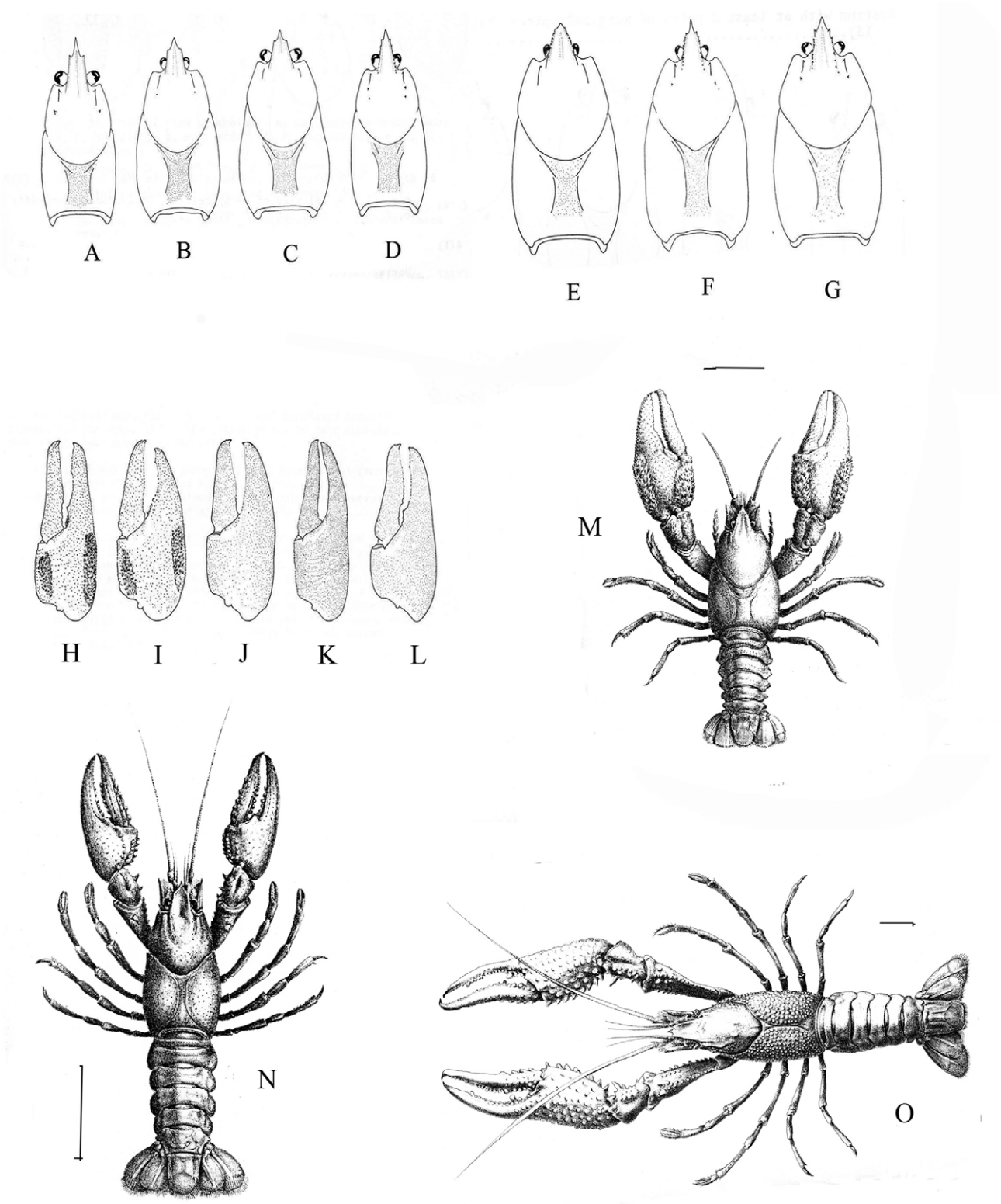

FIGURE 30. Families Astacidae and Cambaridae. Eyes and carapaces: A, *Pacifastacus gambelii* (Girard, 1852); B, *Pacifastacus nigrescens* (Stimpson, 1857); C, *Pacifastacus fortis* (Faxon, 1914); D, *Pacifastacus leniusculus leniusculus* (Dana, 1852); E, *Pacifastacus leniusculus trowbridgii* (Stimpson, 1857); F, *Pacifastacus leniusculus klamathensis* (Stimpson, 1857); G, *Pacifastacus connectens* (Faxon, 1914). Chelae: H, *Pacifastacus connectens*, I, *Pacifastacus gambelii*; J, *Pacifastacus fortis*; K, *Pacifastacus nigrescens*; L, *Pacifastacus leniusculus*. M, *Pacifastacus gambelii*. N, *Orconectes virilis* (Hagen, 1870). O, *Procambarus clarkii* (Girard, 1852); male. Scales: M = 10 mm, N, O = 20 mm. A–L from Hobbs 1976; M–O from Hagen 1870 (as *Astacus gambelii*, *Cambarus virilis* and *Cambarus clarkii*).

Diagnosis. Similar to *P. leniusculus* except rostrum with numerous small teeth, median carina often present. Postorbital ridges lacking posterior teeth or tubercles. Dorsal surface of major chela with two conspicuous patches of setae, as well as minute tubercles. Carapace length to 35 mm.

Color in life. Brown, greenish to blackish.

Habitat and depth. Rivers, streams; shallow.

Range. Snake River and its tributaries in Idaho, Nevada, Utah, and Wyoming; see map by Larson & Olden (2011: Fig. 1). Reported from Oregon, Montana, and Washington, also upper Missouri River and other drainages east of Continental Divide but records may be due to misidentifications. Type locality "California", but there have been no subsequent records from this state (Larson & Olden 2011).

Pacifastacus leniusculus (Dana, 1852)

(Fig. 30D–F, L)

Astacus leniusculus Dana, 1852: 524. — Stimpson 1857b: 493. — Hagen 1870: 94. — Holmes 1900: 166. — Bonnot 1930: 212, figs. 65–67.

Pacifastacus leniusculus. — Riegel 1959: 39, fig. 1F–H, fig. 3A, 6. — Miller & Van Hyning 1970:77, figs. 1, 2. — Abrahamsson & Goldman 1970: 83. — Hobbs 1976: 21, figs. 5a,12 a–c, 14e. — Eng & Daniels 1982: 200, fig. 1a. — McGriff 1983: 227. — Kuris *et al*. 2007: 636. — Larson & Olden 2011: 64, p. 61 figs. C, D.

Diagnosis. Rostrum acute, with single pair marginal teeth or tubercles, with or without median carina, with dorsal surface depressed. Postorbital ridges rounded or with pair of teeth or tubercles. Carapace with prominent cardiac grooves, 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 tooth. Scaphocerite with acute lateral tooth, as long as or slightly longer than rostrum. Third maxilliped setose, ischium armed with sharp spines on mesial, lateral margins of distal margin (forming "crista dentata"), next segment armed with spinules. Major chelae with smooth to tuberculate surface. Length of fingers about 3 times as long as length of palm, fixed finger with low tooth on cutting edge near proximal end. Outer margin of palm convex, inner convex, flared proximal to dactyl. Inner margin of palm with crest, slight depression parallel to crest on inner, upper, 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 tooth at distal inner end, large tooth, row of teeth along lower edge, 2 teeth parallel, inner to this row. Ischium with tubercles in line with those of merus. Pereopods 2, 3 chelate, sparsely setose. Pereopods 4, 5 with dactyls forming claws. Ischia of all pereopods lacking hooks. Male pleopod 1 simple in structure, slender setose ridge along distal mesial surface. Male pleopod 2 with strong endopod, slender exopod. Female pleopod 1biramous. Abdomen heavy. Abdominal somites decreasing in size from 1–5, with pleura ending in points curving posteriorly. Pleura of abdominal somite 6 prolonged into hook around base of uropods. Telson with horizontal fissure along dorsal surface near posterior end, 2 lateral teeth 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. The color notes are from specimesn from Lake Tahoe, Nevada.

Habitat and depth. Rivers, streams, lakes, sloughs; less than 1 m to as much as 40 m (Lake Tahoe, Abrahamsson & Goldman 1970).

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 & Van Hyning (1970: fig. 3) provided a map of the range of the species in Oregon. Larson & Olden (2011: fig. 1) gave a map of the distribution of the subspecies in Oregon, Washington, southern British Columbia and extreme northwestern California.

Remarks. Three subspecies of *P. leniusculus* have been described: *P. leniusculus leniusculus* (Dana, 1852); *P. leniusculus klamathensis* (Stimpson, 1857) and *P. leniusculus trowbridgii* (Stimpson, 1857). 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.

Pacifastacus nigrescens (Stimpson, 1857)
(Fig. 30B, K)

Astacus nigrescens Stimpson, 1857a: 87; 1857b: 492. — Hagen 1870: 92, pl. III, fig. 168. — Holmes 1900: 166. — Bonnot 1930: 212.
Pacifastacus nigrescens. — Riegel 1959: 44 (part, figures probably are of *P. fortis*). — Hobbs 1976: 23, fig. 13b, 14d. — Kuris *et al*. 2007: 636 .— Larson & Olden 2011: 62.

Diagnosis. Similar to *P. leniusculus* except rostrum concave, with prominent, acute apex; 5 or 6 lateral teeth, 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.

Color in life. Blackish.

Habitat and depth. Streams near the coast. Depth not reported.

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 said that he purchased his specimens in a market.

Remarks. There have been 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

Orconectes Cope, 1872

Orconectes virilis (Hagen, 1870)
(Fig. 30N)

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. — Johnson & Johnson 2008: 47, photo page 54. — Larsen & Olden 2011: 66, p. 69 fig. C.

Diagnosis. Rostrum with dorsal groove, acute apex well removed from pair lateral teeth. Carapace with sharp cervical spines, prominent antennal angle. Pereopod 1 merus with large tooth near articulation with carpus, smaller teeth on mesial surface, carpus with two large teeth on mesial side. Major chelae with dorsal groove, double row of tubercles on dorsomedial side of palm in adult male; fingers straight, cutting edges lined by blunt teeth, double row of tubercles along mesial side of movable finger; Male with hooks on ischia of pereopod 3. Copulatory structures of male forked, deeply divided, apices of forks well separated, curving posteriorly. Annulis ventralis of female with high, narrow anterior wall divided by fissure, median depression wide, deep. Carapace length to more than 20 mm.

Color in life. Carapace, abdomen greenish-brown; claws, walking legs bluish-green; apices of chelae orange; see Johnson & Johnson (2008: 54) for good color photographs.

Habitat and depth. Lakes, rivers and streams, especially in swiftly moving, turbid water, shore to 20 m.

Range. Native to Canada and northeastern and north-central United States, but widely distributed throughout United States, either originally or through human introduction. 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 San Gabriel River, Texas.

Procambarus Ortmann, 1905

Procambarus clarkii (Girard, 1852)
(Fig. 30O, Pl.5B)

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. — Rodriguez-Alvarez & Campos 1994: 729. — Johnson & Johnson 2008: 69, photo pages 70–72. — Kuris *et al*. 2007: 636. — Larson & Olden 2011: 66, p. 69 fig. D.

Diagnosis. Rostrum shorter than scaphocerite or antennular peduncle, with one pair teeth on postorbital ridge. Carapace somewhat granulate. Width of areola very narrow, cervical groove, branchiocardiac grooves delineating small triangular area on dorsal surface. Cervical tooth present. Third maxilliped setose, its ischium with inner distal margin ending in large tooth. Chelipeds narrow. Ischium with teeth in line with those of merus. Merus with teeth, tubercles on upper surface, distal margin, row of teeth on lower margin, smaller row mesial to this row. Carpus with 2 large inner teeth as well as tubercles. Palm of chela tuberculate, with teeth on inner margin; fingers longer than palm. Fixed finger with 2 large, 2 small teeth on cutting edge near proximal end. Dactyl may be concave on outer margin, with 2–3 tubercles on proximal end. Pereopods 2, 3 chelate, smooth. Pereopods 3, 4 with ischial hooks. Pereopods 4, 5 with simple dactyls. Abdominal pleura diminishing in size from 1–5, pleura blunt or with minute terminal tooth curved posteriorly. Pleura of abdominal somite 6 forming hook around base of uropods. Abdominal somites 1, 2 with dorsal sulci running across dorsal surface. Male pleopod 1 with prominent shoulder on cephalic surface. Male pleopod 2 with calcified endopod, soft exopod. Telson with lateral, median sulci, V-shaped fissure with 2 teeth on each side of fissure. Outer uropod with fissure and lateral tooth, also median ridge; inner uropod with lateral spine, median ridge. Male total length 82 mm, female smaller.

Color in life. Juveniles often camouflaged, brown, striped, or mottled; adults bluish to dark green, often with red spots on chelipeds; lower parts orange in breeding adults. Albinos are rare. Johnson & Johnson (2008: 70–72) gave a series of photographs of many color morphs of this species.

Habitat and depth. Ponds, shallow streams, ditches, lakes, shore to at least 6 m. After floods, has been found crossing wet ground and can be washed into estuaries.

Range. Native to southern Illinois to northern Mexico and Escambia County, Florida, but introduced widely elsewhere, including California and northern Mexico. Reported as far south as Ensenada in Baja California Norte and San Juan River in Nuevo Leon, Mexico (Rodriguez-Almaraz & Campos 1994); also introduced into Europe and Japan. Type locality "between San Antonio and El Paso del Norte, Texas." Larson & Olsen (2011: fig. 1) gave a map of the distribution in Oregon, Washington, Idaho and Utah.

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.

INFRAORDER PALINURA LATREILLE, 1802

The spiny lobsters are entirely marine. Unlike lobsters of the Astacidea, they have a small rostrum, if any, and do not have heavy pincers. Spiny lobsters have a fragile planktonic larval stage, the phyllosoma. Only one species of one family is native to California and northwestern Mexico. Fitch (1962) reported *Panulirus gracilis* Streets, 1871 from a single specimen taken near the San Diego harbor breakwater, but there have been no subsequent reports of this species from the area.

De Grave *et al*. (2009), following a phylogenetic study by Scholtz & Richter (1995), changed the name of the Infraroder Palinura s.s. to the Achelata. I can see no benefit to changing such a familiar and long-used name. This latest system of classification of spiny lobsters does not include superfamilies.

Family Palinuridae Latreille, 1802

Panulirus White, 1847

Panulirus interruptus Randall, 1840
(Pl. 4D)

Panulirus interruptus Randall, 1840: 137. — Stimpson 1857b: 491. — Rathbun 1904: 148 .— Schmitt 1921: 108, fig. 73. — Johnson & Snook 1927: 315, fig. 268, 270. — Ricketts *et al*. 1985: 195, fig. 168. — Williams 1986b: 21, fig. 49, color fig. 79 h, i. — Holthuis 1991: 142, fig. 271.— Jensen 1995: 79, fig. 161. — Hendrickx 1995b: 155.

Diagnosis. Carapace subcylindrical, rostrum absent. Supraorbital teeth strong, eyes not set in orbits. Carapace with numerous teeth, cervical groove. Antennules slender, antennular peduncle slightly longer than antennal peduncle. Antennal flagellum as long as body, armed with spinules; peduncle heavy, spinulose. Pereopods 1–4 with setose, simple dactyls; female pereopod 5 with hooked dactyl, prominent overlapping hook on propodus. Abdominal somites with deep dorsal sulci separated along dorsal midline; abdominal pleura ending in sharp points. Telson rectangular, with tubercles, teeth toward proximal end; uropods as long as telson, similarly armed with tubercles, spinules. Total length to more than 60 cm.

Color in life. Dark green, reddish or brown, with two "eyepots" above base of first antennae; rarely albino. The color notes are from specimens from southern California.

Habitat and depth. Rocky tide pools at extreme low tide, among surf grass (*Phyllospadix* sp.), rocky reefs, breakwaters, and kelp beds; lowest intertidal zone to 70 m.

Range. San Luis Obispo County, California to Magdalena Bay, Baja California; along west coast of Gulf of California from Carmen I. to vicinity of Cape San Lucas, 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. The adults are taken by hand by divers or in traps used by fishermen.

INFRAORDER POLYCHELIDA WOOD-MASON, 1874

Unlike the spiny lobsters, the flatback lobsters are deep-water benthic species with elongated chelae, held folded against the sides of the cephalothorax in life. The animals have eyestalks but are blind. The larval stage (the "eryonicus" larva) has an inflated cephalothorax filled with lipids.

Family Polychelidae Wood-Mason, 1874

Polycheles Heller, 1862

Polycheles pacificus Faxon, 1893
(Fig. 31A)

Polycheles sculptus pacificus Faxon, 1893: 196; 1895: 122, pl. c, fig. 1, 1a.
Eryonicus caecus?: Faxon 1893: 197; 1895: 110, pl. B, fig. 2; pl. 29, figs. 2, 2f (larval stage).
Eryoneicus Agassizi Bouvier, 1915: 2.
Eryonicus agassizi. — Schmitt 1921: 105, pl. 15, figs. 1, 2.
Stereomastis sculpta pacifica. — De Man 1916: 5. — Firth & Pequegnat 1971: 16.—Wicksten 1980b: 914, fig. 1. — Hendrickx 1995b: 156.
Stereomastis pacifica. — Wicksten 2002: 128.
Polycheles pacificus. — Galil 2000: 332, fig. 20.

Diagnosis. Carapace somewhat rectangular, with posterolateral margins converging. Anterior margin slightly concave, with 2 rostral teeth, 1 tooth at each internal orbital angle, blunt tooth on anteromedial edge of each eyestalk; external orbital angles smooth. Ocular notches broad, rounded; edges not parallel with lateral border. Midline teeth arranged as follows: 2 (rostrum), 1–2–1(cervical groove) 2–2–2; occasionally with 1 tooth instead of 2 at each location. Posterior margin of carapace concave. Four teeth along gastrorbital carinae; 1 more tooth along each side. One tooth each on anterior branches. Superior branchial carinae low, armed with 5–6 teeth on each side.

Abdomen about as long as carapace. Terga of somites 1–5 with anteriorly produced teeth, strongest tooth on fourth tergum. Anterolateral border of first tergum with 3 teeth; edges of first four pleura armed with small tubercles. Abdominal somite 6 with low, double ridge without tubercles or teeth; pleuron almost acute. Base of telson with small blunt tubercle. Two teeth at antero-external edges of antennular peduncle. Ischia of chelipeds unarmed, meri with 1–3 dorsal teeth, carpi with 2 distodorsal, 1 or 2 ventral teeth, inner dorsal edge of propodus with 1 tooth, palms ventrally spinulose, fingers of chela crossing. Female pereopod 5 chelate, male pereopod 5 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 not specified, material came from 7 stations from off Mariato Point and the Gulf of Panama to off the Tres Marias Is., Mexico.

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 (Wicksten 1980b).

INFRAORDER AXIIDEA HUXLEY, 1879

These lobster-like crustaceans formerly included in a single infraorder, the Thalassinidea, have been split into two infraorders based on genetic analyses (Robles *et al*. 2009). De Grave *et al*. (2009) gave an extensive list of references on nomenclature of these decapods.

The rostrum varies from a tiny point to long and triangular or toothed. The eye may or be not pigmented. Pereopods 1, 2 are chelate, but the second are smaller than the first. The first pereopods may be dissimilar in size. 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. These decapods burrow into mud, sand or mixed surfaces.

Classification of the Axiidea has been an ongoing process. Manning & Felder (1991) wrote an extensive revision of the American callianassids, which contains diagnostic drawings and further information on the taxonomy. Poore & Collins (2009) wrote an extensive work on the genera and western Pacific species of the Axiidae. Sakai (2005) presented another system of classification of the Callianassidae and Ctenochelidae.The key presented here will differentiate between axiideans in the area of coverage but does not apply to tropical species. The latest classification of the Axiidea and Gebiidea does not include superfamilies (De Grave *et al*. 2009).

The ghost shrimps (family Callianassidae) are the best studied of the Axiidea. These burrowers range from the intertidal zone to the subtidal continental slope. They are deposit feeders. Their burrows provide shelter for other invertebrates, including shrimps (Alpheidae), crabs (Pinnotheridae), the clam *Cryptomya californica* (Conrad, 1837) and fishes (family Gobiidae).

Little is known of the natural history of species belonging to other species of the Axiidea. In California and Oregon, species of the families Axiidae and Ctenochelidae are found on the continental shelf and slope.

Diagnoses in this section for the most part follow those of Hart (1982) and Williams (1986). MacGinitie & MacGinitie (1968), Haig &Abbott (1980), and Ricketts *et al*. (1985) gave extensive information on the natural history of near-shore species.

Key to species of Axiiidea

1. Abdominal pleura large, firm. Rostrum triangular, with lateral teeth, carapace may have median ridge 2
– Abdominal pleura small or absent. Rostrum broad, with numerous small teeth, setae, or reduced to median tooth or low, rounded margin, carapace without median ridge 6
2. Rostrum slender, carapace with single dorsal ridge. Ridges of telson without teeth . . . . . 3 (Calocarididae)
– Rostrum broad, carapace with more than one ridge, teeth or rows of spinules. Ridges of telson with teeth 4
3. Chelipeds with small marginal teeth. Carapace granulate . . . . . *Lophaxius rathbunae*
– Chelipeds with prominent marginal teeth. Carapace smooth . . . . . *Calastacus stilirostris*
4. Carapace inflated. (Living at more than 200 m, among deep-sea sponges) . . . . . *Eiconaxius acutifrons* (Eiconaxiidae)
– Carapace not inflated. Not always living at 200 m or more, not associated with deep-sea sponges . . . . . 5 (Axiidae)

5. Eyes with pigment. Usually living at 200 m or less . . . . . *Calocarides spinulicauda*
– Eyes without pigment. Usually living at more than 200 m . . . . . *Calocarides quinqueseriatus*
6. Rostrum consisting of median tooth. Eyestalk elongate, unpigmented . . . . . *Callianopsis goniophthalma* (Ctenochelidae)
– Rostrum obscure to absent. Eyestalk flattened, pigmented. . . . . 7 (Callianassidae)
7. Eyestalk with tuberculiform apex. Living among rocks or sandy gravel from Santa Barbara County, California south. . . . . *Neotrypaea biffari*
– Eyestalk without tuberculiform apex. Living in sand or mud of bays or estuaries, Alaska to Baja California 8
8. Eyestalk with outer margin slightly concave, extending to 0.33 to 0.66 length of second segment of antennule . . . . . *Neotrypaea gigas*
– Eyestalk with outer margin slightly convex, barely exceeding distal margin of first segment of antennule . . . . . *Neotrypaea californiensis*

Family Axiidae Huxley, 1879

Calocarides Wollebaek, 1908

Calocarides quinqueseriatus (Rathbun, 1902)

(Fig. 31B)

Calastacus quinqueseriatus Rathbun, 1902a: 887; 1904: 151, fig. 91. — Schmitt 1921: 113, fig. 76. — Wicksten 1980c: 362. — Komai 2000: 229.
Calocaris quinqueseriatus. — Hart 1982: 50, fig. 11. — Wicksten 1989b: 312. —Kensley 1996a: 61, figs. 4, 5 (extensive synonymy).
Calocarides quinqueseriatus. — Sakai & de Saint Laurent 1989: 44. — Hendrickx 1995b: 157.

Diagnosis. Rostrum flattened, median carina extending from mid-rostrum posteriorly, 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, 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, granules also on carpus and merus. Pereopod 2 chelate, with distinct spines on merus, ischium. Other pereopods slender, with simple, setose dactyls. Abdominal pleura rounded. Telson with median tooth, toothed lateral margins, 2 toothed dorsal ridges, curved posterior margins,.Toothed ridge on endopod of uropod. Abdominal somite 1without pleopods. Other pleopods biramous. Sexes separate. Total length 73 mm.

Color in life. Not reported, but preserved specimens were pale.

Habitat and depth. Mud, 288–2200 m.

Range. Sea of Okhotsk to off San Nicolas I., California; Gulf of California off Angel de la Guardia I. and off Sinaloa, Mexico. Type locality off San Luis Obispo Bay, California. Komai (2000: 229) speculated that the specimens from the Sea of Okhotsk "may represent a distinct species."

Remarks. In California, this species was collected most often on the upper continental slopes along the mainland instead of along the offshore islands (Wicksten 1980).

Calocarides spinulicauda (Rathbun, 1902)

(Fig. 31 D, E)

Axius spinulicauda Rathbun, 1902a: 886. — Rathbun 1904: 149, fig. 90.
Axiopsis spinulicauda. — Schmitt 1921: 111, fig. 74. — Hart 1982: 44, fig. 8, color plate. — Wicksten 1989b: 312.
Acanthaxius spinulicaudus. — Sakai & de Saint Laurent 1989: 66.
Calocarides spinulicauda. — Kensley 1996a: 54.

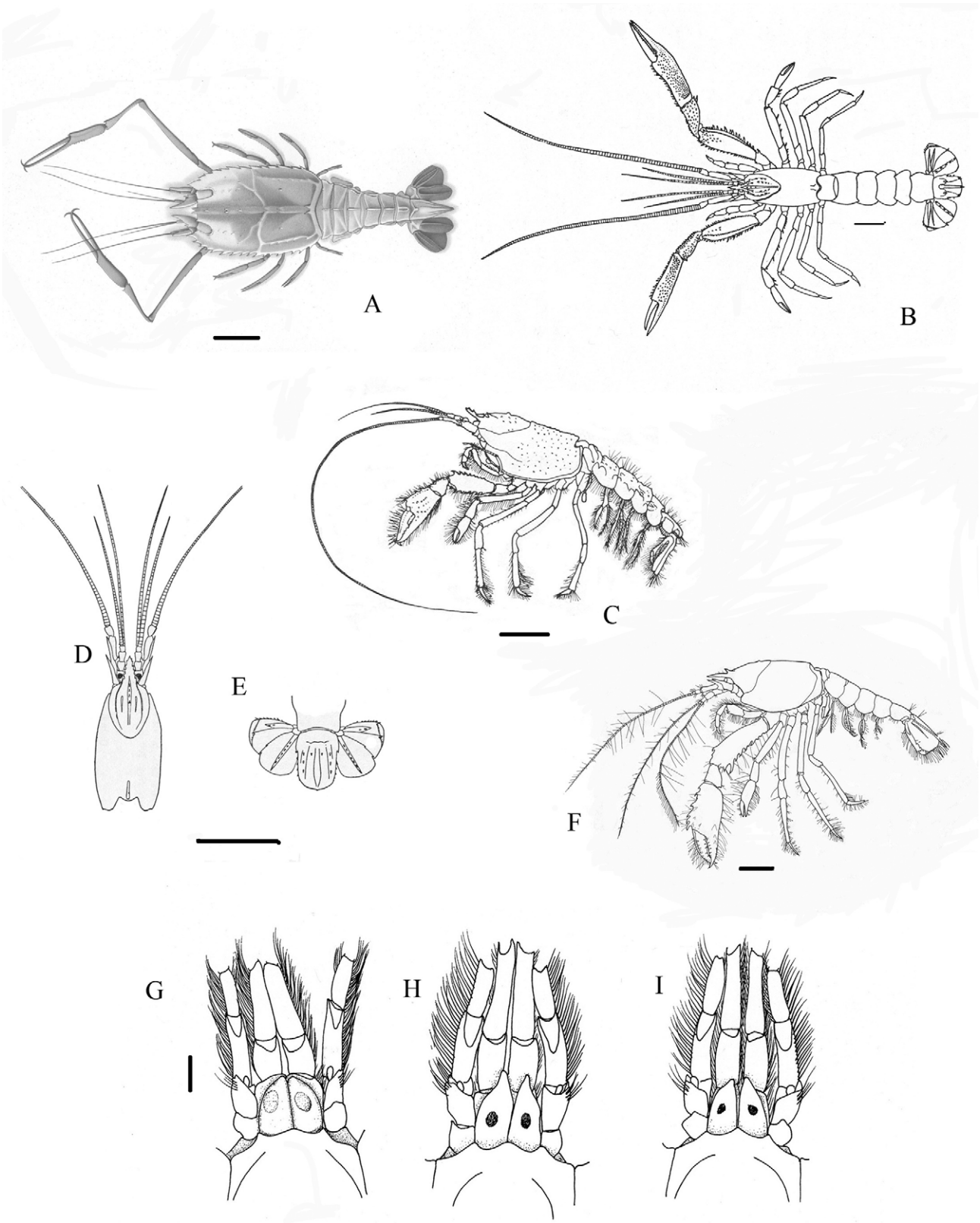

FIGURE 31. Families Polychelidae, Axiiidae, Calocarididae and Callianassidae. A, *Polycheles pacificus* Faxon, 1893. B, *Calocarides quinqueseriatus* (Rathbun, 1902). C, *Lophaxius rathbunae* Kesley, 1989. D, E, *Calocarides spinulicauda* (Rathbun, 1902); D, carapace and frontal appendages; E, tail fan. F, *Calastacus stilirostris* Faxon, 1893. G, *Neotrypaea biffari* (Holthuis, 1991); frontal region in dorsal view. H, *Neotrypaea gigas* (Dana, 1852); frontal region in dorsal view. I, *Neotrypaea californiensis* (Dana, 1854); frontal region in dorsal view. Scales: G–I = 1 mm, A–F = 10 mm. A from Faxon 1895, B, D, E from Schmitt 1921 (B as *Calastacus quinqueseriatus*, D, E as *Axiopsis spinulicauda*); C, F from Hart 1982 (C as *Calocaris investigatoris*), G–I from Campos *et al.* 2009.

Diagnosis. Rostrum reaching middle of second segment of antennular peduncle, slightly deflexed, with 5 or 6 lateral teeth on each side. Carapace with 5 anterior longitudinal carinae, none of them reaching cervical groove, median carina reaching base of rostrum, bearing 4 spines; short median dorsal carina near posterior margin of carapace. Eyes pigmented. Long, thorn-like projections near base of antenna, scaphocerite narrow, 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. Pereopod 2 chelate. Pereopods 3–5 slender, setose, approximately same length, but decreasing in width of segments posteriorly. Abdomen smooth, 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, others biramous. Male with appendix masculina on second pleopod. Male total length 90 mm, female 89 mm.

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 (K. Lee, pers. comm.)

Family Callianassidae Dana, 1852

Until recently, all eastern Pacific ghost shrimps were considered to belong to the genus *Callianassa*. Manning & Felder (1991) revised the classification of genera in this family, and reassigned the species from California and Oregon to the genus *Neotrypaea*. Sakai (2005) continued to use the generic name *Callianassa* for these species.

There has been little recent work on local callianassids. Campos *et al*. (2009) studied the three species of *Neotrypaea* in northern Baja California and provided a key and an analysis of morphological features useful in identifying the species. Pernet *et al*. (2010) used both molecular and morphological methods to study the callianassids of southern California. These authors disagreed about the utility of using some of the morphological features presented by Campos *et al*. in distinguishing between the species. Although features of the major chela of males proved valuable in identification, these appendages may be lost in sampling and are not present in females or immature animals. The features of the eyestalk (presented in the key) proved most consistent in differentiation of the species. As of this writing, there have been no studies of the callianassids taken in benthic surveys of the continental shelf to determine whether or not they are the same species that occur in shallow and intertidal areas. Specimens from California and Oregon have not been compared with specimens from Mexico.

The alpheid shrimps *Betaeus ensenadensis*, *B. harrimani* and *B. longidactylus*, the crabs *Pinnixa franciscana* Rathbun, 1918; *P. schmitti* Rathbun, 1918; and *Scleroplax granulata* Rathbun, 1893 (Pinnotheridae) and the fishes *Clevalandia ios* (Jordan & Gilbert, 1882) and *Typhlogobius californiensis* Steindacher, 1879 have been reported to live with species of the Callianassidae. Campos *et al*. (2009) listed all the symbiotic or parasitic species found with northeastern Pacific callianassids.

Neotrypaea Manning & Felder, 1991

Neotrypaea biffari (Holthuis, 1991)

(Fig. 31G, Pl. 5C)

Callianassa affinis Holmes, 1900: 162, pl. 2, figs. 29, 30. — Rathbun 1904: 154. — Schmitt 1921: 119, fig. 81. — Johnson & Snook 1927: 330, fig. 277c. — Haig & Abbott 1980: 580, fig. 24.3. — Campos & de Campos 1989: 176. [Not *Callianassa affinis* A. Milne-Edwards, 1861, fossil species].

Neotrypaea affinis. — Manning & Felder 1991: 771. — Jensen 1995: 78, fig, 159.

Callianassa biffari. — Holthuis, 1991: 242, fig. 243. — Sakai 2005: 48, fig. 8.

Neotrypaea biffari. — Campos-Gonzalez *et al*. 2009: 1249, figs. 2g,h; 3a, 4c. — Pernet *et al*. 2010: 324.

Diagnosis. Median tooth of front obscure. Eyestalk with tuberculiform extremity, not divergent, pigmented cornea in front of middle of eyestalk. Carapace smooth, with cervical, lateral grooves. Third maxilliped operculiform.

Pereopods 1 unequal, chelate. Major chela of male with carpus shorter than to equal to palm, fingers crossing, without gape. Merus with large lobe near base. Small cheliped slender. Pereopod 2 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. Pleopods 3–5 biramous. Telson subrectangular, uropods about same length as telson. Male total length 61 mm, female not reported.

Color in life. Creamy white. The color note is from shrimp from Point Fermin, Los Angeles County, California; see also Jensen (1995).

Habitat and depth. Tide pools, in sand under rocks, intertidal zone.

Range. Goleta, Santa Barbara County to Tortugas Bay, Baja California, Mexico. Type locality Point Loma, San Diego County, California.

Remarks. This species usually occurs in pairs, often co-habiting its hole with the blind goby, *Typhlogobius californiensis*.

Neotrypaea californiensis (Dana, 1854)

(Fig. 31I, Pl. 5E)

Callianassa californiensis Dana, 1854: 175. — Holmes 1900: 159. — Rathbun 1904: 154. — Schmitt 1921: 117, fig. 78. — Johnson & Snook 1927: 329, figs. 275, 277B. — Haig & Abbott 1980: 579, fig. 24.2. — Hart 1982: 58, fig. 15. — Ricketts *et al*. 1985: 292, fig. 287. — Sakai 2005: 50.

Neotrypaea californiensis. — Manning & Felder 1991: 771, fig. 10. — Jensen 1995: 78, fig. 158. — Kuris *et al*. 2007: 648, pl. 326 G. — Campos-Gonzalez et al. 2009: 1249, figs. 2 a–c, 3c, 4a. — Pernet *et al*. 2010: 323, fig. 2.

Diagnosis. Rostrum bluntly rounded. Carapace smooth, with cervical, lateral grooves. Eyestalk without acute and divergent apex, pigmented cornea at middle of eyestalk. Third maxilliped operculiform. First chelipeds unequal, sexually dimorphic. Major cheliped of male with merus having prominent ventral lobe, carpus strongly incurved, subequal in length to hand, fingers gaping, crossing at apices. In female, immature male hand longer than carpus. Smaller cheliped with carpus longer than hand, fingers shorter than palm. Pereopod 2 chelate, flattened. Pereopod 3 with triangular carpus, broad subrectangular propodus, small rounded dactyl. Pereopods 4, 5 slender, last leg chelate. Abdominal pleura narrow. Male with vestigial pleopod 1, pleopod 2 absent, pleopods 3–5 foliaceous. Female with pleopod 1 uniramous, pleopod 2 biramous. Telson subrectangular, with 2 dorsal ribs, tooth on posterior margin. Uropods about same length as telson, exopod with dorsal ribs. Male total length 115 mm, female 120 mm.

Color in life. White to creamy, patches of pink, yellow to orange on appendages, abdomen pink (Jensen 1995).

Habitat and depth. Mud or sand, intertidal zone.

Range. Mutiny Bay, Alaska to Todos Santos Bay, Baja California, Mexico. Type locality "California" (probably San Francisco Bay or Monterey, where Dana obtained specimens).

Neotrypaea gigas (Dana, 1852)

(Fig. 31H)

Callianassa gigas Dana, 1852: 19. — Holmes 1900: 162. — Rathbun 1904: 154. — Schmitt 1921: 119, fig. 80. — Haig & Abbott 1980: 579. — Hart 1982: 56, fig. 14. — Sakai 2005: 57.

Callianassa longimana Stimpson, 1857a: 86. — Rathbun 1904: 154. — Schmitt 1921: 117, fig. 79. — Johnson & Snook 1927: 329, fig. 276. — Wicksten 1980c: 360.

Neotrypaea gigas. — Manning & Felder 1991: 771. — Kuris *et al*. 2007: 648, pl. 326 H. — Campos-Gonzalez *et al*. 2009: 1249, fig. 2 g, h; fig. 3 b, fig. 4 b–d. — Pernet *et al*. 2010: 323, fig. 2.

Diagnosis. Rostrum usually bluntly rounded, rarely acute. Eyestalk with acute, divergent apices, pigmented area behind middle of stalk. Carapace smooth, with cervical, lateral grooves. Third maxillipeds operculiform. First pereopods chelate, unequal, sexually dimorphic. Male major cheliped almost as long as rest of body, merus with large lobe near base, dorsal, ventral margins of carpus, palm relatively straight, chela elongate, usually without gape between propodus, dactyl when closed. Large cheliped of female, immature male with hand longer than

carpus. Small cheliped in both sexes elongate, carpus, hand subequal. Pereopod 2 chelate, palm wide. Pereopods 3–5 flattened, modified for digging, with simple dactyls. Male with vestigial pleopod 1, none on second abdominal somite; pleopods 3–5 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 mm.

Color in life. Mostly ivory to cream, abdomen flesh-colored dorsally. Hart (1982) gave a detailed description of the color.

Habitat and depth. Mud or sandy mud, intertidal zone to 50 m.

Range. Digby I., British Columbia to San Quentin Bay, Baja California, Mexico. Type locality Puget Sound.

Family Calocarididae Ortmann, 1891

Calastacus Faxon, 1893

Calastacus stilirostris Faxon, 1893
(Fig. 31F)

Calastacus stilirostris Faxon, 1893: 194; 1895: 106, pl. 27, figs. 1–1f. — de Saint Laurent 1972b: 354. — Hart 1982: 46, fig. 9. — Kensley 1989: 961. — Wicksten 1989b: 312. — Hendrickx 1995b: 157.

Diagnosis. Rostrum long, narrow; reaching second segment of antennular peduncle, with stout teeth at base. Carapace with prominent cervical groove, narrow anterior dorsal ridge. Eyestalk 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, setose. Third maxilliped not as long as merus of major chela, with teeth on widest segment. Pereopod 1 with chelipeds subequal, fingers without gape, apices crossing. Palm of chela with prominent dorsal teeth, merus with sharp teeth on both dorsal, ventral sides. Pereopod 2 chelate, posterior pereopods slender, with 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. These crustaceans are hermaphroditic (Hart 1982). 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 southeast of Acapulco, western Mexico (*Albatross* sta. 3418, 16˚ 33' N, 99˚ 52' 30"W).

