf of California; Panama, Galapagos Islands. Type locality Naos Island, Canal Zone, Panama.

Natural history remarks: The only records of this species in California are from San Diego Bay, where it has been collected subtidally on muddy bottoms. It is relatively common off beaches from western Mexico south to Ecuador.



*Ambidexter panamensis*

## Family Ogyrididae

Although uncommon in California, the longeye shrimp, family Ogyrididae, are unmistakable. Their most outstanding features are the long, slender eyestalks. Like the processids, they have the carpus of the second pereopods subdivided into many articles. The first pereopods are chelate, but about equal in size with the other pereopods. Species of the Ogyrididae are found in sand or mud near shore and on the continental shelf.

Genus Ogyrides Stebbing, 1914

Ogyrides alphaerostris (Kingsley)

Ogyris alphaerostris Kingsley, 1880: 420, pl. 14, fig. 7.

Ogyrides alphaerostris: Williams, 1981:144.-- Williams, 1984: 107, fig. 74.—Carvacho and Olson 1984: 66, figs. 3,4.--Hendrickx and Wicksten, 1987: 17.--Wicksten and Méndez, 1988: 624.-- Wicksten and Hendrickx, 1992: 7 (see Williams, 1984 for a more extensive synonymy).

Recognition characters: Rostrum short, depressed, triangular, postrostral carina with 8-14 dorsal teeth flanked by row of setae on each side. Carapace with pterygostomial area obtuse. Eyestalks exceeding antennular peduncles by up to 2.5 x corneal length. Second segment of antennular peduncle the longest, stylocerite with two strong terminal teeth, not exceeding first article of antennular peduncle. Scaphocerite rounded, not reaching end of antennular peduncle. First pereopods chelate, fingers gaping when closed. Carpus of second pereopods with 4 articles. Pereopods 3-5 slender, single spine on ischium and merus each of pereopod 3. Abdominal pleura rounded to obtuse. Telson with pair lateral spines posterior to lateral prominences. Female total length 16 mm.

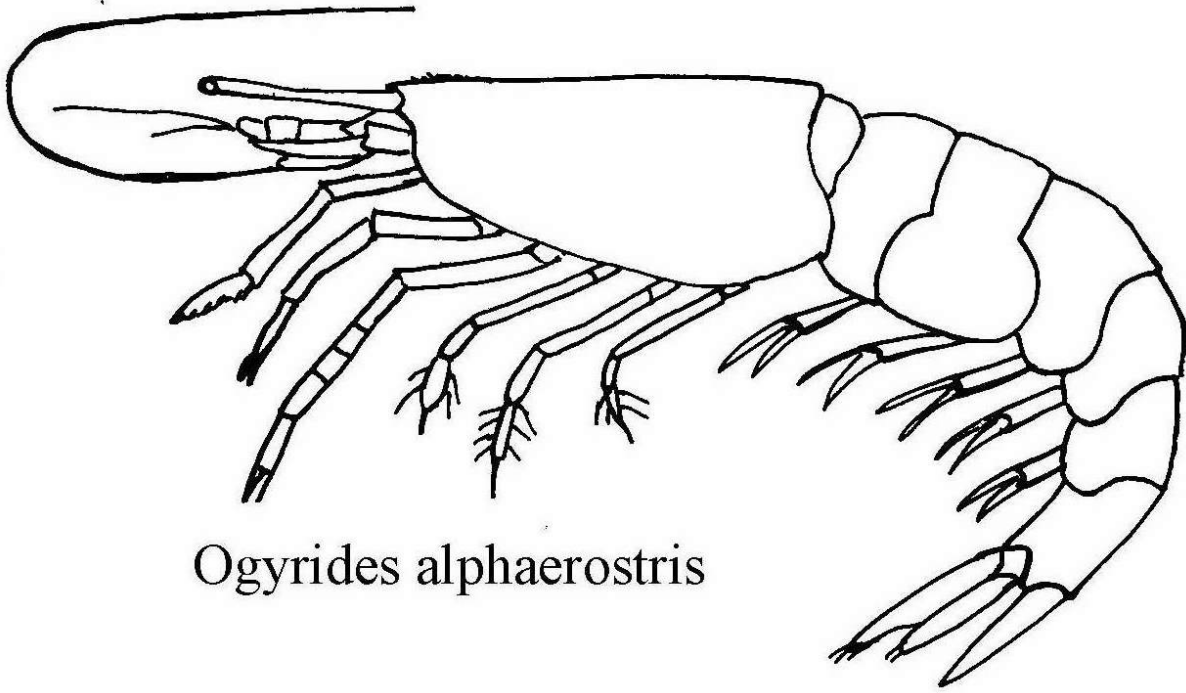
Color in life: Mostly colorless, small red and yellow spots on appendages, eyestalks and appendages, red spots on uropods and sixth abdominal somite.

Habitat: Mud, fine sand to gravel, but usually in very fine sand mixed with silt or clay; mostly subtidal, to 28 m.

Range: Virginia to Brazil; southern California and western Mexico. Type locality Northampton County, Virginia.

Natural history remarks: Specimens from southern California were taken off Huntington Beach at 26-28 m on sand. Other specimens have been collected off Ventura County. Most specimens from western Mexico were collected in Van Veen grabs, suggesting that the species is a burrower. Questions remain as to whether populations in the Atlantic and Pacific are genetically distinct and therefore should constitute separate species.





*Ogyrides alphaerostris*

## Family Pandalidae

Pandalids, known as coonstriped shrimp, spot prawns, or Pacific pink shrimp, are among the largest carideans of California. Many species are common offshore on muddy bottoms, but Pandalus danae can occur at the lowest intertidal zone of bays and rocky coasts from Marin County, California northward.

Pandalids have a long, slender, laterally compressed rostrum armed with teeth or spines. The first pereopod is slender and simple or microscopically chelate, which distinguishes them from the Thoridae, in which the first pereopod is robustly chelate. As in the Thoridae, the second pereopod is slender and has numerous carpal articles. The outer margin of the outer uropod has two distal spines. Many species are striped with red and white, or are colored uniformly scarlet.

Species of Pandalus are well represented in California, as they are in the North Pacific as a whole. These cold-water shrimp do not extend south of Magdalena Bay, Baja California in the Pacific or Martha's Vineyard, Massachusetts in the Atlantic (Williams, 1984; Wicksten, 1989b). Pandalus jordani and Pandalus platyceros are fished commercially. Species of Pandalopsis have been reported in cool seas of the northern and southern hemisphere. Species of Plesionika occur on continental shelves in warm temperate and tropical seas as well as in deep seas.

Pantomus affinis Chace, 1937, usually found from southern Baja California to Peru, has been reported from southern California during "El Nino" events, but does not seem to be able to reproduce and establish a resident population in the area. It can be distinguished from all other pandalids in the area by having a hinge at the base of the rostrum. The second pereopods are unequal, the right shorter than the left. The rostrum has 4-5 dorsal spines and 27-36 ventral spines.

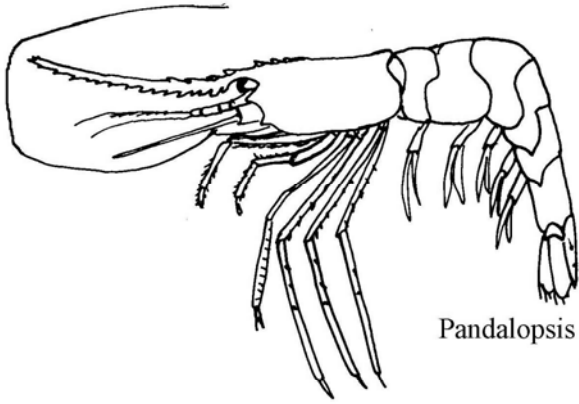
Many species of pandalids are protandrous hermaphrodites, in which the male is smaller, has subchelate third pereopods and has a proportionally more slender rostrum than the female. There may be some geographic variation in the number of rostral spines and teeth as well. The reader should be generous in interpreting meristic features of species of pandalids, recognizing that there may not be a set number per species.

Pandalids are eaten by many birds and fishes, as well as by sea lions. They feed primarily on smaller crustaceans, clams and worms. They are parasitized by the isopod Bopyroides hippolytes and the rhizocephalan Sylon hippolytes (Butler, 1980).

### Key to the Species of the Family Pandalidae

1. First antennae twice length of carapace. Merus of third maxillipeds and ischium of first pereopods with a laminate expansion fringed with long hairs-----2
- First antennae not longer than carapace. Merus of third maxillipeds and ischium of first pereopods without a laminate expansion fringed with long hairs-----3
2. Rostrum without teeth on distal half of rostrum. (Occurs from Washington state south)-----  
-----Pandalopsis ampla Bate

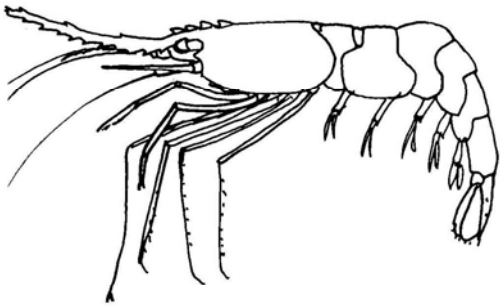
- Rostrum with teeth on distal half of rostrum. (Occurs from Bering Sea to Oregon)-----  
-----Pandalopsis dispar Rathbun
3. Third maxilliped with exopod. (Known to date only from south of Point Conception)-----4  
 Third maxilliped without exopod. (North or south of Point Conception)-----5
4. Rostrum with only two small basal dorsal spines, second pereopods equal, with 15-18 carpal articles. Pelagic at 500-4000 m-----Plesionika sanctaecatalinae Wicksten  
 Rostrum with 4 dorsal teeth and 5-6 dorsal spines, second pereopods very unequal in length, with about 100 left and 20 right carpal articles. Benthic at 55-258 m-----  
-----Plesionika mexicana Chace
5. Dorsal spines reaching behind middle of carapace. (Intertidal to continental shelf)-----6  
 Dorsal spines not reaching behind middle of carapace. (Subtidal to continental slopes)----- 7
6. Antennal scale of moderate width. No patch of pubescence on carapace, rostrum usually with trifid tip-----Pandalus danae Stimpson  
 Antennal scale narrow. Patch of pubescence on carapace, rostrum usually with bifid tip-----  
-----Pandalus stenolepis Rathbun
7. Sixth segment of abdomen about 1.5 x long as wide, carapace pubescent. With horizontal white stripes on carapace in life-----Pandalus platyceros Brandt  
 Sixth segment of abdomen about 3 x long as wide, Carapace smooth and shining. Without horizontal white stripes on carapace in life-----8
8. Rostrum with spines on distal half of superior margin-----Pandalus jordani Rathbun  
 Rostrum without spines on distal half of superior margin-----Pandalus tridens Rathbun



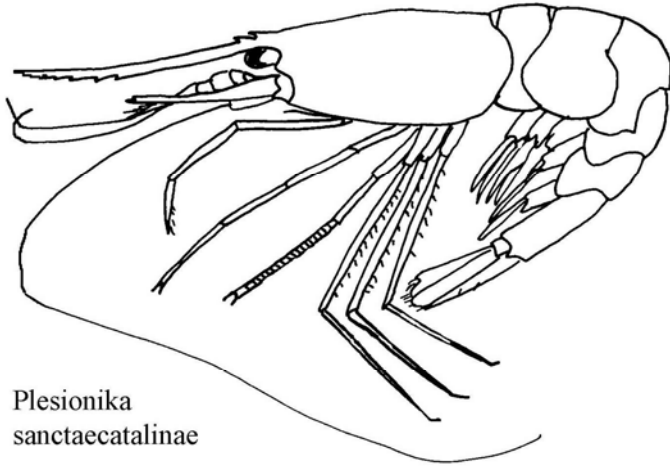
*Pandalopsis ampla*



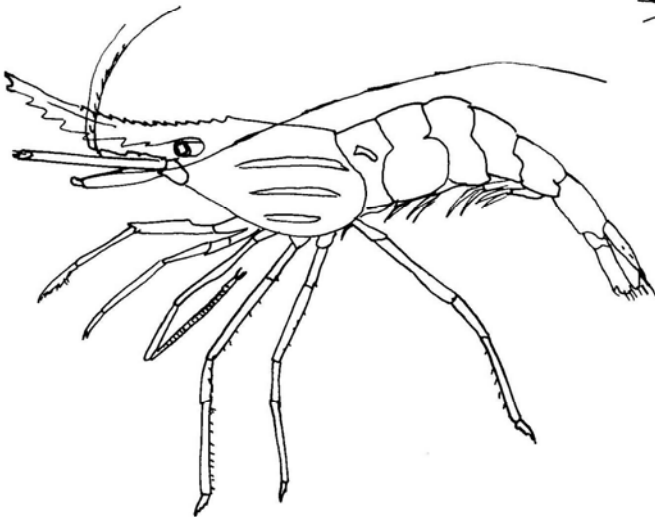
*Pandalopsis dispar*



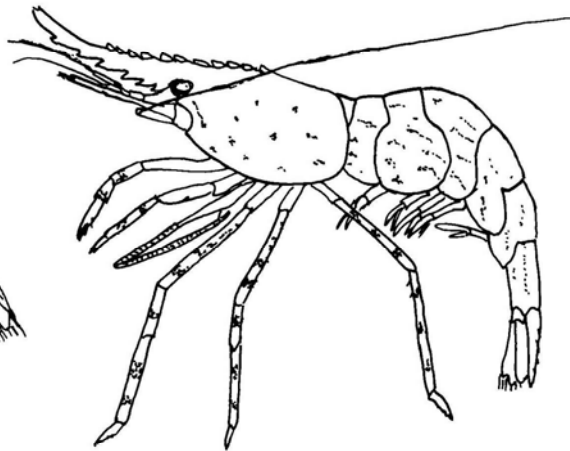
*Plesionika mexicana*



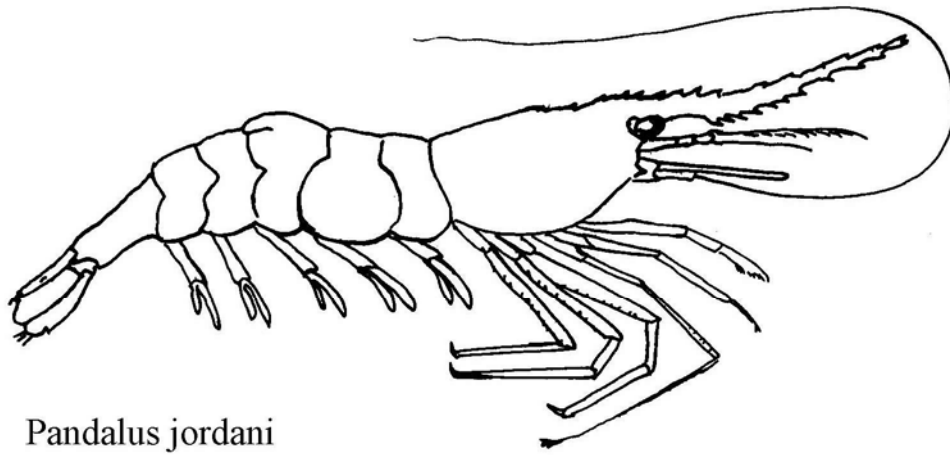
*Plesionika sanctaecatalinae*



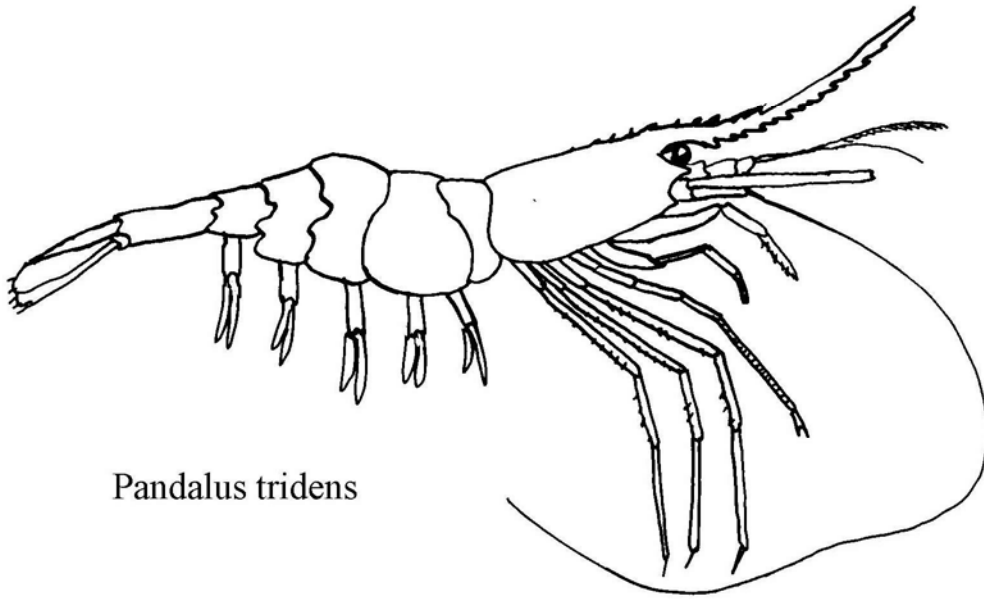
*Pandalus platyceros*



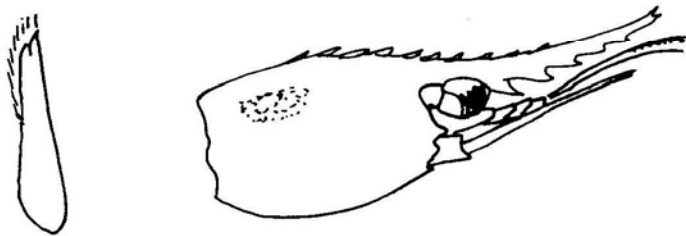
*Pandalus danae*



*Pandalus jordani*



*Pandalus tridens*



*Pandalus stenolepis* (antennal scale left)

Genus Pandalopsis Bate, 1888

Pandalopsis ampla Bate

Pandalopsis amplus Bate, 1888: 671, pl. 175, fig. 3.

Pandalopsis ampla: Faxon, 1895: 155.-- Rathbun, 1904: 51.—Schmitt, 1921: 46, pl. 14, fig. 2.-- Zarenkov, 1960: 345.-- Wicksten, 1982b: 245.-- Takeda and Hatanaka, 1984: 10.-- Wicksten, 1987:54.--Hendrickx and Wicksten, 1989: 82, fig. 10.-- Wicksten, 1989b: 313.-- Wicksten and Hendrickx, 1992: 9.

Pandalus amplus: Wicksten and Hendrickx, 2003: 69.

Recognition characters: Rostrum as long as the carapace, curved upward, with 7-14 dorsal spines and teeth between the middle of the carapace and the midpoint of the rostrum and 13 ventral teeth, tip with 1-3 small teeth. Eye pigmented. Carapace with antennal and pterygostomial teeth; surface punctate. First antennae twice length of carapace. Scaphocerite with blade nearly as long as carapace, blade broadly rounded and exceeded bilateral tooth. Third maxilliped without exopod, with epipod and with broad laminate expansion on ischium. Second pereopods equal or subequal, carpus with 20-24 articles. Third-fifth pereopods long and slender, with slender spinulose dactyls, 1-2 carpal spines and 5-6 meral spines. Third abdominal segment with posterior dorsal lobe. Sixth abdominal segment 1.5 x long as wide. Total length to 165 mm.

Color in life: Bright red.

Habitat and depth: Offshore mud and sand, 550-2000 m.

Range: Washington State to Acapulco; Gulf of California; southeastern Atlantic. Type locality off Montevideo, Uruguay.

Pandalopsis dispar Rathbun

Pandalopsis dispar Rathbun, 1902: 902.--Rathbun, 1904: 54, pl. 1, fig. 2.--Kozloff, 1974: 163.-- Butler, 1980: 124.--Wicksten, 1989b: 313.--Jensen, 1995: 53, fig. 97.

Recognition characters: Rostrum long, arched over eyes, with 13-18 dorsal teeth and 2-3 spines, and 9-15 ventral teeth. Eye large, pigmented. Carapace with strong antennal and moderate pterygostomial teeth. Antennular peduncle short, stylocerite short and flat; outer flagellum longer than body. Antennal scale much longer than antennular peduncle, with blade longer than lateral tooth; antennal flagellum 1.5X body length. Third maxilliped with antepenultimate segment with broad lamella, distal 2 segments slender, epipod present. Pereopods 1-4 with epipod. First pereopod shorter than third maxilliped, ischium with broad lamella, dactylus with rounded tip. Second pereopod long and slender, with 26-33 carpal articles, chelate. Pereopods 3-5 slender, with simple dactyls; pereopod 3 with 0-1 spine on ischium, 7-9 outer and 3-5 inner meral spines, and 2-3 carpal spines; pereopod 4 with 0-1 spine on ischium, 8-9 outer and 1-3 inner meral spines, 1-3 carpal spines; pereopod 5 without spine on ischium, 8-9 outer and 1-3 inner meral spines, 1-3 carpal spines. Posterior margin of third abdominal somite projecting over fourth, pleura of somites 1-3 rounded, 4-5 with distolateral points, small spinule at midlateral posterior border of somites 4-5, sixth somite with posterolateral point. Telson narrow, with acute tip, 5-7 pair dorsolateral spines, outer uropod longer than telson. Male total length 182 mm, female 208.

Color in life: Reddish orange, broken white bars on abdominal somites and posterior half of

carapace, pereopods 3-5 with red and white bars (Butler, 1980, color plate 8D).

Habitat and depth: Continental shelf and upper slope, 46-649 m.

Range: Pribilof Islands to Manhattan Beach, Oregon. Type locality Chernofski Harbor, Unalaska.

Genus Plesionika Bate, 1888

Plesionika sanctaecatalinae Wicksten

Plesionika sanctaecatalinae Wicksten, 1983a: 138, figs. 1-3.—Hendrickx and Wicksten, 1989: 80, fig. 7.—Hendrickx and Estrada-Navarrete, 1996: 133, fig. 82.—Wicksten, 2003: 137.

Plesionika sp.: Ebeling et al., 1970: 12.

Plesionika martia semilaevis: Wicksten, 1978b: 85, fig. 1.—Méndez, 1981: 104, pl. 18, figs. 316-317 (not Plesionika semilaevis Bate, Indo-Pacific species).

Recognition characters: Rostrum long and thin, exceeding scaphocerite, with 2 minute dorsal spines and 8-12 ventral teeth. One-3 tiny spinules on dorsal midline of carapace posterior to rostrum. Dorsal midline slightly raised posterior to rostrum for about half of carapace length. Carapace with small antennal and branchiostegal teeth and minute punctae. Eyes large, cornea not reaching end of first segment of antennular peduncle. First segment of antennular peduncle the longest. Stylocerite longer than cornea of eye. Flagella long and slender. Second antennae with scaphocerite 6.5 x as long as wide, lateral tooth exceeding blade. Basicerite with sharp point on lateral margin, carapocerite reaching first segment of antennular peduncle. Third maxilliped with exopod and epipod. First pereopod minutely chelate. Second pereopods about equal in length, with 15-18 carpal articles. First and second pereopod with epipods. Third-fifth pereopods long and thread-like. Third merus with 10-14 spines, fourth with 6-11 spines, fifth with 4-7 spines. Abdomen lightly punctate. Posterior margin of third somite overhanging fourth somite. Pleura of segments 1-2 rounded, pleuron of third segment subquadrate, pleura of fourth and fifth segments narrowly rounded. Sixth segment about 2 x length of fifth. Telson shorter than sixth segment, with 3 pair small dorsolateral spines and 2 pair terminal spines. Total length 70-75 mm.

Color in life: Scarlet.

Habitat and depth: Pelagic, 500-4000 m.

Range: Santa Barbara Island, California to Peru. Type locality off Santa Catalina Island, California.

Plesionika mexicana Chace

Plesionika mexicana Chace, 1937: 112, fig.1.—Wicksten, 1978b: 85.—Méndez, 1981: 103, figs. 314-315.—Wicksten, 1983b: 21.—Hendrickx and Wicksten, 1989: 78, fig. 6.—Wicksten and Hendrickx, 2003: 69.

Recognition characters: Rostrum twice as long as carapace, slightly ascending. Five spines at base of rostrum, 4-5 teeth on dorsal surface of rostrum proper; tip trifid; 10-14 ventral teeth. Eyes large and globular. Stylocerite of first antennae slightly exceeding first segment. Flagella of first antennae about 1.5 x rostrum. Scaphocerite narrow, exceeded bilateral tooth. Antennal

flagella about 2X body length. Third maxillipeds with exopods. First pereopods microscopically chelate. Second pereopods unequal, right shorter, with 20 carpal articles; left longer than rostrum and with about 100 carpal articles. Posterior pereopods long and slender, with simple dactyls and 5-6 meral spines. Abdomen smooth, without carina. Segments rounded except for points on posterolateral angles of fourth-fifth pleura. Sixth somite 1.6 x fifth segment. Telson with 3 pairs dorsolateral and 3 pairs terminal spines. Total length 50-60 mm.

Color in life: Translucent white with short scarlet longitudinal stripes. Antennae and pereopods barred with scarlet and white. Eyes greenish (Chace, 1937).

Habitat and depth: Mud, sand or shell bottoms, 4-258 m but usually at 50-150 m.

Range: Redondo Beach, California to Mancora Bank, Peru, but usually from Gulf of California southward. Type locality Arena Bank, off Baja California, Mexico.

## Genus Pandalus Leach, 1814

### Pandalus danae Stimpson

Pandalus danae Stimpson, 1857a: 87.--Holmes, 1900: 209, pl. 4, figs. 61-62.--Rathbun, 1904: 47, fig. 13.--Schmitt, 1921: 44, fig. 25, pl. 13, fig. 3.--Johnson and Snook, 1927: 302, fig. 257 a, c.--MacGinitie and MacGinitie, 1968: 272.--Kozloff, 1974: 163.--Carlton and Kuris, 1975: 390.--Butler, 1980: 147, pl. 4A.--Ricketts et al., 1985: 352.--Jensen and Armstrong, 1987: 216.--Wicksten, 1991: 812.--Jensen, 1995: 53, fig. 98.

Pandalus gurneyi Stimpson, 1871: 128.--Rathbun, 1904: 50.--Schmitt, 1921: 46, pl. 13, fig. 1.--Johnson and Snook, 1927: 303, fig. 257b.--Hendrickx and Wicksten, 1989: 83, fig. 8C, D.

Pandalus franciscorum Kingsley, 1878b: 94.

Recognition characters: Rostrum 1.0-1.6 x carapace, nearly straight to sharply upcurved, with 10-15 dorsal teeth and spines and 6-12 ventral teeth, tip trifid. Eye large. Stylocerite of first antennae short, flagella shorter than carapace. Scaphocerite narrow, lateral tooth exceeding blade, flagellum about equal to body length. Carapace with antennal and pterygostomial teeth. Third maxilliped without exopod but with epipod. First pereopod slender and chelate, ischium with slight lamina. Second pereopods unequal, left with about 60 carpal articles and right with 18-21 articles, epipods on first to fourth pereopods. Third-fifth pereopods slender and with spinulose margins, with 6-9 meral spines. Dorsal posterior margin of third abdominal somite slightly produced. Fourth pleuron with weak posterolateral point, fifth pleuron with strong posterolateral point, sixth segment shorter than telson. Telson with 5-6 pair dorsolateral spines, 2 pair terminal spines. Male total length to 123 mm, female to 140.

Color in life: Background translucent, marked with irregular striping and spots of brick red or chocolate brown, with fine brick-red dots between stripes. Fine blue spots on cardiac region of carapace. Antennae and appendages marked with striking bands of white, yellow, red or brown (Butler, 1980, color plate 4A); Wicksten, 1991).

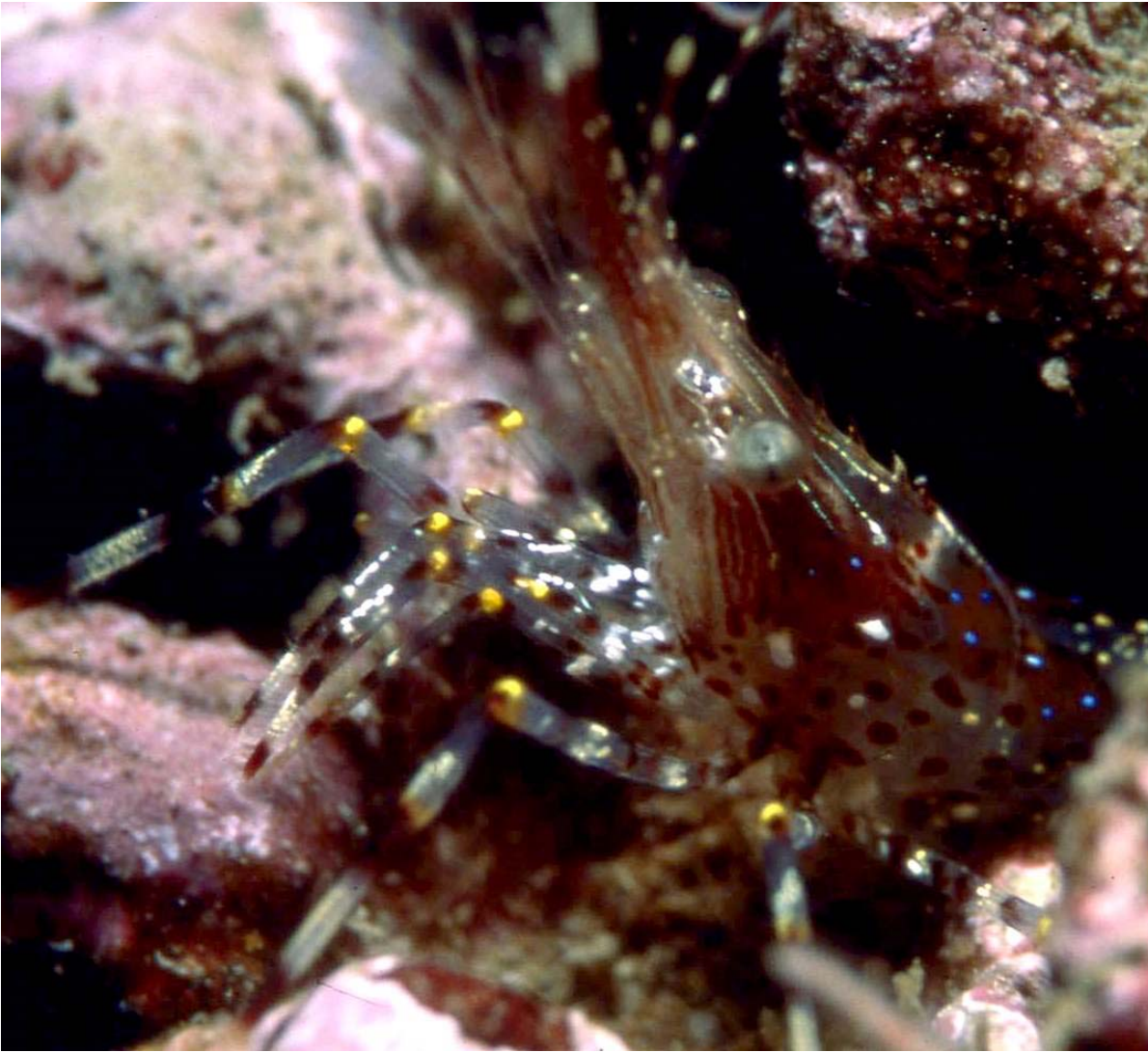
Habitat and depth: Sea grass beds, rocky reefs, offshore shell and sand, intertidal to 185 m.

Range: Black Hills, north side of Alaskan Peninsula, Alaska to San Quintin Bay, Baja California. Type locality Puget Sound.

Natural history and taxonomic remarks: By day, the shrimp often are seen in cracks or near rocks, where they may rest upside down. The long, banded antennae are easily observed. Divers have reported that the shrimp will climb on hands or equipment. Some confusion remains as to whether or not P. danae and P. gurneyi Schmitt, 1921 are separate species. As of this writing,



no molecular studies have been performed to compare the two supposed species.



Pandalus danae

Pandalus stenolepis Rathbun

Pandalus stenolepis Rathbun, 1902: 901.--Rathbun, 1904: 49, fig. 14.--Johnson and Snook, 1927: 303, fig. 257c.--Kozloff, 1974: 163.--Butler, 1980: 145, pl. 2C.--Wicksten, 1989b: 313.

Recognition characters: Body stout. Rostrum with distal two-thirds ascending sharply, 8-12 dorsal teeth and spines and 5-7 ventral teeth, tip bifid. Carapace with strong antennal and moderate to weak pterygostomial teeth, patch of pubescence on cardiac region. Eye large, cornea almost spherical. Antennular peduncle short, stylocerite short and rounder. Antennal scale narrow, lateral tooth exceeding blade, peduncle short. Third maxilliped moderately stout, antepenultimate segment with slight lamina, epipod present. Epipods on pereopods I-IV. First pereopod slender, ischium with slight lamina. Second pereopod chelate, left leg longer and more slender than right, carpus with about 50 articles; carpus of right leg with 10-13 articles. Third pereopod moderately stout, with 0-1 ischial spines, merus with 5-7 spines, carpus with 1-2 spines, propodus with 18-22 spinules, dactyl stout and spinous. Fourth pereopod about as stout as third

pereopod, with 1 ischial spine, 5-7 meral spines, carpus with 1-1 spines, propodus with 14-18 spinules, stout dactyl. Fifth pereopod with 0-1 meral spines, merus with 3-5 spines, carpus with 2 spines, propodus with 15-23 spinules and stout dactyl. Second abdominal somite with distinct transverse dorsal sulcus, third somite with dorsal posterior margin moderately produced, pleuron of fourth somite with weak ventral point, fifth with strong posterolateral point, sixth with moderate posteroventral point. Telson moderately wide, tapering to blunt tip, with 4-5 pairs dorsolateral spines. Male total length about 76 mm, female 82.

Color in life: Grayish to whitish, with patches of red on carapace, abdomen and appendages; blue dots on abdominal somites.

Habitat and depth: Muddy bottoms, 49-229 m.

Range: Unalaska Island to Hecata Bank, Oregon. Type locality Strait of Juan de Fuca.

### Pandalus platyceros Brandt

Pandalus platyceros Brandt, 1851: 123.--Holmes, 1900: 210.--Rathbun, 1904: 44.--Schmitt, 1921: 43, pl. 14, fig. 3.--Kozloff, 1974: 163.--Butler, 1980: 139, pl. 2A.--Wicksten, 1989b: 313.--Jensen, 1995: 55, fig. 102.

Pandalus pubescentulus Dana, 1852: 24.--Stimpson, 1857b: 501.--Kingsley, 1878b: 63.

Recognition characters: Body stout, carapace pubescent. Rostrum 1.2-2.0 x carapace length, with 4-17 dorsal spines and teeth, 6-8 ventral rostral teeth, usually one tooth dorsal and proximal to rostral apex. Carapace with antennal and pterygostomial teeth. Eyes large. First antenna with short stylocerite, inner flagellum longer than outer, both longer than carapace. Antennal scaphocerite slightly longer than 0.5 x rostrum, spine slightly exceeding blade, basicerite with moderate upper lateral spine and strong lower spine, flagellum equalling or exceeding body length. Third maxilliped stout, antepenultimate segment with slight lamina, epipod present. Pereopods 1-4 with epipods. First pereopod with minute chela, ischium with slight lamella. Second pereopods chelate, left longer than right, left with 27-31 articles and right with 8-9 articles. Pereopods 3-5 with dactyls having 4-7 spinules, propodus with 8-23 spinules, carpus with 3 spines, merus with 7-11 spines, ischium with one spine. Dorsal posterior margin of third abdominal somite slightly produced, pleuron of fourth abdominal segment with strong ventral points, fifth with strong posterolateral point; sixth segment shorter than telson. Telson with 4-6 pairs dorsolateral spines. Male total length to 230 mm, female to 253.

Color in life: Dull red to fawn or tan, with 3-4 lateral white stripes on carapace. Pair of conspicuous round white spots on dorsolateral surface of each of first and fifth abdominal somites. Third maxillipeds, pereopods and antennal flagella banded with red and white. Juveniles camouflaged with brown, green or red color similar to algae and eelgrass (Butler, 1980).

Habitat and depth: Juveniles usually shallower than adults, among sea grasses and algae, adults usually among rocks or on steep slopes; intertidal to 487 m.

Range: Unalaska Island to off San Diego; Sea of Japan north along Asiatic Pacific coast. Type locality Unalaska.

Natural history remarks: Observations off British Columbia suggest that the shrimp are primarily nocturnal, and may move into shallower waters during the night (Butler, 1980). Records from California usually come from deeper subtidal waters, often at the shelf break (about 185 m deep).



Pandalus platyceros

Pandalus jordani Rathbun

Pandalus jordani Rathbun, 1902: 900.--Rathbun, 1904: 40.--Schmitt, 1921: 41, pl. 14, fig. 1.--Kozloff, 1974: 163.--Butler, 1980: 133, pl. 4D.--Wicksten, 1989b: 313.

Recognition characters: Body slender, surface smooth. Rostrum as long as carapace, with 4-17 dorsal spines and teeth and 7-10 ventral teeth, tip acute or bifid. Eye large. Stylocerite of first antennae short, both flagella longer than carapace. Scaphocerite of second antenna about 0.5 x rostrum length, lateral tooth and blade equal, basicerite with moderate upper lateral, and strong lower spines, flagellum longer than body. Third maxilliped with antepenultimate segment having slight lamina, epipod present. First pereopod slender, proximal end of merus with slight lamina. Epipods on pereopods 1-4. Second pereopods unequal, left longer and with 58-62 articles, right shorter and with 19-22 articles. Third-fifth pereopods slender, with slender dactyls bearing 4-7 spinules, propodus with 12-23 spinules, merus carpus with 2-3 spines, merus with 7-11 spines, ischium with 1-0 spines, decreasing in number from pereopod 3-5. Third abdominal somite with dorsal posterior part compressed and with carina, posterolateral margin of fourth pleuron with moderate ventral point, fifth with strong posterolateral spine, sixth segment shorter than telson. Telson with 8-13 pairs dorsolateral spines and 3 pairs distal spines. Male total length to 125 mm, female to 175.

Color in life: Fine red dots on translucent grayish background. Proximal part of antennal flagellum pale pink (Butler, 1980).

Habitat and depth: Offshore green mud or mixed sand and mud, 36-457 m.

Range: Iliuliuk Harbor, Unalaska Island to San Nicolas Island, California. Type locality off Santa Cruz Island, California.

Natural history remarks: Pandalus jordani is fished from Vancouver Island to Morro Bay, California, but the highest population density is off central Oregon. Fishing is conducted at depths of 1110-183 m, but catches are highest at 110-183 m.

Pandalus tridens Rathbun

Pandalus montagui tridens Rathbun, 1902:901.-- Rathbun, 1904: 41.--Schmitt, 1921: 42, pl. 13, fig. 2.--Kozloff, 1974: 163.

Pandalus tridens: Butler, 1980: 137, pl. 8B.--Wicksten, 1989b: 313.--Jensen, 1995: 55, fig. 104 (see Butler, 1980 for discussion of nomenclature of this species).

Recognition characters: Body moderately stout, shell thin, surface smooth. Rostrum 1.3-1.8 carapace length, distal half slightly ascending, with 9-13 dorsal spines and teeth and 6-8 ventral teeth; no dorsal teeth on distal half, tip bifid or trifid. Carapace with pterygostomian and antennal teeth. Eye large. First antenna with short stylocerite, flagella extending beyond rostrum by about 0.3x their lengths. Second antenna with scaphocerite reaching middle of rostrum, scaphocerite narrow with lateral tooth slightly exceeding blade, basicerite with weak lower tooth, flagellum longer than body. Third maxilliped with slight lamina on antepenultimate segment, epipod present. Epipods on pereopods 1-4. First pereopod chelate. Second pereopods unequal, left longer and with about 74 carpal articles; right shorter and with 20-28 articles. Third-fifth pereopods with 5-7 spinules on dactyl, propodus with 15-32 spinules, carpus with 2-4 spines, merus with 4-7 spines, ischium with 0-1 spine, decreasing in number from pereopod 3-5. Posterior margin of third abdominal somite with moderate projection. Pleuron of fourth somite with weak ventral point, posterolateral margin of fifth with strong point, sixth shorter than telson. Telson with 5 pair dorsolateral spines. Male total length to 83 mm, female to 123.

Color in life: Fine red dots over translucent background. Red blotches and bands on pereopods, canary yellow blotches on pereopods 3-5, third maxilliped with yellow tip. Antennal flagellum colored by alternate red and transparent bands, flagella of first antenna with red and white bands (Butler, color plate 8B).

Habitat and depth: Rocky areas, 5-1984 m.

Range: Cape Oyutorsky, Pribilof Islands to San Nicolas Island, California, but few records south of Washington state. Type locality off North Head, Akutan Island, Alaska.

Natural history remarks: Pandalus tridens has been fished off British Columbia. Farther south, it has been reported southwest of the Colombia River (McCauley, 1972, as P. montagui tridens) and off Point Arena and San Nicolas Island in California (Schmitt, 1921). Most recent records are from Puget Sound northward.

## Family Alpheidae

The snapping shrimp, family Alpheidae, remind many viewers of small lobsters. At least one of the first pereopods is heavily chelate. The carpus of the second pereopod is divided into articles. The eyes may be exposed or covered by the front of the carapace. Most snapping shrimp hide in burrows, tubes or cracks by day and are active at night.

Most snapping shrimp are much more diverse in tropical areas than in temperate seas. An exception is the diversity of species of Betaeus, the visored shrimp. These shrimp live in the northern Gulf of California and from northwestern Baja California as far north as Alaska. Of the other species of alpheids, only Alpheus clamator occurs north of Monterey Bay.

There have been few studies of the natural history of snapping shrimp in California. Species of Automate and Alpheopsis usually have been taken subtidally in box cores or grab samples, which suggests that they are burrowers. Species of Alpheus live under rocks, in cracks or holdfasts or among worm tubes. Alpheus clamator, A. bellimanus and Synalpheus lockingtoni are abundant from lower intertidal areas to offshore kelp beds, shale reefs and rocky areas, while A. californiensis has been found most often in protected bays. Species of Betaeus live in pairs in tidepools or as associates of other invertebrates.

Species of Alpheus are noted for the loud snaps, clicks and pops produced when the enlarged tooth of the dactyl of the major chela strikes the palm. The sounds function in territorial defense, prey capture and distraction of predators.

Many species of alpheids are sexually dimorphic. The males often have larger chelae. In species of Alpheus, ridges, rows of setae and spines are more likely to be well developed in males than in females. In species of Alpheopsis and Betaeus, males tend to have a gape between the fingers of the chela than do females. The illustrations given here show males unless otherwise noted.

Several specimens of an unidentified species of Salmoneus have been found in Long Beach Harbor, California. There have been no recent collections of this species in the area. Considering that it was found in the harbor, this species may have been accidentally introduced due to human activity. Species of this genus have a large, flat rostrum and chelae with unusually inflated areas proximal to the fingers. See Holthuis (1993) for illustrations.

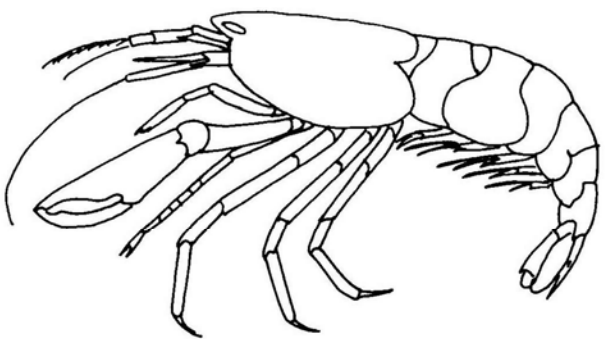
### Key to the Species of the Family Alpheidae

1. Triangular movable plate articulated at posterolateral angle of sixth abdominal somite lateral to base of uropod-----2
- No triangular movable plate articulated at posterolateral angle of sixth abdominal somite lateral to base of uropod-----9
2. Rostrum prominent, orbital hoods armed with spines-----Alpheopsis equidactylus (Lockington)
- Rostrum absent, front without spines-----3

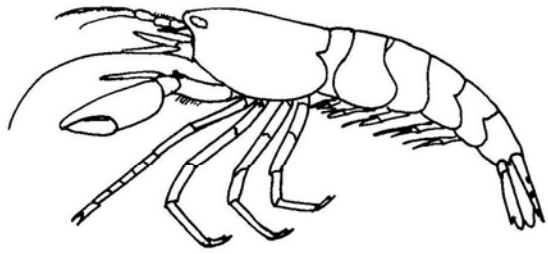
3. Dactyls of walking legs slender and simple-----4  
     Dactyls of walking legs stout and bifid-----6
4. Chelae of first pereopods with fingers longer than palms. Large male with gaping fingers of chelipeds-----Betaeus longidactylus Lockington  
     Chelae of first pereopods with fingers not longer than palms. Large male with heavier, stout chelae, but without gaping fingers-----5
5. Blade of scaphocerite broad distally. Fixed finger of first pereopod decreasing in width evenly to sharp curved tip-----Betaeus harrimani Rathbun  
     Blade of scaphocerite narrow distally. Fixed finger of first pereopod truncate before sharp curved tip-----Betaeus ensenadensis Glassell
6. Front curved, not emarginate. Commensal with sea urchins (Strongylocentrotus spp.)-----Betaeus macginitieae Hart  
     Front emarginate. Commensal with abalone or crabs or free-living-----7
7. Emargination of front shallow. Telson with posterolateral spines small or missing. Commensal with abalones (Haliotis spp.)-----Betaeus harfordi (Kingsley)  
     Emargination of front deep. Telson with posterolateral spines well developed-----8
8. Peduncle of antennule less than 0.5 carapace length. Merus of cheliped with lower inner ridge with long bristles, upper ridge ending in sharp tooth; chela with fingers subequal to palm; chela 3 x as long as wide-----Betaeus gracilis Hart  
     Peduncle of first antenna subequal to carapace length. Merus of cheliped with lower inner ridge usually tuberculate, upper ridge with tuft of hair; chela with fingers longer than palm; chela 2 x long as wide-----Betaeus setosus Hart
9. Eyes fully exposed dorsally-----Automate dolichognatha de Man  
     Eyes covered by carapace-----10
10. Pereopods without epipods. Dactyls of pereopods 3-5 bifid-----Synalpheus lockingtoni Coutiére  
     Pereopods with epipods. Dactyls of pereopods 3-5 with simple tips-----11
11. Dactyl of major chela closing horizontally. Merus of third pereopod with prominent inferior spine-----Alpheus clamator Holmes  
     Dactyl of major chela closing vertically. Merus of third pereopod without prominent inferior spine-----12

12. Orbital hoods with spines. Minor chela with prominent spine posterior to movable finger, movable finger flattened (lamellate)-----Alpheus bellimanus Lockington

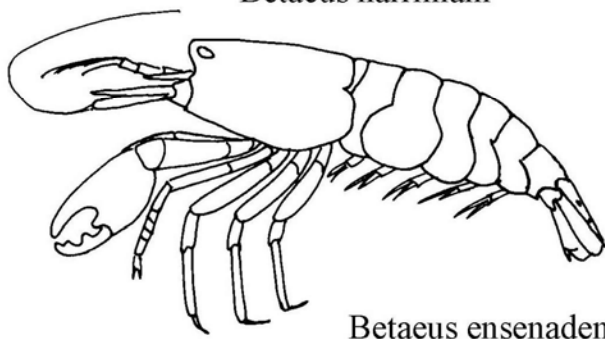
Orbital hoods without spines. Minor chela without prominent spine posterior to movable finger, movable finger not flattened-----Alpheus californiensis Holmes



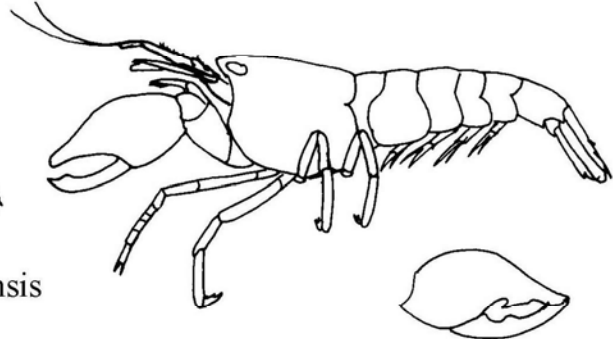
Betaeus harrimani



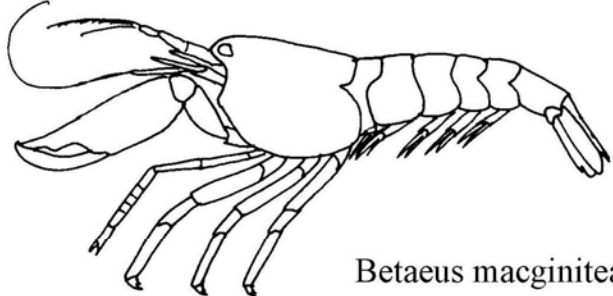
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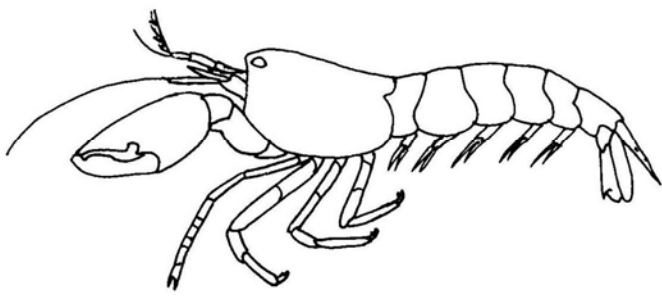
Betaeus ensenadensis



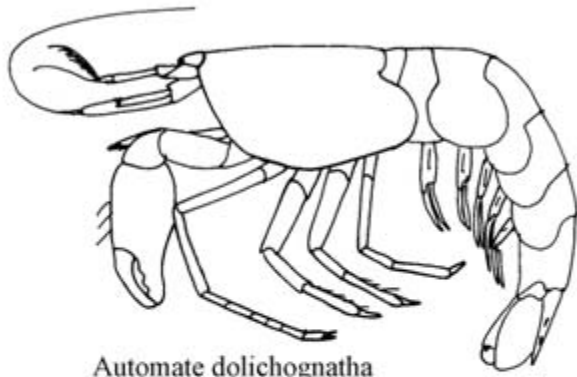
Betaeus setosus



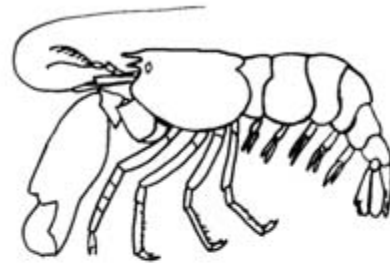
Betaeus macginitiae



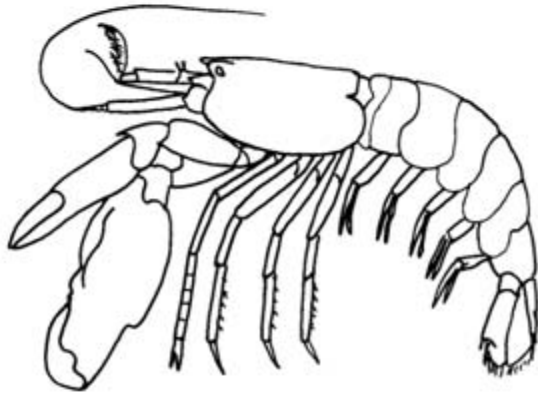
Betaeus harfordi



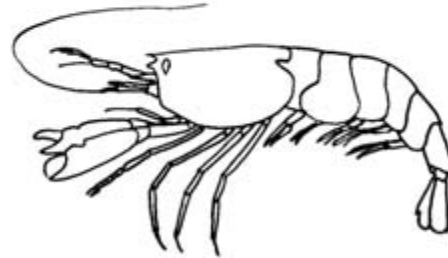
*Automate dolichognatha*



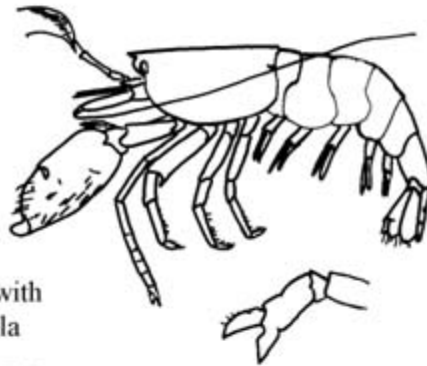
*Synalpheus lockingtoni*



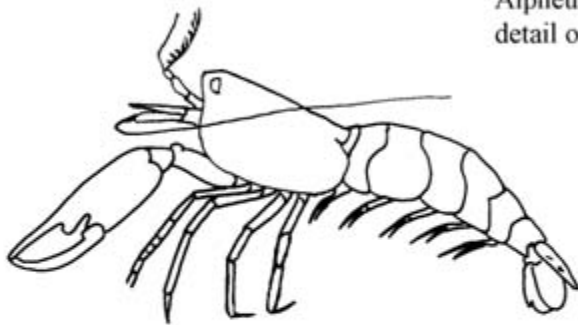
*Alpheus californiensis*



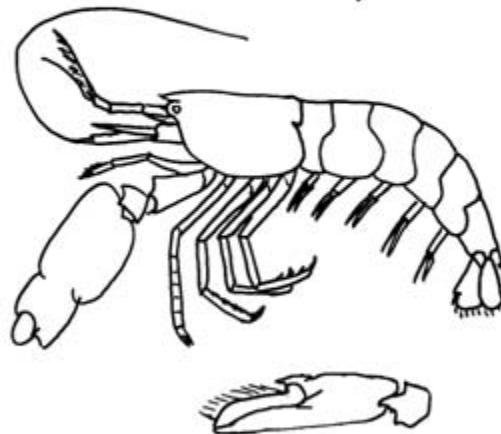
*Alpheopsis equidactylus*



*Alpheus clamator* with  
detail of minor chela



*Betaeus longidactylus* male



*Alpheus bellimanus* with  
detail of minor chela



Genus Alpheopsis Coutière, 1896

Alpheopsis equidactylus (Lockington)

Alpheus equidactylus Lockington, 1877b: 35.--Holmes, 1900: 187; pl. 3, figs. 45-46.--Rathbun, 1904: 10.

Crangon equidactylus: Schmitt, 1921: 76, fig. 53.--Johnson and Snook, 1927: 309.

Alpheopsis equidactylus: Wicksten, 1984aa: 186.--Wicksten, 1994: 120.

Recognition characters: Front trispinose, rostrum narrow and shorter than first segment of antennular peduncle. Ocular teeth acute and shorter than rostrum. Stylocerite reaching end of second segment of antennular peduncle. Scaphocerite with broad blade, spine exceeding blade. Basicerite with small tooth on dorsal margin, 1 small outer lateral tooth and large basolateral tooth. Carpocerite exceeding blade of scaphocerite. Carapace with posterolateral notch. First pereopods similar in size and shape. Chela with transverse groove extending along upper edge almost to posterior margin, dactyl closing vertically. Propodus with 2 teeth on cutting edge. Carpus of second pereopod with 5 articles, the first article as long as the next 4 combined. Pereopods 3-5 slender, with long dactyls; 1-2 small spines on ischium of third and fourth pereopods. Pleura of abdominal somites 1-4 rounded, those of 5 and 6 pointed. Telson with 2 pair dorsolateral and one pair long terminal spines. Total length 19.1 mm.

Color in life: Not recorded.

Habitat and depth: Sand and mud of the continental shelf, subtidal to 85 m.

Range: Monterey to Cortez Bank, California. Type locality Monterey, California.

Taxonomic remarks: Schmitt (1921) mentioned that the species may be identical with Alpheopsis trispinosus Stimpson, currently known to range from New South Wales to Tasmania (Banner and Banner, 1973). However, A. trispinosus has a broader rostrum than A. equidactylus. The carpocerite of A. trispinosus does not extend beyond the scaphocerite. The dactyl of the third pereopod is relatively shorter in A. trispinosus than in A. equidactylus. The basicerite of A. trispinosus does not have a small tooth between the upper margin and the larger lower tooth. In adult A. trispinosus, there are 2 small teeth on the dactyl as well as a large one, while the propodus can bear 4 smaller teeth as well as 2 large ones on the cutting edge.

Genus Betaeus Dana, 1852

Betaeus longidactylus Lockington

Betaeus longidactylus Lockington, 1877a: 35.--Rathbun, 1904: 108.--Schmitt, 1921: 80, pl. 12.--Johnson and Snook, 1927: 310, fig. 262.--Hart, 1964: 441, figs. 20-22, 27, 32-34, 40-42.--MacGinitie and MacGinitie, 1968: 279.--Wicksten, 1994: 121.--Jensen, 1995: 43, fig. 66.—Wicksten and Hendrickx, 2003: 65.

Recognition characters: Front of carapace straight, slightly swollen over eyes. Stylocerite reaching almost to end of second segment of antennular peduncle. Scaphocerite broad, spine exceeding blade, reaching nearly to end of antennular peduncle. Carapace without spines. First pereopods usually similar in size and shape, with narrow fingers which exceed palm. In small individuals, no large teeth on inner margin of fingers and no gape between fingers when closed; in large, teeth and obvious gape can be present. Second pereopod with 4 carpal articles, first

article slightly longer than next three together. Pereopod 3 relatively stout, slightly flattened, with simple dactyl. Pereopods 4 and 5 similar to pereopod 3 but smaller and more slender. Abdominal pleura 1-3 rounded, 4 and 5 slightly angled. Telson with 2 pair spines on dorsal surface, 2 spines on each posterolateral angle, posterior margin deeply curved. Total length 40 mm.

Color in life: Olive green, olive brown, red-brown, blue green; with light middorsal stripe; legs reddish with white tips, tail fan dark with yellow setae (Hart, 1964).

Habitat and depth: Tide pools, among eelgrass, on docks or in burrows of echiuroid worm Urechis caupo or mud shrimp (Upogebia spp.)

Range: Elkhorn Slough, Monterey County, California; to Tepoca Bay, Gulf of California. Type locality San Diego, California.

Natural history remarks: This common tidepool shrimp of southern California often lives in pairs. In the Gulf of California, Mexico, the species lives only in the northern coasts and commonly is collected in the vicinity of Puerto Peñasco, Sonora.



Betaeus longidactylus

### Betaeus harrimani Rathbun

Betaeus harrimani Rathbun, 1904: 108, fig. 49.--Hart, 1964: 435, figs. 1-26, 29-31, 37-39, pl. 1.--Kozloff, 1974: 165.--Butler, 1980: 151.--Wicksten, 1984aa:188.--Jensen, 1995: 43, fig. 67.

Recognition characters: Front of carapace slightly curved and depressed anteriorly. Stylocerite reaching almost to end of second segment of antennular peduncle. Scaphocerite broad, spine exceeding blade, reaching past middle of last segment of antennular peduncle. Anterior margin of carapace with 2 shallow sinuses. First pereopods with fingers 0.5 x to as long as palm, with or without gape. Second pereopods slender, with 5 carpal articles; first article equal in length to next 3 together. Pereopods 3-4 slender, somewhat flattened, with thin, curved dactyls; pereopod 5 similar to 3-4 but with bands of setae forming brush on distal half of propodus. Pleura of abdominal somites 1-3 rounded, pleura of 4 and 5 angled. Telson with 2 pair spines on dorsal surface, 2 spines at each posterolateral angle; posterior margin deeply curved (Hart, 1964). Total length 35 m.

Color in life: Color determined by distribution of blue and red chromatophores: translucent, reddish to purplish, pale green; turning blue at night (Hart, 1964).

Habitat and depth: Intertidal, in pools, among oysters, in burrows of Upogebia pugettensis and Neotrypaea californiensis.

Range: Sitka, Alaska to Newport Harbor, California. Type locality Sitka, Alaska.

### Betaeus ensenadensis Glassell

Betaeus ensenadensis Glassell, 1938: 416.--Hart, 1964: 445, figs. 23-25, 28, 35-36, 43-45.--MacGinitie and MacGinitie, 1968: 270.--Wicksten, 1984aa: 187.

Recognition characters: Front of carapace slightly curved, depressed anteriorly. Stylocerite reaching to about distal third of second segment of antennular peduncle. Scaphocerite with narrow blade, spine exceeding blade, reaching middle of third segment of antennular peduncle. Anterolateral margin of carapace obtuse. Chela of first pereopod covered with fine denticles, dactyl shorter than palm and bearing 3 teeth, fingers gaping. Second pereopod with 5 carpal articles, first article longer than fifth and about equal to second-fourth together. Pereopods 3-4 with dilated merus each, with movable spines on merus and ischium, sharp dactyl. Fifth pereopod with spine on merus only, brush of bristles on propodus. Abdominal pleura 1-4 rounded, fifth pleuron bluntly angled. Telson with 2 pair spines on dorsal surface, 2 spines at each posterolateral angle, posterior margin slightly curved (Hart, 1964). Total length about 25 mm.

Color in life: Mostly translucent, with minute red and blue spots, fingers and telson tinted light purple (Glassell, 1938).

Habitat and depth: In burrows of Neotrypaea californiensis or Upogebia spp., intertidal to 10 m.

Range: Los Angeles Harbor, California to Ensenada, Mexico. Type locality Estero de Punta Banda, Ensenada, Mexico.

### Betaeus macginitieae Hart

Betaeus macginitieae Hart, 1964: 451, figs. 48-49, 55, 62-64, 75-76.--Wicksten, 1984a: 188.—Carvacho and Olson 1984a: 64.--Jensen, 1995: 42, fig. 65. (See Hart, 1964, for previous misidentifications).

Recognition characters: Front of carapace produced to form hood, slightly curved anteriorly but without emargination. Stylocerite reaching to last quarter of second segment of antennular peduncle. Scaphocerite narrow, spine exceeding blade, reaching middle of third segment of antennular peduncle. Lateral margin of carapace faintly curved. Chela of first pereopod elongate, with blunt tooth on proximal part of fixed finger followed by gap before denticulate cutting edge; dactyl with similar proximal tooth. Carpus of second pereopod with 5 articles, first article longest. Pereopod 3 with stout ischium and slightly dilated merus, spine on proximal part of merus, short dactyl. Pereopods 4-5 similar but smaller. Pleura of abdominal somites 1-4 rounded, fifth pleuron somewhat acute. Telson with 2 pair dorsal spines, pair small spines on posterior margin, margin curved (Hart, 1964). Total length about 25 mm.

Color in life: Dark purple, resembling color of sea urchins; blue to reddish brown (Hart, 1964). A specimen photographed at Santa Catalina Island was a rich purple-red color, with red

appendages.

Habitat and depth: Tidepools and subtidal rocky areas, in association with sea urchins (Strongylocentrotus purpuratus and S. franciscanus).

Range: Monterey to Todos Santos Bay, Baja California. Type locality Corona del Mar, Orange County, California.

Betaeus harfordi (Kingsley)

Alpheus harfordi Kingsley, 1878a: 198.

Betaeus harfordi: Rathbun, 1904: 108.--Schmitt, 1921: 79, fig. 55.--Johnson and Snook, 1927: 310, fig. 261.--Hart, 1964: 447, figs, 46-47, 54, 58-61, 73-74.--MacGinitie and MacGinitie, 1968: 279.--Chace and Abbott, 1980: 571, fig. 23.3.--; Wicksten, 1984a: 188.--Campos-Gonzalez, 1988: 384.

Recognition characters: Front of carapace shallowly emarginate, produced over eyes. Stylocerite reaching to distal quarter of second segment of antennular peduncle. Scaphocerite narrow, spine exceeding blade and separated from blade by slit, reaching third segment of antennular peduncle. Anterior margin of carapace shallowly curved. Chela of first pereopod flattened laterally, palm and fingers subequal in length; fingers meeting evenly or gaping. Carpus of second pereopod with 5 articles, first the longest. Pereopod 3 stout, flattened laterally, with movable spine on merus and stout, bifid dactyl. Pereopod 4 similar but shorter than 3, pereopod 5 shorter than 4. Abdominal pleura 1-4 rounded, fifth pleuron acute. Telson with 2 pair dorsal spines, posterolateral spines vestigial or missing, posterior margin curved (Hart, 1964). Total length 24 mm.

Color in life: Dark purple, blue-black, deep blue (Hart, 1964).

Habitat and depth: Lower intertidal to 22 m, living in mantle cavity of abalone (Haliotis spp.) and rarely wavy top, Astraea undosa.

Range: Fort Bragg, California to Magdalena Bay, Baja California, Mexico. Type locality Santa Catalina Island, California.



Betaeus harfordi

### Betaeus gracilis Hart

Betaeus gracilis Hart, 1964: 453, figs. 50-51, 56, 65-67, 77-78.--Wicksten, 1984a: 188.

Recognition characters: Front of carapace depressed, deeply indented medially, covering eyes with two hoods. Stylocerite reaches nearly to end of second segment of antennular peduncle. Scaphocerite broad, with stout spine which exceeds blade and is separated from it for distal third of its length; reaching almost to end of third segment of antennular peduncle. Anterior margin of carapace evenly curved. Chela of first pereopod with palm longer than fingers, little gape between fingers. Carpus of second pereopod with 5 articles, first article longest. Pereopod 3 stout, merus slightly dilated and with movable spine, dactyl narrow and bifid. Pereopods 4-5 similar to third but smaller. Pleura of abdominal somites 1-3 rounded, those of 4 and 5 bluntly square. Telson with 2 pair dorsal spines, well developed posterolateral spines, posterior margin curved. Total length about 25 mm.

Color in life: Pale olive-green.

Habitat and depth: Kelp holdfasts, intertidal to shallow subtidal.

Range: Monterey Bay to Laguna Beach, California. Type locality Laguna Beach.

### Betaeus setosus Hart

Betaeus setosus Hart, 1964: 455, figs. 52-53, 57, 68-72, 79, 80, pl. 2.--Kozloff, 1974: 165.--Butler, 1980: 153.--Wicksten, 1984a: 188.--Ricketts et al., 1985: 408, fig. 312.--Jensen, 1995: 43, fig. 68.

Recognition characters: Front of carapace deeply indented medially, produced laterally over each eye. Stylocerite reaching nearly to end of second segment of antennular peduncle. Scaphocerite slender, spine longer than blade and separated from it for nearly 0.5 its length, nearly reaching end of third segment of antennular peduncle. Anterior margin of carapace smoothly curved. Chela of first pereopod large, much compressed laterally; fixed finger twice as wide at base as dactyl, which is longer than palm. Left chela with large tooth medially on fixed finger, wide gape and smaller proximal teeth; right chela with slight gape but most of teeth intermeshing. Carpus of second pereopod with five articles, first and fifth articles about equal in length and longest. Pereopod 3 with inflated merus bearing large proximal spine, dactyl short, broad and bifid. Pereopods 4 and 5 similar but smaller. Pleura of abdominal somites 1-3 rounded, 4 and 5 angled. Telson with 2 pair dorsal spines, 2 spines at posterolateral angle, posterior margin rounded. Much of body setose. Total length to 25 mm.

Color in life: Variable: nearly white, red, brown or green, matching algae; yellow in light but pink or orange in the dark (Hart, 1964). Specimens from San Mateo County, California were straw-colored.

Habitat and depth: Among rocks, kelp holdfasts, tide pools, on pilings, and among roots of eelgrass (Zostera marina), intertidal to 18 m.

Range: Hecate Strait, British Columbia to Morro Bay, California. Type locality Clayoquot Sound, west coast of Vancouver Island, British Columbia.

Natural history remarks: In Puget Sound, B. setosus is invariably associated with the anomuran crab Pachycheles rudis, both of which often are found in dead shells of giant barnacles (Balanus nubilis). Individuals observed in California were found in quiet tide pools or in marinas, but were

not especially associated with other invertebrates.



Betaeus setosus



Betaeus setosus

Genus Automate de Man

Automate dolichognatha de Man

Automate dolichognatha de Man, 1888: 529, pl. 22, fig. 5.--Banner and Banner, 1973: 299, fig. 1.-  
-Wicksten, 1981:1104.--; Wicksten, 1984a: 186; Wicksten and Hendrickx, 2003: 65. (see Banner  
and Banner, 1973 and Wicksten, 1981 for more extensive synonymies).

Automate haightae Boone, 1931: 184, fig. 22.

Recognition characters: Central part of anterodorsal margin of carapace recessed above eyestalks, leaving them exposed to near base. Rostrum small, rounded, at times triangular, not reaching to level of frontal margin of carapace. Eyestalks exposed, not covered by carapace, with poorly developed corneal area. Stylocerite reaching nearly to end of first article of antennular peduncle. Scaphocerite moderately broad, spine slightly exceeding blade, reaching to or past middle of second segment of antennular peduncle. Chelae of first pereopods unequal. Large chela compressed, 2.5 x long as broad, palm and fingers subequal, with or without teeth on fingers or gape. Smaller first pereopod about half as long as larger first pereopod, fingers without gape or teeth. Carpus of second pereopod with 5 articles, the second slightly longer than the first and longest of all 5 articles. Pereopod 3 with broad merus, propodus with 5 spinules, dactyl simple. Pereopods 4 and 5 similar to 3, but smaller. Telson with 2 pair dorsolateral spines, 2 pair terminal spines; inner spines of terminal pair much longer than outer spines. Total length 16 mm.

Color in life: Pale translucent yellow to nearly translucent, fingers of chelae dull white to overall creamy yellow.

Habitat and depth: Usually along shore, under rocks, to 20 m.

Range: Circumtropical except for western Africa. In eastern Pacific, from off Santa Catalina Island to Galapagos. Type locality Noordwachter Island, Indian Archipelago (Pulau Tuguan, Indonesia).

Taxonomic remarks: This variable species has been described many times as a separate species. Banner and Banner (1973) compared specimens from many geographic regions and of different sizes and sexes, and found no consistency in the variation of the teeth of the chelae or the gape with age, size or habitat. Molecular studies probably would be the best way to resolve taxonomic questions regarding this species. It is easily recognized in California because it is the only alpheid in which the eyestalks are exposed, not covered by the carapace.

## Genus Synalpheus Bate

### Synalpheus lockingtoni Coutiére

Synalpheus lockingtoni Coutiére, 1909: 21, fig. 1.--Schmitt, 1921: 77, fig. 54.--Standing, 1981: 778.--Wicksten, 1983b: 39.--Wicksten, 1984a: 187.--Jensen, 1995: 44, fig. 71.

Recognition characters: Rostrum slightly longer than lateral orbital spines, reaching end of first segment of antennular peduncle. Stylocerite reaching at least to middle of second segment of antennular peduncle. Scaphocerite with spine greatly exceeding narrow blade, reaching end of third segment of antennular peduncle or beyond. Chelae of first pereopods unequal, large chela with conical tubercle on anterior margin of palm. Carpus of second pereopod with five articles, first article the longest and almost equal to combined lengths of other four articles. Pereopod 3 with bifid dactyl, extensor hook of dactyl about twice as long as flexor hook. Telson with posterolateral angles not prolonged into triangular projections, with 2 pair terminal spines. Total length 30 mm.

Color in life: Blue-green when seen at a short distance. The major chela is green, becoming dark green along the distal end and having orange tips on the cutting edges of the fingers. The minor chela and third maxilliped are mostly translucent with red dot chromatophores and green tips.

The third pereopod is translucent. The rest of the body (carapace, abdomen and pereopods) is translucent and bears numerous small red dots. The posterior margins of the abdominal somites and the tail fan bear yellow setae.

Habitat and depth: Among rocks, worm tubes and kelp holdfasts, intertidal to 550 m. Most specimens have been taken at depths of 15 m or less.

Range: Cordell Bank (38 deg 0.7 min. N, 123 deg. 37 min. W, California Academy of Sciences unpublished record) to Punta Marquez, Baja California Sur, Mexico. Type locality off San Nicolas Island, California.

Taxonomic remarks: Coutière (1909) proposed the name S. lockingtoni to replace the name Alpheus laeviusculus Lockington, 1878, which was a homonym of a tropical Pacific species. However, Lockington's type material (which was destroyed by fire) came from the Gulf of California, not southern California. The description of Lockington's type seems to match S. digueti Coutière, which does not occur in California, U.S.A.. (See Wicksten, 1994 for more details). The type locality of San Nicolas Island, California is given here for the material assigned to S. lockingtoni Coutière.

## Genus Alpheus Fabricius, 1798

### Alpheus clamator Lockington

Alpheus clamator Lockington 1877b: 43.--Kingsley, 1878: 197.--Holmes, 1900: 182, pl. 2, figs. 38-40.--Holthuis, 1952b: 49.--Wicksten, 1984a: 187.--Kim and Abele, 1988: 21, fig. 8.--Wicksten, 1990a: 100.--Wicksten, 1994: 120.--Jensen, 1995: 44, fig. 69.

?Alpheus barbara Lockington, 1878: 471.

Alpheus dentipes: Rathbun 1904: 10 (not Alpheus dentipes Guerin, eastern Atlantic species).

Crangon dentipes: Schmitt, 1921: 74, fig. 50.--Johnson and Snook, 1927: 308, figs. 260, 264.

Crangon clamator: MacGinitie and MacGinitie, 1968: 277, fig. 128.

Recognition characters: Rostrum broadly triangular, reaching to middle of visible part of first segment of antennular peduncle. A sharp tooth on each ocular hood, hoods separated from rostral carina by orbitorostral grooves. Second segment of antennular peduncle the longest, stylocerite not reaching to distal margin of first segment. Scaphocerite with blade shorter than distal spine, spine reaching to distal end of antennular peduncle. Basicerite usually with sharp lateral spine, but may be absent or blunt in some individuals. Major chela of first pereopod with movable finger opening and closing in almost horizontal plane, laterally compressed proximally and bluntly bulbous at tip, palm with superior, palmar and inferior grooves, superior crest distal to transverse groove terminating distally in strong tooth at base of movable finger, entire chela setose. Merus of cheliped without spine at distal end. Minor chela of first pereopod compressed, palm with superior and inferior grooves on outer face, superior transverse depression and tuberculate posterior to superior transverse groove, merus without spine at distal end. Second pereopod with 5 carpal articles, the first of these the longest. Third pereopod stout, with biunguiculate dactylus and propodus bearing 5 pairs movable spines; merus armed with strong immovable tooth near distal end of inferior margin, ischium with one movable spine. Fourth and fifth pereopods similar to third but more slender, fifth lacking meral tooth and spine on ischium. Telson armed with 2 pair dorsal spines and pair lateral spines on each side of convex margin. Total length to 37 mm.

Color in life: Much of body tan to brown, large chela mottled in red-brown and yellow (Chace



and Abbott, 1980, fig. 23.2) Shrimp from California appear to be greenish or brownish when seen at a distance. However, at closer inspection, a more complicated pattern appears. The antennae are translucent orange, with mottled bases. The large chela has a complex pattern of dark brown blotches interspersed with china white patches bearing brown dots, with the tips of the fingers red-orange. The small chela is mostly white with brown dots, with brown patches along the superior margin. The rostrum is bluish and the anterior margin of the carapace pale blue-white. Beyond the anterior margin is a dark rusty brown to red band, followed by an irregular white band and then a large area of yellow to rusty brown over the posterior half of the carapace. The walking legs are pale olive with brown chromatophores. The abdomen is pale olive. The tail fan is edged with golden setae.

Habitat and depth: Tidepools, kelp holdfasts, worm tubes and rocky reefs, intertidal to 10 m.

Range: Dark Gulch, Mendocino County, California to San Bartholome Bay, Baja California.

Type locality Santa Barbara Island, California.

Taxonomic remarks: Alpheus clamator has a lengthy list of synonyms. The original description was presented without illustrations in 1876, but was not published until the following year. Kingsley (1878a) referred specimens to the species. The species later was recorded in a list by Holmes (1900) of crustaceans from California, but Schmitt (1921) incorrectly named Holmes as the author in his account. Lockington (1878) described one of Kingsley's specimens, noted to be damaged in front, as a new species, Alpheus barbara. The latter species supposedly differed from A. clamator in lacking spines on the meri of the third pereopods, having slightly different proportions of the carpal articles of the second pereopod, and lacking spines on the basicerites of the antennae. However, the type specimen of A. barbara has been lost. Examination of a large series of A. clamator suggests that proportions of the carpal articles can be difficult to measure accurately, and that spines on the basicerite can be lacking in A. clamator. Alpheus barbara probably is a synonym of A. clamator (Wicksten, 1990a). The nomenclature of the species was confused during a short time in which the Californian species was considered to be identical with the European A. dentipes. Further examination proved the two to be distinct (Holthuis, 1952). In 1956, the International Commission on Zoological Nomenclature decided to award priority to the generic name Alpheus instead of Crangon, the generic name now used for the coastal or sand shrimps of the family Crangonidae.

#### Alpheus bellimanus Lockington

Alpheus bellimanus Lockington, 1877a: 34.--Rathbun, 1904: 108.--Wicksten, 1983b: 41.--

Wicksten, 1984a: 188.--Kim and Abele, 1988: 13, fig. 5.--Wicksten, 1994: 120.--Jensen, 1995: 44, fig. 70.—Wicksten and Hendrickx 2003: 64.

Crangon bellimanus: Schmitt, 1921: 75, fig. 51.--Johnson and Snook, 1927: 309.

Recognition characters: Rostrum narrowly triangular, not clearly carinate posteriorly and far overreaching middle of visible part of first segment of antennular peduncle. Ocular hoods armed with teeth. Second segment of antennular peduncle the longest, stylocerite almost reaching distal margin of first segment. Scaphocerite with blade reaching to middle of distal spine, spine overreaching distal end of antennular peduncle. Basicerite with sharp lateral spine. Major chela of first pereopod with movable finger opening and closing in obliquely horizontal plane, finger with bulbous tip. Palm with superior, palmar and inferior grooves, strong tooth flanking base of dactyl, notches on superior and inferior margins. Merus of cheliped with 6-10 small movable spines on inferior margin and acute immovable spine at distal end. Minor chela of first pereopod

similar to major chela, but movable finger laterally compressed and forming lamellar expansion. Merus of minor first pereopod with 6-7 movable spines. Carpus of second pereopod with 5 articles, the first by far the longest. Third pereopod slender, with simple dactyl, propodus with 7 movable spines, no tooth at end of merus, ischium with strong movable spine. Fourth and fifth pereopods similar to third, but more slender. Telson with 2 pairs dorsal spines, posterior margin shallowly triangular and armed with pair spines on each lateral margin. Total length to 30.3 mm.