Remarks. At present, there are no records of this species between Washington and northern Baja California.

Lophaxius Kensley, 1989

Lophaxius rathbunae Kensley, 1989
(Fig. 31C)

Calocaris investigatoris. — Rathbun, 1904: 151. — Schmitt 1921: 112. — Pereyra & Alton 1972: 450. — Hart 1982: 48, fig. 10. — Wicksten 1989b: 312. [Not *Calastacus investigatoris* Anderson, 1896: 97, pl. 2; Indo-West Pacific species, as illustrated by Schmitt 1921: fig. 75].
Lophaxius rathbunae Kensley, 1989: 963.

Diagnosis. Rostrum slightly shorter than second segment of antennular peduncle, with sides prolonged into sharp ridges reaching gastric region, bearing 2 teeth each. Carapace granulate, with medial carina ending in tubercle, another tubercle in middle of gastric region on dorsal margin, pronounced cervical, branchial grooves. Eyestalk small, cornea without pigment. Antennular peduncle shorter than antennal peduncle. Second, third segments of antennal peduncle bearing thorn-like projections. Third maxillipeds slender. Major chelipeds unequal in size but

similar in shape. Superior, inferior surfaces of merus with sharp teeth. Fingers long, narrow; with proximal gape; 3 rows granules on outer face of palm, palm with small marginal teeth. Pereopod 2 short, chelate. Other pereopods slender, with simple dactyls. Abdominal somites broad, setose, having grooves, 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. These crustaceans are 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 (Hart 1982).

Habitat and depth. Abyssal mud, 549–1733 m.

Range. Eastern Pacific from Aleutian Is. to off San Diego, California. Type localiies from off Dannakh I., Alaska (*Albatross* sta. 3210), off Cascade Head, Oregon (*Albatross* sta. 3347) and two stations off San Diego, California (*Albatross* sta. 2928 and 4352).

Remarks. The illustration provided by Schmitt (1921, fig. 75) is not this species but a similar species that lives in the Indian Ocean. Kensley (1989) did not illustrate the eastern Pacific species when he revised the generic designation.

Family Ctenochelidae Manning & Felder, 1991

Manning & Felder (1991) erected the new family Ctenochelidae for ghost shrimps with a cardiac prominence, strong scaphocerite and pediform third maxilliped usually with a distal spine. Only one species has been reported in the area of coverage.

Callianopsis de Saint Laurent, 1973

Callianopsis goniophthalma (Rathbun, 1902)
(Fig. 32A)

Callianassa goniophthalma Rathbun, 1902: 886; 1904: 154, pl. 8. — Schmitt 1921: 121, fig. 82. — Pereyra & Alton 1972: 450. — Wicksten 1980c: 362; 1989b: 312..

Callianopsis goniophthalma. — de Saint Laurent 1973: 515. — Hart 1982: 54, fig. 1. — Manning & Felder 1991: 789, fig. 18. — Hendrickx 1995b: 158. — Sakai 2005: 229.

Diagnosis. Rostrum small, sharp. Carapace smooth, slight elevation on mid-dorsal margin, distinct cervical, lateral groove. Eyestalk long, with small tooth, cornea unpigmented. Both antennae with slender peduncles, long, setose flagella. Third maxillipeds with semicircular dactyls. Larger cheliped with merus with ventral marginal tooth, carpus wide, palm of chela with sharp margins, fingers setose, toothed; gape between fingers in male. Smaller chela slender. Pereopod 2 chelate, Pereopods 3, 4 with simple dactyls, pereopod 5 subchelate. Abdomen with narrow pleura, membranous; sharp tooth on either side of somite 6. 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 mm.

Color in life. Not reported, but newly preserved specimens were pale.

Habitat and depth. Continental slopes, mud, clay, 483–1920 m.

Range. Clarence Strait, Alaska to off Palos Verdes Peninsula, California; off Ahome Point, Sinaloa, Mexico. Type locality off Point Conception, California.

Family Eiconaxiidae Sakai & Ohta, 2005

***Eiconaxius* Bate, 1888**
***Eiconaxius acutifrons* (Bate, 1888)**
(Fig. 32B)

Axius acutifrons Bate, 1888: 40, pl. 5, fig. 2. — Faxon 1893: 193; 1895: 103, pl. 28, fig. 2. — de Man 1925: 15, 37, pl. 3, figs. 5–5e. — Wicksten 1982: 246, fig. 1; 1989b: 312.
Eiconaxius acutifrons. — Sakai & de St. Laurent 1989: 15. — Hendrickx 1995b: 157.—Kensley 1996b: 475. — Poore & Collins 2007: 40.

Diagnosis. Rostrum broad, with smooth margins or very small denticles, median rostral carina entire to slightly serrate. Carapace smooth, rounded. Eyes without pigment. Third maxilliepds slender. Chelipeds stout, merus with teeth, palm with longitudinal lateral ridge, 4 teeth along dorsal midline, fixed finger of chela with large tooth near proximal end of cutting edge, small teeth beyond it; movable finger with notch into which large tooth inserts. Pereopod 2 chelate. Posterior pereopods with small, sharp dactyls. Abdominal somites smooth, with pointed pleura. Telson with medial row of teeth, row of teeth on dorsal midline of uropod. Female total length 29 mm, male not reported.

Color in life. Creamy white.

Habitat and depth. Sand, mud or rubble bottoms, or among hexactinellid sponges, 595–2310 m. Specimens from California lived inside a sponge.

Range. Off Banda I. and Great Kei I., Indonesia, off Mariato Point, Panama, and south of San Clemente I., California. Type locality off Banda I..

Remarks. Kensley (1996b) described a new species, *Eiconaxius baja*, from off Baja California, Mexico, but did not mention the record of a species of *Eiconaxius* from off California. It would be useful to to compare the specimen on which the above record is based with the description of *E. baja*.

INFRAORDER GEBIIDEA DE SAINT LAURENT, 1979

The Gebiidea are distinguished from the Axiidea by having the first pereopod chelate or subchelate and the second much smaller, either without chelae of subchelate. The first pereopods often are equal or nearly equal in size and shape. Like the Axiidea, these lobster-like animals dig or burrow into mud or sandy mud.

Key to species of Gebiidea

1. Pereopod 1 subchelate. Rostrum not flat, densely setose. Southern California southward. . . . . *Naushonia macginitei* (Laomediidae)
– Pereopod 1 chelate. Rostrum flat, densely setose. Washington to Baja California . . . . . 2 (Upogebiidae)
2. Postocular tooth absent or very tiny. South of Point Conception . . . . . *Upogebia macginitieorum*
– Postocular tooth robust. May live north of Point Conception 3
3. Merus of pereopod 3 with proximolateral teeth . . . . . *Upogebia lepta*
– Merus of pereopod 3 without proximolateral teeth 4
4. Short fixed finger of chela with slender, laterally compressed apex. Alaska to Morro Bay, California, intertidal . . . . . *Upogebia pugettensis*
– Short fixed finger of chela with broad apex flattened, corneous on prehensile edge. San Miguel I., California, subtidal . . . . . *Upogebia onychion*

Family Laomediidae Borradaile, 1903b

Only one genus with one species has been reported from the area.

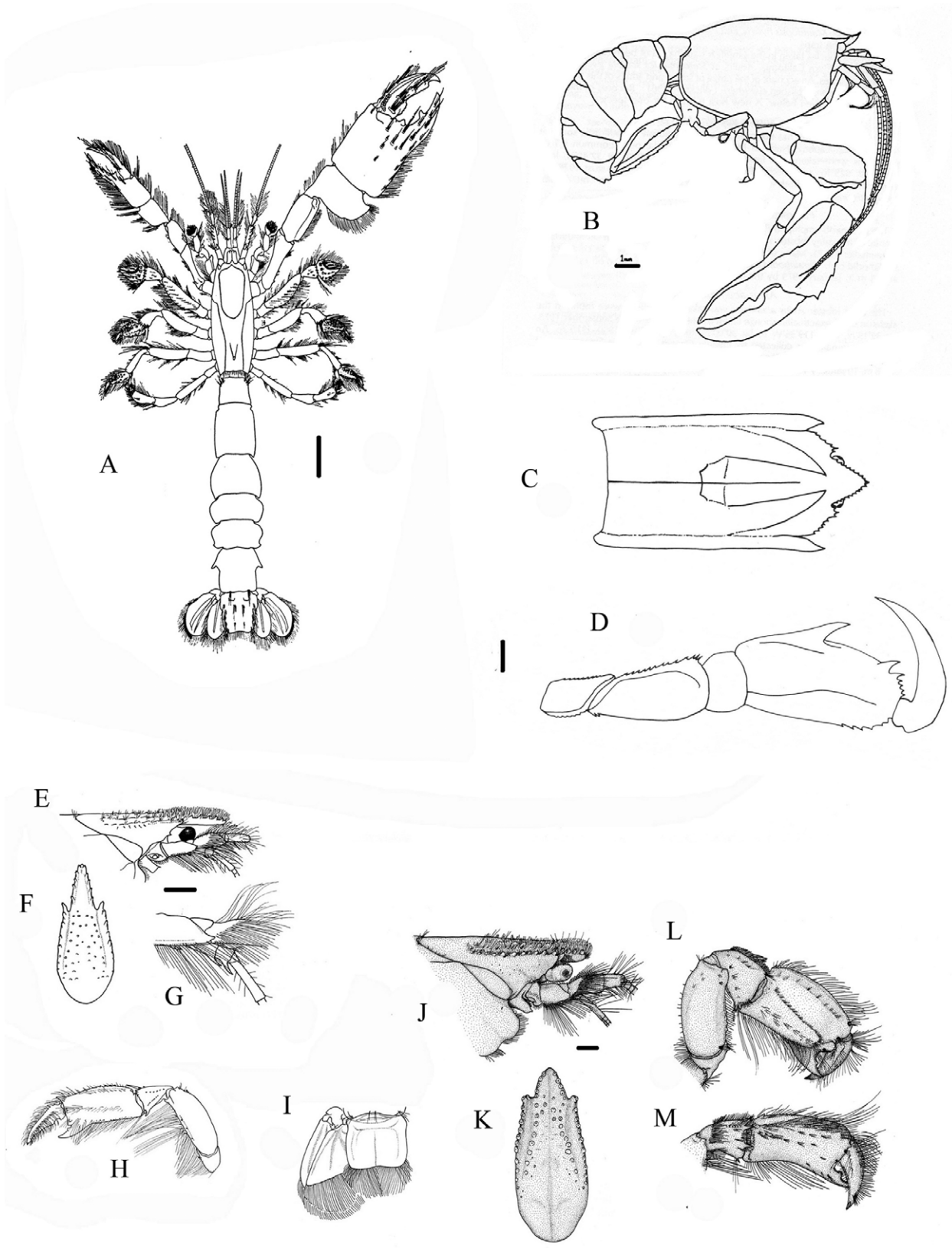

FIGURE 32. Families Ctenochelidae, Eiconaxiidae, Laomediidae, and Upogebiidae. A, *Callianopsis goniophthalma* (Rathbun, 1902). B, *Eiconaxius acutifrons* (Bate, 1888). C, D, *Naushonia macginitei* (Glassell, 1938); C, carapace in dorsal view, D, pereopod 1. E–I, *Upogebia lepta* Williams, 1986; E, frontal region in lateral view; F, carapace, G, detail of antennular peduncle; H, cheliped; I, telson and uropod. J–M, *Upogebia macginitieorum* Williams, 1986; J, frontal region in lateral view; K, carapace in dorsal view; L, cheliped in lateral view; M, cheliped in mesial view. Scales: B–E, J = 1 mm, A = 10 mm. A from Schmitt 1921 (as *Callianassa goniophthalma*), B from Wicksten 1982b (as *Axius acutifrons*), C, D from Goy & Provenzano 1979, E–M from Williams 1986.

Naushonia Kingsley, 1897

Naushonia macginitei (Glassell, 1938)
(Fig. 32C, D)

Homoriscus macginitei Glassell, 1938: 414, figs. 1–4.
Naushonia macginitei. — Goy & Provenzano 1979: 339, figs. 6b,g; 7c, 8c, f, k, l. — Hendrickx 1995b: 159. — Sirota & Martin 2005: 146, fig. 2.

Diagnosis. Rostrum semi-oval, 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, blunt. Antennular peduncle longer than rostrum. Scaphocerite 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 tooth, propodus, dactyl subequal in length, longer than carpus. Pereopod 1 subchelate, propodus broad, upper margin carinate, with large fixed tooth, 3–4 smaller teeth on inner margin. Pereopod 2 short, stout; long setae on merus, simple, setose dactyl. Pereopods 3, 4 more slender, longer than second, with few setae; simple, slender dactyls. Abdominal somites without carinae or teeth. Telson rounded, sides with very fine teeth, 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 & Martin 2005).

Habitat. Under rocks in pool, among eelgrass (*Zostera* sp.), sand flats; intertidal zone to 11.2 m.

Range. Newport Bay and La Jolla, California; Ensenada de San Francisco, Sonora, Gulf of California, Mexico to Wafer Bay, Cocos I., Costa Rica. Type locality La Jolla, California.

Remarks. This peculiar animal was originally thought to be a sand shrimp (Caridea: Crangonidae). The similarity in the subchelate first pereopods could be confusing. The sutures of the uropod, the unusual rostrum and the ridges of the carapace are characteristic.

Family Upogebiidae Borradaile, 1903b

Only one genus of this family, *Upogebia*, is present in the eastern Pacific Ocean. The key and descriptions presented here follow Williams (1986a), which contains detailed synonymies and descriptions. Williams (1986a: 4) also reported a single finding of the Atlantic species, *U. affinis* (Say, 1818), from San Francisco Bay, California. This may be the record on which Sakai (2006) based his statement that *U. affinis* is distributed in the western Atlantic and "in the eastern Pacific Ocean." Campos *et al*. (2009) listed parasitic and symbiotic species found with upogebiids.

Upogebia Leach, 1814

Upogebia lepta Williams, 1986
(Fig. 32E–I)

Upogebia lepta Williams, 1986a: 22, fig. 8. — Sakai 2006: 73. — Campos-Gonzalez *et al*. 2009: 1258.

Diagnosis. Rostrum narrowly triangular, straight, longer than eyestalk, with pair small subapical dorsal teeth, 4 lateral teeth on each side, central part of rostrum without teeth. Much of dorsal surface of carapace covered by spiniform tubercles, postocular tooth present. Cervical groove, thalassinidean line conspicuous. Antennular peduncle shorter than antennal peduncle, first, second articles bearing prominent ventral teeth. Third maxilliped with epipod. Major chelipeds nearly equal, slender; ischium with small spine, merus with small spines on superior, inferior sides; carpus with prominent teeth, palm setose, prominent spine at distal end, fixed finger of chela short, with tooth on cutting edge; movable finger slightly curved, with dentate dorsal crest having long proximal tooth.

Pereopod 2 stout, setose; carpus with teeth. Pereopod 3 with slender dactyl, merus with cluster of weak proximoventral spines. Pereopod 4 slender, merus without spines. Pereopod 5 subchelate. Abdomen smooth. Telson rectangular, very slightly lobed posteriorly, with low transverse anterior ridge, low lateral ridges. Uropods with protopod having tiny tooth, exopod with 3 dorsal ridges, endopod with 1 ridge. Male without first pleopods. Male carapace length 6.2 mm., female not reported.

Color in life. Not reported.

Habitat and depth. Benthic, 74–103 m.

Range. Santa Catalina I., California and Coronado Is., Baja California, Mexico. Type locality Coronado Is.

Remarks. Williams (1986a) did not report the substrate, but the areas in which the specimens were collected often have bottoms of shelly sand.

Upogebia macginitieorum Williams, 1986

(Fig. 32J–M)

Upogebia macginitieorum Williams 1986: 30, fig. 11. — Campos & de Campos 1989: 176. — Sakai 2006: 74. — Campos-Gonzalez 2007: 38. — Campos-Gonzalez *et al*. 2009: 1249, fig. 1a,b.

Diagnosis. Rostrum triangular, straight, longer than eyestalk, with pair short subapical teeth followed on each side by 4 small conical teeth; dorsal teeth near midlength continuing with teeth, tubercles over anterior dorsal part of carapace. Two divergent spiny ridges extending from rostrum to posterior half of carapace. Gastric region posteriorly smooth, cervical groove deep, 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. Ischium with 1 spine, merus with spinules on inferior margin, carpus bearing sharp teeth along posterior margin. Palm of chela broad, fixed finger with 1 large tooth on cutting edge, dactyl curved, overlapping fixed finger. Pereopod 2 very stout, dactyl blunt, not chelate, merus without medioventral tooth. Pereopods 3–5 decreasing in size, setose, with simple dactyls. Abdomen smooth, pleura narrow, pubescent. Telson rectangular, with median indentation, transverse anterior ridge, low lateral ridges. Uropods with tooth on protopod, exopod with 3 dorsal ridges, without transverse suture; 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. Clay banks, high intertidal zone.

Range. Santa Catalina I. and Newport Bay to Tortugas Bay, Baja California, Mexico. Type locality Tijuana Slough, California.

Remarks. This species has been confused with *U. pugettensis* in older literature.

Upogebia onychion Williams, 1986

(Fig. 33A–E)

Upogebia onychion Williams, 1986a: 33, fig. 12. — Sakai 2006: 74.

Diagnosis. Rostrum broadly triangular, pair of moderate subapical dorsal teeth followed by 2 teeth, central surface bearing tufts of setae, almost without teeth, merging with area of sparse spiniform tubercles and tubercles diminishing over anterodorsal carapace. Gastric region posterior to field of tubercles smooth. Cervical groove moderate, continuous, thalassinidean line continuing to posterior margin of carapace. Postocular margin bearing tooth. Antennular peduncle shorter than antennal peduncle. Second segment of antennal peduncle without subdistal ventral tooth. Scaphocerite moderate. Chelipeds nearly equal, moderately stout. Ischium with 1 small ventral spine, merus with 4 spines on ventral margin, subdistal dorsal spine, carpus with obsolescent teeth, 3–4 tiny teeth on anterodorsal margin, also teeth on distomedial, distoventral margins; palm of chela with rows of setae, dorsal crests low, without teeth; fixed finger stubby, with 1 or 2 teeth on cutting edge; dactyl slightly curved, with 1 low tooth on

cutting edge. Pereopod 2 stout, without chela; merus with dorsal tooth, carpus with dorsal, ventral spines. Pereopods 3–5 smaller, setose, without teeth. Abdomen broad, pleura of first somite narrowly rounded psterolaterally, other pleura broadly rounded. Telson rectangular, with low lateral ridges, median groove obsolescent. Uropods with tiny tooth 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 I.

Upogebia pugettensis (Dana, 1852)

(Fig. 33F–J)

Gebia pugettensis Dana, 1852: 19.

Upogebia pugettensis. — Holmes 1900: 157. — Rathbun 1904: 153. — Schmitt 1921; 115, fig. 77. — Johnson & Snook 1927: 327, fig. 274 (part). — Haig & Abbott 1980: 579, fig. 24.1 (part). — Hart 1982: 52, fig. 12. — Ricketts *et al.* 1985: 393, fig. 305 (part). — Williams 1986a: 35, fig. 13. — Jensen 1995: 78, fig. 160. —Sakai 2006: 75. — Kuris *et al*. 2007: 648.

Diagnosis. Rostrum broadly triangular, flanked by shorter frontal process at each side; apex obtuse, length shorter than antennular peduncle; lateral borders with 3–5 conical teeth, short subapical pair remote from apex; 0–2 dorsal teeth near midlength on each side. Row of 11 or 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 tooth, extension of epistome in lateral view bearing 1–3 tiny distal teeth. 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 tooth, scale small, oval. Chelipeds equal. Ischium with small tooth on lower border, merus with upper margin curved, small spine near carpal end, setae, 5 or 6 small teeth on ventrolateral border, 4 spines on ventromedial border; carpus with lateral longitudinal furrow, strong tooth on mediodistal border, 4–10 small teeth nearby, small tooth on distal margin, larger tooth at mediodistal margin, also small tooth at distoventral corner; palm of chela with setose lines, rows of small teeth, setae, mediodistal sharp spine at base of dactyl; fixed finger directed ventromesially, with 1 conical tooth on cutting edge; dactyl slightly curved, upper surface ridged, bearing rows of setae, lateral surface with row of 6 or 7 blunt tubercles, 2 or 3 smaller tubercles near them, 2 low teeth on cutting edge. Pereopod 2 not chelate, merus with tiny tooth on superior margin, carpus with small distal teeth, fringe on setae along lower margins of segments. Pereopods 3–5 setose, decreasing in size, dactyls with spinules on flexor margins. Abdomen rather broad, pleura usually without ventral teeth. Telson widest at anterior end, with low dorsal carina on each side of median furrow. Uropods slightly exceeding telson, bearing dorsal ribs, minute marginal spines, protopod bearing small tooth. Total lengths 75–112 mm, males smaller than females.

Color in life. Deep olive, brown, deep blue to dirty bluish white. The 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 zones near shore.

Range. Sawmill Bay, Alaska to Morro Bay, California. Type locality Puget Sound.

INFRAORDER ANOMURA MACLEAY, 1838

The most recent attempt to analyze the systematics of the families of the Anomura and organize them into superfamilies was that of McLaughlin *et al*. (2007). This system, using a combination of morphological and cladistic analysis, is followed in the current work. Many problems in distinguishing relationships between the various anomurans remain unsolved because of different conclusions based on molecular versus morphological data, examination of only a few specimens in a taxon or over-generalization of the significance of particular features during development. Older works combined the old infraorder Thalassinidea (now the Axiidea and Gebiidea) with the Anomura, but sufficient molecular and morphological evidence supports their removal from the Anomura.

Most anomurans in the northeastern Pacific and adjacent waters are crab-like. The carapace is not fused to the epistome (the area above the mouth). In many species, the second antennae are elongated instead of short, and are not retractable into sockets. Often, one pair of antennae lies mesial to the eyestalks and the other lateral to them. In the hermit crabs, king crabs and galatheoids, the third maxillipeds do not form a plate-like covering of the mouth (an operculum). Pereopod 1 is chelate in all local species but *Emerita analoga*. Pereopod 5 often is 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.

In anomurans and brachyurans, the term "spine" refers to any sharply pointed process and a "tooth" is either flattened or rounded.

Key to families of Anomura

1. Abdomen soft, elongate. Inhabiting shells or tubes 2
– Abdomen usually not soft, if so, rounded, not elongate. Not inhabiting shells or tubes 4
2. Outer maxillipeds close together at base, chelipeds subequal . . . . . Diogenidae
– Outer maxillipeds separated by the width of one maxilliped at least at base, chelipeds not equal in size, shape 3
3. Toothed ridge of outer maxilliped with 1 or more accessory teeth, female with gonopore on both third pereopods. Intertidal or deeper . . . . . Paguridae
– Toothed ridge of outer maxilliped without accessory teeth, female with gonopore on left third pereopod only. Continental shelf, slope . . . . . 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. Pereopods 1 without chelae, telson elongate, spearhead-shaped . . . . . Hippidae
– Pereopods 1 with chelae, telson small, somewhat circular to ovate 6
6. Eyestalks elongate ovoid, with pigmented corneae . . . . . Blepharipodidae
– Eyestalks squarish, corneae without pigment . . . . . Albuneidae
7. Abdomen tightly flexed beneath abdomen, soft to calcified but incapable of being used in swimming, not lobster-like; uropods absent 8
– Abdomen loosely flexed beneath abdomen, lightly calcified, capable of being used in swimming, may be lobster-like; uropods present 9
8. Abdomen soft, uncalcified. Intertidal to shallow subtidal zones, not found at depths of more than 165 m . . . Hapalogasteridae
– Abdomen at least partially calcified but may have membranous sutures. Intertidal zone to continental slopes at greater than 165 m . . . . . Lithodidae
9. Abdomen not lobster-like, folded against cephalothorax, pereopods 1 heavy, not elongate . . . . . Porcellanidae
– Abdomen lobster-like but short, not folded against cephalothorax, pereopods 1 slender, elongate 10
10. Third maxilliped without epipod. Telson folded beneath preceding abdominal somites. Continental slopes, usually living on colonial anthozoans . . . . . Chirostylidae
– Third maxilliped with epipod. Telson not folded beneath preceding abdominal somites. Surface waters to abyssal plains, various substrata 11
11. Front broad, triangular. . . . . Galatheidae
– Front not broad or triangular, composed of slender rostrum flanked by supraorbital spines 12
12. First maxilliped without flagellum or flagellum strongly reduced. Cornea of eye without pigment. Usually found at 200 m or deeper . . . . . Munidopsidae
– First maxilliped with well-developed flagellum. Cornea of eye pigmented. Usually at surface to 200 m. . . . . Munididae

SUPERFAMILY GALATHEOIDEA Samouellle, 1819

Squat lobsters, langostinos or craylets of the families Chirostylidae, Galatheidae, Munididae, and Munidopsidae; generally are found on the continental shelf and deeper in the northeastern Pacific. Ahyong *et al.* (2010), in a recent revision, divided the old family Galatheidae into the Galatheidae s.s. and the families Munididae and Munidopsidae. Most of these species are epibenthic on the continental shelf and in deeper areas. Only *Pleuroncodes planipes* at times is cast ashore or enters near shore waters. Baba *et al.* (2009) listed all of the families, genera and species worldwide.

Ranges of deep benthic galatheoids 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. Macpherson *et al*. (2010), in a biogeographical study, noted the isolation of the eastern Pacific galatheoid fauna. Two genera, *Janetogalathea* and *Pleuroncodes*, are endemic to the eastern Pacific.

Family Chirostylidae Ortmann, 1892

The Chirostylidae are deep-water crabs that superficially resemble the Galatheidae. All chirostylids have elongate chelipeds ending in slender, gaping fingers. They immediately can be distinguished from galatheids by the form of the telson. Baba & Haig (1990) gave a key to the five members of the genus *Gastroptychus* that occur in the eastern Pacific. Janet Haig provided the previously unpublished information and key given here.

Rice & Miller (1991) discussed several examples of commensalism between chirostylids and cnidarians and echinoderms. Both species of *Gastroptychus* from the northeastern Pacific associate with colonial cnidarians..

Key to species of family Chirostylidae

1. Lateral carapace margins strongly convex in posterior 0.66; tergum of abdominal segment 5 unarmed. . . *Gastroptychus iaspis*
– Lateral carapace margins nearly straight posteriorly; tergum of abdominal segment 5 spiny . . . . . .*Gastroptychus perarmatus*

Gastroptychus Caullery, 1896

Gastroptychus iaspis Baba & Haig, 1990
(Fig. 33K, L)

Chirostylus sp: Hart 1982: 166, fig. 65. — Wicksten 1982: 245; 1989b: 315.
Gastroptychus iaspis Baba & Haig 1990: 854, figs. 1, 2.

Diagnosis. Rostrum short, triangular, terminating in narrow spine directed upward. Carapace slightly longer than greatest width. Lateral margins strongly convex in posterior 0.66 of carapace length; well developed anterolateral spine, row of inconspicuous lateral spines. Gastric region bearing 6 prominent spines arranged in hexagon, 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 branchial region with short, widely set spines. Tergum of abdominal somite 1 with transverse row of 5–11 spines. Tergum of somite 2 with transverse row of tubercles, pleura with 1–5 small dorsal spines along anterolateral margin. Tergum of somites 3, 4 unarmed; pleura with 1–4 small posterior marginal spines or none. Tergum of somite 5 unarmed; pleura bearing 1–7 small spines on posterolateral margin, occasionally 1 or 2 small spines on pleural surface. Tergum of somite 6 with 3 prominent posterior marginal spines, 6 (occasionally more) dorsal spines; pleura usually unarmed, rarely with spines on lateral margin. barely reaching end of rostral spine; cornea dilated. Length of chelipeds about 5 times length of carapace excluding rostrum. Merus, carpus, palm with several regular longitudinal rows of spines. Pereopods 2–4 slender, merus and carpus with 6 rows spines, propodus with dorsal, mesial, dorsolateral spines in longitudinal rows, ventral margin with row of closely set movable spinules; length of dactyl less than 0.33 times length of propodus, with ventral spinules, 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, white; spines orange. Antennules, antennae, eyestalk orange; cornea black. Chelipeds orange with white spines, fingers; pereopods 2–4 orange becoming paler on dactyls (Hart 1982). A specimen from southern California was dark carrot-orange.

Habitat and depth. On abyssal muddy sand in northern part of range (Hart 1982); hard bottom on Jasper Seamount (Baba & Haig 1990); 600–1189 m.

Range. Southeastern Vancouver I., 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.

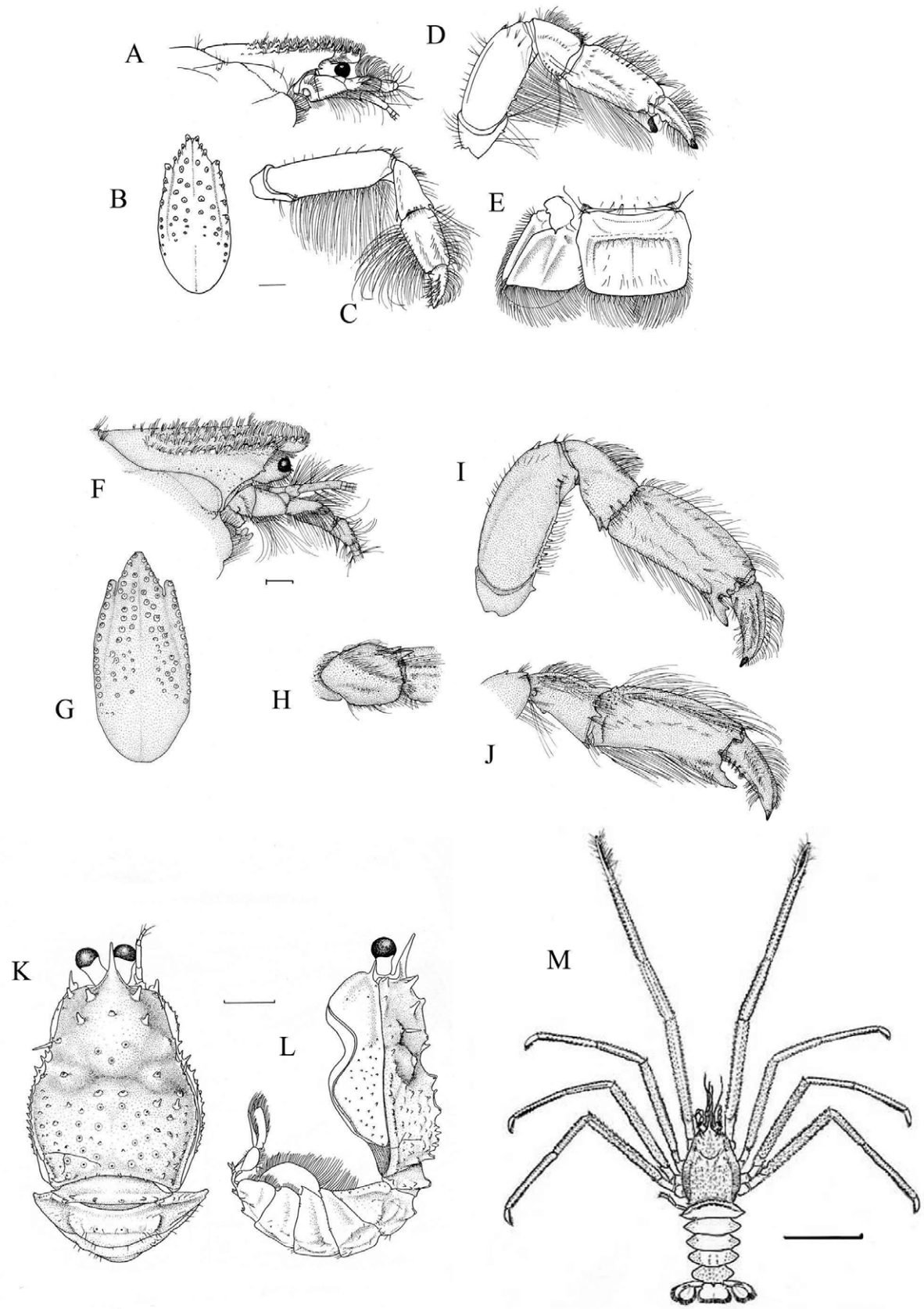

FIGURE 33. Families Upogebiidae and Chirostylidae. A–E, *Upogebia onychion* Williams, 1986; A, frontal region in lateral view; B, carapace in dorsal view; C, pereopod 2; D, cheliped; E, telson and uropod. F–J, *Upogebia pugettensis* (Dana, 1852); F, frontal region in lateral view; G, carapace; H, detail of carpus of cheliped; I, cheliped in lateral view; J, cheliped in mesial view. K, L. *Chirostylus iaspis* Baba & Haig, 1990; K, carapace and abdomen in dorsal view; L. carapace and abdomen in lateral view. M, *Chirostylus perarmatus* (Haig, 1968). Scales: A, F = 1 mm, K, L = 5 mm, M = 20 mm. A–J from Williams 1986, K, L from Baba & Haig 1900, M from Haig 1968 (as *Gastroptychus perarmatus*).

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, California Department of Fish and Game, pers. comm.) These crabs have been caught in baited fish traps off southern California, which suggests that they are scavengers (Wicksten 1982b).

Gastroptychus perarmatus (Haig, 1968)

(Fig. 33M)

Chirostylus perarmatus Haig, 1968: 272, figs. 1–3. — Wicksten 1989b: 315.
Gastroptychus perarmatus. — Baba & Haig 1990: 859.

Diagnosis. Rostrum as in *G. iaspis*. Carapace excluding rostrum 1.5–1.6 times 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 spines, most prominent an epigastric pair. Mid-cervical groove distinctly anterior to halfway point of carapace. Anterior branchial region with several large, small spines; cardiac region with pair prominent spines, few smaller ones; regions posterior to cervical groove with numerous, closely set large, small spines in irregular longitudinal rows. Tergum of abdominal somite 1 with transverse row of 12–18 spines. Tergum of somite 2 with transverse row of small spines, pointed granules, and pointed tubercles at junction with pleura; pleura with small spines on anterolateral margin, dorsal surface. Tergum of somites 3, 4 unarmed except for 1–3 spines on surface. Tergum of somite 5 with 4 longitudinal rows of spines, each outer row at junction with pleuron; pleura with small spines on surface. Tergum of somite 6 bearing numerous large, small spines; pleura with few spines on surface. Eyestalk barely reaching end of rostral spine; cornea dilated. Length of chelipeds about 6 times length of carapace excluding rostrum. Merus, carpus, palm with regular longitudinal rows of spines. Pereopods 2–4 slender, merus, carpus with 6 rows of spines; propodus with dorsal, mesial, dorsolateral rows of spines, ventral margin with row of closely set movable spinules; length of dactyl less than 0.33 times length of propodus, with ventral spinules, terminating in acute corneous claw. Carapace length excluding rostrum: male 20.5 mm, female 16.0 mm.

Color in life. Not reported. Bright pink after a few weeks of preservation in alcohol, soon fading to white (Haig 1968).

Habitat and depth. Green mud bottom or on antipatharians; from 229–366 m.

Range. From north of Anacapa I. to Coronado Bank, California. Type locality north of Anacapa I., from 34˚ 05.8' N, 119˚ 23.3' W to 34˚ 6.0' N, 119˚ 24.3' W.

Remarks. Two specimens collected off Coronado Bank in 366 m were clinging to a branch of black coral, order Antipatharia.

Family Galatheidae Samouelle, 1819

As revised by Ahyong *et al*. (2010), only one species lives in the area of coverage.

Janetogalathea Baba & Wicksten, 1997

Janetogalathea californiensis (Benedict, 1902)

(Fig. 34A, Pl. 7A)

Galathea californiensis Benedict, 1902: 247, fig. 1. — Schmitt 1921: 164, fig. 104. — Wicksten 1982: 245. — Wicksten 1987: 55; 1989b: 315.
Janetogalathea californiensis. — Baba & Wicksten 1997: 38, figs. 1–3. — Hendrickx & Harvey 1999: 375. — Macpherson *et al*. 2010: 234.— Hendrickx *et al*. 2011: 89, figs. 1, 2.

Diagnosis. Rostrum more than twice as long as eye, broad, flattened dorsoventrally, armed with one pair lateral spines, one pair basal spines. Carapace with 6 lateral spines, most anterior of these largest; dorsal surface with

transverse ridges, pair of well developed epigastric spines. Chelipeds with thorn-like spines; fingers of chela with rows of small teeth along cutting edges. Pereopods 2–4 with spines on merus, carpus, dactyls short, stout. Abdomen without spines. Carapace length to 31.3 mm.

Color in life. Reddish on much of surface, carapace with white transverse stripes along main transverse ridges, white background on pereopods. The color ntoes are from a specimen from Monterey Bay, California.

Habitat and depth. Among rocks and sponges, 87–376 m. Hendrickx *et al*. (2011) could find no verified report of the species at 3990 m, the maximum depth given for this species previously (Schmitt 1921).

Range. Monterey Bay, California to off Guadalupe I., Mexico; central Gulf of California. Type locality off Santa Cruz I., California (*Albatross* sta. 2946).

Remarks. This craylet has been taken in baited traps.

Family Munididae Ahyong, Baba, Macpherson & Poore, 2010

In the northeastern Pacific, most members of the Munididae live on the continental shelf or deeper. Some of these craylets are epibenthic, while others dig burrows. Feeding is by scavenging or using the setose third maxillipeds to rake the sediment for edible material. Munidids can swim for some distance by flapping the abdomen and spreading the legs. Pereopod 5 is slender and modified into a cleaning brush. Craylets use this appendage to clean the dorsal surface of the appendages and carapace. They can open the carapace to clean the surfaces of the gills.

Key to species of family Munididae

1. Latero-inferior regions of carapace greatly swollen. Pereopods flattened, fringed with setae . . . . . *Pleuroncodes planipes*
– Latero-inferior regions of carapace not greatly swollen. Pereopods rounded, not fringed with setae 2
2. Branchial regions laterally inflated. Carapace dorsally depressed, orbital margin almost straight . . . . . *Munida macrobrachia*
– Branchial regions not laterally inflated. Carapace not dorsally depressed, orbital margin angled 3
3. Abdomen, posterior margin of carapace unarmed . . . . . *Munida quadrispina*
– Second, third, fourth abdominal somites armed with spines . . . . . *Munida hispida*

Munida Leach, 1820

Munida hispida Benedict, 1902
(Fig. 34C, D; Pl.7 D)

Munida hispida Benedict, 1902: 260, fig. 6. — Schmitt 1921: 166, fig. 106. — Wicksten 1982b: 245; 1987: 55; 1989b: 315. — Hendrickx & Harvey 1999: 375. — Hendrickx 2003a: 124.

Diagnosis. Rostrum spine-like, more than twice as long as supraocular spines. Supraocular spines slightly exceeding corneas of eye. Carapace with ridges, 7–10 lateral spines posterior to larger anterolateral spines; pair gastric spines, also 5 or 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. Pereopods 2–4 with spines on merus, fewer spinules on carpus, propodus, dactyl slender. Abdomen with spinules on second to fourth abdominal somites. Carapace length 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 Is. Type locality off Galapagos Is., *Albatross* station 2817.

Munida macrobrachia Hendrickx, 2003
(Fig. 35A–D)

Munida macrobrachia Hendrickx, 2003a: 121, figs. 4, 5C, D.

Diagnosis (after Hendrickx 2003). Rostrum spiniform, sharp, slightly serrate dorsally and laterally. Eye small. Supraocular spines sharp, almost parallel. Carapace slightly convex anteriorly and latero-posteriorly, almost flat in central part, all main striae strongly elevated. Frontal margin of carapace almost transversal. Gastric region slightly elevated, with 2 pairs epigastric spines; one small hepatic spine, one parahepatic, one anterior branchial spine on each side. Cervical groove deep. Strong anterolateral spine. Lateral margin almost straight in anterior 0.66 of length, slightly convex in posterior third, with 3 spines on anterior branchial margin, 4–6 posterior spines. Abdominal tergites unarmed. Chelipeds of adult male subequal, squamous, with rows of irregularly set mostly blunt spines, tubercles. Length of left cheliped almost 3 times as long as length of carapace. Pereopods 2–4 slender, flattened, outer face, part of inner face covered with flattened tubercles, some tipped with blunt spines. Dactyls with about 25 movable spinules along flexor margins. Carapace length 13.7–30.5 mm without rostrum.

Color in life. Not reported.

Habitat and depth. Continental shelf, 540–612 m. All of the areas in which this species was taken have a steeply sloping bottom.

Range. Off Point Vicente, Santa Catalina I. and San Clemente I., southern California. Type locality 10.4 miles offshore of Point Vicente, Los Angeles County, California (*Velero IV* sta. 24480).

Munida quadrispina Benedict, 1902

(Fig. 34E, F; Pl.7 B)

Munida quadrispina Benedict, 1902: 269, fig. 17. — Rathbun 1904: 166. — Schmitt 1921: 165, fig. 10. — Goodwin 1952: 395. — Pereyra & Alton 1972: 450. — Wicksten 1980c: 363; 1982: 245; 1989: 315. — Hart 1982: 168, fig. 66. — Burd & Brinkhurst 1984: 1, figs. 2, 8. — Jensen 1995: 73, fig. 145. — Hendrickx 2003a: 126, figs. 5A, B; 7–9.

Diagnosis. Rostrum long, spine-like; flanked by pair of supraocular spines reaching to cornea of eye. Carapace with ridges, 8–10 lateral spines, 6 gastric spines. Chelipeds with numerous spines, slender fingers of chela. Pereopods 2–4 armed with short spines. Abdomen without spines except for few spinules on tail fan. Carapace length to 67 mm, usually smaller.

Color in life. Reddish brown, ridges red with grooves white, blue spots in cervical groove. Apices of fingers of chelae white. Pereopods 2–4 with irregular red bands.

Habitat and depth. Among rocks, gravel, mud, and sponge beds, 12–1463 m. Tolerates areas of low oxygen concentration.

Range. Sitka, Alaska to Los Coronados Is., Mexico. Type locality off Cape Beale, Vancouver I. (*Albatross* sta. 2878).

Remarks. This craylet has been observed feeding on zooplankton. Burd & Brinkhurst (1984) observed that crabs occurred in higher densities with less within-species aggressive behavior in areas of low oxygen concentration. The craylet can swim by flapping the abdomen.

Pleuroncodes Stimpson, 1860

Pleuroncodes planipes Stimpson, 1860

(Fig. 34B, Pl.7 B)

Pleuroncodes planipes Stimpson, 1860: 245. — Holmes 1900: 112. — Schmitt 1921: 163, pl. 31, fig. 2. — Haig *et al*. 1970: 22. — Blackburn 1977: 178. — Jensen 1995: 74, fig. 146. — Hendrickx & Harvey 1998: 377. — Kuris *et al*. 2007: 647. — Macpherson *et al*. 2010: 234.

Diagnosis. Rostrum long, slender, flanked by two spine-like supraorbital teeth. Eye large, globular, pigmented. Carapace transversely rugose, with latero-inferior regions swollen; spine at anterolateral angle with few spines on lateral margin. Abdomen dorsally unarmed. Chelipeds, pereopods 2–4 flattened, edged with setae. Carapace length to 50 mm.

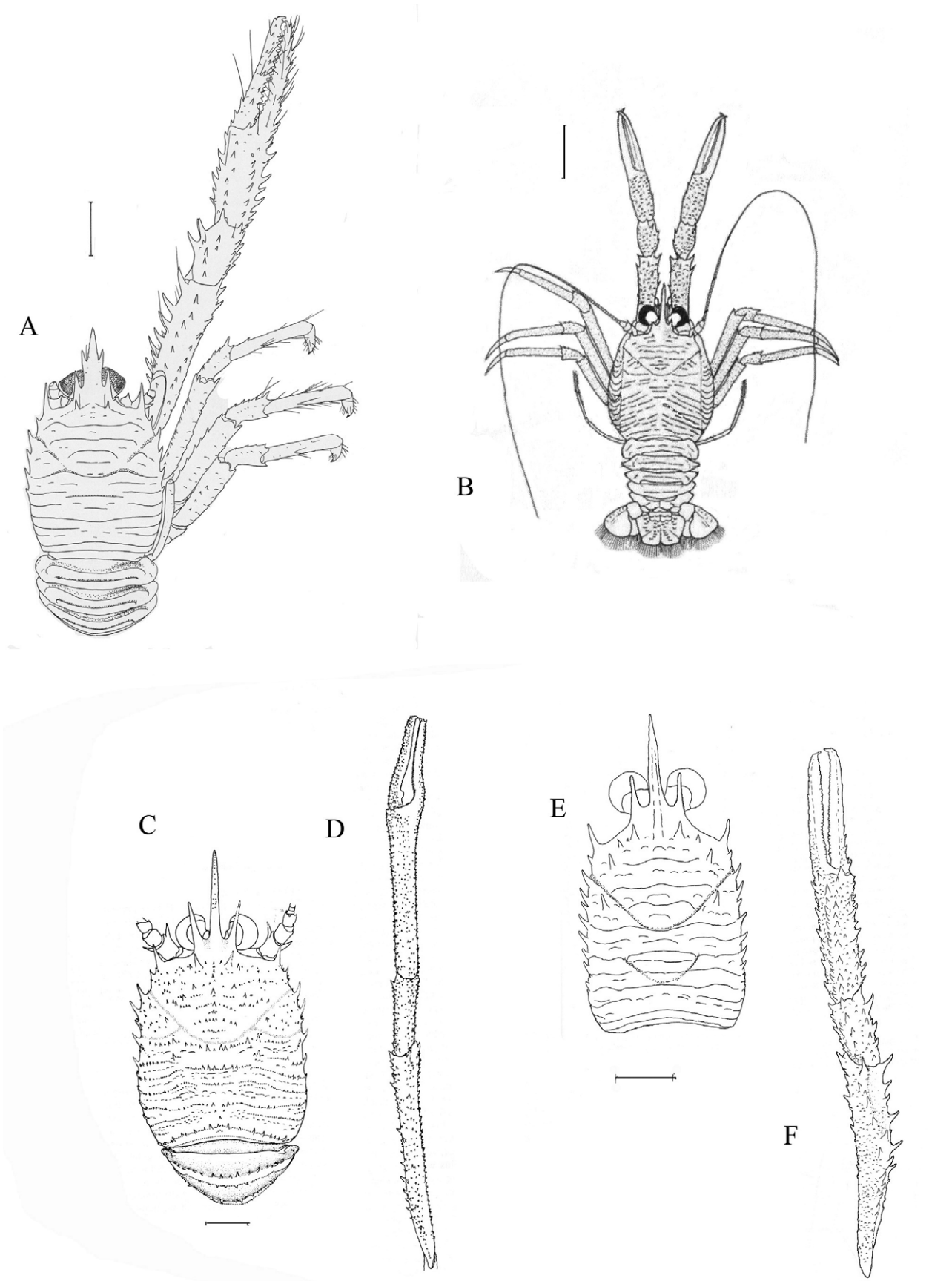

FIGURE 34. Families Galatheidae and Munidae. A, *Janetogalathea californiensis* (Benedict, 1902). B, *Pleuroncodes planipes* Stimpson, 1860. C, D, *Munida hispida* Benedict, 1902; C, carapace and eye; D, cheliped. E, F, *Munida quadrispina* Benedict, 1902; E, carapace and eye; F, cheliped. Scales: A = 5 mm, B, C, E = 10 mm. A from Baba & Wicksten 1997, B adapted from Hendrickx 1995a; C, D from Hendrickx 2000, E, F from Hendrickx 2003.

Color in life. Red, setae golden. The color notes are from craylets from Santa Catalina I.

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. Fishermen call this species the "pelagic red crab" or "tuna crab." Usually, it 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, dolphins and the humpback whale eat these crabs. Hendrickx & Harvey (1998) provided an extensive list of references.

Family Munidopsidae Ortmann, 1898

Key to species of family Munidopsidae

1. Abdomen unarmed 2
– Abdomen with spines or tubercles 4
2. Dorsal surface of carapace covered by spiny-pointed tubercles . . . . . *Munidopsis scabra*
– Dorsal surface without spiny-pointed tubercles 3
3. Chelipeds with epipods. Pereopods not conspicuously setose. Eyes ovate . . . . . *Munidopsis lignaria*
– Chelipeds without epipods. Pereopods conspicuously setose. Eyes globular . . . . . *Munidopsis verrilli*
4. Rostrum with lateral spines 5
– Rostrum without lateral spines 6
5. Eyestalk spined on dorsal surface. Dorsal armature of abdomen not confined to median line . . . . . *Munidopsis hystrix*
– Eyestalk not spined on dorsal surface. Dorsal armature of abdomen confined to median line . . . . . *Munidopsis depressa*
6. Carapace with one very large median dorsal spine, two smaller ones. Anterolateral spine of carapace large . . . . . *Munidopsis diomedeae*
– Carapace without one very large median dorsal spine, any median dorsal spines small. Anterolateral spine of carapace small, if present 7
7. Anterior margin of carapace with small, serrated lobe on either side of base of rostrum behind ocular peduncle, lateral margins arcuate . . . . . *Munidopsis aspera*
– Anterior margin of carapace straight, at right angles to lateral margin; lateral margins straight . . . . . *Munidopsis quadrata*

Munidopsis Whiteaves, 1784

Munidopsis aspera (Henderson, 1885)

(Fig. 35E)

Elasmonotus asper Henderson, 1885: 416.

Munidopsis aspera. — Rathbun 1904: 167. — Schmitt 1921: 171, pl. 31, fig.1. — Wicksten 1989b: 315. — Hendrickx & Harvey 1999: 376.

Diagnosis. Rostrum elongate, triangular, length variable: from same as eyestalk to twice its length. Carapace with small lobe on orbital border, dorsal surface with tubercles, 2 large tubercles on cardiac area. Chelipeds elongate, setose, with scattered spines. Pereopods 2–4 with elongate dactyls. Abdominal somites 2, 3 with tubercles. Total length 28 mm.

Color in life. Not reported.

Habitat and depth. Continental shelf and slope, 104–2748 m.

Range. Santa Catalina I., California to Straits of Magellan; off Brazil and Patagonia. Type localities off coast of Brazil and off Patagonia.

Remarks. There are no accurate and detailed drawings of this species.

Munidopsis depressa Faxon, 1893
(Fig. 35F)

Munidopsis depressa Faxon 1893:189; 1895: 96, pl. 22, figs. 2, 2a, 2b. — Haig 1956: 79. — Wicksten 1980c: 362; 1989b: 315. — Hendrickx & Harvey 1999: 376. — Hendrickx 2003b: 23.

Diagnosis. Rostrum elongate, triangular, with 2 small lateral teeth near apex, 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 medial dorsal spines, small spines and tubercles elsewhere on dorsal surface; posterior margin with large median spine, row of teeth on either side. Chelipeds with thorn-like spines. Pereopods 2–4 with spines on merus, carpus, proximal surface of propodus, dactyls elongate. Abdominal somites 1–4 with spines or tubercles. Carapace length 20.3 mm.

Color in life. Not reported.

Habitat and depth. Continental slope, on green mud and sand, 185–1255 m.

Range. Santa Catalina I., California to off Cape Corrientes, Mexico, including Gulf of California. Type locality off Cape Corrientes (*Albatross* sta. 3425, 21˚ 19' N, 106˚ 24' W).

Munidopsis diomedeae (Faxon, 1893)
(Fig. 35G)

Galacantha diomedeae Faxon, 1893: 180; 1895: 79, pl. 25.
Munidopsis diomedeae. — Haig & Wicksten 1975: 101. — Wicksten 1980c: 364; 1989b: 315. — Hendrickx & Harvey 1999: 376. — Hendrickx 2003b: 24.

Diagnosis. Rostrum without lateral spines, distal part angled upward. Carapace with one very large, 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. Pereopods 2–4 with one spine each at end of carpus, merus. Abdominal somites 1–3 with small median spines. Carapace length to 28 mm.

Color in life. Red.

Habitat and depth. Lower continental slope, on mud and *Globigerina* ooze, 768–3790 m.

Range. San Clemente I., California to Chile. Type locality not designated; type material came from 15 stations between the Gulf of Panama and the Gulf of California.

Remarks. Faxon (1895) noted that this craylet was parasitized by rhizocephalan cirripeds and epicaridean isopods.

Munidopsis hystrix Faxon, 1893
(Fig. 35H)

Munidopsis hystrix Faxon, 1893: 183; 1895: 89, pl. 19, figs. 1,1a. — Rathbun 1904: 166. — Schmitt 1921: 168, fig. 10. — Garth & Haig 1971: 6.6. — Wicksten 1989b: 315. — Hendrickx & Harvey 1999: 376. — Hendrickx 2003 b: 25.

Diagnosis. 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, propodus. Pereopods 2–4 each with sharp tooth at distal end of carpus. Abdomen with spines on second, third somites. Carapace length 26 mm.

Color in life. Not reported.

Habitat and depth. Continental slope, on green mud or *Globigerina* ooze, 552–1243 m.

Range. Anacapa I., California to Peru. Type localities off Cape Corrientes, Mexico (*Albatross* sta. 3424, 21˚ 15' N, 106˚ 23' W and sta. 3425, 21˚ 19' N, 106˚ 24' W) and off Acapulco, Mexico (*Albatross* sta. 3417, 16˚32' N, 99˚48' W.

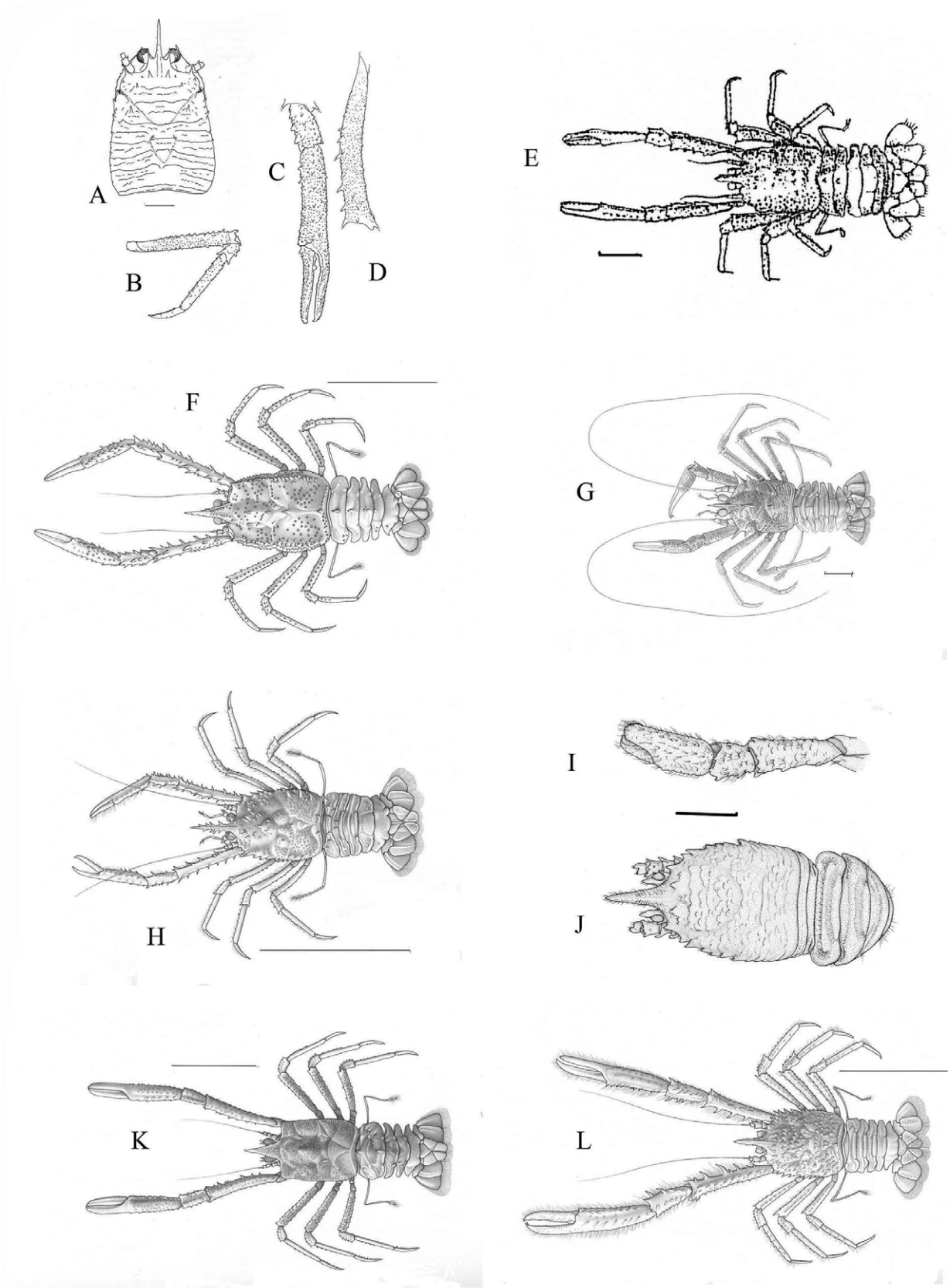

FIGURE 35. Families Munidae and Munidopsidae. A–D, *Munida macrobrachia* Hendrickx, 2003; A, carapace and eye; B, pereopod 2; C, left cheliped, distal segments; D, left cheliped, merus. E, *Munidopsis aspera* (Henderson, 1885). F, *Munidopsis depressa* Faxon, 1893. G, *Munidopsis diomedeae* (Faxon, 1893). H, *Munidopsis hystrix* Faxon, 1893. I, J, *Munidopsis lignaria* Williams & Baba, 1989; I, cheliped; J, carapace and abdomen in dorsal view. K, *Munidopsis quadrata* Faxon 1893. L, *Munidopsis scabra* Faxon, 1893. Scales: I, J = 3 mm; E–H, K, L = 10 mm. A–D from Hendrickx 2003, E from Bate 1888, F, G, H, K, L from Faxon 1895 (G as *Galacantha diomedeae*); I, J from Williams & Baba 1989.

Remarks. In the Gulf of California, Hendrickx (2000b) reported collecting this crab at oxygen levels oxygen levels of 0.15–0.22 ml O2/l, the lowest overall oxygen levels at which species of *Munidopsis* were collected in the area.

Munidopsis lignaria Williams & Baba, 1989

(Fig. 35I, J)

Munidopsis ciliata: Ambler 1980: 19, fig. 4. [Not *M. ciliata* Wood-Mason, 1891, Indo-West Pacific species].
Munidopsis lignaria Williams & Baba, 1989: 904, figs. 2f, 4.

Diagnosis (after Williams & Baba 1989). Rostrum narrowly triangular, exceeding eyestalk by its own or slightly greater length, without lateral spines. Eyes with ovate corneae. Front of carapace with slightly hooked antennal spine lateral to eyestalk followed by concavity ending in small, acute anterolateral angle. Gastric region bearing short setose rugosities behind strong gastric spine at either side of midline, secondary spine lateral to each large spine. Anterior branchial region with less prominent rugosities, lateral margin with strong anterior tooth followed by 4 spines successively smaller in size. Posterior branchial region with moderately developed spine at anterolateral corner, with distinct, transverse rugae. Posterior margin shallowly concave preceded by raised submarginal rim. Abdomen without spines but somites 2, 3 with bold transverse ridges. Chelipeds stout, subequal, with variable rugosities tending to be arranged in longitudinal tracts, ischium with short lateral spine, merus with 3 principal mesial spine, 1 distodorsal spine, distoventral spine, carpus with row of 3 mesiodorsal spines, palm nearly spooned, fingers spooned at apices. Pereopods 2–4 rather long, each merus with crest on dorsal margin ending in distal spine. Carpi with longitudinal spiny dorsal, tuberculate dorsolateral crests, each ending in spine; each propodus slender, with dorsal crest with 2 remote proximal spines, dactyls slender, with row of 10–12 movable spines on flexor margin. Carapace length 6.5–11.6 mm (excluding rostrum).

Color in life. Not reported.

Habitat and depth. In association with sunken wood, deep sea basins, 2020–2875 m.

Range. Cascadia Basin off Oregon, 44˚ 39.8' N, 12˚ 36.4 ' W (type locality) to East Pacific Rise off south central Mexico, 11˚ 52' N, 103˚ 51' W.

Remarks. The craylet can have wood fragments in its stomach contents.

Munidopsis quadrata Faxon, 1893

(Fig. 35K)

Munidopsis quadrata Faxon, 1893: 188; 1895: 97, pl. 23, fig. 1. — Rathbun 1904: 167. — Schmitt 1921: 170, fig. 109. — Pereyra & Alton 1972: 450. — Hart 1982: 170, fig. 67. — Wicksten 1989b: 315. — Hendrickx & Harvey 1999: 376. — Hendrickx 2003b: 25.

Diagnosis (modified from Hart 1982). Rostrum more or less flat, triangular. Carapace rectangular, without prominent spines but covered with granules. Chelipeds setose, armed with thorn-like spines. Pereopods 2 –4 with smll spines on merus, carpus; dactyls with
spinules along flexor margin. Abdominal somites 2–4 with median teeth. Carapace length to 15.5 mm.

Color in life. Carapace pinkish tan. Rostrum pink, white. Chelipeds mostly white, basis orange, ischium pink. Pereopods 2–4 white, pale tan. Abdomen pinkish with white (Hart 1982).

Habitat and depth. Mud and sand, 86–1572 m. Most records are from deeper than 900 m.

Range. Queen Charlotte Is., British Columbia to off Cape Corrientes, Mexico. Type localities off Cape Corrientes (*Albatross* sta. 3424, 21˚ 15' N, 106˚ 23' W and sta. 3425, 21˚ 19' N 106˚ 24' W).

Munidopsis scabra Faxon, 1893
(Fig. 35L)

Munidopsis scabra Faxon, 1893: 186; 1895: 93, pl. XXI, figs. 1, 1a. — Garth & Haig 1971: 6.6. — Pereyra & Alton 1972:450. — Haig & Wicksten 1975:10. — Wicksten 1989b: 315.

Diagnosis. Rostrum without lateral spines, slightly turned upward. Carapace covered with spiny-pointed tubercles; with 9 or 10 lateral spinules, row of 8 spinules on posterior margin. Chelipeds with thorn-like spines except on fingers. Pereopods 2–4 with rows of small, sharp spines. Abdomen without spines. Carapace length 40 mm.

Color in life. Not reported.

Habitat and depth. Continental slope, among sand, mud and rubble, 567–1243 m.

Range. Oregon to Peru. Type localities off Cape Corrientes, Mexico (*Albatross* sta. 3424, 21˚15' N, 106˚ 23' W; and sta. 3425, 21˚ 19' N, 106˚ 24' W).

Munidopsis verrilli Benedict, 1902
(Fig. 36A)

Munidopsis verrilli Benedict, 1902: 291, fig. 34. — Schmitt 1921: 169, fig. 108. — Goodwin 1952: 395. — Wicksten 1989b: 316.

Diagnosis. Rostrum slender, triangular, without lateral spines. Front of carapace angled 45˚ from base of rostrum to anterolateral margin, with sharp spine just posterolateral to eye, lateral margin with 4 spines, surface rough, with low tubercles, two spines on gastric region. Chelipeds relatively short, with sharp thorn-like spines on merus, carpus, two spines on palm of chela, fingers relatively short ,stout. Pereopods 2–4 with sharp spines on merus, carpus; propodus unarmed, dactyls slender. Abdomen without spines. Carapace length 17 mm.

Color in life. Carapace iridescent.

Habitat and depth. Continental slope, 1253–1986 m.

Range. Oregon to off Cedros I., Baja California, Mexico. Type locality off San Diego (*Albatross* station 2923).

Family Porcellanidae Haworth, 1825

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 and scrape detritus from the sea floor by use of the third maxillipeds. They usually do not tear and scavenge food. Pereopod 5 is modified into a cleaning brush. In *Petrolisthes cinctipes* and *P. cabrilloi*, the crabs maintain an individual distance of the length of a second antenna from the nearest neighbor. Individuals of *Petrolisthes cinctipes* use the large chelipeds to raise themselves off the substrate or to "elbow" intruding neighbors. The crabs can swim short distances by flapping the abdomen. Wicksten (1973) and Gonor & Gonor (1973) studied feeding and swimming in porcellanids.

Haig (1960) gave a comprehensive account of porcellanid synonymies, morphological variation and sites where they have been collected. Haig & Abbott (1980) provided additional information on feeding, ecology and larval stages.

Key to species of family Porcellanidae

1. Chelipeds markedly unequal in size, shape; thick and more or less roughened 2
– Chelipeds more or less equal in size, shape; flattened 4
2. Carapace with tuft of plumose hairs on front. Chelipeds covered by velvet-like pubescence . . . . . *Pachycheles holosericus*
– 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, without short pubescence, few if any setae in gape of fingers . . . . . *Pachycheles rudis*

– Chelipeds granulated, with short pubescence, dense pubescence in gape of fingers . . . . . *Pachycheles pubescens*
4. Carapace markedly wider than long, chelipeds with dense fringe of setae on outer surface . . . . . *Polyonyx quadriungulatus*
– Carapace about as wide as long, chelipeds without dense fringe of setae on outer surface 5
5. Carpus of cheliped elongated, more than twice as long as wide 6
– Carpus of cheliped short, less than twice as long as wide 7
6. Carapace with short transverse striations, flattened tubercles. . . . . *Petrolisthes rathbunae*
– Carapace anteriorly with granules, without striations, posteriorly smooth . . . . . *Petrolisthes manimaculis*
7. Carpus of cheliped without lobe on anterior margin, anterior and posterior margins subparallel . . . . . *Petrolisthes eriomerus*
– Carpus of cheliped lobed on anterior margin 8
8. Carpal lobe occupying proximal 0.25 of anterior margin, anterior, posterior margins otherwise subparallel; merus of pereopod 4 not inflated. (Rarely found north of Point Conception, California) . . . . . *Petrolisthes cabrilloi*
– Carpal lobe not confined to proximal 0.25 of anterior margin of chelipeds, anterior, posterior margins converging distally; merus of pereopod 4 inflated. (Usually found north of Point Conception, California . . . . . *Petrolisthes cinctipes*

Pachycheles Stimpson, 1860

Pachycheles holosericus Schmitt, 1921
(Fig. 36B)

Pachycheles holosericus Schmitt, 1921: 177, pl. 33, fig. 3. — Haig 1960: 173, pl. 34, fig. 2. — Haig *et al*. 1970: 23. — Haig & Abbott 1980: 589, fig. 24.21.

Diagnosis. 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, 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 pereopods 2–4 with long plumose setae. Telson of abdomen with 5 plates. Carapace length to 18mm.

Color in life. Body dull brown (Haig & Abbott 1980).

Habitat and depth. Under rocks, on pier pilings and in sheltered places such as kelp holdfasts and in cavities in sponges, intertidal zone to 18 m.

Range. Santa Barbara, California to Magdalena Bay, Baja California, Mexico.Type locality Venice, California. There have been no reports of the crab from its type locality since its original description.

Remarks. Haig & Abbott (1980) reported that these crabs are typically are found in pairs.

Pachycheles pubescens Holmes, 1900
(Fig. 36C, Pl. 7F)

Pachycheles pubescens Holmes, 1900: 110. — Rathbun 1904: 168. — Schmitt 1921: 117, pl. 33, fig. 4; fig. 112. — Johnson & Snook 1927: 350. — Haig 1960: 162, pl. 34, fig. 3. — Haig *et al*. 1970: 23. — Gonor & Gonor 1973: 225, figs. 2–5. — Haig & Abbott 1980: 589, fig. 24.19. — Hart 1982: 102, fig. 35. — Ricketts *et al*. 1985: fig. 31 (larval stages). — Jensen 1995: 74, fig. 148. — Kuris *et al*. 2007: 648, pl. 326 C.

Diagnosis. 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 or 4 uneven, serrate teeth, lobe, 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. Pereopods 2–4 with fringes of plumose setae. Telson with seven plates. Carapace length to 18 mm.

Color in life. Carapace white, dappled with brown, gray, purple; may have blue, tan comma-shaped mark on each branchial region. Chelipeds covered by mud-colored setae. Pereopods 2–4 with merus blue, brown, propodus and dactyl with distal white bands (Hart 1982).

Habitat and depth. Rocky coasts, usually intertidal but as deep as 55 m.

Range. Queen Charlotte Is., British Columbia to Thurloe Head, Baja California, Mexico. Type localities Drake's Bay, Farallon Is. and Humboldt County, California.

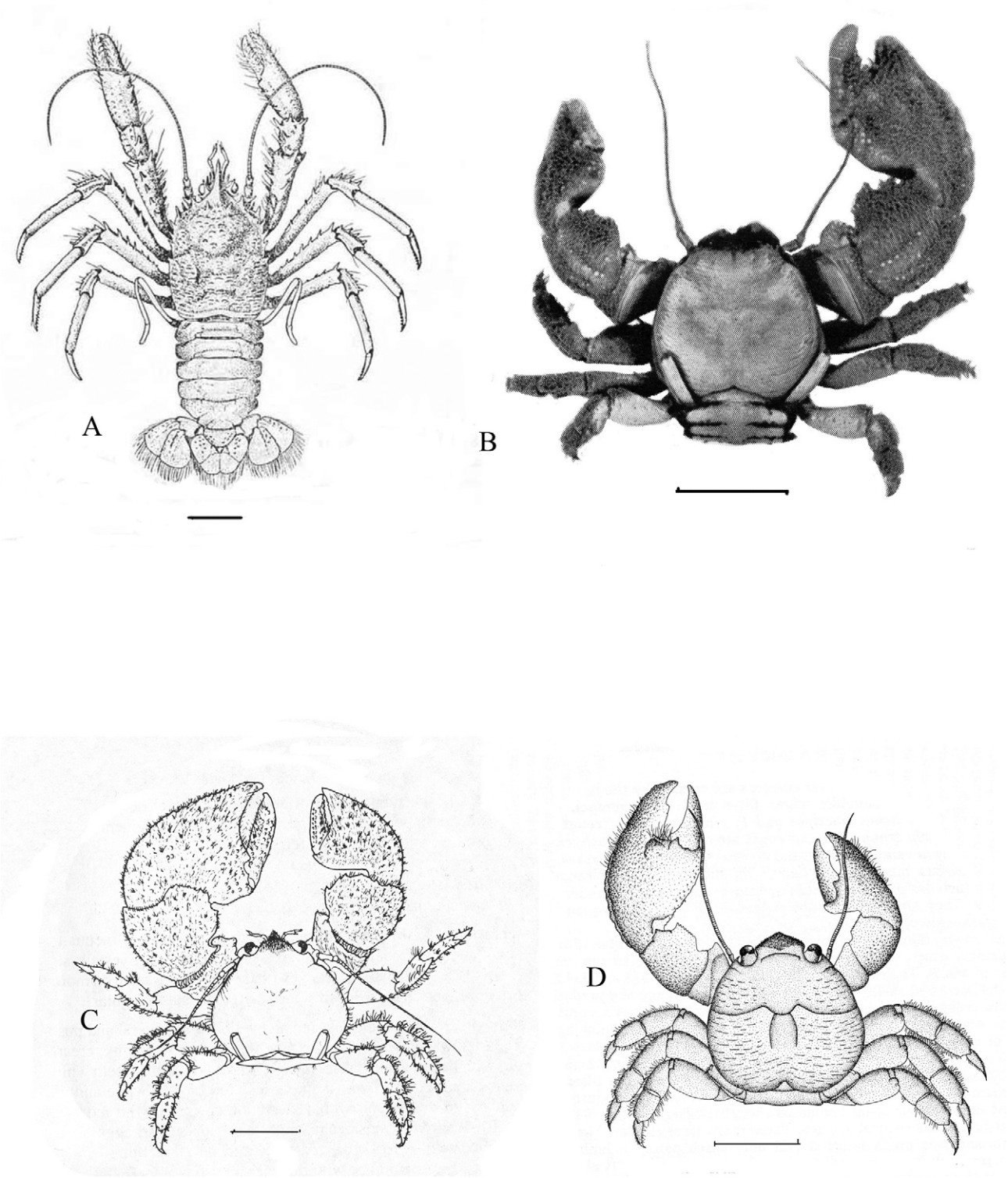

FIGURE 36. Families Munidopsidae and Porcellanidae. A, *Munidopsis verrilli* Benedict, 1902. B, *Pachycheles holosericus* Schmitt, 1921. C, *Pachycheles pubescens* Holmes, 1900. D, *Pachycheles rudis* Stimpson, 1859. Scales = 10 mm. A from Benedict 1902, B from Haig 1960, C from Hart 1982, D from Brusca & Brusca 1978.

Pachycheles rudis Stimpson, 1859
(Fig. 36D, Pl. 7E)

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. 11. — Johnson & Snook 1927: 350, fig. 298. — Haig 1960: 170, pl. 34, fig. 1. — Haig *et al*. 1970: 26. — Gonor & Gonor 1973: 25. — Haig & Abbott 1980: 589, fig. 24.20. — Hart 1982: 100, fig. 101. — Ricketts *et al*. 1985: 402, fig. 308. — Jensen 1986: 180; 1995: 74, fig. 147. — Kuris *et al*. 2007: 648, pl. 326 B1.

Diagnosis. Front narrow, trilobate in frontal view, with dense short setae. Carapace about as broad as long, strongly convex from front to back, mostly punctate or with flattened granules. Chelipeds unequal. Merus rugose, granular, anterior margin with strongly projecting lobe. Carpus with broad subtriangular lobe on anterior margin, dorsal surface covered with long setae, large coarse granules. Chelipeds with large coarse granules; large protuberance at base of dactyl, surface covered with setae which do not extend beyond most proximal part of dactyl. Pereopods 2–4 with thick fringe of plumose setae along anterior margins. Telson with 5 plates. Carapace length to 17.4 mm.

Color in life. Carapace mottled, with gray, brown, white stripes; in smaller animals, may be almost completely white except for one or two brown patches. Chelipeds greenish brown with gray and bluish granules. Pereopods 2–4 mottled with brown, gray, or white The color notes are based on crabs from Pillar Point, San Mateo County, California.

Habitat and depth. Under stones, in holdfasts or in well-protected crevices, usually intertidal, to 29 m.

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* (Jensen 1986).

Petrolisthes Stimpson, 1860

Petrolisthes cabrilloi Glassell, 1945
(Fig. 37A, Pl. 8B)

Petrolisthes cabrilloa Glassell, 1945: 225, fig. 4. — Kropp 1981: 307.
Petrolisthes cabrilloi. — Haig 1960: 88, pl. 26, fig. 3. — Haig *et al*. 1970: 26. — Haig & Abbott 1980: 588, fig. 24.17. — Jensen 1995: 76, fig. 153. — Kuris *et al*. 2007: 648. — Sloan *et al*. 2010: 159.

Diagnosis. Front triangular, with deep median sulcus. Carapace about as long as broad, usually covered with plications, fine granules; but sometimes nearly smooth. Chelipeds finely granular. Merus with strongly projecting lobe on anterior margin. Carpus setose, about twice as long as wide, with small lobe occupying about 0.25 of proximal end, granules along outer margin enlarged, forming crest ending distally in sharp tooth. Chela smooth to lightly pubescent, gape with thick pubescence. Pereopods 2–4 rugose, merus of pereopod 3 unarmed, not inflated; all segments with tufts of setae. Carapace length to 16 mm.

Color in life. Carapace brown to tan, with striations, numerous spots of pale greenish white. Chelipeds brown, chela may have greenish tinge, red spot at base of dactyl. Pereopods 2–4 dull brown, with bands of tan, darker brown on propodus. Outer segments of maxillipeds red (Haig 1960).

Habitat and depth. Among rubble, on pilings or among mussels, intertidal zone.

Range. Morro Bay, California to Magdalena Bay, Baja California, Mexico, including Santa Cruz and Santa Catalina Is., California. Type locality Anaheim Landing, California.

Remarks. This porcelain crab seems to replace *P. cinctipes* south of Point Conception, California. It is extremely common. As many as 22 individuals were found under a single rock with area of about 0.9 m^2 among rocky rubble near Point Fermin, Los Angeles County, California. Sloan *et al*. (2010) reported that it is parasitized by the rhizocephalan *Lernaeodiscus porcellanae*. They also noted that the sizes of the largest individuals in a population varied geographically even among sites separated by only a few kilometers, perhaps in response to food.