Color in life: Specimens from California range from chestnut-brown to rich scarlet. The major chela is mottled with yellow and tan, with white tips to the fingers. The minor chela is overall orange. The walking legs are lightly banded with red and orange.

Habitat and depth: Among rocks, coralline algae or kelp holdfasts, lowest intertidal zone to 95 m.

Range: Monterey, California to Galapagos Islands, but seldom reported north of Point Conception, California. Type locality San Diego, California. Coutière (1899) reported the species from Chile, but there have been no further reports of the species south of Colombia and the Galapagos Islands.



Alpheus bellimanus

Alpheus californiensis Holmes

Alpheus californiensis Holmes, 1900: 186, pl. 2, fig. 42, pl. 3, figs. 43-44.--Rathbun, 1904: 108.--MacGinitie and MacGinitie, 1968: 276, fig. 127.--Wicksten, 1984a: 188.--Kim and Abele, 1988: 70, fig. 29.

Crangon californiensis: Schmitt, 1921: 76, fig. 52.

Recognition characters: Rostrum sharply triangular, carinate posteriorly and reaching to middle

of visible part of first segment of antennular peduncle. Ocular hoods slightly inflated, without spines. Second segment of antennular peduncle the longest, stylocerite scarcely reaching distal margin of first segment. Scaphocerite with distal spine overreaching distal end of antennular peduncle, blade not reaching to distal end of antennular peduncle. Basicerite with small lateral spine. Major chela of first pereopod with fingers closing vertically, acutely rounded at tip. Palm with superior transverse grooves on each faces, shallow inferior depressions and grooves, superior surface bearing shallow notch and inferior margin produced into shoulder. Merus of major pereopod bearing small spine at distal end. Minor chela of first pereopod sexually dimorphic, in male bearing fringes of setae on both fingers; in female, setose, but without such fringes. Fingers with acute tips, palm bearing grooves and notches similar to major chela, but more shallow. Second pereopod with 5 carpal articles, the first by far the longest. Third pereopod slender, with simple dactyl, propodus with 7 movable spines, merus without tooth or spines, ischium with movable spine or slender spinule. Fourth and fifth pereopods similar to third, but more slender. Telson with 2 pair dorsal spines, posterior margin convex and armed with pair of spines at each lateral margin (Kim and Abele, 1988). Total length 39 mm.

Color in life: Not recorded, but a black-and-white photograph by MacGinitie and MacGinitie (1968, fig. 127) shows the animal to be mostly dark-colored.

Habitat and depth: Shallow rocky areas, burrows in mud of bays.

Range: San Pedro, California to Magdalena Bay, Baja California. Type locality San Pedro, California. Modern records in California mostly come from Newport and San Diego Bays. There are no recent reports of the species in San Pedro, where much of the original shoreline has been developed into the facilities of Los Angeles Harbor.

Natural history remarks: *Alpheus californiensis* often lives in pairs in burrows. The shrimp in San Diego Bay build complex systems of burrows in subtidal mud.

## Family Crangonidae

Sand shrimp, family Crangonidae, have subchelate first pereopods: the finger of the chela closes obliquely or horizontally across the distal end of the propodus, like the blade of a pocket knife. The rostrum usually is small and without spines or absent except in Paracrangon echinata. The second pereopod, if present, is slender and equal on both sides, with an unsegmented carpus. The body is depressed or squat. Often, ovigerous females have a broader body than males.

In species of Crangon, spines may be present on the ventral midline of the abdominal somites. The endopod of the pleopods is short, especially on the second to fifth pleopods.

The nomenclature of the crangonids has undergone revision in recent years, and specialists still disagree over generic and subgeneric classification. (See Zarenkov, 1965; Christofferson, 1988b). Schmitt (1921) used the generic name Crago for many common names, and applied the name Crangon to species of snapping shrimp, now called Alpheus. The sand shrimps officially were named Crangon by a ruling of the International Commission on Zoological Nomenclature (1955-56). Revisions by Zarenkov (1965), Kuris and Carlton (1977) and Christofferson (1988b) changed additional designations.

The northern Pacific is recognized as being rich in crangonid shrimp. Species of Mesocrangon and Lissocrangon are confined to the northern Pacific; species of Metacrangon, Crangon, Argis and Neocrangon are more common in the northern Pacific than anywhere else. Parapontophilus occidentalis belongs to a widespread deep-sea genus. A second species of Paracrangon occurs off the west coast of Central America.

Species of Crangon, Mesocrangon, Lissocrangon and Neocrangon are mostly benthic and able to dig into sand. Many remain hidden except for the eyes, antennae and a respiratory channel. Most are dull-colored or camouflaged by chromatophores. They feed on smaller invertebrates. A parasitic isopod, Argeia pugettensis, forms a bulge in the carapace next to the branchial chamber. Sand shrimp are eaten by many demersal fishes, Dungeness crab and harbor seals.

In using the key, the reader should be aware that best results will be obtained with fresh specimens. Diagnostic color marks usually fade in alcohol. In older preserved specimens, dorsal faint carinae and ventral sulci often are difficult to see. Pubescence is lost in preserved specimens or rubbed off in trawled material.

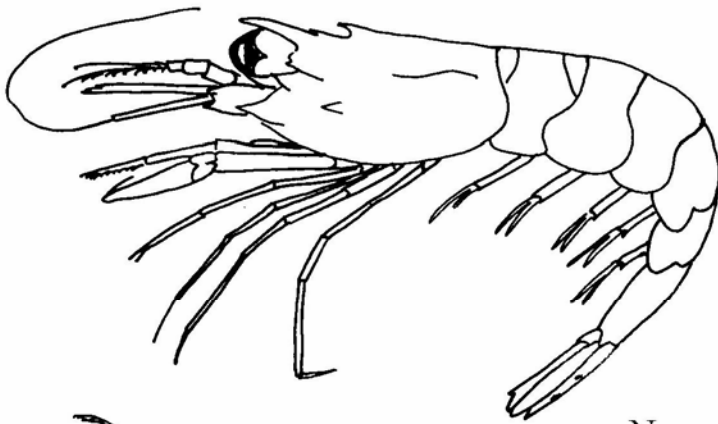
### Key to Species of the Family Crangonidae

1. Second pereopod absent, rostrum elevated, with 4 spines-----Paracrangon echinata Dana  
    Second pereopod present (although sometimes very short)-----2
2. Second pereopod much shorter than other pereopods, eyes nearly without pigment-----  
-----Parapontophilus occidentalis Faxon  
    Second pereopod subequal in length to other pereopods, eyes with obvious pigment-----3

|   |                                       |
|---|---------------------------------------|
| 3. Dactyli of fourth and fifth pereopods flattened, eyes partially concealed by dorsal frontal margin of carapace-----  | 4                                     |
| Dactyli of fourth and fifth pereopods normal, stout to slender; eyes not partially concealed by dorsal frontal margin of carapace -----   | 5                                     |
| 4. Carapace with 2 median spines behind anterior margin, first and second abdominal segments not carinated. (Found south of Point Conception, California)-----                        | <u>Argis californiensis</u> (Rathbun) |
| Carapace with 3-4 median spines behind anterior margin, first to fourth abdominal segments not carinated. (Found from Shelter Cove, California northward)-----                        | <u>Argis levior</u> (Rathbun)         |
| 5. Three to four median dorsal spines on carapace, pleura of second to fifth abdominal somites with posteroventral spines, shell heavily sculptured-----                              | <u>Rhynocrangon alata</u> (Rathbun)   |
| None to two median dorsal spines on carapace, pleura of fifth or sixth abdominal somites only with posteroventral spines (if present at all), shell smooth or lightly sculptured----- | 6                                     |
| 6. Carapace with 2 median dorsal spines-----  | 7                                     |
| Carapace with 1 or no median dorsal spines-----   | 15                                    |
| 7. Carapace without submedian spines-----   | 8                                     |
| Carapace with submedian spines-----   | 10                                    |
| 8. Eyes very large. Exoskeleton noticeably thin. (Usually on lower continental shelf and deeper)-----   | <u>Neocrangon abyssorum</u> (Rathbun) |
| Eyes of moderate size. Exoskeleton not noticeably thin. (Usually on continental shelf)-----   | 9                                     |
| 9. Fifth abdominal somite with broad dorsal carina -----  | <u>Neocrangon communis</u> (Rathbun)  |
| Fifth abdominal somite without broad dorsal carina -----  | <u>Neocrangon resima</u> (Rathbun)    |
| 10. Second lateral carina of carapace armed with spine slightly behind superior lateral spine. (Small, adults 25 mm or less in total length)-----                                     | <u>Mesocrangon munitella</u> (Walker) |
| Second lateral carina of carapace not armed with spine slightly behind superior lateral spine. (Usually larger than 25 mm in total length)-----                                       | 11                                    |
| 11. First to fourth abdominal somites smooth-----   | 12                                    |
| First to fourth abdominal somites carinated-----  | 13                                    |
| 12. Anterior median spine on carapace obliquely erect, larger than posterior, tip of former extending beyond orbital margin-----  | <u>Metacrangon acclivis</u> (Rathbun) |

- Anterior median spine on carapace not obliquely erect, not larger than posterior, tip of former well behind orbital margin-----Metacrangon munita (Dana)
13. First to third abdominal somites laterally unarmed-----Metacrangon variabilis (Rathbun)
- First to third abdominal somites laterally armed-----14
14. First to third abdominal pleura armed laterally with one spine each-----  
-----Metacrangon procax (Faxon)
- First to third abdominal pleura armed laterally with two spines each-----  
-----Metacrangon spinosissima (Rathbun)
15. Carapace without median dorsal spine-----Lissocrangon stylirostris (Holmes)
- Carapace with median dorsal spine-----16
16. Sixth abdominal somite with ventral sulcus-----17
- Sixth abdominal somite without ventral sulcus-----21
17. Hand of first pereopods very slender, 4X long as wide, flexed dactylus almost longitudinal---  
-----Crangon franciscorum (Stimpson)
- Hand of first pereopods not as slender, 3.5X long as wide or less, flexed dactylus not forming angle less than 45° with propodal margin-----18
18. Fifth abdominal somite not carinate. Blade of scaphocerite with anterior margin more advanced at inner than at outer angle. (Usually with large circular spot on sixth abdominal somite)-----Crangon nigromaculata (Lockington)
- Fifth abdominal somite carinate. Blade of scaphocerite with anterior margin more advanced at antero-internal angle. (No large circular spot on sixth abdominal somite)-----19
19. Scaphocerite broad and short, 0.5X carapace length or less, fifth abdominal somite with weak dorsal carina-----Crangon handi Kuris and Carlton
- Scaphocerite longer and more narrow, 0.66 X carapace length or more, fifth abdominal somite with noticeable dorsal carina-----20
20. Tip of scaphocerite narrow, spine long and exceeding blade, finger of hand at about 45° angle to hand-----Crangon alaskensis Lockington
- Tip of scaphocerite broad, spine generally shorter and barely exceeding blade, finger of hand at about 30° angle to hand-----Crangon nigricauda (Stimpson)
21. Hands of first pereopods stout, 2.25X long as wide, anterior margin more longitudinal than transverse. Antepenultimate segment of third maxillipeds greatly dilated--Crangon alba Holmes

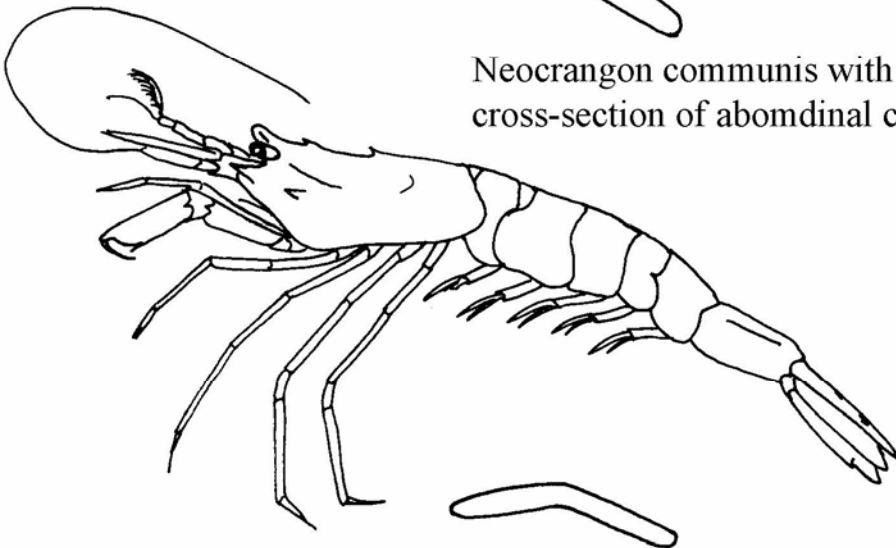
Hands of first pereiopods elongate, 3X long as wide, anterior margin more longitudinal than transverse. Antepenultimate segment of third maxillipeds not dilated-----  
-----Crangon holmesi Rathbun



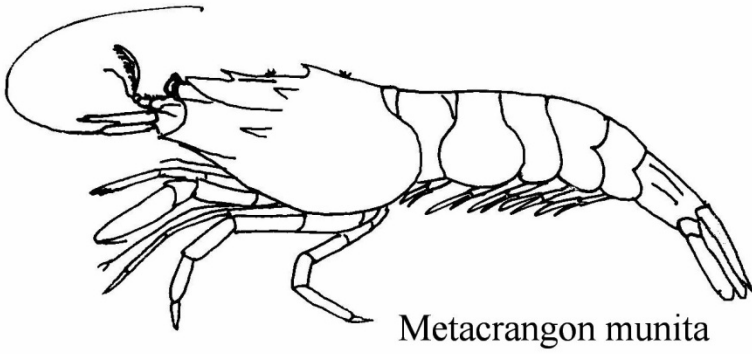
Neocrangon abyssorum



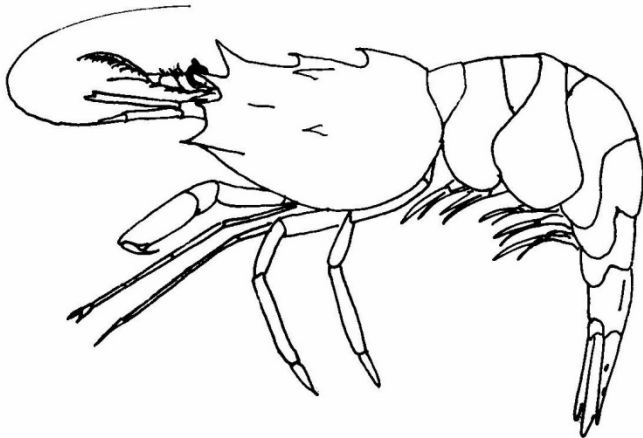
Neocrangon communis with  
cross-section of abdominal carina



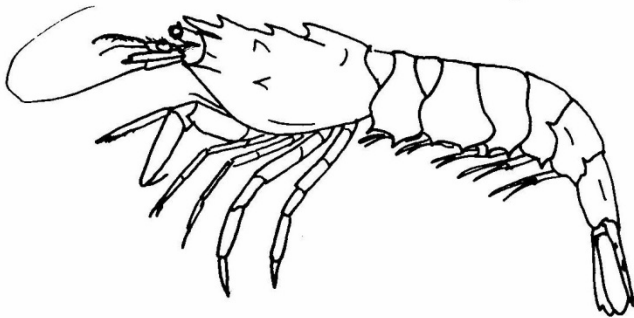
Neocrangon resima with cross section of  
abdominal carina



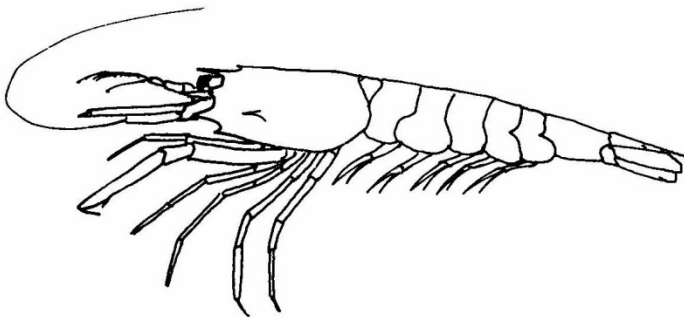
Metacrangon munita



Metacrangon acclivis

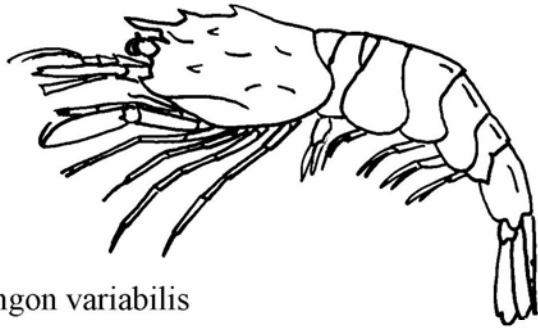


Metacrangon spinosissima

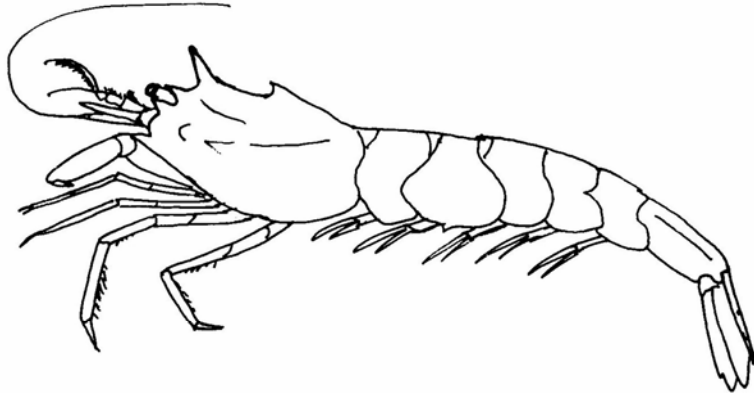


Crangon franciscorum

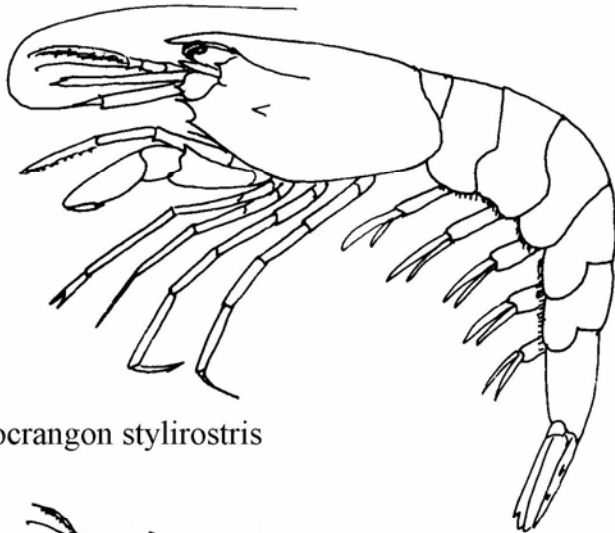




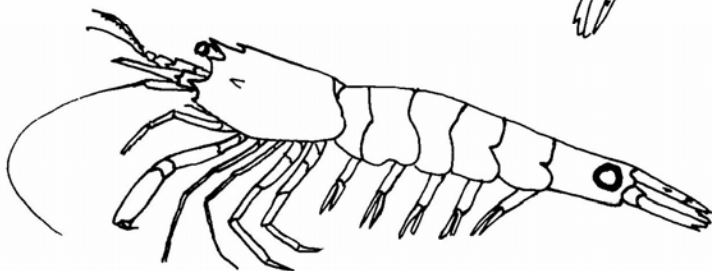
*Metacrangon variabilis*



*Metacrangon procax*



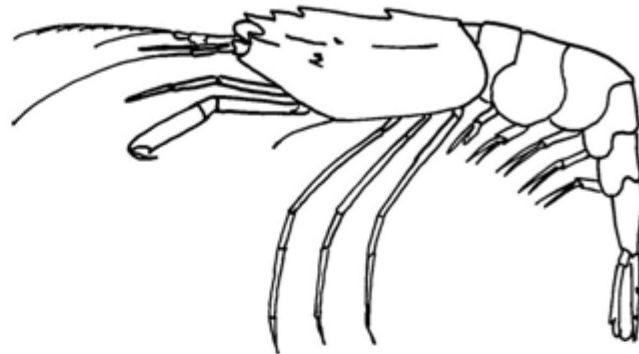
*Lissocrangon stylirostris*



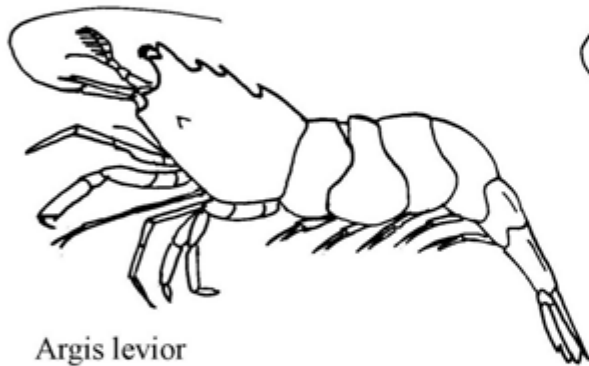
*Crangon nigromaculata*



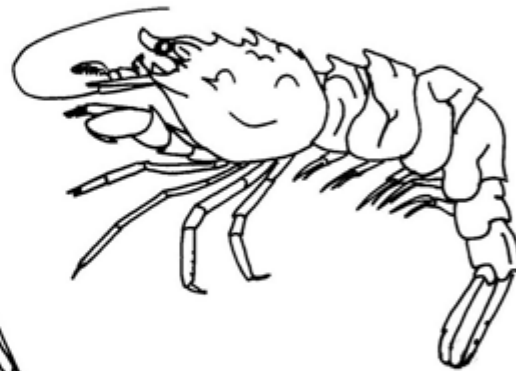
*Paracrangon echinata*



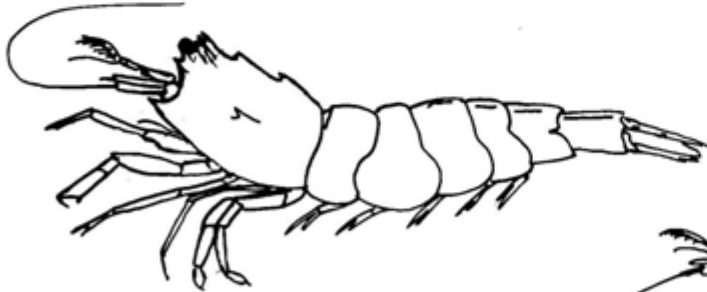
*Parapontophilus occidentalis*



*Argis levior*



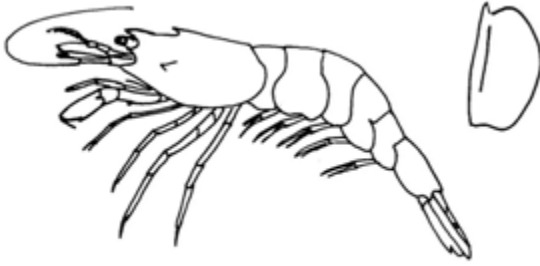
*Rhynocrangon alata*



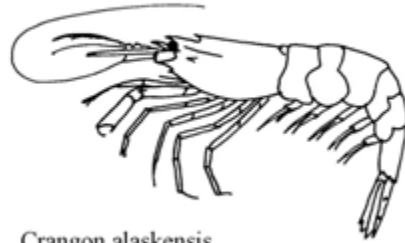
*Argis californiensis*



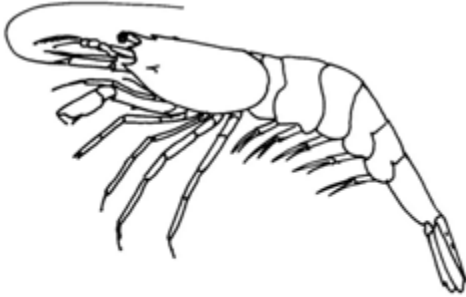
*Mesocrangon munitella*



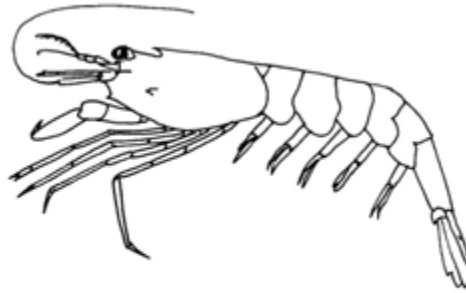
Crangon handi and scaphocerite



Crangon alaskensis



Crangon nigricauda



Crangon alba



Third maxillipeds:  
left, *C. alba*;  
right, *C. holmesi*

Genus Paracrangon Dana, 1852

Paracrangon echinata Dana

Paracrangon echinatus Dana, 1852a: 20.--Dana, 1852b: 538, pl. 33, fig. 6.--Holmes, 1900: 176, pl. 2, figs. 36,37.

Paracrangon echinata: Rathbun, 1904: 103.--Schmitt, 1921: 103, fig. 72.--Johnson and Snook, 1927: 314.--Kobyakova, 1937: 139.--Kozloff, 1974: 164.--Butler, 1980: 75, pl. 2D.--Jensen, 1995: 39, fig. 54.

Recognition characters: Rostrum long, carapace length in male and 0.6-0.8 X carapace length in female, with one moderate dorsal tooth near middle; anterior margin with 1 tooth near tip and long curved tooth at base. Carapace with 4 median dorsal teeth on median carina, anterior teeth smaller than posterior; strong antennal spine, massive and flared branchiostegal spine, strong pterygostomial spine; dorsolateral surfaces carinated forming irregular quadrangular spines with spines at angles of the carinae; deep sulcus from base of posterior median spine across cardiac region. Eyes of moderate size. Peduncle of first antenna long, overreaching carapocerite, stylocerite short, tip rounded. Scaphocerite of second antenna not exceeding second segment of peduncle of first antenna, blade exceeding spine. Third maxilliped long and slender, distal spine on proximal segment, exopod present. First pereopods about as long as third maxilliped, dactylus of subchela closing obliquely, merus with distal spine. Second pereopod absent. Third-fifth pereopods similar, longer than first pereopod, slender, dactyls with acute tips. Abdominal somites carinate behind second somite, third carina especially high, dorsolateral surfaces of pleura 1-5 each with 2 vertical sulci, pleura 1-5 having strong lateral spines. Pleura of sixth somite with 2 median dorsal carinae, midlateral spine, lower lateral, posteroventral and posterodorsal spines. Pleura of male with lateral sternal spines; in female, spines absent. Telson with 2 median dorsal spines and 3 pairs dorsolateral spines. Male total length 44 m, female 65. Color in life: Light brownish gray, generally overlaid with small brown or black spots (Butler, 1980, pl. 2D); mottled brown and translucent or yellowish.

Habitat and depth: Mixed or rocky bottoms, 7-201 m.

Range: Port Etches, Alaska to La Jolla, California; Sea of Okhotsk, Sea of Japan to Korea Strait, Sagami Bay. Type locality Puget Sound.

Natural history remarks: Live animals often assume the cataleptic position--resting with the pereopods against the bottom and the abdomen flexed upward at a nearly 45° angle.

Genus Parapontophilus Christoffersen, 1988

Parapontophilus occidentalis Faxon

Pontophilus occidentalis Faxon, 1893: 200.--Faxon, 1895: 131, pl. D, figs. 2, 2a-2d.--Wicksten, 1977a: 963.

Pontophilus gracilis occidentalis: Chace, 1984: 48.--Wicksten, 1989b: 31.--Wicksten and Hendrickx, 2003: 69.

Parapontophilus occidentalis.-- Komai 2008: 287, figs. 8, 20D.

Recognition characters: Rostrum not reaching end of cornea of eye, with 2 pair lateral teeth. Carapace with dorsal carina, one dorsal spine past midline and 2 spines behind rostrum, lateral

carina with 1 hepatic spine at mid-body, antennal and pterygostomial spines present. Eyes large, colorless and unfaceted. Antennular peduncle about 0.5X length of scaphocerite. Scaphocerite long and narrow, blade about as long as spine. First pereopods subchelate, about as long as scaphocerite, finger of chela closing nearly horizontally to propodus. Second pereopods short and chelate, not reaching end of merus of first pereopod. Third to fifth pereopods long and slender. Abdominal somites without carinae or spines on pleura. Telson long, exceeding uropods. Total length 60 mm.

Color in life: Mostly scarlet, carapace brownish (Faxon, 1895, pl. D, fig. 2).

Habitat and depth: Deep-sea mud, 1789-4082 m.

Range: Off San Clemente Island, California to off Peru. Type locality off Cocos Island, Costa Rica.

Taxonomic remarks: Chace (1984) considered the eastern Pacific specimens to belong to a subspecies of the cosmopolitan deep-sea shrimp Pontophilus gracilis rather than a separate species. However, Christoffersen (1988c) confined the usage of the genus Pontophilus Leach, 1817 to species of the north Atlantic and transferred related species in the Pacific to the genus Parapontophilus. Komai (2008) reviewed the species of this genus world-wide and concluded that Parapontophilus occidentalis is indeed a distinct species.

#### Genus Argis Kröyer, 1842

##### Argis californiensis (Rathbun)

Nectocrangon californiensis Rathbun, 1902: 24.--Rathbun, 1904: 140, figs. 80, 81.--Schmitt, 1921: 71.--Zarenkov, 1965: 1764.

Argis californiensis: Wicksten, 1976:57.-- Wicksten, 1977a: 964, fig.1.--Wicksten 1989b: 313.

Recognition characters: True rostrum absent, but rostral spine adjacent to frontal margin. Carapace with 2 dorsal spines posterior to rostral spine, branchiostegal and pterygostomial spines, hepatic spine on each side. Eyes small, partly concealed by hood formed by fusion of rostral, postorbital and antennal spines. Antennular peduncle shorter than scaphocerite, stylocerite short. Scaphocerite with spine only slightly exceeding blade. Third maxilliped with distal segment flattened, with exopod. First pereopod with dactylus closing obliquely against propodus. Second pereopod slender and chelate. Third pereopod slender with acute dactylus. Fourth and fifth pereopods stout, dactyls flattened. First and second abdominal somites not carinated, third and fourth feebly carinated, fifth strongly carinated, sixth with 2 carinae each ending in sharp tooth. Abdominal pleura 1-4 rounded, fifth pleuron ending in spine. Telson overreaching uropods, with 3 pair dorsolateral spines and acute apex. Female with more inflated carapace and more elevated eye tubercle than male. Total length to 62 mm.

Color in life: Not recorded.

Habitat and depth: Sand, rocks and shell, 20-259 m.

Range: Off Santa Rosa Island, California to off Punta Banda, Baja California. Type locality off Santa Catalina Island, California.

Natural history remarks: Like other species of Argis, A. californiensis probably is a burrower that uses its flattened appendages to dig into the sand. The eyes remain above the surface of the sand. Once thought to be endemic to the offshore islands of southern California, A. californiensis now is known from off Port Hueneme and San Diego. Its distribution seems to be

governed at least in part by the availability of the coarse shelly sand in which it lives. A record of the species (as Nectocrangon californiensis) southwest of the Columbia River, Oregon (McCauley, 1972) probably is due to a misidentification of another species of Argis.

### Argis levior (Rathbun)

Nectocrangon levior Rathbun, 1902: 892.--Rathbun, 1904: 143, figs. 86, 87.--Zarenkov, 1965: 1764.

Argis levior: Kozloff, 1974: 164.--Wicksten, 1976: 56, fig. 1.--Butler, 1980: 89

Recognition characters: Rostral spine short. Carapace with 3 dorsal spines posterior to rostral spine, branchiostegal and pterygostomial spines, hepatic spine on each side. Eyes small, partly concealed by hood. Antennular peduncle not as long as scaphocerite. Spine of scaphocerite slightly exceeding blade. Distal segment of third maxilliped flattened, with exopod. First pereopod subchelate, dactylus closing obliquely against propodus. Second pereopod slender, chelate. Third pereopod slender, dactylus slender and acute. Fourth and fifth pereopods stout, dactyls flattened. Abdominal somites 1-4 without carinae, fifth weakly carinate, sixth with 2 dorsal carinae; pleura rounded except for weak posterolateral spine on fourth pleuron. Telson about as long as uropods, with 3 pairs dorsolateral spines and acute tip. Female total length 47 mm.

Color in life: Not recorded.

Habitat and depth: Sand, boulders and shell, 18-77 m.

Range: Aleutian Islands to Shelter Cove, Humboldt County, California. Type locality Admiralty Inlet, Puget Sound.

### Genus Rhynocrangon Zarenkov, 1965

#### Rhynocrangon alata (Rathbun)

Sclerocrangon alata Rathbun, 1902: 891.--Rathbun, 1904: 134, fig. 72, 73.--Kozloff, 1974: 164.--Wicksten, 1980: 38.

Rhynocrangon alata: Zarenkov, 1965: 1764.--Butler, 1980: 93.--Jensen, 1995: 42, fig. 63.

Recognition characters: Body stout, shell thick and knobby. Rostrum short, about 0.5 carapace length, with broad base, curved concavely from base to apex. Carapace with 2 dorsal spines arising from median carina, antennal, branchiostegal and weak pterygostomial spines, hepatic spine on each side. Eyes small and exposed. Antennular peduncle not as long as scaphocerite. Spine of scaphocerite slightly exceeding blade. Third maxilliped long and stout, with exopod. First pereopod with sharp distal spine on carpus, dactylus of subchela closing transversely across propodus. Second pereopod slender and chelate. Third pereopod slender, dactylus slender and acute. Fourth and fifth pereopods stout, dactyls slender and acute. First and second abdominal somites with large median dorsal tubercles, third somite with high median carina with posterior projection, fourth and fifth each with median dorsal carina, projected posteriorly as blunt spine; pleura rounded or obtuse. Telson shorter than uropods, with 2 pairs minute dorsolateral spines and acute tip. Male total length 44 mm, female 45.

Color in life: Variable, mottled with brown and rose-pink patches (Jensen, 1995).

Habitat and depth: 11-167 m, on hard rocks or shale.

Range: Peter the Great Bay, U.S.S.R.: Akutan Island, Bering Sea to Santa Barbara Channel, (34° 25'N, 120°, 18'W), California. Type locality Admiralty Inlet, Puget Sound.

Genus Neocrangon Zarenkov, 1965

Neocrangon abyssorum (Rathbun)

Crangon abyssorum Rathbun, 1902: 890.--Rathbun, 1904: 125, fig. 66.--Butler 1980: 112.--Krygier and Percy, 1981: 89.

Crago abyssorum: Schmitt, 1921: 97, fig. 65.

Crangon (Neocrangon) abyssorum: Zarenkov, 1965: 1762.--Birshtein and Zarenkov, 1972: 441.

Neocrangon abyssorum: Kuris and Carlton, 1977: 554.

Recognition characters: Exoskeleton very thin. Rostrum short, ascending, narrow, tip acute. Carapace with 2 median dorsal spines, anterior one smaller than posterior; strong antennal, branchiostegal and hepatic spines, weak pterygostomial spine. Eye large, cornea well developed, both eyes contiguous. Antennular peduncle shorter than 0.5x scaphocerite. Scaphocerite slender, spine exceeding blade. Third maxilliped long and slender, exopod present. First pereopod stout, dactyl closing obliquely across propodus, merus and carpus each with strong distal spine. Second pereopod very slender, chelate. Third to fifth pereopods slender, with simple, slightly flattened dactyls. First to fifth abdominal somites smooth, sixth with 2 dorsal carinae, pleura with more or less rounded or obtuse margins. Telson narrow, with acute tip, median dorsal sulcus, 2 pairs dorsolateral spines, exceeding uropods. Male total length 64 mm, female 63.

Color in life: Not recorded.

Habitat: Benthic, 97-2975 m, but usually deeper than 1200 m off California.

ange: East of Kurile Islands, east coast of Japan, Bering Sea to Cortez Bank, California. Type locality Bering Sea, southwest of Pribilof Islands.

Neocrangon communis (Rathbun)

Crangon communis Rathbun, 1902: 889.--Rathbun, 1904: 124, fig. 65.--Kozloff, 1974: 164.--Butler, 1980: 110.

Crago communis: Schmitt, 1921: 95, fig. 63.

Sclerocrangon communis: Kobayakova, 1937: 136.

Crangon (Neocrangon) communis: Zarenkov, 1965: 1762.

Neocrangon communis: Kuris and Carlton, 1977: 554.--Wicksten, 1996:39, fig. 1 d-f.

Neocrangon resima: Green and Butler, 1988: 1, fig. 1 (misidentification).

Recognition characters: Exoskeleton thin, pubescence on anterior part of carapace and in abdominal sulci. Rostrum usually short, rounded., rising at low angle from midline of carapace; rarely rising at a sharp angle and having a ventral plate. Carapace with 2 median dorsal spines, moderate antennal, strong branchiostegal and hepatic, and weak pterygostomial spines. Antennular peduncle short, less than 0.5X length of scaphocerite. Scaphocerite narrow, spine exceeding blade. Third maxilliped long and slender, with exopod. First pereopod with dactylus closing obliquely transverse across propodus, merus with distal spine, carpus with 2 weak distal spines. Second pereopod shorter than first, slender and chelate. Third to fifth pereopods slender,

with simple, slender dactyls. First and second abdominal somites smooth, third to fifth with wide median dorsal carina, sixth with 2 median dorsal carinae. Pleura of fourth and fifth somites with posteroventral spine each. Telson slightly exceeding uropods, with median sulcus, 2 pairs dorsolateral spines, rounded tip. Male total length 61 mm, female 80.

Color in life: Medium gray over most of body, uniform brown over branchial region, overlaid with pale yellow spots, fine brown to charcoal dots over rest of carapace, abdomen with brown spots and blotches and light yellow spots, spots and patches of magenta to rust on pereopods and telson (Butler, 1980, plate 5D). Specimens from California are dull brick red.

Habitat and depth: Mud bottoms, 16-1537 m.

Range: Sea of Japan, east coast of Honshu Island, Chukchi Sea, Bering Sea to San Diego, California, but usually north of Point Conception, California. Type locality off Pribilof Islands, Bering Sea.

### Neocrangon resima (Rathbun)

Crangon resima Rathbun, 1902: 889.--Rathbun, 1904: 124, fig. 65.--Kozloff, 1974: 164.--Butler, 1980: 97.

Crago resima: Schmitt, 1921: 96, fig. 64.--Goodwin, 1952: 394.

Crago zacaе Chace, 1937: 136, fig. 9.

Crangon (Neocrangon) resima: Zarenkov, 1965: 1762.

Neocrangon resima: Kuris and Carlton, 1977: 554.--Wicksten, 1996:39, fig. 1 a-c.—Wicksten and Hendrickx 2003: 69.

Crangon ?(Neocrangon) zacaе: Zarenkov, 1965: 1764.

Neocrangon zacaе: Kuris and Carlton, 1977: 554.--Wicksten, 1980: 39.

Recognition characters: Rostrum highly variable: often slightly ascending, narrow, shorter than cornea of eyes; in some specimens ascending to sharp apex or having a ventral plate with 0-4 small spines. Eyes of moderate size. Carapace with 2 median dorsal spines, the anterior of these the smaller of the two, weak antennal and strong branchiostegal and hepatic spines, no pterygostomial spine. Antennular peduncle short, less than 0.5X scaphocerite. Scaphocerite broader near base than at apex of blade, spine exceeding blade. Third maxillipeds slender, with exopod. First pereopod with 1 strong and 1 weak meral spine, carpus with 2 weak distal spines, dactylus closing obliquely across propodus. Second pereopods slender and chelate. Third to fifth pereopods long and slender, dactyls simple. Abdominal somites smooth to very weakly carinate except for sixth, which bears 2 dorsal carinae. Pleura rounded except for fourth and fifth, which bear posterolateral spines. Telson shorter than or about as long as uropods, with 2 pair dorsolateral spines. Male total length 55 mm, female total length 20-70 mm .

Color in life: Body semi-translucent, mottled with greenish brown and scarlet on dorsal and lateral surfaces, ventral surface white, antennae banded with scarlet and white.

Habitat and depth: Muddy, sandy and rocky bottoms, 28-491 m.

Range: Monterey Bay, California to north of Gorgona Island, western Colombia). Type locality off San Diego, California.

Taxonomic remarks: Until recently, it was thought that N. resima could be recognized by a distinctive raised rostrum with a ventral plate. However, this shape seems to occur in less than 10% of the population,. The shape of the rostrum and its angle relative to the carapace is highly variable and not a reliable feature for identification. See Wicksten, 1996 for illustrations and a discussion.



Genus Mesocrangon Zarenkov, 1965

Mesocrangon munitella (Walker)

Crangon munitellus Walker, 1898: 275, pl. 16.--Holmes, 1900: 176.--Kozloff, 1974: 164.--Wicksten, 1980: 39.--Wicksten, 1983b: 51.

Crangon munitella: Rathbun, 1904: 132.

Crago munitella: Schmitt, 1921: 101, fig. 70.--Johnson and Snook, 1927: 314.

Mesocrangon ?munitella: Zarenkov, 1965: 1762.

Mesocrangon munitella: Butler, 1980: 121.--Carvacho and Olson 1984: 65.--Wicksten and Hendrickx, 2003: 69.--Jensen, 1995: 39, fig. 56.

Recognition characters: Body stout, depressed. Shell thick. Rostrum short, broad and rounded. Carapace with 2 median dorsal spines, submedian spine ahead of midcarapace, lower submedian spine, moderate hepatic spine, each with supporting carina; also moderate antennal, strong branchiostegal and weak pterygostomial spines. Eye moderately large. Antennular peduncle short. Scaphocerite broad, blade exceeding spine. Third maxilliped long, with exopod. First pereopod stout, dactylus closing obliquely across propodus. Second pereopod long, slender and chelate. Third pereopod slender, with simple dactylus, fourth and fifth pereopods stout, with slightly flattened dactyls. Only sixth abdominal somite with flat dorsal median carina; all pleura rounded. Telson shorter than uropods, with 2 pairs dorsolateral spines, rounded tip. Female total length 23 mm.

Color in life: Variable; camouflaged like shell and gravel; mottled brown with white dorsal markings, dark slate, banded with slate, center of body red, banded with slate and red.

Habitat and depth: Sand, rock and shell, 2-94 m.

Range: Goose Island, Queen Charlotte Sound to off Thurloe Head, Baja California, Mexico; San Francisquito Bay and off Tiburon Island, Gulf of California. Type locality Puget Sound.

Genus Metacrangon Zarenkov, 1965

Metacrangon acclivis (Rathbun)

Crangon acclivis Rathbun, 1902: 890.--Rathbun, 1904: 129, fig. 68.--Kozloff, 1974: 164.

Crago acclivis: Schmitt, 1921: 98, fig. 67.

Metacrangon acclivis: Zarenkov, 1965: 1764.--Butler, 1980: 113.

Recognition characters: Rostrum slender, ascending at 45° angle, with rounded apex. Carapace with anterior median spine obliquely erect, larger than posterior spine and extending beyond orbital margin; submedian and hepatic spines with supporting carinae, also antennal and branchiostegal spines; gastric region depressed. Eyes pigmented, cornea with tubercle. Antennules and antennae extremely setose. Scaphocerite with blade longer than spine. Third maxilliped setose, with exopod. First pereopod with subchela, dactyl closing obliquely and nearly vertically against propodus. Second pereopod slender and chelate, third pereopod slender and simple, pereopods 4-5 sturdy, setose, with flattened dactyls. First to fourth abdominal somites

without dorsal carinae and with rounded margins. Fifth abdominal somite with pleuron having posterolateral point. Sixth somite with 2 dorsal carinae. Telson with 2 pair dorsolateral spines and nearly same length as uropods. Total length to 27.5 mm .

Color in life: Not recorded.

Habitat and depth: Continental shelf and slope, among rocks, pebbles and coarse sand, 118-491 m.

Range: Trinity Islands, Alaska to 8 mi. west of Cedros Island, Baja California, Mexico (Velero III sta. 1253-41). Type locality off Santa Cruz Island, California.

### Metacrangon munita (Dana)

Crangon munitus Dana, 1852: 536.--Dana, 1855: pl. 33, fig. 5.

Crangon munita: Rathbun, 1904: 127, fig. 67.--Kozloff, 1974: 165.

Crago munita: Schmitt, 1921: 98, fig. 66.--Johnson and Snook, 1927: 314.

Metacrangon munita: Zarenkov, 1965: 1764.--Butler, 1980: 119.--Jensen, 1995: 39, fig. 56.

Recognition characters: Body short, exoskeleton thick and rugose. Rostrum shorter than eyes, apex rounded. Carapace with 2 median spines, submedian and hepatic spines strong and with supporting carinae, branchiostegal strong, pterygostomial weak; gastric region depressed. Eyes short and pigmented. First and second somites of antennular peduncle broad, third very short; stylocerite short. Scaphocerite with blunt blade exceeding spine, basicerite with 2 lateral spines. Third maxilliped setose, with exopod. First pereopod stout, subchelate, carpus with distal spine; dactyl when flexed obliquely transverse. Second pereopod long and slender, chelate. Third pereopod long and slender, dactyl slender and simple. Pereopods 4 and 5 stout and setose, dactyls flattened. Pleura of abdominal somites 1-4 rounded, fifth pleuron with blunt posterolateral spine and faint median dorsal carina, sixth with 2 dorsal median carinae and strong posterodorsal spine, flared posteroventral parts. Telson with median groove, 2 pair dorsolateral spines, slightly longer than uropods. Male total length 33 mm, female 48.

Color in life: Bases of antennae, most of carapace and anterior half of abdomen china white, rest of carapace and abdomen dark brown. Tail fin ending in mottled white band (Jensen, 1995, color photograph) .

Habitat and depth: Continental shelf, on mixed sand and shell, 13-230 m.

Range: Port Etches, Alaska to San Miguel Island, California. Type locality Puget Sound.

### Metacrangon variabilis (Rathbun)

Crangon variabilis Rathbun, 1902: 890.--Rathbun, 1904: 129, fig. 69.--Kozloff, 1974: 165.

Crago variabilis: Schmitt, 1921: 99, fig. 68.

Metacrangon variabilis: Zarenkov, 1965: 1764.--Birshtein and Zarenkov, 1972: 441.--Butler, 1980: 117.--Wicksten, 1989b: 313.

Recognition characters: Exoskeleton thick. Rostrum short, not exceeding eye, apex rounded. Carapace with 2 median spines, the anterior slightly larger; submedian spine moderate, hepatic strong with supporting carina, branchiostegal strong and with supporting carina, pterygostomial weak, gastric region depressed. Eyes large and pigmented. First segment of antennular peduncle long, with distolateral spine, second shorter, with spine, third shortest, also

with spine. Scaphocerite with spine equal to or longer than blade. Third maxilliped setose, with exopod. First pereopod stout, merus and carpus each with 2 distal spines, subchelate, dactyl when flexed obliquely transverse. Second pereopod slender, chelate, third slender, with simple dactyl, pereopods 4 and 5 stout, setose, with flattened dactyls. Abdominal somites 1-4 with pleura rounded, somites 1-5 with single median dorsal carina; somite 5 with posterolateral spine, somite 6 with 2 prominent dorsal carinae, posteroventral regions strongly flared. Telson with median dorsal groove, 2 pairs lateral spines, about as long as inner uropod. Female total length 38 mm.

Color in life: Transparent with grayish tinge, fine orange-brown and gray-brown chromatophores over body (Butler, 1980, color plate 5F).

Habitat and depth: Continental shelf and slope, 92-1271 m.

Range: Commander and Pribilof Islands, Bering Sea to San Nicolas Island, California. Type locality off North Head, Akutan Island, Alaska.

### Metacrangon procax (Faxon, 1893)

Sclerocrangon procax Faxon, 1893:199.—Faxon 1895:135, pl. 36.

Crago lomae Schmitt, 1921: 100, pl. 12, figs. 3-4.

Crangon lomae: Wicksten, 1980a: 39.-- Wicksten, 1989b: 313.

Metacrangon lomae: Zarenkov, 1965: 1764.—Méndez 1981: 122, figs. 357, 358, pl. 67.—Wicksten 1989: 303, 304, 313.

Metacrangon procax: Komai 1997: 672, fig. 10.—Wicksten and Hendrickx 2003: 69.

Recognition characters: Rostrum short, with tip rounded. Anterior median spine of carapace acutely pointed, nearly erect, nearly as long as rostrum, small denticle between anterior and posterior median carapace spines. Carapace with antennal and branchiostegal spines, hepatic and submedian spines with supporting carinae. Eyes pigmented. First and second segments of antennular peduncle with lateral spine each. Scaphocerite with spine much longer than blade and separated from it by deep incision for about distal 0.25X of length. Third maxilliped setose, with exopod. First pereopod subchelate, with dactyl closing obliquely against propodus. Second pereopod slender, chelate; third pereopod slender with simple dactyl, pereopods 4-5 stout and setose, with flattened dactyls. First and second abdominal somites with weak dorsal carinae, third to fifth somites with carinae on at least part of dorsal midline, sixth with 2 carinae. Ventral surfaces of abdominal somites sexually dimorphic: male with abdominal pleura 1-3 with prominent acute median spine, fourth somite with blunt spine, fifth somite with low tubercle, sixth ventrally unarmed; female with abdominal somites unarmed except for small tubercle between pleopods of fifth somite. Telson with 3-4 pair dorsolateral spines, apex acute, exceeding inner branch of uropods. Male total length 35 mm, female total length 44.

Color in life: Not reported.

Habitat and depth: Continental slope, 800-1629 m.

Range: San Miguel Island and off Point Loma, California to off Atico, Peru. Type locality not specified; type specimens came from off Malpelo island, off Acapulco and in the Gulf of California.

### Metacrangon spinosissima (Rathbun)

Crangon spinosissima Rathbun, 1902: 891.--Rathbun, 1904: 130, fig. 70.

Crago spinosissima: Schmitt, 1921: 100, fig. 69.

Metacrangon spinosissima: Zarenkov, 1965: 1764.--Butler, 1980: 115.

Recognition characters: Exoskeleton thick. Rostrum shorter than eye, with acute or rounded apex. Carapace with anterior median spine larger than posterior, the 2 joined by median carina, also submedian and subhepatic spines with supporting carina each, strong antennal and branchiostegal spines, weak pterygostomial spine. Eye small, pigmented. Antennular peduncle with first segment longest, first and second segments with distolateral spines. Scaphocerite with blade longer than spine, basicerite with 2 blunt lateral spines. Third maxilliped setose, with exopod. First pereopod without spines on merus or carpus, dactyl when flexed obliquely transverse. Second pereopod slender, chelate. Third pereopod slender, with simple dactyl. Fourth and fifth pereopods stout, setose, with flattened dactyls. Abdominal somites 1-5 with 1-2 ventral spines on pleura, somites 1-5 with median dorsal carina (which may be faint), sixth somite with 2 dorsal carinae, posteroventral regions strongly flared. Telson with dorsal median groove, 2 pair dorsolateral spines; shorter than inner uropod. Male total length 30 mm, female 54.

Color in life: Buff with brownish patches, mottling and bars (Butler, 1980, color plate 1B).

Habitat and depth: Continental shelf, 28-220 m.

Range: Nootka Sound, British Columbia to San Martin Island, Baja California. Type locality off Point Arena, California.

#### Genus Lissocrangon Kuris and Carlton, 1977

##### Lissocrangon stylirostris (Holmes)

Crangon stylirostris Holmes, 1900: 174, pl. 2, figs. 33-35.--Rathbun, 1904: 118, fig. 59.--Zarenkov, 1965: 1763.--Butler, 1980: 98.--Chace and Abbott, 1980: 574, fig. 23.11.—Carvacho and Olson 1984: 65.--Jensen, 1995: 41, fig. 61.

Crago stylirostris: Schmitt, 1921: 90, fig. 61.

Lissocrangon stylirostris: Kuris and Carlton, 1977: 551.

Recognition characters: Exoskeleton thin and smooth. Rostrum short and narrow, reaching end of eyes. Carapace without dorsal median spine, with strong antennal and branchiostegal spines, hepatic spine with supporting carina. Eyes small and pigmented. Antennular peduncle with first segment longest, stylocerite blade-like and about as long as first segment. Scaphocerite with spine exceeding blade. Third maxilliped stout, first segment broad, with exopod. First pereopod stout, merus with 1 spine, carpus with 2 spines, propodus distally widened, dactyl when flexed obliquely transverse. Second pereopod slender and chelate. Pereopod 3 slender, dactyl simple. Pereopods 4 and 5 more robust than pereopod 3, with dactyls slightly flattened. Abdominal somites 1, 2 and 4 with pleura ventrally concave, third and fifth pleura rounded, sixth somite with posteroventral spine and slight ventral groove, no abdominal somites with dorsal carinae. Telson with 2 pair lateral spines, shorter than uropods. Male total length 43 mm, female 61.

Color in life: Speckled with brown, tail fan brown (Chace and Abbott, 1980, fig. 23.11).

Habitat and depth: Sandy bottoms, often in surf zone of semiprotected beaches, intertidal-80 m.

Range: Chirikof Island, Alaska to Todos Santos Bay, Baja California. Type locality Trinidad, Humboldt County, California.

Genus Crangon Fabricius, 1798

Crangon franciscorum Stimpson

Crangon franciscorum Stimpson, 1856: 97.--Rathbun, 1904: 120, fig. 61.--Kozloff, 1974: 164.--Jensen, 1995: 40, fig. 57.

Crago franciscorum: Schmitt, 1921: 92, fig. 62.--Johnson and Snook, 1927: 313, fig. 267.--MacGinitie and MacGinitie, 1968: 275.

Crangon (Neocrangon) franciscorum: Zarenkov, 1963: 1764.

Crangon franciscorum franciscorum: Butler, 1980: 101.

Recognition characters: Exoskeleton smooth and thin. Rostrum short, not reaching cornea of eye, apex rounded. Carapace with one dorsal median spine, also hepatic, branchiostegal and moderate pterygostomial spines. Eyes small, pigmented. Stylocerite exceeding first segment of antennular peduncle. First segment of antennular peduncle with distal spine. Scaphocerite with spine exceeding blade. Third maxilliped setose, with exopod. First pereopod with inner spine on merus; hand of subchela elongate, dactyl closing almost longitudinally against inner spine. Second pereopod slender, chelate; third pereopod slender, with simple dactyl; fourth and fifth pereopods setose and more robust than third, with simple dactyls. Abdominal pleura with blunt to rounded pleura, fifth somite with posterolateral spine, sixth with moderate posteroventral spine. Sixth abdominal somite slender, with ventral groove. Telson narrow, with 2 pair lateral spines and acute apex, shorter than uropods. Male total length 49 mm, female 68.

Color in life: Mottled gray.

Habitat and depth: Sand and mud, euryhaline; intertidal to 91 m.

Range: Resurrection Bay, Alaska to San Diego, California. Type locality San Francisco Bay, California.

Taxonomic remarks: Butler (1980) treated C. franciscorum as two separate subspecies, C. franciscorum franciscorum and C. franciscorum angustimana Rathbun, 1902. The latter, having a more slender subchela than the former (6-8X width versus 4-5.5X width), is reported from Kachemak Bay, Alaska to Tillamook Rock, Oregon. It seems to inhabit deeper, cooler, more saline water than the typical form. However, whether this difference in form is genetic or habitat-induced remains unknown.

Crangon nigromaculata Lockington

Crangon nigromaculata Lockington, 1877a: 34.--Holmes, 1900: 173, pl. 2, fig. 32.--Rathbun, 1904: 114, fig. 51.--Ricketts et al., 1985: fig. 153.--Jensen, 1995: 41, fig. 60.

Crago nigromaculata: Schmitt, 1921: 86, fig. 57.--Johnson and Snook, 1927: 313.

Crangon (Neocrangon) nigromaculata: Zarenkov, 1963: 1764.

Recognition characters: Exoskeleton thin, smooth. Rostrum short. Carapace with single dorsal median spine, also hepatic and branchiostegal spines, weak pterygostomial spine. Eyes small, pigmented. Stylocerite as long as first segment of antennular peduncle. Scaphocerite with spine exceeding blade, blade sinuous on inner margin and narrow near distal end. Third maxilliped

setose, with exopod. First pereopod subchelate, dactyl closing obliquely across propodus. Second pereopod slender, chelate; third pereopod slender, with simple dactyl; fourth and fifth pereopods more robust and setose than third, with simple dactyls. Pleura of abdominal somites rounded to blunt. Sixth somite with ventral groove, usually also marked with distinctive circular spot on posterolateral surface. Telson about as long as uropods, with 2 pair dorsolateral spines. Total length to 70 mm.

Color in life: Mottled gray, with obvious spot of purple to blue and surrounding ring of orange to yellow on sixth abdominal somite; rarely without such a spot.

Habitat and depth: Sand and mud, 6-61 m.

Range: San Francisco Bay, California to San Cristobal Bay, Baja California, Mexico. Type locality San Diego, California.

### Crangon handi Kuris and Carlton

Crangon handi Kuris and Carlton 1977: 540, figs. 1-2; Jensen, 1995: 41, fig. 62.

Recognition characters: Rostrum short, not as long as cornea as eye. Carapace with 1 median dorsal spine, also hepatic and branchiostegal spines. Stylocerite short and blunt, not as long as first segment of antennular peduncle. Scaphocerite with very broad blade, exceeding spine. Third maxilliped setose, with exopod. First pereopod stout, merus with 1 spine; hand broad, dactyl closing obliquely against propodus. Second pereopod slender and chelate; third slender, with simple dactyl, fourth and fifth pereopods stouter than third. Pleura of abdominal somites blunt to rounded. Sixth abdominal somite relatively short, with shallow ventral groove. Telson with 2 pair dorsolateral spines, exceeding uropods. Total length to 50.3 mm (Kuris and Carlton, 1977).

Color in life: Well camouflaged with bars and patches of white, black, brown or other colors, resembling the sand on which it rests (Kuris and Carlton, 1977, fig. 2).

Habitat and depth: Coarse sand, intertidal to 55 m.

Range: Shell Beach, Sonoma County, California to Colnett Bay, Baja California, Mexico. Type locality Horseshoe Cove, Bodega Head, Sonoma County, California.

### Crangon alaskensis Lockington

Crangon alaskensis Lockington, 1877a: 34.--Zarenkov, 1965: 1763.--Kozloff, 1974: 164.--Butler, 1980: 108.—Carvacho and Olson 1984: 65.--Jensen, 1995: 40, fig. 59.

Crangon alaskensis elongata Rathbun 1902: 888.--Rathbun, 1904: 115, fig. 54.

Crango alaskensis elongata: Schmitt, 1921: 88, fig. 58.--Johnson and Snook, 1927: 313.

Crango alaskensis: MacGinitie and MacGinitie, 1968: 274.

Recognition characters: Exoskeleton thin and smooth. Rostrum reaching or exceeding cornea of eye, apex rounded. Carapace with 1 median dorsal spine, also hepatic and branchiostegal spines, moderate pterygostomial spine. Eyes pigmented. Stylocerite acute, about as long as first segment of antennular peduncle. Scaphocerite narrow, spine much longer than blade, blade tapering toward distal end. Third maxilliped setose, with exopod. First pereopod with inner spine and strong distal spine on merus, propodus broad, dactyl closing obliquely against propodus. Second pereopod slender and chelate, third slender, with simple dactyl, fourth and

fifth pereopods longer and more robust than third, with simple dactyls. Pleura of abdominal somites rounded or blunt. Sixth abdominal somite with posterolateral spine and ventral groove. Telson with 2 pair dorsolateral spines, about as long as uropods. Male total length 52 mm, female 65 mm.

Color in life: Grayish brown with scattered black spots.

Habitat and depth: Fine sand, euryhaline, intertidal-275 m.

Range: Bering Sea to Todos Santos Bay, Baja California. Type locality Mutiny Bay, Alaska.

Taxonomic remarks: Rathbun (1902) distinguished a southern form, C. alaskensis elongata, on the basis of having a longer rostrum and scaphocerite than specimens from Alaska. However, considerable overlap has been noted in these characters among shrimp from British Columbia (Butler, 1980). I examined 100 specimens from off San Diego, California. In these, shrimp with a carapace length of 7 mm or less often had a broader width/length ratio of the palm of the subchela, about 1/2 instead of 1/3 or more. The rostrum in some of these smaller shrimp was shorter and broader, not reaching the end of the cornea of the eyes. Regardless of the size of the individual, the rostrum usually was more or less level with the plane of the carapace, but in 3 individuals, the rostrum rose at about a 30 degree angle relative to the carapace. Males had a more slender body than adult females. There was little variation in the relative lengths of the scaphocerite, telson and uropods from that mentioned by Butler (1980); therefore, I concur with his suggestion that designation of the form C. alaskensis elongata as a distinct subspecies be dropped from the nomenclature. Holmes (1900) considered C. alaskensis to be a synonym of C. nigricauda, but the two species are distinct in morphology and habitat. The narrow scaphocerite with the long, acute spine is characteristic of the former, which usually occurs in deeper waters than the latter species.

### Crangon nigricauda Stimpson

Crangon nigricauda Stimpson, 1856: 97.--Holmes, 1900: 170, pl. 2, fig. 31.--Rathbun, 1904: 112, fig. 50.--Kozloff, 1974: 164.--Butler, 1980: 106.--Ricketts et al., 1985: 328, fig. 253.--Jensen, 1995: 40, fig. 58.

Crago nigricauda: Schmitt, 1921: 84.--Goodwin, 1952: 395.

Crangon (Neocrangon) nigricauda: Zarenkov, 1965: 1763.

Recognition characters: Exoskeleton thin and smooth. Rostrum reaching base of cornea of eye, apex rounded. Carapace with 1 median dorsal spine, also hepatic and branchiostegal spines, weak pterygostomial spine. Eye pigmented. Stylocerite acute, about as long as first segment of antennular peduncle. Scaphocerite broad, blade about equal to spine. Third maxilliped setose, with exopod. First pereopod with spine on inner surface of merus, propodus broad, dactyl closing nearly transversely across propodus. Second pereopod slender and chelate, third pereopod slender, with simple dactyl; fourth and fifth pereopods more robust and longer than third, with simple dactyls. Pleura of abdominal somites blunt to rounded. Sixth somite with median dorsal carina and ventral groove, moderate posteroventral spine. Telson narrow, with broad median groove, 2 pair dorsolateral spines. Inner uropod longer than telson. Male total length 32 mm, female 53 mm.

Color in life: Speckled with gray, black and white, tail fan dark brown to black, well camouflaged against sand. (Living color notes from specimen from San Francisco Bay, California). See Ricketts, et al. 1985, fig. 253 for photo of living animal.

Habitat and depth: Sand, intertidal-57 m.

Range: Prince William Sound, Alaska to San Geronimo Island, Baja California. Type locality Tomales Bay, California.

Crangon alba Holmes

Crangon alba Holmes, 1900: 174.--Rathbun, 1904: 117, figs. 56, 57.--Zarenkov, 1965: 1763.--Kozloff, 1974: 164.--Butler, 1980: 104.—Carvacho and Olson 1984: 65.

Crago alba: Schmitt, 1921: 89, fig. 59.

Recognition characters: Exoskeleton thin, smooth. Rostrum short, apex rounded. Carapace with 1 median dorsal spine, also hepatic, antennal and branchiostegal spines, weak pterygostomial spine. Eyes pigmented. Stylocerite short. Scaphocerite narrow, spine greatly exceeding blade. Third maxilliped with basal segment greatly expanded and broad, exopod present. First pereopod with propodus broad, dactyl closing obliquely against propodus. Second pereopod slender and chelate, third pereopod slender with simple dactyl, fourth and fifth pereopods longer and more robust than third. Pleura of abdominal somites blunt to rounded. Sixth abdominal somite without ventral groove, with weak posteroventral spine. Telson with 2 pair lateral spines, shorter than uropods. Female total length 44 mm.

Color in life: White, or white dotted with black.

Habitat and depth: Coarse sand or rocks, 22-88 m.

Range: Queen Charlotte Sound, northeast Vancouver Island to Todos Santos Bay, Baja California. Type locality Monterey Bay, California.

Crangon holmesi Rathbun

Crangon holmesi Rathbun, 1902: 888.--Rathbun, 1904: 118, fig. 58.--Zarenkov, 1965: 1763.

Crago holmesi: Schmitt, 1921: 90, fig. 60.

Recognition characters: Exoskeleton thin and smooth. Rostrum short, apex rounded. Carapace with single median spine, also hepatic and branchiostegal spines. Eyes pigmented. Scaphocerite narrow, spine greatly exceeding blade. Third maxilliped setose, with exopod. First pereopod with propodus elongate, dactyl closing obliquely against propodus. Second pereopod slender and chelate, third pereopod slender, with simple dactyl; fourth and fifth pereopods longer than third, with simple dactyls. Pleura of abdominal somites blunt to rounded. Sixth abdominal somite without ventral groove. Telson with 2 pair dorsolateral spines. Total length to 34.0 mm.

Color in life: Not recorded.

Habitat and depth: Sand and mud, 28-107 m.

Range: Wilmington, Los Angeles County, California to Cedros Island, Baja California. Type locality Wilmington, California.



## Family Glyphocrangonidae

Like the crangonids, the species of the family Glyphocrangonidae have subchelate first pereopods. Their common name, the armored shrimp, reflects their firm, sculptured exoskeleton. The rostrum is well developed, dorsoventrally depressed and somewhat concave. The lateral margin of the rostrum bears teeth. The carapace bears grooves, ridges, spines and tubercles. The abdominal somites bear nodules and ventral teeth. The eyes of local species are large and pigmented.

Eastern Pacific armored shrimp were described by Faxon (1893, 1895, 1896). Holthuis (1971) provided a set of descriptive terms for the various features of the exoskeleton. The descriptions and key in this section use Holthuis' terms.

Little is known of the natural history of armored shrimp, largely due to their deep-sea habitats. Glyphocrangon spinicauda was observed from a submarine off Florida. It spent much of the time with the rostrum embedded in the sea bed and the body flexed (Anderson and Bullis, 1970).

Glyphocrangon sculpta of the Atlantic was photographed by a time-lapse camera. It crawled on the bottom at a rate of about 100 cm/hr. Stomach contents of this species included foraminiferans, small bivalve mollusks and small crustaceans (Lampitt and Burnham, 1983). Rice (1981) reported that species of Glyphocrangon eat small infaunal mollusks. He also speculated that the ball and socket joints of the last three abdominal somites and telson could serve as a locking mechanism that would protect the abdomen from attack by predators.

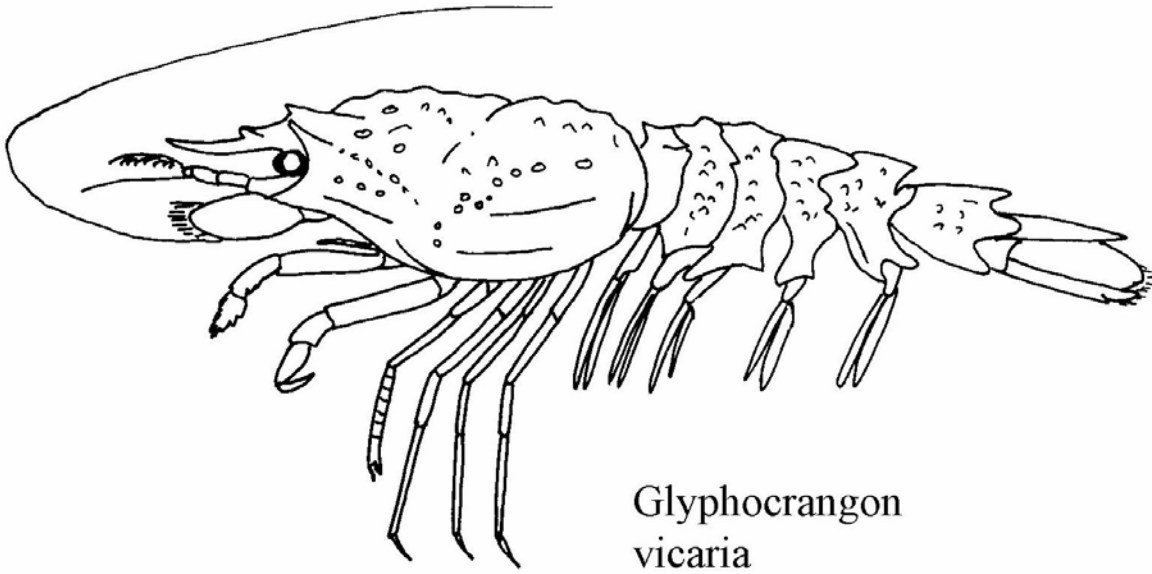
The two species known from California were collected in muddy areas at 938-3880 m. Parasitic isopods (Munidion sp.) have been found on them and other species. Species from other parts of the world also live on continental slopes to abyssal plains. Many freshly caught specimens are brick red, orange or brown in color.

Species of Glyphocrangon have been found world-wide in deeper benthic habitats. There are no reports of them in the eastern Pacific north of southern California, but this may reflect a lack of collecting in the area.

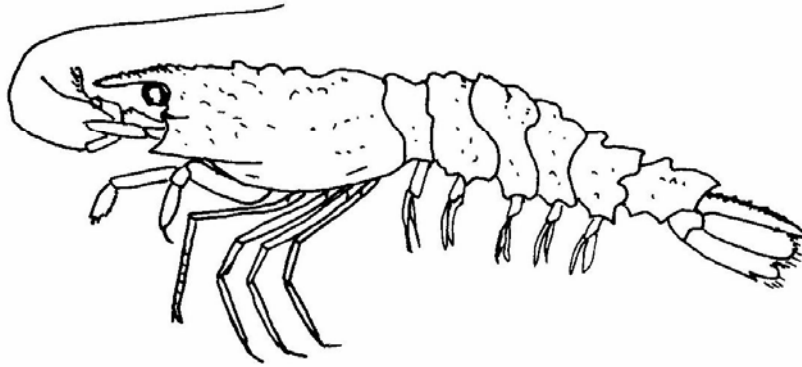
### Key to the Species of the Family Glyphocrangonidae

1. Rostrum with 6-7 lateral teeth, carapace covered with dense spines-----  
-----Glyphocrangon spinulosa Faxon

Rostrum with 2 lateral teeth, carapace with carinae, nodules and anterior spines, but not covered with dense spines-----Glyphocrangon vicaria Faxon



*Glyphocrangon*  
*vicaria*



*Glyphocrangon*  
*spinulosa*

Genus Glyphocrangon A. Milne Edwards, 1881

Glyphocrangon spinulosa Faxon

Glyphocrangon spinulosa Faxon, 1893: 202.-- Faxon, 1895: 138, pl. 38.--Wicksten, 1979c: 220, fig. 3A,B.-- Wicksten, 1989b: 314.--Wicksten and Hendrickx, 2003: 70.

Recognition characters: Entire exoskeleton covered by short spines. Rostrum exceeding antennular peduncle, with 5-7 lateral teeth. Eyes large and pigmented. Carapace with large antennal and branchiostegal teeth, cervical, lateral and anterior grooves. Teeth on lateral carinae larger than those on rest of carapace. Antennular peduncle short and stout, exceeding scaphocerite. Scaphocerite broad, apex rounded, with small lateral tooth near base. Third maxilliped short, stout and setose, with exopod. First pereopod subchelate, ischium with anteroventral tooth. Second pereopods subchelate, right pereopod longer than left, both with multisegmented carpus. Third to fifth pereopods similar, but third dactylus simple and fourth and fifth dactyli more flattened. Abdomen with interrupted median dorsal carina along entire length. First abdominal pleura rounded, second to fifth with two ventral teeth each, sixth with prominent lateral teeth visible from dorsal aspect. Telson longer than uropods. Total length 110 mm.

Color in life: Red (Faxon, 1895).

Habitat and depth: Sand and mud, 1097-1875 m.

Range: Cortez Basin, California, U.S.A. to Costa Rica. Type locality not specified: type material was collected at five stations between the southern Gulf of California (Albatross sta. 3435, 26° 48'0"N, 110° 45'20"N) and off Cape Corrientes, Colombia (7° 6'15"N, 80° 34'0"W, Albatross sta. 3353).

Glyphocrangon vicaria Faxon

Glyphocrangon nobilis?: Faxon 1895: 142.

Glyphocrangon vicaria Faxon, 1896: 159, pl. 1, figs. 5-6.--Wicksten, 1979c: 221, Fig. 4A,B.-- Wicksten, 1989b: 314.--Wicksten and Hendrickx, 2003: 70.

Recognition characters: Exoskeleton firm, with scattered nodules but not covered with spines. Rostrum longer than scaphocerite, with 1 pair lateral spines just beyond cornea of eye and another near base. Carapace with prominent antennal and branchiostegal teeth, each with supporting carina; also cervical and lateral grooves; nodules along submedian carinae, posterior intermediate carina and anterior and posterior antennal carinae. Antennular peduncle stout. Scaphocerite oval, without small tooth. First maxilliped stout, setose, with exopod. First pereopod subchelate. Second pereopod slender, subchelate, carpus multiarticulate. Third to fifth pereopods similar, dactylus of third simple, dactyli of fourth and fifth flattened. First abdominal somite small, pleura rounded. Second abdominal pleura with one ventral tooth, third to fifth with two ventrolateral teeth each. Sixth pleura ending in prominent tooth visible from above. Telson exceeding uropods. Total length 157 mm.

Color in life: Brownish-orange.

Habitat and depth: Mud, 938-3880 m.

Range: San Clemente Basin, California, U.S.A. to off Galapagos Islands. Type locality north of Galapagos Islands: 0° 54'N, 91° 9'W.

## INFRAORDER ASTACIDEA

Members of this infraorder commonly are called crayfishes and lobsters. Unlike spiny lobsters, these species have a spiny rostrum, large chelae on the first pereopods and characteristic reproductive structures. Only the freshwater crayfishes (families Cambaridae and Astacidae) are found in California and Oregon, although species of the marine benthic family Nephropidae have been collected on the lower continental shelf and slope off western Mexico.

In crayfishes, the female bears a “belly button”, called the annulus ventralis, between her gonopores on the coxae of the third pereopods. Immature males have stiff gonopods on the first abdominal somite; mature males have characteristic rigid copulatory appendages at this location. The female carries the eggs under the abdomen until they hatch -- there are no distinct larval stages.

Species of the family Astacidae are native to California and Oregon. Most live in rivers and streams. These crayfish generally live in cold waters. Related species are found in Europe. The male reproductive structures differ only slightly between species.

The family Cambaridae is native to the central and eastern United States, Canada and Mexico, but has been introduced into California and Oregon. Members of this family inhabit rivers, streams, ponds, lakes, caves, marshes and even damp meadows. Species of this family often have different color patterns, shape of the chelae and copulatory organs among immatures, non-reproducing males, reproducing males and females. It can be difficult if not impossible to identify members of this family to species without examining the characteristic copulatory structures of mature males. Only two species usually are found in naturalized in California and Oregon. Of these, Procambarus clarki, widely used for aquaculture, bait or human consumption, usually is the only crayfish found in southern California. Other species of the Cambaridae, such as Procambarus blandingii (Harlan), may have been imported and released from time to time (Bonnot, 1930).