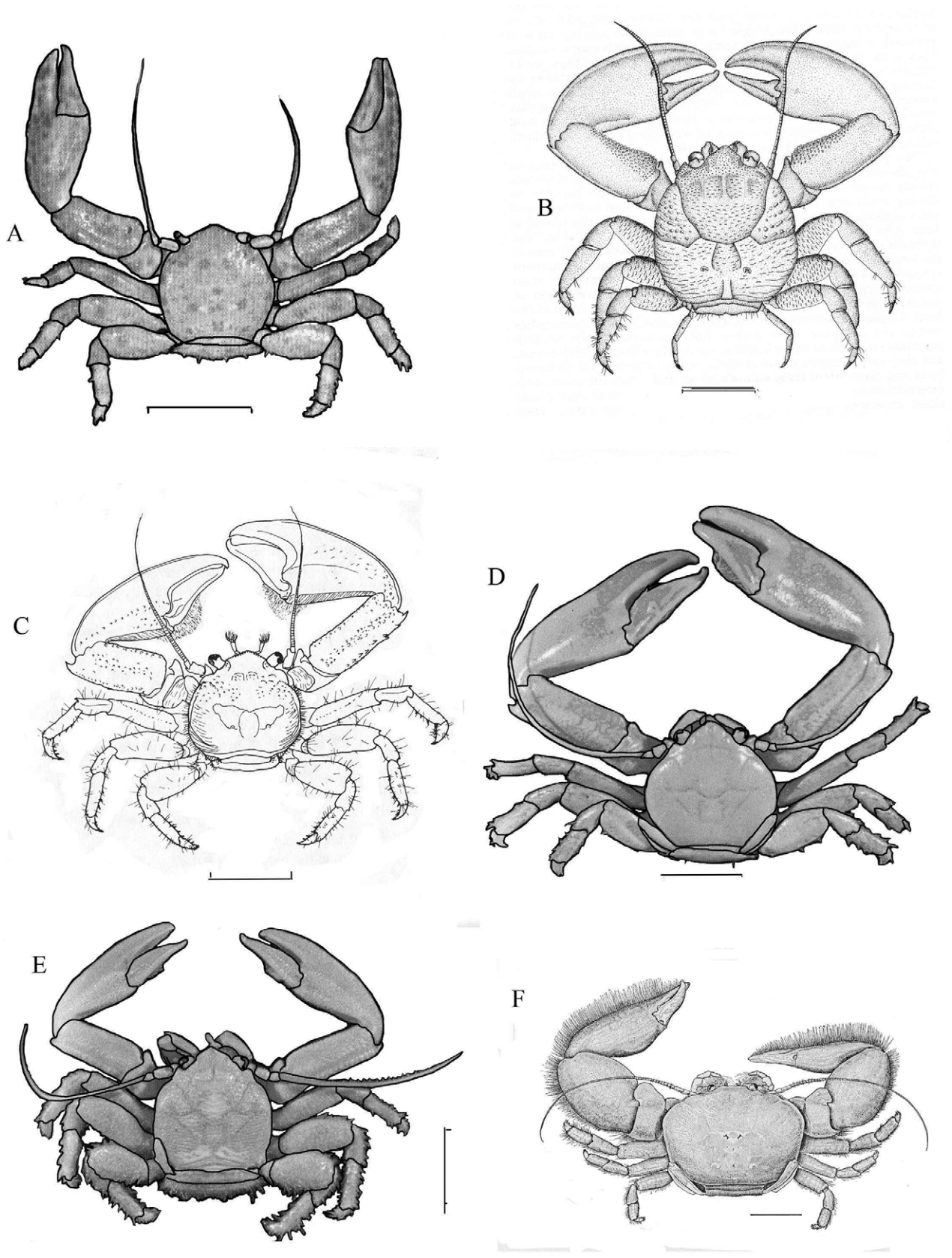

FIGURE 37. Family Porcellanidae. A, *Petrolisthes cabrilloi* Glassell, 1945. B, *Petrolisthes cinctipes* (Randall, 1839). C, *Petrolisthes eriomerus* Stimpson, 1871. D, *Petrolisthes manimaculis* Glassell, 1945. E, *Petrolisthes rathbunae* Schmitt, 1921. F, *Polyonyx quadriungulatus* Glassell, 1935. Scales = 10 mm. A, D, E adapted from Haig & Abbott 1980; B from Brusca & Brusca 1978, C from Hart 1982, F from Glassell 1935.

Petrolisthes cinctipes (Randall, 1840)

(Fig. 37B, Pl. 8A)

Porcellana cinctipes Randall, 1840: 136.

Petrolisthes cinctipes. — Holmes 1900: 107 (part). — Rathbun 1904: 168. — Schmitt 1921: 179, fig. 113, pl. 32, fig. 1. — Johnson & Snook 1927: 351. — Haig 1960: 90, pl. 28, fig. 3 (extensive synonymy). — Wicksten 1973: 161. — Gonor & Gonor 1973: 225. — Haig & Abbott 1980: 588, fig. 24.18. — Hart 1982: 98, fig. 3. — Ricketts *et al*. 1985: 45, fig. 30. — Jensen 1995: 75, fig. 149. — Kuris *et al*. 2007: 648, pl. 326 A.

Diagnosis. 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 1.5–2 times as long as wide, strong lobe occupying more than 0.25 of proximal anterior margin, anterior, posterior margins converging distally, posterior margin with row of tubercles forming ridge, ending distally in strong tooth. Chela smooth, gape with tuft of setae. Pereopods 2–4 rugose, merus unarmed, usually naked, that of third leg inflated; carpus nearly devoid of setae; propodus, dactyl with setae. Carapace length to 24 mm.

Color in life. Light to dark brown, granules bluish, with blue, white comma-like mark on either side of cardiac area. Chelipeds with red spot at base of dactyl. Pereopods 2–4 with yellow median band on propodus, dactyl yellow with narrow brown band. Outer segments of maxillipeds red. Individuals ready to molt may be blue (Hart 1982).

Habitat and depth. Under rocks or among mussel beds, midlittoral zone, rarely as deep as 64 m.

Range. Porcher I., British Columbia to Santa Barbara, California. Type locality incorrectly given as "Sandwich Islands" (Hawaiian Is.). Some of Randall's specimens were 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. In life, pereopods 5 are folded alongside the carapace. Records of *P. cinctipes* from south of Point Conception prior to 1945 are likely to be misidentifications of *P. cabrilloi*.

Petrolisthes eriomerus Stimpson, 1871

(Fig. 37C, Pl. 8C)

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. — Johnson & Snook 1927: 351, fig. 299. — Haig 1960: 74, pl. 26, fig. 4. — Gonor & Gonor 1973: 225. — Haig & Abbott 1980: 587, fig. 24.15. — Hart 1982: 96, fig. 32. — Ricketts *et al*. 1985: 306. — Jensen 1995: 75, fig. 150. — Kuris *et al*. 2007: 648.

Diagnosis. 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, ending in distal tooth. Chela naked, gape filled with thick pubescence. Pereopods 2–4 granular, merus not inflated, all segments with setae. Carapace length to 19 mm.

Color in life. Granules on carapace red-brown or white with blue tinges in grooves, blue, white comma-like mark on either side of cardiac region. Chelipeds with dark, light red granules; orange areas, blue-white patches at junctions of segments; blue spot at base of dactyl. Pereopods 2–4 brown with 2 patches of yellow on merus; red, yellow band proximally, yellow distally on propodus; dactyl brown, yellow. Outer maxillipeds with both surfaces of last two articles bright blue (Hart 1982). Individuals ready to molt may be bluish.

Habitat and depth. Under rocks in lowest intertidal zone, rarely to 86 m.

Range. Chicagof I., Alaska to La Jolla, California. Type locality Mendocino, California.

Petrolisthes manimaculis Glassell, 1945
(Fig. 37D)

Petrolisthes manimaculis Glassell, 1945: 223, text fig. 1. — Haig 1960: 77, pl. 27, fig. 1; see this reference for previous misidentifications. — Haig & Abbott 1980: 587, fig. 24.16. — Jensen 1995: 75, fig. 151. — Wasson *et al*. 2002: 482. — Kuris *et al*. 2007: 648.

Diagnosis. 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 2.5–3 times as long as wide, margins subparallel. Chela naked, fingers long, slender; gape with thick pubescence. Pereopods 2–4 smooth to granular; merus not inflated; all segments covered with scattered tufts of setae. Carapace length 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 (Haig 1960)..

Habitat and depth. Among rocks and in piles of rocky rubble, lowest intertidal zone to at least 2 m.

Range. Baker Beach and Indian Beach, Humboldt County, 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 I., California. It has been confused with *P. gracilis* Stimpson, 1860; which occurs in the Gulf of California.

Petrolisthes rathbunae Schmitt, 1921
(Fig. 37E)

Petrolisthes rathbunae Schmitt, 1921: 181, pl. 32, fig. 3. — Haig 1960: 72, pl. 26, fig. 2. — Haig & Abbott 1980: 587, fig. 24.14. — Campos & de Campos 1989: 174. — Jensen 1995: 76, fig. 152. — Kuris *et al*. 2007: 648.

Diagnosis. 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. Pereopods 2–4 with short rugae, long setae. Carapace length 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 pereopods 2–4 buff dotted with maroon. Carpus, propodus dark brown banded with orange red. Dactyls scarlet. Ventral side mostly red orange (Haig 1960).

Habitat and depth. Under stones or in rock piles, lower intertidal to subtidal zones.

Range. Monterey, California to Tortugas Bay, Mexico. Type locality San Clemente I., California. Most specimens have been taken south of Point Conception, California.

Remarks. There are few records of this porcelain crab. It is difficult to collect because of the speed with which it retreats into cracks between rocks in rubble piles.

Polyonyx Stimpson, 1858

Polyonyx quadriungulatus Glassell, 1935
(Fig. 37F)

Polyonyx quadriungulatus Glassell, 1935: 93, pl. 9. — Haig 1956: 80; 1960: 236, pl. 41, fig. 2; text fig. 12 (1). — Haig *et al*. 1970: 26. — Kudenov & Haig 1974: 105. — Jensen 1995: 76, fig. 154.

Diagnosis. 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, posterior margins fringed with

setae. Chela slender, dorsal surface swollen, without crest in major cheliped; outer margin with sharp crest lined with row of granules, thick fringe of setae extending nearly to apex of dactyl, gape of fingers with scattered short setae. In major chela, dactyl crosses over fixed finger at apex of chela. Pereopods 2–4 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, one on middle or proximal third of posterior margin. Dactyl with 4 fixed spines, distal three large, proximal one small. Telson with 7 plates. Carapace length to 13.5 mm.

Color in life. Carapace, chelipeds dark brown, mottled with green, red; pereopods 2–4 lighter, banded (Glassell 1935).

Habitat and depth. Strictly symbiotic, living in pairs within tubes of polychaete *Chaetopterus variopedatus* (Renier, 1804), intertidal zone to 46 m.

Range. Santa Rosa I., California to Punta San Eugenio, Baja California, Mexico, Gulf of California at Puerto Peñasco, Loreto, and El Mogote. Type locality Estero de Punta Banda, Baja California, Mexico.

SUPERFAMILY HIPPOIDEA Latreille, 1825

The egg-like shape and flat legs of these crabs are specializations for digging into sand. 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.

The three families of the mole crabs are easily distinguished by looking at the edge of the carapace and the eyestalk. Boyko (2002) monographed species assigned to the family Albuneidae and divided it into two families: the Albuneidae in s.s. and the Blepharipodidae. This work contains further synonyms, keys and illustrations.

Key to species of Hippoidea

1. Carapace without lateral teeth . . . . . *Emerita analoga* (Hippidae)
– Carapace with lateral teeth 2
2. Eyes flat, square . . . . . *Lepidopa californica* (Albuneidae)
– Eyes cylindrical. . . . . 3 (Blepharipodidae)
3. Carapace with 4 lateral spines . . . . . *Blepharipoda occidentalis*
– Carapace with 3 lateral spines . . . . . *Lophomastix diomedeae*

Family Albuneidae Stimpson, 1860

Lepidopa Stimpson, 1860

Lepidopa californica Efford, 1971

(Fig. 38C, D)

Lepidopa myops: Holmes 1900: 172. — Schmitt 1921: 172, pl. 31, fig. 4. — Johnson & Snook 1927: 349, figs. 296, 297. — MacGinitie & MacGinitie 1968: 305 fig. 149. — Haig *et al*. 1970: 25. — Haig & Abbott 1980: 583. — Ricketts *et al*. 1985: 336, fig. 216. — Jensen 1995: 77, fig. 157. [Not *Lepidopa myops* Stimpson, 1860: 241 (now *Paraleucolepidopa myops*, from western Mexico, see Boyko 2002].

Lepidopa californica Efford, 1971: 59.—Boyko 2002: 140, figs. 46, 47 (extensive synonymy).— Kuris *et al.* 2007: 648.

Diagnosis. Carapace somewhat square, marked with transverse grooves, median projection of front rounded, anterolateral margin with only one tooth, median ridge unarmed. Both antennae long and setose, first antennae twice as long as carapace. Eyestalk flat. First pereopods chelate. Pereopods 2–4 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 (Jensen 1995).

Habitat and depth. Protected or open coast sandy beaches, lower intertidal zone, 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.

Family Blepharipodidae Boyko, 2002

Blepharipoda Randall, 1840

Blepharipoda occidentalis Randall, 1840

(Fig. 38A, B)

Blepharipoda occidentalis Randall, 1840: 131, pl. 6. — Holmes 1900: 104. — Rathbun 1904: 167. — Schmitt 1921: 172, pl. 31, fig. 6. — Johnson & Snook 1927: 347, fig. 295. — MacGinitie & MacGinitie 1968: 304. — Haig & Abbott 1980: 582, fig. 24.5. — Ricketts *et al*. 1985: 254, fig. 205. — Jensen 1995: 77, fig. 156. — Boyko 2002: 27, figs. 9–11. — Kuris *et al*. 2007: 648.

Diagnosis. Carapace oblong, with 4 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, setose. Eyestalk cylindrical, exceeding length of median projection of carapace. First pereopods with strong, spiny chelipeds. Pereopods 2–4 flattened, with semicircular dactyls. Abdominal somites well separated laterally. Telson rounded. Carapace length to 60 mm.

Color in life. Carapace dark gray, legs cream-colored. The color notes are based on crabs from San Francisco, California.

Habitat and depth. Sandy beaches, lower intertidal zone 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, whereas juveniles filter plankton from the water. The crabs usually are buried out of sight in sand. Molts commonly are cast ashore.

Lophomastix Benedict, 1904

Lophomastix diomedeae Benedict, 1904

(Fig. 38E, F)

Lophomastix diomedeae Benedict, 1904: 621, fig. 1. — Haig & Wicksten 1975: 100. — Boyko 2002: 20, figs. 7, 8.

Diagnosis. Carapace with only 3 large lateral spines, numerous minute spinules along rostrum, frontal margin of carapace. First antennae with feathery setae, second sparsely setose. Eyestalk slender, cylindrical. First pereopods chelate, pereopods 2–4 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 I., California to Cortez Bank, Baja California, Mexico. Type locality off Cortez Bank.

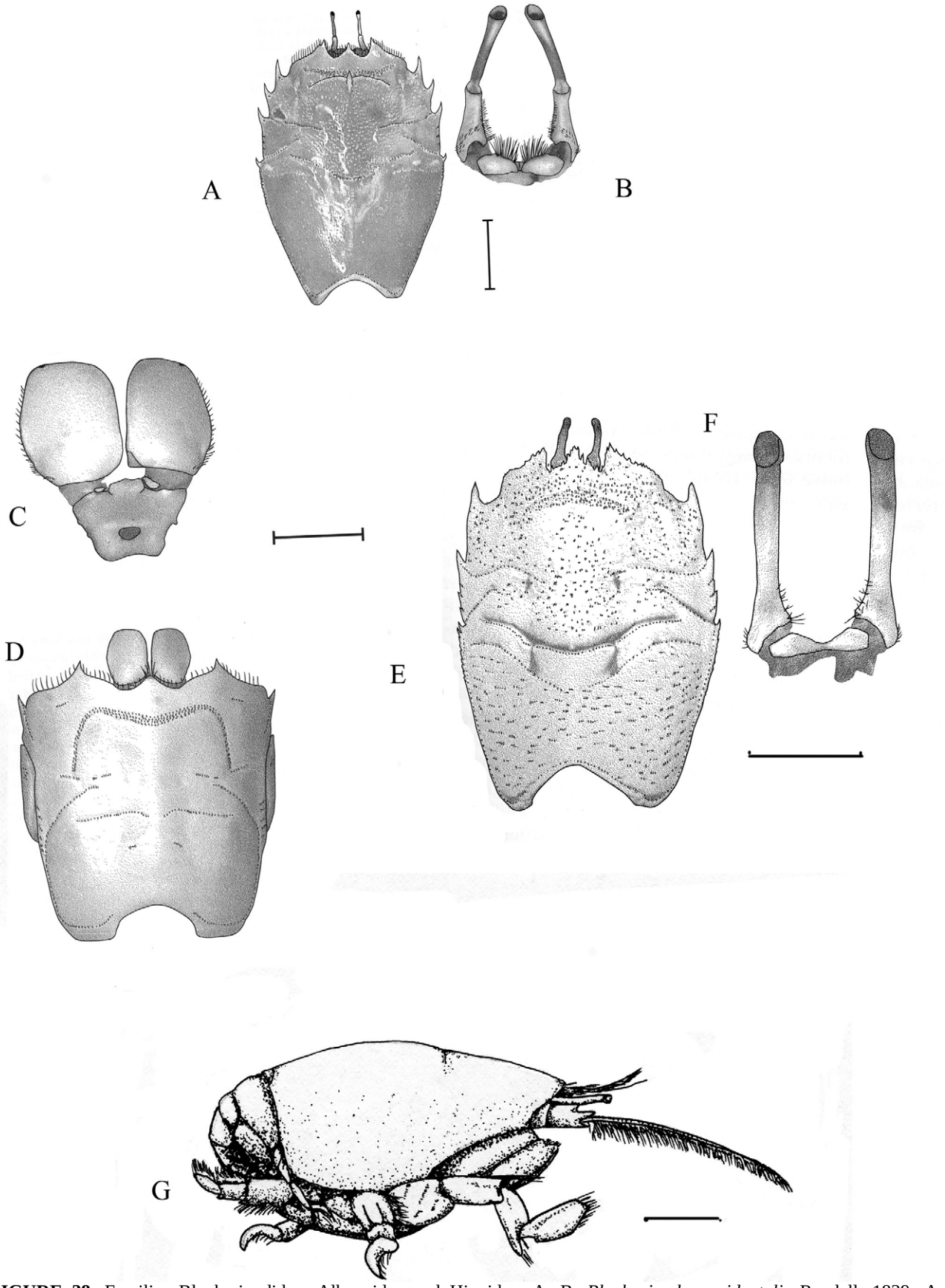

FIGURE 38. Families Blepharipodidae, Albuneidae and Hippidae. A, B, *Blepharipoda occidentalis* Randall, 1839; A, carapace; B, eyestalks. C, D *Lepidopa californica* Efford, 1971; C, eyestalks; D, carapace. E, F, *Lophomastix diomedeae* Benedict, 1904; E, carapace; F, eyestalks. G, *Emerita analoga* (Stimpson, 1857). Scales: D = 4.4 mm, F = 5.8 mm, G = 10 mm, A = 17.2 mm. A–F from Boyko 2002.

Family Hippidae Latreille, 1825

Emerita Scopoli, 1777

Emerita analoga (Stimpson, 1857)

(Fig. 38 G, Pl. 5 D)

Hippa analoga, 1857a: 85. — Holmes 1900: 103.

Emerita analoga. — Rathbun 1904: 168. — Schmitt 1921: 173 (extensive synonymy). — Johnson & Snook 1927: 341, figs. 289–290. — MacGinitie & MacGinitie 1968: 301, figs. 145–148. — Haig *et al*. 1970: 25. — Haig & Abbott 1980: 581, fig. 24.4. — Hart 1982: 164, fig. 64. — Ricketts *et al*. 1985: 252, fig. 204. — Jensen 1995: 77, fig. 155. — Kuris *et al*. 2007: 648, pl. 326 D.

Diagnosis. Body egg-shaped. Carapace with fine transverse striations on anterior half, front with 3 broad teeth, lateral margins without teeth. Eyestalk long, slender; cornea pigmented. Both pairs antennae setose, antennal flagella long, with double rows of setae, capable of being folded beneath mouth parts. First pereopods flattened, not chelate. Pereopods 2–4 flattened, dactyls curved. Abdominal somites decreasing in size, 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 pereopods pink, white, other pereopods mostly pink. Abdomen gray, telson white, with two pink stripes.

Habitat and depth. Surf-swept sandy beaches, mostly in intertidal zone.

Range. Usually from Oregon to Mexico, rarely as far north as Karluk, Kodiak I., Alaska. Records from Peru, Chile and Argentina probably belong to another species (J. Haig, pers. comm.). Type locality "California." (Many of Stimpson's specimens came from the area 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. Haig & Abbott (1980) gave extensive references on this crab.

SUPERFAMILY LITHOIDEA Samouelle, 1819

McLaughlin *et al*. (2007), in a comprehensive morphological and cladistic revision of the Anomura, firmly supported the designation of the king crabs (Lithodidae) and their relatives as a separate superfamily within the Anomura. De Grave *et al*. (2009), in their comprehensive list of the decapods, also followed this system of classification. Although certain aspects of the developmental biology of the pagurids and lithodids suggested that the lithodoids might be derived by carcinization from pagurids (the "hermit to king" hypothesis), McLaughlin *et al*. (2007) found no convincing evidence for this idea. They also supported the division of the Hapalogastridae and Lithodidae s. s. into separate families.

Family Hapalogasteridae Brandt, 1850

Hapalogasterids are confined to the North Pacific, rarely occurring as far south as Point Conception, California.

Key to species of family Hapalogasteridae

1. Carapace distinctly flattened, covered with numerous subequal spines. Legs spiny . . . . . *Acantholithodes hispidus*
– Carapace flattened to moderately convex, without spines; legs sparsely setose to extremely setose but without spines 2
2. Carapace and legs flattened, pubescent. Carapace not granular on upper surface . . . . . *Hapalogaster cavicauda*
– Carapace, legs not flattened or pubescent. Carapace granular on upper surface . . . . . *Oedignathus inermis*

Acantholithodes Holmes, 1895

Acantholithodes hispidus (Stimpson, 1860)
(Pl. 6C)

Dermaturus hispidus Stimpson, 1860: 242. — Bouvier 1895: 174, pl. 11, figs. 3, 16; pl. 12, figs. 2, 16, 31.
Acantholithodes hispidus. — Holmes 1895: 575; 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, fig. 132.

Diagnosis. 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, gastric regions. Abdomen short, broad, soft. Chelipeds, pereopods 2–4 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, black apices (Hart 1982).

Habitat and depth. Usually on vertical rock walls, zone to 165 m but usually subtidal in southern parts of its range.

Range. Off Moorovskoy Bay, Alaska to San Nicolas I., California. Type locality Monterey Bay, California.

Hapalogaster Brandt, 1850

Hapalogaster cavicauda Stimpson, 1859
(Pl. 6G)

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. 9. — Johnson & Snook 1927: 337, fig. 286 .— MacGinitie & MacGinitie 1968: 299. — Haig & Abbott 1980: 582, fig. 24.6. — Ricketts *et al*. 1985: 171, fig. 140. — Dawson 1989: 319. — Jensen 1995: 69, fig. 134. — Hendrickx & Harvey 1999: 374. — Kuris *et al*. 2007: 648.

Diagnosis. Body and legs very flat, covered with dense, short setae. Carapace with front bearing medial tooth, lateral teeth, prominent cervical groove, widest behind midlength. Chelipeds unequal in size, hand of larger chela with 1 or 2 small tubercles on inner surface. Pereopods 2–4 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. The color note is based on crabs from Mendocino, Mendocino County, Calfiornia.

Habitat and depth. Under rocks in low intertidal zone, intertidal zone to 15 m.

Range. Washington; Cape Mendocino, California to San Jeronimo I., Baja California but uncommon south of Monterey Bay, California. Type locality Monterey, California.

Remarks. Schmitt (1921) cited *H. grebnitzkii* Schalfeev, 1892 from "Humboldt Bay, California." There are no other reports of the species from California. Hart (1982) gave the southern geographic limit of this species as Puget Sound, Washington. The record by Schmitt may have come from Humboldt Bay, Alaska instead of California (J. Haig, pers. comm.)

Hendrickx & Harvey (1999) reported *H. cavicauda* from Guaymas, Sonora, Gulf of California. This record surely is in error. This may be a misidentification of *Petrolisthes hirtipes* Lockington, 1878 (Porcellanidae).

Oedignathus Benedict, 1895

Oedignathus inermis (Stimpson, 1860)
(Fig. 39A)

Hapalogaster inermis Stimpson, 1860: 243.
Oedignathus inermis. — Holmes 1900: 119. — Rathbun 1904: 163. — Schmitt 1921: 151, pl. 19, fig. 1; fig. 97 (early synonymy). — Johnson & Snook 1927: 337. — Makarov 1962: 231, fig. 80. — MacGinitie & MacGinitie 1968: 301.— Haig & Abbott 1980:

583, fig. 24.7. — Hart 1982: 68, fig. 18, color plate. — Ricketts *et al*. 1985: 171. — Dawson 1989: 319. — Jensen 1995: 70, fig. 136. — Kuris *et al*. 2007: 648.

Diagnosis. Carapace widest behind midlength, with abrupt angle at anterior edge of widest point; covered with scale-like plates; rostrum triangular, with frontolateral teeth, small teeth just mesial to them. Chelipeds unequal, covered by wart-like granules; hand of larger cheliped large and swollen, fingers with gape at base. Pereopods 2–4 with tubercles, stiff setae on dactyls. Female abdomen somewhat hardened on left side. Carapace length to 30 mm.

Color in life. Brown, with dark tubercles; tubercles on major cheliped of adult blue (Hart 1982).

Habitat and depth. Rocky subtidal zones, especially in areas with strong currents; rarely lowest intertidal zone, to 15 m. In California, it has been collected in the last 20 years at the Farallon Is. off San Francisco.

Range. Korea, Japan; Dutch Harbor, Alaska to Pacific Grove, California. Type locality Puget Sound.

Family Lithodidae Samouelle, 1819

The Lithodidae, including the king crabs, are primarily a cold-water family with the greatest species diversity and diversity in body form in the North Pacific. Few studies have been conducted on their natural history. Most seem to be scavengers or predators on see other invertebrates, including mollusks. Dawson (1989) gave a comprehensive bibliography of lithodids.

From photographs, it may be difficult to distinguish species of *Paralithodes* from brachyuran crabs of the superfamily Majoidea. In lithodids, the longer second antennae lie lateral to the eye; while in brachyurans, both pairs of antennae are short and have their origins mesial to the eye. Lithodids have at most three pairs of locomotory appendages posterior to the chelipeds, while brachyurans usually have four pairs. The abdomen of a lithodid generally is asymmetrical and contains membranous areas, while the abdomen of a brachyuran generally is symmetrical and well calcified.

Dawson (1989: 318) reported *Neolithodes diomedeae* Benedict, 1895 from "Eastern Pacific, Southern California, Mexico to Scotia Sea; deep water." There are specimens identified as this species in the Benthic Invertebrate Collection of Scripps Institution of Oceanography (Luke 1977). It would be wise to re-examine these specimens and confirm the identification.

Key to Species of family Lithodidae

1. Carapace broadly oval, convex and smooth, completely concealing pereopods from dorsal view 2
– Carapace not broadly oval, usually rough, not completely concealing pereopods from dorsal view 3
2. Chelae tuberculate. Rostrum narrowing distally, end rounded . . . . . *Cryptolithodes typicus*
– Chelae smooth. Rostrum widened toward transverse distal end . . . . . *Cryptolithodes sitchensis*
3. Carapace with two deep pits within triangular excavated area, surrounded by rounded papillated tubercles. Abdominal plates with central membranous area. . . . . *Phyllolithodes papillosus*
– Carapace without deep pits, papillated tubercles. Abdominal plates without central membranous area 4
4. Carapace with outline of an equilateral triangle, with deep fossa separating cardiac region from other regions of carapace . . . . . *Rhinolithodes wosnessenskii*
– Carapace with outline more rounded, without deep fossa separating cardiac region from other regions of carapace 5
5. Pereopods 2–4 shorter than greatest width of carapace. Outline of carapace roughly pentagonal or hexagonal, convex, with short tubercles 6
– Pereopods 2–4 longer than greatest width of carapace. Outline of carapace broadly pear-shaped 8
6. Without wart-like prominence on each side of median gastric area. Pereopods 2–4 spinose. Not found north of Los Angeles County, California . . . . . *Glypholithodes cristatipes*
– With wart-like prominence on each side of median gastric area. Pereopods 2–4 tuberculate. Usually found north of Los Angeles County, California 7
7. Tubercles of chelipeds, pereopods 2–4 spiniform, carpus of chelipeds with outer edge excavated, forming deep rounded sinus . . . . . *Lopholithodes foraminatus*
– Tubercles of chelipeds, pereopods 2–4 rounded, blunt; carpus of chelipeds without deep, rounded sinus on outer edge . . . . . *Lopholithodes mandti*
8. Abdomen mostly leathery. Carapace with tubercles or short spines 9
– Abdomen well calcified. Carapace often with long spines 10
9. Carapace spiny. Pereopods 2–4 legs angular . . . . . *Paralomis multispina*

– Carapace with tubercles. Pereopods 2–4 much compressed ..... *Paralomis verrilli*
10. Plates of second abdominal segment more or less fused ..... *Lithodes couesi*
– Plates of second abdominal segment distinct 11
11. Rostrum bifid, anterior lateral spines of rostrum reaching to apex of bifurcation of rostrum ..... *Paralithodes rathbuni*
– Rostrum simply bifid or split, anterior lateral spines of rostrum not reaching half way to bases of terminal spines ..... *Paralithodes californiensis*

Cryptolithodes Brandt, 1848

Cryptolithodes sitchensis Brandt, 1853
(Fig. 40B, Pl. 6B)

Cryptolithodes sitchensis Brandt, 1853: 254. — Holmes 1900: 125, pl. 2, figs. 21–25. — Schmitt 1921: 155, pl. 20, figs. 3, 4, fig. 100. — Johnson & Snook 1927: 339, fig. 287. — Makarov 1962: 268, figs. 108, 109. — Haig & Abbott 1980: 583, figs. 24.8 a–g. — Hart 1982: 76, fig. 22. — Ricketts *et al*. 1985: 171, fig. 139. — Odenweller 1972: 240, figs. 1, 2. — Dawson 1989: 317. — Jensen 1995: 71, fig. 138. — Kuris *et al*. 2007: 648.

Diagnosis. Carapace covering most of body, pereopods, about 1.3 times as wide and long, with lateral extensions almost as long as rostrum, with dorsal tubercles, low teeth along lateral margins. Rostrum widened distally, usually ending in distinct anterolateral angles, sometimes with small median tooth. Chelipeds smooth, unequal. Pereopods 2–4 smooth, flat. Abdomen flat, triangular. Carapace length to 68 mm.

Color in life. Orange, mottled, ivory, red, pink with red spots; see color photographs by Haig & Abbott (1980: figs. 24.8 a–g).

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. This crab is uncommon south of Point Conception.

Remarks. These little crabs sometimes bear injuries around the rim of the carapace. At times, two or more of these crabs will grip each other by the rim of the carapace. Whether this activity constitutes mating behavior or aggression is unknown.

Cryptolithodes typicus Brandt, 1853
(Fig. 39C, D)

Cryptolithodes typicus Brandt, 1853: 654. — Holmes 1900: 124. — Rathbun 1904: 16. — Schmitt 1921: 154, pl. 20, figs. 1, 2. — Johnson & Snook 1927: 339. — Makarov 1962: 270, figs. 110, 111. — Haig & Wicksten 1975: 102. — Hart 1982: 78, fig. 23.—Dawson 1989: 317. — Jensen 1995: 71, fig. 139.

Diagnosis. Carapace about twice as wide as long, with lateral expansions not reaching midlength of rostrum, with dorsal tubercles, broad teeth along lateral margins. Rostrum narrowing distally, end rounded. Chelipeds tuberculate, unequal in size. Pereopods 2–4 flattened. Abdomen flat, triangular. Carapace length to 49 mm.

Color in life. Highly variable: red, ivory, gray, orange, or spotted (Hart 1982).

Habitat and depth. Often in shell rubble by rocky reefs, low intertidal zone to 45 m.

Range. Amchitka I., Alaska to Santa Rosa I., California. Type locality "northern California."

Remarks. Brandt received specimens that came from the coast of California near Fort Ross, which may be the actual type locality of this crab.

Glyptolithodes Faxon, 1893

Glyptolithodes cristatipes (Faxon, 1893)
(Fig. 39E, F)

Rhinolithodes cristatipes Faxon, 1893:163.

Glyptolithodes cristatipes. — Faxon 1895: 43, pl. 7, fig. 2, 2a–2c. — Haig 1974: 161, fig. 5. — Baez & Andrade 1979: 222, pl. 1, fig. 2. — Wicksten 1982: 247. — Wicksten 1989b: 314. — Dawson 1989: 317. — Martin *et al*. 1997: 83, figs. 2, 3 (extensive synonymy). — Hendrickx & Harvey 1999: 374.

Diagnosis (after Haig 1974 and Martin *et al*. 1997). Carapace subtriangular, tuberculate; gastric area raised into conical prominence, crescent-shaped ridge on each branchial region, cardiac area enclosed in deep fossa. Ridges, prominences more marked in juvenile than adult. Rostrum straight, triangular. Anterolateral margin of carapace with 5 teeth. Chelipeds unequal, right one larger; coxa granulated, lower margin of ischium, merus with 3–4 blunt teeth, upper surface of merus toothed. Pereopods 2–4 with crest along anterior margin. Abdomen tubeculate. Juveniles with more spines than adults, carapace more angular, appendages more stout, short. Carapace length to 71.4 mm.

Color in life. Not reported.

Habitat and depth. Continental shelf and slope, 183–800 m.

Range. Palos Verdes Peninsula, California to off Valparaiso, Chile. Type locality Gulf of Panama (*Albatross* sta. 3354, 7˚ 9' 45" N, 80˚ 50' 0" W). Hendrickx & Harvey (1999) mistakenly reported the species from "Palo Alto, California", but the record in fact came from off the Palos Verdes Peninsula, Los Angeles County, California.

Lithodes Latreille, 1806

Lithodes couesi Benedict, 1895

(Pl. 6A)

Lithodes couesi Benedict, 1895: 481. — Schmitt 1921: 162, pl. 28, pl. 29 figs. 3–5. — Makarov 1962: 255, fig. 101. — Pereyra & Alton 1972: 450. — Somerton 1981: 259, figs. 7, 8. — Hart 1982: 94, fig. 31. — Wicksten 1982: 245; 1989b: 314. — Dawson 1989: 317. — Komai & Anaoka 1989: 287. — Martin *et al*. 1997: 79, fig. 1 (extensive synonymy). — Macpherson & Wehrtmann 2010: 148.

Diagnosis. Carapace longer than wide, with spines on dorsal surface and larger ones along margins. Rostrum with bifid apex, pair lateral spines. Chelipeds much shorter than walking legs, with spines; fingers with gape. Pereopods 2–4 with spines on upper surface, margins. Abdomen without spines. Spines relatively larger and rostrum relatively longer in relation to carapace in juveniles than in adults. Individuals varying in shape, length of rostrum; also lateral spines of carapace. Carapace length to 105 mm.

Color in life. Carapace rosy pink, spines red. Chelipeds, other pereopods crimson with white joints. Juveniles scarlet (Hart 1982).

Habitat and depth. Among mud or boulders, 258–1829 m.

Range. Okhotsk Sea off Japan; Bering Sea to south of Tortugas Bay, Baja California, Mexico. 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 tiptoe atop soft muddy sediments (Somerton 1981). Martin *et al*. (1997) reported that the crab can be heavily infested by the rhizocephalan *Briarosaccus callosus* Boschma, 1930.

Lopholithodes Brandt, 1848

Lopholithodes foraminatus (Stimpson, 1859)

(Pl. 6D)

Echinocerus foraminatus Stimpson, 1859: 79.

Lopholithodes foraminatus. — Holmes 1900; 130. — Schmitt 1921: 157, pl. 21, fig. 2; fig. 102. — Johnson & Snook 1927: 340, figs. 288, 294. — Goodwin 1952: 176. — MacGinitie & MacGinitie 1968: 300. — Pereyra & Alton 1972: 450. — Wicksten 1980: 363. — Hart 1982: 80, fig. 24. — Wicksten 1980c: 363; 1982b: 245; 1989b: 314. — Dawson 1989: 318. — Jensen 1995: 72, fig 143. — Martin & Haney 2005: 450. — Kuris *et al*. 2007: 648.

Diagnosis. Carapace tuberculate, depressed; gastric region elevated, margins with low, wide spines. Rostrum short, with median spine, spiny tubercles above base. Chelipeds tuberculate, equal; with broad sinus on carpus forming, with similar sinus on pereopods 2, large respiratory opening. Pereopods 2–4 tuberculate, capable of being drawn tightly against cephalothorax. Abdomen asymmetrical, tuberculate. Carapace length to 165 mm.

Color in life. Drab reddish-brown or tan. The color notes are based on crabs trawled off southern California.

Habitat and depth. Sandy subtidal areas, rarely low intertidal zone to 547 m.

Range. Kodiak, Alaska to San Diego, California. Type locality "near San Francisco, California." The crab often is trawled north of San Francisco.

Remarks. MacGinitie & MacGinitie (1968) gave a good account of the natural history of this burrowing crab. Martin & Haney (2005) reported this species from extinct vent sites in the Oregon Subduction Zone.

Lopholithodes mandtii Brandt, 1848

(Fig. 39G)

Lopholithodes mandtii Brandt, 1848: 174. — Holmes 1900: 128. — Schmitt 1921: 156, pl. 21, fig. 1; fig. 101. — Johnson & Snook 1927: 340. — Makarov 1962: 266, figs. 106, 107. — Pereyra & Alton 1972: 450. — Hart 1982: 82, fig. 25. — Dawson 1989: 318. — Jensen 1995: 73, fig. 144. — Kuris *et al*. 2007: 648.

Diagnosis. Carapace strongly convex; gastric, cardiac, branchial regions each with prominent subconical tubercle, anterolateral margin with large, small spines; large prominence at each posterolateral angle; all raised areas more prominent in juveniles than in adults. Rostrum short, consisting of subconical tubercle, knob with two lateral tubercles with posterior notch. Chelipeds unequal. Chelipeds, pereopods 2–4 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, legs (Hart 1982).

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.

Paralithodes Brandt, 1848

Paralithodes californiensis (Benedict, 1895)

(Fig. 39H, Pl. 6F)

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 & MacGinitie 1968: 300. — Anderson & Cailliet 1974: 29. — Wicksten 1982: 245; 1989b: 314. — Dawson 1989: 318.

Diagnosis. Carapace longer than wide, with long spines on dorsal regions, margins of carapace; one large spine each above origins of pereopods 3, 4. Spines more pronounced in juveniles than in adults. Rostrum bifid, with two subrostral spines extending to end of cornea of eye. Chelipeds slender, spinous. Pereopods 2–4 elongate, spinous. Abdomen with membranous medial area. Carapace length 95 mm.

Color in life. Orange with bluish-white spines. The color notes are from a crab taken off southern California.

Habitat and depth. Mud or rocks, 145–300 m.

Range. Off Pismo Beach to off San Diego, California. Type locality off Santa Cruz I., California.

Remarks. This lithodid crab serves as host or substrate for other species. The gammarid amphipod *Commensipleustes commensalis* (Shoemaker, 1952) has been found on the carapace. Eggs of a snailfish, *Careproctus* sp., have been found in the gill chambers of this crab (Anderson & Cailliet 1974). Some larger crabs had cocoons of marine leeches on the carapace. The crab may be parasitized by rhizocephalan cirripeds.

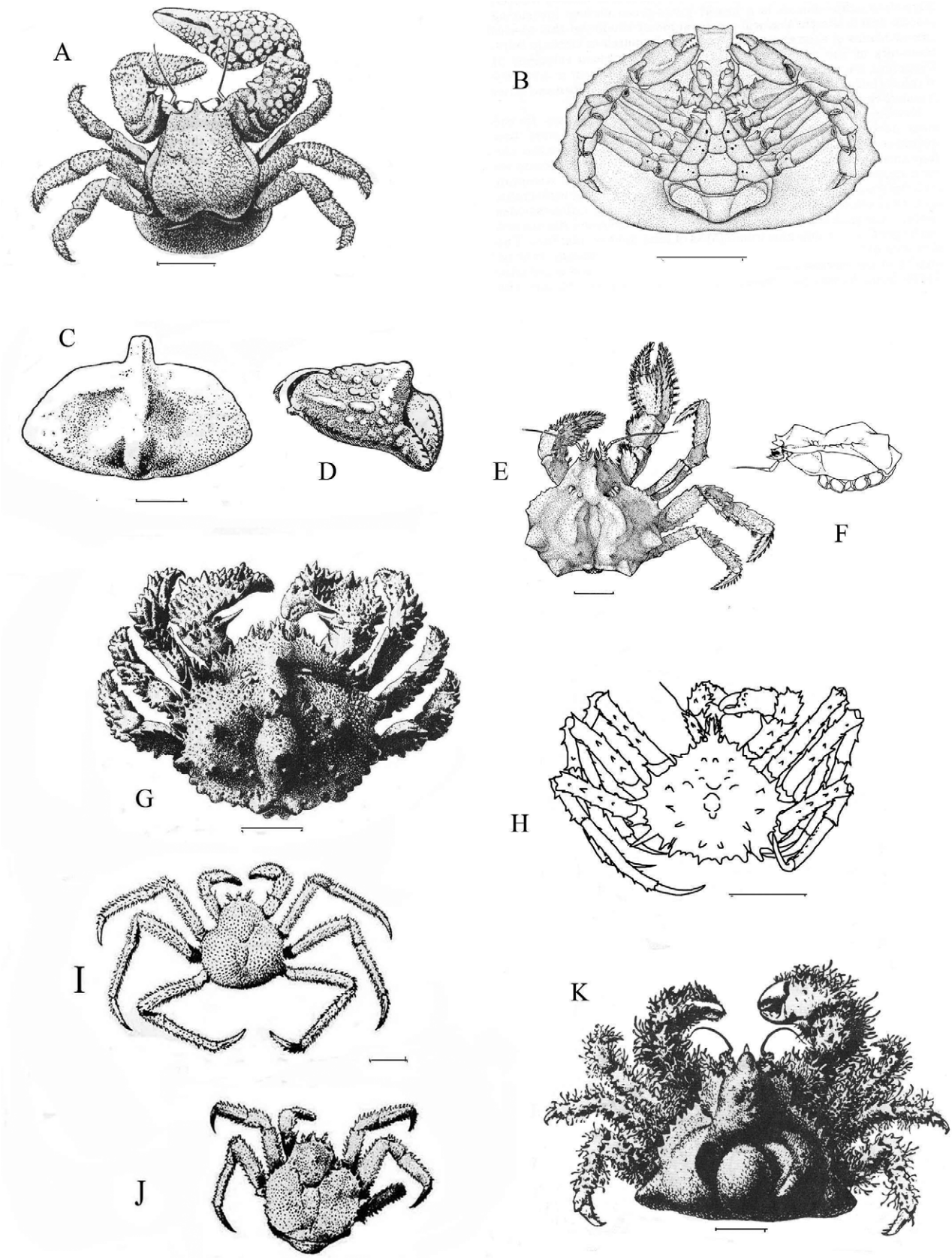

FIGURE 39. Families Hapalogastridae and Lithodidae. A, *Oedignathus inermis* (Stimpson, 1860). B, *Cryptolithodes sitchensis* Brandt, 1853; ventral view. C, D, *Cryptolithodes typicus* Brandt, 1849; C, dorsal view; D, chela. E, F, *Glyptolithodes cristatipes* Faxon, 1893; E, dorsal view; F, carapace in lateral view. G, *Lopholithodes mandtii* Brandt, 1849. H, *Paralithodes californiensis* (Benedict, 1895). I, *Paralomis multispina* (Benedict, 1895). J, *Paralomis verrilli* (Benedict, 1895). K, *Rhinolithodes wosnessenskii* Brandt, 1849. Scales: I, J = 5 mm; A, B, C, K = 10 mm; E, H = 30 mm; G = 50 mm. A–D, G, I–K from Makarov 1962, E, F from Haig 1974, H drawn from photograph by Goodwin 1952.

Paralithodes rathbuni (Benedict, 1895)
(Pl. 6F)

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; 1987: 55; 1989b: 314. — Dawson 1989: 318.

Diagnosis. Carapace slightly wider than long, with long spines on dorsal regions, margins of carapace; more pronounced in juveniles than in adults. Rostrum directed upward, with 2 lateral spines, pair of spines flanking terminal point. Chelipeds slender, armed with strong spines; shorter than walking legs. Pereopods 2–4 slender, spiny. Abdomen with membranous medial area. Carapace length 65 mm.

Color in life. Pale orange. The color note is from a crab taken in Monterey Bay, California.

Habitat and depth. Sand, mud or rock; 92–380 m.

Range. Cordell Bank, California to south of San Benito Is., Baja California. Type locality off San Simeon Bay, California.

Paralomis White, 1856

Paralomis multispina (Benedict, 1895)
(Fig. 39I, Pl. 6A)

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. — Makarov 1962: 257, fig. 102. — Pereyra & Alton 1972: 450. — Wicksten 1980c: 364; 1982: 245; 1989b: 314. — Hart 1982: 88, fig. 28. — Dawson 1989: 318. — Hendrickx & Harvey 1999: 374. — Martin & Haney 2005: 450. — Hall & Thatje 2010: 504, fig. 7.

Diagnosis. Carapace about as long as wide, dorsal surface, lateral margins with numerous spines: stout, sharp-tipped, conical in adult, short, blunt in juvenile with carapace width of 30 mm or less. Rostrum with simple median spine, two basal spines. Chelipeds unequal, slender, with prominent spines on carpus. Pereopods 2–4 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. The color notes are from a crab taken in a trap off southern California.

Habitat and depth. Muddy continental slope, 1100–1577 m. The crab has been found near cold seeps off Japan.

Range. Sagami Bay, Japan; Shumagin Bank, Alaska to off Guadalupe I., Baja California; off Carmen I., Gulf of California. Type locality off Queen Charlotte Is.

Remarks. This large crab has been fished commercially by trapping. The caprellid amphipod *Caprella ungulina* Mayer, 1903; clings to the legs of this crab (Wicksten 1982). Hall & Thatje (2010) demonstrated ontogenetic changes in the morphology of crabs of the genus *Paralomis*, including this species. Juveniles have much shorter dorsal carapace spines than do adults.

Paralomis verrilli (Benedict, 1895)
(Fig. 39J)

Pristopus verrilli Benedict 1895: 486. — Rathbun 1904: 165.
Paralomis verrilli. — Schmitt 1921: 159, pl. 24, pl. 30, figs. 5, 6. — Makarov 1962: 258, fig. 103. — Pereyra & Alton 1972: 450. — Hart 1982: 86, fig. 2. — Wicksten 1989b: 315. — Dawson 1989: 318. — Komai & Amaoka 1989: 288. — Hendrickx & Harvey 1999: 374.

Diagnosis. Carapace slightly longer than wide, with spines, granules; large spines on margins, elevated areas. Rostrum bifid with subrostral spine. Chelipeds shorter than walking legs, spinous; right larger than left. Pereopods

2–4 somewhat flattened, with large teeth on margins, smaller teeth on dorsal surface. Abdomen with small spines, nodules. Carapace length 112 mm.

Color in life. Carapace pale reddish brown, thoracic appendages deep red. Distal half of cutting edges of chelae black or deep brown (Komai & Amaoka 1989).

Habitat and depth. Continental slope, 450–2379 m.

Range. Sea of Okhotsk to off San Benito I., Baja California; and Gulf of California. Type locality off Pribilof Is.

Phyllolithodes Brandt, 1848

Phyllolithodes papillosus Brandt, 1848

(Pl. 6E)

Phyllolithodes papillosus Brandt, 1848: 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. — Johnson & Snook 1927: 339. — Makarov 1962: 238, fig. 82. — Hart 1982: 72, fig. 20. — Dawson 1989: 319. — Jensen 1995: 72, fig. 142.

Diagnosis. 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 subacute median spine. Chelipeds unequal, chelipeds, pereopods 2–4 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. Hart (1982) gave a more extensive description of the living color.

Habitat and depth. Rocky subtidal areas, lowest intertidal zone to 183 m.

Range. Dutch Harbor, Alaska to San Miguel I., California. Type locality Kadiak I., Alaska. Uncommon south of Monterey County, California.

Rhinolithodes Brandt, 1848

Rhinolithodes wosnessenskii Brandt, 1848

(Fig. 39K)

Rhinolithodes wosnessenskii Brandt, 1848: 174. — Schmitt 1921: 158, pl. 22, fig. 1, fig. 103. — Makarov 1962: 260, fig. 104. — Hart 1982: 74, fig. 21. — Dawson 1989: 319. — Jensen 1995: 72, fig. 141.

Diagnosis. Carapace tuberculate, somewhat triangular, with deep semicircular fossa separating cardiac region from other parts of carapace. Rostrum blunt at base, tapering abruptly to median spine. Chelipeds unequal, armed with short spines. Pereopods 2–4 also with short spines. Abdomen with small tubercles. Carapace length to 59 mm.

Color in life. Mostly yellowish to grayish brown, markings of orange, cream in carapace depression; see Hart (1982) for a detailed color description.

Habitat and depth. Rock or gravel bottoms, often in crevices, 6–73 m.

Range. Kodiak, Alaska to Crescent City, California. Type localities Sitka and Kodiak, Alaska.

SUPERFAMILY PAGUROIDEA Latreille, 1802

The most familiar of all anomurans are the hermit crabs. These crabs usually inhabit shells or tubes but may live inside hollows in sponges, bits of crab exoskeleton, twigs or even bones. Species occur from the upper tide pools to the abyssal plains.

In hermit crabs, the abdomen is soft and ends 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 eye are stalked and well developed, with pigmented corneae. The antennules 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. Pereopods 2, 3 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 are found on the continental shelf and deeper areas. The work by McLaughlin (1974) provides keys, illustrations and further information on hermit crabs occurring north of Point Conception, California. Lemaitre & Castaño (2004) presented a list of all the species of *Pagurus* of the eastern Pacific with species group assignments, but noted that, as of their writing, many species had yet to be assigned.

The key to the Paguroidea presented here is modified from a manuscript key by Janet Haig, and includes one as yet undescribed subtidal species from southern California. I have included another artificial key based on color patterns to aid in the identification of living or photographed hermit crabs. Both of these keys originally were presented to a meeting of the Southern California Coastal Water Research Project in February 1977, but never were formally published.

Key to species of Paguroidea

1. Outer maxillipeds approximated at their bases; chelipeds equal or subequal in size . . . . . 2 (Diogenidae)
– Outer maxillipeds widely separated at their bases; right cheliped larger than left 7
2. Pereopod 4 subchelate, no paired pleopods in either sex. Often buried in sand . . . . . *Isocheles pilosus*
– Pereopod 4 simple, paired pleopods in both sexes. Living in sand or among rocks, usually not buried 3
3. Dorsal surface of palms of chelae coarsely granulated, and bearing fluffy clusters of short plumose setae . . *Paguristes parvus*
– 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*
– Chelae relatively narrow, dorsomesial margin not strongly convex . . . . . *Paguristes turgidus*
6. Rostrum broad at base, reaching about to base of eyecales; propodus, dactyl pereopods 2, 3 with small, dark corneous spines on inner surface . . . . . *Paguristes ulreyi*
– Rostrum slender, narrow at base, apex reaching beyond base of eyecales; propodus, dactyl of pereopods 2, 3 unarmed on inner surface ... *Paguristes* undescribed species
7. Crista dentata of outer maxillipeds with 1 or more accessory teeth, first maxilliped exopod with flagellum, female with gonopore on coxa of both third pereopods. (Intertidal zone to continental slopes, common) . . . . . 8 (Paguridae)
– Crista dentata of outer maxillipeds lacking accessory tooth, first maxilliped exopod without flagellum, female with gonopore on coxa of left third pereopod only. (Continental shelf to abyssal plains) . . . . . 38 (Parapaguridae)
8. Telson with posterior margin entire, lacking lobes, median cleft 9
– Telson divided into lobes posteriorly 10
9. Telson unarmed terminally, uropods asymmetrical . . . . . *Enallopaguropsis guatemoci*
– Telson with terminal spines; uropods symmetrical . . . . . *Discorsopagurus schmitti*
10. Propodial rasp of pereopod 4 a single row 11
– Propodial rasp of pereopod 4 with multiple scale rows 13
11. Abdomen straight; uropods symmetrical . . . . . *Pylopagurus holmesi*
– Abdomen coiled; uropods asymmetrical. 12
12. Major chela discoid, dorsal surface of palm convex, bearing many low boss-like tubercles; dactyl with raised ridge on dorsal face; pereopod 4 with preungual process . . . . . *Phimochirus californiensis*
– Major chela subquadrate, dorsal surface of palm slightly concave, with raised margins, scattered slender tubercles; dactyl without facial ridge, but bearing proximal tubercle row on dorsal face; pereopod 4 lacking preungual process . . . *Haigia diegensis*
13. Abdomen straight, uropods symmetrical. Often inhabiting tubes or tubular shells . . . . . *Orthopagurus minimus*
– 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 *Pagurus aleuticus* male 18
15. Dactyls of pereopods with pronounced lateral sulcus . . . . . *Pagurus aleuticus* female

– Dactyls of pereopods lacking lateral sulcus 16
16. Dorsal surface of palm of major chela unarmed proximally; scattered small spinules or spinulose tubercles distally, on fixed finger . . . . . *Parapagurodes makarovi*
– Dorsal surface of palm of major chela armed proximally with one or more irregular rows of widely spaced 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 on chelipeds, other pereopods . . . . . *Parapagurodes laurentae*
– Dactyls of chelae with row of spines in dorsal midline. In life, with bright color marks on chelipeds, other pereopods . . . . . *Parapagurodes hartae*
18. Minor chela with dorsal surface of palm flattened, propodus of pereopod 3 with row of spines on upper margin 19
– Minor chela with dorsal surface of palm elevated, propodus of pereopods usually unarmed on upper margin. 22
19. Dorsomesial margin of minor chela strongly convex, posterior lobes of telson armed on both terminal, lateral margins . . . . . *Pagurus spilocarpus*
– Dorsomesial margin of minor chela nearly straight, posterior lobes of telson armed on terminal margins only 20
20. Dactyls of pereopods 2, 3 with prominent longitudinal sulcus on dorsal surface. . . . . *Pagurus aleuticus*
– Dactyls of pereopods 2, 3 with 3 longitudinal rows of small spines or spinulous tubercles on dorsal surface, separated proximally by 2 shallow longitudinal sulci 21
21. Chelae with moderately short, bluntly conical spines or tubercles on dorsal surface . . . . . *Pagurus ochotensis*
– Chelae with acute spines on dorsal surface . . . . . *Pagurus armatus*
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 pereopods 2, 3 serrate, dactyls not flattened . . . . . *Pagurus tanneri*
– Dorsal margins of propodi of pereopods 2, 3 not serrate, dactyls flattened 24
24. Large hand with apex of raised triangular area horn-shaped in profile . . . . . *Pagurus cornutus*
– Large hand with apex of raised triangular area rounded in profile . . . . . *Pagurus confragosus*
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, operculum-like . . . . . *Pagurus retrorsimanus*
– 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 . . . . . *Pagurus caurinus*
– Merus of major chela with 2 or more prominent tubercles ventrally 29
29. Merus of right cheliped without row of spinules along disto-dorsal margin. Ocular scales tipped with up to 3 spinules . . . . . *Pagurus quaylei*
– Merus of right cheliped with distinct row of spinules along distodorsal margin. Ocular scales tipped with only 1 spinule ... 30
30. Major chela more or less evenly, finely granulated dorsally, palm of minor chela granulated on lower surface . . . . . *Pagurus granosimanus*
– Major chela more or less coarsely, irregularly granulated dorsally, palm of minor chela smooth on lower surface . . . . . *Pagurus beringanus*
31. Carpus of major chela deeper than wide, shield shiny, smooth; entire crab almost hairless . . . . . *Pagurus hemphilli*
– Carpus of major chela wider than deep; shield, legs setose 32
32. Merus of major cheliped with 2 prominent tubercles ventrally, carapace shield distinctly longer than wide . *Pagurus samuelis*
– 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 hirsutiusculus*
– Carapace shield slightly longer than wide. Usually south of Point Conception, California. . . . . *Pagurus venturensis*
34. Eyescales obliquely truncate, oblique margin with 4–5 spinules . . . . . *Pagurus redondoensis*
– Eyescales subovate, usually terminating in single spine. 35
35. Major chela with spines, granules, setae short, inconspicuous . . . . . *Pagurus dalli*
– Major chela with spines but not granules, setae longer, easily seen 36
36. Dactyls of preopods 2, 3 with row of small corneous spinules on lower margins . . . . . *Pagurus capillatus*
– Dactyls of pereopods 2, 3 with row of strong corneous spines on lower margins . . . . . *Pagurus setosus*
38. Dorsal surface of palm of major chela evenly granulate; male with 2 pairs of pleopods . . . . . *Parapagurus benedicti*
– Dorsal surface of palm of major chela with few longitudinal rows of small pointed granules or tubercles; no paired pleopods in male . . . . . *Oncopagurus haigae*

Artificial key to species of common intertidal and shallow subtidal hermit crabs

1. Chelae equal in size, shape 2
– Chelae not equal in size, shape 6

2. Anterior surfaces of chelae not heavily setose, outer surface at least partially visible through coating of setae 3
– Anterior surfaces of chelae heavily setose, outer surface not easily visible through dense covering of setae 5
3. Antennae pale blue, heavily setose. Inhabiting sandy beaches of subtidal sand . . . . . *Isocheles pilosus*
– Antennae banded with brown, translucent areas, with few setae. Inhabiting subtidal rocky areas . . . . . *Paguristes parvus*
4. Antennae sparsely setose. Usually deeper than 30 m in California . . . . . *Paguristes turgidus*
– Antennae heavily setose, moth-like. Often found at less than 30 m 5
5. Chelae broad, about 0.5 times longer than wide . . . . . *Paguristes bakeri*
– Chelae not as broad, about 0.3 times longer than wide . . . . . *Paguristes ulreyi*
6. Right chela more than 2 times wider than left chela, modified to form operculum 7
– Right chela 2 times or less wider than left chela, not modified to form operculum 8
7. Pereopods 2–4 dark red, without stripes. Right chela without lateral expansion . . . . . *Haigia diegensis*
– Pereopods 2–4 reddish brown with cream stripes. Right chela with lateral expansion . . . . . *Phimochirus californiensis*
8. Antennae bright red 9
– Antennae brown, golden, orange or banded 12
9. Pereopods 2–4 brown or greenish, with or without bands 10
– Pereopods 2–4 red, or red with yellow dactyls 11
10. Pereopods 2–4 with bands of white, blue or both colors . . . . . *Pagurus samuelis*
– Pereopods 2–4 without bands, but with bluish or buffy granules . . . . . *Pagurus granosimanus*
11. Pereopods 2–4 dark red, with yellow dactyls. Major chela not twisted under body. . . . . *Pagurus hemphilli*
– Pereopods 2–4 light red, with many minute red dots. Major chela twisted under body . . . . . *Pagurus retrorsimanus*
12. Chelae with large, distinct spines. Eye with large, round black, green or golden cornea 13
– Chelae with small spines or spines absent. Eye narrow, cornea not enlarged 15
13. Dorsomesial margin of minor chela strongly convex. Carpus of chelipeds with bright blue or purple mark. Southern California . . . . . *Pagurus spilocarpus*
– Dorsomesial margin of minor chela almost straight. Carpus of chelipeds without such mark. Northern California northward 14
14. Pereopods 2–4 opalescent with golden sheen. Mendocino County, California northward . . . . . *Pagurus ochotensis*
– Pereopods 2–4 prominently banded with white, red or orange. Usually from Monterey, California northward . . . . . *Pagurus armatus*
15. Pereopods 2–4 with longitudinal white or bluish stripes on dactyls 16
– Pereopods 2–4 without longitudinal white or bluish stripes on dactyls 18
16. Chelae of adults with gape between fingers. Color brown to grayish. . . . . *Pagurus quaylei*
– Chelae of adults without gape between fingers. Color black, dirty brown or olive green 17
17. Dactyls of pereopods 2–4 with distinct stripes of red, white. Usually in southern Califonia, inhabiting shells of *Callianax* sp. . . . . *Pagurus venturensis*
– Dactyls of pereopods 2–4 with stripes of red, pale brown or blue. Usually north of Point Conception, inhabiting shells of *Nucella* spp. or other gastropods . . . . . *Pagurus hirsutiusculus*
18. Pereopods 2–4 with prominent white or cream-colored bands. 19
– Pereopods 2–4 without prominent white or cream-colored bands 20
19. Antennae banded. Merus of cheliped with white band bordered by black band . . . . . *Pagurus redondoensis*
– Antennae orange, not banded. Cream-colored band without black band on merus of cheliped . . . . . *Pagurus caurinus*
20. Inhabiting tubes of worms, twigs, or tubular shells. . . . . *Orthopagurus minimus*
– Inhabiting coiled shells. 21
21. Pereopods 2–4 with red bands separating bluish-gray, greenish or cream-colored areas. Usually found from Mendocino County, California northward . . . . . *Pagurus beringanus*
– Pereopods 2–4 reddish to purple, without red bands. Can be found south of Mendocino County . . . . . *Parapagurodes hartae*

Family Diogenidae Ortmann, 1892

The "even-clawed" hermit crabs are widely distributed, especially in tropical regions. Ayón-Parente & Hendrickx (2010), in a study of species richness in the eastern Pacific, called attention to the paucity of genera and species in the northern temperate provinces. At most, only seven species in three genera occurred in the Californian and Oregonian provinces while 55 species in 11 genera occurred in tropical provinces. In their analysis, *Clibanarius digueti* Bouvier, 1898 and *Dardanus magdalensis* Ayón-Parente & Hendrickx, 2009; neither of which has been recorded farther north than Magdalena Bay, Baja California, were included as northern temperate species.

In California and Oregon, diogenids are primarily subtidal, although *Isocheles pilosus* may be exposed at very low tide. Except for *Paguristes parvus*, the crabs 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 1979a, 1988b). The crabs 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 *Crepipatella* spp.) Bryozoans, algae, or barnacles often heavily encrust shells inhabited by epibenthic species. Although these hermit crabs often seen by divers, there have been few studies or observations on their natural history.

Schmitt (1921: 126, pl. 17, figs. 3, 4) described an additional species, *Dardanus jordani*, from San Francisco Bay, California. The species, based on a single specimen, has not been reported since then. 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.

Isocheles Stimpson, 1860

Isocheles pilosus (Holmes, 1900)

(Fig. 40A–C, Pl. 8D)

Holopagurus pilosus Holmes, 1900: 154. — Schmitt 1921: 127, pl. 17, fig. 2. — Provenzano 1959: 377.
Isocheles pilosus. — Forest 1964: 294. — Haig *et al*. 1970: 17. — Haig & Wicksten 1975: 102. — Wicksten 1979c: 100; 1988b: 321. — Haig & Abbott 1980: 584, fig. 24.9. — Ricketts *et al*. 1985: 336, fig. 262. — Jensen 1995: 67, fig. 127. — Kuris *et al*. 2007: 648.

Diagnosis (based on one specimen each from Newport Bay and Cabrillo Beach, Los Angeles County, California). Rostrum blunt, rounded, reaching about as far forward as lateral projections of carapace. Carapace bluntly triangular, as long as or slightly longer than wide. Second antennae setose. Eyestalks set close together, not dilated, exceeding antennal peduncle but not reaching distal end of antennular peduncle, cornea not dilated. Ocular acicle broad at base, extending into distal protion set at almost a 90˚ angle to basal area; distal portion with 3 strong claw-like spines, 3 strong setae. Antennae densely setose. Antennal acicle reaching close to 0.5 times length of eyestalk, set with small spines, setae. Chelipeds densely setose, similar in size, shape in smaller individuals but left chela wider in large adults. Carpus with with strong dorsal ridge bearing spines, 7–9 larger mesiolateral spines, two rows of larger dorsal spines, scattered rows of smaller spines along lateral margin. Hands horizontally flattened, set with prominent scattered spines, palms gently convex but with transverse depression anterior to base of fingers. Fingers with 3 or 4 rows of prominent spines, ending in sharp apices, without gape. Left cheliped widest across base of fingers, relatively narrower than larger, with inner, outer faces parallel. Pereopods 2, 3 with merus having tubercles, long setae, carpus with 2 rows of dorsal tubercles, mesial margin tuberculate, set with long setae; propodus with strong dorsal spinulose ridge, with rows of long, simple setae; dactyls long, gently curved, with lateral groove, flattened toward apex. Pereopod 4 ischium bearing two large ventral prominences, tuft of lateral setae; merus with lateral, dorsal tufts of elongate setae, carpus with tuberculate dorsal margin, dorsal, lateral tufts of elongate setae; propodus with lateral tuft of setae, well-developed granulate bean-shaped propodial rasp fringed dorsally by stiff setae; dactyl with 5 strong darkly pigmented teeth, fringe of elongate setae. Pereopod 5 chelate. Telson nearly as long as wide, slightly asymmetrical, left lobe slightly longer than right, lateral margins set with acute stiff setae, distal margin with 16 minute teeth, simple setae. Carapace length of larger examined specimen 7.8 mm.

Color in life. Carapace and antennae mottled with bluish, gray tints. Chelipeds cream to orange with bluish tinge on upper surface, line of brick red along chela. Pereopods 2, 3 tan to whitish, marked with brick red stripes. The color notes are from specimens from Cabrillo Beach, San Pedro, California.

Habitat and depth. Medium-grained sand of beaches, 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. Holmes (1900) and Schmitt (1921) provided only a short diagnosis and poor illustrations of this species. Schmitt (1921) reported that the carapace length "of the single Bay specimen" was 28 mm. This length is far greater than that of any specimen I have examined.

This hermit crab can be very abundant on sandy beaches. It inhabits shells of *Polinices* spp., *Callianax biplicata* (G.B. Sowerby, 1825); *Caesea fossatus* (Gould, 1850); and other sand-dwelling gastropods. The crab can scurry on top of the sand or dig into the sand, 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 (Wicksten 1988b).

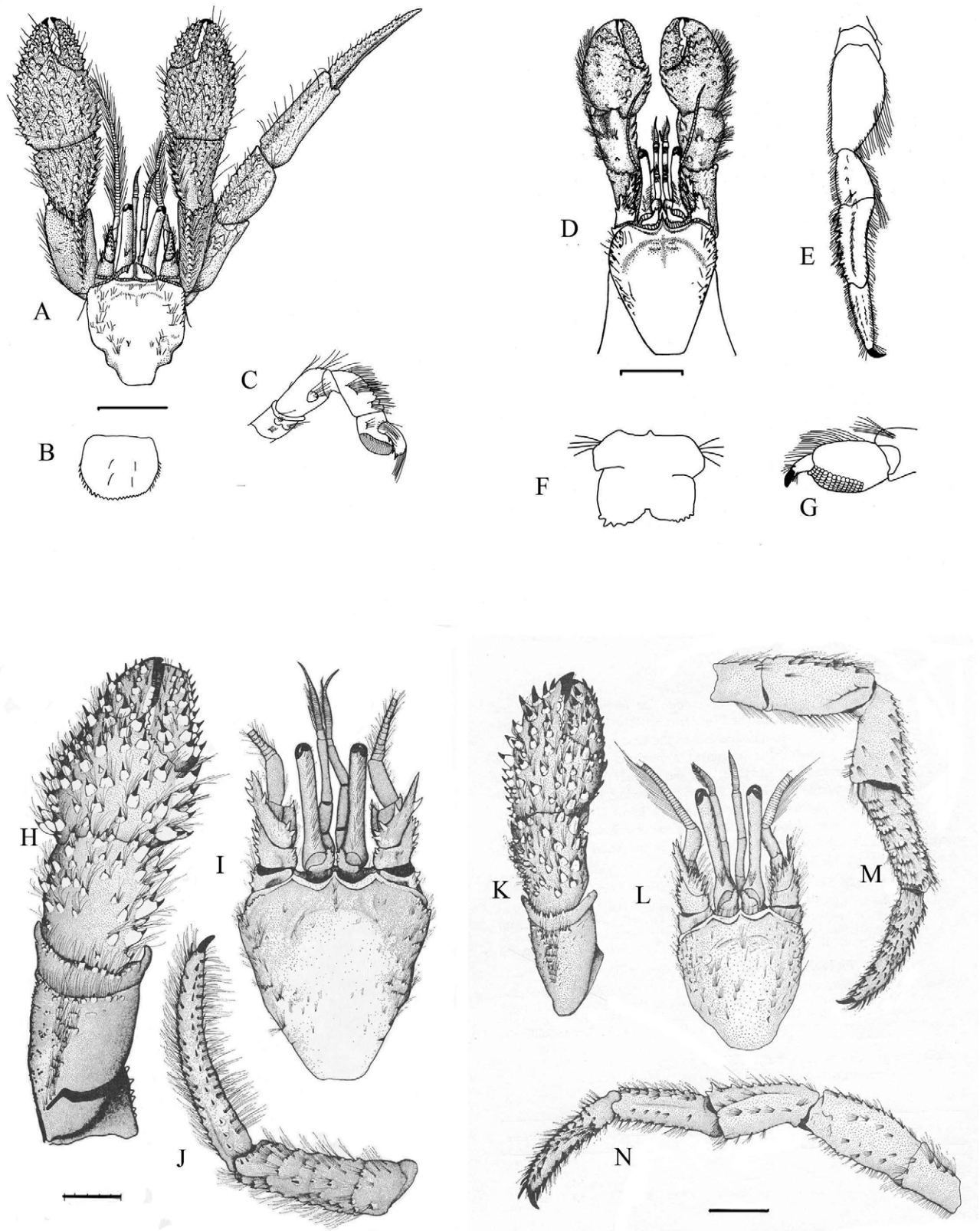

FIGURE 40. Family Diogenidae. A–C, *Isocheles pilosus* (Holmes, 1900); A, carapace and frontal region in dorsal view; B, telson; C, pereopod 4. D–G, *Paguristes parvus* Holmes, 1900; D, carapace and frontal part of crab in dorsal view; E, pereopod 2; F, telson; G, propodial rasp of pereopod 4. H–J, *Paguristes turgidus* (Stimpson, 1857); H, major cheliped; I, carapace and frontal region in dorsal view; J, pereopod 2. K–N, *Paguristes ulreyi* Schmitt, 1921; K, major cheliped; L, carapace and frontal region in dorsal view; M, pereopod 2 in mesial view; N, pereopod 2 in lateral view. Scales: D = 3mm, A, H–N = 5 mm. A–C drawn from crab from Cabrillo Beach, Los Angeles County, California; D–G based on crab from Santa Catalina I., modified from drawings of related species by Provenzano 1959; H–N from McLaughlin 1974.

The southern range limit of this species is uncertain. Specimens identified as *Isocheles pilosus* have been collected at Ballenas Bay, Boca de San Domingo, Hughes Point and San Juanico Bay (Haig *et al*. 1970) and Magdalena Bay, Baja California (Wicksten 2006), but the identification is uncertain.

Provenzano (1959, as *Holopagurus pilosus*) mentioned that this species is very similar to the western Atlantic species *Isocheles wurdemanni.* Stimpson, 1860. He noted that *I. wurdemanni* had chelipeds that could have hands equal in size or the left larger than the right. In specimens that I have examined, these two species differ in three major features: *I. pilosus* is much more setose than *I. wurdemanni*; the dactyl of pereopod 4 bears teeth in *I. pilosus* and not in *I. wurdemanni*, and the telson bears numerous small teeth in *I. pilosus* but only as many as three on each side in *I. wurdemanni*. A fine illustration of *I. wurdemanni* by Provenzano (1959) is marred by an incorrect placement of the chelipeds relative to the eyestalks and antennae.

Paguristes Dana, 1851

Paguristes bakeri Holmes, 1900
(Pl. 8E)

Paguristes bakeri Holmes, 1900: 152. — Schmitt 1921: 124, pl. 18, figs. 2, 6. — Johnson & Snook 1927: 333, fig. 282. — Haig *et al*. 1970: 17. — Wicksten 1988a: 321; 1988b: 321. — Jensen 1995: 68, fig. 130. — Hendrickx *et al*. 2006: 33. — Kuris *et al*. 2007: 648.

Diagnosis. Rostrum about as long as lateral projections of carapace. Second antennae sparsely setose. Length of eyestalk about 0.75 times as long as width of anterior portion of carapace. Hands of chelae broad, about 1.2 times wider than long, outer margin strongly convex; immovable finger about 2 times 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 pereopods 2, 3.

Habitat and depth. Often in silty sand, usually subtidal; lowest intertidal zone to 212 m. According to Hendrickx *et al*. (2006), a report of the species at 232 m probably is in error. Most records are from less than 100 m.

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. Hendrickx *et al.* (2006) provide detailed accounts of the sediments and temperature regimes in which this hermit crab is found in the Gulf of California and southwestern Baja California.

Paguristes parvus Holmes, 1900
(Fig. 40D–G, Pl. 8F)

Paguristes parvus Holmes, 1900: 151, pl. 2, fig. 26. — Schmitt 1921: 124, fig. 83. — Haig *et al*. 1970: 18. — Haig & Wicksten 1975: 102. — Jensen 1995: 68, fig. 131.

Diagnosis (modified from Schmitt 1921, based on specimen from Big Fisherman's Cove, Santa Catalina I., California). Rostrum long, prominent; reaching to or close to end of ocular acicles. Ocular acicles ending in two blunt teeth. Eyestalk about 0.66 times width of anterior portion of carapace, overreaching distal margin of merus of cheliped, distal half of eyestalk about as wide as cornea, proximal half abruptly enlarged. First antennae longer than eyestalk. Peduncle of second antennae with three sharp teeth on lateral, mesio-lateral surfaces. Antennal acicle almost obscured with dense pinnate setae, with one strong lateral tooth, one mesial tooth, bifid apex. Flagellum of second antenna with few sparse setae. Merus of cheliped bearing 3 small teeth on upper distal margin. Carpus with row of 3 large teeth along mesial margin, 2 large teeth on upper surface, smaller tubercle along dorsolateral surface, dense tuft of pinnate setae on disto-lateral margin. Upper surfaces of hands of chelae coarsely granulate, armed with 3 short, stout spines on inner margin proximal to dactyl, row of prominent tubercles dorsal to them, dactyls with small teeth along inner margins, apices dark colored. Pereopods 2, 3 with setose margins, line of lateral setae on carpus, propodus, dactyl; tufts of elongate simple setae proximal to apex of dactyl, dactyl with hooked dark

apex. Pereopod 4 bearing propodal rasp consisting of 13 lines of bead-like tubercles, dactyl curved, dark-tipped. Pereopod 5 ending in short rasp of beaded rows. Telson with left side longer than right, divided into two lobes on each side, without any distal teeth but rows of simple setae on proximal lobes. Carapace length to 7.8 mm.

Color in life. Chelae creamy to light gray, pereopods 2, 3 creamy, banded with dark brown, red-brown; antennae banded with brown. The color notes are based on crabs from Snta Catalina I.

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. Holmes (1900) and Schmitt (1921) provided only a short diagnosis of this hermit crab without adequate illustrations. This is the only species of *Paguristes* in the area of coverage that does not have setose antennae. Its dense covering of pinnate setae also is characteristic. It is the smallest of the species of *Paguristes* 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 turgidus (Stimpson, 1857)

(Fig. 40H–J)

Eupagurus turgidus Stimpson, 1857b: 484, pl. 21, fig. 1.

Paguristes turgidus. — Holmes 1900: 151. — Schmitt 1921: 123, pl. 18, figs. 1, 8. — Johnson & Snook 1927: 332. — Pereyra & Alton 1972: 450. — McLaughlin 1974: 28, figs. 10–12. — Wicksten 1980c: 363; 1989b: 314. — Hart 1982: 104, fig. 36.— Jensen 1995: 68, fig. 129.

Diagnosis. Rostrum about as long as lateral projections of carapace.Second antennae sparsely setose. Length of eyestalk about 0.75 times width of anterior portion of carapace. Hands about 1.33 times 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 pereopods 2, 3 longer than propodi. Propodus, merus of pereopod 2 with strong marginal spines. Telson strongly asymmetrical, left side more elongated than right; with deep lateral notches, teeth along posterior margin. Posterior margin deeply concave. Carapace length to 32 mm.

Color in life. Yellowish to orange-brown, eyestalk with longitudinal crimson stripe.

Habitat and depth. Rocks and muddy sand, 5–465 m.

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* (Redfield, 1846). Crabs from California inhabited shells of species of the cold-water whelks, family Neptuneidae.

Paguristes ulreyi Schmitt, 1921

(Fig. 40K–N, Pl. 8G)

Paguristes ulreyi Schmitt, 1921: 125, pl. 18, figs. 3, 4, 5, 7. — Johnson & Snook 1927: 333 .— Haig *et al*. 1970: 18. — McLaughlin 1974: 19, figs. 7–9. — Hart 1982: 106, fig. 37. — Wicksten 1988b: 321. — Jensen 1995: 67, fig. 128. — Kuris *et al*. 2007: 648.

Diagnosis. Rostrum triangular, acute, reaching to base of eye scales, exceeding lateral projections of carapace. Eyestalk long, 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, 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 0.33–0.5 times longer than wide. Pereopods 2, 3 very setose, their dactyls slightly shorter than the propodi. Pereopod 2 with spines along margin of dactyl, propodus, carpus, pereopod 3 with less prominent spines. Telson asymmetrical, deeply notched along lateral margins, posterior end; posterior margin, posterolateral edge with teeth. Carapace length to 32.3 mm.

Color in life. Orange to dark brown, covered by dense golden setae, often with white spots on maxillipeds. The color notes are based on crabs from Monterey Bay and Redondo Beach, California.

Habitat and depth. Sandy or rocky subtidal areas, rarely cast ashore after storms; 0–157 m.

Range. Frederick I., British Columbia to Pacific coast of Baja California and Punta Gorda, Gulf of California, Mexico. Type locality off Point Loma, San Diego, California, *Albatross* sta. 4303.