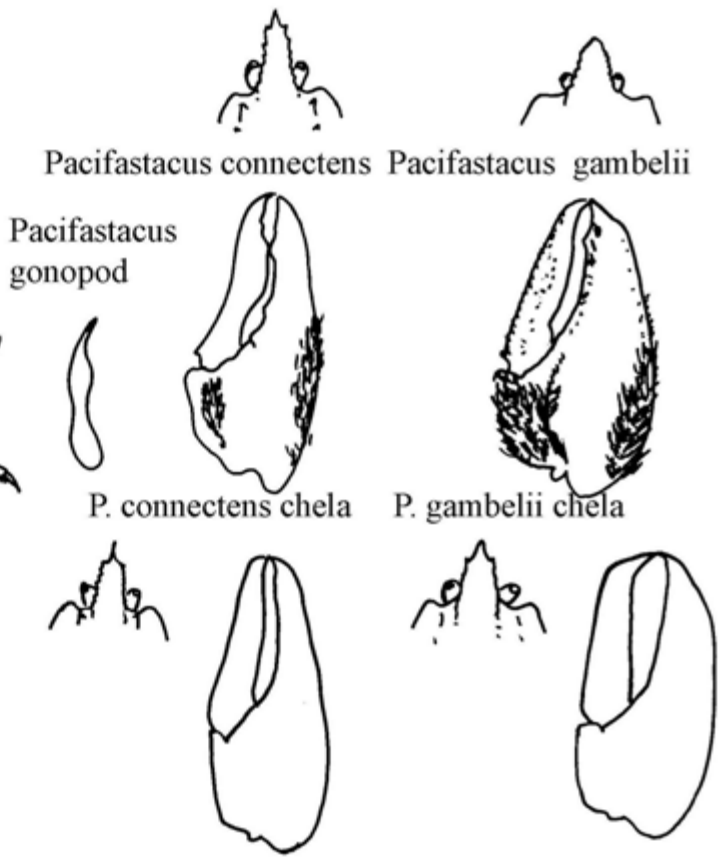
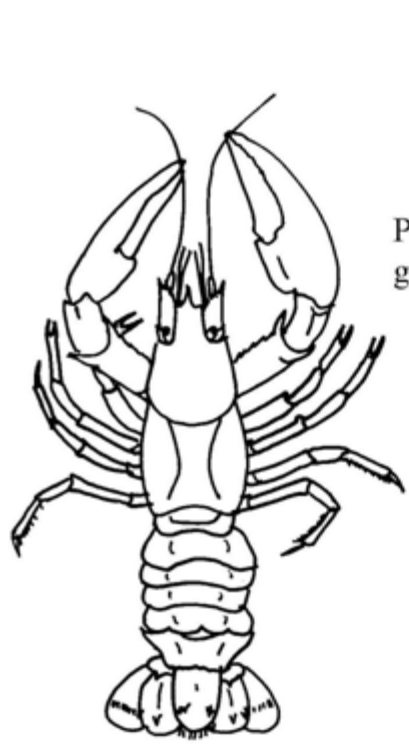
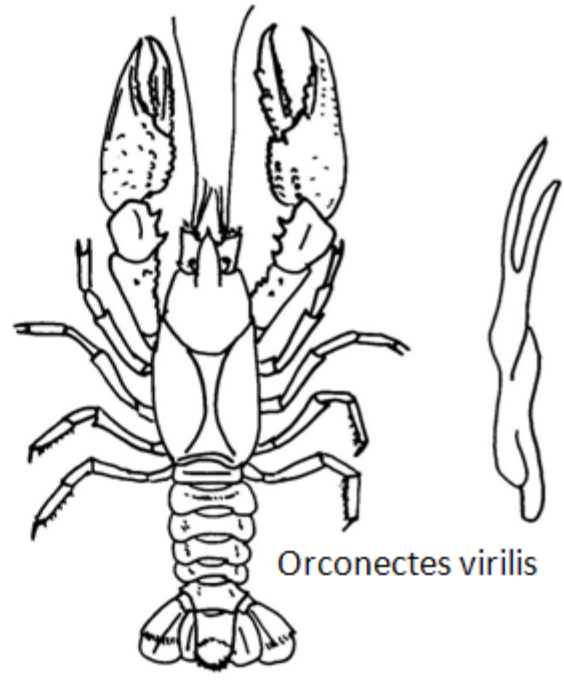
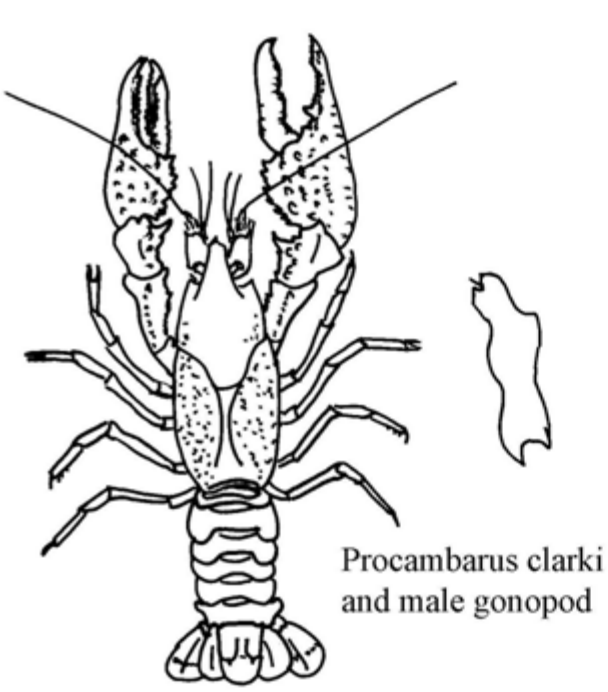
Crayfishes feed on a wide variety of plants, animals and detrital material. Insects, freshwater mollusks and decaying material rich in protein are favored foods. Many crayfishes can tolerate exposure to air for some time, and may be able to crawl across damp meadows or pastures. Most species are active at night. Species of the Cambaridae may dig burrows in mud. Large fishes, raccoons, egrets and herons feed on crayfishes. Crayfishes may be parasitized by leech-like worms (family Branchiobdellidae) and protozoans.

There have been few studies on the natural history of native crayfishes of California and Oregon. The reader seeking more information on any aspect of crayfishes should consult the exhaustive bibliography by Hart and Clark (1987).

### Key to the Species of Crayfishes in California and Oregon

1. Ischia of all pereopods lacking hooks-----2  
    Ischia of third pereopods with hooks-----6
2. Rostrum with single pair of marginal tubercles or spines----- Pacifastacus leniusculus (Dana)

- Rostrum with at least 3 pairs marginal spines-----3
3. Dorsal surface of palm of chela with 2 conspicuous clusters of setae-----4
- Dorsal surface of palm of chela without conspicuous clusters of setae-----5
4. Postorbital ridges with 1-2 pairs posterior spines or tubercles; rostrum lacking median carina-----  
-----Pacifastacus connectens (Faxon)
- Postorbital ridges lacking posterior spines or tubercles; rostrum often with median carina-----  
----- Pacifastacus gambeli (Girard)
5. Width of palm of chela equal to, or greater than, length of mesial margin-----  
-----Pacifastacus fortis (Faxon)
- Width of palm of chela less than length of mesial margin---Pacifastacus nigrescens (Stimpson)
6. First pleopod terminating in 2 elements-----Orconectes virilis (Hagen)
- First pleopod terminating in more than 2 elements-----Procambarus clarkii (Girard)



# Family Astacidae

Genus Pacifastacus Bott

Pacifastacus leniusculus (Dana)

Astacus leniusculus Dana, 1852: 524.--Hagen 1870: 94.--Holmes 1900: 166.--Bonnot 1930: 212, figs. 65, 66, 67.

Pacifastacus leniusculus.--Riegel 1959: 39, fig. 1F-H, fig.3A, 6.--Miller and Van Hyning 1970:77, figs, 1-2.--Hobbs 1976: 21, figs. 5a,12,a-c, 14e.--Eng and Daniels 1982: 200, fig., 1a.--McGriff 1983: 227.

Recognition characters.--Rostrum acute, with single pair marginal spines or tubercles, with or without median carina, with dorsal surface depressed . Postorbital ridges rounded or with pair of spines or tubercles. Carapace with prominent cardiac grooves and paired branchiocardiac grooves, branchial regions slightly to greatly inflated. First antennae small, peduncle about same length as rostrum. Basicerite of second antenna with sharp lateral spine. Antennal scale with acute lateral spine, as long as or slightly longer than rostrum. Third maxilliped setose, ischium armed with sharp spines on mesial and lateral margins of distal margin (forming "crista dentata"), next segment armed with spinules. Major chelae with smooth to tuberculate surface. Fingers about 3X length of palm, fixed finger with low tooth on cutting edge near proximal end. Outer margin of palm convex, inner convex and flared proximal to dactyl. Inner margin of palm with crest, slight depression parallel to crest on both inner and upper and lower surface of palm. Carpus with blunt tooth at distal margin, sharp notch along articulation with chela, 2 teeth on lower margin along distal edge. Merus with large spine at distal inner end, large spine and row of teeth along lower edge and 2 spines parallel and inner to this row. Ischium with tubercles in line with those of merus. Second and third pereopods chelate, sparsely setose. Fourth and fifth pereopods with dactyls forming claws. Ischia of all pereopods lacking hooks. Male first pleopods simple in structure, slender ridge along distal mesial surface. Male second pleopod with strong endopod, slender exopod. Female first pleopods biramous. Abdomen heavy. Abdominal somites decreasing in size from first to fifth, with pleura ending in points curving posteriorly. Pleura of sixth abdominal somite prolonged into hook around base of uropods. Telson with horizontal fissure along dorsal surface near posterior end, 2 lateral spines in line with this fissure. Outer uropod with fissure across dorsal surface, 2 lateral teeth along fissure; median ridge. Inner uropod with median ridge . Total length to 117 mm.

Color in life.--Dark brown to dark greenish.

Habitat.--Rivers, streams, lakes and sloughs.

Range.--British Columbia, Washington, Idaho, Oregon, Nevada (Lake Tahoe area) and California, south at least as far as Little Sur River, Monterey County. Introduced into Sweden. Type locality Columbia River, Oregon. Miller and Van Hyning (1970, Fig. 3) provided a map of the range of the species in Oregon.

Remarks.--Three subspecies of P. leniusculus have been described. However, Hobbs (1976) noted that the descriptions do not clearly define these subspecies, and their ranges overlap. Due to human activity, the subspecies have been introduced into new areas and have intermingled. Bonnot (1930) reported that P. leniusculus had been introduced into California from Oregon and had become naturalized.

Pacifastacus connectens (Faxon)

Astacus connectens Faxon, 1914: 360, pl. 7, figs 6,10; pl. 10, fig. 1.

Pacifastacus connectens.--Hobbs 1976: 22, figs. 12d, 14a.

Recognition characters.--Very similar to P. leniusculus, but rostrum with numerous lateral spines and tubercles. Postorbital ridges with 1-2 pairs posterior spines or tubercles, rostrum lacking median carina. Dorsal surface of major chela with two conspicuous patches of setae, as well as prominent tubercles in patches. Palm of chela not much wider than fingers, edges more or less straight. Total length not reported.

Color in life.--Brown.

Habitat.--Rivers and streams.

Range.--Idaho and Oregon. Type locality Snake River, Idaho.

Pacifastacus gambelii (Girard)

Astacus gambelii Girard, 1852: 90.--Hagen 1870: 90, pl. I, figs. 97-98; pl. III, fig. 170; pl. XI.--Holmes 1900: 164.

Pacifastacus gambeli.--Riegel 1959: 43, fig. 3C, 8.

Pacifastacus gambelii.--Hobbs 1976: 22, figs. 13a, 14b.

Recognition characters.--Similar to P. leniusculus, but rostrum with numerous small spines, median carina often present. Postorbital ridges lacking posterior spines or tubercles. Dorsal surface of major chela with two conspicuous patches of setae, as well as minute tubercles.

Color in life.--Brown, greenish to blackish.

Habitat.--Rivers and streams.

Range.--Streams on Pacific slopes and Missouri River drainage of Idaho, Montana, Wyoming, Nevada, Oregon and California. Type locality "California", but no subsequent records from this state.

Pacifastacus fortis (Faxon)

Astacus nigrescens fortis Faxon, 1914: 360, pl. 7, fig. 5; pl. 9, fig. 2.

Pacifastacus nigrescens.--Riegel 1959: 44, fig. 3D, 9 (in part).

Pacifastacus fortis.--Hobbs 1976: 23, fig. 13c, 14c.--Eng and Daniels, 1982: 197, fig. 1a.

Recognition characters.--Similar to P. leniusculus, but rostrum with numerous sharp teeth. Postorbital ridges with sharp spines. Major chela with out patches of setae, width of chela equal to or greater than length of mesial margin. Male abdomen narrower and major chelae heavier than those of female. Carapace length to 50 mm.

Color in life.--Dark brownish green to dark brown dorsally and bright orange ventrally; occasionally blue-green to bright blue with light salmon color below (Eng and Daniels 1982).

Habitat.--Cool, clear, spring-fed lakes and streams, under rocks on clean firm sand or gravel.

Range.--Streams in Fall River and Hat Creek subdrainages, and area of Pit River connecting them, in Shasta County, California. Type locality Fall River Mills and Hat Creek near Cassel,



California. (Type material came from two localities).

Remarks.--Riegel (1959) considered P. fortis to be a subspecies of P. nigrescens, and included records of that species in his section on the range. His records from Fall River, Fall "City" Mills, and Hat Creek at Cassel surely belong to P. fortis. See the thorough account by Eng and Daniels, 1982 for information on the threatened Shasta crayfish.

Pacifastacus nigrescens (Stimpson)

Astacus nigrescens Stimpson, 1857a: 87. --Stimpson 1857 b: 492.--Hagen 1870: 92, pl. III, fig. 168.--Holmes 1900: 166.--Bonnot 1930: 212.

Pacifastacus nigrescens.--Riegel 1959: 44. (In part, figures probably are of P. fortis).

Pacifastacus nigrescens.--Hobbs 1976: 23, fig. 13b, 14d.

Recognition characters.--Similar to P. leniusculus. Rostrum concave, with prominent, acute apex and 5-6 lateral spines, small spinules on postorbital ridges. Major chelae without clusters of setae, chela narrow, palm barely wider than closed fingers, fingers may be gaping. Abdominal pleura sharply triangular. Total length 78 mm (Stimpson, 1857b).

Color in life.--Blackish.

Habitat.--Streams near the coast.

Range.--Unalaska, Alaska; Fort Steilacoom, Washington, Alameda Creek, Alameda County and Coyote Creek, Santa Clara County, California (Holmes, 1900). Type locality given as San Francisco, California, but Stimpson noted that he purchased his specimens in a market.

Remarks.--There are no reliable records of live P. nigrescens since those of Holmes (1900). Subsequent reports by Bonnot (1930) quoted Holmes or considered P. fortis to be a subspecies of P. nigrescens (Riegel, 1959). Holmes' specimens probably were burned in the fire following the San Francisco earthquake in 1906, so it is impossible to double-check the identification of his material from Washington and Alaska.

## Family Cambaridae

Genus Orconectes Cope

Orconectes virilis (Hagen)

Cambarus virilis Hagen, 1870:63, pl. I, figs.23-28., pl.II, figs. 128-132, pl.III, fig.155., pl.VIII.  
Orconectes virilis.--Hobbs 1976: 91, fig. 72h.--Daniels 1980: 131.--Fetzner 1996: 114, 116, 119.

Recognition characters.--Rostrum with dorsal groove, acute apex well removed from pair lateral spines. Carapace with sharp cervical spines, prominent antennal angle. Major chelae with dorsal groove, double row of tubercles on dorsomesial side of palm in adult male; fingers straight, cutting edges lined by blunt teeth, double row of tubercles along mesial side of movable finger; carpus with two large spines on mesial side, merus with large spine near articulation with carpus and smaller spines on mesial surface. Male with hooks on ischia of third pereopods. Copulatory structures of male forked and deeply divided, tips of forks well separated, curving posteriorly. Annulis ventralis of female with high, narrow anterior wall divided by fissure, median depression wide and deep. Carapace length to more than 20 mm.

Color in life.--Carapace and abdomen greenish-brown, claws and walking legs bluish-green, tips of chelae orange.

Habitat.--Lakes, rivers and streams, especially in swiftly moving, turbid water.

Range.--Native to Canada and northeastern and north-central United States, but widely distributed throughout United States. Many records in California. Type locality not specified; original material came from Lake Superior, Lake Winnipeg., Saskatchewan, Red River and Toronto, Canada; Quincy, Illinois; Davenport and Burlington, Iowa; Miami River, Dayton, Ohio; Osage River, Missouri; Sugar River, Wisconsin and "Texas".

Genus Procambarus Ortmann

Procambarus clarkii (Girard)

Cambarus clarkii Girard, 1852:91.--Hagen 1870: 39, pl. I, figs, 7-10, 99-100; pl. II, figs, 133-134; pl. IV.

Procambarus clarkii.--Hobbs 1976: 72, fig. 56d.

Recognition characters.--Rostrum shorter than antennal scale or antennular peduncle, with one pair spines on postorbital ridge. Carapace somewhat granulate. Width of areola very narrow, cervical groove and branchiocardiac grooves delineating small triangular area on dorsal surface. Cervical spine present. Third maxilliped setose. Ischium with inner distal margin ending in large tooth. Chelipeds narrow, fingers longer than palm. Fixed finger with 2 large and 2 small teeth on cutting edge near proximal end. Dactyl may be concave on outer margin, with 2-3 tubercles on proximal end. Palm tuberculate, with spines on inner margin. Carpus with 2 large inner spines as well as tubercles. Merus with spines and tubercles on upper surface and distal margin, row of teeth on lower margin and smaller row mesial to this row. Ischium with teeth in line with those of merus. Second and third pereopods chelate, smooth. Third and fourth pereopods with ischial hooks. Fourth and fifth pereopods with simple dactyls. Abdominal pleura diminishing in size from first to fifth, pleura blunt or with minute terminal spine curved

posteriorly. Sixth abdominal pleura forming hook around base of uropods. First and second somites with dorsal sulci running across dorsal surface. Male first pleopod with prominent shoulder on cephalic surface. Second pleopod with calcified endopod, soft exopod. Telson with lateral and median sulci, V-shaped fissure with 2 spines on each side of fissure. Outer uropod with figgure and lateral tooth, also median ridge; inner uropod with lateral spine and median ridge. Male total length 82 mm.

Color in life.--Variable. Juveniles often camouflaged, brown, striped, or mottled; adults bluish to dark green, often with red spots on chelipeds; lower parts orange in breeding adults.

Habitat.--Ponds, shallow streams, ditches, lakes. Has been found in estuaries after floods.

Range.--Native to southern Illinois to northern Mexico and Escambia County, Florida, but introduced widely elsewhere, especially in California and northern Mexico. Now reported as far south as Ensenada in Baja California Norte and San Juan River in Nuevo Leon, Mexico (Rodriguez-Almaraz and Campos, 1994); also introduced into Europe and Japan. Type locality "between San Antonio and El Paso del Norte, Texas".

Remarks.--The red swamp crayfish has been introduced as bait or for use in aquaculture in many areas of the United States and Mexico, and now may well be the most abundant and widely distributed crayfish in North America. Any crayfish found in southern California is likely to be this species or the preceding one.



Procambarus clarkii

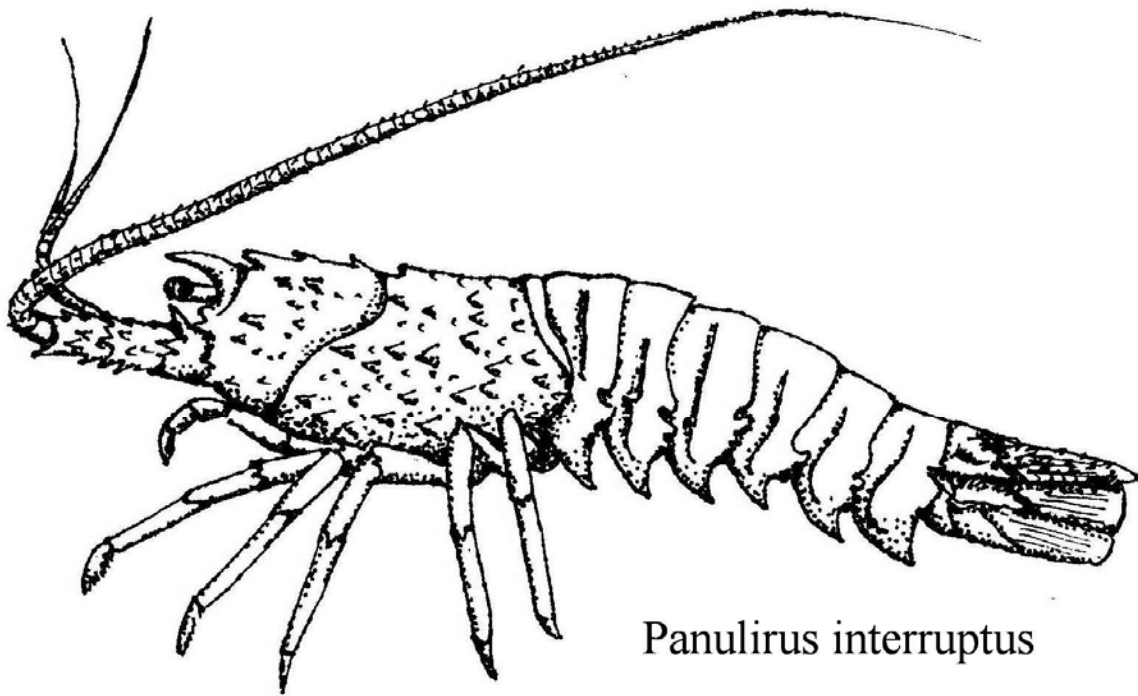
## Infraorder Palinura

The spiny lobsters and their relatives are entirely marine. Unlike lobsters of the Astacidea, they have a small rostrum, if any. In species found in California or Oregon, the first pair of pereopods bear long and slender chelae or none at all, instead of robust "pincers". The carapace is fused to the epistome. The uropods bear transverse sutures. A planktonic larval stage is present. Most species live in tropical or subtropical seas; only two are found in California or Oregon.

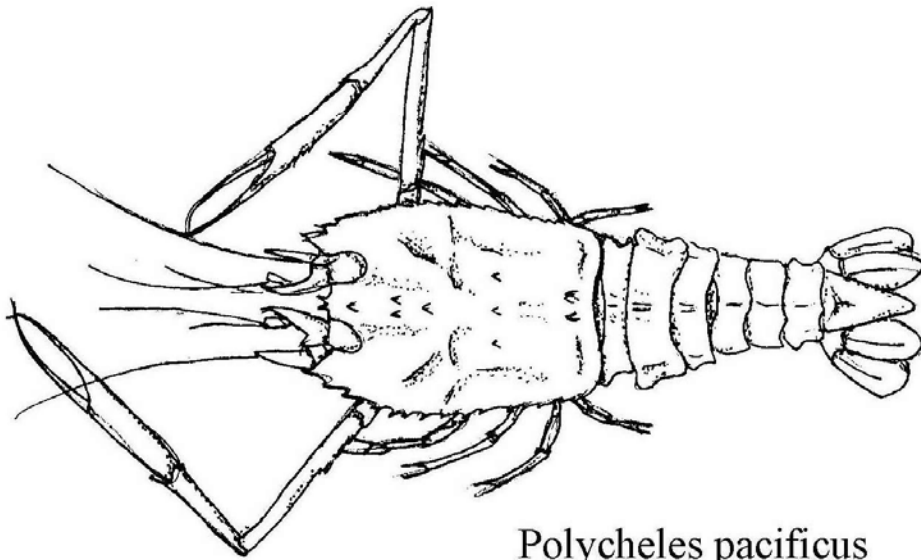
### Key to the species of the Palinura

1. First pereopods with long, slender chelae. Antennal scale present. Carapace of larva globose, adult flattened. Eyes not pigmented-----Polycheles pacificus Faxon

First pereopods without chelae. No antennal scale. Carapace and entire body of larva flattened, adult cylindrical-----Panulirus interruptus (Randall)



*Panulirus interruptus*



*Polycheles pacificus*

## Family Polychelidae

Genus Polycheles Heller, 1862

Polycheles pacificus Faxon

Polycheles sculptus pacificus Faxon, 1893: 196.--Faxon 1895: 122, pl. c, fig. 1, 1a.

Eryonicus caecus? --Faxon 1893: 197.--Faxon 1895: 110, pl. B, fig. 2; pl. 29, figs. 2-2f. (Larval stage).

Eryoneicus Agassizi Bouvier, 1915: 2.

Stereomastis sculpta pacifica --de Man 1916: 5.--Firth and Pequegnat 1971: 16.--Wicksten 1980b: 914, fig. 1.

Stereomastis pacifica.—Wicksten 2002: 128.

Eryonicus agassizi.--Schmitt 1921: 105, pl. 15, fig. 1-2.

Polycheles pacificus.--Galil 2000: 332, fig. 20.

Recognition characters.--Carapace somewhat rectangular, with posterolateral margins converging. Anterior margin slightly concave, with 2 rostral spines, 1 spine at each internal orbital angle and blunt tooth on anteromedial edge of each eyestalk; external orbital angles smooth. Ocular notches broad, rounded; edges not parallel with lateral border. Midline spines arranges as follows: 2(rostrum), 1-2-1-cervical groove-2-2-2; occasionally with 1 spine instead of 2 at each location. Posterior margin of carapace concave. Four spines along gastrorbital carinae; 1 more spine along each side. One spine on anterior branches. Superior branchial carinae low, armed with 5-6 spines on each side. Abdomen about as long as carapace. Terga one through five with anteriorly produced spines, strongest spine on fourth tergum. Anterolateral border of first tergum with 3 spines; edges of first four pleura armed with small tubercles. Sixth abdominal somite with low, double ridge without tubercles or spines; pleuron almost acute. Base of telson with small blunt tubercle. Two spines at anteroexternal edges of antennular peduncle. Ischia of chelipeds unarmed, meri with 1-3 dorsal spines, carpi with 2 distodorsal and 1-2 ventral spines, inner dorsal edge of propodus with 1 spine, palms ventrally spinulose, fingers of chela crossing. Female fifth leg chelate, male fifth leg imperfectly chelate. Total length to 102.5 mm, females growing to larger sizes than males.

Color in life.--Brick red, purplish red to scarlet.

Habitat and depth.--Muddy areas of lower continental shelf and slope, 750-1875 m.

Range. --Off Noyo Canyon, California to off Valparaiso, Chile. Type locality 7° 21'N, 79° 35'W (Gulf of Panama).

Remarks.--The larval stage of this species is the largest decapod larva to be found in the area, reaching 87 mm in total length. The carapace of the larva is filled with fat, giving the animal a blimp-like appearance. Larval stages have been taken in midwater nets at 1846-3692 m; however, there are so few reports of these animals from California or Oregon that these records may not be characteristic of the species. Adults have been collected by dredges or in baited traps.

# Family Palinuridae

## Genus Panulirus White

### Panulirus interruptus Randall

Panulirus interruptus Randall 1839: 137.--Stimpson 1854: 491.--Rathbun 1904: 148.--Schmitt 1921: 108, fig. 73.--Ricketts et al. 1985: 195, fig. 168.--Williams 1986: 21, fig. 49, color fig. 79 h-i.

Recognition characters.--Carapace subcylindrical, rostrum absent. Supraorbital spines strong, eyes not set in orbits. Carapace with numerous spines and with cervical groove. First antennae slender, antennular peduncle slightly longer than antennal peduncle. Antennal flagellum as long as body, armed with spinules; peduncle heavy and spinulose. First to fourth pereopods with setose, simple dactyls; female fifth pereopods with hooked dactyl and prominent overlapping hook on propodus. Abdominal somites with deep dorsal sulci which are separated along dorsal midline; abdominal pleura ending in sharp spines. Telson rectangular, with tubercles and spines toward proximal end; uropods as long as telson and similarly armed with tubercles and spinules. Total length to over 60 cm.

Color in life.--Dark green, reddish or brown, with two "eyespot" above base of first antennae. Albinos are rarely found.

Habitat and depth.--Rocky tidepools at extreme low tide, rocky reefs, breakwaters and kelp beds; lowest intertidal zone to 70 m .

Range.--San Luis Obispo County, California to vicinity of Cape San Lucas and Los Angeles Bay in Gulf of California, but rare north of Point Conception. Type locality "California".

Remarks.--The spiny lobster is primarily nocturnal, hiding in cracks and caves by day and emerging to feed by night. Lobster molts may be found cast ashore in southern California. The adults are taken by hand by divers or in traps used by fishermen. The delicate phyllosoma larval stage is difficult to rear in culture, so the species is not reared in mariculture. Fitch (1962) reported the pinto lobster, Panulirus gracilis Street, from "near the San Diego harbor breakwater". This species generally is found south of Magdalena Bay, Baja California. It can be distinguished readily from P. interruptus by the color pattern, blue to green with striped legs and antennae and white dots on each side of the abdominal somites.



Panulirus interruptus



# INFRAORDER THALASSINIDEA

Thalassinids are lobster-like crustaceans that burrow into mud, sand or mixed surfaces. The rostrum varies from a tiny and triangular to long and toothed. The eyes may be pigmented or not. The first walking legs bear chelae, one often heavier than the other. The second walking legs also bear smaller chelae. The other pereopods end in paddles or simple dactyls. The abdomen is cylindrical, but the exoskeleton may vary from thin and weak to strongly calcified. A telson with flanking uropods is present.

The mud shrimp and ghost shrimp (families Upogebiidae and Callianassidae) are the best-studied of the thalassinids. These burrowers range from the intertidal zone to the subtidal continental slope. They are active burrowers and deposit feeders. Their burrows provide shelter for other invertebrates, including the shrimp Betaeus ensenadensis, members of the crab family Pinnotheridae, the clam Cryptomya californica, and the blind goby Typhlogobius californiensis.

Little is known of the natural history of species belonging to other species of the Thalassinidea. In California and Oregon, species of the families Axiidae and Ctenochelidae are found on the continental shelf and slope. Only one species of the family Laomediidae has been reported from California. Descriptions in this section for the most part follow those of Hart (1982) and Williams (1986). See MacGinitie and MacGinitie (1968), Haig and Abbott (1980), and Ricketts et al. (1985) for information on the natural history of nearshore thalassinideans.

## Key to the Families of the Thalassinidea

1. Abdominal pleura large. Rostrum triangular, with lateral teeth, may have median ridge-----2  
Abdominal pleura small or absent. Rostrum broad, with numerous small teeth and setae, or reduced to median tooth or low, rounded margin-----3
2. First pereopod subchelate. (Southern California only, shallow)-----family Laomediidae  
First pereopod chelate. (Oregon and California, continental shelf and slope)-----family Axiidae
3. Rostrum flat and setose, eye peduncles cylindrical. First pereopods subequal-----  
-----family Upogebiidae  
Rostrum small, consisting of median tooth or low, rounded margin, eye peduncles flattened or elongated. First pereopods unequal in size and shape-----4
4. Rostrum consisting of median tooth. Eyestalks elongate, unpigmented----family Ctenochelidae  
Rostrum obscure to absent. Eyestalks flattened, pigmented-----family Callianassidae

## Family Laomediidae

Only one genus with one species has been reported from the area.

Genus Naushonia Kingsley

Naushonia macginitei (Glassell)

Homoriscus macginitei Glassell, 1938: 414, figs. 1-4.

Naushonia macginitei.--Goy and Provenzano 1979: 339, figs. 6b,g; 7c, 8c, f, k, l.—Sirota and Martin 2005: 146, fig. 2.

Recognition characters.--Rostrum semioval, armed anteriorly with small, sharp teeth; upper surface granulate, slightly concave. Carapace lightly pubescent, with 7 sharp longitudinal ridges. Orbit semicircular, outer orbital angle small and blunt. Antennular peduncle longer than rostrum. Antennal scale with 7-8 sharp teeth on outer margin, shorter than third segment of antennular peduncle. Ischium of third maxilliped armed on inner side with row of spinules, merus with distal spine, propodus and dactyl subequal in length and longer than carpus. First pereopods subchelate, with large fixed tooth and 3-4 smaller teeth on propodus along inner margin of chela. Propodus broad, upper margin carinate. Second pereopod short and stout, with simple, setose dactyl and long setae on merus. Third to fifth pereopods more slender and longer than second, with few setae and simple, slender dactyls. Abdominal somites without carinae or teeth. Telson rounded, sides with very fine teeth and 3 pairs lateral spines. Exopod of uropod shorter than endopod, both divided by sutures across posterior half. Carapace length to 7.7 mm, total length 19.2 mm..

Color in life.—Bright orange, with appendages speckled with white or beige, dorsal surface of abdomen more uniform beige or cream (Sirota and Martin, 2005).

Habitat.--Under rocks in pool, among eelgrass (Zostera marina) sand flats; intertidal to 11.2 m.

Range.—Water Bay, Cocos Island, Ecuador; Ensenada de San Francisco, Sonora, Mexico (Gulf of California), to Newport Bay, California. Type locality La Jolla, California.

Remarks.--This peculiar animal originally was thought to be a sand shrimp (Caridea: Crangonidae). The similarity in the subchelate first pereopods could be confusing to the viewer. However, the sutures of the uropod, the unusual rostrum and the ridges of the carapace are characteristic.

# Family Axiidae

## Key to the Species of the Axiidae

1. Eyes with pigment. (Usually living at 200 m or less)-----Calocarides spinulicauda (Rathbun)  
Eyes without pigment. (Usually living at more than 200 m)-----2
2. Rostrum slender, 2 spines at base. No spines on telson-----Calastacus stylirostris Faxon  
Rostrum broad, with or without spines. Spines on telson-----3
3. Carapace without cervical groove, very inflated. (Associated with deep-sea sponges)-----  
-----Axius acutifrons (Bate)  
Carapace with cervical groove, not inflated. (Burrowers, not associated with sponges)----- 4
4. 2 ridges with spines on carapace. Carapace granulate-----Calocaris investigatoris (Anderson)  
5 ridges with spines on carapace. Carapace smooth-----Calocarides quinqueseriatus (Rathbun)

### Genus Calastacus Faxon

#### Calastacus stylirostris Faxon

Calastacus stylirostris Faxon, 1893: 194.--Faxon 1895: 106, pl. 27, fig. 1-1f.--Hart 1982: 46, fig. 9.

Recognition characters.--Rostrum long and narrow, reaching second segment of antennular peduncle, with stout teeth at base. Carapace with prominent cervical groove and narrow anterior dorsal ridge. Eyestalks short, cornea without pigment. Antennular peduncle narrow. Antennal peduncle with long, narrow, thorn-like projections on second and third segments. Flagella of both antennae long and setose. Third maxilliped not as long as merus of major chela, with teeth on widest segment. Chelipeds subequal, fingers without gape., finger tips crossing. Palm of chela with prominent dorsal teeth, merus with sharp teeth on both dorsal and ventral sides. First walking leg chelate, posterior walking legs slender and having simple dactyls. Abdomen slender, pleura blunt or rounded. Telson subequal in length to uropods, with 2 unarmed dorsal ridges. Uropods with unarmed ridges, outer margins with teeth. First pleopods modified for copulation, uniramous, others biramous. Hart (1982) reports that the species is hermaphroditic. Total length 52 mm.

Color in life.--Not reported.

Habitat and depth.--Brown sand or rock, 700-1208 m.

Range.--Southwestern British Columbia to Peru. Type locality off Acapulco, western Mexico.

Remarks.--At present, there are no records of this species from California or Oregon. However, its occurrence north and south of the area suggests that this deep-water species could be found by proper sampling of its habitat.

Genus Axius Leach

Axius acutifrons (Bate)

Eiconaxius acutifrons Bate, 1888: 40, pl. 5, fig. 2.

Axius acutifrons.--Faxon 1893: 193.--Faxon 1895: 103, pl. 28, fig. 2.--De Man 1925: xx.--Wicksten 1982: 246, fig. 1.

Recognition characters.--Rostrum broad, with smooth margins or very small denticles, median rostral carina entire to slightly serrate. Carapace smooth and rounded. Eyes without pigment. Third maxillipeds slender. Chelipeds stout. Fixed finger with large tooth near proximal end of cutting edge, small teeth beyond it; movable finger with notch into which large tooth inserts, palm with longitudinal lateral ridge and 4 teeth along dorsal midline, merus also with teeth. First walking leg chelate. Posterior walking legs with small, sharp dactyls. Abdominal segments smooth, with pointed pleura. Telson with median row of teeth, row of teeth on dorsal midline of uropod. Female total length 29 mm.

Color in life.--Creamy white.

Habitat and depth.--On sand, mud or rubble bottoms, or among hexactinellid sponges, 595-2310 m. Specimens from California were taken inside a sponge.

Range.--Off Banda Island and Great Kei Island, Indonesia, off Mariato Point, Panama, and south of San Clemente Island, California. Type locality off Banda Island.

Genus Calocaris Bell

Calocaris investigatoris (Anderson)

Calastacus investigatoris Anderson, 1896: 97, pl. 2.--Rathbun 1904: 151.--Schmitt 1921: 112, fig. 75.--Pereyra and Alton 1972: 450.

Calocaris investigatoris .--Hart 1982: 48, fig. 10.

Recognition characters.--Rostrum slightly shorter than second segment of antennular peduncle, with sides prolonged into sharp ridges reaching gastric region and bearing 2 spines each. Carapace granulate, with median carina ending in tubercle, another tubercle in middle of gastric region on dorsal margin, pronounced cervical and branchial grooves. Eyestalk small, cornea without pigment. Antennular peduncle shorter than antennal peduncle. Second and third segments of antennal peduncle bearing thorn-like projections. Third maxillipeds slender. Major chelipeds unequal in size but similar in shape. Fingers long and narrow, with proximal gape; 3 rows granules on outer face of palm, palm with small marginal teeth. Superior and inferior surfaces of merus with sharp teeth. First walking leg short, chelate. Other walking legs slender, with simple dactyls. Abdominal somites broad, setose and having grooves and knobs, pleura rounded. Telson longer than uropods, with 2 dorsal rows of fine spines. Uropods with dorsal ridges, few teeth on lateral margins. First pleopods uniramous, modified for copulation; others biramous. The species is hermaphroditic (Hart, 1982). Total length 60 mm.

Color in life.--Carapace pale gray to pink, abdomen pinkish orange to light brown, fading to white on sides; appendages pale orange.

Habitat and depth.--Abyssal mud, 549-1733 m.

Range.--Eastern Pacific from Aleutian Islands to off San Diego, California; also Arabian Sea.  
Type locality Arabian Sea, off coast of Sind.

Genus Calocarides Wollebaek

Calocarides quinqueseriatus (Rathbun)

Calastacus quinqueseriatus Rathbun, 1902: 887.--Rathbun 1904: 151, fig. 91.--Schmitt 1921: 113, fig. 76.--Wicksten 1980 : 362.

Calocarides quinqueseriatus .--Hart 1982: 50, fig. 11.--Kensley 1996: 61, figs. 4,5. (See this reference for a more extensive synonymy).

Recognition characters.--Rostrum flattened, median carina extending from mid-rostrum posteriorly and armed with 2-6 spines; lateral margins with 3-7 spines, prolonged as ridges on gastric area; these ridges separated by 2 short, spined ridges, forming 5 ridges in all. Carapace smooth, with deep cervical groove. Antennular peduncle short but longer than rostrum. Antennal peduncle with short thorn-like projections on second and third segments. Third maxilliped with teeth on inferior margin of broadest segment. Major chelipeds unequal in size, but similar in shape. Major chela with slight gape between fingers, minor chela without gape. Surfaces of hand granulate, upper margin of palm with teeth, teeth and granules also on carpus and merus. First walking leg chelate, with distinct spines on merus and ischium. Other walking legs slender, with simple, setose dactyls. Abdominal pleura rounded. Telson with median tooth and curved posterior margins, toothed lateral margins, also 2 toothed dorsal ridges. Toothed ridge on endopod of uropod. First abdominal somite without pleopod. Other pleopods biramous. Sexes separate. Total length 73 mm.

Color in life.--Unreported, but probably pale.

Habitat and depth.--Abyssal mud, 288-2200 m.

Range.--Sea of Okhotsk to off San Nicolas Island, California. Type locality off San Luis Obispo Bay, California.

Remarks.--In California, this species was collected most often on the upper continental slopes along the mainland instead of along the offshore islands.

Calocarides spinulicauda (Rathbun)

Axius spinulicauda Rathbun, 1902: 886.--Rathbun 1904: 149, fig. 90.

Axiopsis spinulicauda.--Schmitt 1921: 111, fig. 74.--Hart 1982: 44, fig. 8, color plate.

Calocarides spinulicauda.—Kensley 1996: 54.

Recognition characters.--Rostrum reaching middle of second segment of antennular peduncle, slightly deflexed, with 5-6 lateral teeth on each side. Carapace with 5 anterior longitudinal carinae, none of them reaching cervical groove, median carina reaching base of rostrum and bearing 4 spines, short median dorsal carina near posterior margin of carapace. Eyes pigmented. Long, thorn-like projections near base of antenna, antennal scale narrow and sharp. Maxillipeds as long as end of antennal peduncle. Major chelipeds unequal in size, sexually dimorphic. Major chela of male subrectangular, with numerous marginal teeth; of female, palm with convex margins, fingers slender. Minor chelae of both sexes with finely toothed, curved

margins. First walking leg chelate. Walking legs slender, setose, and approximately same length, but decreasing in width of segments posteriorly. Abdomen smooth and stout, pleura rounded. Telson with tooth on mid-posterior margin, rows of spines on distal surface. Uropods with outer margins toothed, spines on median dorsal ridges. First pleopods uniramous, rest biramous. Male with appendix masculina on second pleopod. Male total length 90 mm, female 89.

Color in life.--Mostly pink to coral pink, patches of orange on tail fan.

Habitat.--Burrowing in mud, 59-256 m.

Range.--Holbert Inlet, British Columbia to off Bodega Head, California. Type locality off Bodega Head. A recent photograph taken off La Jolla, California at 30 m may be this species.

## Family Upogebiidae

Only one genus of this family, Upogebia, is present in the eastern Pacific Ocean. The key and descriptions presented here follow the work of Williams (1986), whose publication should be consulted for more detailed synonymies and descriptions. Williams (1986) also reported a single finding of the Atlantic species, U. affinis (Say), from San Francisco Bay, California.

### Key to the Species of Upogebia

1. Postocular spine absent or very tiny. (Southern California only)-----  
-----Upogebia macginitieorum Williams
- Postocular spine robust-----2
2. Merus of third pereopod with proximolateral spines-----Upogebia lepta Williams
- Merus of third pereopod without proximolateral spines-----3
3. Short fixed finger of chela with slender, laterally compressed tip. (Alaska to Morro Bay, California, intertidal)-----Upogebia pugettensis (Dana)
- Short fixed finger of chela with broad tip flattened on prehensile edge and corneous. (San Miguel Island, California, subtidal)-----Upogebia onychion Williams

### Upogebia macginitieorum Williams

Upogebia macginitieorum Williams, 1986: 30, fig. 11.

Recognition characters.--Rostrum triangular, straight, longer than eyestalks, with pair short subapical spines followed on each side by 4 small conical teeth; dorsal teeth near midlength continuing with spines and tubercles over anterior dorsal part of carapace. 2 divergent spined ridges extending from rostrum to posterior half of carapace. Gastric region posteriorly smooth, cervical groove deep and continuous, lateral groove (thalassinidean line) continuing to posterior margin of carapace. Postocular spine obsolescent or absent. Antennular peduncle shorter than antennal peduncle. Third maxilliped with epipod. Chelipeds nearly equal, setose. Dactyl curved, overlapping fixed finger, fixed finger with 1 large tooth on cutting edge. Palm broad. Carpus bearing sharp spines along posterior margin, merus with spinules on inferior margin, ischium with 1 spine. Second pereopod very stout, dactyl blunt and not chelate, merus without mesioventral spine. . Third to fifth pereopods decreasing in size, setose, with simple dactyls. Abdomen smooth, pleura narrow and pubescent. Telson rectangular, with median indentation and transverse anterior ridge and low lateral ridges. Uropods with spine on protopod, exopod with 3 dorsal ridges, without transverse suture; and endopod with 1 ridge. First pleopod absent in male, biramous in female, other pleopods biramous. Male carapace length 20.7 mm, female carapace length 22.1.

Color in life.--Dull grayish to bluish, appendages with whitish to yellow tinge, tail fan with yellow to orange edge.

Habitat and depth.-- Burrows in clay banks, high intertidal zone.

Range.--Santa Catalina Island and Newport Bay to Tijuana Slough, California. Type locality Tijuana Slough.

Remarks.--This species has been confused with *U. pugettensis* in older literature.

### Upogebia lepta Williams

Upogebia lepta Williams, 1986: 22, fig. 8.

Recognition characters.--Rostrum narrowly triangular, straight, longer than eyestalks, with pair small subapical dorsal spines and 4 lateral spines on each side, central part of rostrum without spines. Much of dorsal surface of carapace covered by spiniform tubercles, postocular spine present. Cervical groove and thalassinidean line conspicuous. Antennular peduncle shorter than antennal peduncle, first and second articles bearing prominent ventral spines. Third maxilliped with epipod. Major chelipeds nearly equal, slender. Movable finger of chela slightly curved, with dentate dorsal crest having long proximal tooth. Fixed finger short, with tooth on cutting edge, palm setose and having prominent spine at distal end. Carpus with prominent spines. Merus with small spines on superior and inferior sides, ischium with small spine. Second pereopod stout and setose, carpus with spines. Third pereopod with slender dactyl, merus with cluster of weak proximoventral spines. Fourth pereopod slender, merus without spines. Fifth pereopod subchelate. Abdomen smooth. Telson rectangular, very slightly lobed posteriorly, with low transverse anterior ridge and low lateral ridges. Uropods with protopod having tiny spine, exopod with 3 dorsal ridges, endopod with 1 ridge. Male without first pleopods. Male carapace length 6.2 mm.

Color in life.--Not reported.

Habitat and depth.--Subtidal, 74-103 m.

Range.--Santa Catalina Island, California and Coronado Islands, Baja California, Mexico. Type locality Coronado Islands.

Remarks.--Although substrate was not reported by Williams (1986), the areas in which the specimens were collected often have bottoms of shelly sand.

### Upogebia pugettensis (Dana)

Gebia pugettensis Dana, 1852: 19.

Upogebia pugettensis.--Holmes 1900: 157.--Rathbun 1904: 153.--Schmitt 1921: 115, fig. 77. --Hart 1982: 52, fig. 12.--Williams 1986: 35, fig. 13.

Recognition characters.--Rostrum broadly triangular, flanked by shorter frontal process at each side; tip obtuse, length shorter than antennular peduncle; lateral borders with 3-5 conical teeth, short subapical pair remote from tip; 0-2 dorsal teeth near midlength on each side. Row of 11-12 teeth on ridge lateral to gastric region of carapace, surface mesial to these rows armed with small tubercles or teeth; anterolateral margin with short ocular spine, extension of epistome in lateral view bearing -13 tiny distal spines. Shoulder of carapace lateral to cervical groove armed with about 20 tiny teeth, thalassinidean line continuing to posterior margin of carapace. First segment of antennular peduncle with sharp tooth at distoventral end of inner border. Second segment of antennal flagellum with small distoventral spine, scale small and oval. Chelipeds equal. Dactyl slightly curved, upper surface ridged and bearing rows of setae, lateral surface



with row of 6-7 blunt tubercles and 2-3 smaller tubercles near them, 2 low teeth on cutting edge. Fixed finger directed ventromesially, with 1 conical tooth on cutting edge. Palm with setose lines and rows of small teeth and setae, mesiodistal sharp spine at base of dactyl. Carpus with lateral longitudinal furrow, strong spine on mesiodistal border and 4-10 small teeth nearby, small spine on distal margin and larger spine at mesiodistal margin, also small spine at distoventral corner. Merus with upper margin curved, small spine near carpal end, setae and 5-6 small teeth on ventrolateral border, 4 spines on ventromesial border. Ischium with small spine on lower border. Second pereopod not chelate, fringe on setae along lower margins of segments, carpus with small distal spines, merus with tiny spine on superior margin. Third to fifth pereopods setose, decreasing in size, dactyls with spinules on flexor margins. Abdomen rather broad, pleura usually without ventral spines. Telson widest at anterior end, with low dorsal carina on each side of median furrow. Uropods slightly exceeding telson, bearing dorsal ribs and minute marginal spines, protopod bearing small spine. Total lengths 75-112 mm, males smaller than females.

Color in life.--Variable: deep olive, brown, deep blue to dirty bluish white. Color may depend on the feeding habits of the individual.

Habitat and depth.--Burrows in muddy beaches, mud flats, sloughs or estuaries, intertidal to shallow subtidal, near shore.

Range.--Sawmill Bay, Alaska to Morro Bay, California. Type locality "Puget Sound".

### Upogebia onychion Williams

Upogebia onychion Williams, 1986: 33, fig. 12.

Recognition characters.--Rostrum broadly triangular, pair of moderate subapical dorsal spines followed by 2 spines, central surface bearing tufts of setae and almost without spines, merging with area of sparse spiniform tubercles and tubercles diminishing over anterodorsal carapace. Gastric region posterior to field of tubercles smooth. Cervical groove moderate and continuous, thalassinidean line continuing to posterior margin of carapace. Postocular margin bearing spine. Antennular peduncle shorter than antennal peduncle. Second segment of antennal peduncle without subdistal ventral spine. Antennal scale moderate. Chelipeds nearly equal, moderately stout. Dactyl slightly curved, with 1 low tooth on cutting edge. Fixed finger stubby, with 1-2 teeth on cutting edge. Palm with rows of setae, dorsal crests low and without spines. Carpus with obsolescent spines and 3-4 tiny spines on anterodorsal margin, also spines on distomesial and distoventral margins. Merus with 4 spines on ventral margin and subdistal dorsal spine. Ischium with 1 small ventral spine. Second pereopod stout, without chela; carpus with dorsal and ventral spines, merus with dorsal spine. Pereopods 3 and 4 smaller, setose, without spines. Abdomen broad, pleura of first somite narrowly rounded posterolaterally, other pleura broadly rounded. Telson rectangular, with low lateral ridges, median groove obsolescent. Uropods with tiny spine on protopod, endopod with 2 ribs, exopod with 3. Carapace length 7.2 mm.

Color in life.--Not reported.

Habitat and depth.--Among sand and rocks, 39 m.

Range.--Known only from type locality, east of Cardwell Point, San Miguel Island.

## Family Ctenochelidae

Manning and Felder (1991) erected the new family Ctenochelidae for ghost shrimp with a cardiac prominence, a strong antennal scale and pediform third maxilliped usually with a distal spine. Only one species, Callianopsis goniophthalmus, is found in California and Oregon, although other species occur in mud on continental shelves and slopes throughout much of the world.

Genus Callianopsis De St. Laurent

Callianopsis goniophthalma (Rathbun)

Callianassa goniophthalma Rathbun, 1902: 886.--Rathbun 1904: 154, pl. 8.--Schmitt 1921: 121, fig. 82.--Pereyra and Alton 1972: 450.--Wicksten 1980: 362.

Callianopsis goniophthalma.--Hart 1982: 54, fig. 13.--Manning and Felder 1991: 789, fig. 18.

Recognition characters.--Rostrum small, sharp. Carapace smooth, slight elevation on mid-dorsal margin, distinct cervical groove and lateral groove. Eyestalk long, with small tooth, cornea unpigmented. Both antennae with slender peduncles and long, setose flagella. Third maxillipeds with semicircular dactyls. Larger cheliped with setose, toothed fingers, gape between fingers in male. Palm of chela with sharp margins. Carpus wide, merus with ventral marginal tooth. Smaller chela slender. First walking leg chelate, second and third with simple dactyls, last pereopod subchelate. Abdomen with narrow pleura, membranous; sharp tooth on either side of sixth segment. Telson subrectangular, uropods longer than telson; all bearing dorsal ribs. Male with first pleopods modified as copulatory appendages, female first pleopods biramous. Total length of male 130 mm, female 100.

Color in life.--Not reported, but probably pale.

Habitat and depth.--Continental slopes, mud and clay, 483-1920 m.

Range.--Clarence Strait, Alaska to off Palos Verdes Peninsula, California. Type locality off Point Conception, California.

## Family Callianassidae

Until recently, all eastern Pacific ghost shrimps were considered to belong to the genus Callianassa. Manning and Felder (1991) revised the classification of genera in this family, and reassigned the species from California and Oregon to the genus Neotrypaea.

As of this writing, no one has attempted a revision of the local species of callianassids. Callianassa longimana has been synonymized with N. gigas. However, there have been no studies of the abundant callianassids recently taken in benthic offshore surveys to determine whether or not they are the same species that occur in shallow and intertidal areas, nor have species from California and Oregon been compared with specimens from Mexico. The reader should assume that ranges and habitats presented here represent limited sampling.

### Key to the Species of the Family Callianassidae

1. Front with sharp and prominent median tooth-----Neotrypaea gigas (Dana)  
Front without sharp and prominent median tooth-----2
2. Eystalks with acute and divergent tips. (Alaska to San Diego County, California)-----  
-----Neotrypaea californiensis (Dana)  
Eystalks with tuberculiform tips, not diverging. (Not known north of Los Angeles County, California)-----Neotrypaea affinis (Holmes)

#### Neotrypaea gigas (Dana)

Callianassa gigas Dana, 1852: 19.--Holmes 1900: 162.--Rathbun 1904: 154.--Schmitt 1921: 119, fig. 80.--Hart 1982: 56, fig. 14.

Callianassa longimana Stimpson, 1857: 86.--Rathbun 1904: 154.--Schmitt 1921: 117, fig. 79.

Neotrypaea gigas.--Manning and Felder 1991: 771.

Recognition characters.--Frontal tooth sharp to subacute. Eystalks with acute and divergent tips, pigmented area behind middle of stalk. Carapace smooth, with cervical groove and lateral groove. Third maxillipeds operculiform. First pereopods chelate, unequal, sexually dimorphic. Male major cheliped almost as long as rest of body, chela elongate, dorsal and ventral margins of palm and carpus relatively straight. Merus with large lobe near base. Large cheliped of female and immature male with hand longer than carpus. Small cheliped in both sexes elongate, carpus and hand subequal. Second pereopod chelate, palm wide. Third to fifth pereopods flattened, modified for digging, with simple dactyls. Male with vestigial first pleopods, none on second abdominal somite; third to fifth pleopods well developed. Female with uniramous first pleopods, biramous second pleopods. Telson subrectangular, with pair dorsal ribs. Uropods as long as or longer than telson, exopod with dorsal rib. Male total length 150 mm. female 106.

Color in life.--Mostly ivory to cream, abdomen flesh-colored dorsally.

Habitat and depth.--Mud or sandy mud, intertidal-50 m.

Range.--Digby Island, British Columbia to San Quentin Bay, Baja California, Mexico. Type locality "Puget Sound".

Neotrypaea californiensis (Dana)

Callianassa californiensis Dana, 1854: 175.--Holmes 1900: 159.--Rathbun 1904: 154.--Schmitt 1921: 117, fig. 78.--Hart 1982: 58, fig. 15.

Neotrypaea californiensis.--Manning and Felder 1991: 771, fig. 10.

Recognition characters.--Median tooth of front short and rounded. Carapace smooth, with cervical and lateral grooves. Eyestalks with acute and divergent tips, pigmented cornea at middle of eyestalk. Third maxilliped operculiform. First chelipeds unequal and sexually dimorphic. Major cheliped of male with fingers gaping, crossed at tip, carpus and hand subequal. In female and immature male, hand longer than carpus. Merus with prominent ventral lobe. Smaller cheliped with carpus longer than hand, fingers shorter than palm. Second pereopod chelate, flattened. Third pereopod with triangular carpus, broad subrectangular propodus and small rounded dactyl. Fourth and fifth pereopods slender, last leg chelate. Abdominal pleura narrow. Male with vestigial first pleopods, second pleopods absent, third to fifth foliaceous. Female with first pleopods uniramous, second biramous. Telson subrectangular, with 2 dorsal ribs and tooth on posterior margin. Uropods about same length as telson, exopod with dorsal ribs. Male total length 115 mm, female 120.

Color in life.--White to creamy, patches of pink, yellow to orange on appendages, abdomen pink.

Habitat and depth.--High intertidal mud or sand.

Range.--Mutiny Bay, Alaska to mouth of Tiajuana River, San Diego County, California. Type locality "California" (probably San Francisco Bay or Monterey).



Neotrypaea californiensis

Neotrypaea affinis (Holmes)

Callianassa affinis Holmes, 1900: 162, pl. 2, figs. 29-30.--Rathbun 1904: 154.--Schmitt 1921: 119, fig. 81.

Neotrypaea affinis.--Manning and Felder 1991: 771.

Recognition characters.--Median tooth of front obscure. Eyestalks with tuberculiform extremities, not divergent, pigmented cornea in front of middle of eyestalk. Carapace smooth, with cervical and lateral grooves. Third maxilliped operculiform. First pereopods unequal, chelate. Major chela of male with fingers crossing, without gape, carpus shorter than to equal to palm. Merus with large lobe near base. Small cheliped slender. Second pereopod chelate, posterior pereopods modified for digging. Abdominal pleura small. Male with vestigial first pleopods, second pleopods absent. Female with uniramous first pleopods, second pleopods biramous. Third to fifth pleopods biramous. Telson subrectangular, uropods about same length as telson. Male total length 61 mm.

Color in life.--Creamy white.

Habitat and depth.--Tidepools, in sand under rocks. Usually occurs in pairs.

Range.--Goleta, Santa Barbara County to San Quintin Bay, Baja California, Mexico (Ricketts et al., 1985). Type locality Point Loma, San Diego County, California.



Neotrypaea affinis

## Infraorder Anomura

The Anomura remains a puzzling group of decapods. While most authors agree on the composition of the superfamilies in the group, which of these superfamilies are related most closely to the other remains uncertain. Some authors consider the families Homolidae and Dromiidae, here considered to belong to the Brachyura, to be anomurans. Although the Thalassinidea historically have been considered to belong to the Anomura, most modern authors place them in a group of their own.

Anomurans in California and adjacent waters are, for the most part, crab-like. The carapace is not fused to the epistome (the area around the mouth). In many species, the second antennae are elongate, not short and retractable into sockets. Often, one pair of antennae lies mesial to the eyestalks and the other lateral to them (but not always). In the hermit crabs, king crabs and galatheids, the third maxillipeds do not form a plate-like covering of the mouth (an operculum). The first pereopods are chelate in all but *Emerita analoga*. The fifth pereopods often are modified for digging, gripping a shell or cleaning the body. The abdomen may be soft, twisted to one side or partially membranous, but not among the mole crabs. Pleopods often are reduced or present on only one side of the abdomen. The telson may be reduced or absent, or form part of a tail fan. Unlike true crabs (Brachyura), anomurans may be able to swim by flapping the abdomen.

### Key to the families of the Anomura

1. Abdomen soft and elongate. Inhabiting shells or tubes-----2  
Abdomen usually not soft, if so, rounded and not elongate. Not inhabiting shells or tubes-----4
2. Outer maxillipeds close together at base, chelipeds subequal-----family Diagneidae  
Outer maxillipeds separated by the width of one maxilliped at least at base, chelipeds not equal in size and shape-----3
3. Toothed ridge of outer maxilliped with 1 or more accessory teeth, female with gonopore on both third pereopods. (Intertidal and deeper) -----family Paguridae  
Toothed ridge of outer maxilliped without accessory teeth, female with gonopore on left third pereopod only. (Continental shelf and slope)-----family Parapaguridae
4. Body somewhat egg-shaped to rectangular, highly modified for digging-----5  
Body not egg-shaped to rectangular, not modified for digging-----7
5. First pereopods without chelae, telson elongate, spearhead-shaped-----family Hippidae  
First pereopods with chelae, telson small, somewhat circular to ovate-----6
6. Eyestalks elongate ovoid, with pigmented corneae-----family Blepharipodidae  
Eyestalks squarish, corneae without pigment-----family Albuneidae

7. Abdomen tightly flexed beneath abdomen, soft to calcified but incapable of being used in swimming, not lobster-like; uropods absent-----family Lithodidae
- Abdomen loosely flexed beneath abdomen, lightly calcified, capable of being used in swimming, may be lobster-like; uropods present-----8
8. Abdomen not lobster-like, folded against cephalothorax, first legs heavy and not elongated-----family Porcellanidae
- Abdomen lobster-like but short, not folded against cephalothorax, first legs slender and elongated-----9
9. Third maxilliped without epipodite. Telson folded beneath preceding abdominal somites. (Continental slopes, usually living on colonial anthozoans)-----family Chirostylidae
- Third maxilliped with epipodite. Telson not folded beneath preceding abdominal somites. (Surface waters to abyssal plains, various substrata)-----family Galatheidae

# Superfamilies Coenobitoidea and Paguroidea: the hermit crabs

The most familiar of all anomurans are the hermit crabs. In California and Oregon, these animals inhabit shells, tubes or rarely bits of hollow crab exoskeleton, twigs or even bones. Species occur from the upper tidepools to the abyss.

Hermit crabs have characteristic anatomy. Most noticeable is the soft abdomen, ending in a small telson and uropods. The pleopods usually are reduced at least along one side of the abdomen. The carapace, although present, usually is lightly calcified. The eyes are stalked and well developed, with pigmented corneae. The first antennae are well equipped with sensory setae, the aesthetascs. In life, the antennae flick, aiding the crab in tracking chemosensory cues. The second antennae are long and whip-like in most species, but setose and used in gathering particles in some species of the Diogenidae. The rostrum varies from long and pointed to almost absent. The third maxillipeds are leg-like and setose. The first pereopods bear chelae, one often larger than the other. In some species, the major cheliped ends in an enlarged chela that can block the aperture of the shell. The size and shape of the chelae can be sexually dimorphic. The second and third pereopods are ambulatory. The last pairs of pereopods are short and grip the shell.

Older books classified all hermit crabs in a single family, the Paguridae. Today, three families are recognized as occurring in California and Oregon. The Paguridae, most often observed and studied, range from the continental slopes to the intertidal zone. Species of the Diogenidae usually are subtidal, and may be able to bury themselves in sand. The Parapaguridae will be found on the continental shelf and deeper areas. Keys, illustrations and further information on hermit crabs occurring north of Point Conception, California can be found in the account by McLaughlin (1974). The key presented here is modified from a manuscript key by the late Janet Haig.

## Key to the Hermit Crabs

1. Outer maxillipeds approximated at their bases; chelipeds equal or subequal in size-----  
----- family Diogenidae---2

Outer maxillipeds widely separated at their bases; right cheliped larger than left-----7

2. Pereopod 4 subchelate; no paired pleopods in either sex. (Living in sand, often buried in sand)-  
-----Isocheles pilosus (Holmes)

Pereopod 4 simple; paired pleopods in both sexes. (Living in sand or among rocks, usually not buried)-----Paguristes---3

3. Dorsal surface of palms of chelae coarsely granulated, and bearing fluffy clusters of short plumose setae-----Paguristes parvus Holmes

Dorsal surface of palms of chelae with large conical tubercles, each tipped with dark corneous spine; chelae bearing many long stiff simple setae-----4



4. Rostrum about as long as lateral frontal projections of carapace; antennal flagellum with short, wide-set hairs on lower surface-----5
- Rostrum longer than lateral frontal projections of carapace; antennal flagellum with long, close-set hairs on lower surface-----6
5. Chelae very broad, their dorsomesial margin strongly convex-----Paguristes bakeri Holmes
- Chelae relatively narrow, dorsomesial margin not strongly convex-----Paguristes turgidus (Stimpson)
6. Rostrum broad at base, reaching about to base of eyescales; propodus and dactyl of walking legs with small, dark corneous spines on inner surface-----Paguristes ulreyi Schmitt
- Rostrum slender, narrow at base, tip reaching beyond base of eyescales; propodus and dactyl of walking legs unarmed on inner surface-----Paguristes undescribed species
7. Crista dentata of outer maxillipeds with 1 or more accessory teeth; female with gonopore on coxa of both third pereopods. (Intertidal to continental slopes, common)-----family Paguridae---8
- Crista dentata of outer maxillipeds lacking accessory tooth; female with gonopore on coxa of left third pereopod only. (Continental shelf to abyssal plains)-----  
-----family Parapaguridae, Parapagurus benedicti de Saint Laurent
8. Telson with posterior margin entire, lacking lobes and median cleft-----9
- Telson divided into lobes posteriorly-----10
9. Telson unarmed terminally; uropods asymmetrical-----Enallopaguropsis guatemoci (Glassell)
- Telson spined terminally; uropods symmetrical-----Discorsopagurus schmitti (Stevens)
10. Propodial rasp of pereopod 4 a single row-----11
- Propodial rasp of pereopod 4 well developed, with multiple scale rows-----13
11. Abdomen straight; uropods symmetrical-----Pylopagurus holmesi Schmitt
- Abdomen coiled; uropods asymmetrical-----12
12. Major chela discoid, dorsal surface of palm convex and bearing many low boss-like tubercles; dactyl with raised ridge on dorsal face; pereopod 4 with preungual process-----  
-----Phimochirus californiensis (Benedict)
- Major chela subquadrate, dorsal surface of palm slightly concave, with raised margins and scattered slender tubercles; dactyl without facial ridge, but bearing proximal tubercle row on dorsal face; pereopod 4 lacking preungual process-----Haigia diegensis (Scanland and Hopkins)

|   |  |    |
|---|--|----|
| 13. Abdomen straight; uropods symmetrical. (Often inhabiting tubes or tubular shells)-----<br>-----   | <u>Orthopagurus minimus</u> (Holmes)               |    |
| Abdomen coiled; uropods asymmetrical-----   |  | 14 |
| 14. Male with short sexual tube on coxa of pereopod 5-----  |  | 15 |
| Male without sexual tube on coxa of pereopod 5 (except <u>P. aleuticus</u> male)-----   |  | 18 |
| 15. Dactyls of pereopods with pronounced lateral sulcus-----<br>(not female)  | <u>Pagurus aleuticus</u> (Benedict) male           |    |
| Dactyls of pereopods lacking lateral sulcus-----  |  | 16 |
| 16. Dorsal surface of palm of major chela unarmed proximally; scattered small spinules or<br>spinulose tubercles distally and on fixed finger----                       | <u>Parapagurodes makarovi</u> McLaughlin and Haig  |    |
| Dorsal surface of palm of major chela armed proximally with one or more irregular rows of<br>widely spaces strong spines, these not extending onto fixed finger-----    |  | 17 |
| 17. Dactyls of chelae without row of spines in dorsal midline. (In life, without bright color marks<br>on chelipeds and walking legs)-----                              | <u>Parapagurodes laurentae</u> McLaughlin and Haig |    |
| Dactyls of chelae with row of spines in dorsal midline. (In life, with bright color marks on<br>chelipeds and walking legs)-----  | <u>Parapagurodes hartae</u> McLaughlin and Jensen  |    |
| 18. Minor chela with dorsal surface of palm flattened; propodus of pereopod 3 with row of spines<br>on upper margin-----  |  | 19 |
| Minor chela with dorsal surface of palm elevated; propodus of pereopods usually unarmed on<br>upper margin-----   |  | 22 |
| 19. Dorsomesial margin of minor chela strongly convex; posterior lobes of telson armed on both<br>terminal and lateral margins-----                                     | <u>Pagurus spilocarpus</u> Haig                    |    |
| Dorsomesial margin of minor chela nearly straight; posterior lobes of telson armed on terminal<br>margins only-----   |  | 20 |
| 20. Dactyls of walking legs with prominent longitudinal sulcus on dorsal surface-----<br>-----  | <u>Pagurus aleuticus</u> (Benedict)                |    |
| Dactyls of walking legs with 3 longitudinal rows of small spines or spinulous tubercles on<br>dorsal surface, separated proximally by 2 shallow longitudinal sulci----- |  | 21 |
| 21. Chelae with moderately short, bluntly conical spines or tubercles on dorsal surface-----<br>-----   | <u>Pagurus ochotensis</u> Brandt                   |    |
| Chelae with acute spines on dorsal surface-----   | <u>Pagurus armatus</u> (Dana)                      |    |

|  |  |
|--|--|
| 22. Minor chela with dorsolateral surface concave; midline elevated into prominent ridge; palm of right chela raised into prominent, triangular plateau----- | 23   |
| Minor chela with dorsolateral surface convex; midline often elevated, but not into prominent ridge-----  | 25   |
| 23. Dorsal margins of propodi of ambulatory legs serrate. Dactyls of ambulatory legs not flattened . (Can occur in California)-----                          | <u>Pagurus tanneri</u> (Benedict)                    |
| Dorsal margins of propodi of ambulatory legs not serrate. Dactyls of ambulatory legs flattened. (Not found south of Oregon)-----                             | 24   |
| 24. Large hand with apex of raised triangular area horn-shaped in profile-----   | <u>Pagurus cornutus</u> (Benedict)                   |
| Large hand with apex of raised triangular area rounded in profile-----   | <u>Pagurus confragosus</u> (Benedict)                |
| 25. Merus of major cheliped with 1 or 2 prominent tubercles on ventral surface-----  | 26   |
| Merus of major cheliped without prominent tubercles on ventral surface-----  | 34   |
| 26. Dorsal surface of palm smooth, paved with tiny, close-set granules. Major chela with sharp lateral angles, enlarged and operculum-like.---               | <u>Pagurus retrorsimanus</u> Wicksten and McLaughlin |
| Dorsal surface of palm of chela roughened, with prominent granules. Major chela with rounded margins, not operculum-like-----                                | 27   |
| 27. Rostrum only slightly produced-----  | 28   |
| Rostrum distinct, produced well beyond lateral frontal lobes of carapace-----  | 31   |
| 28. Merus of major chela with 1 prominent tubercle ventrally-----  | <u>Pagurus caurinus</u> Hart                         |
| Merus of major chela with 2 prominent tubercles ventrally-----   | 29   |
| 29. Ocular scales tipped with 3 or more spines-----  | <u>Pagurus quaylei</u> Hart (in part)                |
| Ocular scales tipped with single spine-----  | 30   |
| 30. Major chela more or less evenly and finely granulated dorsally; palm of minor chela granulated on lower surface-----                                     | <u>Pagurus granosimanus</u> (Stimson)                |
| Major chela more or less coarsely and irregularly granulated dorsally; palm of minor chela smooth on lower surface-----                                      | <u>Pagurus beringanus</u> (Benedict)                 |

31. Carpus of major chela deeper than wide; shield shiny and smooth, entire crab almost hairless-----Pagurus hemphilli (Benedict)
- Carpus of major chela wider than deep; shield and legs hairy-----32
32. Merus of major cheliped with 2 prominent tubercles ventrally; carapace shield distinctly longer than wide-----Pagurus samuelis (Stimpson)
- Merus of major chela with 1 prominent tubercle ventrally; carapace shield wider than long---33
33. Carapace shield distinctly wider than long. (North of Point Conception, California)-----  
-----Pagurus hirsutiussculus (Dana)
- Carapace shield slightly longer than wide. (Usually south of Point Conception, California)-----  
-----Pagurus venturensis Coffin
34. Eyescales obliquely truncate, oblique margin with 4 or 5 spinules-----  
-----Pagurus redondoensis Wicksten
- Eyescales subovate, usually terminating in single spine-----35
35. Propodus of right pereopod 2 with row of spines dorsally; dactyl of left pereopod 3 usually with row of pointed tubercles on dorsal margin and similar row on ventral part of outer surface--  
-----Pagurus quaylei Hart
- Propodus of right pereopod 2 unarmed; dactyl of left pereopod 3 without pointed tubercles on dorsal margin or ventral part of outer surface-----36
36. Major chela with spines and granules, setae short and inconspicuous-----  
-----Pagurus dalli (Benedict)
- Major chela with spines but not granules, setae longer, easily seen-----37
37. Dactyls of walking legs with row of small corneous spinules on lower margins-----  
-----Pagurus capillatus (Benedict)
- Dactyls of walking legs with row of strong corneous spines on lower margins-----  
-----Pagurus setosus (Benedict)
38. Dorsal surface of palm of major chela evenly granulate; male with 2 pairs of pleopods-----  
-----Parapagurus benedicti de Saint Laurent
- Dorsal surface of palm of major chela with few longitudinal rows of small pointed granules or tubercles; no paired pleopods in male-----Sympagurus haigae (de Saint Laurent)

## Family Diogenidae

The "even-clawed" hermit crabs are widely distributed, especially in tropical regions. In California and Oregon, they are primarily subtidal, although Isocheles pilosus may be exposed at very low tide. Except for Paguristes parvus, the animals often have setose second antennae. These antennae can be used to capture particles, which are swept off by the third maxillipeds and then eaten (Wicksten, 1979, 1988b). The animals also can graze and scavenge, feed on smaller invertebrates, or use the third maxillipeds to brush edible debris off the bottom.

Species of the Diogenidae include some of the largest hermit crabs of the area. The shells may contain small polychaetes or slipper shells (Crepidula and Crepidatella spp.) Shells inhabited by epibenthic species often are heavily encrusted by bryozoans, algae, or barnacles. Although often seen by divers, there have been few studies or observations on their natural history.

Schmitt (1921) described an additional species, Dardanus jordani, from San Francisco Bay, California. The species has not been reported since then, and was based on a single specimen. The locality of the collection may have been error, or the specimen might have been of a species native to some other part of the world and dumped into the bay.

Genus Isocheles Stimpson

Isocheles pilosus (Holmes)

Holopagurus pilosus Holmes, 1900: 154.--Schmitt 1921: 127, pl. 17, fig. 2.

Isocheles pilosus.--Forest 1964: 294.--Haig, Hopkins and Scanland 1970: 17.--Carlton and Kuris 1975: 401.--Haig and Wicksten 1975: 102.--Wicksten 1979c: 100.--Haig and Abbott 1980: 584, fig. 24.9.--Ricketts et al. 1985: 336, fig. 262.—Wicksten 1988b: 321.--Jensen 1995: 67, fig. 127.

Recognition characters.--Rostrum blunt and rounded, reaching about as far forward as lateral projections of carapace. Carapace triangular. Second antennae setose. Eyestalks set close together, about 0.66X length of carapace, cornea not dilated. Chelipeds similar in size and shape. Hands horizontally flattened and covered with scattered spines, palms gently convex but with transverse depression anterior to base of fingers. Larger cheliped widest across base of fingers. Smaller cheliped relatively narrower than larger and with inner and outer faces parallel. Dactyls of ambulatory legs long, gently curved, flattened toward apex. Carapace length to about 30 mm.

Color in life.--Carapace and antennae mottled with bluish and gray tints. Chelipeds cream to orange with bluish tinge on upper surface, line of brick red along chela. Walking legs tan to whitish, marked with brick red stripes.

Habitat and depth.--In medium sand, low intertidal zone to 55 m.

Range.--Bodega Bay, California to Estero de Punta Banda, Baja California, Mexico. Type locality off San Diego, California.

Remarks.--This hermit crab can be very abundant on sandy beaches. It inhabits shells of Polinices spp., Olivella biplicata, Nassarius fossatus and other sand-dwelling gastropods. The crab can scurry on top of the sand or dig into the sand, shell and all, leaving only the oral region, eyestalks and antennae exposed. It can feed in three ways: raking the surface of the sand with

the third maxillipeds, capturing particles filtered by the antennae, or using the chelae to pick up food.



Isocheles pilosus

Genus Paguristes Dana

Paguristes parvus Holmes

Paguristes parvus Holmes, 1900: 151, pl. 2, fig. 26.--Schmitt 1921: 124, fig. 83.--Haig, Hopkins and Scanland 1970: 18.--Haig and Wicksten 1975: 102.--Jensen 1995: 68, fig. 131.

Recognition characters.--Rostrum long and prominent, reaching tips of eye scales. Eystalks about 0.66X width of anterior portion of carapace, distal half of eystalks about as wide as cornea, proximal half abruptly enlarged. Second antennae with few sparse setae. Upper surfaces of hands of chelae coarsely granulate, armed with 3 short, stout spines on inner margin proximal to dactyl. Carapace length to 7.8 mm.

Color in life.--Chelae creamy to light gray, walking legs creamy and banded with dark brown and red-brown, antennae banded with brown.

Habitat and depth.--Subtidal rocky areas, lowest intertidal zone to 20 m.

Range.--Off Point Conception, California to Sacramento Reef, Baja California, Mexico. Type locality White's Point, Los Angeles County, California.

Remarks.--This is the only species of Paguristes in the area of coverage that does not have setose second antennae. It also is the smallest of the species in the area. Paguristes parvus is one of the most common subtidal hermit crabs of southern California, especially along the shores of the offshore islands.



Paguristes parvus

Paguristes bakeri Holmes

Paguristes bakeri Holmes, 1900: 152.--Schmitt 1921: 124, pl. 18, figs. 2, 6.--Haig, Hopkins and Scanland 1970: 17.--Wicksten 1988a: 321.—Wicksten 1988b: 321.--Jensen 1995: 68, fig. 130.

Recognition characters.--Rostrum about as long as lateral projections of carapace. Second antennae sparsely setose. Eyestalks about 0.75X as long as width of anterior portion of carapace. Hands of chelae broad, about 1.2X wider than long, outer margin strongly convex; immovable finger about 2X as wide at base as movable finger; upper surface of hands strongly spined. Appendages covered by shaggy setae. Carapace length to 35 mm.

Color in life.--Dark reddish to brown; sometimes with blue shade on legs.

Habitat and depth.--Usually subtidal; lowest intertidal zone to 215 m, often in silty sand.

Range.--Bodega Bay, California to Gulf of California, Mexico. Type locality San Diego, California.

Remarks.--This large hermit crab usually inhabits shells of moon snails (Polinices spp.) It can dig into the sediment, and can use both its antennae and third maxillipeds to capture particles of food.



Paguristes bakeri

Paguristes turgidus (Stimpson)

Eupagurus turgidus Stimpson, 1857: 484, pl. 21, fig. 1.

Paguristes turgidus .--Holmes 1900: 151.--Schmitt 1921: 123, pl. 18, figs. 1, 8.--Pereyra and Alton 1972: 450.--McLaughlin 1974: 28, figs. 10-12.—Wicksten 1980: 363.--Hart 1982: 104, fig. 36.—Wicksten 1989b: 314.--Jensen 1995: 68, fig. 129.

Recognition characters.--Rostrum about as long as lateral projections of carapace. Second antennae sparsely setose. Eyestalks about 0.75X width of anterior portion of carapace. Hands about 1.33 X longer than wide, outer margin slightly convex; immovable finger at base subequal to movable finger; upper surface of hands strongly spined with numerous dark-tipped spines. Appendages densely setose. Dactyls of ambulatory legs longer than propodi. Propodus and merus of first ambulatory leg with strong marginal spines. Telson strongly asymmetrical, left side more elongated than right; with deep lateral notches and spines along posterior margin. Posterior margin deeply concave. Carapace length to 32 mm.

Color in life.--Yellowish, to orange-brown, eyestalks with longitudinal crimson stripe.

Habitat and depth.--Subtidal, 5-465 m on rocks and muddy sand.

Range.--Chuckchi Sea to San Diego, California. Type locality "Puget Sound."

Remarks.--In the northern part of its range, the species often inhabits the shells of Fusitriton oregonensis. Specimens from California inhabited shells of species of the cold-water whelks, family Neptuneidae.



Paguristes ulreyi Schmitt

Paguristes ulreyi Schmitt, 1921: 125, pl. 18, figs. 3,4,5,7.--Haig, Hopkins and Scanland 1970: 18.--McLaughlin 1974: 19, figs. 7-9.--Hart 1982: 106, fig. 37.--Wicksten 1988a: 321.—Wicksten 1988b: 321.--Jensen 1995: 67., fig. 128

Recognition characters.--Rostrum triangular, acute, reaching to base of eye sclae and exceeding lateral projections of carapace. Eyestalks long and slender, as long as or longer than anterior carapace width. Ocular scales each with 4-5 spiniform teeth. Second antennae with thick setae on lower surface, shorter setae above. Chelipeds equal, densely setose; merus with spines on anterior edge and inner border of lower face, carpus with 5 stout spines on upper inner edge; upper surface of hand with dark tipped spines, inner edge of palm proximal to dactyl with 3 prominent spines. Hands about 0.33-0.5X longer than wide. Ambulatory legs very setose, their dactyls slightly shorter than the propodi. First ambulatory leg with spines along margin of dactyl, propodus and carpus, second with less prominent spines. Telson asymmetrical, deeply notched along lateral margins and at posterior end, posterior margin and posterolateral edge with spines. Carapace length to 32.3 mm.

Color in life.--Orange to dark brown, covered by dense golden setae, often with white spots on maxillipeds.

Habitat and depth.--Sandy or rocky subtidal areas, rarely cast ashore after storms; 0- 157 m.

Range.--Frederick Island, British Columbia to Pacific coast of Baja California and Punta Gorda, Gulf of California, Mexico. Type locality off Point Loma, San Diego, California.