Remarks. This is one of the largest hermit crabs of California and Oregon. It is common in kelp beds and rocky subtidal areas. The crab can use its third maxillipeds and setose antennae to capture particles used as food. It also may scavenge on remains left by other predators. I observed an aggregation of more than 20 of these hermit crabs next to a feeding sea star, *Pisaster giganteus* (Stimpson, 1857).

The crabs inhabit a great variety of shells, but especially those of *Astraea* spp. and *Kelletia kelletii* (Forbes, 1852) in southern California. Often, algae, polychaete worms and even small corals encrust the shells. Slipper shells (*Crepipatella* spp.) often live inside the aperture of the shells.

Family Paguridae Latreille, 1802

The "unequal-clawed" hermit crabs are abundant worldwide, and range from the uppermost tide pools to the continental slopes. South of Point Conception, California, one finds members of the genera *Enallopaguropsis*, *Pylopagurus*, *Phimochirus* or *Haigia*, in which the major chela is broad and seals the aperture of the shell. These are primarily tropical genera, formerly all considered belonging to the genus *Pylopagurus*. They usually occur on subtidal rocky bottoms. McLaughlin (1981) performed a 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. Elwood & Neil (1992) produced an extensive, 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.

Discorsopagurus McLaughlin, 1974

Discorsopagurus schmitti (Stevens, 1925)

(Fig. 41C, D)

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 & McLaughlin 1995: 258, figs. 1–10. — Jensen 1995: 62, fig. 111.

Diagnosis. Rostrum triangular, longer than lateral projections of carapace. Eyestalk relatively long, stout; cornea slightly dilated. Major cheliped setose, with scattered spines, granules on carpus and hand; inner margin of palm serrate with large, sharp teeth, outer margin with row of spines. Minor cheliped more slender; carpus, hand with spines, sharp granules. Pereopods 2, 3 slender, setose; dactyl shorter than propodus. Abdomen straight, with pleopods on left side only. Telson with lateral margins rounded, with 4 short teeth on each side of distolateral margin. Uropods developed on both sides, upper uropod longer, with prominent rasp. Carapace length to 6 mm.

Color in life. Chelipeds creamy, mottled with red-brown, apice of fingers red-brown; pereopods 2, 3 banded with cream; red-brown; antennae and eyestalk marked with red-brown. Hart (1982) gave an extensive description of the living color.

Habitat and depth. Usually subtidal; low intertidal zone 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.

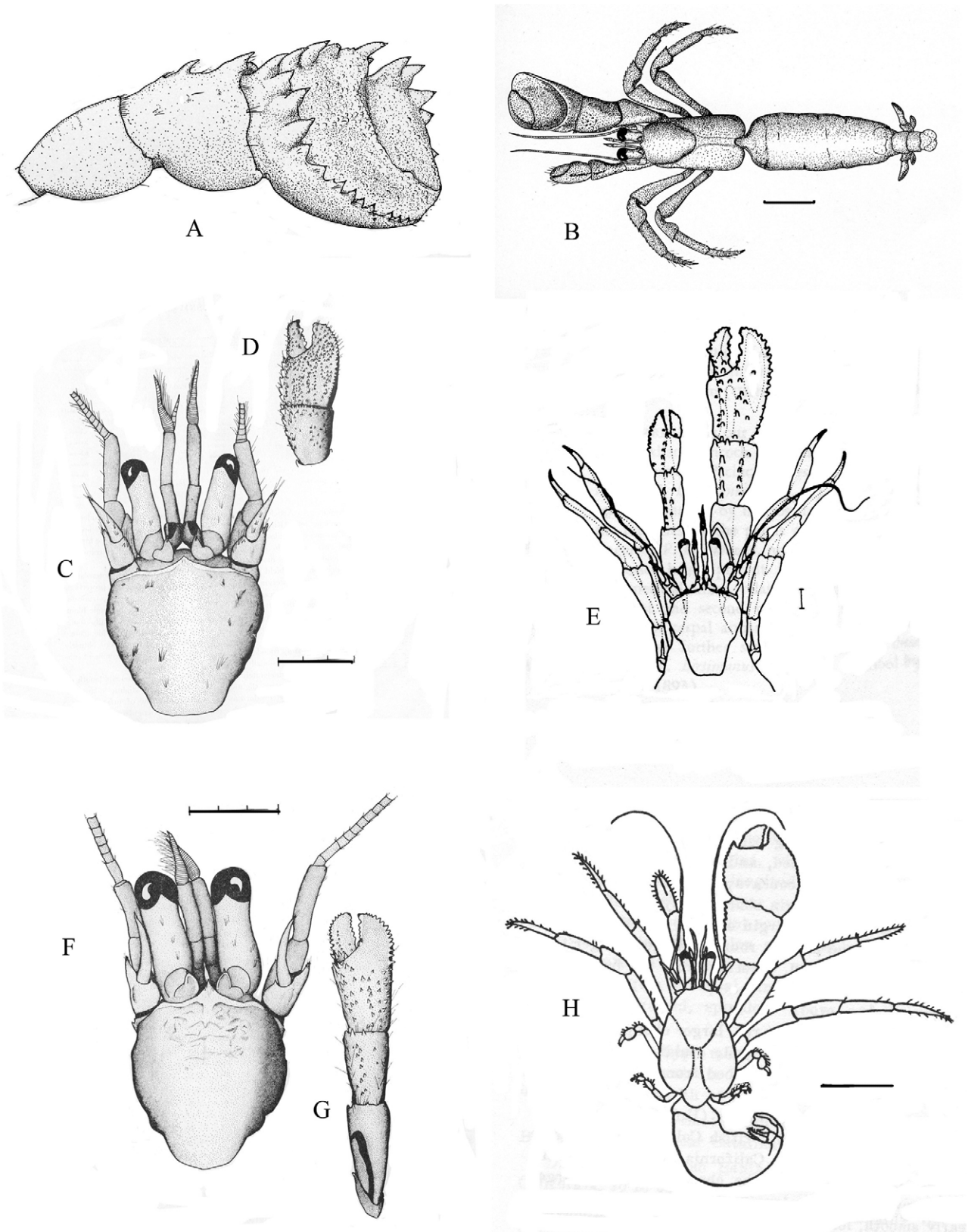

FIGURE 41. Family Paguridae. A, *Enallopaguropsis guatemoci* (Glassell, 1937); major cheliped. B, *Pylopagurus holmesi* Schmitt, 1921. C, D, *Discorsopagurus schmitti* (Stevens, 1925); C, carapace and frontal region; D, major cheliped. E, *Haigia diegensis* (Scanland & Hopkins, 1969). F, G, *Orthopagurus minimus* (Holmes, 1900); F, carapace and frontal region in dorsal view; G, major cheliped. H, *Phimochirus californiensis* (Benedict, 1892). Scales: C, F = 1 mm; I = 2 mm, B, H = 5mm. A, B from Walton 1954; C, D, F, G from McLaughlin 1973; E from Scanland & Hopkins 1969, H from Faxon 1895.

Enallopaguropsis McLaughlin, 1981

Enallopaguropsis guatemoci (Glassell, 1937)
(Fig. 41A)

Pylopagurus guatemoci Glassell, 1937: 254. — Walton 1954: 146, pl. 43B. — Wicksten 1980c: 361.
Enallopaguropsis guatemoci. — McLaughlin 1981: 7; 1982: 849, figs. 9a, 10 a–c.

Diagnosis. Rostrum broad, triangular, carapace with lateral projections rounded but tipped with minute subterminal spinule. Eyestalk cylindrical, cornea slightly dilated. Ocular scale bluntly rounded with acute subterminal spines. Major cheliped with merus smooth, 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, 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, small median row of spines on palm, medial margin unarmed, slightly setose. Pereopods 2, 3 with dactyls shorter than propodi, having spinulose margins. Telson symmetrical, semi-oval, margins entire. Uropods developed on both sides, upper distal face with rasp, posterior blade reduced, rasp covering almost all upper surface. Carapace length 3 mm.

Color in life. Mostly salmon-colored. 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, base of movable finger. Pereopods 2, 3 banded with salmon, red-brown, white. The color notes are from a crab taken off Blue Cavern Point, Santa Catalina I., California.

Habitat and depth. Sand, rocks, shell, or mud, 20–275 m.

Range. Point Hueneme, California to Cedros I., Baja California and Angel de la Guardia I., Gulf of California, Mexico. Type locality 5 miles west of San Jose Point, Pacific coast of Baja California, Mexico.

Haigia McLaughlin, 1981

Haigia diegensis (Scanland & Hopkins, 1969)
(Fig. 41E, Pl. 8E)

Pylopagurus diegensis Scanland & Hopkins 1969: 257, fig. 1. — Haig *et al*. 1970: 21. — Haig & Wicksten 1975: 102.
Haigia diegensis. — McLaughlin 1981: 5. — Jensen 1995: 61, fig. 109. — McLaughlin & Lemaitre 2001: 477, figs. 14a, 14b, 17.

Diagnosis. Rostrum prominent, about 0.5 times length of ocular scale. Lateral projections of carapace very low. Eyestalk swollen at base, ocular scale with 1 blunt spine. Major cheliped with merus essentially smooth, carpus with 3 prominent spines along distal margin, 2 rows of longitudinal spines. Palm of chela with 9–12 tubercles forming oblique ridge from articulation of movable finger to carpus; outer, 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 or 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, row of 9–11 outer, distal marginal teeth. Movable finger with 1 or 2 minute tubercles in proximal half; lateral teeth obscure. Pereopods 2, 3 with short dactyls having 8 spines in longitudinal row. Telson symmetrical, with transverse suture, terminal margins armed with series of small teeth.Uropods asymmetrical. Carapace length 13.8 mm.

Color in life. Chelipeds, pereopods 2, 3 dark pink to brick red. Pereopods 2, 3 banded with cream. Third maxillipeds and first antennae bright blue. The color notes are from crabs from Santa Catalina I., California.

Habitat and depth. Among rocks, boulders and rubble piles; 3–18 m.

Range. Santa Catalina I., California to Guadalupe I., Mexico. Type locality La Jolla Cove, San Diego County, California.

Orthopagurus Stevens, 1927

Orthopagurus minimus (Holmes, 1900)
(Fig. 41F, G)

Pagurus minimus Holmes, 1900: 145.
Pylopagurus minimus. — Schmitt 1921: 114, pl. 16, figs. 1a–1c.
Orthopagurus minimus. — Stevens 1927: 247, fig. 1. — Makarov 1962: 215, pl. 2, fig. 1. — McLaughlin 1974: 363, figs. 98, 99. — Wicksten 1980c: 361. — Hart 1982: 116, fig. 40; color plate. — Jensen 1995: 62, fig. 112.

Diagnosis. Rostrum long, triangular; reaching at least half length of ocular scale. Eyestalk long, stout; cornea slightly dilated, ocular scale rounded. Major cheliped sparsely setose; merus with few or no spines, carpus with dorsal row of spines, scattered spinules; hand widening distally, with spines on palm, fingers; fingers wide, flat; with spines along margins. Minor cheliped small, slender, setose; with few spinules; hand convex, without spines on margins but with rows of spines dorsally, extending to fixed finger. Dactyls, propodi of pereopods 2, 3 equal in length, slender, with marginal setae. Abdomen straight. Telson symmetrical, with deep lateral, terminal notch flanked with 4 or more strong teeth.Uropods symmetrical. Carapace length 5.6 m.

Color in life. Major cheliped with dark red ischium, merus, carpus light golden but covered with dark red spots on spines, teeth; chela dark red with whitish apices to fingers. Minor cheliped light golden but covered with small red dots, pereopods 2, 3 similar but merus of each dark red. Eyestalk, first antennae dark red with irregular white bands. Antennae dark red near base, golden distally. Hart (1982) gave an extensive description of the living color.

Habitat and depth. Rocks 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 the tube mollusk *Serpulorbis squamigerus* (Carpenter, 1857), 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.

Pagurus Fabricius, 1775

Pagurus aleuticus (Benedict, 1892)
(Fig. 42A)

Eupagurus aleuticus Benedict, 1892a: 3.
Pagurus ochotensis aleuticus. — Makarov 1962: 192, pl. 2, fig. 3.
Pagurus aleuticus. — Pereyra & Alton 1972: 45. — McLaughlin 1974: 72, figs. 17–19 (extensive synonymy). — Haig & Wicksten 1975: 101. — Hart 1982: 131, fig. 47. — Wicksten 1989b: 314. — Lemaitre & Castaño 2004: 77.

Diagnosis. Rostrum triangular, about as long as lateral projections of carapace. Eyestalk short, stout; cornea dilated, ocular scale pointed. Major cheliped shorter than pereopods 2, 3; with numerous spines, granules over dorsal, lateral, 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. Pereopods 2, 3 long, slender; with serrate margins, dorsal spines; dactyl curved, with longitudinal groove, longer than propodus. Telson slightly asymmetrical, with lateral, terminal notches; terminal margin with small spinules. Uropods asymmetrical. Carapace length 28.1 mm.

Color in life. Appendages mostly pink. Chelipeds with red spines, sometimes also iridescence. Pereopods 2, 3 iridescent pink with maroon streaks, dark spines, dactyl orange with red stripe, dorsal groove dark red. Eyestalk white, tan; antennal flagellum orange or tan (Hart 1982).

Habitat and depth. Mud or sand, 15–435 m.

Range. Bering Sea to Eureka, California. Type locality Aleutian Is.

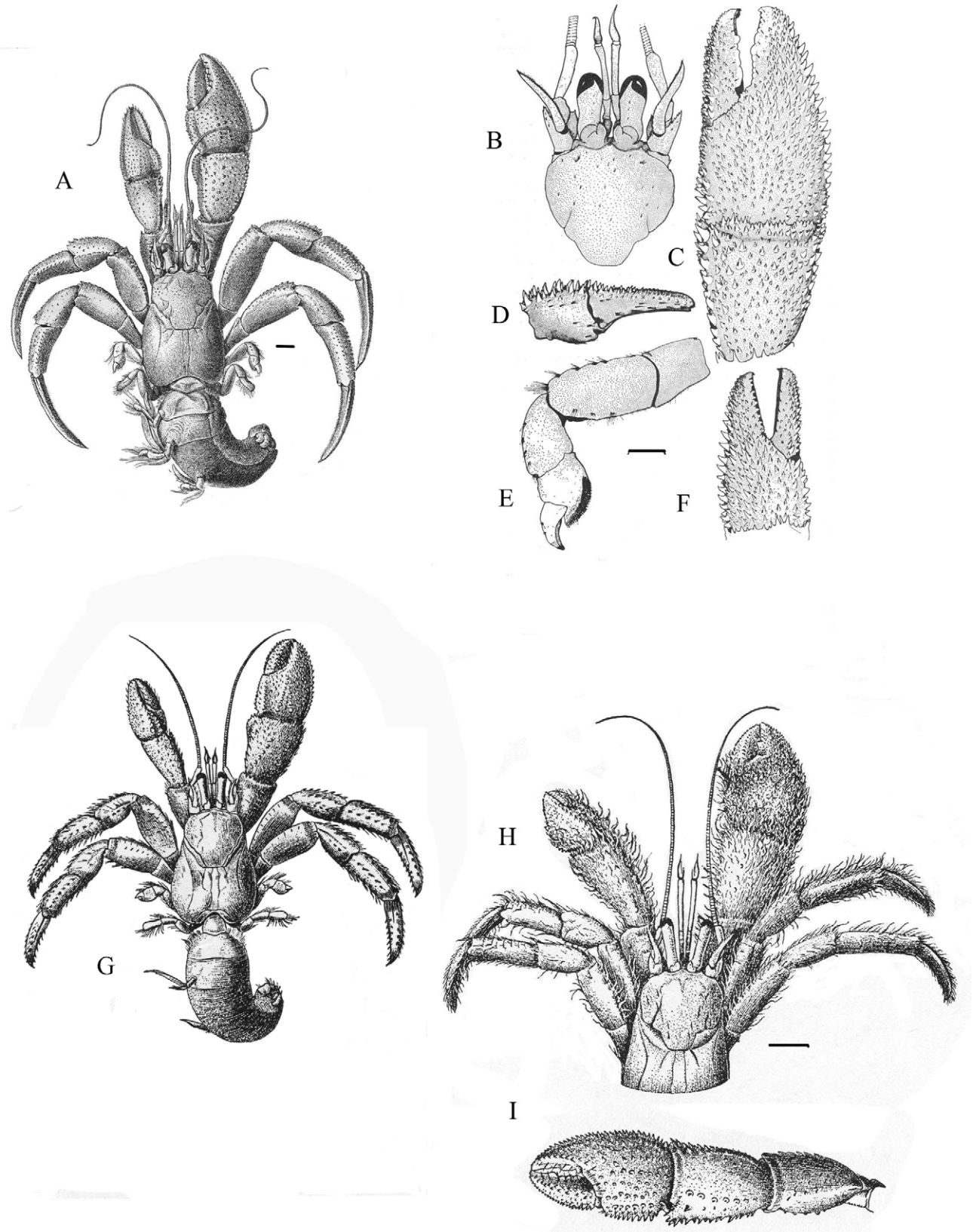

FIGURE 42. Family Paguridae. A, *Pagurus aleuticus* (Benedict, 1892). B– F, *Pagurus armatus* Dana, 1852; B, carapace and frontal region in dorsal view; C, major (right) chela, dorsal view; D, left chela, mesial view; E, pereopod 4; F, left chela in dorsal view. G, *Pagurus beringanus* (Benedict, 1892). H, I, *Pagurus capillatus* (Benedict, 1892); H, front of body in dorsal view; I, denuded major chela. Scales = 5 mm. A from Benedict 1901, B–F from McLaughlin 1974, G–I from Schmitt 1921.

Pagurus armatus (Dana, 1855)

(Fig. 42B–F, Pl. 9C)

Pagurus armatus Dana, 1855: 27. — Makarov 1962: 202, pl 2, fig. 4. — McLaughlin 1974: 48, figs. 13,14. — Wicksten 1984c: 132. — McLaughlin & Gore 1992: 448, figs. 2–7. — Jensen 1995: 64, fig. 117. — Lemaitre & Castaño 2004: 77. — Kuris *et al.* 2007: 649.

Pagurus ochotensis: Schmitt 1921: 130, fig. 84. [Not *Pagurus ochotensis* Brandt, 1851, see McLaughlin 1974].

Diagnosis. Rostrum triangular, longer than lateral projections of carapace. stout, cornea dilated, ocular scale leaf-shaped, ending in stout spine. Major cheliped densely covered by triangular spines, not set into particular rows, setae; spines particularly strong along mesial margin of carpus. Minor cheliped similar, reaching about 0.5 times as long as length of fingers of major cheliped. Pereopods 2, 3 long, with spines along dorsal margins of carpus, propodus, dactyl longer than propodus, curved, with groove, small spinules along dorsal margin. Telson asymmetrical, with lateral notches, concave terminal margin lined by teeth. Uropods asymmetrical. Carapace length to 43 mm.

Color in life. Mostly reddish-orange. Carpus of chelipeds, pereopods 2, 3 with white bands flanked by dark red bands. White marks on maxillipeds. Eyestalk marked with yellowish and dark red, cornea black. Antennal flagella orange. Color of chelipeds may be obscured by silt on setae in life. The color notes are from crabs from Monterey Bay, California.

Habitat and depth. On sand, lowest intertidal zone to 146 m.

Range. Dutch Harbor, Alaska to San Diego, California. Type locality Puget Sound, Washington.

Remarks. This crab runs across sandy bottoms. The shell often is covered by pink hydroids (*Hydractinia* sp.) The crab often inhabits moon shells (family Naticidae). In northern California, the species is very common at depths of 35–75 m (Wicksten 1984c).

Pagurus beringanus (Benedict, 1892)

(Fig. 42G)

Eupagurus beringanus Benedict, 1892a: 17.

Pagurus beringanus. — Rathbun 1904: 159, pl. 5, fig. 5. — Schmitt 1921: 135, fig. 8. — Makarov 1962: 176, pl. 5, fig. 4. — McLaughlin 1974: 139, figs. 35, 36. — Haig & Abbott 1980: 586. — Hart 1982: 140, fig. 52. — Ricketts *et al*. 1985: 289. — Jensen 1995: 65, fig. 122. — Lemaitre & Castaño 2004: 7. — Kuris *et al*. 2007: 649.

Diagnosis. Rostrum triangular but blunt, slightly longer than lateral projections of carapace. Eyestalks moderately stout, cornea not dilated, ocular scale pointed. Major cheliped stout, shorter than pereopods 2, 3; merus with upper surface convex, with large marginal teeth, 2 large ventral knobs, carpus convex, with rows of granules, spines; hand convex, with many granules, spines, serrate margins, fingers short. Minor cheliped smaller, merus laterally compressed, with spinules and granules. Pereopods 2, 3 stout, 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, deep terminal notch, terminal margin with teeth. Uropods asymmetrical. Carapace length to 26 mm.

Color in life. Chelipeds reddish, carpus with bright band at distal end. Pereopods 2, 3 gray to white, with red distal bands on propodus, dactyl; spines reddish. Cornea of eye black with gold or silver. semicircle. Antennal flagellum translucent with red lateral mark. Hart (1982: 140) gave a more extensive description of the living color.

Habitat and depth. Protected intertidal areas to rocky subtidal zones, lowest intertidal zone to 364 m. Usually in subtidal areas in California.

Range. Bering Sea and Aleutian Is. to Monterey, California but rarely found south of Point Arena, California. Type locality Bristol Bay, Alaska.

Remarks. This hermit crab often inhabits shells of *Nucella lamellosa* (Gmelin, 1791); *Ceratostoma foliatum* (Gmelin, 1791); and *Fusitriton oregonensis.*

Pagurus capillatus (Benedict, 1892a)
(Fig. 42H, I)

Eupagurus capillatus Benedict, 1892a: 8.
Pagurus capillatus. — Holmes 1900: 138. — Rathbun 1904: 157, pl. 4, fig. 3. — Schmitt 1921: 132, fig. 85. — Makarov 1962: 208, pl. 3, fig. 2. — McLaughlin 1974: 93, figs. 22, 23. — Hart 1982: 154, fig. 59. — Wicksten 1989b: 314. — Lemaitre & Castaño 2004: 77.

Diagnosis. Rostrum low, about as long as lateral projections of carapace. Eyestalk long, slender; cornea slightly dilated, ocular s 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, scattered larger distal spines; hand with rows of spinules, row of small spines on dactyl, fingers slender. Pereopods 2, 3 slender, setose; carpi of first legs serrate on dorsal margins; dactyls longer than propodi, with ventral spines. Telson asymmetrical, with lateral notches, terminal concavity, terminal teeth. Uropods asymmetrical. Carapace length to 26 mm.

Color in life. Ground color whitish. Chelipeds with merus having bands of rose, brown; carpus with apricot spines and mottling of brown, red; hand light brown, fingers with apricot apices. Pereopods 2, 3 with ischium splotched with pink, red and yellow; merus banded in red and brown, carpus and propodus each with 2 bands, dactyl greenish yellow. Eyestalk with outer rose stripe, 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 caurinus Hart, 1971
(Fig. 43A–D)

Pagurus caurinus Hart, 1971: 1528, figs. 1–7. — McLaughlin 1974: 132, figs. 33, 34. — Haig & Wicksten 1975: 101. — Hart 1982: 152, fig. 58. — Bidle & McLaughlin 1992: 224, figs. 2–8. — Jensen 1995: 66, fig. 123. — Lemaitre & Castaño 2004: 78. — Kuris *et al*. 2007: 650.

Diagnosis. Rostrum obtuse, lateral projections of carapace nearly obsolete. Eyestalk long, slender; slightly constricted medially, cornea slightly dilated, ocular scale with blunt apex, sharp submarginal tooth. Major cheliped stout, with numerous setae; with 1–2 large knobs medio-ventrally, carpus with dorsolateral row of sharp teeth, 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, fixed finger, smaller spines on movable finger. Pereopods 2, 3 stout, carpus of anterior leg with serrate dorsal margin, dactyls more or less straight, with setae, small spines on ventral margin. Telson more or less symmetrical, with notch on lateral margin, terminal margin with notch, sharp teeth. Carapace length to 10 mm.

Color in life. Chelipeds with carpus, chela greenish gray to green, with orange-tipped tubercles, merus red-brown with cream-colored band at distal end. Pereopods 2, 3 banded with reddish brown and cream. Setae of appendages golden-brown. Eyestalk translucent with brown bands. Antennal flagellum orange. Hart (1982) gave a detailed description of the living color.

Habitat and depth. Rocks or sand, lowest intertidal zone to 126 m. Usually found in subtidal areas.

Range. Port Gravina, Alaska to San Pedro, California but rarely reported in California. Type locality Frank I., Tofino, British Columbia.

Pagurus confragosus (Benedict, 1892)
(Fig. 43E–G)

Eupagurus confragosus Benedict, 1892a: 11.
Pagurus confragosus. — Pereyra & Alton 1972: 45. — McLaughlin 1974: 203, figs. 51–54. — Hart 1982: 146, fig. 55. —

Wicksten 1989b: 314. — Lemaitre & Castaño 2004: 78.

Diagnosis. Rostrum acute, triangular, much longer than lateral projections of carapace. Eyestalk short, stout; cornea dilated, ocular scale short, acute. Major cheliped stout, setose, shorter than pereopods 2, 3; merus setose, carpus with small dorsal spines, serrate margins; hand spinose, with raised triangular ridge extending past base of fixed finger. Minor cheliped slender, with rows of spines on carpus, hand, palm greatly inflated on outer side of convex ridge, with row of large spines on right side, small ones on left, extending nearly to middle of fingers. Pereopods 2, 3 stout, carpus serrate on margin of pereopod 2; dactyls longer than propodi, flattened, with longitudinal groove, with stiff dorsal setae, ventral movable spines. Telson nearly symmetrical, with lateral notches, terminal notch, teeth. Carapace length to 20.2 mm.

Color in life. Chelipeds red, white blotched proximally; carpus white with red blotches, spines; hand pink, fingers with white cutting edges. Pereopods 2, 3 with ischium pink, red, white; merus, carpus red, white, tan; propodus with red proximal bands, lighter color between them; dactyl red with lateral stripe, orange distally, pink medially. Eyestalk pink with white stripe, red patches; cornea black with gold flecks (Hart 1982).

Habitat and depth. Continental shelf, 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 cornutus (Benedict, 1892)

(Pl. 9A)

Eupagurus cornutus Benedict, 1892a:12.
Pagurus cornutus. — Makarov 1962: 181, pl. 5, fig. 1. — Pereyra & Alton 1972: 45. — McLaughlin 1974: 225, fig. 57, 58. — Hart 1982: 144, fig. 54. — Wicksten 1989b: 314. — Lemaitre & Castaño 2004: 78.

Diagnosis. Rostrum acute, longer than lateral projections of carapace. Eyestalk short, stout; corneae dilated, ocular scale with subterminal spine. Major cheliped stout, shorter than pereopods 2, 3; 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, with spinous ridge running from middle of base of palm to middle of fixed finger; fixed finger with curved apex. Pereopods 2, 3 setose, carpus of pereopod 2 serrate, also carpus of right pereopod 3; dactyls with stiff dorsal setae, movable ventral spines, dactyls longer than propodi, flattened, with longitudinal groove. Telson asymmetrical, with lateral notch, terminal margin with medial notch, teeth. Carapace length to 18.7 mm.

Color in life. Mostly red to orange. Ischium and merus of each chela with cream stripes, spines, white marginal teeth, carpus with yellow spine; palm pink with yellow spines along margins. Pereopods 2, 3 deep or pale red; merus with distal pink band, dactyl pale. Eyestalk orange with light spots, ocular scale 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 dalli (Benedict, 1892)

(Fig. 43H–K)

Eupagurus (*Trigonochirus*) *dalli* Benendict, 1892: 9.
Pagurus (*Trigonocheirus*) *Dalli*. — Holmes 1900: 139.
Pagurus dalli. — Rathbun 1904: 158, pl. 4, fig. 1. — McLaughlin 1974; 280, figs. 72, 73 (extensive synonymy). — Hart 1982: 160, fig. 62. — Ricketts *et al*. 1985: 300.

Diagnosis (after McLaughlin 1974). Rostrum usually slightly longer than lateral projections of carapace, triangular, ending in small acute spine, usually with terminal tuft of short setae. Eyestalk moderately short, stout; reaching middle of third segment of antennular peduncle. Ocular scale subovate. Major cheliped elongate,

ventromesial margin of merus without strong spinose protuberance; dorsal, lateral surfaces set with sharp teeth. Minor cheliped much smaller than major cheliped, with dorsal surface convex, midline elevated, bearing single row of strong spines. Pereopods 2, 3 nearly equal in size, their segments flat, dactyl equal in size to or slightly exceedinglength of propodus. Telson asymmetrical, lateral margins rounded, terminal margins strongly spinose. Carapace length to 11.9 mm.

Color in life. Overall brown with opaque white bands on distal part of the meri of pereopods 1–3. Hart (1982) gave a detailed description of the color pattern.

Habitat and depth. Gravel, sand or mud, intertidal zone to 276 m (Hart 1982).

Range. Bering Sea to Oregon. Type locality Bristol Bay, Alaska (*Albatross* sta. 3233).

Remarks. Ricketts *et al*. (1985) noted that this hermit crab often lives within holes in the sponge *Suberites ficus* (Johnston, 1842).

Pagurus granosimanus (Stimpson, 1860)

(Fig. 43K–N, Pl. 9E)

Eupagurus granosimanus Stimpson, 1860: 90.

Pagurus granosimanus. — Holmes 1900: 146. — Rathbun 1904: 160, pl. 5, fig. 8. — Schmitt 1921: 141, fig. 91. — Johnson & Snook 1927: 336, figs. 278, 284. — McLaughlin 1974: 158, figs. 39, 40. — Haig & Abbott 1980: 586, fig. 24.13. — Hart 1982: 136, fig. 50. — Ricketts *et al*. 1985: 273. — Jensen 1995: 65, fig. 121. — Lemaitre & Castaño 2004: 78. — Kuris *et al*. 2007: 649, pl. 326 E.

Diagnosis. Rostrum short, blunt, barely longer than lateral projections of carapace. Eyestalk long, corneae slightly dilated, ocular scale rounded. Major cheliped stout, covered with small spinules, granules, fingers very short. Minor cheliped similar to major but with most granules on palm, fingers, fewer on proximal parts. Pereopods 2, 3 stout, with rows of spinules, serrate margins of propodi and carpi, dactyls about as long as propodi, broad. Telson slightly asymmetrical, lateral margins notched, terminal margin with median notch, spinules. Uropods asymmetrical. Carapace length to 19 mm.

Color in life. Reddish to olive green with white or blue granules, pereopods 2, 3 without prominent bands. Eyestalk with faint yellow stripes. Flagellum of antenna bright red.

Habitat and depth. Usually mid-littoral zone of rocky areas, bays and tide pools, intertidal zone to 36 m.

Range. Unalaska, Alaska to Ensenada, Baja California. Type locality Monterey, California.

Remarks. This common intertidal hermit crab usually inhabits shells of *Tegula* spp.

Pagurus hemphilli (Benedict, 1892a)

(Fig. 43O, Pl. 9F)

Eupagurus hemphilli Benedict, 1892a: 16.

Pagurus hemphilli. — Holmes 1900: 147. — Rathbun 1904: 160, pl. 5, fig. 9. — Schmitt 1921: 142, fig. 92. — Johnson & Snook 1927; 336. — McLaughlin 1974: 149, figs. 37, 38. — Haig & Wicksten 1975: 102. — Haig & Abbott 1980: 586, fig. 24.12. — Hart 1982: 134, fig. 49. — Ricketts *et al*. 1985: 58, fig. 2. — Jensen 1995: 63, fig. 114. — Lemaitre & Castaño 2004: 78. — Kuris *et al*. 2007: 649.

Diagnosis. Rostrum wide, triangular, longer than lateral projections of carapace. Eyestalk slender, cornea slightly dilated, ocular scale pointed. Major cheliped much larger than minor cheliped, finely granulate, with few setae, some teeth on distal margins of merus, carpus; carpus laterally compressed, inflated ventrally, triangular in lateral view; fingers of chela very short, broad. Minor cheliped very short, granulate, laterally compressed. Pereopods 2, 3 stout, dorsal margins of propodus, carpus serrate, dactyls broad, stout, as long as or shorter than propodi. Telson asymmetrical, with notches on lateral, terminal margins; terminal margin with teeth. Uropods asymmetrical. Carapace length to 15 mm.

Color in life. Rich maroon with blue granules; ends of dactyls yellow. Cornea with gold ring. Flagellum of antenna red. Juveniles may have white bands on pereopods 2, 3. The color notes are from crabs from Monterey Bay, California.

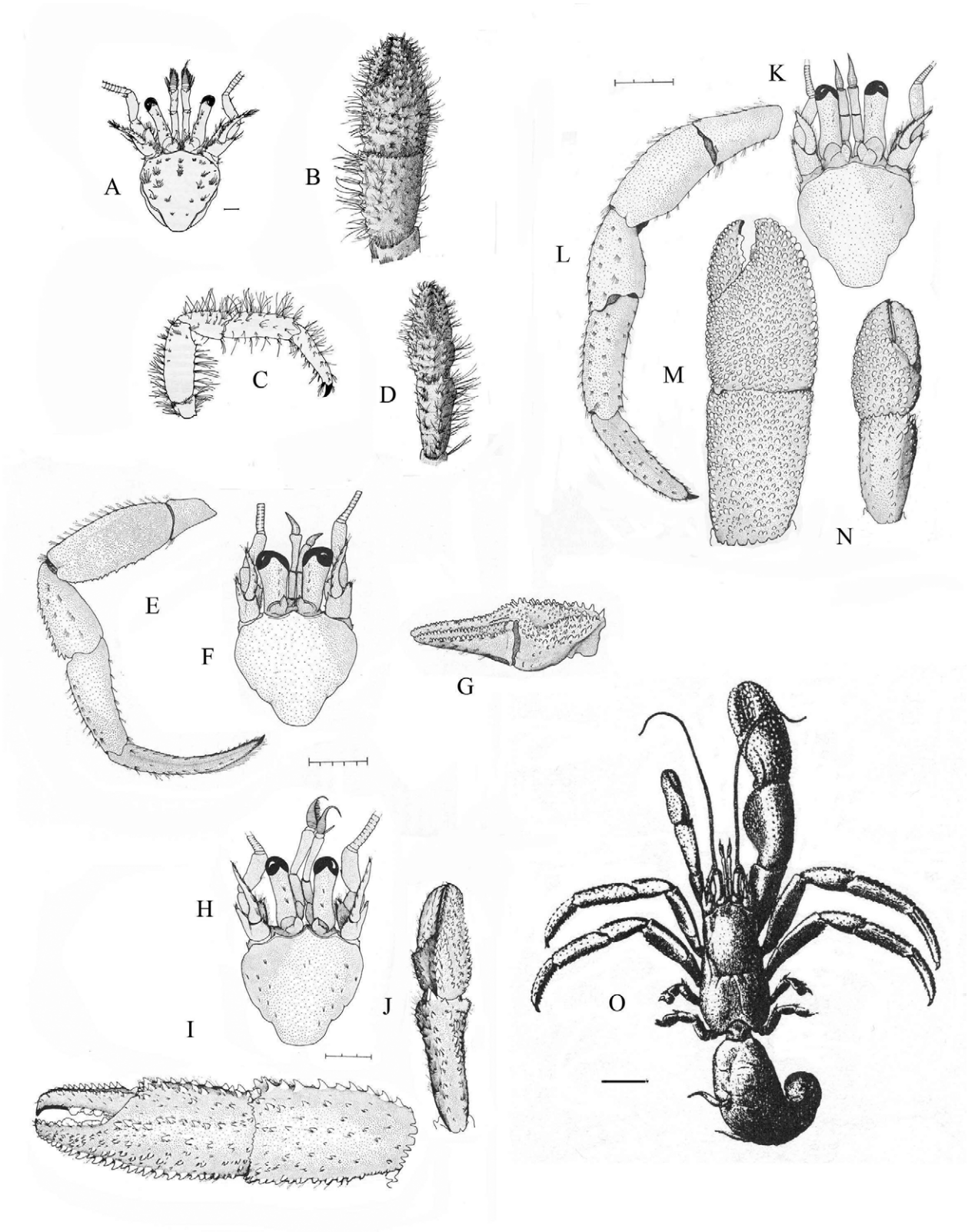

FIGURE 43. Family Paguridae. A–D, *Pagurus caurinus* Hart, 1971; A, carapace and frontal region in dorsal view; B, major chela; C, pereopod 2; D, minor chela. E–G, *Pagurus confragosus* (Benedict, 1892); E, pereopod 2; F, carapace and frontal region in dorsal view; G, major chela in lateral view. H–K, *Pagurus dalli* (Benedict, 1892); H, carapace and frontal region in dorsal view; I, major cheliped; J, minor cheliped. K–N, *Pagurus granosimanus* (Stimpson, 1859); K, carapace and frontal region in dorsal view; L, pereopod 2; M, major cheliped; N, minor cheliped. O, *Pagurus hemphilli* (Benedict, 1892). Scales: A = 1 mm; H, K = 3 mm, F, O = 5 mm. A–D from Hart 1971, E–N from McLaughlin 1974, O from Schmitt 1921.

Habitat and depth. Rocky areas and kelp beds on open coasts; lowest intertidal zone but usually subtidal, to 50 m.

Range. Klokachef I., Alaska to San Miguel I., 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. The slipper shell *Garnotia adunca* (G.B. Sowerby, 1825); and the white limpet *Acmaea mitra* Rathke, 1833 may live atop the shells.

Pagurus hirsutiusculus (Dana, 1851)

(Fig. 44A, B; Pl. 10B)

Bernhardus hirsutiusculus Dana, 1851: 70; 1852: 443, pl. I; 1855: pl. 27, fig. 3.

Pagurus hirsutiusculus.—Holmes 1900: 143 (part). — Rathbun 1904: 159 (part). — Schmitt 1921: 137, fig. 89 (part). — Johnson & Snook 1927: 334, figs. 279, 280 (part). — Makarov 1962: 171, pl. 3, fig. 4. — Wicksten 1977c: 541. — Hart 1982: 138, fig. 51 (part). — Ricketts *et al*. 1985: 278 (part). — Jensen 1995: 66, fig. 125. — Komai & Yakovlev 2000: 305. — Lemaitre & Castaño 2004: 78. — Kuris *et al*. 2007: 650.

Pagurus hirsutiusculus hirsutiusculus. — McLaughlin 1974: 175, figs. 43a–c, 44a–h. — Haig & Abbott 1980: 585, fig. 24.11. — McLaughlin *et al*. 1988: 430. — Mesce 1993: 95.

Diagnosis. Rostrum triangular, pointed, reaching to middle of ocular scale or beyond; much longer than lateral projections of carapace. Eyestalk stout, cornea not dilated, ocular scale pointed. Major cheliped stout, shorter than pereopods 2, 3; merus, carpus setose, with granules, spines, ridges; hand slightly convex, with many granules. Major cheliped elongated, fingers gaping in adult male. Minor cheliped setose, with granules. Pereopods 2, 3 setose, dactyls slender, about as long as propodi. Telson asymmetrical, lateral margins with notches, terminal margin with notch, teeth. Uropods asymmetrical. Carapace length to 19 mm.