Remarks.--This is one of the largest hermit crabs of California and Oregon. It is common in kelp beds and rocky subtidal areas, where it may be seen by divers. The crab can use its third maxillipeds and setose antennae to capture particles used as food. Large aggregations of these crabs at times are seen in cracks between rocks, but the function of this behavior is not known. The crabs inhabit a great variety of shells, but especially those of Astraea spp. and Kelletia kelletii in southern California. Often, the shells are encrusted by algae, polychaete worms and even small corals. Slipper shells (Crepidatella spp.) often live inside the aperture of the shells.



Paguristes ulreyi

## Family Paguridae

The "unequal-clawed" hermit crabs are abundant world-wide, and range from the uppermost tidepools to the continental slopes. California and Oregon have a wide diversity of species. North of Point Conception, California, one does not find members of the genera Enallopaguropsis, Pylopagurus, Phimochirus or Haigia, in which the major chela is broad and seals the aperture of the shell. These primarily tropical genera, formerly all considered to belong to the genus Pylopagurus, usually occur on subtidal rocky bottoms. See McLaughlin (1982) for information on the taxonomic revision of these genera.

Among species in this family, the posterior pereopods and parts of the uropods may bear roughened areas containing tiny scales or spinules. These areas, called rasps, aid the crab in gripping its covering. The telson and uropods can be asymmetrical.

Species of the Paguridae have been studied extensively. Their characteristic behavior of testing, turning and quickly moving from shell to shell has been subjected to numerous experiments. (See Elwood and Neil, 1972 for an illustrated review of hermit crab behavior). The hermit crabs are scavengers, grazers and predators on smaller invertebrates. None of the species of California and Oregon have setose antennae that can be used to capture particles.

Genus Enallopaguropsis McLaughlin

Enallopaguropsis guatemoci Glassell

Pylopagurus guatemoci Glassell, 1937: 254.--Walton 1954: 146, pl. 43B.—Wicksten 1980: 361.  
Enallopaguropsis guatemoci.--McLaughlin 1981: 7.--McLaughlin 1982: 849, figs. 9a, 10a-c.

Recognition characters.--Rostrum broad and triangular, carapace with lateral projections rounded but tipped with minute subterminal spinule. Eyestalks cylindrical, cornea slightly dilated. Ocular scales bluntly rounded with acute subterminal spines. Major cheliped with merus smooth and trigonal in shape, with narrow indentation at margin of ischium; carpus greatly widened distally, with 2 prominent, forward-curving spines; hand discoidal, almost completely surrounded by toothed margin, proximal margin with teeth irregular in size and tipped with spines, some teeth double; teeth on fingers diminishing in size; face of hand set with rounded granules bearing slender spines. Small cheliped with row of spines on dorsolateral margin of carpus; hand depressed, with outer margin of row of spines and small median row of spines on palm, medial margin unarmed and slightly setose. Ambulatory legs with dactyl shorter than propodus and having spinulose margins. Telson symmetrical, semioval, margins entire. Uropods developed on both sides, upper distal face with rasp, posterior blade reduced and with rasp covering almost all upper surface. Carapace length 3 mm.

Color in life.--Mostly salmon-red. Second antennae translucent gold and white. Major cheliped with red dots along outer margin of chela, minor chela with red dots along outer margin of chela and at base of movable finger, walking legs banded with salmon, red-brown and white. (Color notes from animal taken off Blue Cavern Point, Santa Catalina Island, California).

Habitat and depth.--Subtidal, 20-275 m, on bottoms of sand and shell or areas of sand, rocks, shell or mud.

Range.--Point Hueneme, California to Cedros Island, Baja California and Angel de la Guardia Island, Gulf of California, Mexico. Type locality 5 miles west of San Jose Point, Pacific coast of Baja California, Mexico.

Genus Discorsopagurus

Discorsopagurus schmitti (Stevens )

Pylopagurus schmitti Stevens, 1925: 298, figs. 17-22.

Orthopagurus schmitti.--Stevens 1927: 249, figs. 2-4.

Discorsopagurus schmitti.--McLaughlin 1974: 354, figs. 96, 97.--Hart 1982: 118, fig. 41.--Gherardi and McLaughlin 1995: 258, figs. 1-10.--Jensen 1995: 62, fig. 111.

Recognition characters.--Rostrum triangular, longer than lateral projections of carapace. Eyestalk relatively long and stout, cornea slightly dilated. Major cheliped setose, with scattered spines and granules on carpus and hand; inner margin of palm serrate with large, sharp teeth and outer margin with row of spines. Minor cheliped more slender; carpus and hand with spines and sharp granules. Walking legs slender and setose, dactyl shorter than propodus. Abdomen straight, with pleopods on left side only. Telson with lateral margins rounded, with 4 short spines on each side of distolateral margin. Uropods developed on both sides, upper uropod longer and with prominent rasp. Carapace length to 6 mm.

Color in life.--Chelipeds creamy, mottled with red-brown, tips of fingers red-brown; walking legs banded with cream and red-brown, antennae and eyestalks marked with red-brown.

Habitat and depth.--Usually subtidal; low intertidal to 220 m, inhabiting worm tubes ( families Sabellidae and Serpulidae).

Range.--Japan, Sitka Sound, Alaska to near Albion, Mendocino County, California. Type locality off Point Caution, Washington.

Genus Pylopagurus Milne Edwards and Bouvier

Pylopagurus holmesi Schmitt

Pylopagurus holmesi Schmitt, 1921: 144, fig. 94.--Walton 1954: 141, pl. 39.--McLaughlin 1981: 3.—McLaughlin and Lemaitre 2001: 459, figs. 7-9.

Pylopagurus longicarpus Walton, 1954: 144, pl. 40.—McLaughlin 1981: 3.

Recognition characters.--Rostrum narrow, triangular, acute, reaching beyond middle of ocular scales, much longer than lateral projections of carapace. Eyestalks compressed, of equal length throughout. Chelipeds with scant setae. Major chela with granulate carpus; upper surface of hand discoidal, widest at base of fingers, with raised, denticulate margins; fingers flat and wide. Minor cheliped with hand narrow and rounded, fingers slightly gaping. Ambulatory legs with dactyls slightly longer than propodus, strongly compressed, spinulose. Telson symmetrical, with notch in terminal margin; strong, curving flattened tooth at each end of notch. Anterior blades of uropods 2X posterior pair, both setose. Carapace length 7.5 mm.

Color in life.--Not reported.

Habitat and depth.--18-55 m, usually among sand or sand and shell, rarely among rocks.

Range.--San Miguel Island, California to Pacific coast of Baja California; Gulf of California from Lobos Point to Inner Gorda Banks. Type locality near Catalina Harbor, Santa Catalina Island, California.

Remarks.--This species usually inhabits shells of Dentalium spp. or tubes formed by the colonial bryozoan Antropora tincta.

Genus Haigia McLaughlin

Haigia diegensis (Scanland and Hopkins)

Pylopagurus diegensis Scanland and Hopkins, 1969: 257, fig. 1.--Haig, Hopkins and Scanland 1970: 21.--Haig and Wicksten 1975: 102.

Haigia diegensis.--McLaughlin 1981: 5.--Jensen 1995: 61, fig. 109.—McLaughlin and Lemaitre 2001: 477, figs. 14a,14b, 17.

Recognition characters.--Rostrum prominent, about 0.5X length of ocular scales. Lateral projections of carapace very low. Eyestalks swollen at base, ocular scales with 1 blunt spine. Major cheliped with merus essentially smooth, carpus with 3 prominent spines along distal margin and 2 rows of longitudinal spines. Palm of chela with 9-12 tubercles forming oblique ridge from articulation of movable finger to carpus; outer and inner margins lined with tubercles, small tubercle in depression extending from fixed finger toward carpus; 4 minute tubercles in row on inner side beneath inner dorsal margin; entire upper margin lined with setae. Movable finger with 2-3 tubercles in row; outer edge with row of tubercles. Minor cheliped thinner; merus with 6-8 spines on lower, outer distal margin; carpus with 2 close-set subparallel rows of spines; palm with median longitudinal row of tubercles, single outer proximal marginal tooth and row of 9-11 outer, distal marginal teeth. Movable finger with 1-2 minute tubercles in proximal half; lateral teeth obscure. Ambulatory legs with short dactyl having 8 spines in longitudinal row. Telson symmetrical, with transverse suture, terminal margins armed with series of small spines. Uropods asymmetrical. Carapace length 13.8 mm.

Color in life.--Chelipeds and walking legs dark pink to brick red, walking legs banded with cream. Third maxillipeds and first antennae bright blue.

Habitat and depth.--Subtidal among rocks, boulders and rubble piles; 3-18 m.

Range.--Santa Catalina Island, California to Guadalupe Island, Mexico. Type locality La Jolla Cove, San Diego County, California.



Female *Haigia diegensis* Photograph: Scott Webb

Genus Phimochirus McLaughlin

Phimochirus californiensis (Benedict)

Eupagurus californiensis Benedict, 1892: 21.--Faxon 1895: 55, pl. 11, fig. 2-2e.

Pagurus californiensis.--Holmes 1900: 149.--Rathbun 1904: 161.--Schmitt 1921: 143, fig. 93.

Pylopagurus californiensis.--Haig, Hopkins and Scanland 1970: 20.--McLaughlin 1981: 5.

Phimochirus californiensis.--Jensen 1995: 61, fig. 110.

Recognition characters.--Rostrum short and triangular, about as long as lateral projections of carapace. Eyestalks moderately long and slender, not dilated; ocular scales pointed. Major chela with row of spinules on distal margin of merus; carpus with spinules along inner margin; chela suborbicular, feebly granulated, with row of spinules along inner margin. Minor chela very small and slender, less than 0.3X width of palm of larger chela. Dactyls of ambulatory legs thin, setose, with spinules; longer than propodi. Telson with transverse suture, terminal margins oblique, each with series of moderately strong spines. Uropods asymmetrical. Carapace length 26 mm.

Color in life.--Reddish-brown, with whitish spots and bands. Major chela mostly white except for small blue dots; carpus reddish with whitish border on inner surface. Ambulatory legs banded with cream or tan, with faint darker brown stripes. Eyestalk mostly orange, with whitish band at base.

Habitat and depth.--Subtidal, among rocks, kelp beds and sand near rocks, 10-106 m.

Range.--Santa Catalina Island, California to Galapagos Islands. Type locality "California" (possibly Santa Catalina Island).

Remarks.--This is a very common species along the offshore islands of southern California. The large major chela seals the opening of the shell when the hermit crab withdraws into it.



Phimochirus californiensis

Genus Orthopagurus Stevens

Orthopagurus minimus (Holmes)

Pagurus minimus Holmes, 1900: 145.

Pylopagurus minimus.--Schmitt 1921: 114, pl. 16, figs. 1a, 1b, 1c.

Orthopagurus minimus.--Stevens 1927: 247, fig. 1.--McLaughlin 1974: 363, figs. 98, 99.—  
Wicksten 1980: 361,--Hart 1982: 116, fig. 40; color plate.--Jensen 1995: 62, fig. 112.

Recognition characters.--Rostrum long and triangular, reaching at least 0.5X length of ocular scales. Eyestalks long and stout, cornea slightly dilated, ocular scales rounded. Major cheliped sparsely setose; merus with few or no spines, carpus with dorsal row of spines and scattered spinules; hand widening distally, with spines on palm and fingers; fingers wide and flat, with spines along margins. Minor cheliped small, slender and setose, with few spinules; hand convex, without spines on margins but with rows of spines dorsally and extending to fixed finger. Dactyls and propodi of walking legs equal in length, slender and with marginal setae. Abdomen straight. Telson symmetrical, with deep lateral notch and terminal notch flanked with 4 or more strong spines. Uropods symmetrical. Carapace length 5.6 m.

Color in life.--Major cheliped with dark red ischium, merus and carpus light golden but covered with dark red spots on spines and teeth; chela dark red with whitish tips to fingers. Minor cheliped light golden but covered with small red dots, ambulatory legs similar but merus of each dark red. Eyestalks and first antennae . dark red with irregular white bands. Second antennae dark red near base, golden distally.

Habitat and depth.--Subtidal on rock or broken shell and gravel, 11-64 m, rarely cast ashore after storms.

Range.--Tartar Strait and East Sakhalin; Skidegate, Queen Charlotte Sound, British Columbia to San Diego, California. Type locality off San Diego.

Remarks.--This hermit crab often inhabits tubes of polychaetes or tube mollusks (Serpulorbis squamigerus) or shells of Dentalium spp. On rare occasions, one will inhabit a coiled shell, but the crab moves awkwardly and will vacate such a shell quickly if offered a suitable tube.

Genus Parapagurodes McLaughlin and Haig

Parapagurodes makarovi McLaughlin and Haig

Eupagurus mertensii.--Benedict 1892: 2. Not Pagurus Mertensii Brandt, 1851, northwestern Pacific species.

Parapagurus Mertensii.--Holmes 1900: 155.

Parapagurus mertensii.--Rathbun 1904: 162, pl. 5, fig. 6.--Schmitt 1921: 146, pl. 16, fig. 5.

Parapagurodes makarovi McLaughlin and Haig, 1973: 119, figs. 4a, 5-8.

Recognition characters.--Rostrum elongate, considerably exceeding lateral projections of carapace, tirangular and terminating in small spinule. Eyestalks short, stout, corneae dilated; ocular scales triangular, with strong submarginal spine, with acute or subacute apex. Major



cheliped elongate, moderately slender; merus with tufts of setae and few spinules, carpus with dorsal row of strong spines, few spinules and sharp mesial teeth, palm with few spinules, especially along lateral margin, fingers with few spinules. Minor cheliped elongate, merus with mesial spines, carpus with dorsolateral row of strong spines and also smaller spines, palm and fingers with few low spinules. Ambulatory legs elongate, dactyls slender, laterally compressed and shorter than propodi; with small spines. Telson symmetrical, with shallow median cleft; terminal margin with small spines and small median slit. Uropods asymmetrical. Carapace length to 4.6 mm.

Color in life.--Yellowish or tan, meri and carpi of walking legs with 4-5 crimson stripes.

Habitat and depth.--Continental shelf, 75-574 m, on gray sand, rock and mud.

Range.--South of Santa Cruz, Monterey Bay, California to off Cedros Island, Baja California, Mexico. Type locality off Anacapa Island, California.

### Parapagurodes laurentae McLaughlin and Haig

Parapagurodes laurentae McLaughlin and Haig, 1973: 129, figs. 4b, 9-11.

Recognition characters.--Rostrum triangular, acute, often with small spine, longer than lateral projections of carapace and reaching less than half length of ocular scales. Eyestalks robust, short, with corneae dilated; ocular scales subtriangular and ending subacutely. Major cheliped long and slender. Merus with tufts of setae, carpus, palm and fingers with rows of spines, very long and sharp spines along mesial margins. Minor cheliped similar but more elongate, fingers especially long. Ambulatory legs long, dactyls at least as long as propodi with row of strong spines on ventral margins. Telson generally symmetrical; lateral margin notched; with posterior cleft, flanked with spines and spinules. Uropods asymmetrical. Carapace length to 3.5 mm.

Color in life.--Yellowish to whitish, carpi of ambulatory legs with crimson bands separated by clear area.

Habitat and depth.--Subtidal to upper continental slope, 16-475 m, on mud and gray sand.

Range.--Off Santa Cruz Island, California to Pacific coast of Baja California and off San Pedro Nolasco Island, Gulf of California, Mexico. Type locality off Seal Rocks, Santa Catalina Island, California.

### Parapagurodes hartae McLaughlin and Jensen

Pagurus sp. 1.-- Jensen 1995: 66, fig. 124.

Parapagurodes hartae McLaughlin and Jensen 1996: 841, figs. 1-4.

Recognition characters.--Rostrum triangular, greatly exceeding lateral projections of carapace and reaching beyond bases of ocular scales, subacute or with small tooth. Eyestalks moderately stout, with corneae slightly dilated. Major cheliped longer than ambulatory legs in adult male. Mesial margins lined with strong spines, especially on carpus, rows of spines along dorsal surface of carpus and palm, row of spines continuing on each finger, lateral margin of palm and fingers with row of spines. Minor cheliped with long setae on dorsal margin of merus, carpus with 2 rows of strong dorsal spines, rows of spinules on palm and fixed finger, raised ridge near center of palm, few spinules on movable finger. Ambulatory legs slender, dactyls slightly shorter to slightly longer than propodi, with row of 7-13 spines. Telson more or less symmetrical, lateral

margins notched, terminal margin with median cleft and row of spines. Uropods asymmetrical. Carapace length to 2.9 mm.

Color in life.--Appendages covered by large patches of deep violet bordered by crimson.

Chelipeds with orange palms and finger, meri and carpi also orange; ambulatory legs with patches of pale blue to ivory. Eyestalks translucent with bands and stripes of red, first antennae banded with red, white, and/or blue, antennal flagellum transparent.

Habitat and depth.--Subtidal, 6-635 m, among rocks, boulders, sand, gravel and shell.

Range.--Queen Charlotte Island, British Columbia to south of Pyramid Cove, San Clemente Island, California. Type locality Chatham Sound, British Columbia. The species has not been reported from Washington, Oregon or most of northern California ; however, specimens recently have been collected from Carmel Bay, Monterey County.

### Genus Pagurus Fabricius

#### Pagurus spilocarpus Haig

Pagurus spilocarpus Haig, 1977: 646, figs. 1, .-- Jensen 1995: 64, fig. 117.

Recognition characters.--Rostrum shorter than or equal to lateral projections of carapace, obtusely triangular or rounded. Eyestalks long, moderately stout, somewhat inflated basally, corneae dilated, ocular scales with prominent subterminal spine. Major cheliped stout, with fine setae and strong spines dorsally. Lateral and mesial margins with prominent spines. Minor cheliped with strong dorsal and lateral spines, also mesial spines except on carpus. Walking legs elongate. Propodus and carpus serrate, dactyl slender, longer than propodus. Telson asymmetrical, left lobe larger than right, with lateral notches, terminal margin with median cleft and close-set spines. Uropods asymmetrical. Carapace length to 43 mm.

Color in life.--Appendages mostly tan. Chelipeds with spines white at base, purple at tips.

Fingers with row of blue tubercles next to cutting edge; longitudinal bluish line outside of tubercles. Carpus with large dark purple spot on dorsal surface. Merus with triangular reddish-brown area dorsodistally; band of reddish-brown on lateral face. Ambulatory legs with reddish-brown blotch on lateral surface of carpus, merus with broad reddish-brown band at distal end. Eyestalks white with reddish brown areas. In life, setae often covered by silt and color somewhat obscured.

Habitat and depth.--Subtidal, rarely low intertidal to 60 m, on sand.

Range.--Zuma Beach, California to Point Abreojos, Baja California. Type locality off Belmont Pier, Orange County, California.

Remarks.--This species is commonly seen on sand bottoms along the mainland coast of southern California.



Pagurus pilocarpus

Pagurus aleuticus (Benedict)

Eupagurus aleuticus Benedict, 1892:3.

Pagurus aleuticus.--Pereyra and Alton 1972: 450.--McLaughlin 1974: 72, figs. 17-19.--Haig and Wicksten 1975: 101. --Hart 1982: 131, fig. 47.—Wicksten 1989b: 314.

Recognition characters.--Rostrum triangular, about as long as lateral projections of carapace. Eyestalks short and stout, corneae dilated, ocular scales pointed. Major cheliped shorter than ambulatory legs, with numerous spines and granules over dorsal, lateral and mesial surfaces; lateral margins serrate. Minor cheliped exceeding carpus of major cheliped, with spines on dorsal surface, particularly long spines on carpus, margins of chela serrate. Ambulatory legs long and slender, with serrate margins and dorsal spines, dactyl curved, with longitudinal groove, longer than propodus. Telson slightly asymmetrical, with lateral notch and terminal margin with notch and small spinules. Uropods asymmetrical. Carapace length 28.1 mm.

Color in life.--Appendages mostly pink. Chelipeds with red spines, sometimes also iridescence. Ambulatory legs iridescent pink with maroon streaks and dark spines, dactyl orange with red stripe, dorsal groove dark red. Eyestalks white and tan, antennal flagellum orange or tan (Hart, 1982).

Habitat and depth.--Subtidal, 15-435 m, on mud or sand.

Range.--Bering Sea to Eureka, California. Type locality Aleutian Islands.

### Pagurus ochotensis Brandt

Pagurus ochotensis Brandt, 1851: 108.--McLaughlin 1974: 57, figs. 15, 16.--Haig and Wicksten 1975: 101.--Hart 1982: 128, fig. 46.--McLaughlin, Crain and Gore 1992: 507, figs. 1-12.--Jensen 1995: 64, fig. 118.

Not Pagurus ochotensis of Schmitt, 1921: 130, fig. 84 (= Pagurus armatus [Dana]).

Recognition characters.--Rostrum triangular, about as long as or slightly longer than lateral projections of carapace. Eyestalks short and stout, corneae dilated, ocular scales pointed. Major cheliped stout, shorter than walking legs; carpus with 2 rows dorsal spines, strong spines along lateral and mesial borders; hand with 3 rows small spines not continuing on to fixed finger but also with numerous spinules on dorsal surface and fingers; row of low spines on lateral margin. Minor cheliped with spines similar to major cheliped. Ambulatory legs long, with spines along margins of carpus and propodus; dactyls longer than propodi, curved, with serrate dorsal margins, 2 shallow grooves and close-set ventral spines. Telson asymmetrical, left lobe longer than right, with notches on lateral margins, terminal margin concave, with spines. Uropods asymmetrical. Carapace length to 27.7 mm.

Color in life.--Right cheliped with ischium and merus white, merus with pearly iridescence and streaks and bands of maroon; carpus gray to brown with gray spines and green, pink or bronze iridescence; hand white or pinkish covered by gray or brown spines and granules, maroon streak along fixed finger. Left cheliped similar but no prominent maroon streak on hand. Ambulatory legs with ischium yellowish, merus light brown with maroon and blue areas and green iridescence, carpus and propodus similar but also with 2 maroon stripes, dactyl with marks of maroon and blue stripes. Eyestalk white with red spots and greenish yellow band; cornea distinctively greenish yellow. Antennae pinkish brown. The color of the corneae and the iridescence of the appendages are distinctive.

Habitat and depth.--Usually subtidal, lowest intertidal zone to 388m on sand or mud.

Range.--Pribilof Islands, Alaska to Point Arena, California. Type locality "Okhotsk Sea".

Remarks.--The species usually inhabits shells of Polinices spp. Divers may see it running across sandy bottoms.

### Pagurus armatus (Dana)

Pagurus armatus Dana, 1855: 270.--McLaughlin 1974: 48, figs. 13,14.--Wicksten 1984: 132.--McLaughlin and Gore 1992: 448, fig. 2-7.--Jensen 1995: 64, fig. 117.

Pagurus ochotensis of Schmitt, 1921: 130, fig. 84

Recognition characters.--Rostrum triangular, longer than lateral projections of carapace. Eyestalks stout, corneae dilated.; ocular scale leaf-shaped, ending in stout spine. Major cheliped

densely covered by triangular spines, not set into particular rows, and setae; spines particularly strong along mesial margin of carpus. Minor cheliped similar, reaching about 0.5X length of fingers of major cheliped. Ambulatory legs long, with spines along dorsal margins of carpus and propodus, dactyl longer than propodus, curved, with groove and small spinules along dorsal margin. Telson asymmetrical, with lateral notches and concave terminal margin lined by spines. Uropods asymmetrical. Carapace length to 43 mm.

Color in life.--Mostly reddish-orange. Carpus of chelipeds and ambulatory legs with white bands flanked by dark red bands. White marks on maxillipeds. Eyestalks marked with yellowish and dark red, corneae black. Antennal flagella orange. Color of chelipeds may be obscured by silt on setae in life.

Habitat and depth.--Mostly subtidal, lowest intertidal zone to 146 m, on sand.

Range.--Dutch Harbor, Alaska to San Diego, California. Type locality Puget Sound, Washington.

Remarks.--This species commonly is seen running across sandy bottoms. The shell often is covered by pink hydroids (*Hydractinia* sp.) The crab often inhabits shells of *Polinices* spp. In northern California, the species is very common at depths of 35-75 m.



Pagurus armatus

Pagurus tanneri (Benedict)

Eupagurus tanneri Benedict, 1892: 10.

Pagurus tanneri .--Holmes 1900: 140.--Rathbun 1904: 158, pl. 4, fig. 7.--Schmitt 1921: 133, fig. 86.--Pereyra and Alton 1972: 450.--McLaughlin 1974: 216, figs. 55, 56.--Hart 1982: 142, fig. 53.—Wicksten 1988a: 243.—Wicksten 1989b: 314.

Recognition characters.--Rostrum triangular, longer than lateral projections of carapace. Eyestalks short and stout, corneae dilated, ocular scales with sharp points. Major cheliped stout, slightly shorter than ambulatory legs; merus setose, carpus with small dorsal spines and serrate margins; hand spiny, with raised triangular ridge, small spines on fingers, margin setose. Minor cheliped smaller and slender, hand slightly swollen on left side, with curved raised ridge edged with 2 rows of spines on palm; fingers elongate. Ambulatory legs slender, carpus and merus with dorsal serrate edges, dactyls slightly longer than propodi, curved; with dorsal setae and small ventral spines. Telson asymmetrical, with lateral notches, terminal margin with median notch and spines. Uropods asymmetrical. Carapace length 18.1 mm.

Color in life.--Orange to scarlet overall. Chelipeds with white spines and granules; palm yellowish. Eyestalks orange with white tip, corneae black, antennal flagellum scarlet.

Habitat and depth.--Boulders of lower continental shelf and slope, 91-1372 m; usually deeper than 390 m in California.

Range.--Bering Sea and Unalaska to off Point Loma, San Diego County, California. Type locality Clarence Strait, Alaska.

Remarks.—This species often lives in shells of Neptunea sp. or Bathybembix bairdi. Stalked barnacles, family Scalpellidae, may attach to the shell.



Pagurus tanneri

Pagurus retrorsimanus Wicksten and McLaughlin

Pagurus species 2: Jensen 1995: 67.

Pagurus retrorsimanus Wicksten and McLaughlin 1998: 153, figs. 1-2.

Recognition characters.—Rostrum triangular to obsolete, much shorter than lateral projections of carapace. Eyestalks short, corneae slightly dilated, ocular scales triangular to subovate, with submarginal spine. Major cheliped stout, slightly longer than walking legs; merus relatively smooth, carpus with lateral surface strongly produced ventrally and all surfaces covered with flattened tubercles; hand covered by flattened, plate-like tubercles, palm very broad and dorsoventrally compressed; movable finger with 1 broad tooth and 3 smaller distal teeth, fixed finger with broad tooth and few smaller distal teeth. Major chela carried with chela twisted back toward body in life. Minor cheliped reaching only to proximal half of palm of major cheliped; fingers longer than palm, with few tufts of stiff setae and small teeth; carpus subtriangular. Ambulatory legs stout, with spinules on propodus and ending in short claw-like dactylus. Telson with distinct transverse suture; posterior lobes separated by median cleft, terminal margins oblique and armed with 3-5 strong spines and smaller spines. Shield length to 6.2 mm.

Color in life.—Ocular peduncles and antennules dark, translucent blue. Antennal flagellum reddish. Third maxilliped orange-red. Major chela proper usually white, rarely red. The walking legs, minor cheliped and major cheliped except for the chela proper are covered with dark red specks, giving crab a reddish color when seen from a distance.

Habitat and depth.—Subtidal among rocks, sand and gravel; kelp beds, 11-50 m.

Range.—Monterey, California to Los Coronados Islands, Mexico. Type locality off Redondo Beach, California.

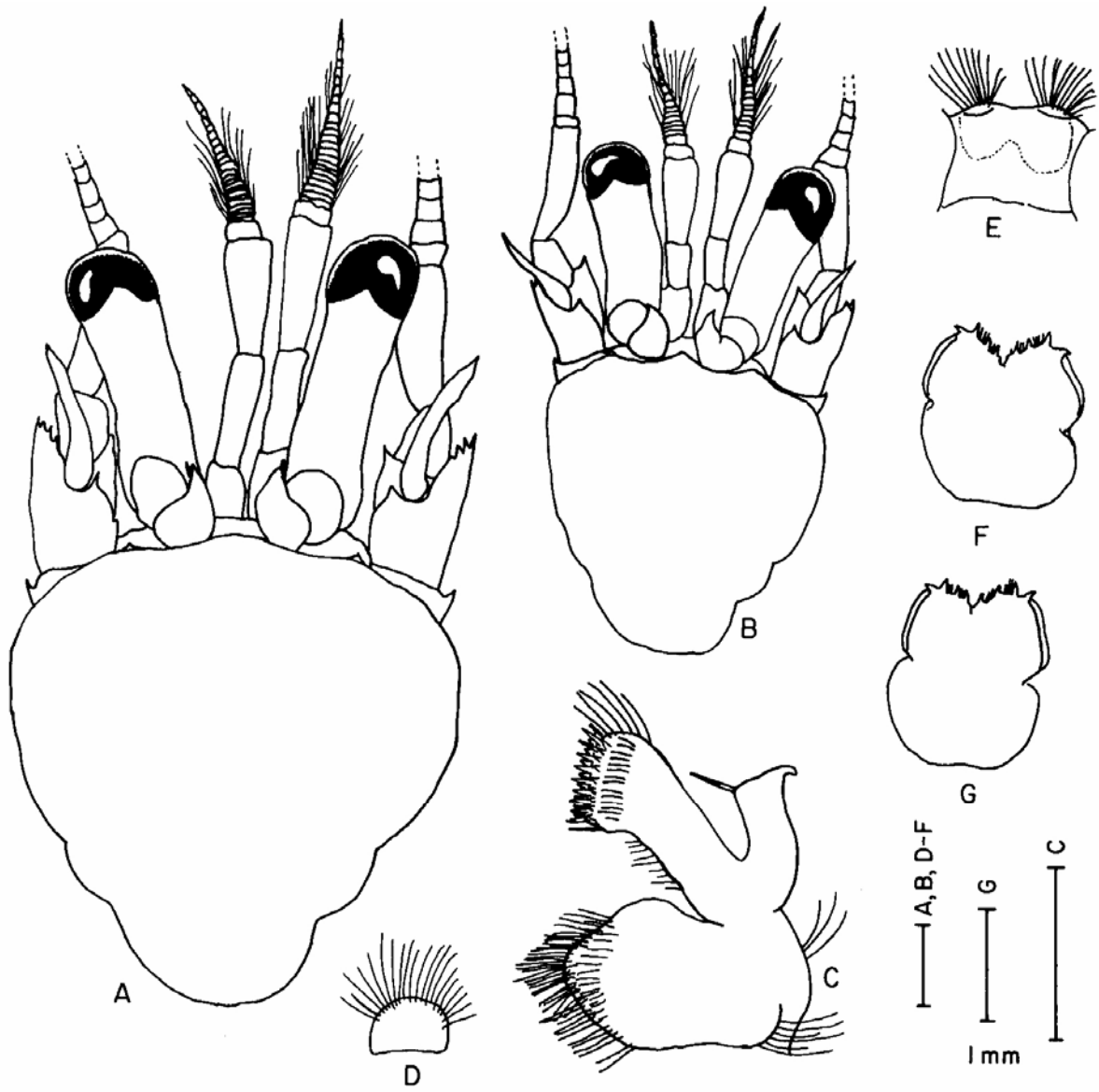


Fig. 1. *Pagurus retrorsimanus*, new species. A, shield and cephalic appendages of male; B, shield and cephalic appendages of female; C, maxillule of male; D, anterior lobe of sternite of third pereopods of male; E, sternite of fifth pereopods of male; F, telson of male; G, telson of female. Scales equal 1.0 mm.



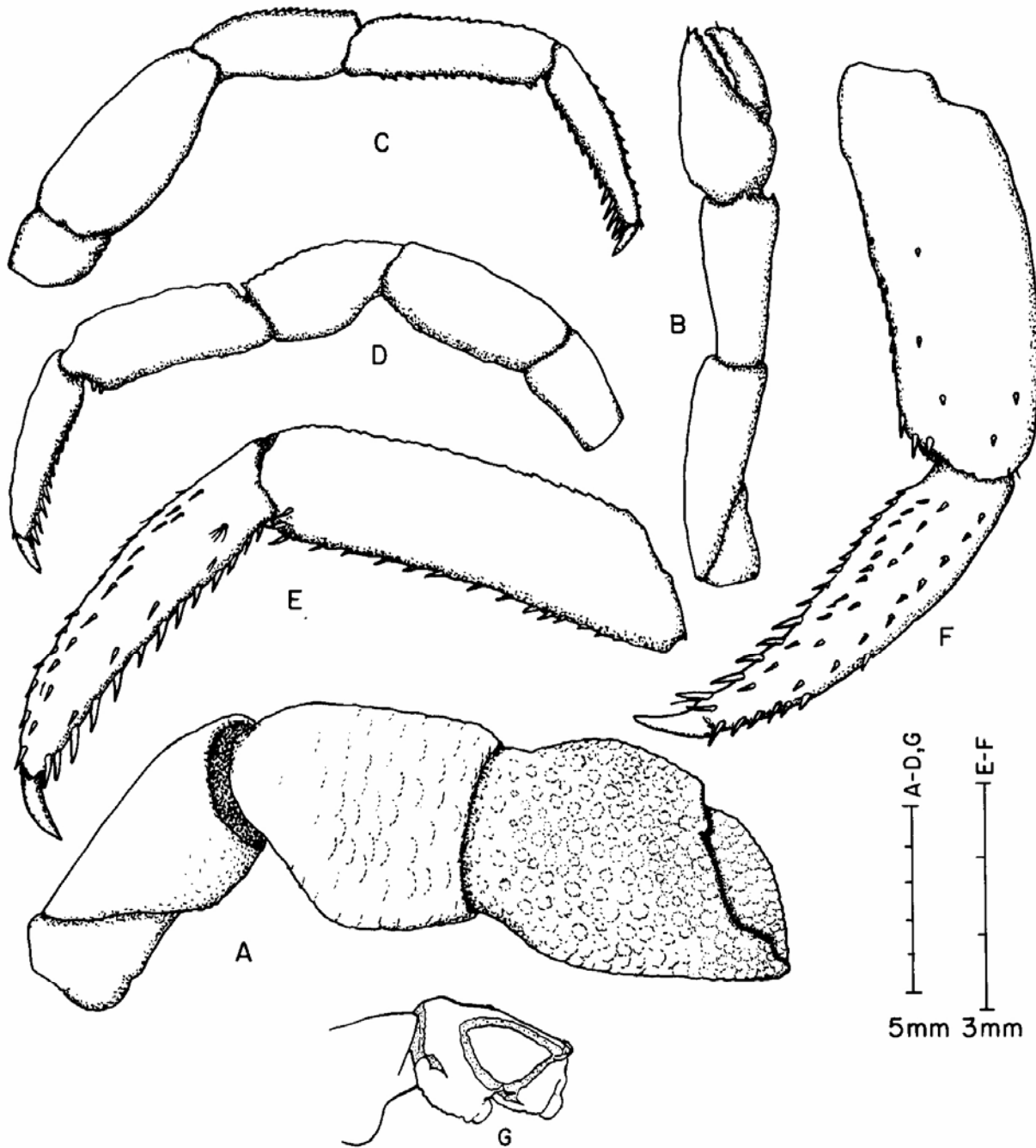


Fig. 2. *Pagurus retrorsimanus*, new species. A, right cheliped (dorsolateral view); B, left cheliped (dorsal view); C, right second pereopod (lateral view); D, left third pereopod (lateral view); E, dactyl and propodus of left second pereopod (mesial view); F, dactyl and propodus of left third pereopod (mesial view); G, merus of right cheliped (mesial view). Scales equal 3.0 mm (E, F) and 5.0 mm (A-D, G). Note: 2G was drawn from a different specimen than that illustrated in A-F.

Pagurus cornutus (Benedict)

Eupagurus cornutus Benedict, 1892:12.

Pagurus cornutus.--Pereyra and Alton 1972: 450.-- McLaughlin 1974: 225, fig. 57, 58.-- Hart 1982: 144, fig. 54.— Wicksten 1989b: 314.

Recognition characters.--Rostrum acute, longer than lateral projections of carapace. Eyestalks short and stout, corneae dilated, ocular scales with subterminal spine. Major cheliped stout, shorter than ambulatory legs, with setae; merus with distal toothed margin; carpus with serrate margins and few dorsal spines, large, triangular horn-shaped ridge on palm, apex past base of fixed finger. Minor cheliped stout, hand swollen on left side and with spined ridge running from middle of base of palm to middle of fixed finger; fixed finger with curved tip. Ambulatory legs setose, carpus of first ambulatory leg serrate, also carpus of right second leg; dactyls with stiff dorsal setae and movable ventral spines, dactyls longer than propodi, flattened, with longitudinal groove. Telson asymmetrical, with lateral notch, terminal margin with median notch and spines. Carapace length to 18.7 mm.

Color in life.--Mostly red to orange. Ischium and merus of each chela with cream stripes and spines, white marginal teeth, carpus with yellow spine; palm pink with yellow spines along margins. Walking legs deep and pale red; merus with distal pink band, dactyl pale. Eyestalk orange with light spots, ocular scales orange, cornea black with silver flecks. Antennal flagellum pale orange (Hart, 1982).

Habitat and depth.--Continental shelf and slope, on mud or sand, 160-830 m.

Range.--Northwestern Pacific and Bering Sea to west of Columbia River mouth, Oregon. Type locality Clarence Strait, Alaska.



Pagurus cornutus

Pagurus confragosus (Benedict)

Eupagurus confragosus Benedict, 1892: 11.

Pagurus confragosus.--Pereyra and Alton 1972: 450.--McLaughlin 1974: 203, figs. 51-54.--Hart 1982: 146, fig. 55.—Wicksten 1989b: 314.

Recognition characters.--Rostrum acute, triangular, much longer than lateral projections of carapace. Eyestalks short and stout, corneae dilated, ocular scales short and acute. Major cheliped stout, setose and shorter than ambulatory legs; merus setose, carpus with small dorsal spines and serrate margins; hand spinose and with raised triangular ridge extending past base of fixed finger. Minor cheliped slender, with rows of spines on carpus, and palm greatly inflated on outer side of convex ridge and with row of large spines on right side and small ones on left, extending nearly to middle of fingers. First and second ambulatory legs stout. Carpus serrate on margin of first legs; dactyls longer than propodi, flattened, with longitudinal groove and with stiff dorsal setae and ventral movable spines. Telson nearly symmetrical, with lateral notches and terminal notch and spines. Carapace length to 20.2 mm.

Color in life.--Chelipeds red and white blotched proximally; carpus white with red spots and spines; hand pink, fingers with white cutting edges. Ambulatory legs with ischium pink, red and white; merus and carpus red, white and tan; propodus with red proximal bands and lighter color between them; dactyl red with lateral stripe, orange distally, pink medially. Eyestalk pink with white stripe and red patches; cornea black with gold flecks (Hart, 1982).

Habitat and depth.--Continental shelf and slope, on rocks, mud, sand or gravel, 55-435 m.

Range.--Bristol Bay, Alaska to Columbia River mouth, Oregon. Type locality Portlock Bank, Alaska.

#### Pagurus caurinus Hart

Pagurus caurinus Hart, 1971: 1528, figs. 1-7.--McLaughlin 1974: 132, figs. 33, 34.--Haig and Wicksten 1975: 101.--Hart 1982: 152, fig. 58.--Bidle and McLaughlin 1992: 224, figs. 2-8.--Jensen 1995: 66, fig. 123.

Recognition characters.--Rostrum obtuse, lateral projections of carapace nearly obsolete. Eyestalks long and slender, slightly constricted medially, corneae slightly dilated; ocular scales with blunt tip and sharp submarginal tooth. Major cheliped stout, with numerous setae; with 1-2 large knobs medio-ventrally, carpus with dorsolateral row of sharp teeth and smaller spinules, palm with numerous spines, distolateral margin with spines, smaller spines along mesial margin. Minor cheliped slender, setose, with 2 rows of spines on dorsal surface of carpus, 2-3 rows of spines on hand and fixed finger, smaller spines on movable finger. Ambulatory legs stout, carpus of anterior leg with serrate dorsal margin, dactyls more or less straight, with setae and small spines on ventral margin. Telson more or less symmetrical, with notch on lateral margin, terminal margin with notch and sharp teeth. Carapace length to 10 mm.

Color in life.--Chelipeds with carpus and chela greenish gray to green, with orange-tipped tubercles, merus red-brown with cream-colored band at distal end. Ambulatory legs banded with reddish brown and cream. Setae of appendages golden-brown. Eyestalks translucent with brown bands. Antennal flagellum orange.

Habitat and depth.--Usually subtidal, lowest intertidal zone to 126 m, on rocks or sand.

Range.--Port Gravina, Alaska to San Pedro, California but rarely reported in California. Type locality Frank Island, Tofino, British Columbia.

Pagurus quaylei Hart

Pagurus quaylei Hart, 1971: 1532, figs. 8-16.--McLaughlin 1974: 85, figs. 20, 21.--Hart 1982: 158, fig. 61.

Recognition characters.--Rostrum triangular and low, barely longer than lateral projections of carapace. Eyestalks elongate, corneae slightly longer than stalk, ocular scales oval, with 1 or more marginal teeth. Major cheliped stout, shorter than ambulatory legs, setose; merus with 1 or more large ventral knobs, carpus with small dorsal spines and larger spines on inner margin; hand convex with numerous sharp spines in irregular rows, finger short. Minor cheliped long and slender, setose and spinulose; row of prominent spines on dorsomesial surface of carpus; fingers gaping. Ambulatory legs long and slender, with tufts of setae; first legs with serrate margins of carpi and propodi, second legs with few spines on carpus, dactyls longer than propodi, slightly curved. Dactyl of left second legs may be armed with numerous spines and tubercles. Telson asymmetrical, lateral margins with notches, terminal margin with deep notch and spinules. Uropods asymmetrical. Carapace length 4.3 mm.

Color in life.--Mostly brown or gray. Major cheliped with merus dark brown with light spots and pale distal band; carpus mottled gray to brown with gray spots and spines; palm greenish-brown with gray and white spines; fingers white. Minor cheliped similar but distal part of carpus is white, distal part of hand gray-blue. Ambulatory legs with band of red-brown, gray and whitish on merus, carpus gray to white with red-brown stripes; propodus gray with 4 red-brown stripes, dactyl with dark gray patch proximally, short red-brown stripes dorsally and laterally. Eyestalks pale brown with red, brown and white dots, cornea with 2 circular bands. Antennal flagellum irregularly banded with dark brown (Hart, 1982).

Habitat and depth.--Mostly subtidal on sand or gravel, lowest intertidal zone to 97 m.

Range.--San Fernando Island, Alaska to San Quentin Bay, Baja California, Mexico. Type locality off Frederick Island, British Columbia.

Remarks.--Along the Palos Verdes Peninsula, California, this small hermit crab is very common on sandy bottoms and among tubes of sand-dwelling polychaete worms.

Pagurus granosimanus (Stimpson)

Eupagurus granosimanus Stimpson, 1859: 90.

Pagurus granosimanus.--Holmes 1900: 146.--Rathbun 1904: 160, pl. 5, fig. 8.--Schmitt 1921: 141, fig. 91.--McLaughlin 1974: 158, figs. 39, 40.--Carlton and Kuris 1975: 402, pl. 98, fig. 66.--Haig and Abbott 1980: 586, fig. 24.13.--Ricketts et al. 1985: 273.--Hart 1982: 136, fig. 50.--Jensen 1995: 65, fig. 121.

Recognition characters.--Rostrum short and blunt, barely longer than lateral projections of carapace. Eyestalks long, corneae slightly dilated, ocular scales rounded. Major cheliped stout, covered with small spinules and granules, fingers very short. Minor cheliped similar to major but with most granules on palm and fingers, fewer on proximal parts. Ambulatory legs stout, with rows of spinules and serrate margins of propodi and carpi, dactyls about as long as propodi and broad. Telson slightly asymmetrical, lateral margins notched, terminal margin with median notch and spinules. Uropods asymmetrical. Carapace length to 19 mm.

Color in life.--Reddish to olive green with white or blue granules, legs without prominent bands. Eyestalks with faint yellow stripes. Flagellum of antenna bright red.

Habitat and depth.--Usually mid-littoral zone of rocky areas, bays and tidepools, to 36 m. This is one of the most common intertidal hermit crabs.

Range.--Unalaska, Alaska to Ensenada, Baja California. Type locality Monterey, California.

Remarks.--This species usually inhabits shells of Tegula spp.



Pagurus granosimanus

Pagurus beringanus (Benedict)

Eupagurus beringanus Benedict, 1892: 17.

Pagurus beringanus.--Rathbun 1904: 159, pl. 5, fig. 5.--Schmitt 1921: 135, fig. 87.--McLaughlin 1974: 139, figs. 35, 36.--Hart 1982: 140, fig. 52.--Haig and Abbott 1980: 586.--Ricketts et al. 1985: 289.--Jensen 1995: 65, fig. 122. --Debelius 1999: 237.

Recognition characters.--Rostrum triangular but blunt, slightly longer than lateral projections of carapace. Eyestalks moderately stout, corneae not dilated, ocular scales pointed. Major cheliped stout, shorter than ambulatory legs, merus with upper surface convex and with large marginal teeth and 2 large ventral knobs, carpus convex, with rows of granules and spines; hand convex, with many granules, spines and serrate margins, fingers short. Minor cheliped smaller, merus laterally compressed, with spinules and granules. Ambulatory legs stout and setose, merus laterally compressed, carpi with serrate margins, propodus of first leg serrate, dactyls about as long as propodi and stout. Telson asymmetrical, with lateral notches and deep terminal notch, terminal margin with spines. Uropods asymmetrical. Carapace length to 26 mm.

Color in life.--Chelipeds reddish, carpus with bright band at distal end. Ambulatory legs gray to white, with red distal bands on propodus and dactyl, spines reddish. Cornea of eyes black with gold or silver. semicircle. Antennal flagellum translucent with red lateral mark.

Habitat and depth.--Protected intertidal areas to rocky subtidal zones, low tide to 364 m. Usually subtidal in California.

Range.--Bering Sea and Aleutian Islands to Monterey, California but rarely found south of Point Arena, California. Type locality Bristol Bay, Alaska.

Remarks.--This species often inhabits shells of Nucella lamellosa, Ceratostoma foliata and Fusitriton oregonensis.

Pagurus hemphilli (Benedict)

Eupagurus hemphilli Benedict, 1892: 16.

Pagurus hemphilli.--Holmes 1900: 147.--Rathbun 1904: 160, pl. 5, fig. 9.--Schmitt 1921: 142, fig. 92.--McLaughlin 1974: 149, figs. 37, 38.--Hart 1982: 134, fig. 49.--Carlton and Kuris 1975: 401.--Haig and Wicksten 1975: 102.--Haig and Abbott 1980: 586, fig. 24.12.--Ricketts et al. 1985: 58, fig. 23.--Jensen 1995: 63, fig. 114.

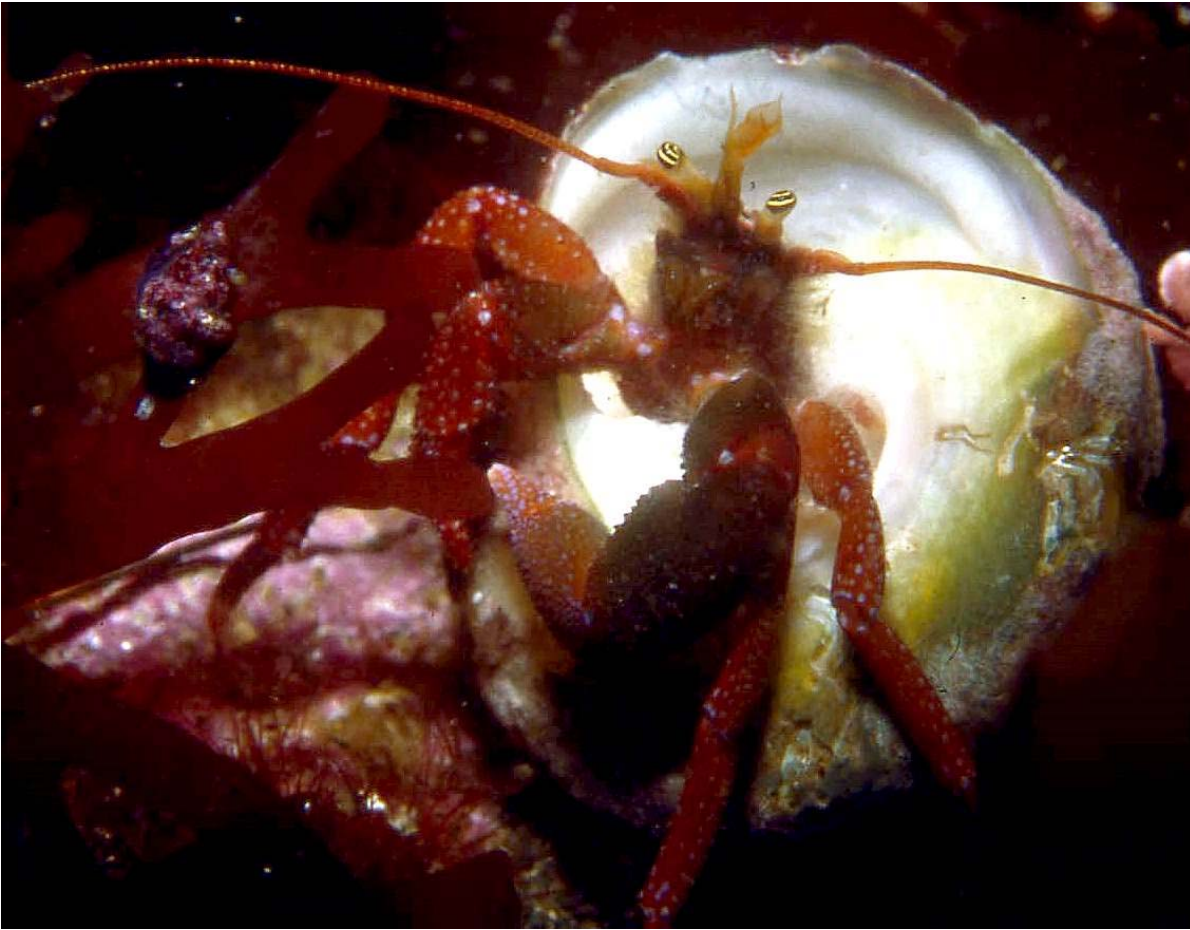
Recognition characters.--Rostrum wide, triangular, longer than lateral projections of carapace. Eyestalks slender, corneae slightly dilated., ocular scales pointed. Major cheliped much larger than minor cheliped, finely granulate, with few setae, some teeth on distal margins of merus and carpus; carpus laterally compressed and inflated ventrally, triangular in lateral view; fingers of chela very short and broad. Minor cheliped very short, granulate, laterally compressed. Ambulatory legs stout, dorsal margins of propodus and carpus serrate, dactyls broad and stout, as long as or shorter than propodi. Telson asymmetrical, with notches on lateral margins and terminal margin, terminal margin with teeth. Uropods asymmetrical. Carapace length to 15 mm.

Color in life.--Rich maroon with blue granules; ends of dactyls yellow. Corneae with gold rings. Flagellum of antenna red. Juveniles may have white bands on the ambulatory legs.

Habitat and depth.--Rocky areas and kelp beds on open coasts; lowest intertidal but usually subtidal, to 50 m.

Range.--Klokachef Island, Alaska to San Miguel Island, California. Particularly common in central California from Mendocino to San Luis Obispo counties. Type locality Monterey, California.

Remarks.-- This hermit crab usually inhabits shells of Tegula and Astraea spp. Often, the shells are encrusted with red algae. Slipper shells (Crepidula adunca) and limpets (Acmaea mitra) may live atop the shells.



Pagurus hemphilli

Pagurus samuelis (Stimpson)

Eupagurus samuelis Stimpson, 1857: --Stimpson 1859: 90, pl. 1, fig. 8.

Pagurus samuelis.--Holmes 1900:144.--Rathbun 1904: 160, pl. 5, fig. 7.--Schmitt 1921: 139, pl. 16, figs. 2, 3.--McLaughlin 1974: 166, figs. 41, 42.--McLaughlin 1976: 24.--Carlton and Kuris 1975: 401, pl. 98, fig. 67.--Haig and Abbott 1980: 584, fig. 24.10.--Hart 1982: 132, fig. 48.--Ricketts et al. 1985: 37, fig. 22.--Jensen 1995: 65, fig. 120.

Recognition characters.--Rostrum triangular and low, longer than lateral projections of carapace. Eyestalks stout, corneae not dilated; ocular scales pointed. Major cheliped shorter than ambulatory legs; carpus and hand with granules, lateral margins beaded; fingers broad. Minor cheliped barely longer than carpus of major cheliped, ventral margin of merus with strong teeth; carpus and chela with granules. Ambulatory legs stout, dorsal margins with stiff setae, dactyls stout, curved,; propodus and dactyl of left second waling leg with spines and granules ventrally. Telson asymmetrical proximal to left lateral groove, terminal margin with very shallow concavity and spines. Uropods asymmetrical. Carapace length to 19 mm.

Color in life.--Greenish brown to olive, granules red, fingers of chelae with orange tips, ambulatory legs with prominent blue band in adult, bands of blue and white in juvenile; antennal flagellum red, carapace with white stripes.

Habitat and depth.--High intertidal zone of open coasts.

Range.--Nootka Sound, British Columbia to Point Eugenia, Baja California, Mexico. Type locality Tomales Bay, California. Reports from Japan should be referred to a sibling species, Pagurus geminus McLaughlin, 1976.

Remarks.--This is the best-known intertidal hermit crab of California and Oregon. It is abundant along the outer coastline and just inside the mouths of larger bays and harbors, such as San Francisco Bay and Los Angeles Harbor. It usually inhabits shells of Tegula spp. Slipper shells (Crepidula spp.) may live inside the aperture of the shell or on top of it.



juvenile Pagurus samuelis





Pagurus samuelis

Pagurus hirsutiusculus (Dana)

Bernhardus hirsutiusculus Dana, 1851: 70. -- Dana 1852: 443, pl. I.--Dana 1855: pl. 27, fig. 3.  
Pagurus hirsutiusculus.--Holmes 1900: 143 (in part).--Rathbun 1904: 159 (in part).--Schmitt 1921: 137, fig. 89 (in part).--Carlton and Kuris 1975: 402.--Wicksten 1977c: 541.--Hart 1982: 138, fig. 51 (in part).--Ricketts et al. 1985: 278 (in part).--Jensen 1995: 66, fig. 125.  
Pagurus hirsutiusculus hirsutiusculus.--McLaughlin 1974: 175, figs. 43a-c, 44a-h.--Haig and Abbott 1980: 585, fig. 24.11.--McLaughlin, Gore and Crain 1988: 430.

Recognition characters.--Rostrum triangular, pointed, reaching to middle of ocular scales or beyond; much longer than lateral projections of carapace. Eyestalks stout, corneae not dilated, ocular scales pointed. Major cheliped stout, shorter than ambulatory legs, merus and carpus setose, with granules, spines and ridges; ahdn slightly convex, with many granules. Major cheliped elongated, fingers gaping in adult male. Minor cheliped setose, wtih granules. Ambulatory legs setose, dactyls slender, about as long as propodi. Telson asymmetrical, lateral margins with notches, terminal margin with notch and spines. Uropods asymmetrical. Carapace length to 19 mm.

Color in life.--Almost black to greenish brown, tips of minor chela tan or orange. Ambulatory legs with white band on propodus, often also blue dot; dactyl whitish, striped with blue and red. Antennal flagellum banded with translucent and brown.

Habitat and depth.--Usually upper and middle intertidal zone, to 110 m, often in protected areas with silt or in bays or harbors.

Range.--Pribilof Islands to Monterey, California. Type locality "Puget Sound". Records from southern California refer to the following species, Pagurus venturensis.

Remarks.--This is a common intertidal hermit crab in more protected areas than P. samuelis, although it can co-occur within an intertidal area. It often inhabits shells of Nucella spp. except in San Francisco Bay, where it uses shells of gastropod species introduced from the Atlantic. Slipper shells (Crepidula spp.) may live inside the aperture of the shell.



Pagurus hirsutiusculus



Pagurus hirsutiusculus

Pagurus venturensis Coffin

Pagurus hirsutiusculus venturensis Coffin, 1957: 1, fig. 2.--McLaughlin 1974: 185, figs. 43d, 44i.-  
-Haig and Abbott 1980: 585.--McLaughlin, Gore and Crain 1988: 431.

Pagurus venturensis.--Crain and McLaughlin 1993: 985, figs. 1-11.

Recognition characters.--Rostrum triangular, reaching beyond bases of ocular scales and exceeding lateral projections of carapace. Eyestalks stout, corneae weakly dilated, ocular scales subacute, with subterminal spines. Major cheliped tuberculate, carpus with dorsal setae; fingers very short and stout, gap between fingers. Minor cheliped with 2 rows of sharp dorsal spines on carpus, palm tuberculate. Ambulatory legs stout, setose; dactyls subequal to propodi, dactyls with row of ventral spines. Carpus with 2-3 rows of spines. Telson asymmetrical, with cleft on lateral margin and concavity in terminal margin; terminal margin with spines. Uropods asymmetrical. Carapace length to 4.6 mm.

Color in life.--Olive brown to light gray. Tips of chelae white. Ambulatory legs with white bands at distal ends of merus, carpus and propodus. Carpus with white stripe. Dactyl pale blue, with

longitudinal reddish stripes. Eyestalks light golden brown. Antennal flagella translucent brown. (Color notes from specimens from Cabrillo Beach, San Pedro, California).

Habitat and depth.--Low intertidal zone of sheltered areas with mixed rocks and sand.

Range.--Monterey Peninsula to San Diego, California. Type locality 12 miles north of Ventura, California.

Remarks.--See Crain and McLaughlin (1993) for a complete synonymy of this species and the related P. hirsutiusculus. The larval stages of the two species also differ. In life, P. venturensis tends to be lighter in color than P. hirsutiusculus. It is not known to grow as large as its northern counterpart. Pagurus venturensis often inhabits the shells of Olivella biplicata and Acanthina spp.

### Pagurus redondoensis Wicksten

Pagurus redondoensis Wicksten, 1982d: 605, figs. 1-3.--Harvey and McLaughlin 1991: 20.--Haig and Harvey 1991: 10.--Jensen 1995: 62, fig. 113.

Recognition characters.--Rostrum short, rounded to triangular, about as long as lateral projections of carapace. Eyestalks long, slender, corenae dilated; ocular scales ending in 4-5 spinules. Major cheliped with setae on carpus and chela; carpus with spines along mesial and distal margins; palm with 2 rows of dorsal spines, teeth along mesial margin; gap between fingers in adult males. Minor cheliped with prominent distal spines on carpus, low spines or teeth along mesial margin of merus, carpus and chela; 2 rows of large spines on palm. Ambulatory legs setose, dactyls shorter than propodi, with ventral spines. Telson asymmetrical, lateral margins with cleft, terminal margin with deep u-shaped cleft and spines. Uropods asymmetrical. Carapace length to 6 mm.

Color in life.--Greenish brown to reddish, but color often obscured by silt on setae. Chelipeds with prominent white band and narrow dark band at distal end of merus. Ambulatory legs with white band at distal end of merus. Eyestalks with gray tinge, lightly banded with darker shades. Antennal flagellum dark brown with white bands.

Habitat and depth.--Lowest intertidal zone to 50 m, usually in protected areas and often among tube mollusks (Serpulorbis squamigerus).

Range.--Redondo Beach, California to La Jolla, California. Type locality Redondo Beach.

Remarks.--This is a very common hermit crab in the appropriate habitat and depth in southern California.

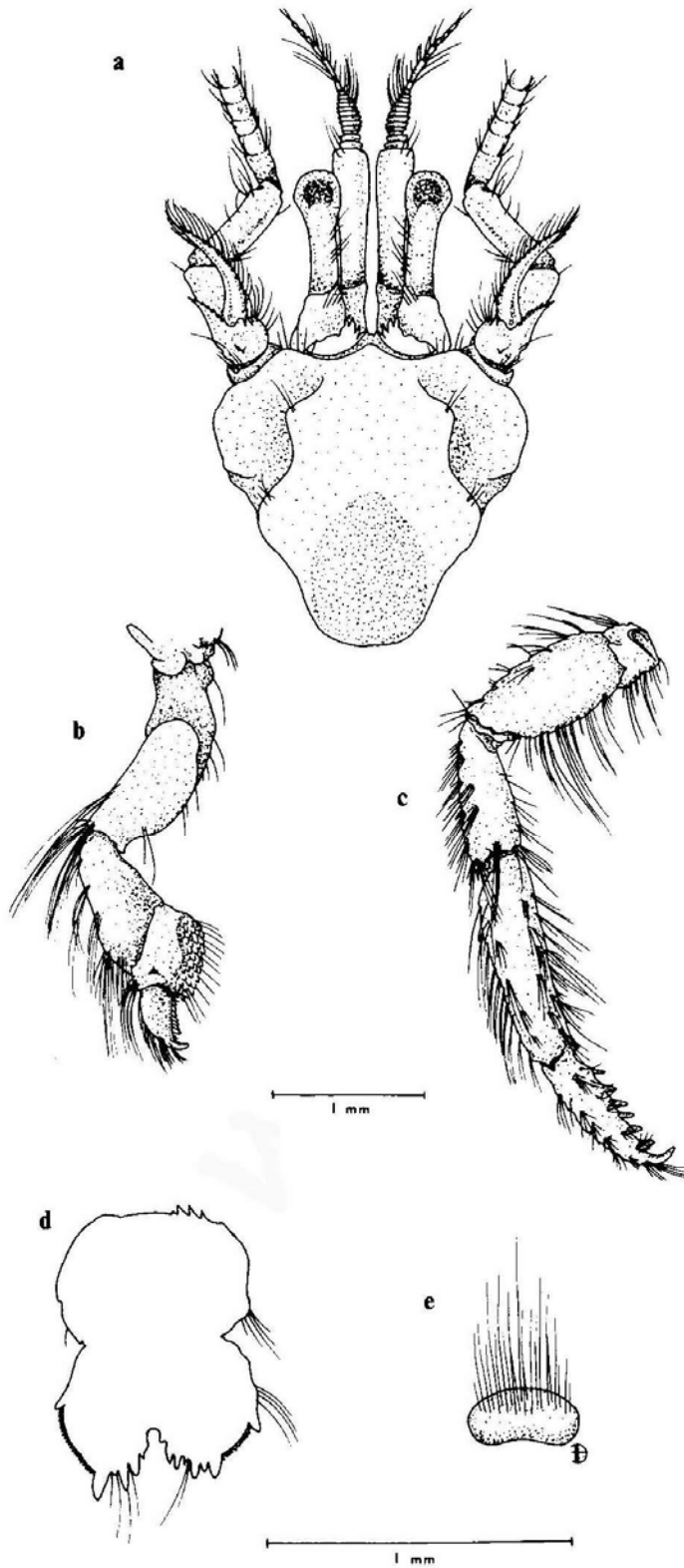


Fig. 1. *Pagurus redondoensis*, new species. Male, shield length 3.2 mm. Off Redondo Beach, California. a, shield and cephalic appendages; b, right fourth pereopod; c, left second pereopod; d, telson; e, sternite of third pereopod.

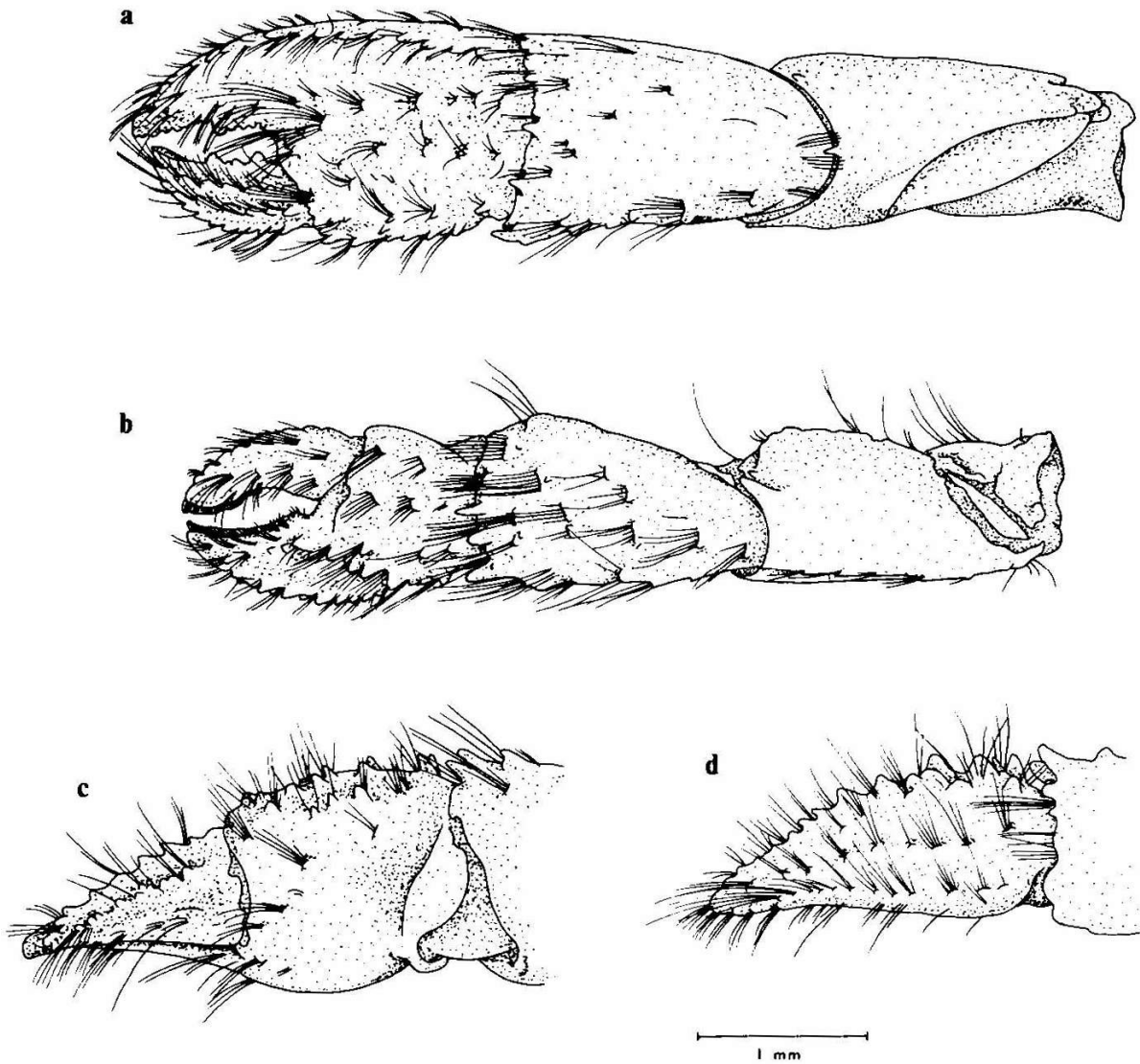


Fig. 2. *Pagurus redondoensis*, new species. a, right cheliped in dorsal view; b, left cheliped in dorsal view; c, right chela in lateral view; d, left chela in lateral view.

### Pagurus capillatus (Benedict)

Eupagurus capillatus Benedict, 1892: 8.

Pagurus capillatus.--Holmes 1900: 138.--Rathbun 1904: 157, pl. 4, fig. 3.--Schmitt 1921: 132, fig. 85.--McLaughlin 1974: 93, figs. 22, 23.--Hart 1982: 154, fig. 59.—Wicksten 1989b: 314.

Recognition characters.--Rostrum low, about as long as lateral projections of carapace. Eyestalks long and slender, corneae slightly dilated, ocular scales pointed. Major cheliped setose, dorsal surface with spines, mesial margin with serrate margin, outer margin with low teeth, fingers slender. Minor cheliped setose; carpus with proximal row of dorsal spines and scattered larger distal spines; hand with rows of spinules, row of small spines on dactyl, fingers slender. Ambulatory legs slender and setose; carpi of first legs serrate on dorsal margins; dactyls longer than propodi, with ventral spines. Telson asymmetrical, with lateral notches and terminal concavity and terminal spines. Usopods asymmetrical. Carapace length to 26 mm.

Color in life.--Ground color whitish. Chelipeds with merus having bands of rose and brown; carpus with apricot spines and mottling of brown and red, hand light brown, fingers with apricot tips. Ambulatory legs with ischium splotched with pink, red and yellow; merus banded in red and brown, caprus and propodus each with 2 bands, dactyl greenish yellow. Eyestalk with outer rose stripe and inner brown stripe, cornea black with gold flecks. Antennal flagellum translucent. In life, color often obscured by silt on setae (Hart, 1982).

Habitat and depth.--Muddy subtidal areas, 4-439 m.

Range.--Northwestern Pacific, Chukchi Sea; Bering Sea to off Santa Cruz, California. Type locality Norton Sound, Alaska.

### Pagurus setosus (Benedict)

Eupagurus setosus Benedict, 1892: 19.

Pagurus setosus.--Rathbun 1904: 159, pl. 5, fig. 1.--Schmitt 1921: 136, fig. 58.--McLaughlin 1974: 110, figs. 27-29.

Recognition characters.—Rostrum rounded, slightly longer than lateral projections of carapace. Eyestalks elongate, corneae not dilated, ocular scales pointed. Major cheliped with carpus and chela proper sharply spinose, chela proper setose and bearing 7 longitudinal rows of spines. Minor cheliped setose, carpus and chela also bearing spines. Ambulatory legs with elongate dactyls, series of spines on carpus of anterior pair only, both pairs with scattered setae. Telson with left lobe slightly larger than right, with V-shaped median cleft; right terminal margin with 4-8 small teeth and 1 stronger laterodistal tooth; left with 4-9 small teeth and one larger laterodistal tooth. Carapace length to 21 mm.

Color in life.—Not recorded. Rathbun (1904) noted that the walking legs were banded.

Habitat and depth.--Subtidal, 9-476 m.

Range.--Kodiak, Alaska to off Santa Cruz Island, California. Type locality Sitka, Alaska.

Remarks.—A small and common hermit crab of the continental shelf off southern California has been identified as P. setosus (Wicksten, 1980). This identification needs further confirmation.



Pagurus setosus



## Family Parapaguridae

Like the members of the Paguridae, the species of the Parapaguridae have the third maxillipeds widely separated at the base. The chelipeds are dissimilar and unequal. In this family, only the male bears abdominal appendages other than the uropods. The female has only one oviduct, which opens on the coxa of the left third pereopod. Species of this family are found from the continental shelf down to the abyssal plains. Typically, the dactyls of the pereopods are elongate. Species of this family may carry sea anemones or zoanthids on their shells.

### Genus Parapagurus Smith

#### Parapagurus benedicti de Saint Laurent

Parapagurus pilosimanus benedicti de Saint Laurent, 1972: 103, pl. 1, fig. 6.—McLaughlin 1974: 372, figs. 100, 101. (See this reference for more information on the synonymy of this species).—Wicksten 1980: 364.—Wicksten 1982: 245.—Wicksten 1989b: 314.

Parapagurus pilosimanus.—Haig 1955: 17.—Pereyra and Alton 1972: 450.

Parapagurus benedicti.—Lemaitre 1989b: 11.—Hendrickx and Harvey 1999: 373.

Recognition characters.—Rostrum rounded, slightly longer than lateral projections of carapace. Ocular scales usually bifid but sometimes with 1-3 points. Eyestalks slender and elongate, corneae slightly wider than eyestalks. Major cheliped elongate, much longer than minor cheliped, set with small tubercles but without spines; palm of chela broad, with short fingers having irregular teeth; chela in adults can be covered by thick golden setae. Minor cheliped more slender and with fingers more elongate in proportion to chela than in major chela. Walking legs slender, dactyls almost as long as propodus and carpus combined. Telson with convex posterior margin, often with very slight median sinus; with 6-12 teeth on lateral margins. Carapace length to 16 mm.

Color in life.—Bright red; setae of major chela golden.

Habitat and depth.—Continental slope, 750-1902 m.

Range.—Alaska to Chile. Type locality off Point Sur Light, California.

#### Parapagurus haigae de Saint Laurent

Parapagurus haigae de Saint Laurent, 1972:115, figs. 9, 17.—Wicksten 1980: 362.—Wicksten 1987: 55.—Wicksten 1989b: 314.

Oncopagurus haigae.—Lemaitre 1996:194.—Hendrickx and Harvey 1999: 373.

Recognition characters.—Rostrum a low rounded prominence, barely surpassing low lateral projections of carapace. Ocular scales ending in single point. Eyestalks short and robust, not as long as first segment of antennular peduncle, cornea wider than proximal part of eyestalk. Major cheliped robust, carpus with numerous spinules; chela proper oval-shaped, hand with row of small dorsal spinules, movable finger semicircular along lateral margin. Ambulatory legs with dactyls curved (CL not reported).

Color in life.—Not reported.

Habitat and depth.—Rocks, and or mud; continental shelf and slope, 185-224 m.

Range.—Off San Miguel Island, California to Gulf of Panama including Gulf of California. Type locality off Santa Cruz Island, California (Velero III station 993-39). The type locality given in the original description, “Golfe de Californie”, is incorrect, although the species has been taken near Cabo San Lucas.

## Family Lithodidae

The Lithodidae, including the king crabs, are primarily a cold-water family with the greatest species diversity and diversity in body form in the northern Pacific. Few studies have been conducted on their natural history. Most seem to be scavengers or predators on other invertebrates, including mollusks.

The casual observer may have difficulty distinguishing these crabs from other unrelated species. Species of Paralithodes, with their long legs, can be confused with brachyuran crabs of the family Majidae. Species of Hapalogaster superficially look like porcellanids. Note that in anomurans, the longer second antennae lie lateral to the eyes, while in brachyurans, both pair of antennae are short and have their origins mesial to the eyes. Anomurans have at most three pair of locomotory legs posterior to the chelipeds, while brachyurans usually have four pair. The abdomen of an anomuran generally is asymmetrical and contains membranous areas, while that of a brachyuran generally is symmetrical and well calcified.

For more synonyms and additional references, see Dawson (1989) for a comprehensive bibliography.

### Key to the Species of the Family Lithodidae

- Abdomen soft, unsegmented, at most only basal and two terminal segments with thin calcareous plates-----2
- Abdomen segmented, subdivided into well-calcified plates-----4
2. Carapace distinctly flattened and covered with numerous subequal spines. Legs spiny-----  
-----Acantholithodes hispidus (Stimpson)
- Carapace flattened to moderately convex, without spines; legs sparsely setose to extremely setose but without spines-----3
3. Carapace and legs flattened and pubescent. Carapace not granular on upper surface-----  
-----Hapalogaster cavicauda Stimpson
- Carapace and legs not flattened nor pubescent. Carapace granular on upper surface-----  
-----Oedignathus inermis (Stimpson)
4. Carapace broadly oval, convex and smooth, completely concealing ambulatory legs from dorsal view-----5
- Carapace not broadly oval, usually rough and not completely concealing ambulatory legs from dorsal view-----6
5. Chelae tuberculate. Rostrum narrowing distally, end rounded---Cryptolithodes typicus Brandt

|  |       |   |
|--|-------|---|
| Chelae smooth. Rostrum widened toward distal end, which is transverse  | ----- | <u>Cryptolithodes sitchensis</u> Brandt     |
| 6. Carapace with two deep pits within triangular excavated area, surrounded by rounded papillated tubercles. Abdominal plates with central membranous area | ----- | <u>Phyllolithodes papillosus</u> Brandt     |
| Carapace without deep pits and papillated tubercles. Abdominal plates without central membranous area  | ----- | 7   |
| 7. Carapace with outline of an equilateral triangle, with deep fossa separating cardiac region from other regions of carapace                              | ----- | <u>Rhinolithodes wosnessenskii</u> Brandt   |
| Carapace with outline more rounded, without deep fossa separating cardiac region from other regions of carapace  | ----- | 8   |
| 8. Ambulatory legs shorter than greatest width of carapace. Outline of carapace roughly pentagonal or hexagonal, convex, with short tubercles              | ----- | 9   |
| Ambulatory legs longer than greatest width of carapace. Outline of carapace broadly pear-shaped  | ----- | 11  |
| 9. Without wart-like prominence on each side of median gastric area. Ambulatory legs spinose. (Not found north of Los Angeles County, California)          | ----- | <u>Glypholithodes cristatipes</u> Faxon     |
| With wart-like prominence on each side of median gastric area. Ambulatory legs tuberculate. (Usually found north of Los Angeles County, California)        | ----- | 10  |
| 10. Tubercles of chelipeds and ambulatory legs spiniform; carpus of chelipeds with outer edge excavated, forming deep rounded sinus                        | ----- | <u>Lopholithodes foraminatus</u> (Stimpson) |
| Tubercles of chelipeds and ambulatory legs rounded and blunt; carpus of chelipeds without deep, rounded sinus on outer edge                                | ----- | <u>Lopholithodes mandtii</u> Brandt         |
| 11. Abdomen mostly leathery. Carapace with tubercles or short spines   | ----- | 12  |
| Abdomen well calcified. Carapace often with long spines  | ----- | 13  |
| 12. Carapace spiny. Ambulatory legs angular  | ----- | <u>Paralomis multispina</u> (Benedict)      |
| Carapace with tubercles. Ambulatory legs much compressed   | ----- | <u>Paralomis verrilli</u> (Benedict)        |
| 13. Plates of second abdominal segment more or less fused  | ----- | <u>Lithodes couesi</u> Benedict             |
| Plates of second abdominal segment distinct  | ----- | 14  |

14. Rostrum bifid, anterior lateral spines of rostrum reaching to apex of bifurcation of rostrum----  
-----Paralithodes rathbuni (Benedict)

Rostrum simply bifid or split, anterior lateral spines of rostrum not reaching half way to bases of  
terminal spines-----Paralithodes californiensis (Benedict)

Genus Acantholithodes

Acantholithodes hispidus (Stimpson)

Dermaturus hispidus Stimpson, 1860: 242.—Bouvier 1895: 174, pl. 11, figs. 3, 16; pl. 12, figs. 2, 16, 31.

Acantholithodes hispidus.—Holmes 1895: 575.—Holmes 1900: 120.—Schmitt 1921: 152, pl. 19, fig. 2; fig. 98.—Hart 1982: 70, fig. 19.—Wicksten 1982: 246.—Dawson 1989: 319.--Jensen 1995: 69.

Recognition characters.—Rostrum prominent, ending in strong spines. Carapace flattened, with numerous short setose spines; broadly pear-shaped, widest just past midlength; branchial regions with slight depressed area, sharp narrow cleft between cardiac and gastric regions. Abdomen short, broad and soft. Chelipeds and ambulatory legs armed with numerous spines. Carapace length to 62 mm.

Color in life.—Body yellowish to tan, spines darker, sometimes with faint bands of red on legs; hands of chelipeds with tinge of red, fingers bright red with white teeth and black tips.

Habitat and depth.—Usually on vertical rock walls, intertidal to 164 m but usually subtidal in southern parts of its range.

Range.—Off Moorovskoy Bay, Alaska to San Nicolas Island, California. Type locality Monterey Bay.



Acantholithodes hispidus

Genus Hapalogaster

Hapalogaster cavicauda Stimpson

Hapalogaster cavicauda Stimpson, 1859: 81, pl. 1, fig. 7.—Bouvier 1895: 166, pl. 12, fig. 29.—Holmes 1900: 113.—Schmitt 1921: 149, pl. 29, fig. 1; fig. 95.—MacGinitie and MacGinitie 1968: 299.—Smith and Carlton 1975: 399.—Haig and Abbott 1980: 582, fig. 24.6.—Ricketts et al. 1985: 171, fig. 140.—Dawson 1989: 319.—Jensen 1995: 69.—Hendrickx and Harvey 1999: 374.

Recognition characters.—Body and legs very flat, covered with dense, short hair. Carapace with front bearing medial tooth and lateral teeth, prominent cervical groove, widest behind midlength. Chelipeds unequal in size, hand of larger chela with 1-2 small tubercles on inner surface. Walking legs with deep incisions on anterior margins; these hidden by setae. Abdomen bulbous, visible in dorsal view. Carapace length 18.3 mm.

Color in life.—Yellowish brown.

Habitat and depth.—Under rocks in low intertidal zone, intertidal to 15 m.

Range.—Washington; Cape Mendocino, California to San Jeronimo Island, Baja California but uncommon south of Monterey Bay, California. Type locality Monterey, California.

Remarks.—Schmitt (1921) included H. grebnitzkii Schalfeew in his work on the decapods of California, citing it from “Humboldt Bay, California”. There have not been any other reports of the species from California. The record may have come from Humboldt Bay, Alaska instead of California. Hendrickx and Harvey (1999) reported this species from Guaymas, Sonora, Gulf of California. This record surely is in error. This may be a misidentification of Petrolisthes hirtipes (family Porcellanidae).



Hapalogaster cavicauda

## Genus Oedignathus

### Oedignathus inermis (Stimpson)

Hapalogaster inermis Stimpson, 1860: 243.

Oedignathus inermis.—Holmes 1900: 119.—Rathbun 1904: 163.—Schmitt 1921: 151, pl. 19, fig. 1; fig. 97. (See this work for early synonymy of the species).—MacGinitie and MacGinitie 1968: 301.—Smith and Carlton 1975: 399.—Haig and Abbott 1980: 583, fig. 24.7.—Hart 1982: 68, fig. 18 and color plate.—Ricketts et al. 1985: 171.—Dawson 1989: 319.—Jensen 1995: 70.

Recognition characters.—Carapace widest behind midlength, with abrupt angle at anterior edge of widest point; covered with scale-like plates; rostrum triangular, with frontolateral teeth and small teeth just mesial to them. Chelipeds unequal, covered by wart-like granules; hand of larger cheliped large and sullen, fingers with gape at base. Walking legs with tubercles; stiff setae on dactyls. Female abdomen somewhat hardened on left side. Carapace length to 30 mm. Color in life.—Brown. Tubercles darker; tubercles on major cheliped of adult blue.

Habitat and depth.—Rocky subtidal zones, especially in areas with strong currents. Rarely intertidal, to 15 m.

Range.—Korea, Japan; Dutch Harbor, Alaska to Pacific Grove, California. Type locality Puget Sound.

## Genus Cryptolithodes

### Cryptolithodes typicus Brandt

Cryptolithodes typicus Brandt, 1849: 185.—Holmes 1900: 124.—Rathbun 1904: 164.—Schmitt 1921: 154, pl. 20, figs. 1, 2.—Haig and Wicksten 1975: 102.—Hart 1982: 78, fig. 23.—Dawson 1989: 317.—Jensen 1995: 71.

Recognition characters.—Carapace about twice as wide as long, with lateral expansions not reaching midlength of rostrum, with dorsal tubercles and broad teeth along lateral margins. Rostrum narrowing distally, end rounded. Chelipeds tuberculate and unequal in size. Walking legs flattened. Abdomen flattened and triangular. Carapace length to 49 mm.

Color in life.—Highly variable: red, ivory, gray, etc.

Habitat and depth.—Often in shell rubble by rocky reefs, low intertidal to 45 m.

Range.—Amchitka Island, Alaska to Santa Rosa Island, California. Type locality “northern California”.

Remarks.—The reader will note the year in which this species was described. Brandt is known to have received specimens that came from the coast of California near Fort Ross, which may be the actual type locality of this crab.

### Cryptolithodes sitchensis Brandt

Cryptolithodes sitchensis Brandt, 1853: 254.—Holmes 1900: 125, pl. 2, figs. 21-25.—Schmitt 1921: 155, pl. 20, figs. 3-4; Fig. 100.—Smith and Carlton 1975: 399.—Haig and Abbott 1980: 583,



figs. 24.8a-g.—Hart 1982: 76, fig. 22.—Ricketts et al. 1985: 171, fig. 139.—Dawson 1989: 317.—Jensen 1995: 71.

Recognition characters.—Carapace about 1.3 times as wide and long, with lateral extensions almost as long as rostrum, with dorsal tubercles and low teeth along lateral margins. Rostrum widened distally, usually ending in distinct anterolateral angles. Sometimes with small median tooth. Chelipeds smooth and unequal. Walking legs smooth and flat. Abdomen flattened and triangular. Carapace length to 68 mm.

Color in life.—Highly variable: orange, mottled, ivory, red, etc. See color photographs by Haig and Abbott, 1980.

Habitat and depth.—Rocky reefs and tide pools, lowest intertidal zone to 17 m.

Range.—Sitka, Alaska to Point Loma, California. Type locality Sitka, Alaska. The species is uncommon south of Point Conception.

Remarks.—These little crabs sometimes bear injuries around the rim of the carapace, suggesting that something grabbed them. The injuries can heal. On occasion, two or more of these crabs are seen gripping each other. Whether this activity constitutes mating behavior or aggression is unknown.



Cryptolithodes sitchensis



Cryptolithodes sitchensis

Genus Phyllolithodes

Phyllolithodes papillosus Brandt

Phyllolithodes papillosus Brandt, 1849: 175.—Bouvier 1895: 174, pl. 11, fig. 12; pl. 12, figs. 14; 25; pl. 13, fig. 1.—Holmes 1900: 122.—Rathbun 1904: 164.—Schmitt 1921: 153, pl. 22, fig. 2.—Hart 1982: 72, fig. 20.—Dawson 1989: 319.—Jensen 1995: 72.

Recognition characters.—Carapace triangular, with deep pits within heart-shaped area on dorsal surface; lateral margins with strong spines, posterior margin with large nodes. Rostrum ending in two horns, with a subacute median spine. Chelipeds unequal, chelipeds and walking legs with long spines. Carapace length to 90 mm.

Color in life.—Carapace grayish, reddish or brown; walking legs often with cream-colored band above dactyl.

Habitat and depth.—Rocky subtidal areas, lowest intertidal zone to 183 m.

Range.—Dutch Harbor, Alaska to San Miguel Island, California. Type locality Kodiak Island, Alaska. Uncommon south of Monterey Bay, California.



Phyllolithodes papillosus

Genus Rhinolithodes

Rhinolithodes wosnessenskii Brandt

Rhinolithodes wosnessenskii Brandt, 1849: 174.—Schmitt 1921: 158, pl. 22, fig. 1, fig. 103.—Hart 1982: 74, fig. 21.—Dawson 1989: 319.—Jensen 1995: 72.

Recognition characters.—Carapace tuberculate, somewhat triangular, with deep semicircular fossa separating cardiac region from other parts of carapace. Rostrum blunt at base and tapering abruptly to median spine. Chelipeds unequal, armed with short spines. Walking legs also with short spines. Abdomen with small tubercles. Carapace length to 59 mm.

Color in life.—Mostly yellowish to grayish brown, markings of orange and cream in carapace depression.

Habitat and depth.—Rock or gravel bottoms, often in crevices, 6-73 m.

Range.—Kodiak, Alaska to Crescent City, California. Type locality Sitka and Kodiak, Alaska.

Genus Glyptolithodes

Glyptolithodes cristatipes Faxon

Rhinolithodes cristatipes Faxon, 1893:163.

Glyptolithodes cristatipes.—Faxon 1895: 43, pl. 7, fig. 2, 2a-2c.—Haig 1974: 161, fig. 5.—Baez and Andrade 1979: 222, pl. 1, fig. 2.—Wicksten 1982: 247.—Wicksten 1989b: 314.—Dawson 1989: 317.—Hendrickx and Harvey 1999: 374.

Recognition characters.—Carapace subtriangular, tuberculate; gastric area raised into conical prominence, crescent-shaped ridge on each branchial region, cardiac area enclosed in deep fossa. Ridges and prominences more marked in juvenile than adult. Rostrum straight and triangular. Anterolateral margin of carapace with 5 teeth. Chelipeds unequal, right one larger; cox granulated, lower margin of ischium and merus with 3-4 blunt teeth, upper surface of merus toothed. Ambulatory legs with crest along anterior margin. Abdomen tuberculate. Carapace length to 71.4 mm.

Habitat and depth.—Continental shelf and slope, 183-800 m.

Range.—Palos Verdes Peninsula, California to off Valparaiso, Chile. Type locality Albatross station 3354, Gulf of Panama, 7° 9'45"N, 80° 50' 0"W. Hendrickx and Harvey mistakenly reported the species from "Palo Alto, California", but the record in fact came from off the Palos Verdes Peninsula, Los Angeles County, California.

## Genus Lopholithodes

### Lopholithodes foraminatus (Stimpson)

Echinocerus foraminatus Stimpson, 1859: 79.

Lopholithodes foraminatus.—Holmes 1900:p 130.—Schmitt 1921: 157, pl. 21, fig. 2; fig. 102.—Goodwin 1952: 176.—MacGinitie and MacGinitie 1968: 300.—Pereyra and Alton 1972: 450.—Wicksten 1980: 363.—Hart 1982: 80, fig. 24.—Wicksten 1982: 245.—Wicksten 1989b: 314.—Dawson 1989: 318.—Jensen 1995: 72.

Recognition characters.—Carapace tuberculate, depressed; gastric region elevated, margins with low, wide spines. Rostrum short, with median spine and spiny tubercles above base. Chelipeds tuberculate, equal; with broad sinus on carpus forming, with similar sinus on first pair of ambulatory legs, large respiratory opening. Walking legs tuberculate, capable of being drawn tightly against cephalothorax. Abdomen asymmetrical and tuberculate. Carapace length to 165 mm.

Color in life.—Drab reddish-brown or tan.

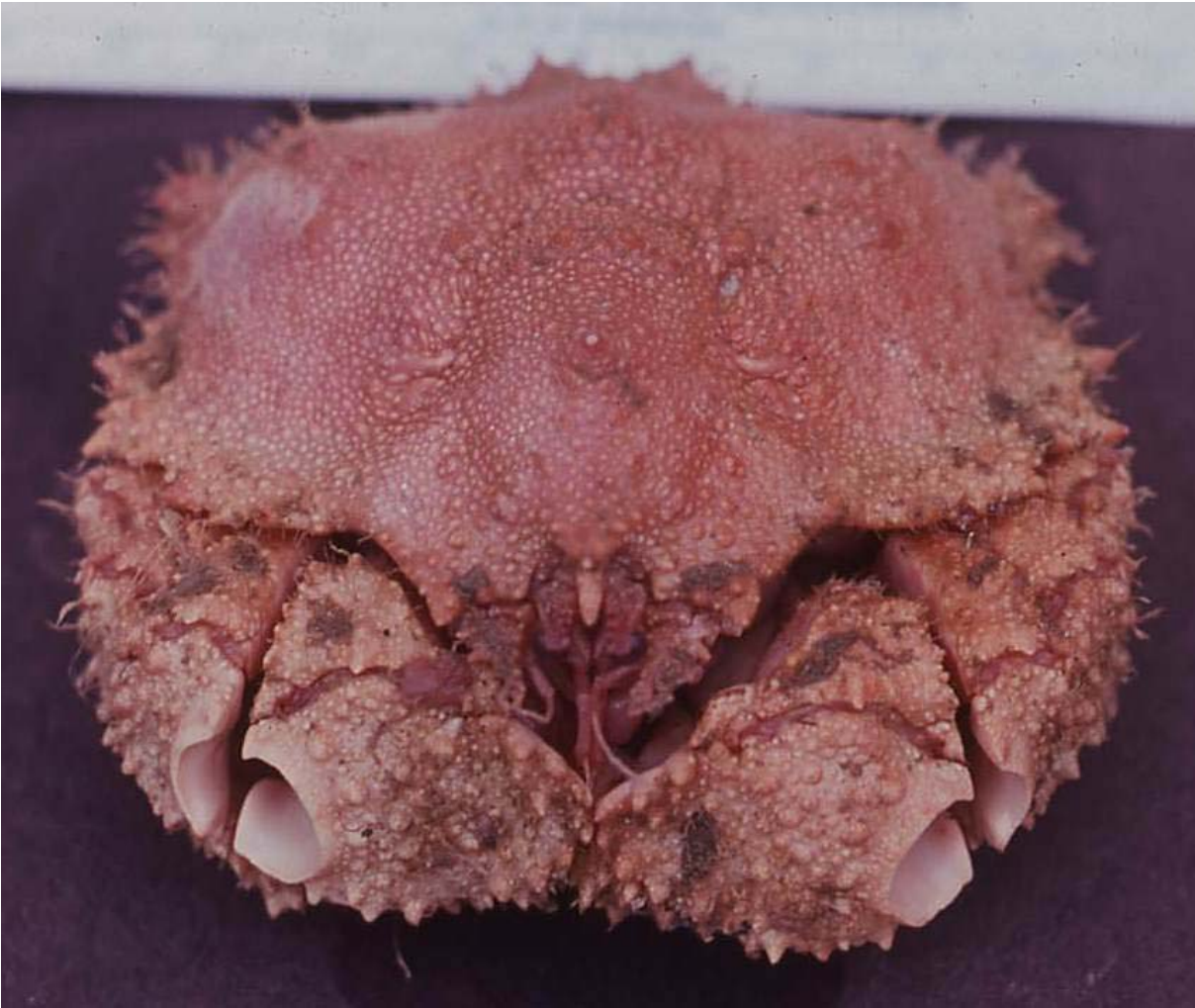
Habitat and depth.—Sandy subtidal areas, rarely low intertidal to 547 m.

Range.—Kodiak, Alaska to San Diego, California. Type locality "near San Francisco, California". The species often is trawled north of San Francisco.

Remarks.—See MacGinitie and MacGinitie (1968) for a good account of the natural history of this burrowing crab.



Lopholithodes foraminatus



Lopholithodes foraminatus

Lopholithodes mandtii Brandt

Lopholithodes mandtii Brandt, 1849: 174.—Holmes 1900: 128.—Schmitt 1921: 156, pl. 21, fig. 1; fig. 101.—Pereyra and Alton 1972: 450.—Hart 1982: 82, fig. 25.—Dawson 1989: 318.—Jensen 1995: 73.

Recognition characters.—Carapace strongly convex; gastric, cardiac and branchial regions each with prominent subconical tubercle, anterolateral margin with large and small spines; large prominence at each posterolateral angle; all raised areas more prominent in juveniles than in adults. Rostrum short, consisting of subconical tubercle and knob with two lateral tubercles with posterior notch. Chelipeds unequal. Chelipeds and ambulatory legs with tubercles. Abdomen asymmetrical, with tubercles. Carapace length to 177.8 mm.

Color in life.—Scarlet, red or orange, with bright purple markings on ventral part of body and on legs.

Habitat and depth.—Usually subtidal rocky areas, rarely lowest intertidal zone, to 200 m.

Range.—Sitka, Alaska to Monterey, California but few reports south of Washington. Type locality Sitka, Alaska.

## Genus Paralomis

### Paralomis multispina (Benedict)

Leptolithodes multispinus Benedict, 1895: 484.—Rathbun 1904: 165.

Paralomis multispina.—Bouvier 1896: 25.—Schmitt 1921: 159, pl. 23, pl. 30, figs. 7, 8.—Goodwin 1952: 176, fig. 8.—Pereyra and Alton 1972:450.—Wicksten 1980: 364.—Hart 1982: 88, fig. 28.—Wicksten 1982: 245.—Wicksten 1989b:314.—Dawson 1989: 318.—Hendrickx and Harvey 1999: 374.

Recognition characters.—Carapace about as long as wide, dorsal surface and lateral margins with numerous spines. Rostrum with simple median spine and two basal spines. Chelipeds unequal, slender, with prominent spines on carpus. Ambulatory legs elongate, cylindrical, thickly set with spines. Female abdomen twisted to right. Carapace length 80 mm.

Color in life.—Body red to pale pink, spines dark red.

Habitat and depth.—Muddy continental slope, 1100-1577 m.

Range.—Japan; Shumagin Bank, Alaska to off Guadalupe Island, Baja California; off Carmen Island, Gulf of California.. Type locality off Queen Charlotte Islands.

Remarks.—This large crab has been fished commercially by trapping. The caprellid amphipod Caprella unguina has been found clinging to the legs of this crab.

### Paralomis verrilli (Benedict)

Pristopus verrilli Benedict 1895: 486.—Rathbun 1904: 165.

Paralomis verrilli.—Schmitt 1921: 159, pl. 24, pl. 30, figs. 5-6.—Pereyra and Alton 1972: 450.—Hart 1982: 86, fig. 27.—Wicksten 1989b:315.—Dawson 1989: 318.—Hendrickx and Harvey 1999: 374.

Recognition characters.—Carapace slightly longer than wide, with spines and granules; large spines on margins and elevated areas. Rostrum bifid with subrostral spine. Chelipeds shorter than walking legs, spinose; right larger than left. Walking legs somewhat flattened, with large teeth on margins and smaller teeth on dorsal surface. Abdomen with small spines and nodules.

Color in life.—Not recorded.

Habitat and depth.—Lower continental slope, 1238-2379 m.

Range.—Sea of Okhotsk to off San Benito Island, Baja California; and Gulf of California. Type locality off Pribilof Islands.

## Genus Lithodes

### Lithodes couesi Benedict

Lithodes couesi Benedict, 1895: 481.—Schmitt 1921: 162, pl. 28, pl. 29 figs. 3-5.—Pereyra and Alton 1972: 450.—Somerton 1981: 259, figs. 7, 8.—Hart 1982: 94, fig. 31—Wicksten 1982: 245.—Wicksten 1989b: 314—Dawson 1989: 317.

Recognition characters.—Carapace longer than wide, with spines on dorsal surface and larger ones along margins. Rostrum with bifid tip and pair lateral spines. Chelipeds much shorter than walking legs, with spines; fingers with gape. Walking legs with spines on upper surface and margins. Abdomen without spines. Spines relatively larger and rostrum relatively longer in relation to carapace in juveniles than in adults. Carapace length to 105 mm.

Color in life.—Carapace rose pink, spines red. Chelipeds and walking legs crimson with white joints. Juveniles scarlet.

Habitat and depth.—Among mud or boulders, 258-1829 m.

Range.—Japan; Bering Sea to off San Diego, California. Type locality north of Unalaska.

Remarks.—Lithodes couesi has three adaptations to survival in areas of low oxygen concentration: inflated branchial chambers, large exhalent openings and large scaphognathites. Photographs show the crab walking on tip-toe atop soft muddy sediments (Somerton, 1981).

## Genus Paralithodes

### Paralithodes rathbuni (Benedict)

Lithodes rathbuni Benedict, 1895: 482.—Holmes 1900: 131,

Paralithodes rathbuni.—Bouvier 1896: 23.—Schmitt 1921: 160, pl. 26, pl. 27, figs. 6-7; pl. 30, figs. 3-4.—Goodwin 1952: 177, fig. 9.—Wicksten 1982: 245.—Wicksten 1987: 55.—Wicksten 1989b: 314.—Dawson 1989: 318.

Recognition characters.—Carapace slightly wider than long, with long spines on dorsal regions and margins of carapace, more pronounced in juveniles than in adults. Rostrum directed upward, with two lateral spines and pair of spines flanking terminal point. Chelipeds slender, armed with strong spines; shorter than walking legs. Walking legs slender and spiny. Abdomen with membranous medial area. Carapace length 65 mm.

Color in life.—Pale orange.

Habitat and depth.—Sand, mud or rock; 92-380 m.

Range.—Cordell Bank, California to south of San Benito Islands, Baja California. Type locality off San Simeon Bay, California.





juvenile Paralithodes rathbuni

Paralithodes californiensis (Benedict)

Lithodes californiensis Benedict, 1895: 483.—Holmes 1900: 131.

Paralithodes californiensis.—Bouvier 1896: 23.—Schmitt 1921: 161, pl. 25, pl. 30, figs. 1-2.—Goodwin 1952: 178, fig. 10.—MacGinitie and MacGinitie 1968: 300.—Anderson and Cailliet 1974: 29.—Wicksten 1982: 245.—Wicksten 1989b: 314.—Dawson 1989: 318.

Recognition characters.—Carapace longer than wide, with long spines on dorsal regions and margins of carapace; one large spine each above origins of second and third walking legs. Spines more pronounced in juveniles than in adults. Rostrum bifid, with two subrostral spines extending to end of cornea of eye. Chelipeds slender and spinose. Walking legs elongate and spinose. Abdomen with membranous medial area. Carapace length 95 mm.

Color in life.—Orange with bluish-white spines.

Habitat and depth.—Mud or rocks, 145-300 m.

Range.—Off Pismo Beach to off San Diego, California. Type locality off Santa Cruz Island, California.

Remarks.—This lithodid crab serves as host or substrate for other species. The gammarid amphipod Parapleustes commensalis has been found on the carapace. In a strange symbiosis, eggs of the snailfish Careproctus ? osborni may be found in the gill chambers of this crab. Some larger crabs had cocoons of marine leeches on the carapace. The crab may be parasitized by rhizocephalan cirripeds.

# Superfamily Galatheoidea

## Family Galatheidae

Sometimes called craylets or squat lobsters, most members of this family in the northeastern Pacific live on the continental shelf or deeper. Some of these animals are epibenthic, while others are known to dig burrows. Feeding is by scavenging or using the setose third maxillipeds to rake the sediment for edible material. Galatheids can swim for some distance by flapping the abdomen and spreading the legs. The fifth pereopod is slender and modified into a cleaning brush. The animal uses this appendage to clean its dorsal surface, and can open the carapace to clean the surfaces of the gills.

Ranges of deep benthic galatheids of the eastern Pacific remain uncertain, as does some classification to species. It is not known yet whether populations of species thought to be pan-Pacific or cosmopolitan are actually separate species. Molecular studies are needed, but collecting these animals at great depths is very difficult and expensive.

In Chile, large species of Munida are fished commercially and eaten under the name “langostinos”. The species of galatheids off the western coast of the U.S.A. probably also are edible, but they are too scarce or too small to support a fishery.

### Key to species of the family Galatheidae

1. Latero-inferior regions of carapace greatly swollen. Pereopods flattened, fringed with setae; capable of swimming for long distances-----Pleuroncodes planipes Stimpson  
    Latero-inferior regions of carapace not greatly swollen. Pereopods rounded, not fringed with setae; not capable of swimming for long distances-----2
2. Eyes pigmented-----3  
    Eyes not pigmented-----5
3. Rostrum broad, flattened dorsoventrally, laterally toothed-----  
-----Janetogalatea californiensis (Benedict)  
    Rostrum long and slender, spine-like, without lateral teeth-----4
4. Abdomen and posterior margin of carapace unarmed-----Munida quadrispina Benedict  
    Second, third and fourth segments of abdomen armed with spines-----  
-----Munida hispida Benedict
5. Abdomen unarmed-----6  
    Abdomen with spines or tubercles-----7

6. Dorsal surface of carapace covered by spiny-pointed tubercles-----Munidopsis scabra Faxon  
 Dorsal surface without spiny-pointed tubercles----- Munidopsis verrilli Benedict
7. Rostrum with lateral spines-----8  
 Rostrum without lateral spines-----9
8. Eyestalks spined on dorsal surface. Dorsal armature of abdomen not confined to median line --  
 -----Munidopsis hystrix Faxon  
 Eyestalks not spined on dorsal surface. Dorsal armature of abdomen confined to median line--  
 -----Munidopsis depressa Faxon
9. Carapace with one very large median dorsal spine and two smaller ones. Anterolateral spine of carapace large-----Munidopsis diomedea (Faxon)  
 Carapace without one very large median dorsal spine, any median dorsal spines small.  
 Anterolateral spine of carapace small, if present-----10
10. Anterior margin of carapace with small, serrated lobe on either side of base of rostrum behind ocular peduncle, lateral margins arcuate-----Munidopsis aspera (Henderson)  
 Anterior margin of carapace straight, at right angles to lateral margin; lateral margins straight-----Munidopsis quadrata Faxon.

*Pleuroncodes planipes* Stimpson

*Munida hispida* Benedict, 1902

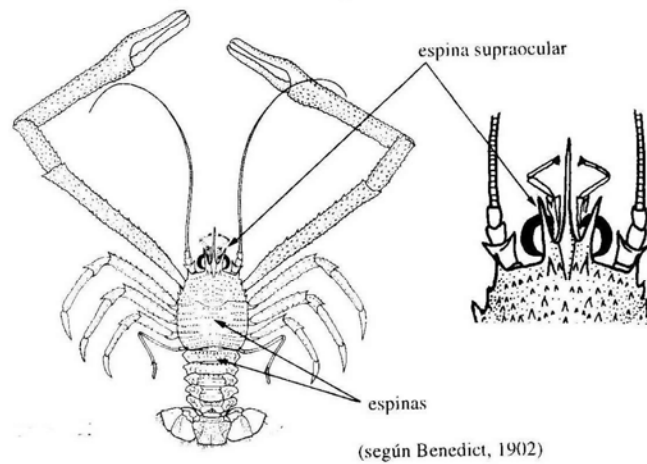
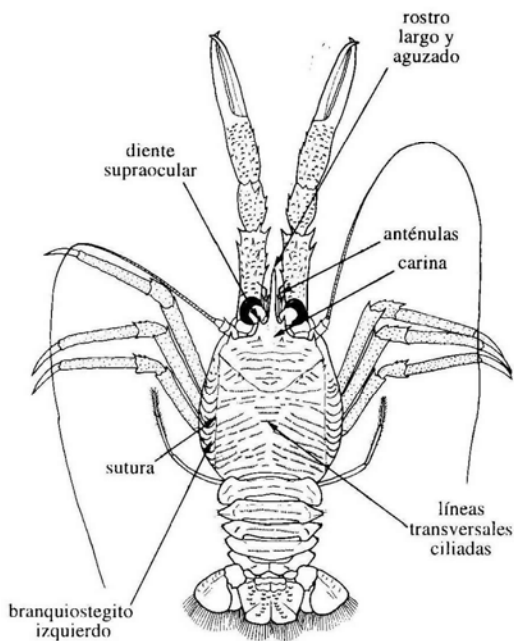


Illustration by M.E. Hendrickx

Genus Pleuroncodes Stimpson

Pleuroncodes planipes Stimpson

Pleuroncodes planipes Stimpson, 1860: 245.—Holmes 1900: 112.—Schmitt 1921: 163, pl. 31, fig. 2.—Jensen 1995: 74.—Hendrickx and Harvey 1998: 377. (See this work for additional references).

Recognition characters.—Rostrum long and slender, flanked by two spine-like supraorbital teeth. Eyes large, globular and pigmented. Carapace transversely rugose, with latero-inferior regions swollen; spine at anterolateral angle with few spines on lateral margin, Abdomen dorsally unarmed. Chelipeds and ambulatory legs flattened, edged with setae. CL to 50 mm.

Color in life.—Red, setae golden.

Habitat and depth.—Existing as both a swimming and benthic phase, surface to 90 m.

Range.—San Francisco, California to the Gulf of California and Central America. Southern range limit not defined; has been taken in Costa Rica (J. Haig, pers. comm.). Type localities “Pacific ocean, 24°N, 130°W and Monterey, California”.

Remarks.—The pelagic red crab generally occurs off the coast of Baja California, Mexico but can be carried northward during years of warm currents. The crabs may be stranded in tide pools and on the beach. Numerous pelagic fishes and the humpback whale will eat these crabs, but they are too small to be of interest to a fishery in California.



Pleuroncodes planipes

Genus Janetogalatea Baba and Wicksten

Janetogalatea californiensis (Benedict)

Galathea californiensis Benedict, 1902: 247, fig. 1.—Schmitt 1921: 164, fig. 104.—Wicksten 1982: 245.—Wicksten 1987: 55.—Wicksten 1989: 315.

Janetogalatea californiensis.—Baba and Wicksten 1997: 38, figs. 1-3.—Hendrickx and Harvey 1999: 375.

Recognition characters.—Rostrum more than twice as long as eyes, broad, flattened dorsoventrally, armed with one pair lateral spines and one pair basal spines. Carapace with 6 lateral spines, the most anterior of these largest; dorsal surface with transverse ridges and pair of well developed epigastric spines. Chelipeds with thorn-like spines; fingers of chela with rows of small teeth along cutting edges. Ambulatory legs with spines on merus and carpus, dactyls short and stout. Abdomen without spines. CL to 31.3 mm.

Color in life.—Reddish on much of surface, carapace with white transverse stripes along main transverse ridges and white background on pereopods.

Habitat and depth.—Among rocks and sponges, 89-3993 m.

Range.—Monterey Bay, California to Gulf of California. Type locality off Santa Cruz Island, California (Albatross station 2946).

Remarks.—This poorly-known crab has been taken in baited traps.

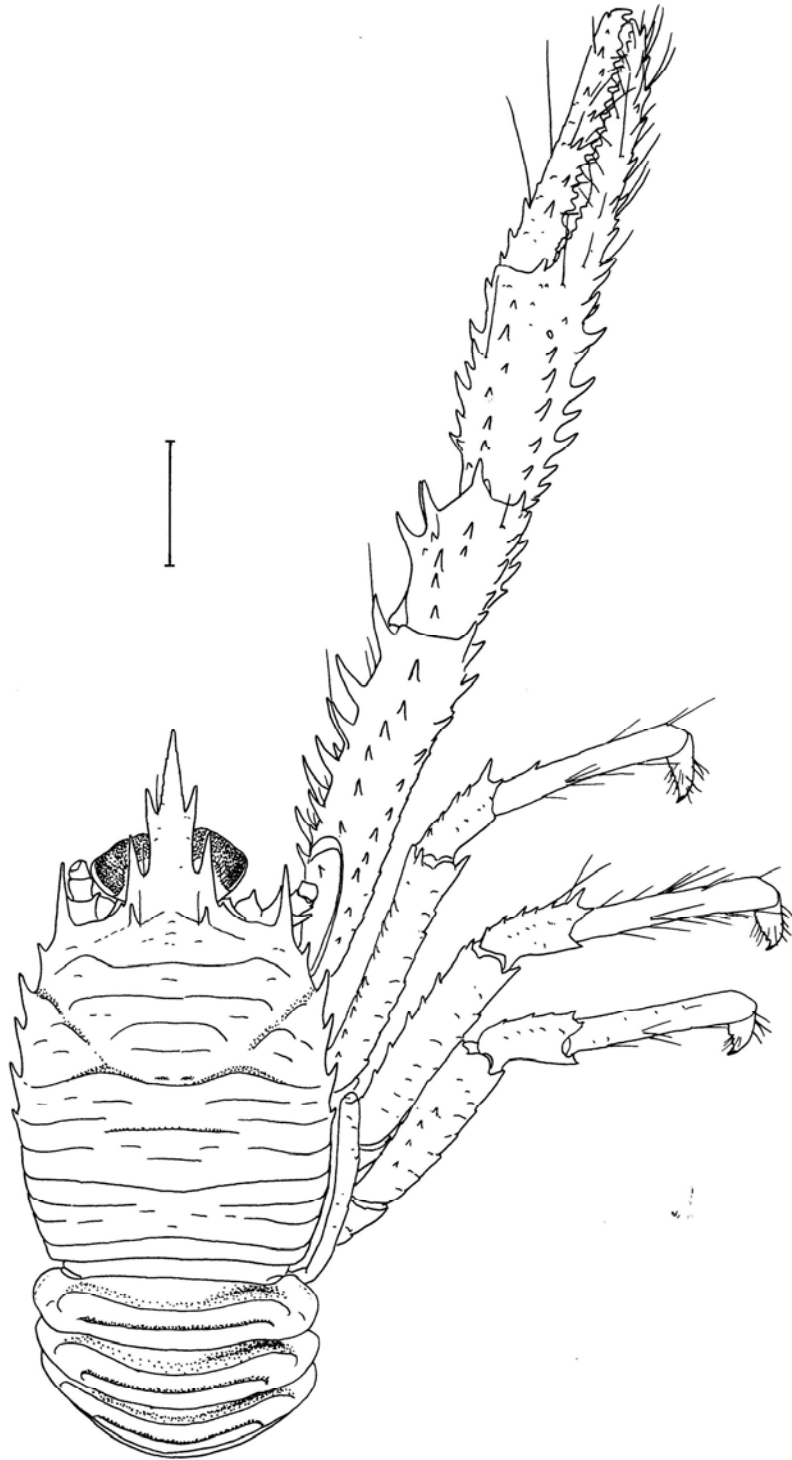


Fig. 1. *Janetogalatea californiensis* (Benedict, 1902), paralectotype, ov. ♀ cl, 13.7 mm, USNM 20551. Scale = 5 mm.



Janetogalathea californiensis



## Genus Munida Leach

### Munida quadrispina Benedict

Munida quadrispina Benedict, 1902: 269, fig. 17.—Rathbun 1904: 166.—Schmitt 1921: 165, fig. 105.—Goodwin 1952: 395.—Pereyra and Alton 1972: 450.—Wicksten 1980: 363.—Wicksten 1982: 245.—Hart 1982: 168, fig. 66.—Burd and Brinkhurst 1984: 1, figs. 2, 8.—Jensen 1995: 73.—Wicksten 1989: 315.

Recognition characters.—Rostrum long, spine-like; flanked by pair of supraocular spines reaching to cornea of eyes. Carapace with ridges, 8-10 lateral spines, 6 gastric spines. Chelipeds with numerous spines and slender fingers of chela. Ambulatory legs armed with short spines. Abdomen without spines except for few spinules on tail fan. CL to 67 mm, usually smaller.

Color in life.—Overall reddish brown, ridges red with grooves white, blue spots in cervical groove. Tips of fingers of chelae white. Ambulatory legs with irregular red bands.

Habitat and depth.—Among rocks, gravel, mud and sponge beds, 12-1463 m. This crab tolerates areas of low oxygen concentration.

Range.—Sitka, Alaska to Los Coronados Islands, Mexico. Type locality off Cape Beale, Vancouver Island (Albatross station 2878).

Remarks.—This crab has been observed feeding on zooplankton. Burd and Brinkhurst (1984) observed that crabs occurred in higher densities with less within-species aggressive behavior in areas of low oxygen concentration. The crab can swim.

### Munida hispida Benedict

Munida hispida Benedict, 1902: 260, fig. 6.—Schmitt 1921: 166, fig. 106.—Wicksten 1982: 245.—Wicksten 1987: 55.—Wicksten 1989: 315.—Hendrickx and Harvey 1999: 375.

Recognition characters.—Rostrum spine-like, more than twice as long as supraocular spines. Supraocular spines slightly exceeding corneas of eyes. Carapace with ridges, 7-10 lateral spines posterior to larger anterolateral spines; pair gastric spines, also 5-6 spines in line along gastric region; smaller spinules on posterior dorsal surface of carapace, posterior border of carapace with 10-18 low spines. Chelipeds with numerous spinules. Fingers of chelae slender, gaping in adult male. Ambulatory legs with spines on merus, fewer spinules on carpus and propodus, dactyl slender. Abdomen with spinules on second to fourth abdominal somites. CL to 20 mm.

Color in life.—Mostly reddish. Carapace with white grooves. spines on chelipeds dark red.

Habitat and depth.—Rocky or muddy areas, 165-500 m.

Range.—Monterey Bay, California to Galapagos Islands. Type locality off Galapagos Islands, Albatross station 2817.



Munida hispida



female Munida hispida

## Genus Munidopsis Whiteaves

### Munidopsis scabra Faxon

Munidopsis scabra Faxon, 1893: 186.—Faxon 1895: 93, pl. XXI, figs. 1, 1a.—Garth and Haig 1971: 6.6.—Pereyra and Alton 1972:450.—Haig and Wicksten 1975:101.—Wicksten 1989: 315.

Recognition characters.—Rostrum without lateral spines, slightly turned upward. Carapace covered with spiny-pointed tubercles; with 9-10 lateral spinules and row of 8 spinules on posterior margin. Chelipeds with thorn-like spines except on fingers. Ambulatory legs with rows of small, sharp spines. Abdomen without spines. CL 40 mm.

Color in life.—Not recorded.

Habitat and depth.—Continental slope, among sand, mud and rubble, 567-1243 m.

Range.—Oregon to Peru. Type localities off Cabo Corrientes, Mexico, Albatross stations 3424 and 3425.

### Munidopsis verrilli Benedict

Munidopsis verrilli Benedict, 1902: 291, fig. 34.—Schmitt 1921: 169, fig. 108.—Goodwin 1952: 395.—Wicksten 1989: 316.

Recognition characters.—Rostrum slender and triangular, without lateral spines. Front of carapace angled 45 degrees from base of rostrum to anterolateral margin, with sharp spine just posterolateral to eyes, lateral margin with 4 spines, surface rough, with low tubercles and two spines on gastric region. Chelipeds relatively short, with sharp thorn-like spines on merus and carpus, two spines on palm of chela, fingers relatively short and stout. Ambulatory legs with sharp spines on merus and carpus, propodus unarmed, dactyls slender. Abdomen without spines. CL 17 mm.

Color in life.—Carapace iridescent.

Habitat and depth.—Continental slope, 1253-1986 m.

Range.—Oregon to off Cedros Island, Baja California, Mexico. Type locality off San Diego, Albatross station 2923.

### Munidopsis hystrix Faxon

Munidopsis hystrix Faxon, 1893: 183.—Faxon 1895: 89, pl. 19, figs. 1, 1a.—Rathbun 1904: 166.—Schmitt 1921: 168, fig. 107.—Garth and Haig 1971:6.6.—Wicksten 1989: 315.—Hendrickx and Harvey 1999: 376.

Recognition characters.—Rostrum long, armed with 2-5 spines on each side. Carapace setose, covered with small spinous tubercles, one at external angle of each orbit, 3 prominent spines on gastric region, one on cardiac area, one on each branchial area, row of spines on each lateral margin. Chelipeds with thorn-like spines on merus, carpus and propodus. Abdomen with spines on second and third somites. CL 26 mm.

Color in life.—Not recorded.

Habitat and depth.—Continental slope, on green mud or Globigerina ooze, 552-1243 m.

Range.—Anacapa Island, California to Peru. Type localities off Tres Marias Islands (Albatross stations 3424 and 3425) and off Acapulco, Mexico (Albatross station 3417).

Munidopsis depressa Faxon

Munidopsis depressa Faxon 1893: 189.—Faxon 1895: 96, pl. 22, figs. 2, 2a, 2b.—Haig 1956: 79.—Wicksten 1989: 315.—Hendrickx and Harvey 1999: 376.

Recognition characters.—Rostrum elongate, triangular, with 2 small lateral teeth near apex and smaller posterior ones, denticles along median groove. Carapace wider near posterior margin than in front half, with sharp anterolateral spines, rows of sharp spinules along lateral surfaces, 3 median dorsal spines and small spines and tubercles elsewhere on dorsal surface; posterior margin with large median spine and row of teeth on either side.. Chelipeds with thorn-like spines. Ambulatory legs with spines on merus, carpus and proximal surface of propodus, dactyls elongate. Abdominal somites 1-4 with spines or tubercles. CL 20.3 mm.

Color in life.—Not recorded.

Habitat and depth.—Continental slope, on green mud and sand, 185-1255 m.

Range.—Santa Catalina Island, California to off Tres Marias Islands, Mexico. Type locality off Tres Marias Islands (Albatross station 3425).

Munidopsis diomedae (Faxon)

Galacantha diomedae Faxon, 1893: 180.—Faxon 1895: 79, pl. 25.

Munidopsis diomedae.—Haig and Wicksten 1975: 101.—Wicksten 1980: 364.—Wicksten 1989: 315.—Hendrickx and Harvey 1999: 376.

Recognition characters.—Rostrum without lateral spines, distal part angled upward. Carapace with one very large and 2 smaller median dorsal spines; large anterolateral spine followed by smaller one on each side,; anterior part of carapace with tubercles, posterior half with tuberculate ridges. Pereopods tuberculate. Carpus of cheliped with 2 distal spines. Ambulatory legs with one spine each at end of carpus and merus. Abdominal somites 1-3 with small median spines. CL to 28 mm.

Color in life.—Red.

Habitat and depth.—Lower continental slope, on mud and Globigerina ooze, 768-3790 m.

Range.—San Clemente Island, California to Chile. Type locality not designated; type material came from 14 stations between the Gulf of Panama and the Gulf of California.

Remarks.—Faxon (1895) noted that this species was parasitized by rhizocephalan cirripeds and epicaridean isopods.

Munidopsis aspera (Henderson)

Elasmonotus asper Henderson, 1885: 416.

Munidopsis aspera.—Rathbun 1904: 167.—Schmitt 1921: 171, pl. 31, fig. 1.—Wicksten 1989: 315.—Hendrickx and Harvey 1999: 376.

Recognition characters.—Rostrum elongate and triangular, length variable: from same as eyestalks to twice their length. Carapace with small lobe on orbital border, dorsal surface with tubercles, two large tubercles on cardiac area. Chelipeds elongate and setose, with scattered spines. Ambulatory legs with elongate dactyls. Second and third abdominal somites with tubercles. Total length of body 28 mm.

Color in life.—Not recorded.

Habitat and depth.—Continental shelf and slope, 104-2748 m.

Range.—Santa Catalina Island, California to Straits of Magellan; off Brazil and Patagonia. Type localities off coast of Brazil and off Patagonia.

### Munidopsis quadrata Faxon

Munidopsis quadrata Faxon, 1893: 188.—Faxon 1895: 97, pl. 23, fig. 1.—Rathbun 1904: 167.—Schmitt 1921: 170, fig. 109.—Pereyra and Alton 1972: 450.—Hart 1982: 170, fig. 67.—Wicksten 1989: 315.—Hendrickx and Harvey 1999: 376.

Recognition characters.—Rostrum more or less flat and triangular. Carapace rectangular, without prominent spines but covered with granules. Chelipeds setose and armed with thorn-like spines. Ambulatory legs with small spines on merus and carpus, dactyls with spinules along flexor margin. Abdominal somites 2-4 with median teeth. CL to 15.5 mm.

Color in life.—Carapace pinkish tan. Rostrum pink and white. Chelipeds mostly white, basis orange, ischium pink. Ambulatory legs white and pale tan. Abdomen pinkish with white (after Hart, 1982).

Habitat and depth.—Mud and sand, 86-1572 m.

Range.—Queen Charlotte Islands, British Columbia to Islas Tres Marias, Mexico. Type locality off Islas Tres Marias (Albatross sta. 3424).

## Family Porcellanidae

Porcelain crabs are flattened dorso-ventrally and able to slip under rocks, into cracks and other tight spaces. The third maxillipeds are fringed with long setae, which are extended into the water and employed to capture plankton. The crabs also can graze on filamentous algae, but are unable to tear and scavenge food. The fifth pereopods are modified into cleaning brushes. In species of Petrolisthes, the crabs maintain an individual distance of one second antenna's length from the nearest neighbor. The large chelipeds may be used to raise the crab off the substrate or to "elbow" intruding neighbors. The crabs can swim short distances by flapping the abdomen.

Porcelain crabs are recognizable as larval stages by their elongate anterior and posterior carapace spines. To identify the adults and find a comprehensive account of their synonymies, variation and collecting localities, see the authoritative work by Haig (1960).

### Key to the species of the Porcellanidae

1. Chelipeds markedly unequal in size and shape, thick and more or less roughened-----2  
    Chelipeds more or less equal in size and shape, flattened-----4
2. Carapace with tuft of plumose hairs on front. Chelipeds covered by velvet-like pubescence-----  
-----Pachycheles holosericus Schmitt  
  
    Carapace without tuft of plumose hairs on front. Chelipeds either with few, coarse hairs or  
    with short pubescence interspersed with tufts of longer hairs-----3
3. Chelipeds tuberculate above, chelipeds without short pubescence, few if any setae in gape of  
fingers-----Pachycheles rudis Stimpson  
  
    Chelipeds granulated, chelipeds with short pubescence, dense pubescence in gape of fingers-----  
-----Pachycheles pubescens Holmes
4. Carapace markedly wider than long, chelipeds with dense fringe of setae on outer surface-----  
-----Polyonyx quadriungulatus Glassell  
  
    Carapace about as wide as long, chelipeds without dense fringe of setae on outer surface-----5
5. Carpus of cheliped elongate, over twice as long as wide-----6  
  
    Carpus of cheliped short, usually less than twice as long as wide-----7
6. Carapace with short transverse striations and flattened tubercles-----  
-----Petrolisthes rathbunae Schmitt  
  
    Carapace smooth posteriorly, with granules anteriorly without striations-----  
-----Petrolisthes manimaculis Glassell

7. Carpus without a lobe on anterior margin, anterior and posterior margins subparallel-----  
-----Petrolisthes erimerus Stimpson

Carpus lobed on anterior margin-----8

8. Carpal lobe occupying proximal 1/4 of anterior margin, anterior and posterior margins otherwise subparallel; merus of third ambulatory leg not inflated. (Not found north of Point Conception, California)-----Petrolisthes cabrilloi Glassell

Carpal lobe not confined to proximal 1/4 of anterior margin of chelipeds, anterior and posterior margins converging distally; merus of third ambulatory leg inflated. (Found north of Point Conception, California)-----Petrolisthes cinctipes (Randall)

### Genus Pachycheles Stimpson

#### Pachycheles holosericus Schmitt

Pachycheles holosericus Schmitt, 1921: 177, pl. 33, fig. 3.—Haig 1960: 173, pl. 34, fig. 2.—Haig and Abbott 1980: 589, fig. 24.21.

Recognition characters.— Front narrow, trilobate in frontal view, with tuft of plumose setae. Carapace about as long as broad, strongly convex from front to back, plicate on posterolateral regions. Chelipeds unequal. Merus rugose and granular, anterior margin with strongly projecting granular lobe. Carpus with broad lobe on anterior margin, edged with large granules, rest of surface covered by small granules largely concealed by thick setae. Chelae with large coarse granules, upper surface covered with short plumose setae; fingers gaping in major cheliped; gape in major cheliped with tuft of plumose setae. All segments of ambulatory legs with long plumose setae. Telson of abdomen with 5 plates. CL to 18mm.

Color in life.—Body dull brown.

Habitat and depth.—Intertidal to 18 m, under rocks, in sheltered places such as kelp holdfasts and in cavities in sponges.

Range.—Santa Barbara, California to Magdalena Bay, Baja California, Mexico. Type locality Venice, California.

Remarks.—Haig and Abbott (1980) reported that these crabs are practically always found in pairs. There have been no recent reports of the crab from its type locality, which has undergone extensive habitat alteration by human activity. The crab has been found elsewhere in low intertidal and shallow subtidal habitats and also on pier pilings.

#### Pachycheles rudis Stimpson

Pachycheles rudis Stimpson, 1859: 76, pl. 1, fig. 5.—Holmes 1900: 109.—Rathbun 1904: 168, fig. 6.—Schmitt 1921: 176, pl. 32, fig. 2; fig. 111.—Haig 1960: 170, pl. 34, fig. 1.—Smith and Carlton 1975: 399, fig. 63A, 63B.—Haig and Abbott 1980: 589, fig. 24.20.—Hart 1982: 100, fig. 101.—Ricketts et al. 1985: 402, fig. 308.—Jensen 1995: 74.

Recognition characters.—Front narrow, trilobate in frontal view, with thick-set short setae. Carapace about as broad as long, strongly convex from front to back, mostly punctate or with flattened granules. Chelipeds unequal. Merus rugose and granular, anterior margin with strongly projecting lobe. Carpus with broad subtriangular lobe on anterior margin, dorsal surface covered with long setae and large coarse granules. Cheliped with large coarse granules; large protuberance at base of dactyl, surface covered with setae which do not extend beyond most proximal part of dactyl. Ambulatory legs with thick fringe of plumose setae along anterior margins. Telson with 5 plates. CL to 17.4 mm.

Color in life.—Carapace mottled and stripes with gray, brown, and white; in smaller animals, may be almost completely white except for one or two brown patches. Chelipeds greenish brown with gray and bluish granules. Ambulatory legs mottled with brown, gray and white.

Habitat and depth.—Usually intertidal, to 29 m, under stones, in holdfasts or in well-protected crevices.

Range.—Kodiak, Alaska to Magdalena Bay, Baja California, Mexico. Type locality Monterey, California.

Remarks.—This crab may live in pairs, sometimes in association with the shrimp Betaeus setosus.



adult Pachycheles rudis





juvenile Pachycheles rudis

Pachycheles pubescens Holmes

Pachycheles pubescens Holmes, 1900: 110.-- Rathbun 1904: 168.--Schmitt 1921: 117, pl. 33, fig. 4; fig. 112.—Haig 1960: 162, pl. 34, fig. 3.—Smith and Carlton 1975: 399, fig. 64.—Haig and Abbott 1980: 589, fig. 24.19.--Hart 1982: 102, fig. 35.-- Ricketts et al. 1985: fig. 31 (larval stages). - Jensen 1995: 74.

Recognition characters.—Front trilobate in frontal view, with small tuft of setae. Carapace slightly broader than long, strongly convex from front to back, plicate on posterolateral regions, punctate elsewhere. Chelipeds unequal. Merus of chelipeds with flattened granules, anterior margin with strongly projecting subtriangular lobe. Carpus with broad lobe on anterior margin, cut into 3-4 uneven, serrate teeth, lobe and remainder of carpus covered with granules. Entire surface of chelipeds thickly covered with short plumose setae. Fingers slightly gaping in major cheliped; gape thickly covered with short setae. Ambulatory legs with fringes of plumose setae. Telson with seven plates. CL to 18 mm.

Color in life.—Carapace white, dappled with brown, gray and purple; may have blue and tan comma-shaped mark on each branchial region. Cheliped covered by mud-colored setae. Ambulatory legs with merus blue and brown, propodus and dactyl with distal white bands. Habitat and depth.—Rocky coasts, usually intertidal but sometimes subtidal as deep as 55 m. Range.—Queen Charlotte island, British Columbia to Thurloe Head, Baja California, Mexico. Type localities Drake's Bay, Farallon Islands and Humboldt County, California.



Pachycheles pubescens

Genus Polyonyx Stimpson

Polyonyx quadriungulatus Glassell

Polyonyx quadriungulatus Glassell, 1935: 93, pl. 9.—Haig 1956: 80.—Haig 1960: 236, pl. 41, fig. 2; text-fig. 12(1).—Jensen 1995: 76.

Recognition characters.—Front convex or concave in dorsal view, with short fringe of setae. Carapace subovate, 1.2-1.4 times as broad as long. Chelipeds unequal. Merus with broad, rounded lobe on anterior margin; posterior margin fringed with fine setae. Carpus with anterior margin bearing high lamellar crest, anterior and posterior margins fringed with setae. Chela slender, dorsal surface swollen and without crest in major cheliped; outer margin with sharp crest lined with row of granules and with thick fringe of setae extending nearly to tip of dactyl, gape of fingers with scattered short setae. In major chela, dactyl crosses over fixed finger at tip of chela. Ambulatory legs smooth, all segments with fringe of fine setae. Merus with fringe of fine setae. Propodus with pair of movable spinules at distal end of posterior margin, single

movable spine posterior to them and one on middle or proximal third of posterior margin. Dactyl with 4 fixed spines, distal three large, proximal one small. Telson with 7 plates. CL to 13.5 mm. Color in life.—Carapace and chelipeds dark brown, mottled with green and red; ambulatory legs lighter and banded.

Habitat and depth.—Strictly commensal with polychaete Chaetopterus variopedatus, intertidal to 46 m.

Range.—Santa Rosa Island, California to Punta San Eugenio, Baja California, Mexico. Type locality Estero de Punta Banda, Baja California, Mexico.

Remarks.—These crabs live in pairs inside the worm's tube.

### Genus Petrolisthes Stimpson

#### Petrolisthes rathbunae Schmitt

Petrolisthes rathbunae Schmitt, 1921: 181, pl. 32, fig. 3.—Haig 1960: 72, pl. 26, fig. 2.—Smith and Carlton 1975: 399.—Haig and Abbott 1980: 587, fig. 24.14.—Jensen 1995: 76.

Recognition characters.—Front triangular, with deep median sulcus. Carapace about as long as wide, with short, transverse striations. Chelipeds equal, lightly pubescent. Merus rugose, with strongly projecting lobe on anterior margin. Carpus about 2.5 times as long as wide, margins subparallel, covered with flattened granules. Chela granular, inner margin with large flattened granules; dactyl with longitudinal median crest composed of tubercles; gape with thick pubescence. Ambulatory legs with short rugae and long setae. CL to 17 mm.

Color in life.—Carapace with dotted stripes of dark purple on ground of greenish dark olive. Chelae brown, becoming lighter distally. Merus of ambulatory legs buff dotted with maroon. Carpus and propodus dark brown banded with orange red. Dactyls scarlet. Ventral side mostly red orange.

Habitat and depth.—Lower intertidal under stones, subtidal rock piles.

Range.—Monterey, California to Isla Guadalupe, Mexico. Type locality San Clemente Island, California. Most specimens have been taken south of Point Conception, California.

Remarks.—There are few records of this porcelain crab, possibly because of the speed with which it retreats into cracks between rocks in rubble piles.

#### Petrolisthes manimaculis Glassell

Petrolisthes manimaculis Glassell, 1945: 223, text-fig. 1.—Haig 1960: 77, pl. 27, fig. 1.—Haig and Abbott 1980: 587, fig. 24.16.—Jensen 1995: 75.

Recognition characters.—Front triangular, with deep median groove. Carapace slightly longer than wide, somewhat granular. Chelipeds finely to roughly granular. Merus with strongly projecting lobe on anterior margin. Carpus from 2.5 to 3 times as long as wide, margins subparallel. Chela naked, fingers long and slender, gape with thick pubescence. Ambulatory legs smooth to granular; merus not inflated; all segments covered with scattered tufts of setae. CL to 20 mm.

Color in life.—Ground color chocolate brown, row of blue dots on median longitudinal ridge of palm of chela, red spot at base of dactyl of chela.

Habitat and depth.—Lowest intertidal zone to at least 2 m, among rocks and in piles of rocky rubble.

Range.—Bodega Bay, California to Punta Eugenia, Baja California, Mexico. Type locality Morro Bay, California.

Remarks.—This species is common in shallow subtidal rock piles along Santa Catalina Island, California. It has been confused with *P. gracilis*, which occurs in the Gulf of California. See Haig, 1960, for information on misidentifications of this crab.

### *Petrolisthes eriomerus* Stimpson

*Petrolisthes eriomerus* Stimpson, 1871: 119.—Lockington 1878: 395.—Holmes 1900: 108, pl. 1, fig. 15.—Rathbun 1904: 168.—Schmitt 1921: 180 (in part), pl. 23, fig. 2, fig. 114.—Haig 1960: 74, pl. 26, fig. 4.—Smith and Carlton 1975: 401.—Haig and Abbott 1980: 587, fig. 24.15.—Hart 1982: 96, fig. 32.—Ricketts et al. 1985: 306.—Jensen 1995: 75.

Recognition characters.—Front broad, triangular, with deep median groove. Carapace about as long as wide, anterior part covered with rough granules, posterolateral areas plicate. Chelipeds covered with large granules. Merus with strongly projecting lobe on anterior margin. Carpus twice as long as wide, margins subparallel; outer margin serrate and ending in distal tooth. Chela naked, gape filled with thick pubescence. Ambulatory legs granular, merus not inflated, all segments with setae. CL to 19 mm.

Color in life.—Granules on carapace red-brown or white with blue tinges in grooves, blue and white comma-like mark on either side of cardiac region. Chelipeds with dark and light red granules with orange areas and blue-white patches at junctions of segments; blue spot at base of dactyl. Walking legs brown with 2 patches of yellow on merus; red and yellow band proximally and yellow distally on propodus; dactyl brown and yellow. Outer maxillipeds with both surfaces of last 2 articles bright blue. Individuals ready to molt may have a bluish color.

Habitat and depth.—Under rocks in lowest intertidal zone, rarely to 86 m. Tolerant of sand and silt.

Range.—Chicagof Island, Alaska to La Jolla, California. Type locality Mendocino, California.



Petrolisthes eriomerus

Petrolisthes cabrilloi Glassell

Petrolisthes cabrilla Glassell 1945: 225, fig. 4.—Kropp 1981: 307.

Petrolisthes cabrilloi: Haig 1960: 88, pl. 26, fig. 3.—Haig and Abbott 1980: 588, fig. 24.17.—Jensen 1995: 76.

Recognition characters.—Front triangular, with deep median sulcus. Carapace about as long as broad, covered with placations and fine granules in most specimens, but nearly smooth in others. Chelipeds finely granular. Merus with strongly projecting lobe on anterior margin. Carpus setose, about twice as long as wide, with small lobe occupying about 1/4 of proximal end, granules along outer margin enlarged and forming crest ending distally in sharp tooth. Chela smooth to lightly pubescent, gape with thick pubescence. Ambulatory legs rugose, merus of third leg not inflated; all segments with tufts of setae. CL to 16 mm.

Color in life.—Carapace brown, with striations and numerous spots of pale greenish white. Chelipeds brown, chela may have greenish tinge, red spot at base of dactyl. Ambulatory legs dull brown, with bands of tan and darker brown on propodus. Outer segments of maxillipeds red.

Habitat and depth.—Intertidal, among rubble fields, on pilings or among mussels. Tolerant of sand and silt.

Range.—Morro Bay, California to Magdalena Bay, Baja California, Mexico, including Santa Cruz and Santa Catalina Islands, California. Type locality Anaheim Landing, California.

Remarks.—This species seems to replace P. cinctipes south of Point Conception, California. It is extremely common (up to 22 individuals under a single rock) among rocky rubble around the Palos Verdes Peninsula of Los Angeles County, California.



Petrolisthes cabrilloi



small Petrolisthes cabrilloi

Petrolisthes cinctipes (Randall)

Porcellana cinctipes Randall, 1839: 136.

Petrolisthes cinctipes.—Holmes 1900: 107 (part).—Rathbun 1904: 168.—Schmitt 1921: 179, fig. 32, fig. 1, fig. 113.—Haig 1960: 90, pl. 28, fig. 3. (See this reference for an extensive synonymy).—Wicksten 1973: 161.—Smith and Carlton 1975: 401, fig. 62.—Haig and Abbott 1980: 588, fig. 24.18.—Hart 1982: 98, fig. 33.—Ricketts et al. 1985: 45, fig. 30.—Jensen 1995: 75.

Recognition characters.—Front strongly deflexed, triangular, with deep median groove. Carapace about as long as wide, covered with fine granules. Chelipeds covered with fine granules, without setae. merus with strongly projecting lobe on anterior margin. Carpus 1.5 to twice as long as wide, strong lobe occupying more than 1/4 of proximal anterior margin, anterior and posterior margins converging distally, posterior margin with row of tubercles forming ridge and ending distally in strong tooth. Chela smooth, gape with tuft of setae. Ambulatory legs

rugose, merus unarmed and usually naked, that of third leg inflated; carpus nearly devoid of setae; propodus and dactyl with setae. CL to 24 mm.

Color in life.—Light to dark brown, granules bluish, with blue and white comma-like mark on either side of cardiac area. Cheliped with red spot at base of dactyl. Ambulatory legs with yellow median band on propodus, dactyl yellow with narrow brown band. Outer segments of maxillipeds red. Individuals ready to molt may be blue.

Habitat and depth.—Midlittoral zone, under rocks or among mussel beds, rarely as deep as 64 m. This species does not tolerate sand and silt.

Range.—Porcher Island, British Columbia to Santa Barbara, California. Type locality incorrectly given as “Sandwich islands “ (Hawaii). Some of Randall’s specimens are known to have been collected at or near Monterey, California, which may be the actual type locality.

Remarks.—This is another very common intertidal crab, often found under rocks in rubble beds in the midlittoral zone.



Petrolisthes cinctipes



## Family Chirostylidae : by Janet Haig

The Chirostylidae are deep-water crabs that superficially resemble the Galatheidae. They can be immediately distinguished from the latter family by the form of the telson (see key to the families of the superfamily Galatheoidea). Baba (1988) provided a key to the five genera in the family.

The genus Gastroptychus is represented by two species in waters off Oregon and California. Baba and Haig (1990) gave a key to the five members of the genus known to occur in the eastern Pacific.

Rice and Miller (1991) discussed several examples of commensalism between chirostylids and coelenterates and echinoderms. Chirostylid-coelenterate associations occur in both species of Gastroptychus known from California and Oregon.

### Key to the Species of Chirostylidae

1. Lateral carapace margins strongly convex in posterior two-thirds; tergum of 5th abdominal segment unarmed-----Gastroptychus iaspis Baba and Haig
- Lateral carapace margins nearly straight posteriorly; tergum of 5th abdominal segment spiny-----Gastroptychus perarmatus (Haig)

### Genus Gastroptychus Caullery

#### Gastroptychus iaspis Baba and Haig, 1990

Chirostylus sp.--Hart 1982: 166, fig. 65.--Wicksten 1982: 245.--Wicksten 1989: 315.  
Gastroptychus iaspis Baba and Haig, 1990: 854, figs. 1,2.

Recognition characters.--Rostrum short, triangular, terminating in narrow spine directed upward. Carapace excluding rostrum from 1.1-1.2X as long as greatest width. Lateral margins strongly convex in posterior two-thirds of carapace length; well developed anterolateral spine and row of inconspicuous lateral spines. Gastric region bearing 6 prominent spines arranged in hexagon and few additional, widely set spines. Mid-cervical groove located about halfway along carapace. One or 2 pronounced spines on anterior branchial region; cardiac region with pair prominent spines; posterior branchials with short, widely set spines. Tergum of 1st abdominal segment with transverse row of 5-11 spines. Tergum of 2nd segment with transverse row of tubercles, each usually bearing simple or pointed granules; pleura with 1-5 small dorsal spines along anterolateral margin. Tergum of 3rd-4th segments unarmed; pleura with 1-4 small posterior marginal spines or none. Tergum of 5th segment unarmed; pleura bearing 1-7 small spines on posterolateral margin, and occasionally 1-2 small spines on pleural surface. Tergum of 6th segment with 3 prominent posterior marginal spines and 6 (occasionally more) dorsal spines; pleura usually unarmed, rarely with few spines on surface and up to 7-8 on lateral margin. Eyestalks barely reaching end of rostral spine; cornea dilated. Chelipeds about 5X length of carapace excluding rostrum. Merus, carpus and palm with several regular longitudinal rows of spines. Fingers slender, gaping. Walking legs slender; first walking leg, when extended, falling

short of distal end of carpus of cheliped. Merus and carpus with 6 rows spines; propodus with dorsal, mesial and dorsolateral spines in longitudinal rows, ventral margin with row of closely set movable spinules; dactyl less than 0.33X length of propodus, bearing row of movable spinules ventrally, terminating in acute corneous claw. Carapace length excluding rostrum: male 30.0 mm, ovigerous female 25.5.

Color in life.--Anterior carapace bluish pink, laterally pale pink and white; spines orange. Antennules, antennae and eyestalks orange; cornea black. Chelipeds orange with white spines and fingers; walking legs orange becoming paler on dactyls (Hart, 1982). Dark carrot-orange (M.K. Wicksten, personal communication).

Habitat.--On abyssal muddy sand in northern part of range (Hart, 1982); hard bottom on seamount (Baba and Haig, 1990); 600-1189 m.

Range.--From southeastern Vancouver Island, British Columbia, 48° 13'N (Hart, 1982) to Jasper Seamount off Baja California, 30° 25'N. Type locality Jasper Seamount, from 30° 25.6'N, 122° 43.7'W to 30° 25.5'N, 122° 44.3'W.

Remarks.--This species is an important member of the Jasper Seamount community at the 600-1100 m depth interval, where it was usually seen on gorgonians and antipatharians (A. Genin, personal communication). The occurrence of these crabs in baited fish traps off southern California suggests that they are scavengers (Wicksten, 1982).

#### Gastroptychus perarmatus (Haig)

Chirostylus perarmatus Haig, 1968: 272, figs. 1-3.--Wicksten 1989: 315.

Gastroptychus perarmatus.--Baba and Haig 1990: 859.

Recognition characters.--Rostrum as in G. iaspis. Carapace excluding rostrum 1.5-1.6X as long as greatest width. Lateral margins nearly straight posteriorly; strong anterolateral spine and row of small lateral spines. Gastric region with numerous small spines and spinules interspersed with larger spine, most prominent an epigastric pair. Mid-cervical groove distinctly anterior to halfway point of carapace. Anterior branchial region with several large and small spines; cardiac region with pair prominent spines and few smaller ones; regions posterior to cervical groove with numerous, closely set large and small spines in irregular longitudinal rows. Tergum of 1st abdominal segment with transverse row of 12-18 spines. Tergum of 2nd segment with transverse row of small spines and pointed granules, and small group pointed tubercles at junction with pleura; pleura with small spines on anterolateral margin and on dorsal surface. Tergum of 3rd and 4th segments unarmed except for 1-3 spines on surface. Tergum of 5th segment with 4 longitudinal rows of spines, each outer row at junction with pleuron; pleura with small spines on surface. Tergum of 6th segment bearing numerous large and small spines; pleura with few spines on surface. Eyestalks barely reaching end of rostral spine; cornea dilated. Chelipeds about 6X length of carapace excluding rostrum. Merus, carpus and palm with regular longitudinal rows of spines. Fingers slender, gaping. Walking legs slender; first walking leg, when extended, reaching about to distal end of carpus of cheliped. Merus and carpus with 6 rows of spines; propodus with dorsal, mesial and dorsolateral rows of spines, ventral margin with row of closely set movable spinules; dactyl less than 0.33X length of propodus, with row of movable spinules ventrally, terminating in acute corneous claw. Carapace length excluding rostrum: male 20.5 mm, female 16.0.

Color in life.--Not recorded. Bright pink after a few weeks of preservation in alcohol, soon fading to white (Haig, 1968).

Habitat.--Green mud bottom; from 229-366 m.

Range.--From north of Anacapa Island to Coronado Bank, California. Type locality north of Anacapa Island, California, from 34° 05.8'N, 119° 23.3'W to 34° 06.0'N, 119° 24.3'W.

Remarks.--Two specimens, collected off Coronado Bank in 366 m, were clinging to a branch of black coral, Antipathes sp.

## Mole Crabs: Superfamily Hippoidea

Many a biologist has listened to a puzzled beachgoer's attempts to describe a mole crab. The egg-like shape and digging, not scuttling, motion do not at first glance reveal that the animal is a crab. Specialized for digging into sand, these anomurans show numerous adaptations of their anatomy. The pereopods are flattened, fold against the body, and bear fringes of setae that keep sand away from the body proper. The eye shape ranges from elongate to very flat. The antennae are long and setose, providing a channel for respiration while the animal is buried. The abdomen can flap, aiding in quick backward motion. Mole crabs generally feed on small particles strained from the water or caught in the setae of the antennae during the backwash of wave action.

Species formerly assigned to the family Albuneidae recently have been monographed by Boyko (2002), who has divided this family into two families: the Albuneidae in the strict sense and the Blepharipodidae. The Albuneidae have flat, square-shaped eyes; the Blepharipodidae have cylindrical eyestalks. Interested readers should refer to this work for further synonyms, keys and illustrations.

## Family Hippidae

### Genus Emerita

#### Emerita analoga (Stimpson)

Hippa analoga Stimpson, 1857: 85.--Holmes 1900: 103.

Emerita analoga.—Rathbun 1904: 168.—Schmitt 1921: 173.—MacGinitie and MacGinitie 1968: 301, figs. 145-148.--Smith and Carlton 1975: 399, pl. 98, fig. 65.--Hart 1982: 164, fig. 64.--Ricketts et al. 1985: 252, fig. 204.--Haig and Abbott 1980: 581, fig. 24.4—Jensen 1995: 77.

Recognition characters.—Body egg-shaped. Carapace with fine transverse striations on anterior half, front with three broad teeth. Eyestalks long and slender, cornea pigmented. Both pairs antennae setose, antennal flagella long, with double rows of setae, capable of being folded beneath mouth parts. First four pairs of pereopods flattened and not chelate; fifth pereopod chelate, used in cleaning body. Abdominal segments decreasing in size and ending in arrowhead-shaped telson. Uropods well developed. Carapace length to 35 mm.

Color in life.—Carapace greenish to gray with fine stripes of light color anteriorly, with two white dots posteriorly on light colored mid-dorsal area, lateral areas pink. First pereopod pink and white, other appendages mostly pink. Abdomen gray, telson white, with two pink stripes.

Habitat and depth.—Surf-swept sandy beaches, mostly intertidal.

Range.—Rarely as far north as Karluk, Kodiak Island, Alaska; usually from Oregon to Mexico. Records from Peru, Chile and Argentina probably belong to another species. Type locality “California”. (Many of Stimpson’s specimens came from the vicinity of San Francisco to Monterey, California).

Remarks.—This small crab is an important prey item for nearshore fishes and shorebirds, as well as a much-used item of bait. See Haig and Abbott (1980) for extensive references on this species.



*Emerita analoga*



*Emerita analoga*

# Family Blepharipodidae

## Key to the species of the family Blepharipodidae

1. Carapace with four lateral spines-----Blepharipoda occidentalis

Carapace with three lateral spines-----Lophomastix diomedea

### Genus Blepharipoda

#### Blepharipoda occidentalis Randall

Blepharipoda occidentalis Randall, 1839: 131, pl. 6.—Holmes 1900: 104.—Rathbun 1904: 167.—Schmitt 1921: 172, pl. 31, fig. 6.—MacGinitie and MacGinitie 1968: 304.—Smith and Carlton 1975: 399.—Haig and Abbott 1980: 582, fig. 24.5.—Ricketts et al. 1985: 254, fig. 205.—Jensen 1995: 77.—Boyko 2002: 27, figs. 9-11.

Recognition characters.—Carapace oblong, with four sharp spines on each side, somewhat scaly in front, smooth posteriorly; median projection spiniform, longitudinal median ridge with spine at anterior end. Both pairs of antennae long and setose. Eystalks cylindrical, exceeding length of median projection of carapace. First pereopods with strong, spiny chelipeds. Walking legs flattened, with semicircular tdactyls. Abdominal somites well separated laterally. Telson rounded. Carapace length to 60 mm.

Color in life.—Carapace dark gray, legs cream-colored.

Habitat and depth.—Lower intertidal zone of sandy beaches, to 9 m.

Range.—Stinson Beach, California to Santa Rosalia Bay, Baja California, Mexico. Type locality San Diego, California.

Remarks.—Adults of this species are scavengers, while juveniles filter plankton from the water. The animals usually are buried out of sight in sand. Molts are commonly found cast ashore.

### Genus Lophomastix

#### Lophomastix diomedea Benedict

Lophomastix diomedea Benedict, 1904: 621, fig. 1.—Haig and Wicksten 1975: 100.—Boyko 2002: 20, figs. 7, 8.

Recognition characters.—Carapace with only three large lateral spines, numerous minute spinules along rostrum and frontal margin of carapace. First antennae with feathery setae, second sparsely setose. Eystalks slender and cylindrical. First pereopods chelate, second to fourth with sickle-shaped dactyls. Abdominal somites widely separated laterally, telson rounded. Carapace length to 21 mm.

Color in life.— Not reported.

Habitat and depth.—Sand and shell, 29-68 m.

Range.—Santa Cruz Island, California to Cortez Bank, Baja California, Mexico. Type locality off Cortez Bank.

## Family Albuneidae

### Genus Lepidopa

#### Lepidopa californica Efford

Lepidopa californica Efford, 1971: 59.—Boyko 2002: 140, figs. 46, 47.

Lepidops myops Stimpson, 1860: 241.

Lepidopa myops.—Holmes 1900: 172.—Schmitt 1921: 172, pl. 31, fig. 4.—MacGinitie and MacGinitie 1968: 305, fig. 149.—Haig and Abbott 1980: 583.—Ricketts et al. 1985: 336, fig. 216.—Jensen 1995: 77.

Recognition characters.—Carapace somewhat square, marked with transverse grooves, median projection of front rounded, anteriolateral margin with only one spine, median ridge unarmed. Both antennae long and setose, first antennae twice as long as carapace. Eyestalks flat. First pereopods chelate, Walking legs flattened, with semicircular dactyls. Abdominal somites well separated laterally, telson triangular. Carapace length to 20 mm.

Color in life.—Gray, white or bluish, with iridescent sheen.

Habitat and depth.—Low intertidal zone of protected or open coast sandy beaches, rarely as deep as 128 m.

Range.—Rarely as far north as Monterey Bay, California; usually from San Pedro, California to the Gulf of California. Type locality Long Beach, California.

Remarks.—This crab burrows deeply. The long antennules form a passageway for respiration while buried.



# Infraorder Brachyura

True crabs are characterized by a symmetrical abdomen which is straight and not used in swimming. In most brachyurans (and in all of those of California and Oregon), the abdomen is closely bent under the thorax instead of extending posteriorly. The abdomen usually is symmetrical and calcified. The uropods (if present) are not biramous. The cephalothorax is fused with the epistome at the sides. The third maxillipeds are broad and often form a cover over the oral field. The first pair of legs form strong chelipeds, often with distinctive teeth. The antennae are relatively short in most species. The fifth pereopods are not developed into cleaning brushes or shell-holding appendages as in the Anomura.

Species of the families Cancridae and Majidae are particularly common in California and Oregon. Other families, such as the Xanthidae, Calappidae, Leucosiidae and Parthenopidae, are more abundant in tropical regions and are represented in California and Oregon by as few as a single species apiece. Some of these species, however, may be conspicuous.

Recent comparative genetic studies and examination of the genital apparatus in brachyurans have led to different interpretations of the classification of brachyurans into superfamilies. (See, for example, Guinot, 1977, 1978). For purposes of this guide, an artificial key has been prepared, based on characters readily visible in most specimens. The male gonopods of brachyurans have species-specific shapes, but these are visible only in mature individuals. The reader should consult more detailed works for further information on genital morphology.

Brachyurans range from estuaries to the deep sea; from the upper intertidal zone to the continental slope. The reader should consult Garth and Abbott (1980) for good accounts of the natural history of many nearshore and intertidal species.