Color in life. Almost black to greenish brown. Apices of minor chela tan or orange. Pereopods 2, 3 with white band on propodus, often also blue dot; dactyl whitish, striped with blue, red. Antennal flagellum banded with translucent and brown. The color notes are from crabs from Coyote Point, San Francisco Bay, California.

Habitat and depth. Often in protected areas with silt or in bays or harbors. Usually upper and middle intertidal zone, to 110 m.

Range. Eastern Hokkaido, Kuril Is., Kamchatka; Pribilof Is. to Monterey, California. Type locality Puget Sound. Records from southern California refer to *Pagurus venturensis* Coffin, 1957.

Remarks. This is a common intertidal hermit crab. It usually lives in areas more protected from strong surf than *P. samuelis*, although both species can co-occur. It often inhabits shells of *Nucella* spp. In San Francisco Bay, it uses shells of gastropod species introduced from the Atlantic. Slipper shells (*Crepidula* spp.) may live inside the aperture of the shell. Mesce (1993) determined that setae on the minor chela of *P. hirsutiusculus* act as mechanoreceptors and chemoreceptors during examination of gastropod shells.

Pagurus ochotensis Brandt, 1851

(Fig. 44C–G)

Pagurus ochotensis Brandt, 1851: 108. — Johnson & Snook 1927: 333 (part). — Makarov 1962: 188, pl. 2, fig. 2. — McLaughlin 1974: 57, figs. 15, 16 (extensive synonymy). — Haig & Wicksten 1975: 101. — Hart 1982: 128, fig. 46. — McLaughlin *et al*. 1992: 507, figs. 1–12. — Jensen 1995: 64, fig. 118. — Lemaitre & Castaño 2004: 78. — Kuris *et al*. 2007: 649.

Not *Pagurus ochotensis* of Schmitt, 1921: 130, fig. 84; =*Pagurus armatus* (Dana).

Diagnosis. Rostrum triangular, about as long as or slightly longer than lateral projections of carapace. Eyestalk short, stout; cornea dilated, ocular scale pointed. Major cheliped stout, shorter than walking legs; carpus with 2 rows dorsal spines, strong spines along lateral, mesial borders; hand with 3 rows small spines not continuing to fixed finger but also with numerous spinules on dorsal surface, fingers; row of low spines on lateral margin. Minor cheliped with spines similar to major cheliped. Pereopods 2, 3 long, with spines along margins of carpus, propodus; dactyls longer than propodi, curved, with serrate dorsal margins, 2 shallow grooves, close-set ventral spines. Telson asymmetrical, left lobe longer than right, with notches on lateral margins, terminal margin concave, with teeth. Uropods asymmetrical. Carapace length to 27.7 mm.

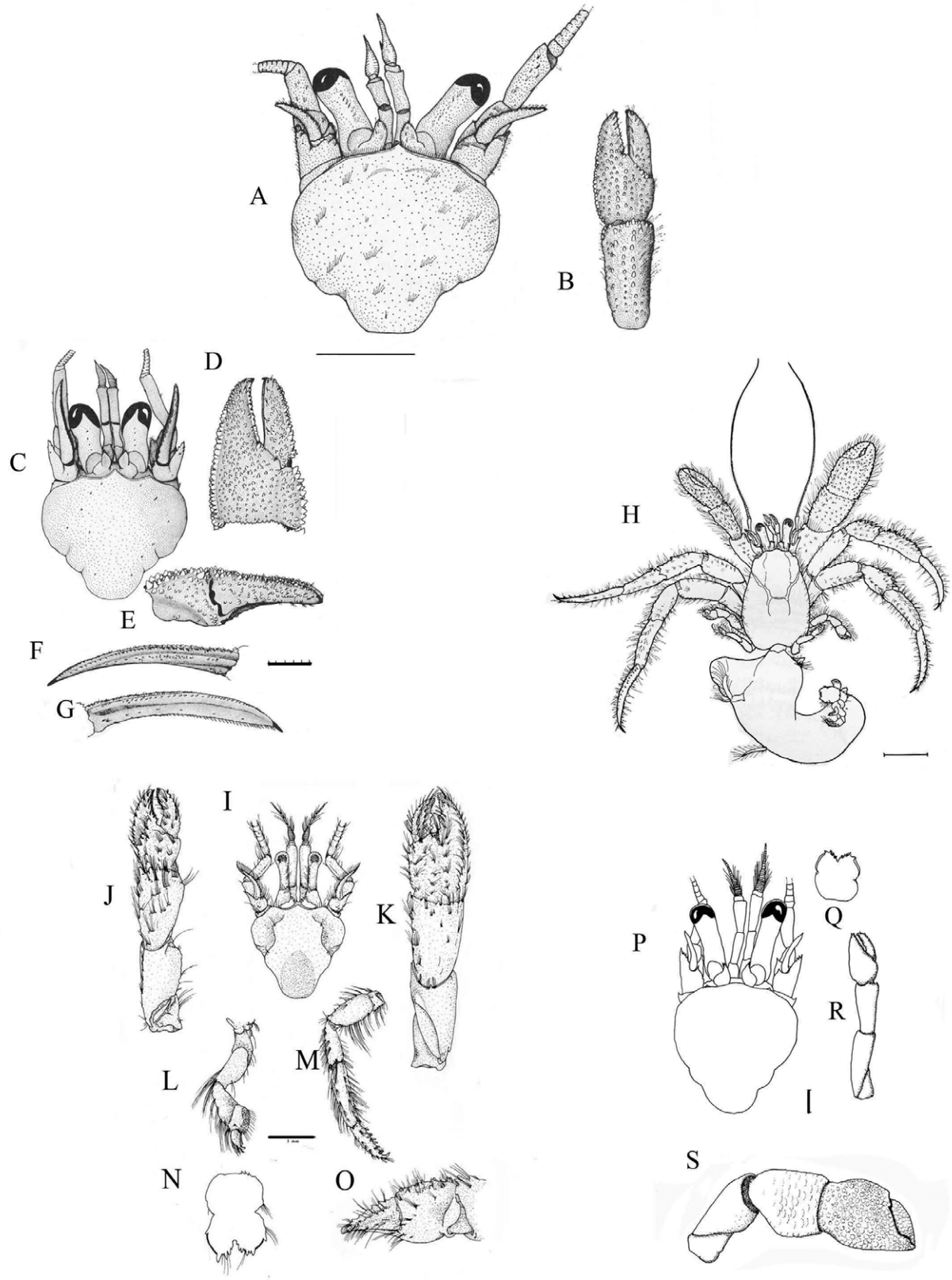

FIGURE 44. Family Paguridae. A, B, *Pagurus hirsutiusculus* (Dana, 1851); A, carapace and frontal region in dorsal view; B, major chela. C–G, *Pagurus ochotensis* Brandt, 1851; C, carapace and frontal region in dorsal view; D, left chela in dorsal view; E, left chela in mesial view; F, dactyl of left pereopod 3, dorsolateral view; G, dactyl of left pereopod 3, mesial view. H, *Pagurus quaylei* Hart, 1971. I–O, *Pagurus redondoensis* Wicksten, 1982; I, carapace and frontal region in dorsal view; H, minor cheliped; K, major cheliped; L, pereopod 4; M, pereopod 2, N, telson; O, pereopod 2. P–S, *Pagurus retrorsimanus* Wicksten & McLaughlin, 1998; P, carapace and frontal region in dorsal view; Q, telson; R, minor cheliped; S, major cheliped. Scales: I, P = 1 mm; A, C = 5 mm. A–G from McLaughlin 1974, I–O from Wicksten 1982d, P–S from Wicksten & McLaughlin 1998.

Color in life. Right cheliped with ischium, merus white, merus with pearly iridescence, streaks, bands of maroon; carpus gray to brown with gray spines, green, pink or bronze iridescence; hand white or pinkish covered by gray or brown spines, granules; maroon streak along fixed finger. Left cheliped similar but no prominent maroon streak on hand. Pereopods 2, 3 with ischium yellowish, merus light brown with maroon, blue areas, green iridescence, carpus, propodus similar but also with 2 maroon stripes, dactyl with marks of maroon, blue stripes. Eyestalk white with red spots, greenish yellow band; cornea distinctively greenish yellow. Antennae pinkish brown (McLaughlin 1974). The color of the cornea and the iridescence of the appendages are distinctive.

Habitat and depth. Sand or mud, usually subtidal, lowest intertidal zone to 388m.

Range. Pribilof Is., Alaska to Point Arena, California. Type locality "Okhotsk Sea."

Remarks. This species often inhabits the shells of large moon snails (Naticidae). Divers have seen it running across sandy areas.

Pagurus quaylei Hart, 1971

(Fig. 44H)

Pagurus quaylei Hart, 1971: 1532, figs. 8–16. — McLaughlin 1974: 85, figs. 20, 21. — Hart 1982: 158, fig. 61. — Lemaitre & Castaño 2004: 79.

Diagnosis. Rostrum triangular, low; barely longer than lateral projections of carapace. Eyestalk elongate, cornea slightly longer than stalk, ocular scale oval, with 1 or more marginal teeth. Major cheliped stout, shorter than pereopod 2, setose; merus with 1 or more large ventral knobs, carpus with small dorsal spines, larger spines on inner margin; hand convex with numerous sharp spines in irregular rows, finger short. Minor cheliped long, slender, setose, spinulose; row of prominent spines on dorsomedial surface of carpus; fingers gaping. Pereopods 2, 3 long, slender, with tufts of setae; pereopods 2 with serrate margins of carpi, propodi; pereopods 3 with few spines on carpus, dactyls longer than propodi, slightly curved. Dactyl of left pereopod 3 may be armed with numerous spines, tubercles. Telson asymmetrical, lateral margins with notches, terminal margin with deep notch, spinules. Uropods asymmetrical. Carapace length 4.3 mm.

Color in life. Mostly brown or gray. Major cheliped with merus dark brown with light spots, pale distal band; carpus mottled gray to brown with gray spots, spines; palm greenish-brown with gray, white spines; fingers white. Minor cheliped similar but distal part of carpus white, distal part of hand gray-blue. Pereopods 2, 3 with band of red-brown, gray, 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, laterally. Eyestalk pale brown with red, brown, white dots; cornea with 2 circular bands. Antennal flagellum irregularly banded with dark brown (Hart 1982).

Habitat and depth. Sand or gravel, lowest intertidal zone to 97 m.

Range. San Fernando I., Alaska to San Quentin Bay, Baja California, Mexico. Type locality off Frederick I., British Columbia.

Remarks. Along the Palos Verdes Peninsula, California, this small hermit crab is very common on sandy sea floors and among tubes of sand-dwelling polychaete worms.

Pagurus redondoensis Wicksten, 1982

(Fig. 44I–O)

Pagurus redondoensis Wicksten, 1982d: 605, figs. 1–3. — Harvey & McLaughlin 1991: 20. — Haig & Harvey 1991: 10. — Jensen 1995: 62, fig. 113. — Lemaitre & Castaño 2004: 79.

Diagnosis. Rostrum short, rounded to triangular, about as long as lateral projections of carapace. Eyestalk long, slender, cornea dilated; ocular scale ending in 4–5 spinules. Major cheliped with setae on carpus, chela; carpus with teeth along mesial, 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, chela; 2 rows of large spines on palm. Pereopods 2, 3 setose, dactyls shorter than propodi,

with ventral spines. Telson asymmetrical, lateral margins with cleft, terminal margin with deep u-shaped cleft and teeth. 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, narrow dark band at distal end of merus. Pereopods 2, 3 with white band at distal end of merus. Eyestalk with gray tinge, lightly banded with darker shades. Antennal flagellum dark brown with white bands. The color notes are from crabs from Catalina Harbor, Santa Catalina I.

Habitat and depth. Usually in protected bays or harbors, often among tube mollusks (*Serpulorbis squamigerus*), lowest intertidal zone to 50 m.

Range. Redondo Beach, 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.

Pagurus retrorsimanus Wicksten & McLaughlin, 1998

(Fig. 44P–S, Pl. 9D)

Pagurus species 2: Jensen 1995: 67.
Pagurus retrorsimanus Wicksten & McLaughlin, 1998: 153, figs. 1, 2. — Lemaitre & Castaño 2005: 79.

Diagnosis. Rostrum triangular to obsolete, much shorter than lateral projections of carapace. Eyestalk short, cornea slightly dilated, ocular scale triangular to subovate, with submarginal spine. Major cheliped stout, slightly longer than walking legs; merus relatively smooth, carpus with lateral surface strongly produced ventrally, all surfaces covered with flattened tubercles; hand covered by flattened, plate-like tubercles, palm very broad, dorsoventrally compressed; movable finger with 1 broad tooth, 3 smaller distal teeth, fixed finger with broad tooth, 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, small teeth; carpus subtriangular. Pereopods 2, 3 stout, with spinules on propodus, ending in short claw-like dactyl. Telson with distinct transverse suture; posterior lobes separated by median cleft, terminal margins oblique, armed with 3–5 strong teeth, smaller teeth. Shield length to 6.2 mm.

Color in life. Ocular peduncles, antennules dark, translucent blue. Antennal flagellum reddish. Third maxilliped orange-red. Major chela proper usually white, rarely red. Pereopods 2, 3, minor cheliped and major cheliped except for chela proper covered with dark red specks, giving crab reddish color when seen from distance. The color notes are from a crab from Long Point, Palos Verdes Peninsula, Los Angeles County, California.

Habitat and depth. Rocks, sand, gravel, kelp beds, 11–50 m.

Range. Monterey, California to Los Coronados Is., Mexico. Type locality off Redondo Beach, California.

Pagurus samuelis (Stimpson, 1857)

(Fig. 45C–G, Pl. 10A)

Eupagurus samuelis Stimpson, 1857a: 86. — Stimpson 1860: 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. — Johnson & Snook 1927: 334, figs. 281, 284a. — McLaughlin 1974: 166, figs. 41, 42; 1976: 24. — Haig & Abbott 1980: 584, fig. 24.10. — Hart 1982: 132, fig. 48. — Ricketts *et al*. 1985: 37, fig. 22. — Jensen 1995: 65, fig. 120. — Lemaitre & Castaño 2004: 79. — Kuris *et al*. 2007: 649, pl. 326 F.

Diagnosis. Rostrum triangular and low, longer than lateral projections of carapace. Eyestalk stout, cornea not dilated; ocular scale pointed. Major cheliped shorter than pereopods 2, 3; carpus, 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, chela with granules. Pereopods 2, 3 stout, dorsal margins with stiff setae, dactyls stout, curved; propodus, dactyl of left pereopod 3 with spines, granules ventrally. Telson asymmetrical proximal to left lateral groove, terminal margin with very shallow concavity, teeth. Uropods asymmetrical. Carapace length to 19 mm.

Color in life. Greenish brown to olive with red granules. Fingers of chelae with orange apices. Pereopods 2, 3 with prominent blue band in adult, bands of blue and white in juvenile. Antennal flagellum red, carapace with

white stripes. Crabs close to molting may be colored blue. Hart (1982) gave a more detailed description of the living color.

Habitat and depth. Rocks, tide pools and jetties, high intertidal zone.

Range. Nootka Sound, British Columbia to Point Eugenia, Baja California, Mexico. Type locality Tomales Bay, California. Reports from Japan and Russia 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 (Calyptraeidae) may live inside the aperture of the shell or on top of it.

Pagurus setosus (Benedict, 1892)

(Fig. 45H)

Eupagurus setosus Benedict, 1892a: 19.
Pagurus setosus. — Rathbun 1904: 159, pl. 5, fig. 1. — Schmitt 1921: 136, fig. 58. — McLaughlin 1974: 110, figs. 27–29. — Lemaitre & Castaño 2004: 79.

Diagnosis. Rostrum rounded, slightly longer than lateral projections of carapace. Eyestalk elongate, cornea not dilated, ocular scale pointed. Major cheliped with carpus, chela proper sharply spinose, chela proper setose, bearing 7 longitudinal rows of spines. Minor cheliped setose, carpus, chela also bearing spines. Pereopods 2, 3 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, 1 stronger laterodistal tooth; left with 4–9 small teeth, one larger laterodistal tooth. Carapace length to 21 mm.

Color in life. Not reported. Rathbun (1904) noted that pereopods 2, 3 were banded.

Habitat and depth. Mud or sand, 9–476 m.

Range. Kodiak, Alaska to off Santa Cruz I., 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 1980c: 361). This identification needs confirmation.

Pagurus spilocarpus Haig, 1977

(Fig. 44I–M, Pl. 9B)

Pagurus spilocarpus Haig, 1977: 646, figs. 1, 2. — Jensen 1995: 64, fig. 117. — Lemaitre & Castaño 2004: 79.

Diagnosis (after Haig 1977). Rostrum shorter than or equal to lateral projections of carapace, obtusely triangular or rounded. Eyestalk long, moderately stout, somewhat inflated basally, cornea dilated, ocular scales with prominent subterminal spine. Major cheliped stout, with fine setae, strong spines dorsally. Lateral, mesial margins with prominent spines. Minor cheliped with strong dorsal, lateral spines, also mesial spines except on carpus. Pereopods 2, 3 elongate, propodus, carpus serrate, dactyl slender, longer than propodus. Telson asymmetrical, left lobe larger than right, with lateral notches, terminal margin with median cleft, close-set teeth. Uropods asymmetrical. Carapace length to 43 mm.

Color in life. Appendages mostly tan. Chelipeds with spines white at base, purple at apices. 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. Pereopods 2, 3 with reddish-brown blotch on lateral surface of carpus, merus with broad reddish-brown band at distal end. Eyestalk white with reddish brown areas (Haig 1977). In life, setae often covered by silt, color somewhat obscured.

Habitat and depth. Sand, low intertidal zone to 60 m, usually subtidal.

Range. Zuma Beach, California to Point Abreojos, Baja California. Type locality off Belmont Pier, Orange County, California.

Remarks. This hermit crab commonly lives on sand bottoms along the mainland coast of southern California.

Pagurus tanneri (Benedict, 1892)
(Fig. 45N)

Eupagurus tanneri Benedict, 1892: 10.
Pagurus tanneri. — Holmes 1900: 140. — Rathbun 1904: 158, pl. 4, fig. 7. — Schmitt 1921: 133, fig. 8. — Makarov 1962: 184, pl. 5, fig. 5. — Pereyra & Alton 1972: 450. — McLaughlin 1974: 216, figs. 55, 56. — Hart 1982: 142, fig. 53. — Wicksten 1988a: 243; 1989b: 314. — Lemaitre & Castaño 2004: 79.

Diagnosis. Rostrum triangular, longer than lateral projections of carapace. Eyestalk short and stout, cornea dilated, ocular scale with sharp points. Major cheliped stout, slightly shorter than pereopods 2, 3; merus setose, carpus with small dorsal spines, serrate margins; hand spiny, with raised triangular ridge, small spines on fingers, margin setose. Minor cheliped smaller, slender, hand slightly swollen on left side, with curved raised ridge edged with 2 rows of spines on palm; fingers elongate. Pereopods 2, 3 slender, carpus, merus with dorsal serrate edges, dactyls slightly longer than propodi, curved; with dorsal setae, small ventral spines. Telson asymmetrical, with lateral notches, terminal margin with median notch, teeth. Uropods asymmetrical. Carapace length 18.1 mm.

Color in life. Mostly orange to scarlet. Chelipeds with white spines and granules; palm yellowish. orange with white apex, cornea black, antennal flagellum scarlet. Hart (1982) gave a more detailed description of the living color.

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* (Dall, 1889). Stalked barnacles, family Scalpellidae, may attach to the shell.

Pagurus venturensis Coffin, 1957
(Fig. 45A, B, Pl. 10C)

Pagurus hirsutiusculus venturensis Coffin, 1957: 1, fig. 2. — McLaughlin 1974: 185, figs. 43d, 44. — Haig & Abbott 1980: 585. — McLaughlin *et al*. 1988: 431.
Pagurus venturensis. — Crain & McLaughlin 1993: 985, figs. 1–11 (extensive synonymy). — Lemaitre & Castaño 2004: 79.

Diagnosis. Rostrum triangular, reaching beyond base of ocular scale, exceeding lateral projections of carapace. Eyestalk stout, cornea weakly dilated, ocular scale subacute, with subterminal spine. Major cheliped tuberculate, carpus with dorsal setae; fingers very short, stout; gap between fingers. Minor cheliped with 2 rows of sharp dorsal spines on carpus, palm tuberculate. Pereopods 2, 3 stout, setose; dactyls subequal to propodi, dactyls with row of ventral spines, carpi with 2–3 rows of spines. Telson asymmetrical, with cleft on lateral margin, concavity in terminal margin; terminal margin with teeth. Uropods asymmetrical. Carapace length to 4.6 mm.

Color in life. Olive brown to light gray. Apices of chelae white. Pereopods 2, 3 with white bands at distal ends of merus, carpus, propodus. Carpus with white stripe. Dactyl pale blue, with longitudinal reddish stripes. Eyestalk light golden brown. Antennal flagella translucent brown. The color notes are from crabs from Cabrillo Beach, Los Angeles County, California.

Habitat and depth. Sheltered bays, tide pools with mixed rocks and sand; low intertidal zone.

Range. Monterey Peninsula to San Diego, California. Type locality 12 miles north of Ventura, California.

Remarks. In life, *P. venturensis* usually is lighter in color than *P. hirsutiusculus*. It does not grow to as large a size as its northern counterpart. *Pagurus venturensis* often inhabits the shells of *Callianax biplicata* and *Acanthina* spp.in Los Angeles Harbor.

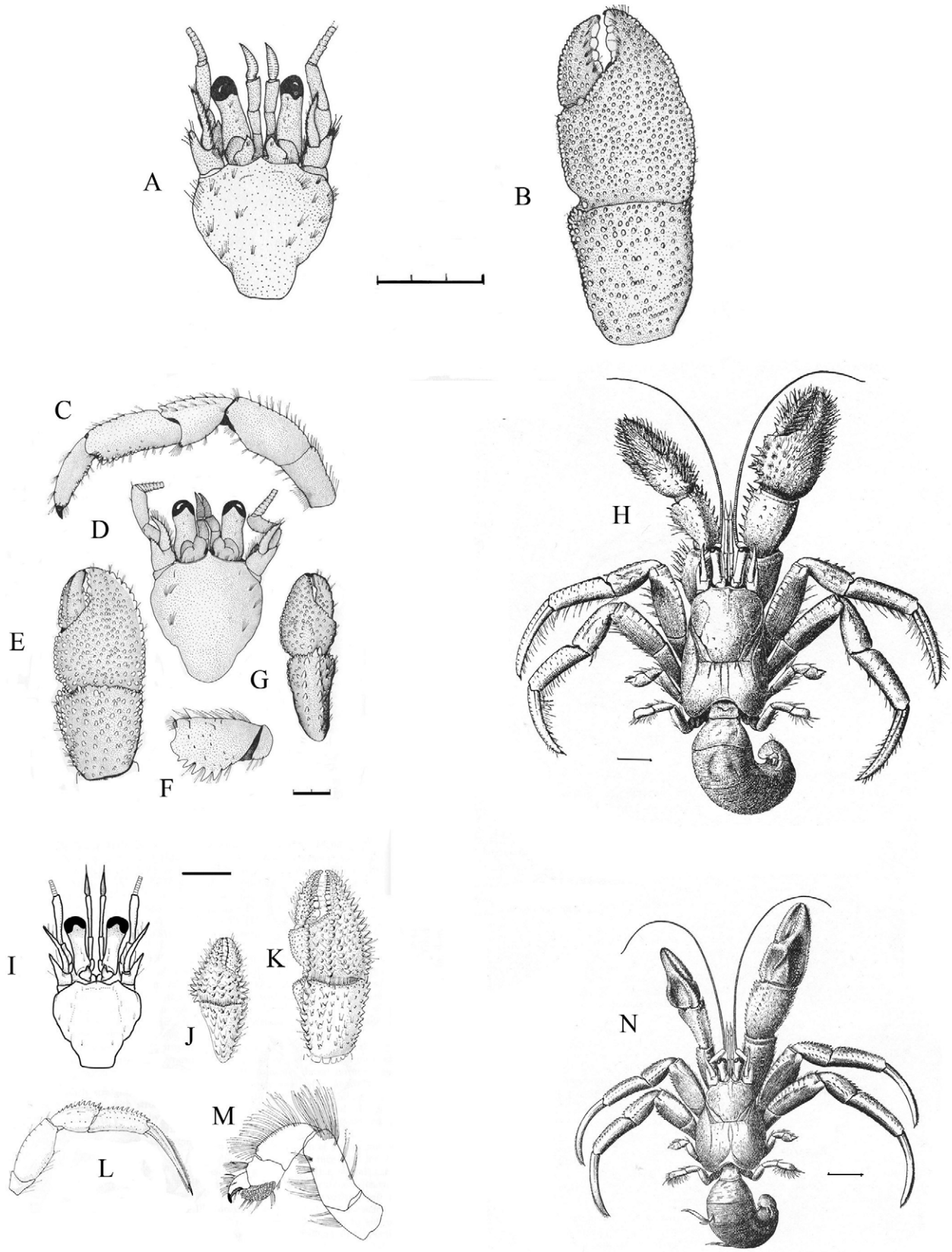

FIGURE 45. Family Paguridae. A, B, *Pagurus venturensis* Coffin, 1957; A, carapace and frontal region in dorsal view; B, major chela. C–G, *Pagurus samuelis* (Stimpson, 1857); C, pereopod 2; D, carapace and frontal region in dorsal view; E, major chela; F, detail of merus of minor cheliped; G, minor chela. H, *Pagurus setosus* (Benedict, 1892). I–M, *Pagurus spilocarpus* Haig, 1977; I, carapace and frontal region in dorsal view; J, minor chela; K, major chela; L, pereopod 2; M, pereopod 4. N, *Pagurus tanneri* (Benedict, 1892). Scales: C–E, G = 1 mm; A, B = 3 mm; H–L, N = 10 mm. A–G from McLaughlin 1974, H, N from Schmitt 1921, I–M from Haig 1977.

Parapagurodes McLaughlin & Haig, 1973

Parapagurodes hartae McLaughlin & Jensen, 1996
(Fig. 46A–F)

Pagurus sp: Hart 1982: 148, fig. 56.
Pagurus sp. 1: Jensen 1995: 66, fig. 124.
Parapagurodes hartae McLaughlin & Jensen, 1996: 841, figs. 1–4.

Diagnosis. Rostrum triangular, greatly exceeding lateral projections of carapace and reaching beyond base of ocular scale, subacute or with small tooth. Eyestalk moderately stout, with cornea slightly dilated. Major cheliped longer than pereopods 2, 3 in adult male. Mesial margins lined with strong spines, especially on carpus, rows of spines along dorsal surface of carpus, palm; row of spines continuing on each finger, lateral margin of palm; 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, fixed finger; raised ridge near center of palm, few spinules on movable finger. Pereopods 2, 3 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, row of teeth. 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, fingers; meri, carpi also orange; pereopods 2, 3 with patches of pale blue to ivory. Eyestalk translucent with bands, stripes of red, first antennae banded with red, white, and/or blue, antennal flagellum transparent (McLaughlin & Jensen 1996).

Habitat and depth. Among rocks, boulders, sand, gravel and shell; 6–635 m.

Range. Queen Charlotte Is., British Columbia to south of Pyramid Cove, San Clemente I., California. Type locality Chatham Sound, British Columbia. The crab has not been reported from Washington, Oregon or most of northern California except Carmel Bay, Monterey County.

Parapagurodes laurentae McLaughlin & Haig, 1973
(Fig. 46G–J)

Parapagurodes laurentae McLaughlin & Haig, 1973: 129, figs. 4b, 9–11.

Diagnosis. Rostrum triangular, acute, often with small spine, longer than lateral projections of carapace and reaching less than half length of ocular scale. Eyestalk robust, short, with cornea dilated; ocular scale subtriangular and ending subacutely. Major cheliped long and slender. Merus with tufts of setae, carpus, palm, fingers with rows of spines, very long, sharp spines along mesial margins. Minor cheliped similar but more elongate, fingers especially long. Pereopods 2, 3 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 teeth, spinules. Uropods asymmetrical. Carapace length to 3.5 mm.

Color in life. Not reported.

Habitat and depth. Mud and gray sand, upper continental slope, 16–475 m.

Range. Off Santa Cruz I., California to Pacific coast of Baja California and off San Pedro Nolasco I., Gulf of California, Mexico. Type locality off Seal Rocks, Santa Catalina I., California.

Parapagurodes makarovi McLaughlin & Haig, 1973
(Fig. 46K–N)

Eupagurus mertensii. — Benedict, 1892a: 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 & Haig, 1973: 119, figs. 4a, 5–8.

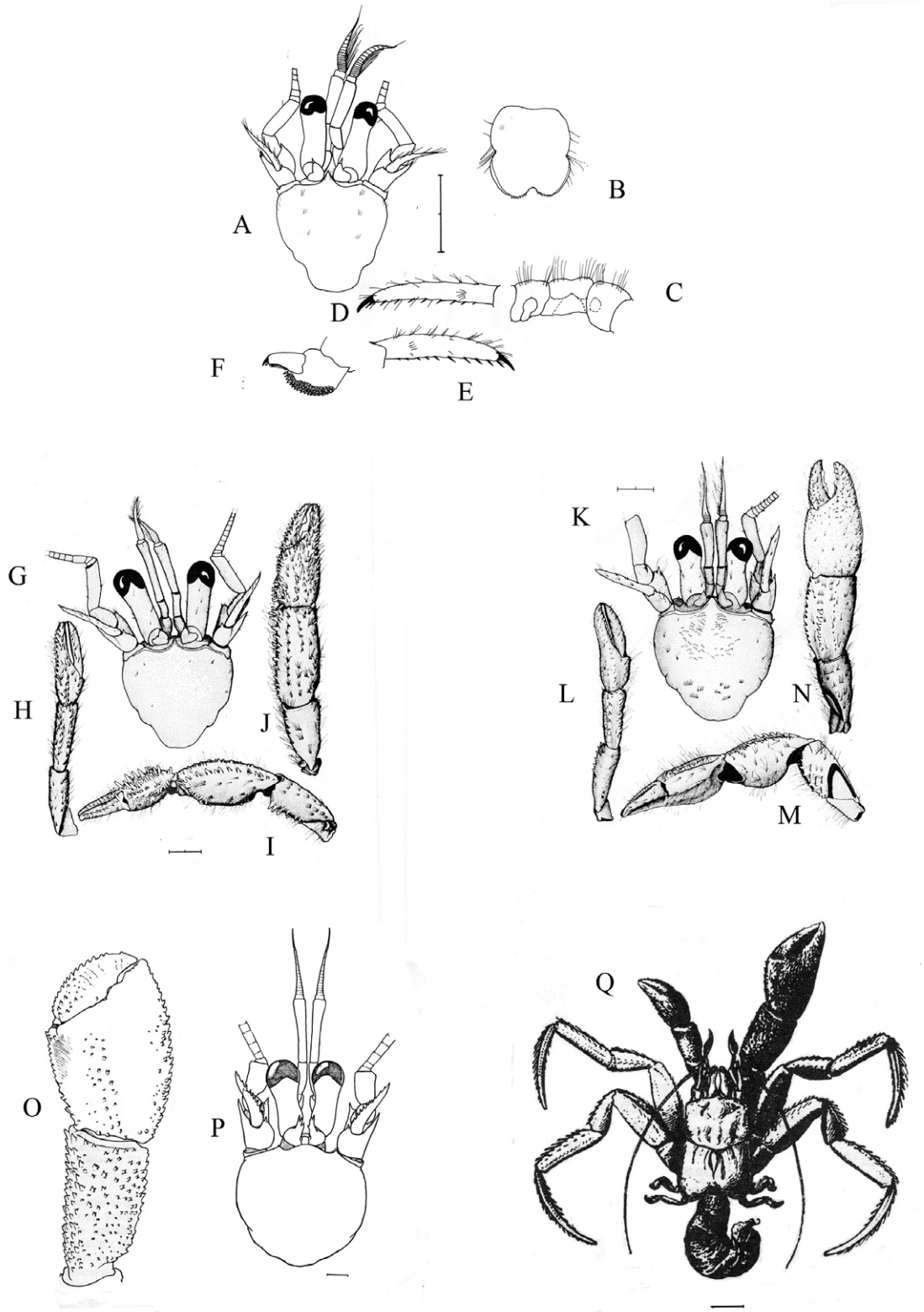

FIGURE 46. Families Paguridae and Parapaguridae. A–F, *Parapagurodes hartae* McLaughlin & Jensen 1995; A, carapace and frontal region in dorsal view; B, telson; C, sternite and coxa of pereopod 5; D, dactyl of right pereopod 2; E, dactyl of left pereopod 3; F, dactyl and propodus of left pereopod 4. G–J, *Parapagurodes laurentae* McLaughlin & Haig, 1973; G, carapace and frontal region in dorsal view; H, minor cheliped; I, major cheliped in lateral view; J, major cheliped in dorsal view. K–N, *Parapagurodes makarovi* McLaughlin & Haig, 1973*;* K, carapace and frontal region in dorsal view; L, minor cheliped; M, major cheliped in lateral view; N, major cheliped in dorsal view. O, P, *Oncopagurus haigae* (de Saint Laurent, 1972); O, major cheliped; P, carapace and frontal region in dorsal view. Q, *Parapagurus benedicti* de Saint Laurent, 1972. Scales: G–P = 1 mm; A = 2 mm, Q = 10 mm. A from McLaughlin & Jensen 1996, G–N from McLaughlin & Haig 1973, O, P from de Saint Laurent 1972 (as *Parapagurus haigae*), Q from Makarov 1962 (as *Parapagurus pilosimanus*).

Diagnosis. Rostrum elongate, considerably exceeding lateral projections of carapace, triangular, terminating in small spinule. Eyestalks short, stout, cornea dilated; ocular scale triangular, with strong submarginal spine, with acute or subacute apex. Major cheliped elongate, moderately slender; merus with tufts of setae, few spinules; carpus with dorsal row of strong spines, few spinules, 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, also smaller spines; palm, fingers with few low spinules. Pereopods 2, 3 elongate, dactyls slender, laterally compressed, shorter than propodi; with small spines. Telson symmetrical, with shallow median cleft; terminal margin with small teeth, small median slit. Uropods asymmetrical. Carapace length to 4.6 mm.

Color in life. Not reported.

Habitat and depth. Gray sand, rock and mud of continental shelf, 75–574 m.

Range. South of Santa Cruz, Monterey Bay, California to off Cedros I., Baja California, Mexico. Type locality off Anacapa I., California.

Phimochirus McLaughlin, 1981

Phimochirus californiensis (Benedict, 1892)

(Fig. 41H, Pl. 9G)

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 *et al*. 1970: 20. — McLaughlin 1981: 5.
Phimochirus californiensis. — McLaughlin 1981: 5. — Jensen 1995: 61, fig. 110.

Diagnosis. Rostrum short, triangular, about as long as lateral projections of carapace. Eyestalk moderately long, slender, not dilated; ocular scale 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, slender, its width less than 0.3 times width of palm of larger chela. Dactyls of pereopods 2, 3 thin, setose, with spinules; longer than propodi.Telson with transverse suture, terminal margins oblique, each with series of moderately strong teeth. Uropods asymmetrical. Carapace length 26 mm.

Color in life. Reddish-brown, with whitish spots, bands. Major chela mostly white except for small blue dots; carpus reddish with whitish border on inner surface. Pereopods 2, 3 banded with cream or tan, with faint darker brown stripes. Eyestalk mostly orange, with whitish band at base. The color notes are from a crab from Blue Cavern Point, Santa Catalina I. California).

Habitat and depth. Rocks, kelp beds and sand near rocks, 10–106 m.

Range. Santa Catalina I., California to Galapagos Is. Type locality Catalina Harbor, Santa Catalina I., California.

Remarks. This is a very common species along the offshore islands of southern California. The large major chela tightly seals the opening of the shell when the hermit crab withdraws into it. The shell may be heavily encrusted by bryozoans.

Pylopagurus Milne-Edwards & Bouvier, 1893

Pylopagurus holmesi Schmitt, 1921

(Fig. 41 B)

Pylopagurus holmesi Schmitt, 1921: 144, fig. 94. — Walton 1954: 141, pl. 39. — McLaughlin 1981: 3. — McLaughlin & Lemaitre 2001: 459, figs. 7–9.
Pylopagurus longicarpus Walton, 1954: 144, pl. 40. — McLaughlin 1981: 3.

Diagnosis. Rostrum narrow, triangular, acute, reaching beyond middle of ocular scale, much longer than lateral projections of carapace. Eyestalk 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, wide. Minor cheliped with hand narrow, rounded, fingers slightly gaping. Pereopods 2, 3 with dactyls slightly longer than propodus, strongly compressed, spinulous. Telson symmetrical, with notch in terminal margin; strong, curving flattened tooth at each end of notch. Anterior blades of uropods 2 twice size of posterior pair, both setose. Carapace length 7.5 mm.

Color in life. Not reported.

Habitat and depth. Usually among sand or sand and shell, rarely among rocks, 18–55 m.

Range. San Miguel I., California to Pacific coast of Baja California; Gulf of California from Lobos Point to Inner Gorda Banks. Type locality near Catalina Harbor, Santa Catalina I., California.

Remarks. This species usually inhabits shells of *Dentalium* spp. or tubes formed by the colonial bryozoan *Antropora tincta* (Hastings, 1930).

Family Parapaguridae Smith, 1882

As in species 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 left pereopod 3. Species of this family are found from the continental shelf down to the abyssal plains. Typically, the dactyls of the pereopods are elongated. Parapagurids may carry sea anemones or zoanthids on their shells.

Oncopagurus Lemaitre, 1996

Oncopagurus haigae (de Saint Laurent, 1972)
(Fig. 46O, P)

Parapagurus haigae de Saint Laurent, 1972a: 115, figs. 9, 17. — Wicksten 1980: 362; 1987: 55; 1989b: 314.
Sympagurus haigae. — Lemaitre 1989: 37.
Oncopagurus haigae. — Lemaitre 1996: 194. — Hendrickx & Harvey 1999: 373.

Diagnosis. Rostrum a low rounded prominence, barely surpassing low lateral projections of carapace. Ocular scales ending in single point. Eyestalk short, 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. Pereopods 2, 3 with dactyls curved. Carapace length not reported.

Color in life. Not reported. Preserved specimens were pale.

Habitat and depth. Rocks, sand or mud; continental shelf, slope, 185–224 m.

Range. Off San Miguel I., California to Gulf of Panama including Gulf of California. Type locality off Santa Cruz I., California (*Velero III* sta. 993-39). The type locality given in the original description, "Golfe de Californie", is incorrect, although the species has been collected near Cape San Lucas.