## Key to the Families of the Brachyura

1. Fifth pereopods conspicuously smaller than anterior legs, subdorsal, dactyls with hooks or spines, capable of gripping objects. Male and female genital openings coxal-----2

Fifth pereopods usually nearly as long as anterior legs, but if smaller, usually lateral; dactyls usually without hooks or spines, not capable of gripping objects. Female genital opening sternal, male opening coxal or sternal-----4

2. Carapace with pair longitudinal suture lines. Eyes not retractile into orbits. Third maxillipeds slender, not rectangular or triangular and not forming cover over mouth----- family Homolidae

Carapace without pair longitudinal suture lines. Eyes retractile into orbits. Third maxillipeds rectangular or triangular and forming cover over mouth-----3

3. Mouth field square. Carapace inflated-----Family Dromiidae

Mouth field triangular. Carapace flat-----Family Cyclodorippidae

4. Mouth field triangular. Outgoing branchial channels opening at middle of endostome. (Often

- burrowing into sand or living on sandy substrates)-----5
- Mouth field square to oval, outgoing branchial channels opening laterally. (Living on various substrates)-----6
5. Chelipeds folding flat against body, dactyl of cheliped at right angle to palm -----  
-----family Calappidae
- Chelipeds not folding flat against body, dactyl of cheliped extending horizontally from palm ---  
-----family Leucosiidae
6. Front of carapace narrow, often with rostrum, carapace triangular to rounded, branchial region inflated-----7
- Front of carapace broad, usually without rostrum, carapace oval to square, branchial region not inflated-----9
7. Distinct shelf of exoskeleton between carapace and walking legs, walking legs long, with simple, elongated dactyls-----family Inachoididae
- No distinct shelf of exoskeleton between carapace and walking legs, walking legs long or short, dactyls variable-----8
8. Carapace and walking legs usually with hooked setae. Carapace rounded, pear-shaped to somewhat square, not triangular, fingers of cheliped not deflexed-----family Majidae
- Carapace and walking legs without hooked setae. Carapace triangular, fingers of cheliped deflexed-----family Parthenopidae
9. Front of carapace with 3 teeth, one of these median; antennules folding longitudinally. (Carapace broadly oval, with 9-11 lateral teeth)-----family Cancridae
- Front of carapace with or without teeth, but if present, never with median tooth; antennules folding obliquely or transversely. (Carapace oval-square, with or without lateral teeth)----- 10
10. Fifth pereopods ending in flattened dactyls, usually forming swimming paddles; carapace with 5 or more lateral teeth-----family Portunidae
- Fifth pereopods not ending in flattened dactyls, not forming swimming paddles; carapace with or without lateral teeth-----11
11. Carapace rectangular, wider than long, front narrow, without median notch, eyes with long stalks-----family Ocypodidae
- Carapace oval, round, rectangular or square, front wide, often with median notch, eyes with short stalks-----12
12. Last pair of walking legs short, at most slightly longer than merus of preceding leg; often

subdorsal -----13

Last pair of walking legs only slightly shorter than entire length of previous leg, always lateral-----14

13. Eyes very large. Carapace broadly transverse, anterolateral margins dentate. (Not commensal, well calcified)-----family Palicidae

Eyes small. Carapace round to subcylindrical, anterolateral margins without teeth. (Usually commensal with larger invertebrates, sometimes poorly calcified)-----family Pinnotheridae

14. Carpus of third maxilliped not articulating at or near anterointernal angle of merus, lateral margins of mouth frame parallel to extremely convergent. (Intertidal or living on floating debris or sea turtles)-----family Grapsidae

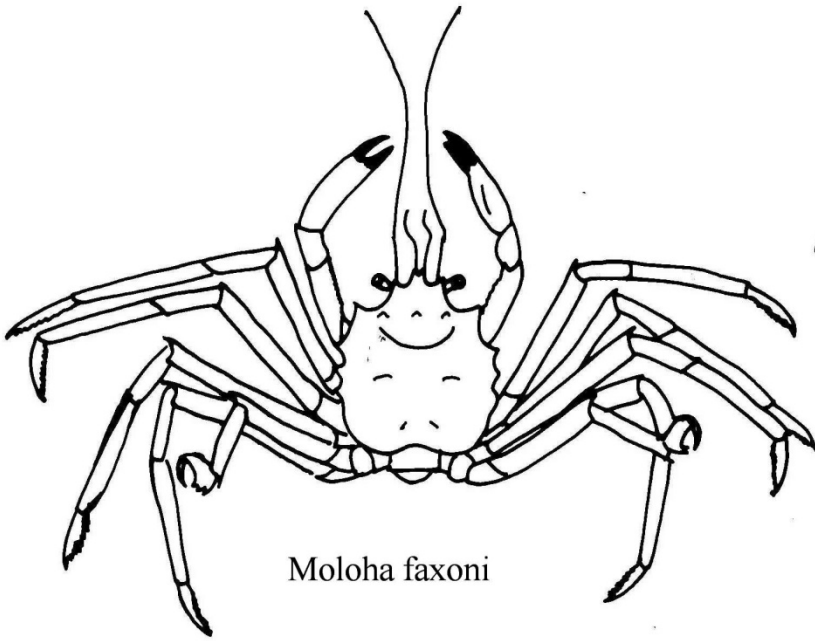
Carpus of third maxilliped not articulating at or near anterointernal angle of merus, lateral margins of mouth frame parallel to divergent. (Intertidal to subtidal)-----15

15. Carapace square, male genital openings coxal or sternal. Chelipeds not especially strong, not capable of crushing mollusks. (Burrowing in mud flats or protected sand)-----family Goneplacidae

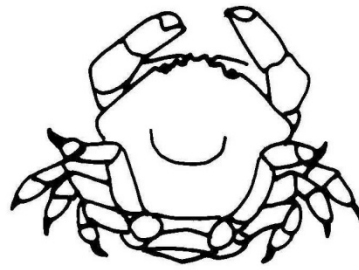
Carapace oval to trapezoidal, male genital openings coxal. Chelipeds strong, capable of crushing mollusks. (Usually among rocks)-----16

16. Carapace and appendages set with coarse setae-----family Pilumnidae

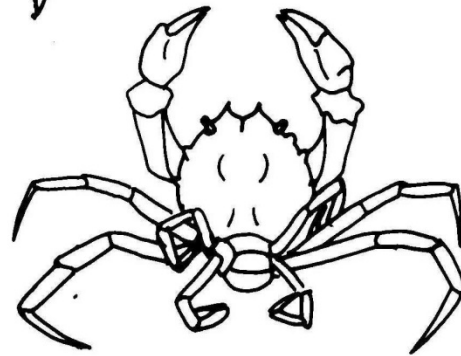
Carapace and appendages not set with coarse setae-----family Xanthidae



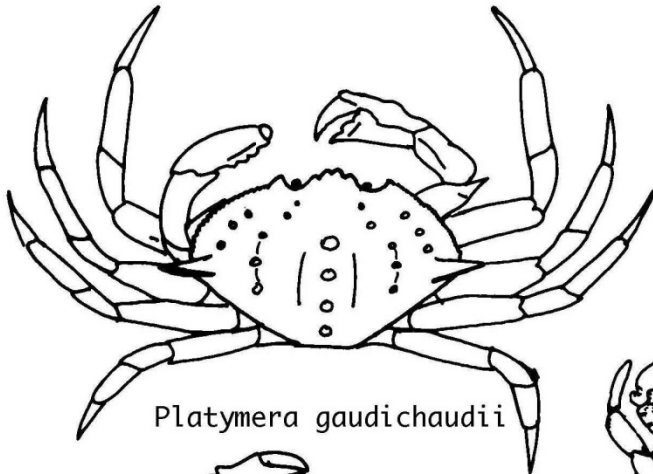
*Moloha faxoni*



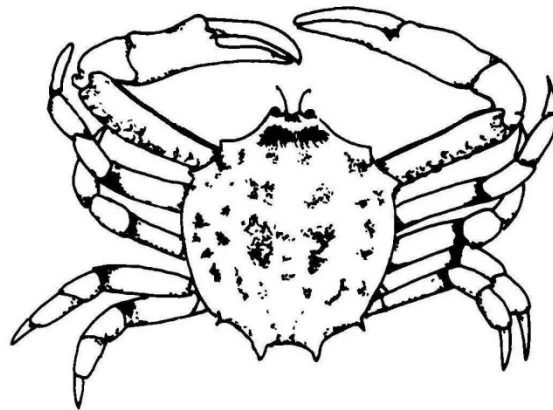
*Cryptodromiopsis larraburei*



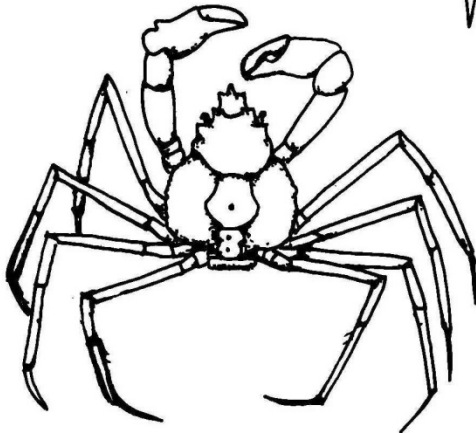
*Deilocerus planus*



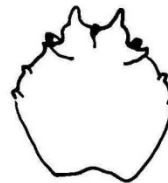
*Platymera gaudichaudii*



*Deilocerus decorus*



*Pyromaia tuberculata*



## Family Homolidae

Genus Moloha Barnard, 1947

Moloha faxoni (Schmitt)

Homola faxoni Schmitt, 1921: 184, pl. 31, fig. 7.

Paromola faxoni .--Rathbun 1937: 68, pl. 18, pl. 19, fig. 1.--Guinot and Richer de Forges 1981: 536.--Wicksten 1985: 476.--Kuck and Martin 1994:177, figs. 1-4.

Moloha faxoni.--Guinot and Richer de Forges 1995: 383, fig. 33 c-d, g-h.--Hendrickx 1997: 33, fig. 41.

Recognition characters .--Carapace somewhat square, longer than broad, with short pubescence; short spiniform rostrum present, stout supraorbital spines with small hooked spines on upper surfaces, smaller spines posterior to supraorbital spines and in line with their base, spines on hepatic, gastric and brachial regions; tubercles on much of carapace. Distinct pair of suture lines (linea homolica) on carapace. Antennal flagellum relatively long. Eyes exposed, without orbits. Third maxillipeds slender, not covering mouth field. Chelipeds long and slender, setose, with dark tips to fingers. Second to fourth pereopods slender, with sharp spine on dorsal margin of merus, dactyl long and slender. Fifth pereopods subdorsal, shorter than preceding pereopods, with curved dactyl folding against spiny propodus. Basal segments of abdomen armed with sharp median tubercle apiece. Female genital openings coxal. Length of male carapace to 83.3 mm, female to 59.3. (See Kuck and Martin, 1994 for a more complete description).

Color in life .--Brown, golden brown, or brick red.

Habitat .--Continental shelf, 18-460 m. m.

Range .--Tajiguas, Santa Barbara County, California to Cedros Island, Baja California; Isla San Jose, Gulf of California. Type locality off Point Loma, California.

Remarks .--In life, the crab may carry a piece of gorgonian or sponge in its fifth pereopods.



Moloha faxoni

## Family Dromiidae

Genus Cryptodromiopsis Borradaile

Cryptodromiopsis larraburei (Rathbun)

Dromidia larraburei Rathbun, 1910: 553, pl. 48, fig. 4.--Schmitt 1921: 183, pl. 33, fig. 1.--Rathbun 1937: 35, text-fig. 13, pl. 7, figs. 4,5.

Cryptodromiopsis larraburei.--McLay 1993: 187.--Hendrickx 1997: 17, fig. 33.

Recognition characters .--Carapace setose, rounded, inflated, longer than wide. Front narrow, with 3 teeth, lateral margins with 4-6 small teeth. Flagellum of antenna long, eyes and antennules retractile into common orbito-antennary pits. Third maxilliped more or less square to rectangular, covering mouth field. Chelipeds short and stout, fingers gaping at base. Second and third pereopods ambulatory, with curved dactyls; fourth pereopod narrow and subdorsal, with curved dactyl, fifth pereopod short, subdorsal, with spiny dactyl folding against spine of propodus. Female genital openings coxal. Sixth abdominal somite with uropod plates. Carapace length of male 15 mm, female carapace length 28.

Color in life .--Pale brown, tips of chelae red.

Habitat.--Rocks, sand; low intertidal zone to 82 m.

Range .--Monterey Bay, California to Sechura Bay, Peru, but rarely collected north of Baja California, Mexico. Type locality Sechura Bay, Peru.

Remarks .--In life, the crab carries a sponge or colonial ascidian over its dorsal surface.

## Family Cyclodorippidae

These small crabs occur on shell hash bottoms along the coast of California. The last pereopods are held subdorsally. Both local species belong to the genus Deilocerus.

### Key to Species of the Family Cyclodorippidae

1. Frontal lobes ending in pronounced cylindrical blunt spines, carapace distinctly granulate-----  
-----Deilocerus decorus Rathbun

Frontal lobes ending in blunt teeth, carapace minutely granulate to smooth-----  
-----Deilocerus planus (Rathbun)

### Genus Deilocerus Milne-Edwards and Bouvier

#### Deilocerus decorus Rathbun

Clythrocerus decorus Rathbun, 1933: 185.--Rathbun 1937: 118, text-fig. 30, pl. 34, figs. 3,4.--  
Wicksten 1988: 242.

Deilocerus decorus.—Tavares 1993: 140.—Hendrickx 1997: 37, fig. 43.

Recognition characters.--Carapace rounded, about as long as wide, granulate; frontal lobes ending in cylindrical blunt spines and separated by triangular sinus, orbit with triangular notch above and outer subacute spine. Lateral margin with two prominent teeth. Flagellum of antennae short, peduncle with tubercle. Eyes short and without true orbits. Third maxillipeds elongate. Chelipeds stout, excurrent branchial openings near their bases; carpus with two lobes on outer margin and one at inner angle, large tooth at proximal outer margin of propodus and another at articulation with dactyl. Second and third pereopods long and slender, merus and carpus spinulous on margins; dactyls long and simple. Fourth and fifth pereopods short, subdorsal, with dactyl closing against propodus. Basal segments of abdomen visible in dorsal view, female abdomen particularly wide and cupped, male abdomen narrow. Male and female genital openings coxal. Carapace length 6 mm.

Color in life.--Not reported.

Habitat and depth.--Subtidal, shell hash; 70-185 m.

Range.--Off Soberanes Point, Monterey County, California to off Point Loma, California; north of Isla Angel de la Guarida and south of Isla Tiburon, Gulf of California, Mexico. Type locality off Brockway Point, Santa Rosa Island, California.

Remarks.--One was observed to carry a sponge in its hind legs.

#### Deilocerus planus (Rathbun)

Cyclodorippe plana Rathbun, 1900b: 519.--Schmitt 1921: 186, fig. 115.

Clythrocerus planus.--Rathbun 1904: 168, pl. 9, fig. 4.--Rathbun 1937: 114, text-fig. 29, pl. 34, figs. 1,2.--Wicksten 1982: 306.

Deilocerus planus.—Tavares 1993: 140.—Hendrickx 1997: 43, fig. 47.



Recognition characters.--Similar to *D. decorus*, but frontal lobes ending in blunt teeth, carapace minutely granulate to smooth. Male carapace length 3.4 mm, female carapace length 2.8.

Color in life.--Pale-dark gray to whitish.

Habitat.--Shell hash, 20-60 m.

Range.--Santa Catalina Island, California to Gulf of California. Type locality not specified, probably Santa Catalina Island, California.

Remarks.--These small crabs carry pieces of shell, pebbles, sticks, algae, etc. over their carapaces by means of the specialized hind legs. They are abundant on shell hash bottoms along the offshore islands of California, rarely occurring along the mainland coast except in areas of steep rocky bottoms.



*Deilocerus planus*

## Family Calappidae

Although the Calappidae are common in tropical seas, only one species occurs in California and Oregon. These crabs use their powerful chelae to crush the mollusks that they eat. They can burrow into sand or mud, using the space between the chelipeds and the body as a respiratory opening.

Genus Platymera Milne-Edwards

Platymera gaudichaudii Milne-Edwards

Platymera gaudichaudii Milne-Edwards, 1837: 108.--Holmes 1900: 99.--Rathbun 1904: 170.—Galil 1993: 371.—Hendrickx 1997: 101, fig. 77. (See this reference for a more extensive synonymy).

Mursia gaudichaudii.--Weymouth 1910: 19.--Schmitt 1921: 190.--Rathbun 1937: 220, pl. 66, figs. 1-3.--Garth 1957: 16.--Carlton and Kuris 1975: 393, pl. 96, fig. 49.

Recognition characters.--Carapace convex, front narrow, lateral margins edged by about 15 small teeth and very large lateral spine. Eyes not completely retractile into orbits. Third maxillipeds not completely covering mouth field. Chelipeds strong, chelae proper armed with teeth and ridges bearing tubercles, fingers at right angle to palm, bearing teeth; cheliped folding flat against frontal part of cephalothorax. Second to fifth pereopods all lateral and similar, decreasing in size from anterior to posterior, with sharp dactyls. Abdomen concealed under cephalothorax. Male genital openings coxal, female sternal. Carapace length of male 76 mm.

Color in life.--Carapace with light olive gray background and covered with orange to red tubercles ranging to overall brick red with cream tubercles. Chelae dull gray with red shading to brick red, lower surface pale yellow to whitish. Walking legs pale olive gray with purple spots to overall reddish, lower parts and tips of dactyls whitish to cream.

Habitat.--Sand or mud, 48-402 m.

Range.--Off Columbia River, Oregon to Talcahuano, Chile. Type locality "coast of Chile".



Platymera gaudichaudii

## Family Leucosiidae

The purse crabs burrow in sand, leaving only the front of the carapace, eyes, antennae and a respiratory channel exposed. Only one species occurs in California. The family is well represented in tropical and subtropical areas in other parts of the world.

Genus Randallia Stimpson

Randallia ornata (Randall)

Ilia ornata Randall, 1839: 129.

Randallia ornata.--Stimpson 1854: 471, pl. 19, fig. 3.--Holmes 1900: 100.--Rathbun 1904: 170.--Weymouth 1910: 18, pl. 1, fig. 3.--Schmitt 1921: 188, fig. 116.--Rathbun 1937: 172, pl. 49, figs. 1,2.--Carlton and Kuris 1975: 393, pl. 96, fig. 48.--Ricketts et al. 1985: 321, fig. 247.--Hendrickx 1997: 163, fig. 114. (See this reference for a more extensive synonymy).

Randallia angelica Garth, 1940: 54, pl. 11, figs. 1-2.

Recognition characters.--Carapace of adult nearly smooth, with few scattered granules and minute spinules on lateral margin, juveniles with numerous rough tubercles, posterior margin with two prominent tubercles. Front short and narrow, with concave anterior margin, eyes set into margin. Third maxillipeds triangular and long. Cheliped long and subcylindrical, hand and fingers narrow, fingers acute. Second to fifth pereopods similar, with simple dactyls. Abdomen concealed under cephalothorax. Male and female genital openings sternal. Male carapace length 43 mm, female 31.

Color in life.--Carapace cream marked with reddish to purple spots and patches, chelipeds and legs cream, chelipeds with red-purple bars and blotches, legs with prominent red to purple bands on merus.

Habitat.--Sand, lowest intertidal zone to 94 m.

Range.--Mendocino County, California to Magdalena Bay, Baja California; northern Gulf of California between Isla Angel de la Guardia, Point Willard, Isla Tiburon and Cape Tepoca, Sonora.. Type locality "California".

Remarks.--Schmitt (1921) and Rathbun (1937) included a species known as Randallia bulligera Rathbun from San Diego, California and ranging to Peru. However, there have been no subsequent reports of this crab from California. This crab has a tuberculate carapace. Schmitt speculated that this crab might actually be the juvenile of another species, but Hendrickx (1997) treated it as a distinct species, usually ranging from Baja California, Mexico to Peru.



Randallia ornata

## Family Inachoididae

Member of the family Inachoididae are inhabitants of sand, mud or pilings in harbors. Although proposed as a distinct family as early as 1851, the group has been considered as part of the family Majidae until a revision by Drach and Guinot (1983) provided evidence to support their differentiation from the latter family. Inachoidids are characterized by having relatively long and slender legs relative to a pear-shaped to rounded body. The lateral edges of the carapace are set in a groove of the pleural (gill chamber) walls, with the external part visible as pleural plates. The first pleonite is joined to the carapace. The nine genera comprising the family are found along coasts of the Americas, but only one species, Pyromaia tuberculata, is reported from California and Oregon.

### Genus Pyromaia Stimpson

#### Pyromaia tuberculata tuberculata (Lockington)

Inachus tuberculatus Lockington, 1877: 30.

Dasygius tuberculatus.--Holmes 1900: 27.--Rathbun 1904: 172, pl. 10, figs. 3, 3a, text-fig. 92.

Inachoides tuberculatus.--Schmitt 1921: 199, text-figs. 123a, 123b.

Pyromaia tuberculata.--Rathbun 1925: 133, pl. 40, fig. 3; pl. 218, figs. 1-4.--Garth 1958: 85, pl. E, fig. 7, pl. 6, figs. 1,2.--Carlton and Kuris 1975 :393.--Ricketts et al. 1985: 334.—Hendrickx 1999: 75, fig. 42. (See this reference for a more extensive synonymy).

Pyromaia tuberculata tuberculata.--Garth and Abbott 1980: 597, fig. 25.1.

Recognition characters.--Rostrum acute, tips of postorbital spines pointing anteriorly, upper margin of orbit prominent but without supraocular spine. Basal antennal article with outer margin prolonged into slightly incurved spine. Carapace broadly triangular, pear-shaped, convex; surface granulate and tuberculate, with fine pubescence, especially in small individuals. Male chelipeds short and stout, granulate, chela inflated, fingers nearly as long as palm, gaping at base; female chelipeds more slender, margins of hand parallel, fingers slightly gaping.

Ambulatory legs slender and similar, diminishing in length from first to fourth pair, dactyls moderately curved and almost smooth. Male carapace length 15.7 mm, carapace width 12.3 mm.

Color in life.--Dull green-brown, ventral surface dirty white.

Habitat.--Pilings, sandy bottoms, sand and shell, among seaweeds, extreme low tide to 415 m.

Range.--Tomales Bay, California to Cape Corrientes, western Colombia. Type locality mouth of San Diego Bay, California.

Remarks.--Pyromaia tuberculata may be found almost devoid of a covering or may be densely covered by small bits of algae. The crab can move with great agility on sand. Small ones have been found associating with pink sea stars (Pisaster brevispinus), from which they may have been collecting scraps of food. Specimens from the Gulf of California, Mexico belong to a separate subspecies, P. tuberculata mexicana.



Pyromaia tuberculata

## Family Majidae

The spider crabs are diverse in California and Oregon, and range from the intertidal zone to the continental slopes. As the common name implies, the body is spider-like in that the ambulatory legs usually are relatively long in comparison with the body. A rostrum often is present. The second article of the antennae is well developed, but usually fused with the epistome and often with the front. The orbits usually are incomplete. The chelipeds are slender and agile at least in smaller individuals, and can be used in delicate picking and twisting maneuvers as well as in crushing.

Most species possess hooked setae on the dorsal surface of the body and walking legs at least during part of their life cycle, and can attach food or camouflaging materials to these setae. (See Wicksten, 1993 for a review of this behavior). Well-camouflaged species commonly are called decorator crabs (regardless of their generic classification). The crabs usually attach materials that are flexible and common in their habitat. Attachment is mechanical; the crabs do not secrete bioadhesive materials to the material. Some species store uneaten food on their hooked setae; others usually camouflage themselves with inedible materials.

Spider crabs usually feed on algae, smaller invertebrates, detritus and dead animals. Species of *Loxorhynchus* prey on echinoderms as well. The crabs in turn fall prey to sea otters, large fishes such as wolf eels and cabezon, and octopuses.

Adult spider crabs reach sexual maturity after a terminal molt, and do not molt or regenerate lost or damaged appendages after reaching maturity. Adult males usually are larger than females. The chelipeds often are longer than in females; the chelae often are heavier and broader and may be brightly colored. Adult females have slender chelipeds and rounded bodies. The decorating habit is lost in adult males and sometimes adult females of larger species of spider crabs.

The definitive work on spider crabs of the eastern Pacific is that of Garth (1958). Readers seeking more extensive synonymies and detailed information on anatomy and distribution should consult this work.

### Key to the Species of the Family Majidae

1. Basal antennal article extremely long and slender. Eyes without orbits; generally long; either non-retractile or retractile against sides of carapace. (Ambulatory legs very long and slender, rostrum simple). Subfamily Inachinae Alcock-----2

Basal antennal article stout. Eyes without orbits or with commencing orbits; shorter, concealed by supraocular spine, retractile. (Ambulatory legs stout or slender, rostrum often bifid)-----4

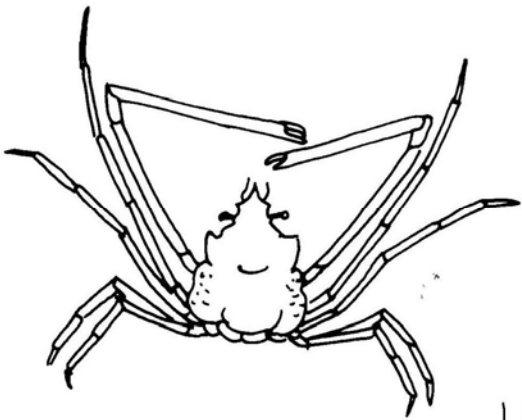
2. Merus of outer maxilliped as broad as ischium, palp of moderate size. Carapace with supraocular spine, surface spinous-----*Erileptus spinosus* Rathbun

Merus of outer maxilliped narrower than ischium, palp large. Carapace without supraocular spine, surface with tubercles-----3

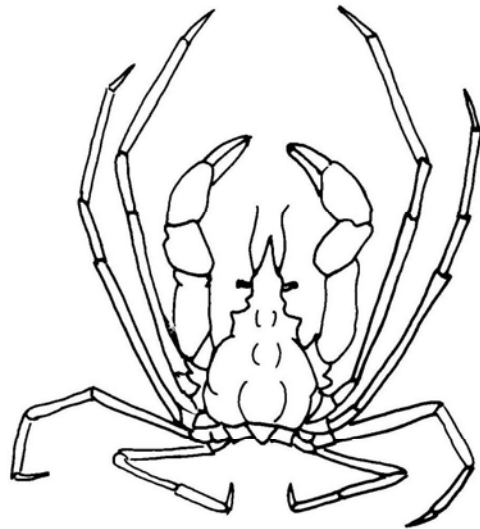


3. Only one tubercle on first abdominal segment. No strap-shaped hepatic spine-----  
-----Podochela hemphilli (Lockington)
- Two tubercles on first abdominal segment. Strap-shaped hepatic spine-----  
-----Podochela lobifrons Rathbun
4. Eyes with incomplete or commencing orbits; if commencing, without large, cupped postocular process into which eye retracts. Subfamily Epialtinae Macleay-----5
- Eyes with commencing orbits, with large, cupped postocular process into which eye retracts. Subfamily Pisinae Alcock-----15
5. Eyestalks short, little movable, and either concealed by supraocular spine or sunk in sides of rostrum. Basal antennal article truncate-triangular. (Rostrum usually bifid, prominent)-----6
- Eyestalks long or short, movable, neither concealed by supraocular spine nor sunk in sides of rostrum. Basal antennal article narrow. Subfamily Oregoniinae Garth-----13
6. Five free abdominal segments in both sexes. Rostrum with shallow apical notch. (Carapace nearly smooth, with broad hepatic and branchial lobes)-----Epialtoides hiltoni (Rathbun)
- Seven free abdominal segments in both sexes. Rostrum bifid. (Carapace smooth or with tubercles, with or without lobes)-----7
7. Antennae not visible at sides of rostrum in dorsal view. Carapace broadly oval, smooth-----  
-----Taliepus nuttalli (Randall)
- Antennae visible at sides of rostrum in dorsal view. Carapace varying in shape, smooth or with tubercles-----8
8. Carapace with broad lateral expansions, leaflike branchial expansion overlapping hepatic dorsally-----Mimulus foliatus Stimpson
- Carapace without broad lateral expansions, expansions inwardly separated-----9
9. With smaller secondary spine between postorbital and hepatic spines at slightly lower level. (Southern California to northern Mexico)-----Pugettia venetiae Rathbun
- Without smaller secondary spine between postorbital and hepatic spines at slightly lower level-----10
10. Hepatic projection a transverse spine not joined with postorbital spine by lateral expansion of carapace. Postorbital projection an ovate lobe directed forward-----Pugettia dalli Rathbun
- Hepatic projection a triangular tooth, joined completely or incompletely with postorbital spine by lateral expansion of carapace. No such ovate lobe-----11

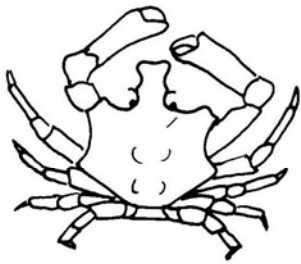
11. Carapace smooth, sides subparallel. No constriction between hepatic and branchial tooth-----  
-----Pugettia producta (Randall)
- Carapace tuberculate, sides not subparallel. Constriction between hepatic and branchial tooth-----12
12. Tubercles of carapace uneven in size. Hepatic tooth broadly joined to postorbital, its outer margin trending toward longitudinal-----Pugettia gracilis Dana
- Tubercles of carapace even in size. Hepatic tooth deeply separated from postorbital, its outer margin trending toward transverse-----Pugettia richii Dana
13. Carapace longer than broad, rostrum elongate-----Oregonia gracilis Dana
- Carapace either broader than long, or very little longer than broad; rostrum short-----14
14. Interspace between branchial regions of carapace deep. Two small subequal spines at curve made by intersection of two dorsal branchial ridges-----Chionoecetes tanneri Rathbun
- Interspace between branchial regions of carapace shallow. Large spine at angle made by intersection of two dorsal branchial ridges-----Chionoecetes angulatus Rathbun
15. Intercalated spine present. (Body and walking legs flattened, legs with small lateral spines)--  
-----Herbstia parvifrons Randall
- Intercalated spine absent. (Body and legs not flattened, legs with or without spines)-----  
----- 16
16. Rostrum bifid for not more than half its length. Walking legs with broad, flat segments-----  
-----Pelia tumida (Lockington)
- Rostrum bifid for more than half its length. Walking legs with rounded segments-----17
17. Rostrum with slender spines. (Continental shelf and slope only)-----Chorilia longipes Dana
- Rostrum with broad spines. (Intertidal-continental shelf)-----18
18. Rostrum flat, horizontal; spines shaped like feathers of arrow-----Scyra acutifrons Dana
- Rostrum deflexed; spines not shaped like feathers of arrow-----19
19. Carapace with many small spines; 2 spines on hepatic region. Front strongly deflexed. (Adult male and female with few setae and without camouflaging material)-----  
-----Loxorhynchus grandis Stimpson
- Carapace with large tubercles or raised areas; one spine on hepatic region. Front less strongly deflexed. (Adult male and female setose, adult male usually with camouflaging material on rostrum only, female covered by material)-----Loxorhynchus crispatus Stimpson



*Erileptus spinosus*



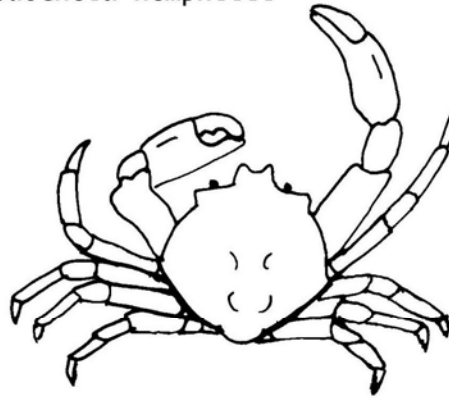
*Podochela hemphilli*



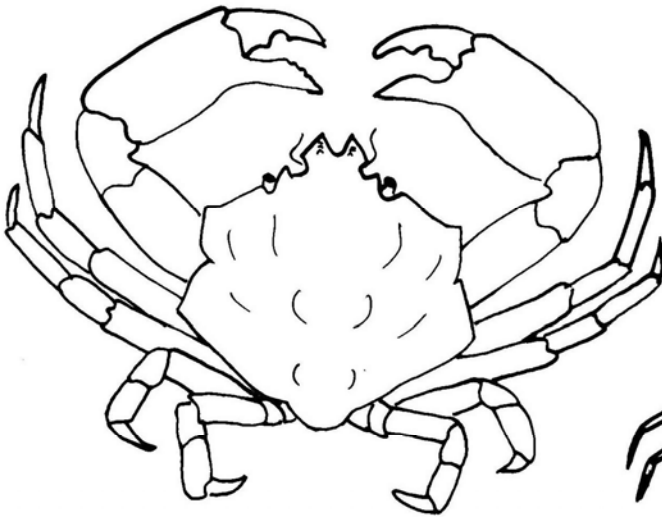
*Epialtoides hiltoni*



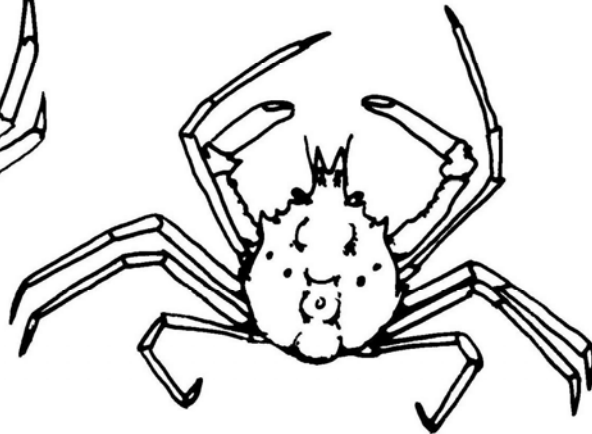
*Podochela lobifrons*



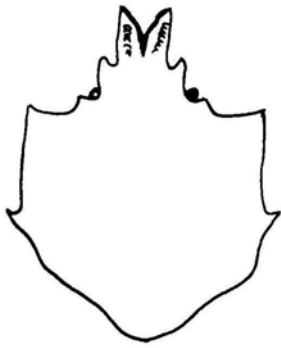
*Taliepus nuttalli*



*Mimulus foliatus*



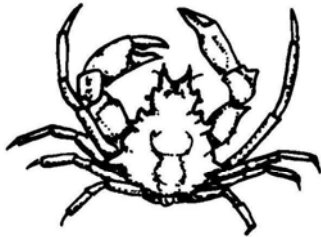
*Pugettia venetiae*



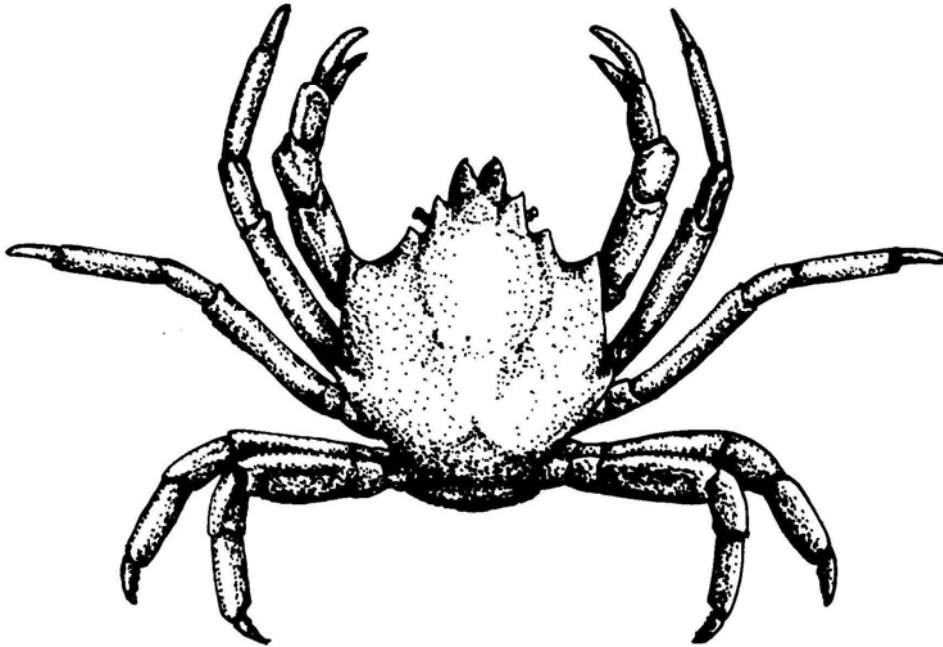
*Pugettia gracilis*



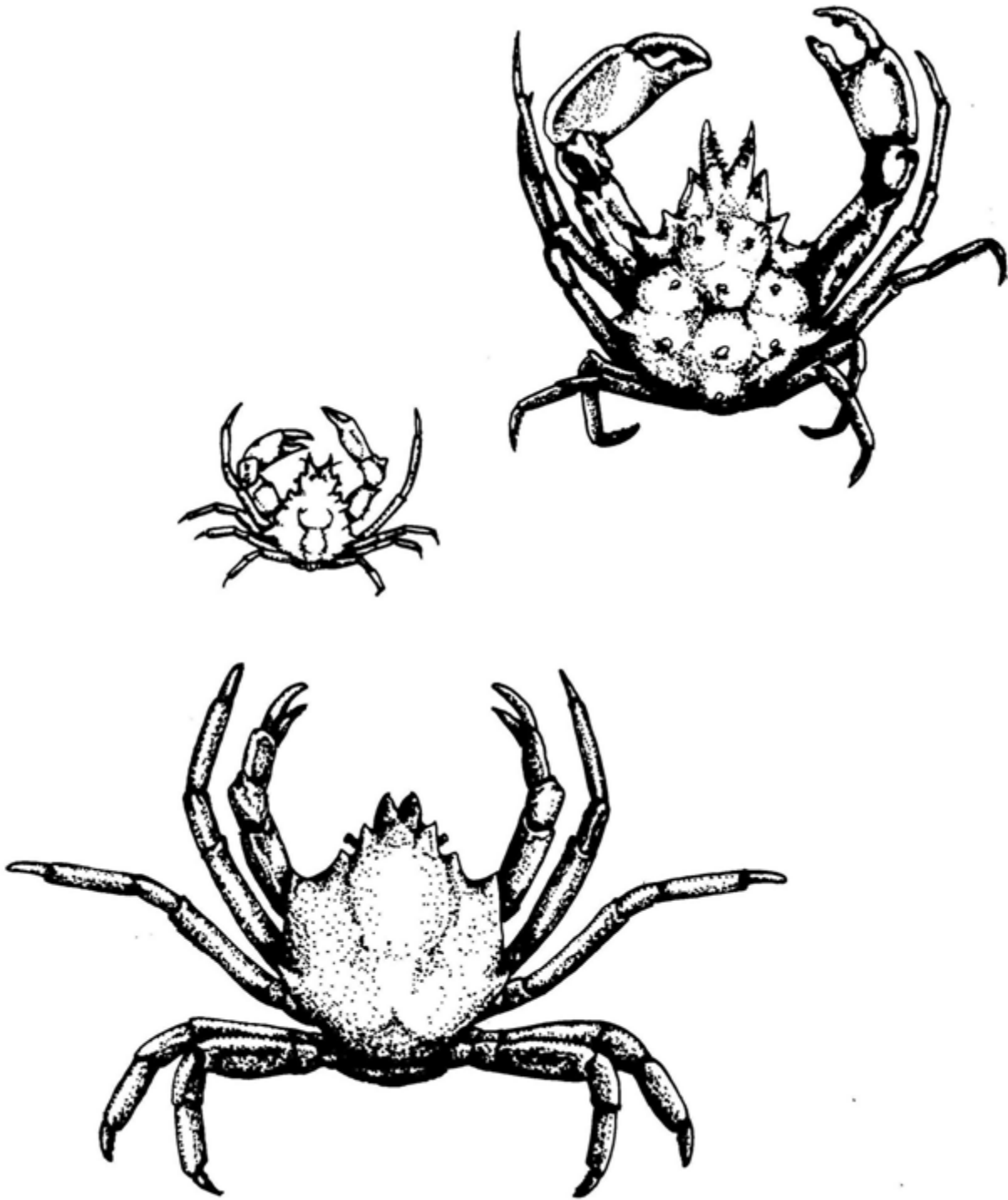
*Pugettia richii*



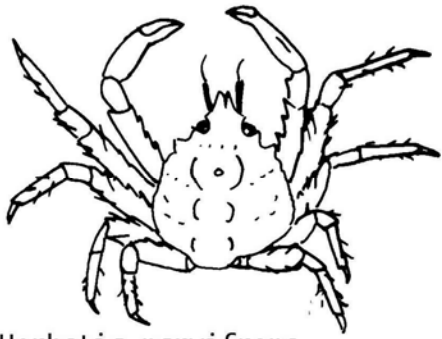
*Pugettia dalli*



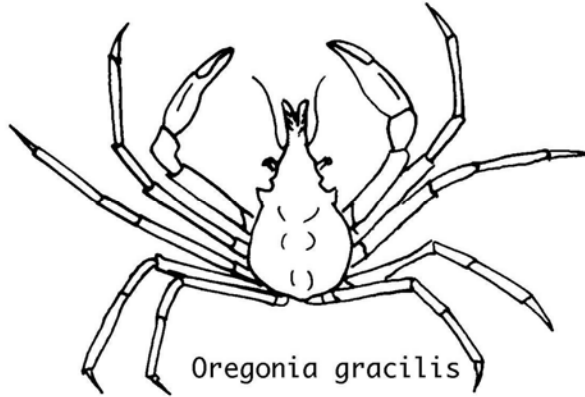
*Pugettia producta*



Top right: *Pugettia richii*; middle, *P. dalli*; lower, *P. producta*



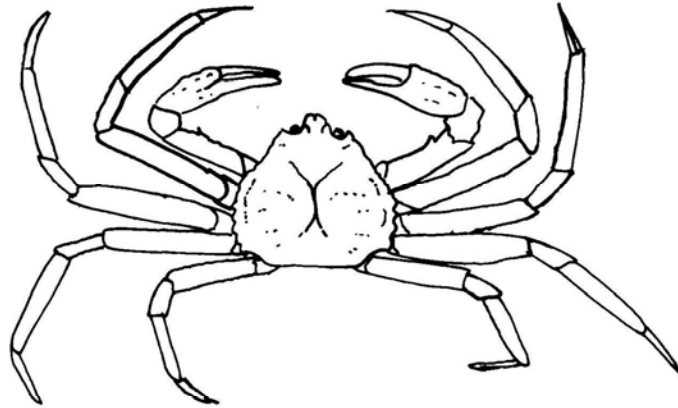
*Herbstia parvifrons*



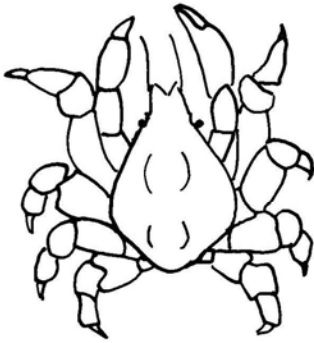
*Oregonia gracilis*



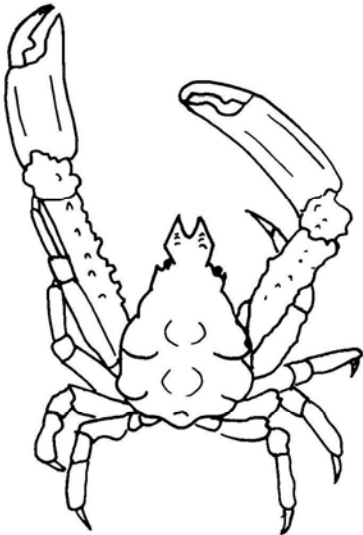
*Chionoecetes angulatus*



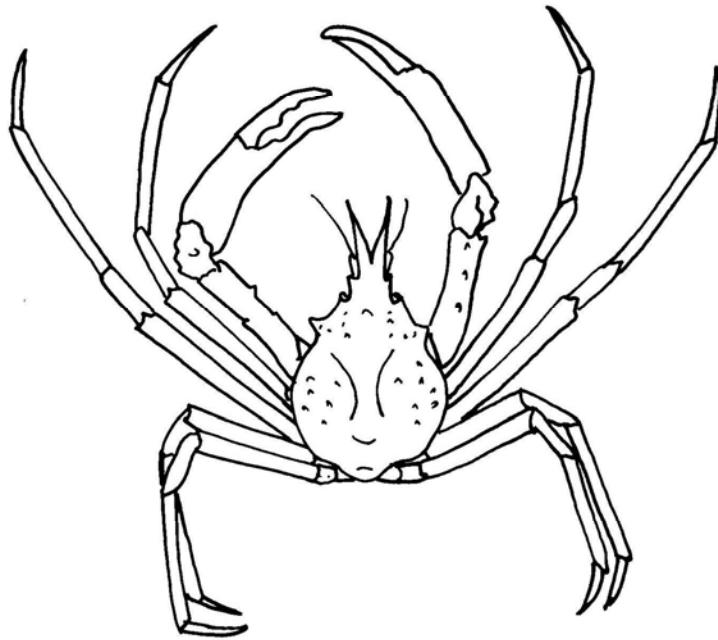
*Chionoecetes tanneri*



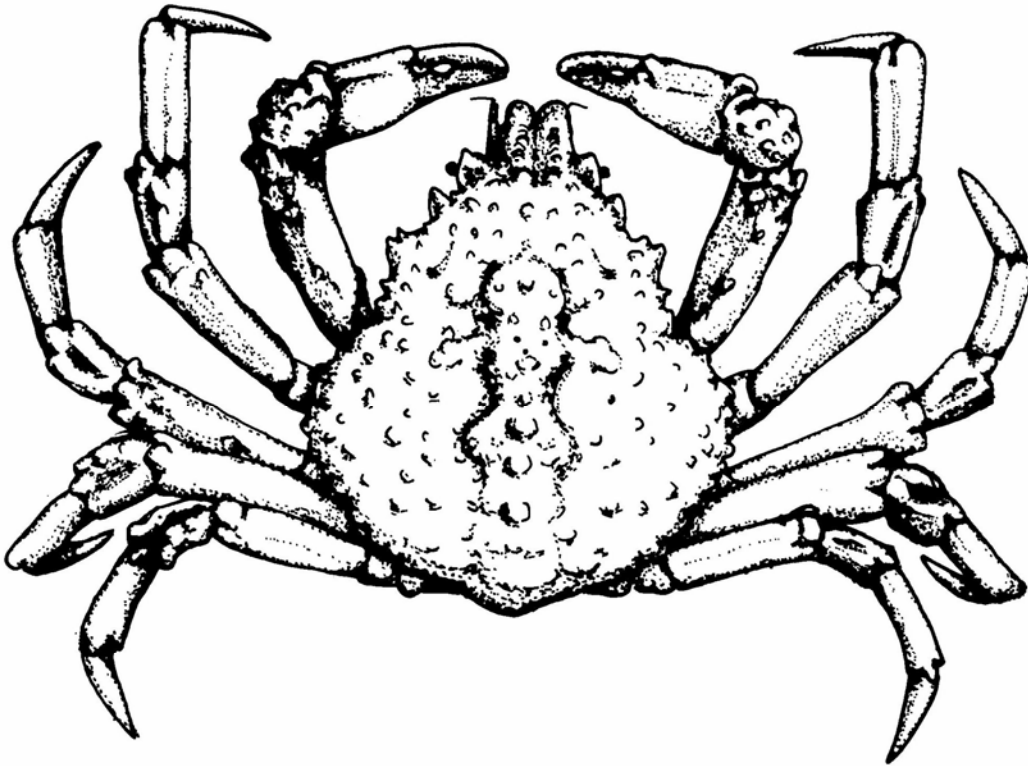
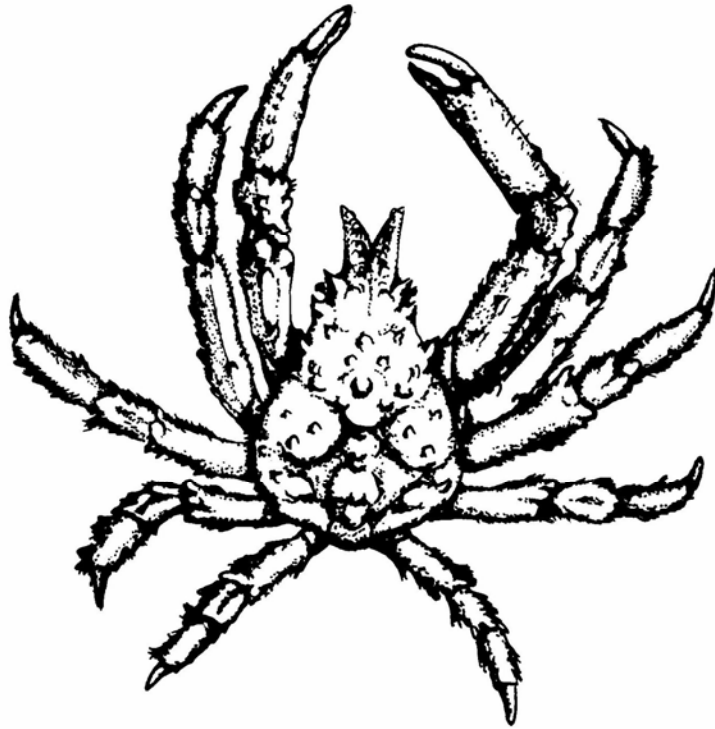
*Pelia tumida*



*Scyra acutifrons*



*Chorilia longipes*



Upper: *Loxorhynchus crispatus*; lower, *L. grandis*

Genus Erileptus Rathbun

Erileptus spinosus Rathbun

Erileptus spinosus Rathbun, 1893: 227.--Holmes 1900: 21.--Rathbun 1904: 171, pl. 10, fig. 1.--Rathbun 1925: 68, pls. 212, 213, text-fig. 18.--Garth 1958: 91, pl. E, fig. 8, pl. 5, fig. 2.—Hendrickx 1999: 12, fig. 5.

Anasimus spinosus.--Schmitt 1921: 196, text-figs. 121a, 121b.

Recognition characters.--Strongly sexually dimorphic. Male with slender, spinulose rostrum, about 0.5X length of postfrontal portion of carapace. Carapace spinulose; 2 spines on median line; one long spine on branchial region with small spine in front of it and two on margin; spine on margin of hepatic region and 2 very small ones arranged transversely on gastric region; slender spine on orbital arch. Postorbital spine small, distant from eye. Abdomen with spine on first segment. Chelipeds nearly 3X long as carapace, granulate; merus with one spine at anterior margin; hand slender, slightly flattened vertically, fingers gaping. Ambulatory legs very slender, decreasing regularly in length from first to fourth. Female with slender, upcurved, spinulose rostrum. Carapace with 2 median spines, 2 spines on each branchial region and one on each protogastric region, lateral margins spinulose, surface pubescent. Prominent supraorbital spine. Abdomen with spine on first segment and smaller spine on second segment. Chelipeds weak, margins of merus spinulose, slender spine near carpus; hand slender, granulate; fingers in contact. Ambulatory legs slender and pubescent, decreasing in length from first to fourth. Dactyls of ambulatory legs slender and spinulose in both sexes. Male carapace length 11 mm, width 6.8; female carapace length 5.7, width 4.0.

Color in life.--Dull brown to grayish.

Habitat.--Usually shelly sand, often in steeply-sloping areas, 4-554 m.

Range.--San Miguel Island, California to Magdalena Bay, Baja California; Gulf of California from Rocky Point, Sonora to Isla Cardones, Panama. Type locality off San Diego, California.

Remarks.--This small crab is especially common on "shell hash" bottoms along the islands of southern California.

Genus Podochela Stimpson

Podochela hemphillii (Lockington)

Microrhynchus hemphillii Lockington, 1877: 30.

Podochela hemphillii.--Holmes 1900: 17.--Rathbun 1904: 1717, pl. 10, fig. 2.--Schmitt 1921: 195, text-fig. 120.--Rathbun 1925: 49, pl. 18; pl 209, fig. 2.

Podochela hemphilli.--Garth 1958: 104, pl. H, fig. 6, pl. 7.--Ricketts et al. 1985: 420.—Hendrickx 1999: 28, fig. 15.

Recognition characters.--Rostrum broad to acutely triangular, variable in length, ending in spine, with hooked setae. Carapace pyriform; gastric region prominent, rounded, and bearing hooked setae; hepatic regions bearing 2 pointed tubercles; cardiac region separated by shallow grooves from branchial and bearing prominent elevation; branchial regions flattened or raised. No supraorbital tooth or spine, no tooth at posterior margin of orbit but sometimes small one short distance behind orbit. Eyestalks constricted at middle. Basal antennal article with longitudinal



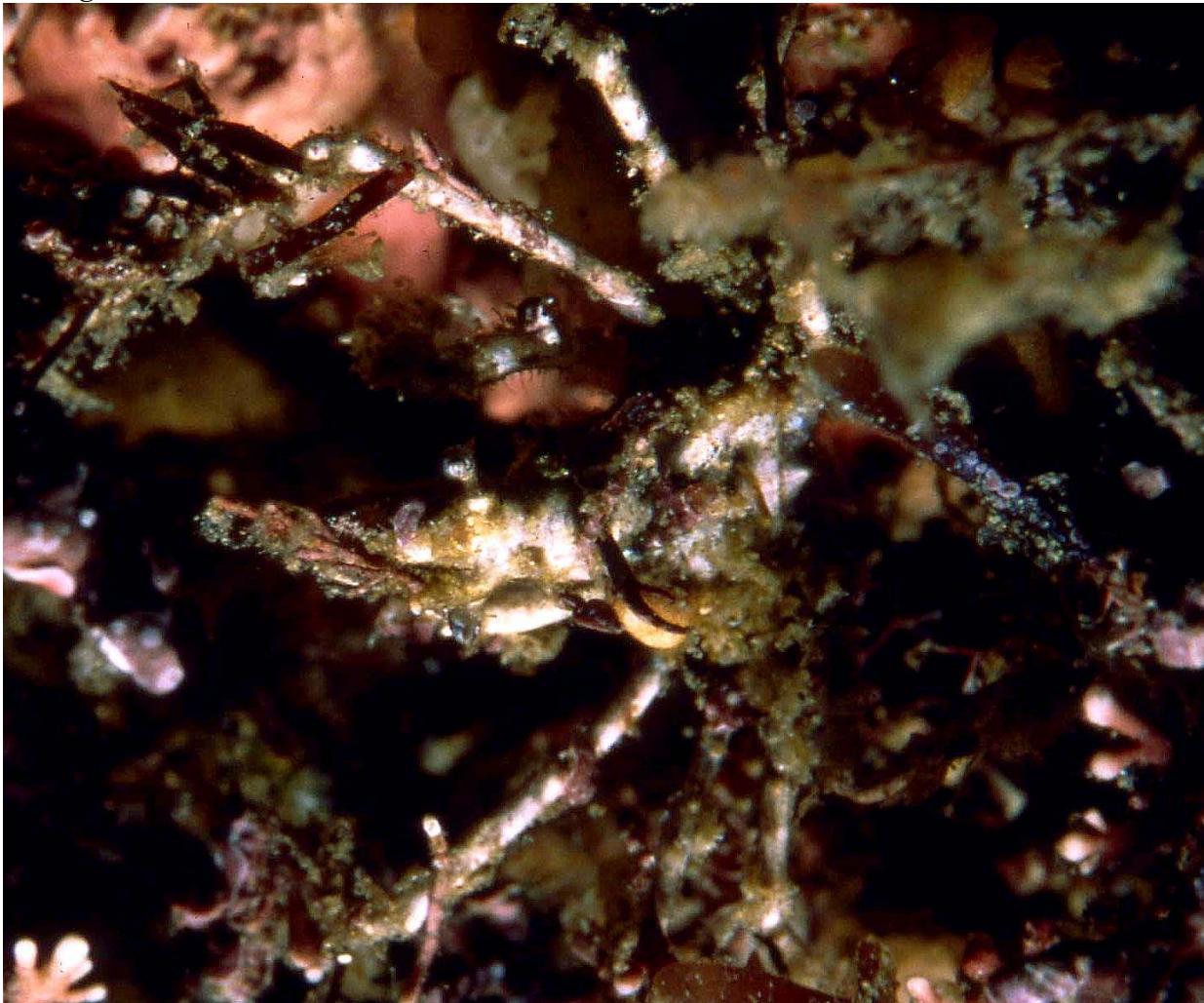
ridge on posterior half or two-thirds with groove on either side. Male with robust chelipeds, merus incurved and having outer spiny ridge; carpus with posterior spine on upper side, hand oblong, palm inflated, fingers gaping at base. Female chelipeds smaller, slender, fingers nearly straight. Ambulatory legs long and slender, furnished with hooked setae, dactyls slender and curved. Abdomen of male six-segmented, narrow; female abdomen with five segments and rounded; female sternum and ventral surface of abdomen hollowed out. Male carapace length 34 mm, width 22.4; female carapace length 18.5 mm, width 11.5.

Color in life.--Dorsal surface of carapace pale olive buff with band of carmine along each side, two patches of carmine on cardiac region and two smaller patches on intestinal region. Chelipeds yellowish cream. Ambulatory legs marked with carmine. Lower body surface creamy white.

Habitat.--Docks, pilings, among low-growing algae on rocks, sand; shore to 166 m but usually at 100 m or less.

Range.--Monterey Bay, California to Magdalena Bay, Baja California; Angel de la Guardia Island, Gulf of California to Cape Corrientes, Colombia. Rarely reported north of San Miguel Island, California. Type locality San Diego Bay, California.

Remarks.-Podochela hemphillii frequently is covered by algae, hydroids or bryozoans which may be attached perpendicular to the axis of the ambulatory legs. The crab may store edible material among the hooked setae and then remove and eat it later.



Podochela hemphillii

Podochela lobifrons Rathbun

Podochela lobifrons Rathbun, 1893: 226.--Garth 1958: 116, pl. H, fig. 1; pl. 8, fig. 1.—Hendrickx 1999: 34, fig. 19.

Podochela barborensis Rathbun, 1924: 1.--Rathbun 1925: 54, p. 20, figs. 3,4, text-fig. 13.

Recognition characters.--Rostrum a long, slender spine, 0.5-0.6X postrostral carapace length. Carapace setose; cardiac region with large conical elevation; 2 median gastric tubercles, prominent strap-shaped spine on hepatic region and small, similar one on pterygostomial ridge, small postorbital spine, orbital arch finely spinulose. Antennae overreaching rostrum, movable articles of peduncle slender, basal article with spinulose outer margin. Two blunt median tubercles on first segment of abdomen. Chelipeds spinulose and setose, spine at outer distal margin of merus, knob on outer surface of carpus, chela widest behind middle of palm, one tooth on finger of cheliped at middle of gape. First ambulatory legs up to 3X carapace length, very slender, dactyl very slender. Second-fourth ambulatory legs with curved dactyls. Male carapace length 21.5 mm, width 12.5; female carapace length 18.3 mm, width 10.9.

Color in life.--Brown, chelipeds banded with red.

Habitat.--Sand, rocks and among algae, 2-230 m.

Range.--Point Mugu, California to San Cristobal Bay, Baja California; Angel de la Guardia Island to outer Gorda Bank, Gulf of California. Type locality off Abreojos Point, Baja California.

Remarks.--Podochela lobifrons usually occurs deeper than P. hemphilli. Freshly caught specimens often are coated with mud, foraminiferans and debris.

Genus Epialtoides Garth

Epialtoides hiltoni (Rathbun)

Epialtus bituberculatus Rathbun, 1894: 67 (in part).--Schmitt 1921: 203 (not text-fig. 126). (Not Epialtus bituberculatus Milne-Edwards, 1834, western Atlantic species).

Epialtus hiltoni Rathbun, 1923: 72.--Rathbun 1925: 156, pl. 46, figs. 1,2, text-figs. 53 m,n.

Epialtoides hiltoni.--Garth 1958: 234, pl. O, fig. 7; pl. 26, fig. 3.--Garth and Abbott 1980: 597, fig. 25.2.—Hendrickx 1999: 93, fig. 53.

Recognition characters.--Rostrum oblong, tip bilobed; deeply emarginate in young animals. Carapace high in median region, lateral wings broad, ascending, anterior lobe larger, intervening sinus deep. Posterior margin of hepatic lobe convex. Preorbital tooth outstanding, postorbital tooth inconspicuous. Male and female with 5 free abdominal segments. Male chelipeds of moderate size, merus bluntly angled, carpus and manus with subacute outer carina, tubercle on upper surface of carpus, outer margin of fingers with carina, large tooth on dactyl within narrow gape. Female with less massive cheliped, merus and manus foreshortened. Ambulatory legs rather stout, 2 tubercles on lower margin of merus of first leg, dactyls with spinules. Male carapace length 17.3 mm, width 15.7; female carapace length 10.7 mm, width 9.6.

Color in life.--Camouflaged like brown algae; brown, olive, mottled with dark brown or cream.

Habitat.--Among low-growing algae, in kelp holdfasts of among surf grasses (Phyllospadix spp.), shore-5 m.

Range.--Santa Catalina Island, California to Magdalena Bay, Baja California. Type locality Laguna Beach, California.

Remarks.--Epialtoides hiltoni may attach bits of algae to its rostrum. This crab may be abundant, but its small size and cryptic coloration renders it inconspicuous.



Epialtoides hiltoni

Genus Taliepus A. Milne-Edwards

Taliepus nuttalli (Randall)

Epialtus nuttallii Randall, 1839: 109.--Holmes 1900: 23.--Rathbun 1904: 173.--Schmitt 1921: 202, text-fig. 125.

Taliepus nuttallii.--Rathbun 1925: 162, pls. 50, 51; text-fig. 61.--Garth and Abbott 1980: 597, fig. 25.3--Ricketts et al. 1985: 136.

Taliepus nuttalli.--Garth 1958: 208, pl. L, fig. 8; pl. 22.—Hendrickx 1999: 117, pl. 2D, 3A, B.

Recognition characters.--Rostrum with convergent sides, inclined downward, with triangular notch at apex. Carapace ovate, convex, smooth. No preorbital tooth, postorbital tooth small. Antennae not reaching end of rostrum. Seven free abdominal segments in both sexes. Male cheliped stout, unarmed, fingers gaping, margins of fingers with row of low teeth; female cheliped more slender, fingers not gaping. Ambulatory legs stout, subcylindrical, dactyls strongly curved, with 2 rows of spinules on dactyls. Male carapace length 106 mm, carapace width 92; female approximately half this size.

Color in life.--Juvenile camouflaged like algae, olive-green to reddish; adults red-brown to dark purple.

Habitat.--Shore to 92 m, but usually less than 50 m; rocky shores, kelp beds, especially among brown algae.

Range.--Santa Barbara, California to Magdalena Bay, Baja California. Type locality "Upper California".

### Genus Mimulus Stimpson

#### Mimulus foliatus Stimpson

Mimulus foliatus Stimpson, 1860: 200, pl. 5.--Holmes 1900: 23.--Rathbun 1904: 173.--Schmitt 1921: 204, fig. 127a, 127b.--Rathbun 1925: 182, pl. 60, text-figs. 70,71.--Garth 1958: 183, pl. L, fig. 1; pl. 25, fig. 3.--Carlton and Kuris 1975: 395, pl. 96, fig. 46.--Garth and Abbott 1980: 600, fig. 25.8.--Ricketts et al. 1985: 170, fig. 138.

Recognition characters.--Rostral horns flattened, notch between them triangular, rows of hooked setae on rostrum. Carapace flattened, median region with 2 small tubercles; lateral margin bearing broad, leaflike expansions divided by narrow fissure. Hooked setae present on median region of small crabs. Preorbital tooth large, triangular, acute; postorbital tooth small and pointing obliquely downward. Peduncle of antennae reaching about to tip of rostrum. Male and female abdomens with seven free segments. Male cheliped large, merus rough, carpus with ridge on inner margin, hand with fingers bent downward and curved inward, gaping near base but distally with small teeth. Female cheliped smaller, without prominent ridge on merus, fingers not gaping, dentate along entire margin. First ambulatory legs longer than following legs. Propodus of all ambulatory legs with setose tooth near middle of inferior margin. Male carapace length 23.4 mm, width 39; female carapace length 19.3 mm, width 32.4.

Color in life.--Carapace highly variable: reddish, rose-red, purple, tan and marked with stripes, white with brick-red rostrum, red-brown with white "V" mark to orange. Legs reddish with white bands; male cheliped reddish or white with red fingers.

Habitat.--Among rocks and algae, shore to 129 m but usually at 30 m or less.

Range.--Unalaska, Alaska to San Diego, but uncommon south of Point Conception, California. Type locality off Monterey, California.

Remarks.--Mimulus foliatus may attach bits of algae to its carapace. Large individuals may have encrusting sponges or bryozoans on the carapace. This species is very common among coralline algae and kelp holdfasts.



Mimulus foliatus

Genus Pugettia Dana

Pugettia venetiae Rathbun

Pugettia venetiae Rathbun, 1924: 2.--Rathbun 1925: 180, pl. 59, figs. 5-7, text-figs. 68, 69.--Garth 1958: 204, pl. L, fig. 5, pl. 21, fig. 2.—Hendrickx 1999: 113, fig. 66.

Recognition characters.--Rostral horns long, acute, divergent. Carapace tuberculate and spinous, with 4 gastric, 2 lateral, one cardiac, 3 intestinal and 4-5 branchial tubercles, one branchial and

2 hepatic lateral spines. Postorbital spine slender. Supraocular eave less expanded over eye than in related species. Preorbital spine large, directed forward, antennal spine visible in front of it. Basal antennal article having anteroexternal spine and 2 smaller spines. Male chelipeds about as long as carapace, ischium with spine on inner margin, merus with spines on inner, upper and outer margins, carpus with 2 spines on inner margin and 4 on outer margins, palm with spinules on upper surface, fingers narrow, deflexed and toothed, narrow gape at base. Female cheliped shorter and similar, fingers not gaping. Ambulatory legs subcylindrical, dactyls with two rows sharp spinules. Much of dorsal surface of both sexes setose. Male carapace length 16.2 mm, width 10.7; female length 23.9 mm, width 17.3.

Color in life.--Rostrum, frontal region and chelae dull orange. Carapace gray-tawny brown with white and lavender marks. Fingers of chela purple-brown at base, becoming orange-red and fading to white at tips. Ambulatory legs brownish orange, banded. Ventral surface dull lilac on abdomen and orange on front.

Habitat.--Sand and shell, rock, 9-120 m, usually at 90 m or less.

Range.--San Miguel Island, California to Magdalena Bay, Baja California. Type locality off Newport Beach, California.

Remarks.--Specimens of *P. venetiae* are unusual for spider crabs in being relatively clean of attached material.

### Pugettia dalli Rathbun

*Pugettia dalli* Rathbun, 1893: 232.--Holmes 1900: 26.--Rathbun 1904: 173, pl. 2, figs. 1, 1a.--Rathbun 1925: 178, pl. 59, figs. 1-4, text-fig. 67.--Garth 1958: 199, pl. L, fig. 6, pl. 21, fig. 1.—Hendrickx 1999: 107, fig. 62.

Recognition characters.--Rostral horns slender, divergent. Carapace subtriangular, more rounded in females than males; with hooked setae and covered with small prominences. Large tubercle on cardiac region, intestinal region and each protogastric lobe; female with swollen gastric region. Lateral carapace margin with slender hepatic spine and stout and upturned branchial spine. Preorbital tooth sharply pointed. Postorbital tooth thin, obtuse, upper surface flattened into smooth oval lobe. Antennae exceeding rostrum; large lobe on outer margin of basal article. Male cheliped strong, merus with thin and irregular ridge on margins, carpus with strong ridge above and on inner margin, hand large, compressed, margins thin, fingers gaping, tooth near base of dactyl. Female cheliped similar but with slender chela, fingers in contact. Ambulatory legs slender, first pair as long as or longer than chelipeds, remaining legs shorter, margins fringed with coarse setae. Male carapace length 18.0 mm, width 13.8; female carapace length 14.6 mm, width 10.3.

Color in life.--Reddish to brown, similar to algae.

Habitat.--Among algae and sea grasses, open coasts and harbors, intertidal to 118 m but usually at less than 50 m.

Range.--San Miguel Island, California to Thurloe Bay, Baja California. Type locality "Southern California" (probably Catalina Harbor, Santa Catalina Island, based on records of other specimens examined by Rathbun).

Remarks.--*Pugettia dalli* is common, but small and cryptic. It can be collected in abundance among low-growing algae and holdfasts. These crabs decorate themselves life-long with pieces of algae, bryozoans and hydroids.



Pugettia dalli

Pugettia producta (Randall)

Epialtus productus Randall, 1839: 110.--Holmes 1900: 22.--Rathbun 1904: 173.--Schmitt 1921: 201, text-fig. 124.

Pugettia producta.--Rathbun 1925: 167, pls. 56, 57, text-figs. 62, 63.--Garth 1958: 188, pl. L, fig. 2, pl. 19.--Carlton and Kuris 1975: 395, pl. 97, fig. 56.--Garth and Abbott 1980: 598, fig. 25.4.—Wicksten and Bostick 1983: 364.--Ricketts et al. 1985: 134, fig. 106.—Hendrickx 1999: 110, pl. 2B.

Recognition characters.--Rostrum deeply notched, with hooked setae on horns. Carapace smooth, sides subparallel, with large hepatic tooth broadly but distantly joined with postorbital; large tooth midway between anterolateral tooth and posterior margin; posterior margin with strong convexity in middle. Newly-settled crabs bearing tufts of coarse setae on lateral margins of carapace. Small preorbital and postorbital tooth. Male chelipeds stout, shorter than first ambulatory legs, carpus with outer ridge, hand long and narrow but inflated in largest individuals; fingers slender, bent downward and curved inward, inner margins dentate, gaping in largest males; female cheliped more slender. Ambulatory legs decreasing in length posteriorly, dactyls slender and with spinules. Male carapace length 71 mm, width 62; female carapace length 69 mm, width 59.

Color in life.--Camouflaged like algae; light olive-green to almost black. Ventral surface yellowish in juveniles and females, brilliant red in mature male. (Color may depend on age, nearness to next molt and uptake of pigments from algal food).

Habitat.--Wharves, docks, pilings, kelp beds, tidepools, eel grass flats, beds of brown algae (especially Egregia spp.) Intertidal to 74 m, but usually shallow and near shore.

Range.--Prince of Wales Island, Alaska to Point Asuncion, Baja California. Type locality "Upper California".

Remarks.--Pugettia producta is the largest and most easily observed of the kelp crabs. The crab may store bits of algae on the rostrum, and later remove and eat the algae. Kelp crabs may move from place to place during the year to feed on algae or mate.



male Pugettia producta





juvenile Pugettia producta

Pugettia gracilis Dana

Pugettia gracilis Dana, 1851.--Holmes 1900: 25.--Rathbun 1904: 173.--Schmitt 1921: 206, pl. 33, fig. 7, text-figs. 128a, 128b.--Rathbun 1925: 172, pl. 58, text-figs. 64, 65.--Garth 1958: 196, pl. L, fig. 4, pl. 20, fig. 2.--Carlton and Kuris 1975: 395.--Garth and Abbott 1980: 598, fig. 25.5.--Ricketts et al. 1985: 298.

Recognition characters.--Rostrum deeply notched, outer margins of rostral horns subparallel. Carapace oval, with 2 gastric, one cardiac and one intestinal tubercles; tuft of setae preceding each tubercle, hooked setae on rostrum and sides of carapace. Lateral projections of carapace broad, anterior one large and winglike, posterior projection smaller with anterior end lobiform and posterior end spiniform. Hepatic tooth broad and completely joined to postorbital tooth. Basal article of antennae bearing tooth at anteroexternal angle, flagellum not reaching end of rostrum. Chelipeds large and strong, merus triangular, with superior crest bearing 3 or more teeth; carpus with 2 longitudinal crests, propodus with superior crest and inferior margin with prominent posterior lobe; male chela with fingers widely gaping, large tooth near base of dactylus; female fingers not gaping. Ambulatory legs stout, with small tubercles, dactyls with sharp tips. Male carapace length 35.5 mm, width 26.5; female carapace length 33.5 mm, width 25.0.

Color in life.--Greenish brown, yellow or reddish, ventral side lighter.

Habitat.--Docks, pilings, among rocks and algae, eel grass beds.

Range.--Attu Island (Aleutian Islands) to Monterey Bay, California, but usually north of San Francisco. Type locality Puget Sound, Washington.

Remarks.--Pugettia gracilis usually has little material attached to its dorsal surface.

Pugettia richii Dana

Pugettia richii Dana 1851: 268.--Holmes 1900: 24.--Rathbun 1904: 173.--Schmitt 1921: 207, pl. 33, fig. 6, text-fig. 129.--Rathbun 1925: 176, text-fig. 66.--Carlton and Kuris 1975: 395.--Garth and Abbott 1980: 599, fig. 25.6.—Hendrickx 1999: 111, pl. 2C.

Pugettia richi.--Garth 1958: 193, pl. L, fig. 3, pl. 20, fig. 1.

Recognition characters.--Rostrum with long horns, deep notch and hooked setae. Carapace ovate, tuberculate, constricted at base of hepatic tooth, broader in female than in male. Median region of carapace with three anterior tubercles in row and one somewhat anterior to them; rows of hooked setae near lateral tubercles, cardiac and intestinal regions with tubercle each, 2 tubercles on branchial region, posterior margin of carapace markedly convex. Supraorbital tooth acute and directed forward, postorbital tooth acute and triangular, large, slender tooth posterior to postorbital tooth, prominent pointed tubercle and posterolateral margin of carapace, spine on subbranchial region, pterygostomian region with 3-6 small teeth. Flagella of antennae visible near rostrum. Male chelipeds larger and more robust than those of female; merus with tubercles and ridge along inner side in adult, carpus with 2-3 ridges, especially in adult, hands compressed, fingers gaping in adult. Female chelipeds more slender, fingers not gaping. Ambulatory legs subcylindrical, dactyls sharp. Male carapace length 44 mm, width 36; female carapace length 33 mm, width 26.5.

Color in life.--Bright to dark red, matching red algae. Legs banded.

Habitat.--Tidepools, docks, pilings and among algae and sea grasses; intertidal to 98 m but usually in shallow areas near shore.

Range.--Prince of Wales Island, Alaska to San Geronimo Island and Asuncion Bay, Baja California. Type locality "California", possibly San Diego.

Remarks.--Pugettia richii decorates heavily throughout its lifespan. The crab may be covered by pieces of algae, hydroids or bryozoans, often with long "streamers" of material projecting forward from the rostrum.



Pugettia richii

Genus Oregonia Dana

Oregonia gracilis Dana

Oregonia gracilis Dana 1851: 270.--Holmes 1900: 19.--Rathbun 1904: 171.--Schmitt 1921: 198, text-figs. 122a, 122b.--Rathbun 1925: 71, pls. 24, 25, text-figs. 19, 20.--Garth 1958: 136, pl. I, fig. 2, pl. 10, pl. 11, fig. 1.--Carlton and Kuris 1975: 395.--Ricketts et al. 1985: 298, 334.

Recognition characters.--Rostrum with two long, slender contiguous spines and rows of hooked setae. Carapace subtriangular, setose and covered by prominences, broader in female than male. Prominence on anterior side of eye peduncle. Postorbital spine remote from eye, acute, directed outward. Septum between first antennae produced into spine. Chelipeds of male robust, those of female more slender, exceeding length of ambulatory legs, merus subcylindrical and tuberculate, carpus rounded, hand long and slender, fingers slender, smooth and incurved. Ambulatory legs cylindrical and decreasing in length posteriorly, dactyls long, tipped by claws. Male carapace length 65.7 mm, width 39; female carapace length 27.5-44.6 mm, width 165.

Color in life.--Tan or gray, red marking on chelae.

Habitat.--Among algae, eel grass and pilings, intertidal to 390 m but usually subtidal in California and Oregon.

Range.--Bristol Bay, Bering Sea to Monterey Bay, California; also Japan; rarely found south of Point Arena, California. Type locality Puget Sound, Washington.

Remarks.--Oregonia gracilis decorates heavily with bits of algae, hydroids, bryozoans, sponges and wood chips.

Genus Chionoecetes Kroyer

Chionoecetes tanneri Rathbun

Chionoecetes tanneri Rathbun, 1893: 76, pl. 4, figs. 1-4 (in part).--Holmes 1900: 40.--Rathbun 1904: 174.--Schmitt 1921: 210, text-fig. 131.--Rathbun 1925: 243, pls. 88, 89, 234.--Garth 1958: 156, pl. I, fig. 8; pl. 16, fig. 2.—Hendrickx 1999: 49, pl. 1A, C.

Recognition characters.--Rostrum short, with wide space between horns, horns slightly upturned, hooked setae present in newly-settled juvenile only. Carapace broad, swollen at branchial regions, spinous; space between branchial regions deep. Outer spine of branchial row as large as outer spine of transverse row and directly in front of it, another row of spines forming lateral supramarginal border of branchial region; spines continuing of pterygostomian region and branchial region; irregular row of small spines crossing gastric region. Orbits, outer margin of postorbital teeth and inferolateral and posterior margins of carapace armed with spinules. All spinules may be blunt in very large crabs. Male cheliped much longer than that of mature female, palm swollen, fingers long and curved. Ambulatory legs flattened, armed with spines, dactyls long and flat. Male carapace length 31 mm, width 29; female carapace length 31 mm, width 29.1.

Color in life.--Bright scarlet, tips of appendages yellow.

Habitat.--Green mud, fine gray sand, 54-1960 m but usually between 200-500 m on continental slopes; may migrate vertically along bottom during year.

Range.--Bering Sea to off Coronado Islands, Baja California. Type locality Gulf of the Farallones, California.

Remarks.--The Tanner crab is edible, and is the object of a fishery off Oregon. Unlike other majids, species of Chionoecetes have a relatively thinner and more flexible exoskeleton in relation to their musculature, and yield more meat per unit of volume than other large spider crabs.



Chionoecetes tanneri

Chionoecetes angulatus Rathbun

Chionoecetes angulatus Rathbun, 1893: 76 (in part).--Rathbun 1925: 247, pls. 90, 91.--Garth 1958: 159, pl. I, fig. 7; pl. 16, fig. 1.

Recognition characters.--Rostrum small, teeth wide and inclined upward. Carapace broad, spinulose, pubescent, lateral margins partially concealed by expanded branchial regions; space between branchial regions shallow. Dorsal ridges of branchial region converging in straight lines and meeting in acute angle marked by large spine. Male cheliped longer than that of female; palm inflated, fingers narrow and curved. Ambulatory legs flattened, meri little dilated; dactyls long and slender. Male carapace length 24.6 mm, width 23.3; female carapace length 26.4 mm, width 24.8.

Color in life.--Not reported.

Habitat.--Green mud, fine black sand; 90-3000 m but usually on continental slope.

Range.--Bering Sea off Pribilof Islands to northwest of Cape Blanco, Oregon. Type locality south of Pribilof Islands.

Genus Herbstia Milne-Edwards

Herbstia parvifrons Randall

Herbstia parvifrons Randall, 1839: 107.--Holmes 1900: 38.--Schmitt 1921: 215, text-fig. 135.--Rathbun 1925: 296, pl. 106, text-fig. 99.--Garth 1958: 316, pl. 8, fig. 5; pl. 34, fig. 2.--Garth and

Abbott 1980: 602, fig. 25.13.—Hendrickx 1999: 124, pl. 4B, D.

Recognition characters.--Rostral horns short, notch shallow. Carapace ovate, tuberculate, flattened and setose, gastric region with 4 inconspicuous tubercles in transverse row and median tubercle on posterior portion; 3-4 small tubercles on cardiac region, and 5 on each branchial region; 2 tubercles in transverse line on intestinal area, intestinal area projecting slightly beyond posterior marginal level. Preorbital spine present, acute; 2 small spines at margin of orbit between preorbital and postorbital spines; anterolateral margin of carapace provided with postorbital spine and 5 other spines, and several smaller ones above these and on posterior margin. Three subhepatic spines and row of 5-6 pterygostomian spinules. First movable segment of antenna short, not reaching tip of rostrum. Male cheliped more robust than ambulatory legs and exceeding length of first leg; female cheliped more slender. Merus with 5 larger spines on superior inner margin and numerous smaller external spine; carpus with 10-11 spinules; hand with 5-6 blunt spines on superoproximal border, male dactyl with ridge in gape, female chela without gape. Ambulatory legs elongate, setose; meri with 7-9 spinules on anterior margins; no more than 3 on posterior margins; carpi with single distal spinule; propodi long and unarmed, dactyls spinulose. Male carapace length 33.0 mm, width 30.0; female length 19.5 mm, width 17.1.

Color in life.--Tan mottled with dark brown to reddish, legs barred with reddish brown.

Habitat.--Almost always among rocks or rocky rubble, intertidal to 74 m.

Range.--Monterey Bay, California to Magdalena Bay, Baja California. Type locality "western America".

Remarks.--In its natural habitat, H. parvifrons slips into narrow spaces between and under rocks. The crab frequently is covered with small calcareous sponges.



Herbstia parvifrons

## Genus Pelia Bell

### Pelia tumida (Lockington)

Pisoides ? tumidus Lockington, 1877: 30.

Pelia tumida.--Holmes 1900: 35.--Rathbun 1904: 174.--Schmitt 1921: 211, pl. 34, figs. 5,6.--Rathbun 1925: 281, pl. 99, figs. 2,3.--Garth 1958: 271, pl. Q, fig. 1; pl. 31, fig. 2.--Garth and Abbott 1980: 601, fig. 25.12.—Hendrickx 1999: 150, fig. 86, pl. 6C.

Pelia clausa Rathbun, 1907: 72.--Schmitt 1921: 211, pl. 34, figs. 1-4.

Recognition characters.--Rostrum with shallow notch, rostral horns nearly parallel. Carapace pyriform, pubescent, without spines. Gastric region rounded and elevated, with small rounded tubercle; branchial regions inflated, cardiac region with rounded elevation. Anterolateral margin entire. Basal antennal segment longer than wide, with tooth at anteroexternal angle, flagella longer than rostrum. Chelipeds unarmed, hand inflated, male with fingers widely gaping, tubercle on margin of dactyl near base. Ambulatory legs flattened, pubescent, dactyls with sharp, curved tips. Male carapace length 21.2 mm, width 14.5; female carapace length 20.5 mm, width 13.0.

Color in life.--Carapace buff, tan or orange, chelae white, mottled with brown, chela of adult male bright red; ambulatory legs with marks of orange and brown.

Habitat.--Rocks and reefs, intertidal to 129 m, but usually at 50 m or less.

Range.--Monterey Bay to Petatlan Bay, Mexico including Gulf of California. Type locality near San Diego.

Remarks.--Pelia tumida always has sponges attached to its dorsal surface. The crab attaches pieces to itself soon after molting. The sponge regenerates and grows to cover the entire dorsal surface of the crab. Many crabs are covered by yellow sponges, which at present are unidentified. The early confusion in the nomenclature of this species reflects the marked sexual dimorphism seen in adults. Immature males, like females, do not have as expanded chelae as mature males, nor is there a gape between the fingers.



Pelia tumida

Genus Chorilia Dana

Chorilia longipes Dana

Chorilia longipes Dana, 1851: 269.--Rathbun 1904: 174.--Schmitt 1921: 209, text-fig. 130.--Rathbun 1925: 203, pl. 224, figs. 1-3.--Garth 1958: 263, pl. P, figs 4,5; pl. 30.

Chorilia longipes turgida Rathbun, 1924: 3.—Garth 1958: 263.—Hendrickx 1999: 120, fig. 69, pl. 6A.

Recognition characters.--Rostrum almost half as long as remainder of carapace, horns tapering. Carapace covered by numerous tubercles and spines; largest spine at widest part of carapace at



margin of branchial region; 2 median gastric spines, ridge or tubercle on hepatic region. Slender preorbital spine. Basal antennal segment with 2 spines on outer margin, followed posteriorly by triangular tooth. Chelipeds massive; merus rough and with spines and tubercles; carpus also rough, hand compressed, upper edge thin, finger narrow, gaping in male; dactyl with subbasal tooth, distal ends of fingers meeting. First ambulatory legs about as long as chelipeds; other legs shorter; merus of each with short sharp point; dactyls slender and curved. Male carapace length 50.4 mm, width 30.2; female carapace length 54 mm, width 40.

Color in life.--White to dirty brown.

Habitat.--Among boulders, 33-1200 m, usually found at greater depths toward southern end of range.

Range.--Off Shumagin Bank, Alaska to Cortez Bank, California; northern Peru. Type locality "Oregon territory".

Remarks.--Two subspecies are recognized. Chorilia longipes Dana has a blunt ridge on the hepatic region; C. longipes turgida Rathbun has a spine on the hepatic region. Chorilia longipes occurs from Alaska to off Santa Catalina Island, California; C. longipes turgida has been found from Monterey Bay to off San Diego. The distribution of the typical form seems to be related to colder water temperatures, for the occurrence of this form toward the south is related to zones of upwelling.



Chorilia longipes

## Genus Scyra Dana

### Scyra acutifrons Dana

Scyra acutifrons Dana, 1851: 269.--Holmes 1900: 41.--Rathbun 1904: 175.--Schmitt 1921: 214, text-figs. 134a, 134b.--Rathbun 1925: 195, pl. 79; pl. 224, figs. 4,5; text-fig. 79.--Garth 1958: 252, pl. P, fig. 1; pl. 27, fig. 1.--Carlton and Kuris 1975: 395.--Garth and Abbott 1980: 600, fig. 25.9.--Ricketts et al. 1985: 169.—Hendrickx 1999: 156, fig. 90, pl. 6D, E.

Recognition characters.--Rostrum flattened, short, horns shaped like feathers or arrow; rows of hooked setae on horns. Carapace pyriform; median region separated from cardiac and branchial regions by conspicuous depression; acute tubercle near center of median region and larger tubercle behind it. Branchial regions with felt-like setae and bearing large, projecting tubercle; in front of this an elevated prominence usually bearing several small tubercles, large tubercle on cardiac region and smaller one on intestinal region. Considerable variation among individuals and between sexes in width of carapace and degree of prominence and elevation of tubercles and regions of carapace. Preorbital spine acute. Pterygostomian regions with several rounded teeth. Two spines on outer margin of basal antennal segment, lobe on its outer margin, flagellum long. Male cheliped considerably more robust than those of female, merus subcylindrical and somewhat flattened below, bearing pustules; carpus pustulate and having ridges on outer side; hand long, narrow, compressed, palm often with inflated ridge; fingers deflexed, in older male, gaping and with tooth near base of dactyl. Ambulatory legs subcylindrical, pubescent, propodi bearing groove on either side; dactyls short and rounded at apex. Male carapace length 46.5 mm, width 33.7; female carapace length 23.9 mm, width 15.9.

Color in life.--Dull tan to gray with marks of red on chelipeds and walking legs.

Habitat.--Rocks, reefs and pilings; intertidal to 114 m but usually less than 50 m.

Range.--Kachemak Bay, Cook Inlet, Alaska to Point San Carlos, Baja California. Type locality "Oregon".

Remarks.--Scyra acutifrons usually does not decorate, but instead is encrusted by sponges, barnacles, bryozoans or tunicates. Although many reports state that they rest with the anterior region aimed downward, there is no consistency in posture among crabs observed in subtidal areas. Considerable variation exists in shape of the carapace and its prominences within this species; likewise, maximum sizes of adults also vary. It is easy to confuse this species with similar subtidal spider crabs unless one studies the specimen carefully.



Scyra acutifrons

Genus Loxorhynchus Stimpson

Loxorhynchus grandis Stimpson

Loxorhynchus grandis Stimpson, 1857: 85.--Holmes 1900: 29.--Rathbun 1904: 175.--Schmitt 1921: text-figs. 132a, 132b.--Rathbun 1925: 198, pls. 64, 65, text-fig. 80.--Garth 1958: 257, pl. P, fig. 2; pl. 29.—Wicksten 1979b: 37.--Garth and Abbott 1980: 600, fig. 25.10.—Hendrickx 1999: 141, pl. 5D.

Recognition characters.--Rostrum slightly longer than broad, much deflexed, horns convex above and below and separated for more than half their length, with rows of hooked setae except in mature adults. Carapace rounded, inflated, and covered with small, conical tubercles which may be worn in mature adults; juveniles with abundant hooked setae. Stout spine on maring of

hepatic region and another one just below margin. Preorbital spine large, often double pointed; postorbital spine subconical, acute. Basal antennal segment with anteroexternal spine and tubercle on outer margin; another on anterior margin at insertion of next segment. Chelipeds of adult male large, tuberculate; hand with palm inflated; female with shorter chelipeds, palm not inflated; chela slender and with narrow fingers in juveniles. Ambulatory legs subcylindrical, with few tubercles, propodi with grooves above, dactyls short and stout. Male carapace length 190 mm, width 145 mm; female carapace length 114 mm, width 86.

Color in life.--Brown, becoming bluish-gray to chalky white in aging adults; ventral surface white. (Stimpson's color notes as given by Garth, 1958, surely were of a dead or preserved animal).

Habitat.--Rocks, pilings, subtidal sand flats and sand dollar beds, lowest intertidal zone to 125 m.

Range.--Cordell Bank, California to Thurloe Head, Baja California. Type locality near San Francisco, California.

Remarks.--Juvenile L. grandis usually are almost impossible to detect in their natural habitat because they tend to remain inactive by day. Their bodies are covered by a dense coat of bryozoans, sponges, algae, hydroids, pieces of gorgonians or other materials. As the animals grow and mature, the hooked setae are lost or worn off. Mature males and females do not decorate at all. Adult L. grandis have been observed to congregate into mating "pods" in subtidal areas near the Redondo Submarine Canyon. Although most reports of these crabs describe them as "sluggish", they can move with surprising agility as long as they are submerged. Usually, they are found on the bottom, but individuals occasionally climb up among kelp or on pilings. Molts and dead individuals of L. grandis can be cast ashore in southern California. Live animals may be caught in traps. However, these crabs have a thick, hard exoskeleton that encases proportionally less meat than that of a Tanner crab, and therefore there is little market for these crabs for human food. Loxorhynchus grandis is the largest and heaviest crab found in California.



Loxorhynchus grandis

Loxorhynchus crispatus Stimpson

Loxorhynchus crispatus Stimpson, 1857: 453, pl. 22, figs. 2-4.--Holmes 1900: 30.--Rathbun 1904: 175.--Schmitt 1921: 213, text-figs. 133a, 133b.--Rathbun 1925: 200, pls. 66, 67.--Garth 1958: 260, pl. P, fig. 3, pl. 27, fig. 2; pl. 28, fig. 1.--Carlton and Kuris 1975: 395, pl. 97, fig. 58a, 58b, 58c.—Wicksten 1977b: 122.--Wicksten 1978: 217.--Wicksten 1979b: 37. Garth and Abbott 1980: 601, fig. 25.11.--Ricketts et al. 1985: 168, fig. 136.—Hendrickx 1999: 140, pl. 5C.

Recognition characters.--Rostrum with more divergent horns than in L. grandis, not as deflexed, separated for more than half length of rostrum, with rows of hooked setae. Carapace somewhat triangular, more rounded in females than males, with few large tubercles. Carapace with prominent tubercle on cardiac region connected by prominent ridge with tubercle on intestinal region; two tubercles on branchial regions, large tubercle and domelike prominence on hepatic region; tubercle on anterior and one on posterior portion of median region; tubercle on either side of anterior median tubercle; row of small blunt tubercles on each median region extending to each rostral horn; in most individuals, all tubercles, with surrounding pile, standing out as discrete masses. Carapace densely covered with pile and with patches of hooked setae in all but oldest mature males. Preorbital spine prominent, subconical. Cheliped of adult male longer than in female, chela much more massive. In both sexes, cheliped with 3-4 upper tubercles on merus; carpus with small tubercles; fingers of chela curved. Ambulatory legs rather short, with hooked setae; first pair shorter than chelipeds of adult male but longer in female, merus grooved above, dactyls of all legs short and stout. Male carapace length to 196 mm, width to 140; female 105 mm, width 68. (Largest male was exceptionally big for this species).

Color in life.--Light brown, with dark bands on legs of freshly-molted individuals, fingers of chelae white, with red marks in adult male.

Habitat.--Rocks, jetties, pilings, kelp beds, rocky reefs, worm tube beds; extreme low tide to 200 m.

Range.--Orford Reef, Oregon to Natividad Island, Baja California, but rarely found north of San Francisco, California. Type locality San Miguel Island, California.

Remarks.--The moss crab Loxorhynchus crispatus is the most heavily decorated crab of California or Oregon. Juveniles camouflage themselves with pieces of algae, bryozoans, sponges, ascidians, hydroids, or whatever is flexible and available (including such exotic materials as leaves from a redwood tree). The decorating behavior remains in adult females but is lost in mature males, which decorate the rostrum if any part at all. Large adults of both sexes also may bear barnacles, tunicates, tube worms and other organisms that settle on them in situ. Although reported to be "sluggish", L. crispatus can amble at a reasonable rate for a crab of its size, and can move up to 50 m or more during a single night. It is primarily nocturnal, and sometimes will climb up among kelp to feed.



male Loxorhynchus crispatus



juvenile Loxorhynchus crispatus

## Family Parthenopidae

Members of the family Parthenopidae are commonly called elbow crabs, and with good reason. The elongated chelipeds, folded across the front, suggest the name. These sand-dwelling crabs, mostly tropical in distribution, are represented in California by only one species.

Parthenopid crabs have retractile eyes with small and well-defined orbits. The basal antennal segment is small and deeply imbedded between the inner angle of the orbit and the pits at the bases of the first antennae. The first antennae fold somewhat obliquely, not vertically. The distinctive chelipeds have fingers bent at an angle. The ambulatory legs are short, flattened and have broad segments.

Elbow crabs can dig into sand and remain motionless with only the eyes, tip of the rostrum and a respiratory passage exposed. Their cryptic coloration renders them further difficult to detect.

Genus Heterocrypta Stimpson

Heterocrypta occidentalis (Dana)

Cryptopodia occidentalis Dana, 1854: 430.

Heterocrypta occidentalis.--Holmes 1900: 44.--Rathbun 1904: 170.--Schmitt 1921: 192, text-fig. 119.--Rathbun 1925: 559, pls. 204, 205.--Garth 1958: 476, pl Z, figs. 14, 14a; pl. 55, fig. 2.--Carlton and Kuris 1975: 393, pl. 96, fig. 47.--Ricketts et al. 1985: 321, fig. 246.—Hendrickx 1999: 251, pl. 8C.

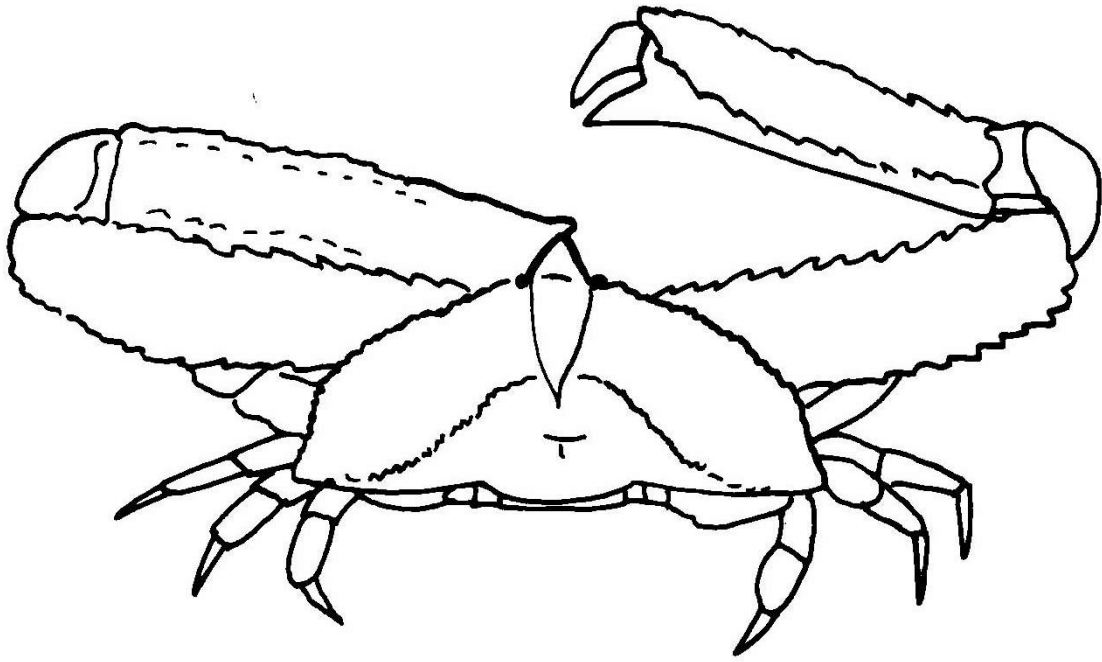
Recognition characters.--Rostrum subtriangular, subacute, short. Carapace broadly triangular; median region narrow, flattened upper surface bounded by 2 granulated ridges, converging to triangular point posteriorly. Cardiac region with 3-sided elevation, edges usually granulated. Posterolateral regions large, with S-shaped, granulated crest, pair minute tubercles in front of anterior bend of crest. Anterolateral margins striaght to slightly concave in front, convex near middle, posterior portion extending outwards and backwards and arching over legs; teeth on anterior part small and irregular, but becoming larger posteriorly, there furnished with secondary denticles. Posterolateral margins transverse; posterior margin not produced over abdominal segments. Chelipeds long, triangular in cross-section; sides of merus convex, edge sharply granulate to toothed; carpus with 3-4 granulate lines; hand about as long as merus, angles prominent and dentate and sides convex; dactyl short but longer than fixed finger, when closed, outer margin at right angle to long axis of palm. Chelipeds folding against long triangular concave area of body, this area fringed by setae. Ambulatory legs compressed, strongly ridged above; dactyls narrow, curved. Male carapace length 21.0 mm, width 34.0; female carapace length 17.3 mm, width 26.8.

Color in life.--Grayish or brownish, sometimes with minute spots of white and purple; camouflaged like sand. Lower surface light yellow.

Habitat and depth.--Sand, sand mixed with shell, rock, or mud; intertidal to 175 m, but usually at less than 100 m.

Range.--Drake's Bay, Marin County, California to Dewey Channel, Baja California; also Gorda Bank, Gulf of California and Boca de Piedras, Sinaloa, Mexico. Type locality Monterey, California.





*Heterocrypta occidentalis*



*Heterocrypta occidentalis*

## Family Cancridae

The rock crabs, among the largest species of crabs in California or Oregon, have broad, oval carapaces and strong chelae. The front has several teeth, including a median tooth. The antennules fold back longitudinally. The antennal flagella are short and bear setae, especially in small animals. The third maxillipeds overlap the endostome. In many species, the ventrolateral parts of the body bear dense setae.

Nations (1975) considered all of the local species of the Cancridae to belong to a single genus, Cancer, but divided them into four subgenera: Glebocarcinus, Romaleon, Metacarcinus and Cancer in the strict sense. Recent fossil and molecular evidence supports the elevation of these former subgenera into genera in their own right. See Harrison and Crespi, 1999 and Schweitzer and Feldmann, 2000 ( <http://dpc.uba.nl/ctz/vol69/nr04/art02> ) for extensive discussions of the phylogeny, distribution and classification by both molecular and morphological means for these crabs.

Species of the Cancridae inhabit both rocky and sandy bottoms, or areas of rocks lying among sand. Metacarcinus magister and M. gracilis, which usually live on open sand, have especially flattened appendages with long dactyls. Other species tend to have more rounded appendages with shorter dactyls, which often bear stiff setae or spines. Juveniles and megalops larvae of Romaleon jordani cling to the medusae of large jellyfishes.

Many species of the Cancridae are large and edible, so it is not surprising that they were among the first crabs to receive a scientific name. The generic name "Cancer" indeed means "crab"; the dreaded disease is named from a fanciful resemblance of the spreading malignant cells to the engulfing pincers of a crab. The most comprehensive recent work on the Cancridae is that of Nations (1975), from which the following key is largely derived. Larger common species can be identified with the popular guide by Phillips (1973), bearing in mind that the generic names have been changed.

### Key to the Species of the Family Cancridae

1. Carapace rounded, with sharply differentiated, elevated regions set with coarse and rounded granules. (Small adult size)----- 2  
Carapace more or less oval in shape, regions not as sharply elevated, not set with coarse and rounded granules. (Adults small to large)-----3
2. Carapace widest at seventh or eighth tooth, with 12-13 anterolateral teeth. (Rarely found south of Point Arena, California)-----Glebocarcinus oregonensis (Rathbun)  
Carapace widest at ninth tooth, with 9 anterolateral teeth. (In eastern Pacific, from El Segundo, California to Magdalena Bay, Mexico)-----Glebocarcinus amphioetus (Rathbun)
3. Carapace widest at tenth anterolateral tooth; no eleventh tooth. Fingers of chelipeds with pale color. (Ambulatory legs flattened)-----Metacarcinus magister (Dana)

Carapace widest at ninth anterolateral tooth; with tenth and sometimes eleventh tooth. Fingers of chelipeds pale or dark. (Ambulatory legs usually not flattened)-----4

4. Anterolateral teeth low, not spiny-pointed. Fingers of chelae without dark color. Merus of third maxillipeds rounded anteriorly-----Metacarcinus gracilis (Dana)

Anterolateral teeth projecting more than 0.3X length of base, often spiny-pointed. Fingers of chelae with dark color. Merus of third maxillipeds truncated anteriorly-----5

5. Front not produced, anterolateral teeth not separated to bases. Chela with orange blotch on inner surface of palm-----Metacarcinus anthonyi (Rathbun)

Front strongly to moderately produced, anterolateral teeth separated to bases. Chela without orange blotch on inner surface of palm-----6

6. Front markedly produced, projecting beyond outer orbital angles, with 5 subequal teeth. (Palm of chela roughened above)-----Cancer productus Randall

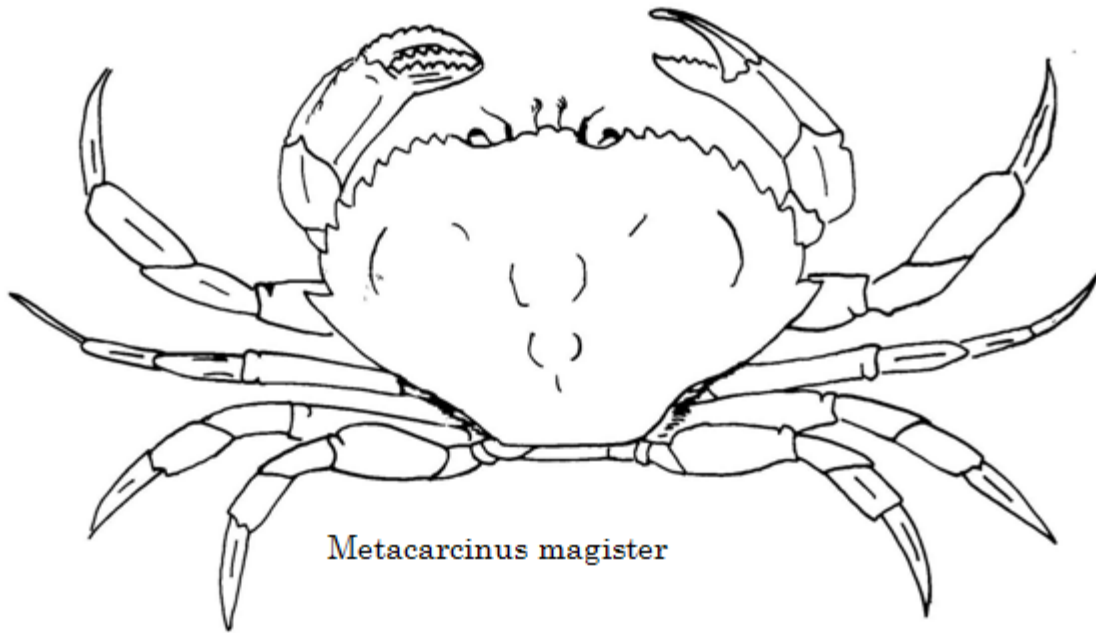
Front not markedly produced, not projecting beyond outer orbital angles, with 5 unequal teeth. (Palm of chela smooth or roughened above)-----7

7. Carpus of cheliped with single spine above distal end; hand without spines. Lower surface of body spotted or blotched with red-----Romaleon antennarius (Stimpson)

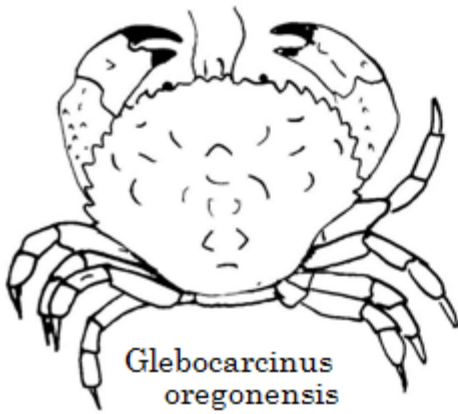
Carpus of cheliped with 2 spines above distal end; hand with 2 or more spines (which may be inconspicuous). Lower surface of body not spotted or blotched with red-----8

8. Carapace with prominent raised areas, tenth anterolateral tooth conspicuous. Dactyl of cheliped with spines-----Romaleon branneri (Rathbun)

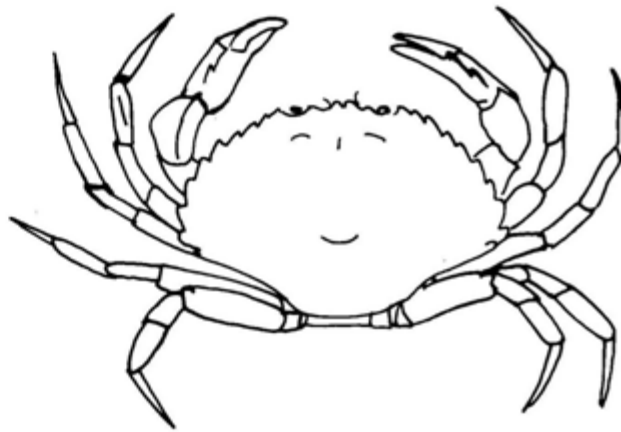
Carapace with slightly raised areas, tenth anterolateral tooth inconspicuous. Dactyl of cheliped without spines-----Romaleon jordani (Rathbun)



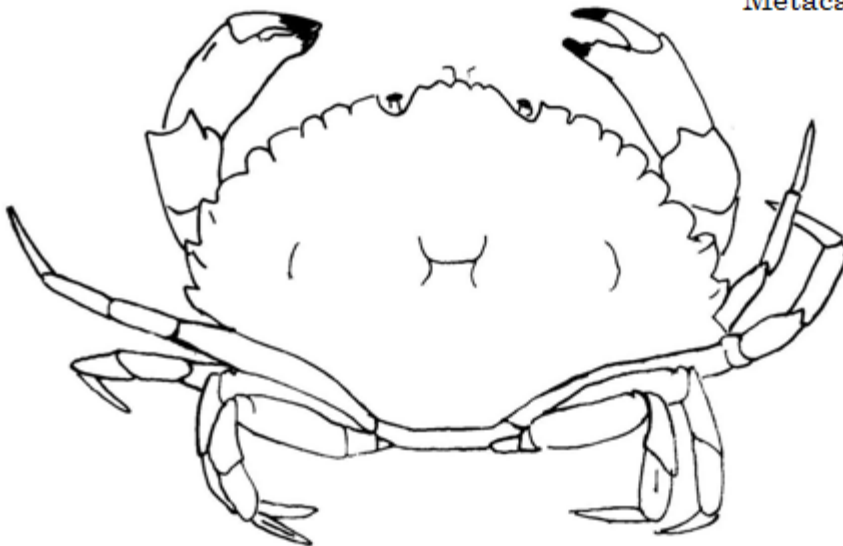
*Metacarcinus magister*



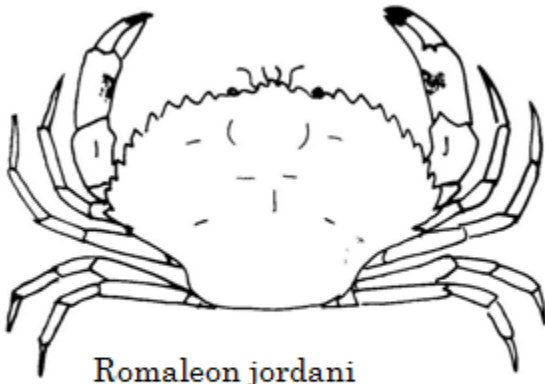
*Glebocarcinus oregonensis*



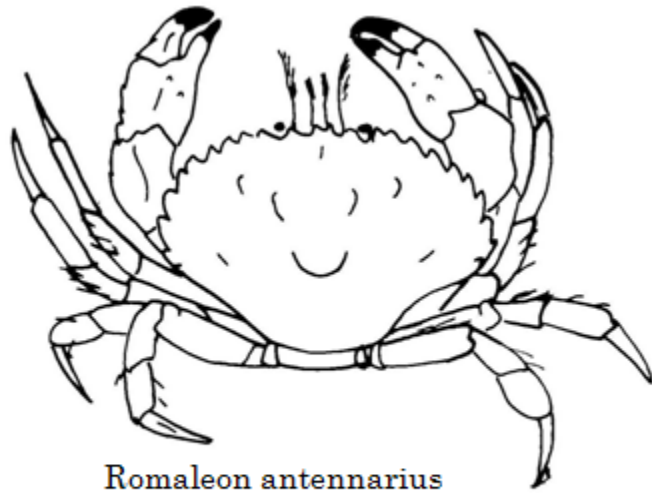
*Metacarcinus gracilis*



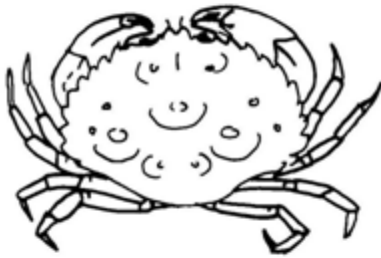
*Cancer productus*



*Romaleon jordani*



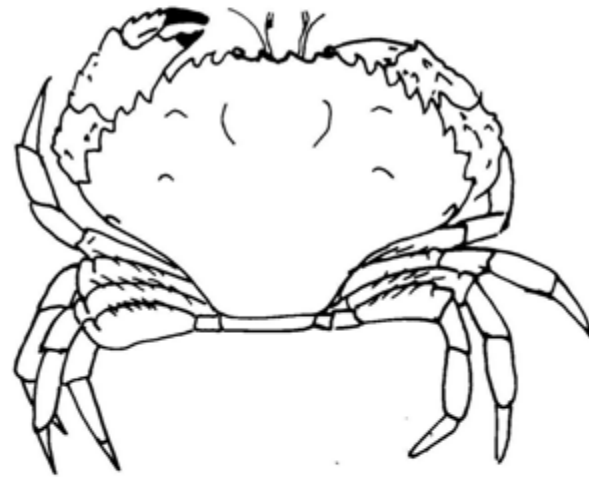
*Romaleon antennarius*



*Romaleon branneri*



*Glebocarcinus amphioetus*



*Metacarcinus anthonyi*

Genus Glebocarcinus Nations

Glebocarcinus oregonensis (Dana)

Trichocera oregonensis Dana, 1852: 86.

Cancer oregonensis --Rathbun 1904: 178, pl. 7, fig. 1.--Schmitt 1921: 234, pl. 36, figs. 3-4.--Rathbun 1930: 226, pl. 96.--Carlton and Kuris 1975: 396.--Nations 1975: 38, figs. 17E, 17F, 18E, 18F, 30-1, 30-2.—Wicksten 1979d: 1181.--Garth and Abbott 1980: 607, fig. 25.21.--Ricketts et al. 1985: 305, fig. 237.

Glebocarcinus oregonensis. --Schweitzer and Feldmann 2000:  
<http://dpc.uba.uva.nl/ctz/vol69/nr04/art02> .

Recognition characters.--Carapace rounded, anterolateral and posterolateral margins not meeting at distinct angle; widest at seventh or eighth tooth; 12-13 anterolateral teeth. Ornamentation of dorsal surface of carapace variable; from moderately raised areas to pronounced tuberculate patches. Merus of third maxilliped with antero-external angle produced. Carpus of chelipeds with spine at antero-internal angle with tooth below it; hand thick and high, upper edge of palm with 2 rows small tubercles; outer surface with 5 granulated lines. Carapace length to 36.5 mm.

Color in life.--Usually dark red-brown above, lighter below; walking legs may have bands of light color. Some individuals may have red spots or bands of orange or yellow on carapace, others may have gray carapace. Chelipeds with dark tips.

Habitat.--Intertidal to 435 m, among rocks, tidepools, in barnacle shells, among mussels on pilings.

Range.--St. George Island, Pribilofs to off Palos Verdes Peninsula, California, but rarely found south of Point Arena, Mendocino County, California. Type locality "Puget Sound".

Glebocarcinus amphioetus (Rathbun)

Cancer amphioetus Rathbun, 1898: 582.--Rathbun 1904: 175, pl. 6, fig. 3.--Schmitt 1921: 223, pl. 36, figs. 1, 2.--Rathbun 1930: 205, pl. 91.--Nations 1975: 30, figs. 15A, 15B, 16A, 16B, 30-7-, 30-8.- --Garth and Abbott 1980: 604.

Glebocarcinus amphioetus. --Schweitzer and Feldmann 2000:  
<http://dpc.uba.uva.nl/ctz/vol69/nr04/art02> .

Recognition characters.--Carapace smooth and strongly areolated (with prominent raised areas), front with 5 median teeth, median tooth small; anterolateral margins with 9 flat, broadly triangular teeth, tiny tenth tooth. Third maxilliped with merus truncated anteriorly. Body not setose. Carpus of cheliped with 2 spines, one at distal end and second below it on inner angle; hand of cheliped with 1-2 spines on upper margin and 3 longitudinal ridges on outer surface. Ambulatory legs stout. Male carapace length 22.2 mm, female 27.5.

Color in life.--Reddish brown, lighter beneath; fingers of chelae dark, with color reaching more than 0.5x length of outer margin.

Habitat.--Intertidal to 148 m, usually subtidal; on rocks, sand, shells and mud.

Range.--El Segundo, California to Magdalena Bay, Baja California; Gulf of California, Japan, Korea and northern China. Type locality "off the Korean coast".

Genus Cancer Linnaeus

Cancer productus Randall

Cancer productus Randall, 1839: 116.--Rathbun 1904: 175.--Schmitt 1921: 220, text-fig. 136.--Rathbun 1903: 203, text-fig. 32.--Carlton and Kuris 1975: 396, pl. 97, fig. 57.--Nations 1975: 40, figs. 13A, 13B, 14A, 14B, 39-1, 39-2.--Garth and Abbott 1980: 607, fig. 25.22.--Ricketts et al. 1985: 134, fig. 105.

Recognition characters.--Front markedly produced beyond outer orbital angles, with 5 subequal teeth, fronto-orbital width about 0.2X width of carapace. Carapace very broad, widest at ninth anterolateral tooth, tenth tooth present. Surface of carapace somewhat convex and smooth to minutely granulate. Carpus of chelipeds with large tooth at antero-internal angle and smaller one at upper hinge joint, palm with ridge along dorsal surface and granulate ridges on palm. Carapace length of female 66.4 mm.

Color in life.--Juveniles highly variable: carapace red, orange, striped with white and red, mottled, gray or gray with median stripe of red; legs striped or red. (See color photographs given by Garth and Abbott, 1980). Adult dark red above, white to yellowish below. Chelae with dark tips.

Habitat.--Tidepools, rocks in sand, rocky reefs, breakwaters; intertidal to 79 m.

Range.--Kodiak Island, Alaska to San Diego, California. Older reports from Magdalena Bay, Baja California are unconfirmed. Type locality "western America".

Remarks.--The red rock crab can have a carapace width of up to 173.5 mm. The exoskeleton is well calcified. The crab is one of the largest intertidal crabs in California and Oregon, as well as one of the heaviest. It is edible but not sufficiently common to support a commercial fishery.



Cancer productus



juvenile Cancer productus

Genus Metacarcinus Milne-Edwards

Metacarcinus magister (Dana)

Cancer magister Dana, 1852: 73.--Rathbun 1904: 177.--Schmitt 1921: 229, text-fig. 138.--Rathbun 1930: 222, text-figs. 35, 36.--Carlton and Kuris 1975: 396, fig. 2.--Nations 1975: 37, figs. 17A, 17B, 18A, 18B, 23, 34-1, 34-2.--Garth and Abbott 1980: 605, Fig. 25.20.--Ricketts et al. 1985: 199, fig. 170.

Metacarcinus magister.--Schweitzer and Feldmann 2000:  
<http://dpc.uba.uva.nl/ctz/vol69/nr04/art02> .

Recognition characters.--Front of carapace not produced, with 3 small median teeth. Carapace widest at tenth anterolateral tooth, no eleventh tooth; anterolateral teeth serrate anteriorly. Carapace wide, granulate. Carpus of chelipeds with single distal spine, palm with dorsal serrate ridge having conspicuous teeth and ridges on sides; movable finger with dorsal teeth and lateral ridges. Merus of third maxilliped widened distally, its anterior margin forming obtuse angle with outer margin. Ambulatory legs broad and flat. Carapace length 120.7 mm.

Color in life.--Carapace reddish brown to gray, lower surface and appendages creamy white to yellowish. Fingers of chelipeds light-colored.

Habitat.--Bays, harbors, sandy beaches, eelgrass flats, sandy areas of continental shelf, low



intertidal to 230 m.

Range.--Tanaga Island, Aleutians to Pismo Beach, California. Old records from Santa Barbara, California and Magdalena Bay, Baja California are unconfirmed. Type locality San Francisco Bay.

Remarks.--The Dungeness crab is the most important commercial crab of the Pacific coast of the United States. Adult crabs usually are trapped off shore, but juveniles often can be found in bays and harbors at low tide. Very small juveniles and megalops larvae sometimes ride on jellyfishes and the by-the-wind sailor Velella.



Metacarcinus magister

Metacarcinus gracilis (Dana)

Cancer gracilis Dana, 1852: 73.--Rathbun 1904: 177.--Schmitt 1921: 232, pl. 35, fig. 2.--Rathbun 1903: 219, pl. 95, text-fig. 34.--Carlton and Kuris 1975: 396.--Nations 1975: 34, figs. 17C, 17D, 18C, 18D, 36-1, 36-2.--Garth and Abbott 1980: 604, fig. 25.18.--Ricketts et al. 1985: 543.

Metacarcinus gracilis. --Schweitzer and Feldmann 2000:  
<http://dpc.uba.uva.nl/ctz/vol69/nr04/art02> .

Recognition characters.--Carapace strongly convex, front not produced, with 3 median teeth. Anterolateral teeth of carapace low and not pointed, carapace granulated and widest at ninth tooth; small tenth anterolateral tooth present. Merus of third maxillipeds elongated, rounded anteriorly. Carpus of chelipeds with 2 spines, one above at distal angle and second below it. Palm with rows of minute spinules, movable finger roughened dorsally but without large teeth. Ambulatory legs slender, dactyls elongated. Carapace length 27.3 mm.

Color in life.--Carapace brownish to gray, lower surface and much of legs yellowish, purple

marks on anterior ambulatory legs. Tips of chelipeds white.

Habitat.--Mud flats, sandy beaches, eel grass beds, sandy coasts; intertidal to 174 m.

Range.--Prince William Sound, Alaska to Playa Maria Bay, Baja California, Mexico. Type locality San Francisco, California.

Remarks.--Megalops larvae and juveniles of this crab have been found on large jellyfishes.



Metacarcinus gracilis

Metacarcinus anthonyi (Rathbun)

Cancer anthonyi Rathbun, 1897: 111.--Rathbun 1904: 176, pl. 6, fig. 2.--Schmitt 1921: 227, pl. 35, fig. 1.--Rathbun 1930: 218, pl. 94, fig. 3.--Carlton and Kuris 1975: 396.--Nations 1975: 32, figs. 13E, 13F, 14E, 14F, 35-5, 35-6.--Garth and Abbott 1980: 604, fig. 25.17.

Metacarcinus anthonyi. --Schweitzer and Feldmann 2000:

<http://dpc.uba.uva.nl/ctz/vol69/nr04/art02> .

Recognition characters.--Front narrow, not produced, with 3 teeth. Carapace granulate, convex, widest at ninth anterolateral tooth; anterolateral teeth broad, last 3 teeth with sharp tips; tenth anterolateral tooth indistinct. Merus of third maxillipeds oblong, anterior margins slightly oblique. Carpus of chelipeds with single distal spine; hand smooth or granulated, without spines. Ambulatory legs sparsely setose to smooth. Male carapace length 52.1 mm.

Color in life.--Brownish-red to yellowish-orange, lighter beneath and without spots; a blotch of orange on inner surface of palm of chela; fingers of chela black. Juveniles may have a mottled carapace with markings of white, brown and tan.

Habitat.--Among rocks in bays and estuaries, intertidal to 132 m.

Range.--Humboldt Bay, California to Magdalena Bay, Baja California, but uncommon north of Los Angeles County, California. Type locality Long Beach, California.

Remarks.--The yellow crab is another large, heavily calcified intertidal crab. It seems to prefer slightly warmer waters than C. productus and Romaleon antennarius, the other similar large

crabs that live in rocky habitats. Records north of San Pedro usually come from bays and harbors rather than the open coast.



Metacarcinus anthonyi

Genus Romaleon Gistel

Romaleon antennarius (Stimpson)

Cancer antennarius Stimpson, 1856: 96.--Rathbun 1904: 176.--Schmitt 1921: 224, pl. 35, fig. 3; pl. 36, fig. 8; text-fig. 137.--Rathbun 1930: 210, pl. 92, pl. 93, fig. 2; text-fig. 33.--Carlton and Kuris 1975: 396, pl. 97, fig. 61.--Nations 1975: 31, figs. 13C, 13D, 14C, 14D, 32-5, 32-6.--Garth and Abbott 1980: 602, fig. 25.16.--Ricketts et al. 1985: 133, fig. 104.—Breen and Wicksten 1990: 10.

Romaleon antennarius. --Schweitzer and Feldmann 2000:  
<http://dpc.uba.uva.nl/ctz/vol69/nr04/art02> .

Recognition characters.--Carapace smooth, with front not produced and with 3 median teeth. Carapace widest at eighth anterolateral tooth, 11 anterolateral teeth present. Merus of third maxillipeds with distal margin nearly transverse, angles rounded. Chelipeds may be slightly unequal in size. Carpus of chelipeds with single spine above, carpus and palm bearing faint ridges, movable finger smooth. Ambulatory legs sturdy, usually setose. Juveniles may be more setose than adults. Male carapace length 61.7 mm, female to 54.1 mm.

Color in life.--Dark reddish above, yellowish with red spots below. Fingers of chelae dark.

Habitat.--Under rocks set in sand, tidepools, among sea grasses, breakwaters and rocky reefs, intertidal to 40 m.

Range.--Coos Bay, Oregon to Todos Santos Islands, Baja California. Reports from British Columbia are unconfirmed. Type locality San Francisco Bay.

Remarks.--The rock crab is one of the most common larger crabs in California and Oregon. It is taken by sport fishermen as well as predatory fishes, octopuses and sea otters.



Romaleon antennarius

Romaleon branneri (Rathbun)

Cancer branneri Rathbun, 1926: 63.--Rathbun 1930 211, pl. 93, fig. 1.--Nations 1975: 33, figs. 15E, 15F, 16E, 16F, 31-1, 31-2.--Garth and Abbott 1980: 605.

Cancer gibbosulus.--Schmitt 1921, pl. 36, fig. 7.--Carlton and Kuris 1975: 406. Not Cancer gibbosulus (De Hann, 1835) = Asiatic species. See Rathbun, 1930, for full synonymy.

Romaleon branneri. --Schweitzer and Feldmann 2000: <http://dpc.uba.uva.nl/ctz/vol69/nr04/art02> .

Recognition characters.--Carapace markedly areolated, sparsely setose with coarse setae. Front with 5 acute teeth, anterolateral margin with 9 forward-curving teeth, all but first 2 teeth tipped with spines; tenth and eleventh teeth present. Merus of third maxillipeds abruptly truncated. Chelipeds hairy, carpus with 2 spines, one above at distal end and second below it at inner angle; upper surface of hand with 2 rows of 3-5 spines; outer surface of hand with 5 ridges marked with setae and small spines; upper margin of movable finger spinose. Ambulatory legs setose; dactyls somewhat long and straight, tipped with spines. Male carapace length to 35.5 mm.

Color in life.--Variable: whitish with irregular reddish blotches, ambulatory legs light banded with red to dark reddish brown. Fingers of chelae dark.

Habitat.--Intertidal to 80 m, on sandy mud, coarse sand or shells.

Range.--Port Althorp, Alaska to Cedros Island, Baja California, Mexico. Type locality San Francisco, California.

Remarks.--This small crab has been collected in abundance at Redondo Beach, California and may be common elsewhere.

Romaleon jordani (Rathbun)

Cancer jordani Rathbun, 1900: 133.--Rathbun 1904: 176, pl. 6, fig. 4.--Schmitt 1921: 228, pl. 36, figs. 5-6.--Rathbun 1903: 215, pl. 94, figs. 1-2.--Carlton and Kuris 1975: 396.--Nations 1975: 36, fig. 15C, 15D, 16C, 16D, 31-3, 31-4.--Garth and Abbott 1980: 605, fig. 25.19.

Romaleon jordani. --Schweitzer and Feldmann 2000: <http://dpc.uba.uva.nl/ctz/vol69/nr04/art02> .

Recognition characters.--Carapace slightly areolated, setose. Front with 5 teeth, almost hidden by setae, median tooth very small; anterolateral carapace margin with 9 prominent teeth, often alternating in size; tenth tooth present in older specimens. Merus of third maxilliped obliquely truncated. Carpus of cheliped with 2 spines, palm of cheliped with 2 superior and 5 external ridges, fringed with setae, several spines on upper ridges, movable finger without spines. Male carapace length 25.4 mm, female 15.5.

Color in life.--Mottled with light brown and tan, lower surface yellowish, setae brownish to golden, fingers of chelae dark.

Habitat.--Lowest intertidal zone to 104 m; on sand or among kelp holdfasts. Juveniles often associate with large medusae.

Range.--Coos Bay, Oregon to Cape Thurloe, Baja California. Type locality Monterey Bay, California.

## Family Portunidae

The swimming crabs are most abundant in warm temperate to tropical seas. Three species may be found in southern California, but only one of these is common. The Atlantic green crab Carcinus maenas has been introduced into bays.

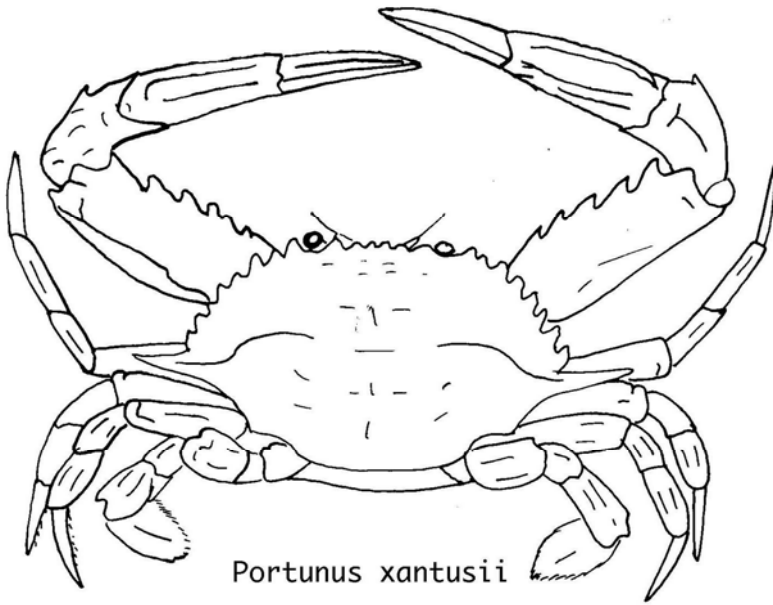
Swimming crabs usually have a carapace that is wider than long. There is no rostrum. The carapace bears lateral teeth, the posterior of which may be considerably larger than the anterior teeth. The orbit is complete. The first antennae fold obliquely or transversely. The chelae are toothed; the cheliped bears spines.

As the common name suggests, most swimming crabs can swim strongly by means of paddle-like dactyls of the fifth pereopods. Common nearshore species can dig rapidly into sand.

Except for Carcinus maenas, species of the Portunidae of the eastern Pacific have been discussed in detail in the work by Garth and Stephenson (1966). The descriptions and key given here are in large part derived from the 1966 work, which the reader should consult for further information on anatomy, ranges and classification.

### Key to the Species of the Family Portunidae

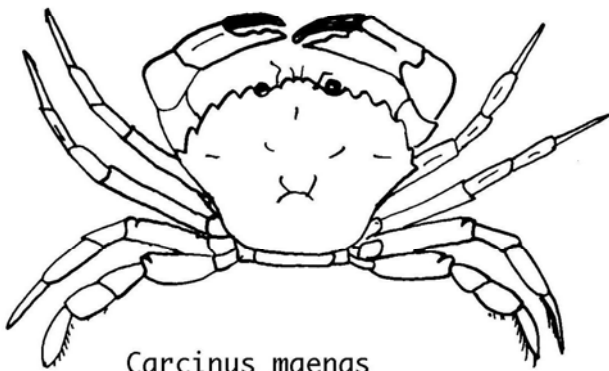
1. Eyestalks extremely long, one third or more of carapace breadth-----Euphylax dovii Stimpson  
Eyestalks not as long, much less than one third of carapace breadth-----2
2. Carapace narrow, 5 anterolateral teeth; fifth legs without flattened swimming paddles-----  
-----Carcinus maenas (Linnaeus)  
Carapace broad, 9 anterolateral teeth, fifth legs with flattened swimming paddles-----3
3. Male abdomen triangular; anteroexternal angle of merus of third maxilliped not strongly produced laterally-----Portunus xantusii xantusii (Stimpson)  
Male abdomen shaped like inverted T; anterolateral angle of merus of third maxilliped strongly produced laterally-----Callinectes arcuatus Ordway



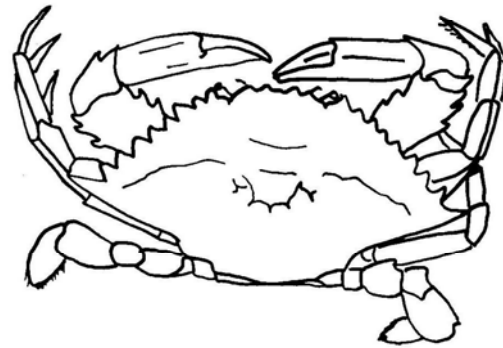
*Portunus xantusii*



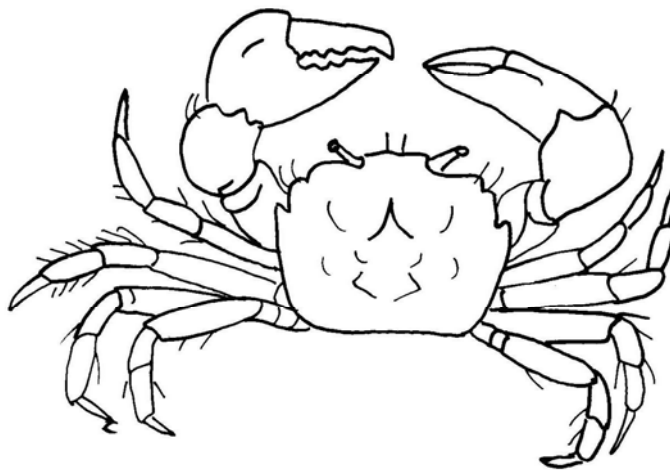
*Euphylax dovi*



*Carcinus maenas*



*Callinectes arcuatus*



*Malacoplax californiensis*

## Genus Euphylax Stimpson

### Euphylax dovii Stimpson

Euphylax dovii Stimpson, 1860: 226, pl. 5, figs. 5, 5a.--Rathbun 1930: 147, pl. 65.--Garth and Stephenson 1966: 64, pl. VI, figs. A,B; pl. VIII, fig. F, pl.X, figs. F, G; pl. XII, fig. G, text-figs. 3a.--Word. 1976: 161, fig. 1.--Chivers 1979: 276.

Recognition characters.--Carapace relatively long, roughly ovoid; widest near middle, cardiac and branchial regions swollen. Front narrow, T-shaped, with median notch. Orbital region broad, length of eyestalk over 0.66X carapace breadth. Four-five anterolateral teeth or lobes; first most stout, last most protruding. Third maxilliped with anteroexternal angle laterally produced. Chelipeds long, hands compressed. Fingers with well spaced large teeth, movable finger with dorsal carina. Walking legs elongate; merus of fifth leg with subterminal spine on posterior margin; dactyls broad and flat, fifth leg with swimming paddle. Male carapace length to 52.8 mm, female to 25.9.

Color in life.--Carapace and merus of all legs deep purple, rest of appendages wine red; undersides blue, sternum white, abdomen brownish.

Habitat and depth.--Intertidal to 65 m but often taken well offshore; capable of swimming long distances.

Range.--Monterey Bay, California to Gulf of Guayaquil, Peru. Type locality "western coast of Central America". The species rarely occurs in California.

## Genus Carcinus Leach

### Carcinus maenas (Linnaeus)

Cancer maenas Linnaeus, 1758: 627.

Carcinides maenas.--Rathbun 1930: 15, fig. 4.

Carcinus maenas.--Williams 1984: 356, fig. 289.-- Ricketts et al. 1985: 296, fig. 231.

Recognition characters.--Carapace about 0.75X long as broad. Front with 3 broad teeth, anterolateral margin with 5 strong teeth. Third maxilliped with anteroexternal angle not produced. Chelipeds slightly unequal, nearly smooth except for 2 ridges on upper surface of hand; merus short, carpus with broad internal tooth or angle. Walking legs smooth and unarmed, dactyl of fifth leg lance-shaped, not forming swimming paddle. Male and female carapace length to 60 mm.

Color in life.--Variable. Carapace dark green, bluish to reddish, sometimes China white; legs varying to yellowish white to tile white or violet; juveniles often more colorful and polymorphic in pigmentation than adults.

Habitat.--Intertidal to 200m, but usually shallow; bays, tidepools; among rocks, oysters, gravel or shells. Tolerant of low salinities.

Range.--Northumberland Strait to Virginia in North America; Kvaenangen, Norway, Baltic Sea and North Sea to Mauritania. Introduced into San Francisco Bay, California and Willapa Bay, Washington; also Australia, Burma, Red Sea, Madagascar, India and Ceylon. Type locality Marstrand north of Goteborg, west coast of Sweden.

Remarks.--Hardy and a prolific breeder, the green crab easily can be spread by human activity.



It is a predator on clams and oysters, and thus is considered a pest by fishermen.

Genus Portunus Weber

Portunus xantusii xantusii Stimpson

Achelous xantusii Stimpson, 1860: 222.

Portunus xantusii.--Holmes 1900: 71.--Schmitt 1921: 237, text-fig. 141.--Ricketts et al. 1985: 322, fig. 248.

Portunus xantusii xantusii.--Garth and Stephenson 1966: 32, pl. IV, fig. A; pl. VII, fig. B; pl. IX, fig. B, pl. XI, fig. B.--Garth and Abbott 1980: 602, fig. 25.14.

Recognition characters.--Carapace broad, pilose, posterolateral corner rounded. Front advanced, with 4 lobes. Orbital region with inner supraorbital angle partially subdivided; supraorbital fissures open to closed. Supraorbital tooth acute to blunt, suborbital fissure open. First anterolateral tooth blunt, fifth tooth stouter than fourth or sixth; ninth tooth very long. Third maxilliped with anteroexternal angle of merus not produced laterally. Chelipeds moderately long, robust; with 4-6 spines on anterior border. Wrist with inner and outer spines moderately well developed, fingers short and stout. Fifth leg with posterodistal border of merus with spinules. Male carapace length to 70.7 mm, female to 55.9.

Color in life.--Speckled with gray, black and white; tips of legs pinkish, walking legs with white and brown bands; camouflaged like sand.

Habitat.--Usually on sand, intertidal to 181 m, but usually shallow; capable of swimming to surface.

Range.--South of Santa Cruz Island and SE of Santa Barbara Point, California to Marquis Point, Baja California; and from San Ignacio Bay to near Punta Piaxtla, Sinaloa, Mexico. Type locality Cape San Lucas. Other subspecies range into the Gulf of California and south to Colombia.



Portunus xantusii xantusii



mating Portunus xantusii xantusii

Genus Callinectes Stimpson

Callinectes arcuatus Ordway

Callinectes arcuatus Ordway, 1863: 578.--Rathbun 1930: 121, pl. 52, text-figs. 15h, 16h, 17f, 18g.-  
-Garth and Stephenson 1966: 43, pl. V, fig. A; pl. VIII, fig. A; pl. X, fig. A; pl. XII, fig. D.--Garth  
and Abbott 1980: 603, fig. 25.15.

Recognition characters.--Carapace with surface moderately finely granulate, regions well marked. Front with 4 triangular teeth, orbital region with inner supraorbital lobes square-cut, inner supraorbital fissure closed, suborbital tooth prominent. Anterolateral teeth stout, first 4 blunt; fifth to seventh sharp, eighth tooth very sharp, ninth moderately long. Chelipeds with carinae of hand granular. Fifth leg with swimming paddle. Male carapace length to 51.3 mm, female to 43.3.

Color in life.--Carapace olive gray-green, chelipeds olive green dorsally, whitish ventrally, tips yellow-brown; legs turquoise with olive stain, setae golden; fifth legs olive green with turquoise tints, paddles with black stain. Juveniles may be more variable in color and camouflaged like sand or shell.

Habitat.--Bays and estuaries, sand, mud or shell bottoms, shore to 28 m.

Range.--Los Angeles Harbor, California to off Puerto Pizarro, Peru. Type locality Cape San Lucas.

Remarks.--In California, scattered populations have been reported at Anaheim Slough and in San Diego County. This large and edible crab probably has suffered from loss of habitat in southern California.

## Family Xanthidae

The family Xanthidae, primarily tropical and subtropical in distribution, contains the greatest diversity of genera and species of any brachyuran group. Williams (1984) summarized some of the major controversies regarding classification of these crabs. Guinot (1971, 1978) divided the family into new families and subfamilies; however, characters used to define genera in these families at times overlap with those of crabs considered to belong to separate families. There has been no recent comprehensive systematic work on the xanthid crabs of the eastern Pacific. In this work, members of the family Goneplacidae are treated as a separate family. The key presented here is artificial. The key to the species of Lophopanopeus is modified from that of Menzies (1948). Subspecies are treated in the sections on the species.

Xanthids commonly are called mud crabs, an appropriate name for the species that inhabit bays along the Atlantic coast and Gulf of Mexico in the U.S.A. However, the native species of the Pacific coast live among rocks, reefs and shells.

Like species of the family Cancridae, xanthids can be common in intertidal areas, especially in southern California. Among xanthids, the antennules fold obliquely or transversely, not lengthwise. The flagellum of the antenna is smooth, not hairy. The anterolateral teeth of the carapace often are fewer in number or are more blunt than those of cancrids. The chelipeds may differ greatly in size; the fingers may bear a large crushing tooth. Only one xanthid crab grows to the size of an edible cancrid. Xanthids rarely inhabit sandy shores or sandy areas of the continental shelf, and do not have flattened appendages, as in some common cancrids.

Heteractaea lunata (Milne-Edwards and Lucas, 1847) was reported by Schmitt (1921) as occurring in San Diego, California. However, Garth (1957) noted that this is primarily a species of the tropical eastern Pacific, and is associated with corals of the genus Pocillopora. These corals do not live in California. It seems likely that the record from San Diego is an error or due to a crab thrown overboard from a fishing boat.

### Key to the Species of the Family Xanthidae

1. Carapace and chelipeds with prominent rounded tubercles-----Paraxanthias taylori (Stimpson)  
Carapace and chelipeds without prominent rounded tubercles-----2
2. Fronto-orbital border less than half of greatest width of carapace. Anterolateral margin of carapace with 8-10 teeth-----Cycloxanthops novemdentatus (Lockington)  
Fronto-orbital border half or more of greatest width of carapace. Anterolateral margin of carapace with 3-5 teeth-----3
3. Carapace transversely oval; front divided by open, rounded notch. (San Diego to Cape San Lucas) ----- Micropanope latimana Stimpson  
Carapace hexagonal to subquadrate; front divided by slight notch to more or less closed fissure. (Alaska-Baja California)-----4

4. Fingers of chelae with white tips or white throughout their length. Carpal joints of walking legs not bilobed-----5

Fingers of chelae with black or brown tips. Carpal joints of walking legs slightly to strongly bilobed-----6

5. Dactyl of major chela strongly curved. Fingers of chelae light-colored throughout their length. (Introduced into bays)-----Rhithropanopeus harrisi (Gould)

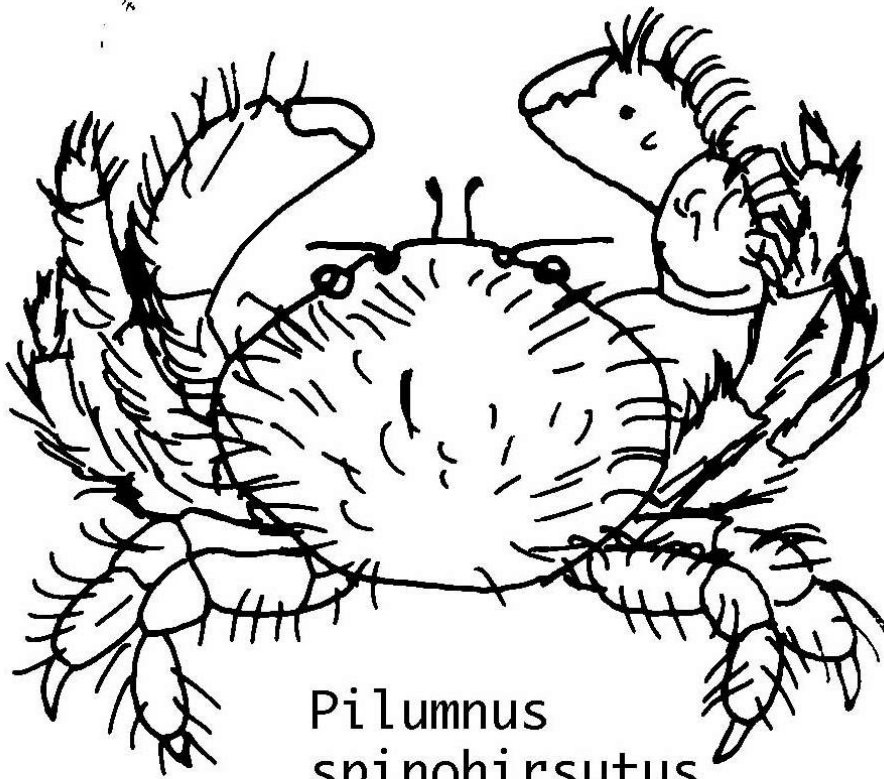
Dactyl of major chela angled downward. Fingers of chelae with proximal dark blotches. (Subtidal off Anacapa island, California)-----Eurypanopeus hyperconvexus Garth

6. No enlarged tooth present at proximal end of cutting edge of dactyl of major cheliped-----Lophopaneopus frontalis (Rathbun)

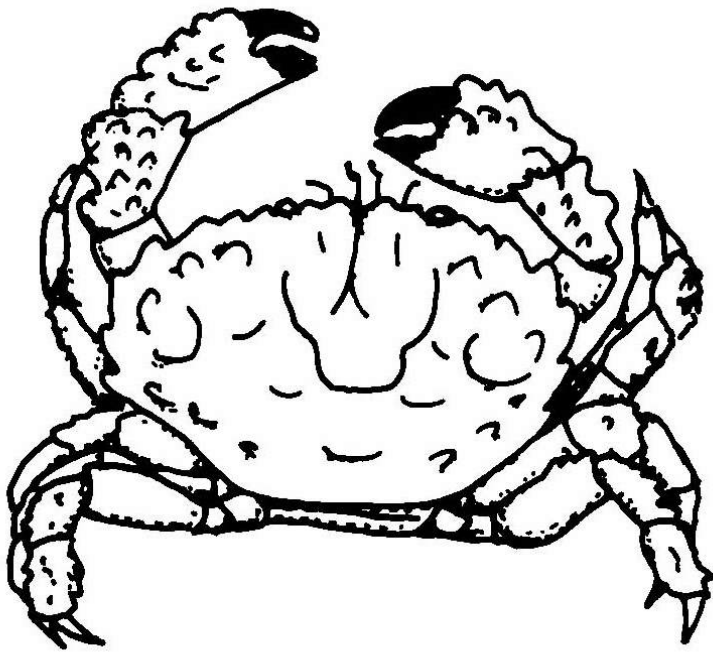
Enlarged tooth present at proximal end of cutting edge of dactyl of major cheliped-----7

7. Ambulatory legs with carpal and meral segments not pubescent. Carapace smooth. Carpus of chelipeds smooth or pitted, never covered with bumps---Lophopaneopus leucomanus (Lockington)

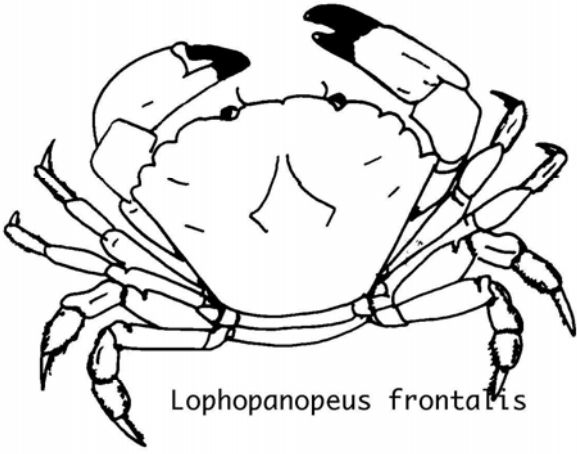
Ambulatory legs with carpal; and meral segments pubescent. Carapace pubescent. Carpus of chelipeds smooth or covered with irregular raised bumps-----Lophopaneopus bellus (Stimpson)



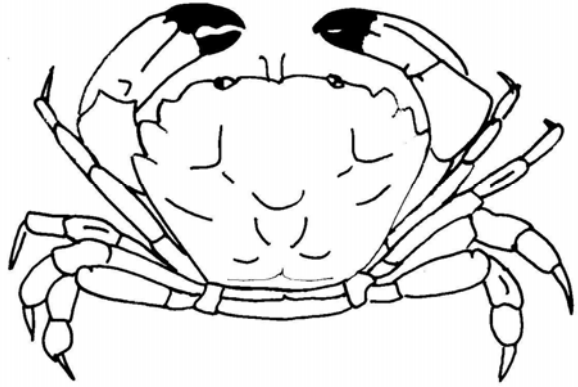
*Pilumnus  
spinohirsutus*



*Paraxanthias taylori*



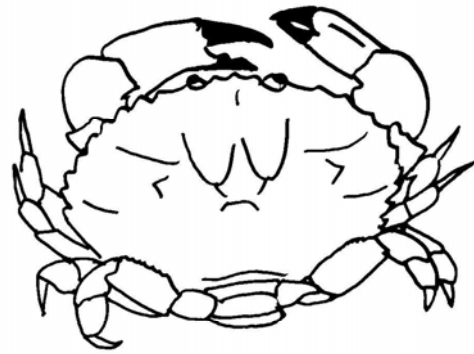
Lophopanopeus frontalis



Lophopanopeus leucomanus



Lophopanopeus bellus



Cycloxanthops novemdentatus



Rithropanopeus harrisi

Genus Paraxanthias Odhner

Paraxanthias taylori (Stimpson)

Xanthodes taylori Stimpson, 1860: 208, pl. 3, fig. 3.

Xanthias taylori.--Holmes 1900: 65.--Rathbun 1904: 185.--Schmitt 1921: 246, fig. 147.

Paraxanthias taylori.--Rathbun 1930: 466, pl. 188, pl. 189, fig. 1.--Carlton and Kuris 1975: 398, pl. 97, fig. 55.--Garth and Abbott 1980: 611, fig. 25.28.--Ricketts et al. 1985: 172, fig. 142.

Recognition characters.--Carapace nearly flat posteriorly, front divided by wide, rounded notch, with 4-5 anterolateral teeth, anterior half of carapace bearing bumps or tubercles. Chelipeds often unequal, carpus covered with rounded tubercles, hand with tubercles in 7-8 longitudinal rows; fingers stout and black; gaping in major chela. Walking legs covered with bristles. Carapace length 24.6 mm.

Color in life.--Dark red, lighter below, fingers black.

Habitat.--Intertidal to 100 m, among rocks, kelp holdfasts or among tube mollusks.

Range.--Monterey, California to Magdalena Bay, Baja California. Type locality Monterey.

Remarks.--Records of Paraxanthias taylori suggest that the species has a discontinuous distribution. Specimens have been collected from Monterey, Pacific Grove and Carmel Bay, and then south of Point Conception, especially from Santa Monica Bay southward into Baja California.



Paraxanthias taylori



Genus Cycloxanthops Rathbun

Cycloxanthops novemdentatus (Lockington)

Xanthodes ? novem-dentatus Lockington, 1877: 32.

Cycloxanthops rugosa Holmes, 1900: 59.

Cycloxanthops rugosus.--Rathbun 1904: 180.--Schmitt 1921: 240.

Cycloxanthops novemdentatus.--Holmes 1900: 56, pl. 1, fig. 2.--Rathbun 1904: 180, pl. 7, fig. 10.--Schmitt 1921: 239, pl. 37, fig. 7, text-fig. 142.--Rathbun 1930: 292, pl. 134, fig. 1; pl. 135, figs. 2-3, text-fig. 46.--Carlton and Kuris 1975: 398.--Garth and Abbott 1980: 608, fig. 25.23.--Ricketts et al. 1985: 172, fig. 141. (See Rathbun, 1930, for information on early synonyms).

Recognition characters.--Carapace broad, slightly convex, somewhat roughened toward anterior; front with deep, closed median notch (more evident in smaller individuals), anterolateral margin with 8-9 teeth besides postorbital tooth. Merus of third maxillipeds obliquely truncate at anterior end. Carpus of chelipeds roughened, with 2 blunt teeth at antero-internal angle; hand roughened above, upper and lower margins nearly parallel; fingers long and grooved, not gaping. Ambulatory legs with setose margins, dactyls longer than propodi. Carapace length 23.9 mm.

Color in life.--Brown, purple or red, rarely white; fingers of chelipeds black, teeth along inner chela margins white.

Habitat.--Low intertidal zone to 73 m, tidepools, rocks, or among sea grasses or tube mollusks.

Range.--Monterey Bay, California to Magdalena Bay, Baja California. Type locality San Diego, California.

Remarks.--This is the largest xanthid crab of California, and the most likely to be confused with a species of the Cancridae.



Cycloxanthops novemdentatus

Genus Micropanope Stimpson

Micropanope latimanus Stimpson

Micropanope latimana Stimpson, 1871: 107.

Xanthodes latimanus Lockington, 1876: 31.

Xanthias latimanus.-- Holmes 1900: 66.--Rathbun 1904: 185.--Schmitt 1921: 247.

Micropanope latimanus.--Rathbun 1930: 433. (See this reference for more information on synonyms).

Recognition characters.--Carapace moderately convex, smooth except for granules along anterior and antero-lateral margins. Front broad. Chelipeds angular, palms broader than long, smooth and polished, strongly protuberant at postero-inferior angle; fingers as long as palm, deflexed and black. Chelipeds unequal, minor chela with fingers more deflexed than those of major chela. Ambulatory legs with slender dactyls, with sparse setae. Carapace length 7.1 mm. This species has never been illustrated.

Color in life.--"Marbled" (Lockington, 1877).

Habitat.--Not reported, but probably intertidal.

Range.--San Diego, California to Cape San Lucas, Baja California, and in Gulf of California from Mulege Bay, Port Escondido and San Jose Island. Type locality Cape San Lucas.

Remarks.--Despite the long synonymy of the species, all of the specimens seem to have been destroyed. Stimpson's material, Lockington's types and any other early specimens of the California Academy of Sciences probably were burned. The few records seem to indicate that the species should occur more frequently in Baja California Sur than in California, U.S.A. Garth (1986) noted that the genus Micropanope probably needs revision, so the discoverer of this crab may be able to add yet another synonym to the list.

Genus Rhithropanopeus Rathbun

Rhithropanopeus harrisii (Gould)

Pilumnus harrisii Gould, 1841: 326.

Rhithropanopeus harrisii.--Rathbun 1930: 456, pl. 183, figs. 7,8.--Carlton and Kuris 1975: 398.--Garth and Abbott 1980: 610, fig. 25.27.--Williams 1984: 401, figs. 316-317.--Ricketts et al. 1985: 296.

Recognition characters.--Carapace subquadrate, about as long as wide, sparsely pubescent toward anterolateral angles, lines of granules across carapace. Front almost straight, slightly notched. First anterolateral tooth fused with postorbital angle, followed by 2-3 other anterolateral teeth. Chelipeds unequal. Carpus with moderately developed internal tooth. Major chela with short fixed finger, strongly curved dactyl. Minor chela with proportionately longer fixed finger and long straight dactyl. Walking legs long, slender, compressed and somewhat hairy. Male carapace length 15.6 mm, female carapace length 12.4 (after Williams, 1984).

Color in life.--Brown above, pale below; fingers of chelae light-colored throughout their length.

Habitat.--Intertidal to 36.6 m, but usually shallow; rocks, oyster shells, or debris, often in

estuarine areas.

Range.--Native to southwestern Gulf of St. Lawrence, Canada to Veracruz, Mexico; introduced into parts of Europe and San Francisco and Coos Bays on west coast of U.S.A. Type locality Cambridge Marshes and Charles River, Massachusetts.



Rhithropanopeus harrisi

Genus Eurypanopeus A. Milne-Edwards

Eurypanopeus hyperconvexus Garth

Eurypanopeus hyperconvexus Garth, 1986: 11, fig. 6A-F.

Recognition characters.--Carapace convex, with rough lines forming ridges on carapace of female. Front with shallow notch and closed fissure. First and second anterolateral teeth fused, low; third and fourth teeth subequal, fifth tooth short and triangular. Merus of third maxilliped subrectangular. Chelipeds similar. Carpus with inner tooth blunt. Palm somewhat swollen, upper margins with faint double crest. Finger of major chela without large basal tooth, fingers of minor chela longer and more slender than those of major, neither chela with gape. Ambulatory legs slender, carpi without lobes, dactyls long. Male carapace length 10.5 mm, female carapace length 9.6.

Color in life.--Body not reported, but fingers of chelae with brown bases, color of immovable fingers extending short distance on palm, tips white.

Habitat.--Subtidal on rock and sand, 68-79 m.

Range.--Known only from type locality, 0.5-1 mile NW of Anacapa Island light, California.

Genus Lophopanopeus Rathbun

Lophopanopeus frontalis (Rathbun)

Lophozozymus frontalis Rathbun, 1893: 236.

Lophoxanthus frontalis.--Holmes 1900: 64, pl. 1, figs. 5-6.

Lophopanopeus frontalis.--Rathbun 1904: 181, p. 7, fig. 8.--Schmitt 1921: 242, pl. 37, fig. 3; text-fig. 144.--Rathbun 1930: 323, pl. 152.--Garth and Abbott 1980: 610, fig. 25.26.--Ricketts et al. 1985: 296.

Recognition characters.--Carapace almost smooth, somewhat broader than long. Front prominent, with median notch; with 3 developed anterolateral teeth. Chelipeds with carpus and hand smooth, hand with large lobe on upper margin, dactyl without enlarged tooth. Ambulatory legs with carpus slightly bilobed, propodus with convex anterior margin. Male carapace length 17.2 mm.

Color in life.--Yellowish-brown, fingers of chela black, dark color extending to palm.

Habitat.--Intertidal to 37 m, among rocks and among mussels on pilings.

Range.--Santa Monica Bay, California to Magdalena Bay,, Baja California. Type locality San Diego.

Lophopanopeus leucomanus (Lockington)

Xanthodes leucomanus Lockington, 1876: 32.

Lophopanopeus heathii Rathbun, 1900: 137.--Rathbun 1904: 182, pl. 7, fig. 9.--Schmitt 1921: 243, pl. 37, fig. 1.

Lophopanopeus leucomanus.--Rathbun 1904: 182.--Schmitt 1921: 243, pl. 37, fig. 6, text-fig. 145.--Rathbun 1903: 324, pl. 153, figs. 5,9; pl. 154, fig. 4.

Lophopanopeus leucomanus leucomanus.--Menzies 1948: 10, pl. 2, figs. 9-14; pl. 5, fig. 35.--Campos and de Campos 1989: 175.

Lophopanopeus leucomanus heathii.--Menzies 1948: 13, pl. 2, figs. 15-16; pl. 5, fig. 34.--Carlton and Kuris 1975: 399, pl. 97, fig. 60.--Garth and Abbott 1980: 610.--Ricketts et al. 1985: 169, fig. 137.

Recognition characters.--Carapace with anterior half irregularly roughened; granulated patch on hepatic region, front with shallow notch, 3 developed anterolateral teeth. Carpus of chelipeds smooth to pitted. Movable finger of major chela with strong basal tooth. Carpus of ambulatory legs slightly to strongly bilobed, without pubescence, propodus broad. Male carapace length to 12.2 mm.

Color in life.--Highly variable: white, dark red, brown, gray or mottled; legs may have different color than carapace; fingers of chelae with dark color not extending back on palm.

Habitat.--Intertidal to 200 m, among rocks, tidepools and tube mollusks.

Range.--Moss Beach, San Mateo County, California to Cedros Island, Baja California, Mexico. Type locality Monterey, California.

Remarks.--There are two subspecies of this species. The typical form, L. leucomanus leucomanus (Lockington), ranges from Carmel to Cedros Island. The carpus of the cheliped bears a network of lines ("reticulating ridges") which extends to the palm of the chela. The carpus of the walking legs is bilobed. L. leucomanus heathii Rathbun ranges from Moss Beach to La Jolla, California. It does not have the reticulating ridges on the carpus, and the carpus of the walking legs is barely bilobed. See Menzies (1948) for further details.

Lophopanopeus bellus (Stimpson)

Xantho bella Stimpson, 1860: 204, pl. 5, fig. 2.

Lophopanopeus bellus.--Rathbun 1904: 180.--Schmitt 1921: 241, p. 37, fig. 4, text-fig. 143.--Rathbun 1930: 320, pl. 150, 151.--Carlton and Kuris 1975: 399, pl. 97, fig. 59.--Ricketts et al. 1985: 305.

Lophopanopeus diegensis Rathbun, 1900: 137.--Rathbun 1904: 184, pl. 9, fig. 3.--Schmitt 1921: 245, pl. 37, fig. 5, text-fig. 146.--Rathbun 1930: 327, pl. 153, figs., 6,7, 10; text-fig. 49.

Lophopaneopus bellus bellus.--Menzies 1948: 4, pl. 1, figs. 1-5; pl. 5, fig. 38.--Garth and Abbott 1980: 609, fig. 25.24.--Campos and de Campos 1989: 175.

Lophopanopeus bellus diegensis.--Menzies 1948: 7, pl. 1, figs. 6-8.--Garth and Abbott 1980: 609.--Campos and de Campos 1989: 175.

Recognition characters.--Carapace with few granules on anterior regions, front with tiny notch, 3 developed anterolateral teeth, pubescent. Carpus of chelipeds with tubercles or roughened, tubercles continued on palm or not; major chela with enlarged tooth on movable finger. Carpus of ambulatory legs slightly to prominently bilobed, carpus and merus pubescent. Male carapace length to 13.7 mm.

Color in life.--Variable; bluish, red, yellowish, mottled with red, brown or gray; carapace and appendages may be of contrasting colors. Dark color on fingers of chelae does not extend to palm.

Habitat.--Rocks, under rocks in sand, tidepools, kelp holdfasts and bases of sea grasses, intertidal to 73 m.

Range.--Resurrection Bay, Alaska to off Cape Tortolo, Baja California. Type locality Monterey, California.

Remarks.--There are two subspecies of this species. L. bellus bellus (Stimpson) is the northern form, ranging from Alaska to Tortugas Bay, Baja California. It is most abundant north of Point Conception, California. In this subspecies, the carpus of the chelipeds may be smooth to roughened, but does not bear irregular raised bumps or tubercles. The carpus of the ambulatory legs is not markedly bilobed and does not have bumps. L. bellus diegensis Rathbun ranges from Monterey Bay to off Cape Tortola, Baja California, but usually is found south of Point Conception. The carpus of the chelipeds bears irregular raised bumps. The carpus of the ambulatory legs is markedly bilobed and has bumps.



Lophopanopeus bellus



Lophopanopeus bellus

## Family Pilumnidae

Genus Pilumnus Leach

Pilumnus spinohirsutus (Lockington)

Acanthus spino-hirsutus Lockington, 1876: 32.

Pilumnus spino-hirsutus.--Holmes 1900: 67.

Pilumnus spinohirsutus.--Rathbun 1904: 185, pl. 7, fig. 2.--Schmitt 1921: 247, pl. 37, fig. 10.--Rathbun 1903: 503, pl. 203.--Garth and Abbott 1980: 611, fig. 25.29.--Ricketts et al. 1985: 172, fig. 143.

Recognition characters.--Carapace strongly convex, covered with stiff setae; median frontal lobes truncated and separated by prominent notch; each frontal lobe armed with 4-5 spines; orbits armed with strong spines; 5 anterolateral spines. spines. Chelipeds unequal, setose, carpus with spines, hand with several series of spines, fingers dark colored. Carapace length 25.4 mm.

Color in life.--Pale brown to golden brown. Transverse ridge in front of mouth area with bright red tint.

Habitat.--Intertidal to 25 m, among rocks or tube mollusks, tidepools, breakwaters and harbors.

Range.--Venice, Los Angeles County, California to Magdalena Bay, Baja California. Type locality San Diego, California.

Remarks.--This crab usually is well hidden under rocks or in holes. It seems to prefer warmer waters, and is common near outlets of power plants as in King Harbor at Redondo Beach, California.



Pilumnus spinohirsutus

## Family Goneplacidae

Species of the Goneplacidae are most abundant in mud or sand. The family is well represented in tropical and subtropical regions, especially on the continental shelf, but only one species occurs in California.

Goneplacids have oblong orbits with relatively long eyestalks. The carapace bears marginal teeth; the front is less than half the width of the carapace. The third maxillipeds are moderately separated from each other. The legs are relatively slender and somewhat flattened; the chelipeds may be unequal in size and shape. The color may be white, yellowish, tan or mottled with red, but the crabs often are stained with the mud they inhabit.

### Genus Malacoplax Guinot

#### Malacoplax californiensis (Lockington)

Eucrate ? californiensis Lockington, 1877a: 33.

Speocarcinus californiensis.--Holmes 1900: 77.--Rathbun 1904: 190, pl. 9, fig. 1.--Rathbun 1918: 42, text-fig. 16, pl. 10, figs. 2-3.--Schmitt 1921: 249, fig. 148, pl. 34, fig. 7.

Malacoplax californiensis.--Guinot 1969:259, fig. 27.--Garth and Abbott 1980: 612, fig. 25.30.--Ricketts et al. 1985: 357, fig. 274.--Hubbard and Dugan 1989: 55.

Recognition characters.--Carapace nearly smooth, front over 0.25X width of carapace, front notched in center; anterolateral carapace margins strongly curved and furnished with 3 teeth apiece. Third maxillipeds diverging anteriorly. Chelipeds unequal; carpus with spine on antero-internal angle, ridge at distal end of outer surface; hands wide and compressed, upper edge acute and sharply granulated, fingers ridged and nearly straight. Fifth pereopods upturned and relatively short. Carapace length 20.8 mm.

Color in life.--Brownish to white, chelae with tips of fingers black.

Habitat.--Intertidal zone to 33 m, but usually middle to low intertidal zones of mud flats.

Range.--Morro Bay, California to Magdalena Bay, Baja California; but usually south of Point Conception. Type locality San Diego, California.

Remarks.--Malacoplax californiensis, the California burrowing crab, is uncommon and may be endangered by habitat destruction.



## Family Pinnotheridae

The pea crabs generally are commensals of larger invertebrates, including polychaete and echiuroid worms, pelecypods, large chitons, keyhole limpets, sea urchins, sea cucumbers and ascidians. The species generally associate with only one general type of host: those that live with polychaetes usually do not associate with mollusks and vice versa, for example. However, the associations are not known to be species-specific.

Pinnotherids have a rounded to rectangular carapace, often wider than long. Usually, the carapace is soft. Most pinnotherids are colored whitish to yellowish, but some, such as Opisthopus transversus, may have a spotted carapace and banded legs. The front, eyes and orbits may be reduced. The antennules fold transversely.

Sexual dimorphism is pronounced in certain pinnotherids, with males being smaller and having a less inflated body than the females. In others, the chelae of the male are more sturdy than those of the female. The dactyls of the ambulatory legs may be modified for crawling, grasping, or gripping the surface of a host. The ambulatory legs themselves may differ in size and shape from anterior to posterior.

Members of the family Pinnotheridae lately have undergone taxonomic revision. The generic placement of tropical species has been revised; males and females of sexually dimorphic groups have been matched so that some names applied only to one sex have been put into synonymy. For references prior to 1970, the account by Schmitt, McCain and Davidson (1973) remains valuable. The reader should be alert for further changes. The key below follows the work of Davidson (1968) and Zmarzly (1992). Zmarzly's study of species of Pinnixa should be consulted for additional anatomical details and illustrations.

Two species, Pinnotheres holmesi Rathbun, 1918 and P. nudus Holmes, 1895 have been reported from one and two specimens respectively, and have not been seen since their description. The reader should consult the work of Rathbun, 1918 for descriptions of each. These may be synonyms of other species.

### Key to the Species of the Family Pinnotheridae

1. Ischium of third maxillipeds rudimentary or indistinguishably fused with merus; palp not more than 0.5X as large as merus-ischium. Carapace rounded, subquadrate or broadly transverse-----2

Ischium of third maxillipeds usually distinct from merus, although smaller and sometimes imperfectly joined with it; palp of larger size, usually about as large as merus-ischium. Carapace broadly transverse-----6

2. Carapace much broader than long, anterior margin nearly straight. Ambulatory legs diminishing in length from first to last, last very small-----Parapinnixa affinis Holmes

Carapace suborbicular or subquadrate, not strikingly wider than long. Ambulatory legs not successively diminishing in length from first to last-----3

3. Carapace without 2 longitudinal, impressed lines leading posteriorly from middle of upper margin of orbit. (Commensal in ascidians)-----Pinnotheres pugettensis Holmes
- Carapace with 2 longitudinal, impressed lines leading posteriorly from middle of upper margin of orbit. (Usually commensal in pelecypods, occasionally echinoderms, rarely ascidians)----- 4
4. Female: second ambulatory legs unlike, right longer than left. (Male unknown). (Commensal in keyhole limpet, Megathura crenulata)-----Enigmatheres canfieldi Rathbun
- Female: second ambulatory legs alike. (Commensal in pelecypods, echinoderms and rarely ascidians)-----5
5. Female: Front sharply deflexed with transverse sulcus across vertical front between orbits; hand of cheliped widening distally and bearing two rows of setae along lower margin. Male: terminal abdominal segment semi-circular, immovable finger of chela bearing large serrate lobe on upper margin. (Alaska to La Jolla)-----Fabia subquadrata (Dana)
- Female: Front sharply deflexed but lacking transverse sulcus across vertical front between orbits; hand of cheliped not widening distally, bearing one row of setae along lower margin. Male: terminal abdominal segment widening distally with distal margin slightly deflexed, immovable finger of chela bearing 2 small teeth or lobes on upper margin. (San Pedro-Magdalena Bay)-----Fabia concharum (Rathbun)
6. Carapace about as wide and long, suborbicular. Ambulatory legs more or less subequal, second pair longest. Carapace spotted with red to purple-----Opisthopus transversus Rathbun
- Carapace much wider than long. Third pair of ambulatory legs longest. Carapace whitish to brown, not spotted-----7
7. Third ambulatory legs not markedly longer than others, legs more or less subequal. Carapace hard and granulate anteriorly; lower anterolateral margin curving gradually into posterolateral margin-----Scleroplax granulata Rathbun
- Third ambulatory legs markedly longer and larger than others. Carapace usually soft, if hard, not granulate; lower anterolateral margin forming angle with posterolateral margin-----8
8. Carapace strongly convex and hard, 1.5X wider than long. (Often commensal with holothurians)-----Pinnixa barnharti Rathbun
- Carapace flat or slightly convex, more than 1.5X times wider than long. (Not commensal with holothurians)-----9
9. Dactyl of fourth pereopod shorter than propodus-----10
- Dactyl of fourth pereopod equal to or longer than propodus-----14
10. Distal tip of dactyl of fifth pereopod falling short of or just reaching distal end of merus of fourth pereopod when both legs extended-----11

- Distal end of dactyl of fifth pereopod reaching beyond distal end of merus of fourth pereopod when both are extended-----12
11. Posteroventral margin of ischium of fifth pereopod with 2-3 large tubercles; margins of fifth pereopod with long fringe of setae-----Pinnixa longipes (Lockington)
- Posteroventral margin of ischium of fifth pereopod without tubercles; fifth pereopod without long fringe of setae-----Pinnixa tubicola Holmes
12. Ventral margin of propodus of fourth pereopod with 2 ridges, ridges granulate or serrate; dactyl of fourth pereopod spinous and slightly curved-----Pinnixa tomentosa Lockington
- Ventral margin of propodus of fourth pereopod without ridges; dactyl of fourth pereopod smooth and strongly curved-----13
13. Male: fixed finger of chela slightly deflexed relative to palm; inner margin of dactyl of chela toothless. Female: fixed finger slightly deflexed; slight gape visible between opposing margins of fingers of chela when fingers tightly closed-----Pinnixa littoralis Holmes
- Male: fixed finger of chela straight relative to palm; inner margin of dactyl of chela with single blunt triangular tooth. Female: fixed finger nearly straight; opposing margins of fingers of chela meeting tightly, no gape-----Pinnixa faba (Dana)
14. Anterolateral aspect of carapace with granulate or serrate ridge-----15
- Anterolateral aspect of carapace smooth and round, without granulate or serrate ridge-----19
15. Fixed finger of chela angled obliquely downward relative to palm-----16
- Fixed finger of chela straight or curving upward; not deflexed-----17
16. Length of propodus of fourth pereopod 1.5-2X width-----Pinnixa occidentalis Rathbun
- Length of propodus of fourth pereopod at least 2.5X width-----Pinnixa scamit Martin and Zmarzly
17. Anterior face of chela entirely smooth, without granules or with line of coarse granules just above ventral margin of propodus and scattered granules over rest of propodus-----Pinnixa schmitti Rathbun
- Anterior face of chela with line of tubercles or granules above ventral margin, rest of palm smooth or granulate-----18
18. Anterior face of chela with line of tubercles just above ventral margin, largely confined to region where fixed finger meets palm; rest of palm smooth-----Pinnixa hiatus Rathbun

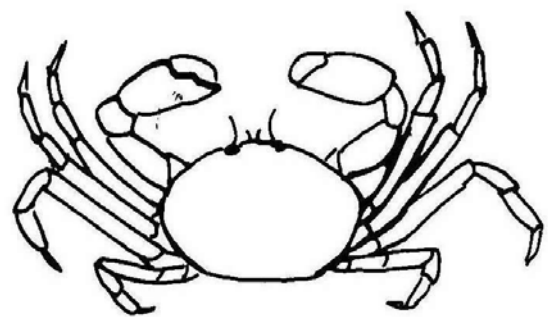
Anterior face of chela with prominent line of densely packed granules forming ridge above ventral margin, running most of length of propodus; dorsal margin of propodus granulate-----  
-----Pinnixa franciscana Rathbun

19. Inner margin of dactyl of chela with single small triangular tooth at midpoint-----  
-----Pinnixa weymouthi Rathbun

Inner margin of dactyl of chela toothless-----20

20. Fingers of chela long, about 2X as long as palm; tip of dactyl of fifth pereopod falling short of distal end of carpus of fourth pereopod when both legs extended-----  
-----Pinnixa forficulimanus Zmarzly

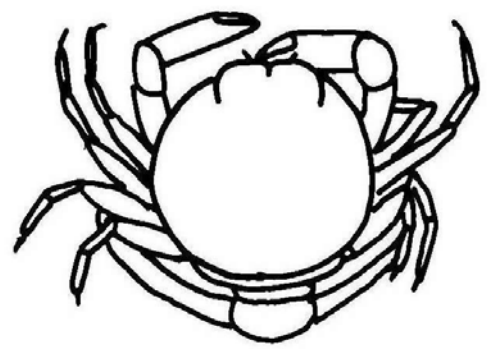
Fingers of chela short, about as long as palm; tip of dactyl of fifth pereopod exceeding distal end of carpus of fourth pereopod when both legs extended-----  
-----Pinnixa minuscula Zmarzly



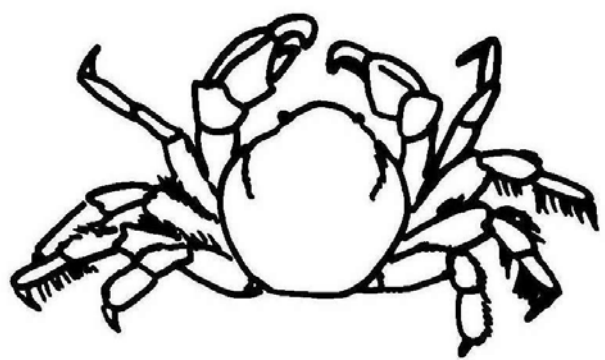
*Scleroplax granulata*



*Opisthopus transversus*



*Fabia subquadrata*



*Fabia concharum*

## Genus Parapinnixa Holmes

### Parapinnixa affinis Holmes

Parapinnixa affinis Holmes, 1900: 95.--Schmitt 1921: 255.--Glassell 1933: 321, pls. 20, 21.--Schmitt et al. 1973: 31.--Garth and Abbott 1980: 614, fig. 25.33.--Campos, Campos and Ramirez 1992: 756.

Recognition characters.--Carapace smooth and shining, transversely oval, anterolateral corner dilated and making straight line at anterior margin. Front broad and triangular, with short median groove. Orbit oval, inner hiatus wide and partly filled by basal segment of small, short antenna. Antennule folding obliquely. Buccal area small, broadly triangular. Ischium of third maxilliped rudimentary, merus large and triangular, with 3-segmented palp. Chelipeds stout and smooth, hand dilated, dactyl hooked at tip and armed with small tooth near middle of inner margin, upper side smooth; fixed finger with 2 teeth at tip and large triangular tooth extending from tip to proximal side of center. Single row of setae extending longitudinally from margin of carpus to fixed finger, gap of dactyl with fringe of short setae. First pair ambulatory legs larger than others; dactyl short and stout. Next two pairs ambulatory legs comparatively slender, with slightly longer dactyls; last pair small, reaching about to tip of merus of preceding pair, dactyls short and stout, slightly hooked. Merus of posterior three ambulatory legs compressed and broad. Abdomen with 7 segments, widest at third segment, seventh segment nearly twice as long as broad. Carapace length to 3.6 mm long (Glassell, 1933).

Color in life.--Carapace light amber with mottling of dark ochre, protogastric and cardiac regions light orange; rarely white. Legs pale ochre with greenish tinge, dactyl yellow with white tip. Setae on second and third ambulatory legs reddish brown.

Habitat.--Bays and harbors, low intertidal zone among mud, sand, shells and algae; living in tube with polychaetes: Amphitrite sp., Terebella californica and Loimia montagui.

Range.--San Pedro to San Diego, California; La Bajada, Tortugas Bay, Baja California, Mexico. Most reports are from Newport Bay, Orange County. Reports from Sakhalin and the Kurile Islands may refer to Parapinnixa yokoyai Glassell. Type locality San Pedro, California.

Remarks.--Although Glassell (1933) was able to study "hundreds" of this crab, the California bay pea crab has rarely been reported since then. The type locality was dredged and turned into an industrial area; other protected bays have undergone various types of habitat destruction which have adversely affected this crab.

## Genus Pinnotheres Bosc

### Pinnotheres pugettensis Holmes

Pinnotheres pugettensis Holmes, 1900: 86.--Rathbun 1904: 185.--Rathbun 1918: 63, pl. 17, figs. 7, 8; pl. 18, fig. 1, text-fig. 39.--Schmitt et al. 1973: 82.--Garth and Abbott 1980: 613.--Hart 1982: 232, fig. 96.

Recognition characters.--Female: carapace soft, smooth, subpentagonal. Front triangular, curved downwards. Orbits nearly circular. Antennae short. Third maxillipeds oblique, strongly pubescent; merus narrow with outer margin convex; penultimate joint broad, subquadrate, distally truncated; dactyl inserted at lower proximal edge. Chelipeds smooth, merus short, upper

margin with setae, hands narrow, elongated and smooth, dactyl and inner side of palm short, pubescent, fingers nearly straight with hooked tips, dactyl with low tooth near base of inner margin. Ambulatory legs slender, increasing in length posteriorly, propodi setose, dactyls narrow, compressed and having the tip forming short, curved claw. Dactyl of fifth pereopods longer than propodus and longer than that of preceding walking leg. Carapace length 10 mm. Male: Smaller than female, entire body usually covered by dense brown pile. Carapace slightly longer than wide to about as long as wide, front produced and with a median sulcus, faint grooves along gastric and cardiac regions. Orbits and antennae small. Third maxilliped similar to that of female, but last two segments slightly shorter. Abdomen with 7 segments, tapering from proximal end to obtusely pointed apex. Chelipeds robust, chela with groove on inner surface from articulation of dactyl to proximal dorsal edge. Fingers of chelae with acute tips, crossing; fixed finger with row of sharp teeth on cutting edge. Walking legs decreasing gradually in length from first to last, but all robust and pilose. Second to fourth walking legs with long setae on propodus or propodus and carpus. Dactyls acute and long, subequal in size. Carapace length or width to 5.8 mm.

Color in life.--Female very pale, almost translucent white to yellowish, outer surface of palm of chela with light-colored net-like pattern. Male light brown.

Habitat.--Subtidal, commensal in large solitary ascidians, the sponge Tethya aurantium and the rock scallop Hinnites giganteus.

Range.--Spider Anchorage, British Columbia; Puget Sound, Monterey Bay and King Harbor, Los Angeles County, California. Type locality "Puget Sound".

Remarks.--This pinnotherid may be more common than the records suggest, but it cannot be collected without inspecting large ascidians and other invertebrates.

#### Genus Enigmatheres Campos

#### Enigmatheres canfieldi Rathbun

Fabia canfieldi Rathbun, 1918: 106, text-fig. 57, pl. 24, figs. 5, 7.--Schmitt 1921: 254, pl. 39, figs. 5, 6.--Schmitt et al. 1973: 22.

Enigmatheres canfieldi Campos, 2009: 31, fig. 1.

Recognition characters.--Female: Carapace broad, soft. Front without setae, with short, longitudinal median depression. Second segment of palp of third maxilliped small, shorter and narrower than first segment, terminal segment attached at middle. Palm of chela increases in width to distal end, fingers long, inclined downward, lower margin of propodus sinuous, fingers not gaping, setose on upper surface, prehensile tooth at middle of dactyl and smaller one at base of fixed finger. Ambulatory legs slender and subcylindrical, second leg on right side about 0.3X longer than on left; first leg stouter than others, propodi slightly curved, dactyls short, slender, with hooked tips except on second right pereopod, with dactyl long and straight. Carapace length about 5 mm. Male unknown. (Rathbun, 1918).

Color in life.--Not recorded, but probably white to yellowish.

Habitat.--In mantle cavity of keyhole limpet, Megathura crenulata. Depth not recorded, but probably low intertidal or subtidal.

Range.--Known only from type locality, Monterey, California.

Remarks.-- Like Fabia subquadrata, this species has a soft carapace. Campos (2009) re-examined the only known specimen of this species and verified that it differs from other pinnotherids in having asymmetrical pereopods.

## Genus Fabia Dana

### Fabia subquadrata Dana

Fabia subquadrata Dana, 1851: 253.--Holmes 1900: 87 (in part).--Rathbun 1918: 102, pl. 24, figs. 1, 3; text-fig. 53 (part).--Schmitt 1921: 253, pl. 39, figs. 1, 2; text-fig. 150.--Davidson 1968: 85, fig. 1A, 1D, 1G, 1H.--Schmitt et al. 1973: 24.--Carlton and Kuris 1975: 398, pl. 96, fig. 53.--Garth and Abbott 1980: 612, fig. 25.31.--Ricketts et al. 1985: 221, fig. 179.--Campos-Gonzalez 1986: 238.

Recognition characters.--Carapace smooth, membranous, subquadrate; soft in adult female, hard in male. Female front sharply deflexed with transverse sulcus across vertical front between orbits. Anterolateral margin rounded, marked by round cluster of pits, male with dense pubescence along margin. Antennules in very wide grooves. Male with large orbits. Palp of third maxilliped about as long as adjacent segment, merus with small point on distomesial margin. Palm of chela widened distally, bearing 2 rows of setae along lower margin. Immobile finger with large serrate lobe on upper margin; dactyl with 1 large tooth on lower margin, upper margin with tuft of dense setae. Ambulatory legs with segments flattened, margins densely pubescent. Dactyls large, subequal and curved. Male abdomen with terminal segment semi-circular, lateral margins of penultimate segment distally depressed, broader at proximal end than distal but not markedly so. Male carapace length to 7.3 mm, female to 16.2.

Color in life.--Translucent whitish to yellowish, at times with dark areas on carapace.

Habitat.--Intertidal-subtidal. Usually commensal in pelecypods, especially mussels, Mytilus spp. and soft-shell clams, Mya arenaria, but also reported from other pelecypods, rarely sea urchins and ascidians. See Garth and Abbott (1980) for a list of hosts.

Range.--Akutan Pass, Aleutian Islands to Todos Santos Bay, Baja California, Mexico. Type locality "Puget Sound".

Remarks.--The grooved mussel crab perhaps is the largest and best known of the pinnotherids of the western coast of North America. However, its change of size, shape and habitat during its life cycle can cause confusion with other species. Smaller individuals are more setose and can swim. The first host usually is a clam. The crabs produce hard shells prior to molting, accomplished while the crabs swarm into the plankton. Oviparous females develop a large, soft exoskeleton later when they move to a larger host, often a mussel. Males remain hard-shelled. See Garth and Abbott (1980) for further information and references on the life cycle.

### Fabia concharum (Rathbun)

Cryptophrys concharum Rathbun, 1893b: 250 (in part).

Raphonotus lowei Rathbun, 1900c: 590.

Fabia lowei Rathbun 1918: 104, pl. 24, figs. 2, 4, text-fig. 55.--Schmitt 1921: 254, pl. 39, figs. 3, 4, text-fig. 151.

Pinnotheres concharum.--Rathbun 1918: 86, pl. 20, figs. 3-6, text-fig. 42 (in part).--Schmitt 1921: 252, pl. 38, figs. 1,2,3,4.

Fabia concharum.--Davidson 1968: 87, fig. 1B, 1C, 1E, 1F.--Schmitt et al. 1973: 23.--Garth and Abbott 1980: 613, fig. 25.32.

Recognition characters.--Carapace subpentagonal, slightly longer than broad, smooth, rigid, with ridge of coarse setae along anterior and anterolateral margins. Female front sharply deflexed, lacking transverse sulcus across vertical front between orbits. Orbits circular, antennules large and nearly transverse. Palp of third maxilliped very small, merus produced on distomesial margin. Hand of cheliped not widened distally, bearing one row of setae along lower margin. Three anterior pair ambulatory legs subequal, fourth pair shortest, dactyls about as long as propodi and ending in curved hooks. Male abdomen with terminal segment widening distally, sixth segment hairless with margins subparallel, abdomen considerably wider near proximal end than at distal end. Male carapace length 3.0 mm, female 10.0.

Color in life.--Yellow-brown.

Habitat.--Intertidal-subtidal, commensal in mantle cavities of pelecypods. Males may move between hosts.

Range.--San Pedro, California to Turtle Bay, Baja California. Type locality San Diego Bay, California.

Remarks.--See Davidson (1968) for an explanation of the confusion between this species and Fabia subquadrata.

#### Genus Opisthopus Rathbun

#### Opisthopus transversus Rathbun

Opisthopus transversus Rathbun, 1893b: 252.--Holmes 1900: 97.--Rathbun 1904: 188, text-fig. 95.--Rathbun 1918: 173, pl. 37, figs. 4, 5; text-fig. 110.--Schmitt 1921: 268, pl. 44, figs. 4, 5, text-fig. 158.--Schmitt et al. 1973: 131.--Carlton and Kuris 1975: 398.--Garth and Abbott 1980: 618, fig. 25.42.--Ricketts et al. 1985: 105, fig. 80.--Campos, Campos and Ramirez 1992: 754.

Recognition characters.--Carapace somewhat rounded, convex, moderately hard. Front deflexed, almost straight, with slight median groove. Antennules well developed and set in deep notches. Third maxilliped with ischium well developed, merus broad, palp 3-jointed, last joint articulated on inner side of preceding joint. Chelae short and stout. Ambulatory legs similar to each other, segments rather broad, dactyls curved and small. Abdomen of male narrow at base and tapering from third segment to end; abdomen of female wide and long. Male carapace length to 10 mm, female to 17.

Color in life.--Carapace mottled with vermilion to deep red, legs banded with red to purple, background white to cream.

Habitat.--Intertidal-subtidal, commensal in mantle cavities of pelecypods, gastropods (including large opisthobranchs), and giant chiton Cryptochiton stelleri, in cloacae of sea cucumbers, and with polychaete Chaetopterus variopedatus.

Range.--Monterey, California to San Ignacio Lagoon, Baja California; San Felipe, Baja California (Gulf of California). Type locality Monterey.

Remarks.--Evidence suggests that the color of the crab is dependent on the the habitat and host. Crabs that inhabit suspension-feeding pelecypods tend to have less color than those that live in deposit-feeding or grazing hosts. See Garth and Abbott (1980) for more information and references. After storms, the mottled pea crab may be cast ashore alive and away from a host.



The crabs can crawl readily. Whether or not they move from host to host under normal conditions is not known.



Opisthopus transversus

Genus Scleroplax Rathbun

Scleroplax granulata Rathbun

Scleroplax granulata Rathbun, 1893b: 251.--Rathbun 1904: 188, pl. 7, fig. 5.--Rathbun 1918: 171, pl. 37, figs. 1-3, text-fig. 109.--Schmitt 1921: 267, pl. 44, figs. 1-3.--Schmitt et al. 1973: 96.--Carlton and Kuris 1975: 396.--Garth and Abbott 1980: 618, fig. 25.41.--Ricketts et al. 1985: 384, fig. 300.

Recognition characters.--Carapace subpentagonal, hard, granulate anteriorly and near margins, punctate elsewhere; front narrow, produced, slightly convex. Orbits nearly circular, eyestalks short and thick. Antennules almost transverse. Chela of male swollen and heavy, those of female not as large. Dactyl curved, fixed finger with large tooth, fingers gaping. Ambulatory legs slender, granulate, fourth pereopods longest. segments narrow and flattened, dactyls slender and almost straight, nearly as long as dactyls. Male abdomen narrow, tapering gradually to broad terminal segment, female abdomen fringed with setae. Male carapace length about 3 mm, female to 6 mm.

Color in life.--Grayish white, brownish, yellowish mottled with red-brown.

Habitat.--Intertidal to 13 m in bays and harbors, commensal with echiuroid worm Urechis caupo and ghost shrimps Neotrypaea californiensis and Upogebia pugettensis.

Range.--Roller Bay, Vancouver Island to Ensenada, Baja California; off Mazatlan, Sinaloa, Mexico. Type locality Ensenada.



Scleroplax granulata

Genus Pinnixa White

Pinnixa barnharti Rathbun

Pinnixa barnharti Rathbun, 1918: 149, fig. 91, pl. 32, text-fig. 91.--Schmitt 1921: 261, pl. 41.--Schmitt et al. 1973: 103.--Carlton and Kuris 1975: 407.--Garth and Abbott 1980: 614, fig. 25.34.--Ricketts et al. 1985: 338.--Zmarzly 1992: 679, figs. 2,3.

Recognition characters.--Carapace hexagonal, calcified, convex, antero-lateral margin with line of fine granules, surface coarsely pubescent towards sides, furrow behind gastric region shallow, 3 deep pits on each side anteriorly, posterior margin concave. Lobes of front prominent and arcuate. Orbits broadly oval. Antenna as long as width of front and one orbit. Chelipeds large, chelae dilated toward fingers, sinus in lower margin near base of fixed finger, which is subhorizontal, tip obliquely truncate, lower corner armed with short, sharp tooth, dactyl oblique, making gape with fixed finger, strong tooth in middle of dactyl, fringe of setae above, patch of setae in gape. Merus of cheliped and ambulatory legs setose above, merus and propodus of last 2 ambulatory legs setose below, carpus and propodus of last ambulatory leg setose above. Ambulatory legs thick, first nearly as long as second, third longest, propodus of all tapering, dactyl short and straight. Female carapace length 10.7 mm.

Color in life.--Creamy to brownish with brown mottling.

Habitat.--Low intertidal to subtidal, bays and sandy areas, commensal in cloacae of sea cucumbers, especially Caudina spp.

Range.--Puget Sound; Venice, California to Ballenas Bay, Baja California; Zihuatanejo, Guerrero, Mexico. Type locality Venice, California.

Pinnixa longipes (Lockington)

Tubicola longipes Lockington, 1876: 55.

Pinnixa longipes.--Holmes 1900: 92.--Rathbun 1904: 188.--Rathbun 1918: 137, figs. 80, 81.--Schmitt 1921: 257, text-fig. 152.--Schmitt et al. 1973: 113.--Carlton and Kuris 1975: 398, pl. 96, fig. 50.--Garth and Abbott 1980: 617, fig. 25.38.--Ricketts et al. 1985: 307, fig. 238.--Zmarzly 1992: 695, fig. 10.

Recognition characters.--Carapace more than 2X long as wide, with acute lateral angle, somewhat flattened, with transverse depression behind gastric area. Frontal area concave, dissected by deep longitudinal groove. Anterolateral region smooth, rarely with weakly granulate ridge. Body entirely surrounded by fringe of long plumose setae. Chelipeds small, short and setose, chelae stout, those of mature male more robust than female. Inner margin of dactyl with single triangular tooth; inner margin of fixed finger irregularly serrated. Gape present when fingers closed. Anterior face of propodus with tubercles just above ventral margin. First 2 pairs ambulatory legs slender and similar, with long, slender and nearly straight dactyls nearly equal to length of propodi. Third ambulatory legs enormously developed relative to other legs. Posteroventral margin of ischium tuberculate. Dorsal margin of merus smooth to serrate, posteroventral margin of merus denticulate and propoduced as shelf. Ventral margin of propodus granulate. Dactyl short and thick. Last pereopod short, not reaching end of merus of third pereopod, slender, more stout than first two pereopods, dactyl short and stout. Carapace length 3.2 mm.

Color in life.--Pale brownish to yellowish white.

Habitat.--Intertidal to 128 m, commensal with polychaete worms, rarely echiurans; common in sandy sediments at 45 m.

Range.--Bodega Bay, California to Ensenada, Baja California, Mexico. Type locality Tomales Bay, California.

Pinnixa tubicola Holmes

Pinnixa tubicola Holmes, 1894: 569, pl. 20, figs. 17-18.--Holmes 1900: 91.--Rathbun 1904: 187.--Rathbun 1918: 165, fig. 103, pl. 36, figs. 5-8.--Schmitt 1921: 265, pl. 43, figs. 5-8.--Schmitt et al. 1973: 122.--Carlton and Kuris 1975: 398.--Scanland and Hopkins 1978: 636, figs. 1D-F, 2D-F.--Garth and Abbott 1980: 617, fig. 25.39.--Ricketts et al. 1985: 82.--Zmarzly 1992: 709, fig. 16.

Recognition characters.--Carapace subcylindrical, 2.5X wide as long in female to 2X wide as long in male, transverse depression behind gastric region, from which carapace curves sharply downward; outer portion of anterolateral margin defined by ridge. Chelipeds small, hand oblong, fingers hooked at tips, inner margins meeting when closed, immovable finger curved upward distally; lower margin of palm convex. First pair ambulatory legs slender with slender dactyls equal in length to propodi, second pair longer and stouter than first, with relatively stouter dactyls, third pair stout, little longer than second with short and stout dactyls, last pair of ambulatory legs similar to but shorter than third, but not exceeding end of merus of third pair. Propodi of third and fourth pair ambulatory legs only slightly longer than wide, with inflated appearance. Length of carapace 4 mm.

Color in life.--Golden brown with spots of bluish gray or white on dorsal surface, lighter and uniform in color on ventral surface.

Habitat.--Commensal with polychaetes, often living in male-female pairs; intertidal to 57 m.  
Range.--Prince Rupert, British Columbia to Blanca Bay, Baja California; unverified reports from "Alaska". Type locality not specified; type material from Trinidad (Humboldt County), Cape Mendocino and Bodega Bay, California.



Pinnixa tubicola

Pinnixa tomentosa Lockington

Pinnixa tomentosa Lockington, 1876: 156.--Rathbun 1918: 141, pl. 30, fig. 8, text-figs. 85, 86.--Schmitt 1921: 258, text-fig. 153.--Schmitt et al. 1973: 121.--Scanland and Hopkins 1978: 636, figs. 1A-C, 2A-C.--Garth and Abbott 1980: 617.--Zmarzly 1992: 706, fig. 15.

Recognition characters.--Carapace 1.7-2.5X long as wide, rounded and sloping toward margins; shallow depression behind gastric region, cardiac region swollen. Transverse depression behind margin of front; anterolateral margin with granulated line on branchial region. Both carapace and pereopods setose. Hand of chela oblong, margins convex. Fingers with hooked tips, each with small tooth near midpoint, not gaping when closed. First ambulatory leg slender and short, second leg nearly as long as third but less stout, dactyls of first and second legs slender and slightly curved. Third and fourth dactyls stout and short, not hooked. Third ambulatory leg broad, propodus nearly square, fourth leg similar to third but much smaller, reaching to end of merus of fourth leg. Female carapace length 7.5 mm.

Color in life.--Dull brown.

Habitat.--Commensal with polychaetes, especially Chaetopterus variopedatus; intertidal to subtidal (at least 21 m).

Range.--Monterey, California to Cape San Lucas, Baja California; in Gulf of California at San Felipe, Point Cholla and Angeles Bay. Type locality Angeles Bay, Gulf of California. Most records are from southern California.

Pinnixa littoralis Holmes

Pinnixa littoralis Holmes, 1894: 571, pl. 20, figs. 14-16. Rathbun 1904: 188.--Rathbun 1918: 145, pl. 31, figs. 5-8, text-fig. 89, 90.--Schmitt 1921: 260, pl. 40, figs. 5-8, text-fig. 155.--Schmitt et al.

1973: 112.--Carlton and Kuris 1975: 396, pl. 96, figs. 51A, 51B.--Garth and Abbott 1980: 616, fig. 25.36.--Ricketts et al. 1985: 377.--Campos-Gonzalez 1986: 238.--Zmarzly 1992: 693, fig. 9.

Recognition characters.--Carapace about 2X long as wide, pointed at sides, flattened above, with transverse depression behind median region. Orbits pointed at outer angle. Hands of chelipeds compressed, fingers gaping, especially in adult male, dactyl strongly curved, fingers usually without teeth. Ambulatory legs slender, third pair thickest. Propodus of each elongate, dactyl strongly curved and shorter than propodus on all legs. Merus of third ambulatory legs broad. Dactyl of last walking leg slightly exceeding end of merus of third leg when extended. Carapace length 4.5 mm.

Color in life.--Grayish white, often with brownish-tipped walking legs.

Habitat.--Usually living in mantle cavity of pelecypods, rarely with tube anemones (order Ceriantharia), intertidal to 91 m.

Range.--Sitka, Alaska to Santa Maria, Baja California, Mexico. Type locality Bodega Bay, California.

Remarks.--Pinnixa littoralis is easily confused with P. faba. See Zmarzly (1992) for additional information; however, juveniles of the two species may be nearly impossible to differentiate.

### Pinnixa faba (Dana)

Pinnotheres faba Dana, 1851: 253.

Pinnixa faba.--Holmes 1900: 93.--Rathbun 1904: 188.--Rathbun 1918: 142, pl. 31, figs. 1-4, text-figs. 27, 88.--Schmitt 1921: pl. 40, figs. 1-4, text-fig. 154.--Schmitt et al. 1973: 108.--Carlton and Kuris 1975: 396, pl. 96, figs. 52A, 52B.--Garth and Abbott 1980: 615, fig. 25.35.--Ricketts et al. 1985: 377.--Zmarzly 1992: 682, fig. 4.—Schneider 1993: 842.

Recognition characters.--Carapace 1.5-1.9X long as wide, strongly convex, truncated at sides, no transverse ridge behind gastric area; anterolateral margins marked by low ridge; orbits oval. Female more rotund than male, with bilobed frontal region. Hands of chelipeds flattened, pubescent on inner side between fingers; fingers of female short and straight, those of male curved and gaping. Male chela more robust than that of female. Ambulatory legs robust, carpus and propodus about equal in length, dactyl shorter than propodus and somewhat curved. Third ambulatory leg longest. Dactyl of last ambulatory leg reaching middle of carpus of third leg. Female carapace length 11.7 mm.

Color in life.--Brown to brownish red, dirty white, yellowish to pure white.

Habitat.--Usually symbiotic in mantle cavity of pelecypods, rarely gastropods, holothurians, and ascidians in sheltered intertidal areas.

Range.--Prince of Wales Island, Alaska to Camalu Point, Baja California, Mexico. Type locality Puget Sound, Washington.

Remarks.--The mantle pea crab is another common pinnotherid of intertidal habitats, but can be confused with P. littoralis. Males of P. faba have characteristic chelae in which the fixed fingers are straight and tapering to a conical tip; in P. littoralis, the fixed fingers are slightly deflexed and have excavated tips. Females of P. faba have fingers of the chelae without gapes; in P. littoralis, the fingers gape slightly when closed. For further details on differentiation of P. faba from P. littoralis, see Zmarzly (1992).

Pinnixa occidentalis Rathbun

Pinnixa occidentalis Rathbun, 1893: 248.--Holmes 1900: 89.--Rathbun 1904: 187, pl. 7, fig. 4, pl. 9, figs. 6, 6a (in part).--Rathbun 1918: pl. 34, fig. 1, text-fig. 96.--Schmitt 1921: 262, pl. 42, figs. 5,6; text-fig. 156.--Schmitt et al. 1973: 115.--Carlton and Kuris 1975: 407.--Zmarzly 1992: 700, fig. 12.

Recognition characters.--Carapace about 2X as long as wide, dorsal surface pitted and irregular. Carapace with cardiac crest, crest bilobed in males; anterolateral margin with granulated ridge running from orbit diagonally outward and backward, crossing hepatic region. Chelipeds stout and setose, immovable finger short and markedly deflexed, with stout tooth in middle and small tooth near apex; dactyl much curved, with or without tooth at middle. Male chela more robust than that of female, with proportionally shorter fixed finger having stout, flat tooth proximally. Ambulatory legs setose and with slender dactyls. First legs shorter than chelipeds, second pair longer and stronger than first, third pair longest, fourth legs reaching carpus of third leg and with dactyl as long as propodus. Male carapace length 9.5 mm, female 10.5.

Color in life.--Dirty white.

Habitat.--Subtidal to 439 m, in green sand or mud, commensal with echiuroid worms. Very common along continental shelf of southern California.

Range.--Unalaska to Magdalena Bay, Baja California. Unverified report from "Gulf of California". Type locality south of Unimak Island, Alaska.

Pinnixa scamit Martin and Zmarzly

Pinnixa scamit Martin and Zmarzly, 1994: 354, figs. 1-2.

Recognition characters.--Carapace 2X wider than long, highly sculptured, with anterolateral ridge bearing pronounced and slightly anteriorly-curved teeth; frontal margin with deep median cleft; cardiac ridge present and granular. Chelipeds slightly dimorphic, left larger. Fixed finger slightly deflexed, nearly 0.5X length of palm. Dactyl and fixed finger each with pronounced tooth at approximately midlength and row small transparent teeth merging distally into sharp ridge along cutting edges. Palm with scattered short setae and granules on outer surface, serrate ridge on dorsal border. Carpus and merus with acute teeth on dorsolateral and dorsodistal surfaces. Ambulatory legs long and slender. Each leg with row of well developed teeth on dorsal and ventral borders of merus, carpus and propodus. Dactyls more or less straight. Fourth pereopod longest; its propodus with ventral margin bearing two ridges. Carapace width 7.4 mm.

Color in life.--Not reported.

Habitat.--311 m, "soft bottom".

Range.--Known only from type locality, western Santa Barbara Channel, SSW of Point Arguello, California.

Pinnixa schmitti Rathbun

Pinnixa schmitti Rathbun, 1918: 162, pl. 35, figs. 6,7,9; text-fig. 101.--Schmitt 1921: pl. 42, figs. 7-9, text-fig. 157.--Schmitt et al. 1972: 120.--Carlton and Kuris 1975: 407.--Garth and Abbott 1980: 617.--Ricketts et al. 1985: 387.--Zmarzly 1992: 702, figs. 13, 14.

Recognition characters.--Carapace 1.8-2.2X wider than long, laterally truncate; with prominent ridge of small, tightly packed granules curving along dorsal surface and ending at hepatic region. Numerous scattered granules along fronto-lateral parts of carapace. Perimeter of dorsal carapace pitted. Gastric region with transverse depression. Palm of chela swollen, upper and lower surfaces sinuous to slightly convex; outer and upper surfaces granulate in female, shiny and smooth in mature male. Tips of fingers of chela curving inward, without gape in female, with small gape in male. Inner margin of dactyl with small proximal tooth, fixed finger with several small teeth toward proximal end. Carpus of female cheliped scalloped. Ambulatory legs setose, with relatively long and slender dactyls. Rows of granules on merus of each ambulatory leg and also on carpus and propodus of last 2 pair walking legs. Third pair ambulatory legs longest, fourth pair reaching carpus of third pair. Carapace length 5 mm.

Color in life.--Not reported.

Habitat.--Intertidal to 146 m, in sand, commensal with echinuroids, holothurians, polychaetes, callinassids and rarely ophiuroids. Common in bays.

Range.--Port Levassheff, Unalaska, Alaska to San Diego, California. Type locality San Francisco Bay, California.

#### Pinnixa hiatus Rathbun

Pinnixa hiatus Rathbun, 1918: 164, pl. 36, figs. 1-4, text-fig. 102.--Schmitt 1921: 265, pl. 43, figs. 1-4.--Schmitt et al. 1972: 111.--Zmarzly 1992: 690, fig. 8.

Recognition characters.--Carapace about 2X wide as long, anterolateral margin without definite angle and marked by raised and granulate ridge up to hepatic region; posterior margin long and straight; front advanced and widely emarginate. Surface smooth, sparingly punctate, groove behind gastric region. Subhepatic region prominent. Chelae robust. Palm suboblong, upper margin convex, lower margin of palm and fixed finger with granulate ridge on distal half just above lower edge. Dactyl curved, with ridge and tooth near middle. Fixed finger shorter than dactyl and curving up toward it, having large tooth; in male, finger deeply excavate at distal tip and forming notch into which tip of dactylus can insert. Fingers gaping when closed. First ambulatory leg most slender. Dactyls of walking legs elongate and slender. Anterior edge of merus and posterior of propodus of each finely serrate, posterior edge of merus coarsely granulate. Posterior margin of third leg and both margins of last leg fringed with setae. Female carapace length 3.6 mm.

Color in life.--Not recorded.

Habitat.--Subtidal, 27-100 m, in green sand or mud. Commensal associations unknown.

Range.--Goleta, Santa Barbara County to San Diego and offshore islands, California. Type locality off Santa Catalina Island, California.

#### Pinnixa franciscana Rathbun

Pinnixa franciscana Rathbun, 1918: 161, pl. 35, figs. 1-4, text-fig. 100.--Schmitt 1921: 263, pl. 42, figs. 1-4.--Schmitt et al. 1973: 110.--Carlton and Kuris 1975: 398.--Garth and Abbott 1980: 671, fig. 25.38.--Ricketts et al. 1985: 307, fig. 238.--Zmarzly 1992: 687, fig. 7.

Recognition characters.--Carapace about 2X as wide as long, pitted, with blunt, straight cardiac ridge and granulate ridge running from orbit to branchial region. Palm of chela densely granulate, with ridge just above lower edge continued to end of fixed finger, finger fringed with setae and with line of granules through middle. Fingers wide, slightly gaping, tips crossing, dactyl with large triangular tooth, fixed finger also with tooth. Dactyls of walking legs slender. First walking leg reaching middle of dactyl of second. Third leg much larger than others. Dorsal margin of merus, carpus and propodus serrate, ventral margin of merus also serrate. Fourth leg setose, reaching middle of carpus of third. Female carapace length 5.7 mm.

Color in life.--Dirty brown to golden brown.

Habitat.--Intertidal to 47 m, sandy mud, commensal with echiurans, polychaetes and callianassid shrimp.

Range.--San Francisco Bay, California to Turtle Bay, Baja California. Type locality San Francisco Bay.



Pinnixa franciscana

Pinnixa weymouthi Rathbun

Pinnixa weymouthi Rathbun, 1918: 166, pl. 36, figs. 9-10, text-fig. 104.--Schmitt 1921: 266, pl. 43, figs. 9-10.--Schmitt et al. 1973: 124.--Carlton and Kuris 1975: 396.--Garth and Abbott 1980: 618, fig. 25.40.--Zmarzly 1992: 710, fig. 17.

Recognition characters.--Carapace smooth, sides subtruncate, anterolateral angles prominent; front advanced but deflexed, weakly bilobed; transverse depression in gastric region. Palm of chela with short coarse setae and scattered granules. Dactyl setose dorsally, longer than fixed finger, with small triangular tooth toward proximal end and row of small teeth near tip of dactyl. Fixed finger with triangular tooth at middle and small teeth opposite those of dactyl. Fingers with small gape proximally when closed. Ambulatory legs fringed with setae, with nearly straight dactyls. Fourth leg longest and thickest. Ventral margin of propodus of second



ambulatory leg with 6 spines, that of third or fourth ambulatory leg with 4 spines. Dactyl of last walking leg extending to carpus of third leg. Male carapace length 3.3 mm.

Color in life.--Yellowish white.

Habitat.--Low intertidal zone to 10 m, in polychaete tubes.

Range.--Monterey and Pacific Grove, California. Type locality Monterey Bay, California.

### Pinnixa forficulimanus Zmarzly

Pinnixa forficulimanus Zmarzly, 1992: 685, fig. 6.

Recognition characters.--Carapace 1.8-2.2 X wide as long, flattened, shiny, dorsal surface with shallow pits, anterolateral region smooth and lacking ridge. Slight depression in gastric region. Frontal margin straight; median groove not well developed. Chela small and scissorslike, with long, thin fingers. Fingers about 2X palm, tips crossing when closed. Palm of chela sparsely setose, dorsal margin of dactyl also setose. Ambulatory legs similar in form and flattened, with smooth margins. Third pair legs more robust than others. Dactyls slender and straight to slightly curved. Tip of dactyl of last walking leg reaching middle of carpus. Carapace length about 2 mm.

Color in life.--Carapace translucent, organs visible within, with brown coloration.

Habitat.--Sandy areas, 12-46 m. Commensal associations unknown.

Range.--Santa Cruz to San Diego, California. Type locality Santa Cruz, California.

### Pinnixa minuscula Zmarzly

Pinnixa minuscula Zmarzly, 1992: 697, fig. 11.

Recognition characters.--Carapace oval, 1.7-2.0X wider than long, surface smooth and flat, anterolateral region smooth and without ridge, with slight depression in gastric region. Ventrally directed edge of anterolateral region granulate, sometimes with long plumose setae. Chelae sexually dimorphic. Female and immature male with fingers about equal in length of palm, tips of fingers curving inward, tip of dactyl closing into toothed pocket on fixed finger. Dorsal margin of dactyl with 6-10 tubercles, sparsely setose. Inner margin of dactyl concave, with small serrations. Fixed finger robust, with small serrations. No gape when closed. Mature male with more robust chela, palm wider than in female and fingers relatively shorter. Ambulatory legs flattened, with long slender dactyls. Third ambulatory leg most robust, its propodus with 4-6 sharp spines on ventral margin. Dactyl of last ambulatory leg reaching distal end of carpus of preceding leg. Carapace length about 2 mm.

Color in life.--Carapace somewhat translucent, internal organs visible within, otherwise orange brown.

Habitat.--Sandy substrates, 27-50 m. Commensal associations unknown.

Range.--Goleta, Santa Barbara County to San Diego, California. Type locality San Diego.

## Family Ocypodidae

The ghost crabs and fiddler crabs are common in sandy areas, marshes and mangroves swamps of tropical areas; however, only one species lives in southern California. Previous records of Ocypode gaudichaudii Milne Edwards and Lucas and Uca musica Rathbun from California, U.S.A. and Vancouver Island, British Columbia are based on incorrect locality labels. Both of these species do not occur north of Magdalena Bay, Baja California or the Gulf of California.

These active crabs possess elongate stalked eyes that fold into long transverse orbits. The third maxillipeds almost cover the rounded oral field. The carapace is more or less rectangular and without lateral teeth. Members of the family are almost entirely intertidal, although some may construct deep burrows. The reader should consult the volume by Crane (1975) for an exhaustive treatment of the species of Uca worldwide.

### Genus Uca Leach

#### Uca crenulata crenulata (Lockington)

Gelasimus crenulatus Lockington, 1876: 149.

Uca crenulata.--Holmes 1900: 75, pl. 1, figs. 7-9.--Rathbun 1904: 190.--Rathbun 1918: 409, pl. 146.--Schmitt 1921: 279, fig. 164.--Ricketts et al. 1985: 354, fig. 273.

Uca crenulata crenulata.--Crane 1975: 232, pl. 30 E-I, figs. 70D, G, 101.--Garth and Abbott 1980: 622, fig. 25.46.--Bonfil, Carvacho and Campos 1992: 50, fig. 5B.

Recognition characters.--Frontal region, narrow, less than 0.3X width of carapace. Orbits nearly straight, suborbital margins with rounded tubercles. Carapace smooth, moderately convex; lateral margins nearly parallel behind acute anterolateral angles, then converging. Male major cheliped with outer surface finely granulated; inner surface with oblique tuberculate ridge running vertically down from dorsal surface, then bending obliquely to run somewhat parallel to gape; two rows of denticles at base of fixed finger. Fingers of old male cheliped longer than those of younger male. Smaller chela of both sexes with fingers equal, gape narrow. Ambulatory legs with pile, merus transversely granulate. Abdomen of male with 7 segments. Carapace length to 13 mm in either sex. (See Crane, 1975 for more detailed description).

Color in life.--Carapace grayish white to pale brown. Major chela of male with merus bright red on exterior surface, inner surface of merus and fingers of chela bright white, Palm and inner part of chela yellowish to white. Minor chela pinkish. Merus of first walking leg crimson red; otherwise cream-colored; other legs marked with cream. Female chelae brownish to cream-colored.

Habitat.--Upper parts of mud flats and salt marshes.

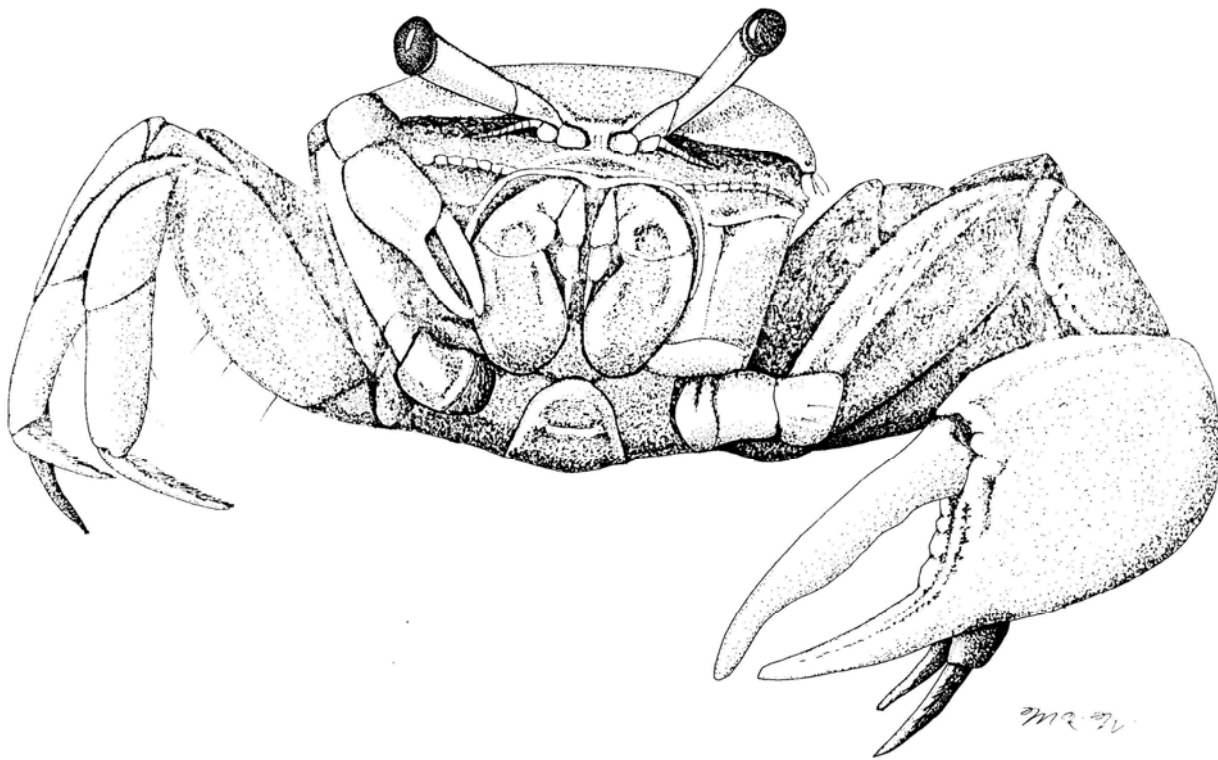
Range.--Discontinuous; from Goleta, California to Turtle Bay, Baja California, including Santa Catalina Island, California; and San Felipe to La Paz and Guaymas to Tenacatita Bay, western Mexico. Type locality Todos Santos Bay, Baja California. A distinct subspecies, U. crenulata coloradensis (Rathbun), lives at the head of the Gulf of California.

Remarks.--Fiddler crabs dig burrows in the upper reaches of mud flats and salt marshes. They manipulate balls of sediment in their mouthparts as they extract detritus and other food material. The burrows, mud balls and tracks are good indication of their presence even if the crabs themselves are not visible. The burrow may extend over 0.5 m into the sediment. Males

use the large chela in waving displays during courtship and in territorial interactions with other crabs. The crabs can autotomize limbs and regenerate them, which serves them well in escaping from predators such as black-crowned night herons. Because of their restricted habitat, fiddler crabs today live in California mostly in wildlife refuges and other areas protected from human habitat destruction.



Uca crenulata crenulata



Uca crenulata crenulata

## Family Grapsidae

The shore crabs and their relatives, family Grapsidae, inhabit intertidal regions or floating objects. Fast-moving and hardy, they are conspicuous inhabitants of temperate and tropical regions world-wide. Their eyestalks are not as long as those of the Ocypodidae, but their vision apparently is keen. They tend to be scavengers and grazers on algae instead of deposit feeders. They do not construct long burrows, as do the Ocypodidae. The crabs often are sexually dimorphic, with the male being larger and more brightly colored than the female.

Except for the smallest crabs, which tend to be translucent to drably colored, colors tend to be species-specific in the grapsid crabs of California and Oregon. However, a rare color form, in which the carapace is either entirely china white to yellowish or patched with these colors, and the walking legs are banded, occurs in both species of Hemigrapsus.

Three species of the Grapsidae are common in intertidal areas of California and Oregon. Another two species rarely occur on floating objects, and may be cast ashore after severe storms. Holmes (1900, p. 84) described yet another grapsoid, Grapsodius eximius, from San Diego, California. This crab resembled a species of Pachygrapsus, but had the posterior surface of the orbits "bulging outwards". The crab has not been reported since its description, and may be an aberrant specimen of a species of Pachygrapsus. A record of Pachygrapsus transversus (Gibbes) from California (Schmitt, 1921) probably is in error. The species ranges from the southern Gulf of California south to Peru.

### Key to the Species of the Family Grapsidae

1. Carapace as long as or longer than broad, subcircular, smooth. Anterior edges of ambulatory legs with thick fringe of setae. Pelagic, usually found among floating debris or on sea turtles-----2

Carapace broader than long, square to somewhat trapezoidal, smooth or marked with grooves. Anterior edges of ambulatory legs without thick fringe of setae. Intertidal -----3

2. Lateral margins of carapace convex, front with slight median depression. Upper margin of cheliped rounded-----Planes minutus Dana.

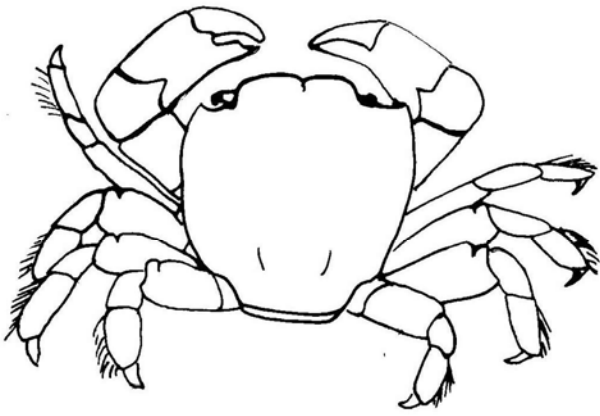
Lateral margins of carapace straight, front straight. Upper margin of cheliped angled-----Planes marinus Rathbun.

3. Carapace transversely striated. External maxillipeds with wide gape-----Pachygrapsus crassipes Randall.

Carapace more or less smooth. External maxillipeds with moderate gape-----4

4. Ambulatory legs setose. Front with deep median sinus. Chelae not spotted with red or purple-----Hemigrapsus oregonensis (Dana).

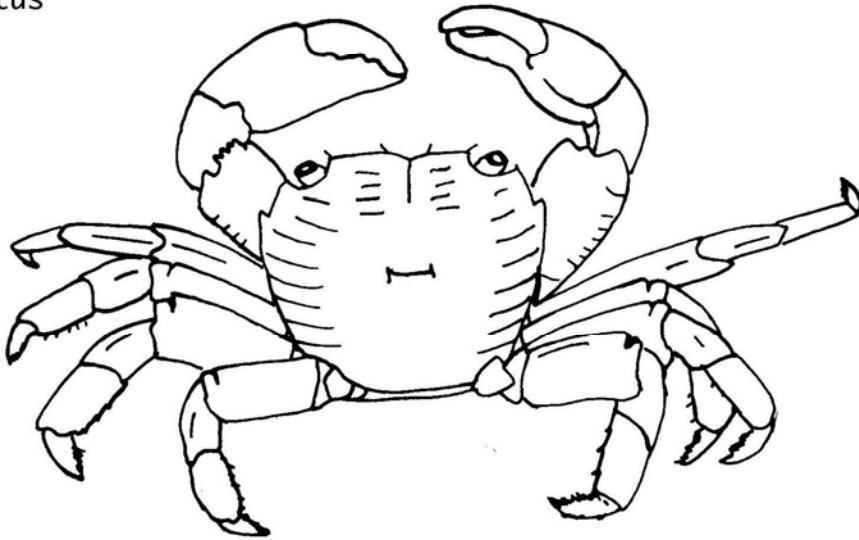
Ambulatory legs smooth. Front somewhat sinuous. Chelae spotted with red or purple-----Hemigrapsus nudus (Dana).



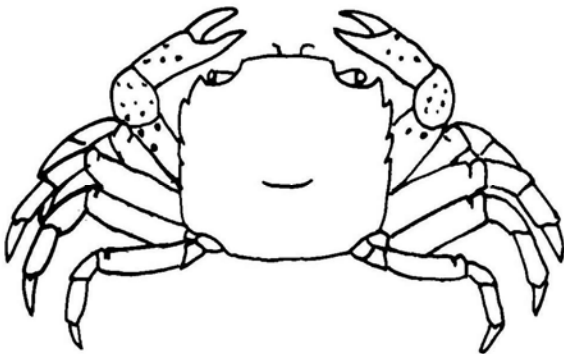
Planes minutus



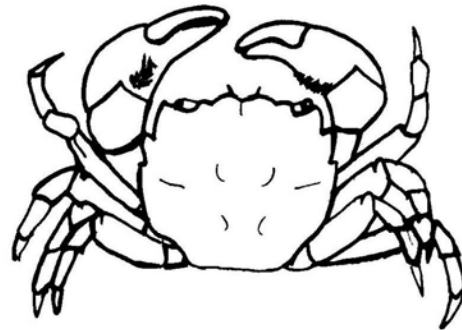
Planes marinus



Pachygrapsus crassipes



Hemigrapsus nudus



Hemigrapsus oregonensis

## Genus Planes Bowdich

### Planes cyaneus Dana

Planes cyaneus Dana, 1851: 250.--Chace 1951: 65.--Hart 1963: 127.--Chace 1966: 646.--Manning and Holthuis 1981: 235.

Planes minutus.--Rathbun 1904: 189.--Rathbun 1918: 253, pl. 63 (in part).--Schmitt 1921: 272, pl. 46.--Garth 1946: 510.

Not Planes minutus (Linnaeus, 1758).

Recognition characters.--Carapace as long as broad, subcircular, almost smooth but for few faint lines on anterior and lateral regions, single blunt tooth behind postorbital angle, front sinuous. Chela broad, fingers somewhat deflexed, with several oblique lines on dorsal and ventral surfaces, somewhat obscure longitudinal line on lower portion of propodus; one tooth on inner margin of lower finger and 2-3 on dactyl. Ambulatory legs broad, somewhat flat, especially propodus and dactyl, anterior margins with dense fringe of setae, 1-3 spinules on lower distal margin of merus. Carapace length 15 mm.

Color in life.--Two color phases: mottled with yellowish brown or dark brown and white; or blue.

Habitat.--Pelagic among floating debris and barnacles (Lepas spp.) or on sea turtles, often near tail of turtle.

Range.--Widespread between 41° N and 35° S in Pacific; eastern Pacific from off British Columbia to Peru; Indian Ocean, southern Atlantic Ocean; rare in northern Atlantic and Gulf of Mexico.. Type locality Pacific Ocean at 28° N, 174°E (west of Midway Island).

Remarks.--Specimens of P. cyaneus from off Panama were encrusted by the naked barnacle Conchoderma virgatum.

### Planes marinus Rathbun

Planes marinus Rathbun, 1915: 120, pl. 3.--Rathbun 1918: 258, pl. 64.--Chace 1966: 646.

Pachygrapsus marinus.--Chace 1951: 65.--Edmondson 1959: 169, fig. 8b.--Hart 1963: 127.--Carlton and Kuris 1975: 408.

Recognition characters.--Carapace somewhat broader than long, lateral margins nearly straight and converging posteriorly, one blunt tooth behind postorbital tooth; front more or less straight; surface of carapace marked by grooves. Chelipeds heavy, merus marked by short lines, antero-distal border expanded and dentate; carpus with blunt tooth at inner angle, palm swollen, fingers curved and with teeth. Ambulatory legs short, flat, merus broad, anterior border of propodus with dense setae, dactyl short and bearing spines and setae. Male carapace length 9 mm, female carapace length to 15 mm.

Color in life.--Not reported.

Habitat.--On floating objects.

Range.--British Columbia to Baja California, off Oahu, Hawaiian Islands; New Zealand, off St. Helena in southern Atlantic. Type locality west of "Lower California".

Remarks.--There are fewer reports of this species than of Planes cyaneus in California and Oregon. It has been taken at sea off British Columbia and been cast ashore in Oregon. Planes cyaneus and Planes marinus may co-occur on the same drifting log.

## Genus Pachygrapsus Randall

### Pachygrapsus crassipes Randall

Pachygrapsus crassipes Randall, 1839: 125, pl. 5, fig. 4.--Holmes 1900: 79.--Rathbun 1904: 189.--Rathbun 1918: 241, pl. 59.--Schmitt 1921: 270, text-fig. 159, pl. 45.--Carlton and Kuris 1975: 393.--Garth and Abbott 1980: 619, fig. 25.43.--Ricketts et al. 1985: 42, fig. 27.

Recognition characters.--Carapace nearly square, lateral margins broadest behind orbit; entirely upper surface except cardiac and intestinal regions transversely grooved; sides with single tooth posterior to prominent postorbital tooth. Third maxillipeds with merus lobate at antero-internal angle. Chela of adult male broad and heavy, raised line present on upper side of propodus and smaller line on lower portion of outer surface, tips of fingers spooned. Female chela not as broad as male. Merus of each ambulatory leg broad, with tooth on posterodistal angle except on fifth legs; propodus and dactyl of each leg spinulose. Male carapace length 41 mm.

Color in life.--Carapace dark green with faint whitish stripes, inner surface of chela white, male chela bright red above, white below.

Habitat.--Upper intertidal rocks, sometimes docks and pilings or mud flats.

Range.--Charleston, Oregon to Santa Margarita Island and Alijos Rocks, Pacific coast of Baja California; sporadic in Gulf of California; also Japan and Korea. Type locality "Sandwich Islands", but probably an error. Most of Randall's specimens came from California, especially near Monterey, Los Angeles and San Diego.

Remarks.--Pachygrapsus crassipes is one of the most common crabs of California and Oregon. The megalops larvae can ride on drifting seaweed or wood, thus giving the species great capacity for dispersal. The population in Asia may have been introduced in ballast water from ships.



Pachygrapsus crassipes

Genus Hemigrapsus Dana

Hemigrapsus oregonensis (Dana)

Pseudograpsus oregonensis Dana, 1851: 248.--Dana 1852: 334.--Dana 1855: pl. 20, fig. 6.

Hemigrapsus oregonensis.--Rathbun 1904: 189.--Rathbun 1918: 270, pl. 70.--Schmitt 1921: 274, text-fig. 162, pl. 48.--Carlton and Kuris 1975: 393, pl. 92, figs. 4A-D, 5.--Garth and Abbott 1980: 621, fig. 25.45.--Ricketts et al. 1985: 358, fig. 275.--Bonfil, Carvacho and Campos 1992: 39, fig. 1B.

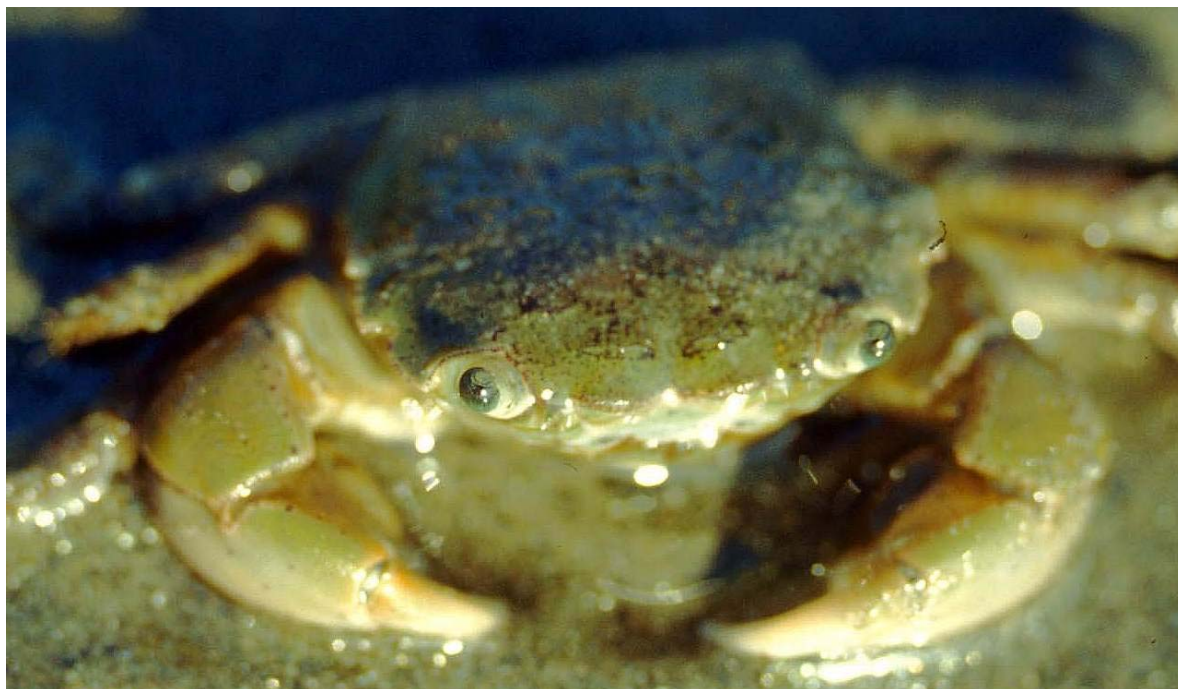
Recognition characters.--Carapace more or less square and smooth, with two lateral teeth posterior to postorbital tooth. Front with deep median sinus. Chelipeds smooth, adult male with rounded lobe on antero-internal angle of merus and patch of setae on inner surface of propodus; fingers of cheliped curved, with teeth and spooned. Ambulatory legs with coarse, sparse setae, dactyls narrow. Male carapace length to 29 mm.

Color in life.--Greenish to muddy gray, sometimes with minute black dots; fingers of chela white and without red-purple spots.

Habitat.--Intertidal, usually salt marshes and mud flats but also quiet, protected tidepools and gravel flats.

Range.--Resurrection Bay, Alaska to Turtle Bay, Baja California, Mexico. Type locality "Puget Sound".

Remarks.--In bays and harbors, H. oregonensis can occur by the hundreds.



Hemigrapsus oregonensis

Hemigrapsus nudus (Dana)

Pseudograpsus nudus Dana, 1851: 249.--Dana 1852: 335.--Dana 1855: pl. 20, fig. 7.

Hemigrapsus nudus.--Rathbun 1904: 189.--Rathbun 1918: 267, pl. 68.--Schmitt 19821: 273, text-fig. 161, pl. 47.--Carlton and Kuris 1975: 393.--Garth and Abbott 1980: 621, fig. 25.44.--Ricketts



et al. 1985: 358, fig. 275.

Recognition characters.--Carapace more or less square, posteriorly flat, front somewhat sinuous, with two lateral spines posterior to postorbital spines. Chelipeds smooth, fingers curved, with teeth on margins and spooned, larger in male than in female; male chela with patch of pile on inner surface of propodus. Ambulatory legs without setae, dactyls short. Length of male carapace to 45 mm.

Color in life.--Carapace dark red to purple, upper parts of ambulatory legs same color as carapace, lower parts yellowish to white; chelae with conspicuous spots of red to purple.

Habitat.--Tide pools, boulder and cobble fields, upper to mid-tidal zone.

Range.--Yakobi Island, Alaska to Turtle Bay, Baja California, but uncommon south of Point Conception, California. Type locality "Puget Sound". Records of this species from the Gulf of California are in error.

Remarks.--This is another very common intertidal crab.



Hemigrapsus nudus



partial albino Hemigrapsus nudus

## Family Palicidae

Only one species and only one specimen of this family have been reported from California. Older works refer to this family as the Cympolidae, but the generic name Cympolia has been found to be a homonym. See Holthuis and Gottlieb (1958) for further information on the nomenclature of this family.

Genus Palicus Philippi

Palicus lucasii Rathbun

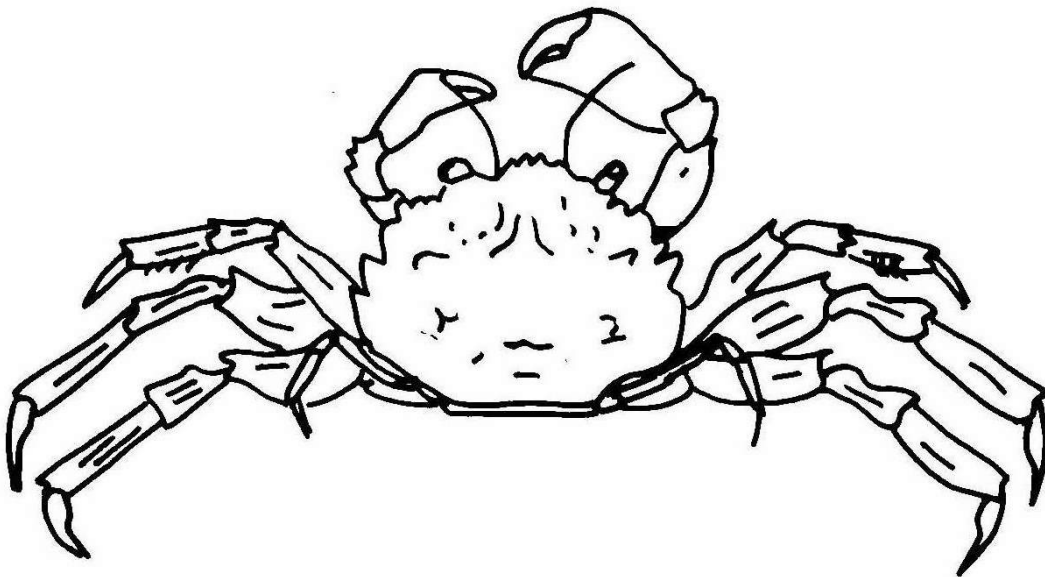
Palicus lucasii Rathbun, 1898: 600, pl. 43, fig. 2.

Cympolia lucasii.—Rathbun 1918: 193, pl. 44, figs. 1-2; text-fig. 119.—Garth 1947: 500, pl. 87, fig. 1.

Recognition characters.—Eyes large. Carapace slightly wider than long, with 4 frontal lobes, anterolateral margin with 2 acute teeth beyond exorbital; supraorbital teeth sharp; dorsal surface of carapace tuberculate. In adult male, right chela heavier than left. Ambulatory legs wide, merus of legs 1 and 2 with sharp tooth at distal end; merus of leg 3 with rounded lobe. Dactyls of legs 2 and 3 with sinuous margins. In adult male, first walking leg with shaggy setae. Last ambulatory leg short, slightly longer than merus of leg 3. Male carapace length to 13.5 mm. Color in life.—Carapace with solid median band of blood red extending from front to posterior border. Most of carapace white; anterolateral and preorbital teeth blood red, orbital tooth white. Legs 1-3 banded with red and white; tip of dactyl white; reduced leg entirely white (color notes by Garth, 1947).

Habitat.—Muddy and sandy bottoms, 9-111 m.

Range.—Off Malaga Cove, Palos Verdes Peninsula, California to Galapagos Islands. Type locality off Cape San Lucas, Baja California, Mexico.



*Palicus lucasii*

## Crustaceans As Pets

With the increased interest in marine and freshwater invertebrates as pets or as display animals for schools and offices, numerous crustaceans are being imported into pet stores. Most of these are tropical species collected in the Philippines, Indonesia and Ceylon in the Indo-Pacific or off Florida in the Atlantic, but specimens also at times are imported from the Gulf of California, Mexico and eastern Africa. The popular book by Debelius (1999) gives names and photographs of many of these species. The majority of these animals, unable to tolerate cold temperatures, do not survive in the wild in California or Oregon.

Perhaps the most common pet crustacean is the land hermit crab, Coenobita clypeatus, from the Caribbean region. This semi-terrestrial crab stores water in its shell and its gill chambers. An omnivore, it eats commercial fish food pellets, dog food, soft plants and many other foods. In captivity, care should be taken not to give it food that will spoil or attract flies. It is wise to provide the crabs with a source of calcium carbonate, such as egg shell.

Coenobita is most active at night, although it will move around if sprayed with water at any time of day. These crabs normally release their larval stages into the ocean, and so will not readily reproduce in captivity.

At times, other live crustaceans such as fiddler crabs (Uca spp.), blue crabs (Callinectes sapidus), Maine lobsters (Homarus americanus) or other crustaceans may be available for sale from dealers in live bait, seafood dealers or biological supply companies. These animals should be used for food or investigation in the aquarium and not be released into the wild. State and federal laws are very strict regarding the introduction of potential pests into the western United States.

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