Parapagurus Smith, 1879

Parapagurus benedicti de Saint Laurent, 1972
(Fig. 46Q)

Parapagurus pilosimanus benedicti de Saint Laurent, 1972a: 103, pl. 1, fig. 6. — McLaughlin 1974: 372, figs. 100, 101 (extensive synonymy). — Wicksten 1980c: 364; 1982: 245; 1989b: 314. — Hart 1982: 108, fig. 38.
Parapagurus pilosimanus. — Haig 1955: 1. — Makarov 1962: 212, fig. 747. — Pereyra & Alton 1972: 450.
Parapagurus benedicti. — Lemaitre 1989b: 11. — Hendrickx & Harvey 1999: 373.

Diagnosis. Rostrum rounded, slightly longer than lateral projections of carapace. Ocular scale usually bifid but sometimes with 1–3 points. Eyestalk slender, elongate, cornea slightly wider than eyestalk. 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, fingers more elongate in proportion to chela than in major chela. Pereopods 2, 3 slender, dactyls almost as long as propodus, 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. The color notes are from a crab collected off southern California.

Habitat and depth. Muddy sea floor of continental slope, 750–1902 m.

Range. Alaska to Chile. Type locality off Point Sur Light, Monterey County, California.

INFRAORDER BRACHYURA LATREILLE, 1802

A straight, symmetrical abdomen, not used in swimming, characterizes brachyuran crabs. In most brachyurans (and in all of those in 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 laterally. The third maxillipeds are broad and often from a cover over the oral field. Pereopod 1 forms a strong cheliped, often with distinctive teeth. The antennae are relatively short in most species. Pereopod 5 is not developed into cleaning brushes or shell-holding appendages as in the Anomura. Consult Garth & Abbott (1980) for good accounts of the natural history of many near-shore and intertidal species.

Recent comparative genetic studies and examination of the genital apparatus in brachyurans have led to different interpretations of the higher classification of brachyurans into sections, tribes or superfamilies. Guinot (1977, 1978) conducted a major reconsideration of the sections, incorporating the location of the genital openings into classification and stressing the importance of the male copulatory structures. She and most other authors have considered the brachyurans to constitute a monophyletic group. Spears *et al.* (1992), based on a molecular analysis, and Rice (1980) suggested that features of the larval development tended to link some of the "primitive" brachyurans, such as the dromiids, with the Anomura. Ng *et al*. (2008) summarized new evidence for the Brachyura as a monophyletic group and provided an extensive new description of the group. They also provided morphological and genetic evidence for the arrangement of families into superfamilies and attempted to place them in a sound phylogenetic order. These major works contain further information regarding classification to superfamilies and families.

The key to the families is artificial and based on characters readily visible in species that occur in the area. Family names follow Ng *et al*. (2008). For the sake of uniformity with other sections of the text, I have omitted the names of sections, tribes or subfamilies.

Benedict (1892b: 224) reported a specimen of *Telmessus cheiragonus* (Tilesius, 1815: 347, pl. 7, fig. 1) (Atelecyclidae), from "Port Townsend, Oregon", but Port Townsend actually is in the state of Washington. Kuris *et al*. (2007: 653) reported *Telmessus cheiragonus* as being "northern, subtidal, rarely low intertidal" in California and Oregon but did not document the source of this information. Schmitt (1921: 235) reported this species from "California", but he quoted a report by Holmes (1900: 70) of the crab from "upper California." Holmes mentioned that there was a specimen of this species at the museum of the University of California. (This specimen has been lost). He noted that the label said that it came from the "Gulf of California", but "possibly this is wrong as this species appears to be a northern one." Rathbun (1930: 152) quoted Stimpson (1857b) in saying that the species was collected "off northern California."

Stimpson (1857b: 465) (as *Cheirogonus hippocarcinoides*) said of the species that it "was found on the coast of Upper California by Dr. Le Conte." John Le Conte was a noted naturalist who studied some of the beetles collected during the United States Exploring Expedition (Watson 1985). In 1841, that expedition made collections in Puget Sound south to the mouth of the Columbia River, and visited San Francisco Bay. John Le Conte was not a member of the expedition, nor did he collect on the west coast of North America, but he may have sent specimens to Stimpson. Stimpson and others complained that specimens from the Expedition had no labels and their catalog records were lost or in error. The boundary between "Oregon Territory" and "Upper California" was poorly defined

in 1841. It is possible that both the collector and the location of Stimpson's specimen from "California" (presumably lost in the Chicago Fire of 1871) were in error.

Key to families of Brachyura

1. Fifth pereopods conspicuously smaller than anterior legs, subdorsal, dactyls with hooks or spines, capable of gripping objects. Male, 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. Eye not retractile into orbits. Third maxilliped slender, not rectangular or triangular, not forming cover over oral field . . . . . Homolidae
– Carapace without pair longitudinal suture lines. Eye at least partially retractile into orbits. Third maxilliped rectangular or triangular, forming cover over oral fields 3
3. Oral field square. Carapace inflated. In life, carrying piece of shell, sponge or ascidian over dorsal surface of body, usually concealing entire animal when seen in dorsal view . . . . . Dromiidae
– Oral field triangular. Carapace flat. In life, carrying piece of shell or sponge over dorsal surface of body but often partially visible when seen in dorsal view . . . . . Cyclodorippidae
4. Oral field triangular. Outgoing branchial channels opening at middle of endostome. Often into living on or buried in sandy substrates 5
– Oral field square to oval. Outgoing branchial channels opening laterally. Living on various substrates 6
5. Chelipeds folding flat against body, dactyl or chelipeds at right angle to palm . . . . . Calappidae
– Chelipeds not folding flat against body, dactyl of chelipeds extending horizontally from palm . . . . . 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 12
7. Chelipeds projecting laterally, fingers deflexed. Carapace, posterior pereopods without hooked setae. Carapace triangular . . . . . Parthenopidae
– Chelipeds not projecting laterally, fingers not deflexed. Carapace, posterior pereopods with hooked setae, at least in juveniles. Carapace pear-shaped, squarish to rounded but not triangular 8
8. Eye without orbits; ocular peduncles long, either non-retractile or retractile against sides of carapace or against acute postorbital spine. Basal antennal article extremely long, slender 9
– Eye with incomplete or commencing orbits. Basal antennal article not extremely long 10
9. Lateral edges of carapace set in groove of gill chamber walls, with external part visible as pleural plates. First pleonite joined to carapace. Carapace pubescent, especially in small individuals . . . . . Inachoididae
– Lateral edges of carapace not set in groove of gill chamber walls, without external part visible as pleural plates. First pleonite not joined to carapace. Carapace not pubescent . . . . . Inachidae
10. Male abdomen terminally broadened, seventh segment subquadrate, inserted deeply into sixth segment. Inhabiting continental shelf, slope or subtidal north of Monterey Bay, California . . . . . Oregoniidae
– Male abdomen not terminally broadened, seventh segment subtriangular, not inserted deeply into sixth segment. Intertidal or deeper, with ranges extending south of Monterey Bay, California 11
11. Eyestalk either concealed by supraocular spine or sunk in sides of rostrum. Usually found among algae . . . . . Epialtidae
– Eyestalk with commencing orbits having, in addition to supraocular spine, large cupped postocular process into which eye retracts. Usually found among rocks, sponges or mixed habitats . . . . . Pisidae
12. Front of carapace with 3 teeth, one of these medial; antennules folding longitudinally. Carapace broadly oval, with 9–11 lateral teeth . . . . . 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 13
13. Fifth pereopods ending in flattened dactyls, usually forming swimming paddles; carapace with 5 or more sharp lateral teeth . . . . . Portunidae
– Fifth pereopods not ending in flattened dactyls, not forming swimming paddles; carapace with or without lateral teeth. 14
14. Ocular peduncles elongate, folding horizontally against front of cephalothorax. Carapace rectangular, front narrow . . . . . Ocypodidae
– Ocular peduncles short, folding into sockets. Carapace rectangular or not, front usually wide 15
15. Last pair of walking legs short, at most slightly longer than merus of preceding leg; often subdorsal 16
– Last pair of walking legs only slightly shorter than entire length of anterior leg, always lateral 17
16. Eyes very large. Carapace broadly transverse, anterolateral margins dentate. Not symbiotic, well calcified . . . . . Palicidae
– Eyes small. Carapace round to subcylindrical, anterolateral margins without teeth. Usually symbiotic with larger invertebrates, sometimes poorly calcified . . . . . Pinnotheridae
17. Carpus of third maxilliped not articulating at or near anterointernal angle of merus, lateral margins of mouth frame parallel to extremely convergent. Carapace square to trapezoidal, intertidal zone or living on floating debris or sea turtles. 18
– Carpus of third maxilliped not articulating at or near antero-internal angle of merus, lateral margins of oral frame parallel to divergent. Carapace square to oval, intertidal to subtidal zones 19
18. Lower margin of orbit oriented downward toward buccal cavity, not distantly supplemented by suborbital crest. Intertidal or pelagic on sea turtles or floating debris . . . . . Grapsidae
– Lower margin of orbit not oriented downward toward buccal cavity, distantly supplemented by suborbital crest. Intertidal to

shallow subtidal, not pelagic . . . . . Varunidae
19. Carapace, appendages set with coarse setae . . . . . Pilumnidae
– Carapace, appendages not set with coarse setae 20
20. Male first gonopod apex having numerous complex folds. Carapace more or less squarish to pentagonal, usually with no more than 3 lateral teeth; if 5 teeth, posterior ones smaller than anterior 3 teeth . . . . . Panopeidae
– Male first gonopod with simple apex. Carapace usually more or less oval, usually with 4–9 lateral teeth . . . . . Xanthidae

SUPERFAMILY HOMOLOIDEA De Haan, 1839

Family Homolidae de Haan, 1839

Homolid crabs, sometimes called carrier crabs, range from the lower subtidal zone down into abyssal depths. Their characteristic subdorsal legs are used to carry objects over the posterior part of the carapace. Only one species lives off California and northern Mexico.

Moloha Barnard, 1947

Moloha faxoni (Schmitt, 1921)

(Fig. 47A)

Homola faxoni Schmitt, 1921: 184, pl. 31, fig. 7.
Paromola faxoni. — Rathbun 1937: 68, pl. 18, pl. 19, fig. 1. — Guinot & Richer de Forges 1981: 536. — Wicksten 1985: 476. — Kuck & Martin 1994: 177, figs. 1–4.
Mohola faxoni.—Guinot & Richer de Forges 1995: 383, fig. 33 c, d, g, h. — Hendrickx 1997: 33, fig. 41.

Diagnosis (after Kuck & Martin 1994). Carapace some what 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 in line with their base, spines on hepatic, gastric, branchial regions; tubercles on much of carapace. Distinct pair of suture lines (linea homolica) on carapace. Antennal flagellum relatively long. Eye exposed, without orbit. Third maxillipeds slender, not covering oral field. Chelipeds long, slender, setose; fingers with dark apices. Pereopods 2–4 slender, with sharp spine on dorsal margin of merus, dactyl long, slender. Pereopod 5 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. Male carapace length to 83.3 mm, female to 59.3 mm.

Color in life. Brown, golden brown or brick red. The color notes are from crabs collected off southern California.

Habitat and depth. Continental shelf, 18–460 m.

Range. Tajiguas, Santa Barbara County, California to Cedros I., Baja California; San Jose I., Gulf of California. Type locality off Point Loma, California.

Remarks. The crab may carry a piece of gorgonian or sponge in its fifth pereopods (Wicksten 1985).

SUPERFAMILY DROMIOIDEA De Haan, 1833

Family Dromiidae de Haan, 1833

The sponge crabs use their subdorsal posterior pereopods to carry pieces of sponges, ascidians or shells, concealing their entire bodies. The crabs cut pieces of sponge or ascidian, and then tumble over to fit the body against the interior of the "cap." Only one species has been reported from California. Many species are nocturnal.

Cryptodromiopsis Borradaile, 1903

Cryptodromiopsis sarraburei (Rathbun, 1910)
(Fig. 47B)

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. — Kerstich 1989: 244.
Dromidia segnipes Weymouth, 1910: 15, pl. 1, figs. 1, 2.
Cryptodromiopsis larraburei. — McLay 1993: 187. — Hendrickx 1997: 17, fig. 33.
Cryptodromiopsis sarraburei. — Boyko 1998: 234.

Diagnosis. Carapace setose, rounded, inflated, longer than wide. Front narrow, with 3 teeth, lateral margins with 4–6 small teeth. Flagellum of antenna long; eye, antennules retractile into common orbito-antennary pits. Third maxilliped more or less square to rectangular, covering oral field. Chelipeds short, stout; fingers gaping at base. Pereopods 2, 3 with curved dactyls; pereopod 4 narrow, subdorsal, with curved dactyl; pereopod 5 short, subdorsal, with spiny dactyl folding against spine of propodus. Female genital openings coxal. Abdominal somite 6 with uropods plates. Male carapace width 15 mm, female 28 mm.

Color in life. Pale brown to gray, apices of chelae red (color photo by Kerstich 1989).

Habitat and depth. Rocks or 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.

SUPERFAMILY CYCLODORIPPOIDEA Ortmann, 1892b

Family Cyclodorippidae Ortmann, 1892b
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 family Cyclodorippidae

1. Frontal lobes ending in pronounced cylindrical blunt spines, carapace distinctly granulate . . . . . *Deilocerus decorus*
– Frontal lobes ending in blunt teeth, carapace minutely granulate to smooth . . . . . *Deilocerus planus*

Deilocerus Tavares, 1993

Deilocerus decorus (Rathbun, 1933)
(Fig. 47C, D)

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.

Diagnosis. Carapace rounded, about as long as wide, granulate; frontal lobes ending in cylindrical blunt spines separated by triangular sinus, orbit with triangular notch above, outer subacute spine. Lateral margin with two prominent teeth. Flagellum of antenna short, peduncle with tubercle. Eye short, without true orbit. Third maxillipeds elongate. Chelipeds stout, excurrent branchial openings near their bases; carpus with two lobes on outer margin, one at inner angle; large tooth at proximal outer margin of propodus, another at articulation with dactyl. Pereopods 2, 3 long and slender; merus, carpus spinulous on margins; dactyls long, simple. Pereopods 4, 5 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, female genital openings coxal. Carapace length 6 mm.

Color in life. Not reported.

Habitat and depth. Among broken shells, 70–185 m.

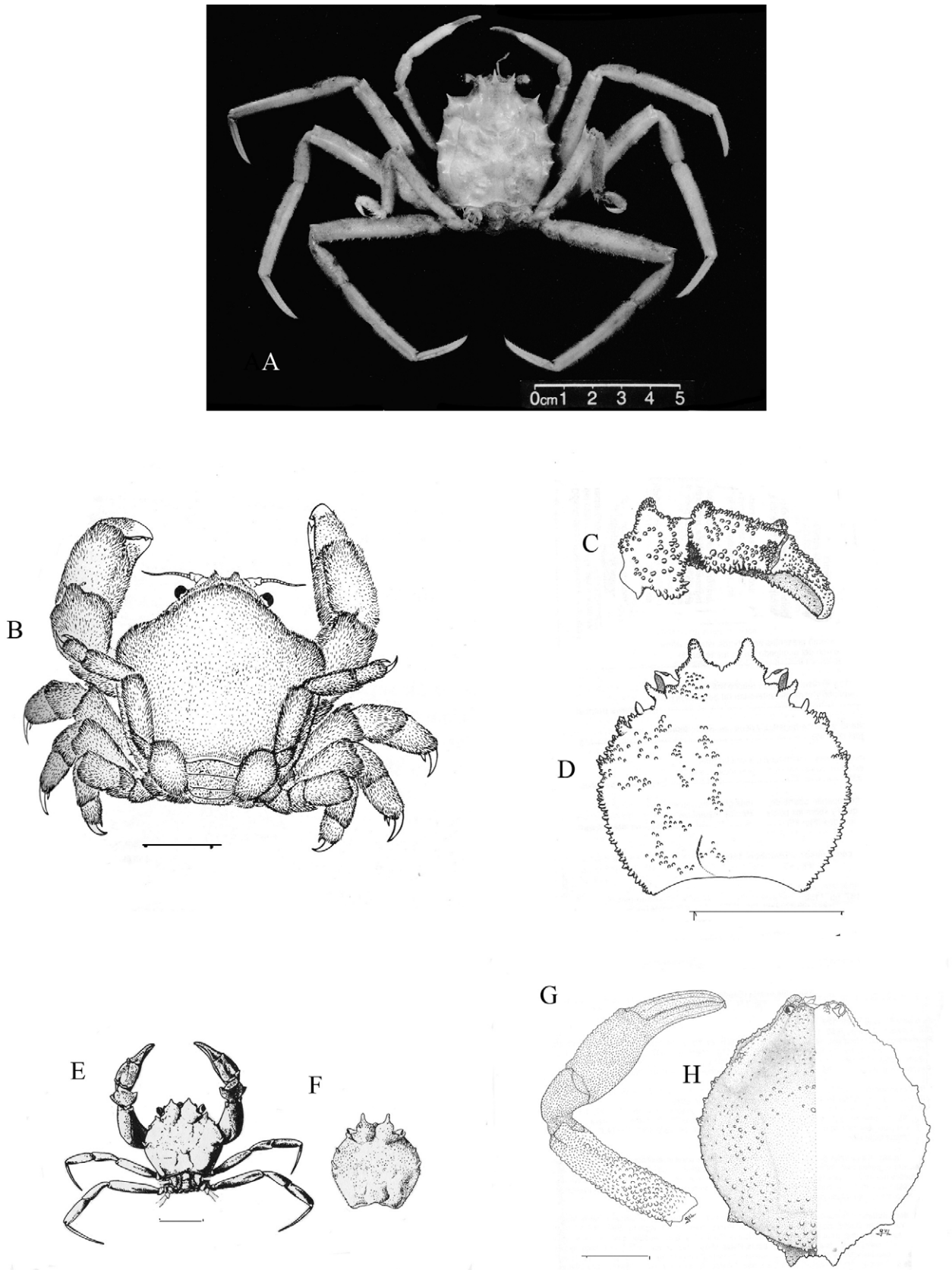

FIGURE 47. Families Homolidae, Dromiidae, Cyclodorippidae and Leucosiidae. A, *Moloha faxoni* (Schmitt, 1921). B, *Cryptodromiopsis sarraburei* (Rathbun, 1910). C, D, *Deilocerus decorus* (Rathbun, 1933); C, cheliped; D, carapace; E, F, *Deilocerus planus* (Rathbun, 1900); E, dorsal view (pereopods 4, 5 missing); F, carapace. G, H, *Randallia ornata* (Randall, 1839); G, cheliped; H, carapace. Scales: E, F = 2 mm; C, D = 4 mm; B, G, H = 10 mm; A in cm. A from Kuck & Martin 1994, as *Paromola faxoni*, B from Brusca 1980, C, D from Rathbun 1937 (as *Clythrocerus decorus*); E, F from Schmitt 1921 (as *Clythrocerus planus*); G, H from Hendrickx 1997.

Range. Off Soberanes Point, Monterey County, California to off Point Loma, California; north of Angel de la Guardia I. and south of Tiburon I., Gulf of California, Mexico. Type locality off Brockway Point, Santa Rosa I., California.

Remarks. One was observed to carry a sponge in its hind legs (Wicksten 1988).

Deilocerus planus (Rathbun, 1900)

(Fig. 47E, F)

Cyclodorippe plana Rathbun, 1900: 519. — Schmitt 1921: 186, fig. 115.
Clythrocerus planus. — Rathbun 1904: 168, pl. 9, fig. 4; 1937: 114, text fig. 29, pl. 34, figs. 1 2. — Wicksten 1980c: 361; 1982: 306.
Deilocerus planus. — Tavares 1993: 140. — Hendrickx 1997: 43, fig. 47.

Diagnosis. Similar to *D. decorus* except frontal lobes ending in blunt teeth, carapace minutely granulate to smooth. Male carapace length 3.4 mm, female 2.8 mm.

Color in life. Pale-dark gray to whitish. The color notes are from crabs from Catalina I.

Habitat and depth. Among broken shells, 20–60 m.

Range. Santa Catalina I., California to Gulf of California. Type locality "southern California at Catalina Harbor (probably)" [*sic*] (Rathbun 1937).

Remarks. These small crabs carry pieces of shell, pebbles, sticks, or algae over their carapaces by means of the specialized hind legs (Wicksten 1982). 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.

SUPERFAMILY CALAPPOIDEA De Haan, 1833

Family Calappidae H. Milne-Edwards, 1837

Although the Calappidae and related families are well represented in tropical seas, only one species occurs in the Californian and Oregonian provinces. 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.

Platymera H. Milne-Edwards, 1837

Platymera gaudichaudii H. Milne-Edwards, 1837

(Pl. 10D)

Platymera gaudichaudii H. Milne-Edwards, 1837: 108. — Holmes 1900: 99. — Rathbun 1904: 170. — Galil 1993: 371. — Hendrickx 1997: 101, fig. 77 (extensive synonymy).— Kuris *et al*. 2007: 640, pl. 319, fig. K.
Mursia gaudichaudii. — Weymouth 1910: 19. — Schmitt 1921: 190. — Rathbun 1937: 220, pl. 66, figs. 1–3. — Garth 1957: 16. — Haig & Wicksten 1975: 102. — Hart 1982: 173, fig. 68.

Diagnosis. Carapace convex, front narrow, lateral margins edged by about 15 small teeth, very large lateral spine. Eye not completely retractile into orbit. Third maxillipeds not completely covering mouth field. Chelipeds strong, chelae proper armed with teeth, ridges bearing tubercles, fingers at right angle to palm, bearing teeth; cheliped folding flat against frontal part of cephalothorax. Pereopods 2–5 lateral, similar, decreasing in size from anterior to posterior, with sharp dactyls. Abdomen concealed under cephalothorax. Male genital openings coxal, female sternal. Male carapace width 162.5 mm, female 71.8 mm.

Color in life. Carapace with light olive gray background, covered with orange to red to overall brick red with cream tubercles. Chelae dull gray with red shading to brick red, lower surface pale yellow to whitish. Pereopods 2–5 pale olive gray with purple spots to overall reddish, lower parts, apices of dactyls whitish to cream. The color notes are from crabs taken off Newport Beach, California.

Habitat and depth. Sand or mud, 48–402 m, rarely cast ashore.

Range. Off Englefield Bay, Queen Charlotte Is. and SW of La Pérouse Bank, British Columbia, to Talcahuano, Chile. Type locality "coast of Chile."

SUPERFAMILY LEUCOSIOIDEA Samouelle, 1819

Family Leucosiidae Samouelle, 1819

The purse crabs burrow in sand, leaving only the front of the carapace, eye, antennae and a respiratory channel exposed. Members of the superfamily are diverse in tropical and warm-temperate waters elsewhere in the world, but only one species occurs in California.

Randallia Stimpson, 1857

Randallia ornata (Randall, 1840)

(Fig. 47G, H, Pl. 10G)

Ilia ornata Randall, 1840: 129.

Randallia ornata. — Stimpson 1857b: 471, pl. 19, fig. 3. — Holmes 1900: 100. — Rathbun 1904: 170; 1937: 172, pl. 49, figs. 1 2. — Weymouth 1910: 18, pl. 1, fig. 3. — Schmitt 1921: 188, fig. 11. — Johnson & Snook 1927: 363, fig. 314 — Ricketts *et al*. 1985: 321, fig. 247. — Jensen 1995: 34, fig. 52. — Hendrickx 1997: 163, fig. 114 (extensive synonymy). — Kuris *et al*. 2007: 640, pl. 319, fig. J.

Randallia angelica Garth, 1940: 54, pl. 11, figs. 1, 2.

Diagnosis. 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, narrow; with concave anterior margin, eye set into margin. Third maxillipeds triangular, long. Cheliped long and subcylindrical; hand, fingers narrow, fingers acute. Pereopods 2–5 similar, with simple dactyls. Male, female genital openings sternal. Male carapace width 53.2 mm, female 34.9 mm.

Color in life. Carapace cream marked with reddish to purple spots, patches; chelipeds, legs cream; chelipeds with red-purple bars, blotches; legs with prominent red to purple bands on merus. The color notes are from crabs taken at San Pedro, California.

Habitat and depth. Sand, lowest intertidal zone to 94 m. The crab often buries itself leaving only the front exposed.

Range. Mendocino County, California to Magdalena Bay, Baja California; northern Gulf of California between Isla Angel de la Guardia, Point Willard, Tiburon I. and Cape Tepoca, Sonora. Type locality "California" (perhaps Monterey, where some of Randall's specimens were collected).

Remarks. Weymouth (1910), Schmitt (1921), and Rathbun (1937) reported *Randallia bulligera* Rathbun, 1898 from San Diego, California.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: 160) treated it as a distinct species, usually ranging from Baja California, Mexico to Peru.

SUPERFAMILY MAJOIDEA Samouelle, 1819

Until recently, all of the spider crabs were included in one family, the Majidae. Garth (1958) placed the genera that occur in the entire eastern Pacific Ocean into seven subfamilies, three of which do not occur in the area of coverage. Drach & Guinot (1983) and Hendrickx (1995c, 1999) elevated the existing eastern Pacific subfamilies (as presented by Garth) to family status, and added another family, the Inachoididae. I have followed this family arrangement in the text that follows. Martin & Davis (2001) listed seven families under the superfamily Majoidea, but did not elevate Garth's subfamily Oregoniinae to family status. Ng *et al*. (2008) and Ng *et al*. (2009) considered the family Pisidae to be poorly defined but included it as a subfamily, the Pisinae, of the Epialtidae. In a molecular analysis, Hultgren & Stachowitz (2008) found good support for the family Oregoniidae and Inachidae but a "close

phylogenetic association" between the Epialtidae and Pisidae. However, their analysis was limited to only 36 species, mostly common and shallow water inhabitants of the north Pacific. The species of the epialtoids and pisids in the Californian-Oregonian region are distinct in morphology and habitat, and therefore are considered here to be separate families.

The spider crabs are common 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 pereopods 2–5 usually are relatively long in comparison with the body. A rostrum usually 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. 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 (Wicksten 1993).

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 the sea otter *Enhydra lutris* (Linneaeus, 1758); large fishes including *Anarrichthys ocellatus* Ayres, 1855; and *Scorpaenichthys marmoratus* (Ayres, 1854); large cancroid crabs 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 males' chelipeds often are longer than those of females, and the chelae often are heavier, broader and brightly colored on the interior surface. Adult females have slender chelipeds and rounded bodies. The decorating habit often is lost in adult males.

The definitive work on spider crabs of the eastern Pacific is that of Garth (1958). Extensive synonymies and detailed information on anatomy and distribution can be found in this work.

Family Epialtidae MacLeay, 1838

Commonly called kelp crabs, these crabs generally are found among algae.

Key to species of family Epialtidae

1. Five free abdominal segments in both sexes. Rostrum with shallow apical notch. Carapace nearly smooth, with broad hepatic, branchial lobes . . . . . *Epialtoides hiltoni*
– Seven free abdominal segments in both sexes. Rostrum bifid. Carapace smooth or with tubercles, with or without lobes 2
2. Antennae not visible at sides of rostrum in dorsal view. Carapace broadly oval, smooth . . . . . *Taliepus nuttallii*
– Antennae visible at sides of rostrum in dorsal view. Carapace varying in shape, smooth or with tubercles 3
3. Carapace with broad lateral expansions, leaf-like branchial expansion overlapping hepatic region dorsally . . *Mimulus foliatus*
– Carapace without broad lateral expansions, expansions inwardly separated 4
4. With smaller secondary spine between postorbital, hepatic spines at slightly lower level. South of Point Conception to northern Mexico . . . . . *Pugettia venetiae*
– Without smaller secondary spine between postorbital, hepatic spines at slightly lower level. May range north of Point Conception 5
5. Hepatic projection a transverse spine not joined with postorbital spine by lateral expansion of carapace. Postorbital projection consisting of ovate lobe directed forward . . . . . *Pugettia dalli*
– Hepatic projection a triangular tooth, joined completely or incompletely with postorbital spine by lateral expansion of carapace. No such ovate lobe. 6
6. Carapace smooth, sides subparallel. No constriction between hepatic, branchial tooth . . . . . *Pugettia producta*
– Carapace tuberculate, sides not subparallel. Constriction between hepatic, branchial tooth 7
7. Tubercles of carapace uneven in size. Hepatic tooth broadly joined to postorbital, its outer margin trending toward longitudinal . . . . . *Pugettia gracilis*
– Tubercles of carapace even in size. Hepatic tooth deeply separated from postorbital, its outer margin trending toward transverse . . . . . *Pugettia richii*

Epialtoides Garth, 1958

Epialtoides hiltoni (Rathbun, 1923)
(Fig. 49A, B)

Epialtus bituberculatus Rathbun, 1894: 67 (part). — Schmitt 1921: 203 (not text fig. 126). [Not *Epialtus bituberculatus* Milne-Edwards, 1834, western Atlantic species].
Epialtus hiltoni Rathbun, 1923: 72; 1925: 156, pl. 46, figs. 1 2; text figs. 53 m, n.
Epialtoides hiltoni. — Garth 1958: 234, pl. O, fig. 7; pl. 26, fig. 33. — Garth & Abbott 1980: 597, fig. 25.2. — Jensen 1995: 25, fig. 25.—Hendrickx 1999: 93, fig. 53.

Diagnosis. Rostrum oblong, apex 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 chelipeds of moderate size, merus bluntly angled, carpus, 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, manus foreshortened. Pereopods 2–5 rather stout, 2 tubercles on lower margin of merus of first leg, dactyls with spinules. Male, female with 5 free abdominal segments. Male carapace length 17.3 mm, width 15.7 mm; female 10.7 mm, width 9.6 mm.

Color in life. Camouflaged like brown algae; brown, olive, mottled with dark brown or cream. The color notes are from crabs from Santa Catalina I.

Habitat and depth. Among low-growing algae, in kelp holdfasts of among surf grasses (*Phyllospadix* spp.), intertidal zone to 5 m.

Range. Santa Catalina I., 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 render it inconspicuous.

Mimulus Stimpson, 1860

Mimulus foliatus Stimpson, 1860
(Fig. 49C, Pl. 12A)

Mimulus foliatus Stimpson, 1860: 200, pl. 5. — Holmes 1900: 23. — Rathbun 1904: 173; 1925: 182, pl. 60, text figs. 70 71 — Weymouth 1910:30, pl. 4, figs. 12, 13. — Schmitt 1921: 204, fig. 127a,b. —Johnson & Snook 1927: 368, fig. 320 .— Garth 1958: 183, pl. L, fig. 1; pl. 25, fig. 3. — Garth & Abbott 1980: 600, fig. 25.8. —Hart 1982: 182, fig. 72. — Ricketts *et al*. 1985: 170, fig. 138. — Jensen 1995: 26, fig. 29. — Kuris *et al.* 2007: 641, pl. 319, fig. H.— Hultgren & Stachowitz 2008: 994.

Diagnosis. 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, leaf-like expansions divided by narrow fissure. Hooked setae present on median region of small crabs. Preorbital tooth large, triangular, acute; postorbital tooth small, pointing obliquely downward. Peduncle of antennae reaching to or near rostrum apex. Male cheliped large, merus rough, carpus with ridge on inner margin, hand with fingers bent downward, 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. Pereopod 2 longer than following pereopods. Propodus of pereopods 2–5 with setose tooth near middle of inferior margin. Male, female abdomens with seven free segments. Male carapace length 23.4 mm, width 39 mm; female carapace length 19.3 mm, width 32.4 mm.

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 or orange. Male cheliped reddish or white with red fingers. Pereopods 2–5 reddish with white bands. The color notes are from crabs from Monterey Bay, California.

Habitat and depth. 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 crab often is found among coralline algae and kelp holdfasts.

Hultgren & Stachowitz (2008), in a molecular analysis, noted that *M. foliatus* nested in a clade with *Pugettia* spp. and is morphologically and ecologically similar to other *Pugettia* species. They noted that Rathbun (1894) also suggested that there was not good reason for placing *Mimulus* in a genus distinct from *Pugettia*. They suggested that *M. foliatus* be reclassified as a member of the genus *Pugettia* but did not formally change the designation of this crab.

Pugettia Dana, 1851

Pugettia dalli Rathbun, 1894
(Fig. 48C)

Pugettia dalli Rathbun, 1894: 232; 1904: 173, pl. 2, figs. 1, 1a; 1925: 178, pl. 59, figs. 1–4, text fig. 67. — Holmes 1900: 26. — Johnson & Snook 1927: 369, fig. 322. — Garth 1958: 199, pl. L, fig. 6, pl. 21, fig. 1. — Jensen 1995: 22, fig. 18. — Hendrickx 1999: 107, fig. 62.

Diagnosis. Rostral horns slender, divergent. Carapace subtriangular, more rounded in females than males; with hooked setae, covered with small prominences. Large tubercle on cardiac region, intestinal region, each protogastric lobe; female with swollen gastric region. Lateral carapace margin with slender hepatic spine; stout, 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, irregular ridge on margins, carpus with strong ridge above, 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. Pereopods 2–5 slender, pereopods 2 as long as or longer than chelipeds, remaining legs shorter, margins fringed with coarse setae. Male carapace length 18.0 mm, width 13.8 mm; female 14.6 mm, width 10.3 mm.

Color in life. Reddish to brown, similar to algae. The color notes are from crabs from Redondo Beach, California.

Habitat and depth. Among algae, sea grasses; open coasts and harbors, intertidal zone to 118 m but usually at less than 50 m.

Range. San Miguel I., California to Thurloe Bay, Baja California. Type locality "Southern California" (possibly Catalina Harbor, Santa Catalina I., based on records of 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 gracilis Dana, 1851
(Fig. 48A)

Pugettia gracilis Dana, 1851. — Holmes 1900: 25. — Rathbun 1904: 173; 1925: 172, pl. 58, text figs. 64,65. — Weymouth 1910: 29, pl. 4, fig. 10. — Schmitt 1921: 206, pl. 33, fig. 7, text figs. 128a, b. — Johnson & Snook 1927: 368, fig. 322. — Garth 1958: 196, pl. L, fig. 4, pl. 20, fig. 2. — Garth & Abbott 1980: 598, fig. 25.5. — Hart 1982: 186, fig. 74. — Ricketts *et al.* 1985: 298. — Jensen 1995: 23, fig. 15. — Kuris *et al.* 2007: 641.

Diagnosis. Rostrum deeply notched, outer margins of rostral horns subparallel. Carapace oval, with 2 gastric, one cardiac, one intestinal tubercles; tuft of setae preceding each tubercle, hooked setae on rostrum, sides of carapace. Lateral projections of carapace broad, anterior one large, wing-like; posterior projection smaller with anterior end lobiform, posterior end spiniform. Hepatic tooth broad, completely joined to postorbital tooth. Basal article of antennae bearing tooth at anteroexternal angle, flagellum not reaching end of rostrum. Chelipeds large, strong; merus triangular, with superior crest bearing 3 or more teeth; carpus with 2 longitudinal crests, propodus with

superior crest, inferior margin with prominent posterior lobe; male chela with fingers widely gaping, large tooth near base of dactylus; female fingers not gaping. Pereopods 2–5 stout, with small tubercles, dactyls with sharp apices. Male carapace length 35.5 mm, width 26.5 mm; female carapace length 33.5 mm, width 25.0 mm.

Color in life. Greenish brown, yellow or reddish, ventral side lighter (Garth 1958).

Habitat and depth. Docks, pilings, among rocks, algae, eel grass beds; intertidal zone to 140 m.

Range. Attu I., Aleutian Is. 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 producta* (Randall, 1840)**

(Fig. 48D, Pl. 12B, C)

Epialtus productus Randall, 1840: 110. — Holmes 1900: 22. — Rathbun 1904: 17. — Weymouth 1910: 28, fig.93. — Schmitt 1921: 201, text fig. 124. — Johnson & Snook 1927: 367, fig. 318.

Pugettia producta. — Rathbun 1925: 167, pls. 56–57, text figs. 62, 633. — Garth 1958: 188, pl. L, fig. 2, pl. 19. — Garth & Abbott 1980: 598, fig. 25.4. — Mastro 1981: 64. — Hart 1982: 184, fig. 73. — Wicksten & Bostick 1983: 364. — Ricketts *et al*. 1985: 134, fig. 106. — Jensen 1995: 22, fig. 16. — Hendrickx 1999: 110, pl. 2B. — Kuris *et al*. 2007: 641.

Diagnosis. 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, posterior margin; posterior margin with strong convexity in middle. Newly-settled crabs bearing tufts coarse setae on lateral margins of carapace. Small preorbital, postorbital tooth. Male chelipeds stout, shorter than pereopods 2, carpus with outer ridge, hand long, narrow but inflated in largest individuals; fingers slender, bent downward, curved inward; inner margins dentate, gaping in largest males; female cheliped more slender. Pereopods 2–5 decreasing in length posteriorly, dactyls slender, with spinules. Male carapace length 71 mm, width 62 mm; female 69 mm, width 59 mm.

Color in life. Camouflaged like algae; light olive-green to almost black. Ventral surface yellowish in juveniles, females; brilliant red in mature males. Color may depend on age, nearness to next molt and uptake of pigments from algal food. The color notes are from crabs from Pillar Point, San Mateo County, California.

Habitat and depth. Wharves, docks, pilings, kelp beds, tide pools, eel grass flats, and beds of brown algae (especially *Egregia* spp.); intertidal zone to 74 m, but usually shallow and near shore.

Range. Prince of Wales I., 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 (Mastro 1981). Kelp crabs may move from place to place during the year to feed on algae or mate.

***Pugettia richii* Dana, 1851**

(Fig. 48B)

Pugettia richii Dana 1851: 268. — Holmes 1900: 24. — Rathbun 1904: 173; 1925: 176, text fig. 66. — Weymouth 1910: 30, pl. 4, fig. 11. — Schmitt 1921: 207, pl. 33, fig. 6, text fig. 129. — Johnson & Snook 1927: figs. 322, 324. — Garth & Abbott 1980: 599, fig. 25.6. — Hart 1982: 188, fig. 75. — Jensen 1995: 22, fig. 17. — Hendrickx 1999: 111, pl. 2C. — Kuris *et al*. 2007: 641.

Pugettia richi.—Garth 1958: 193, pl. L, fig. 3, pl. 20, fig. 1.

Diagnosis. Rostrum with long horns, deep notch, 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, one somewhat anterior to them; rows of hooked setae near lateral tubercles, cardiac, intestinal regions with tubercle each, 2 tubercles on branchial region, posterior margin of carapace markedly convex. Supraorbital tooth acute, directed forward; postorbital tooth acute, triangular; large, slender tooth posterior to postorbital tooth, prominent pointed tubercle on posterolateral margin of carapace, spine on subbranchial region, pterygostomian region with 3-6 small teeth. Flagella of antennae visible near rostrum. Male chelipeds larger, more robust than those of female;

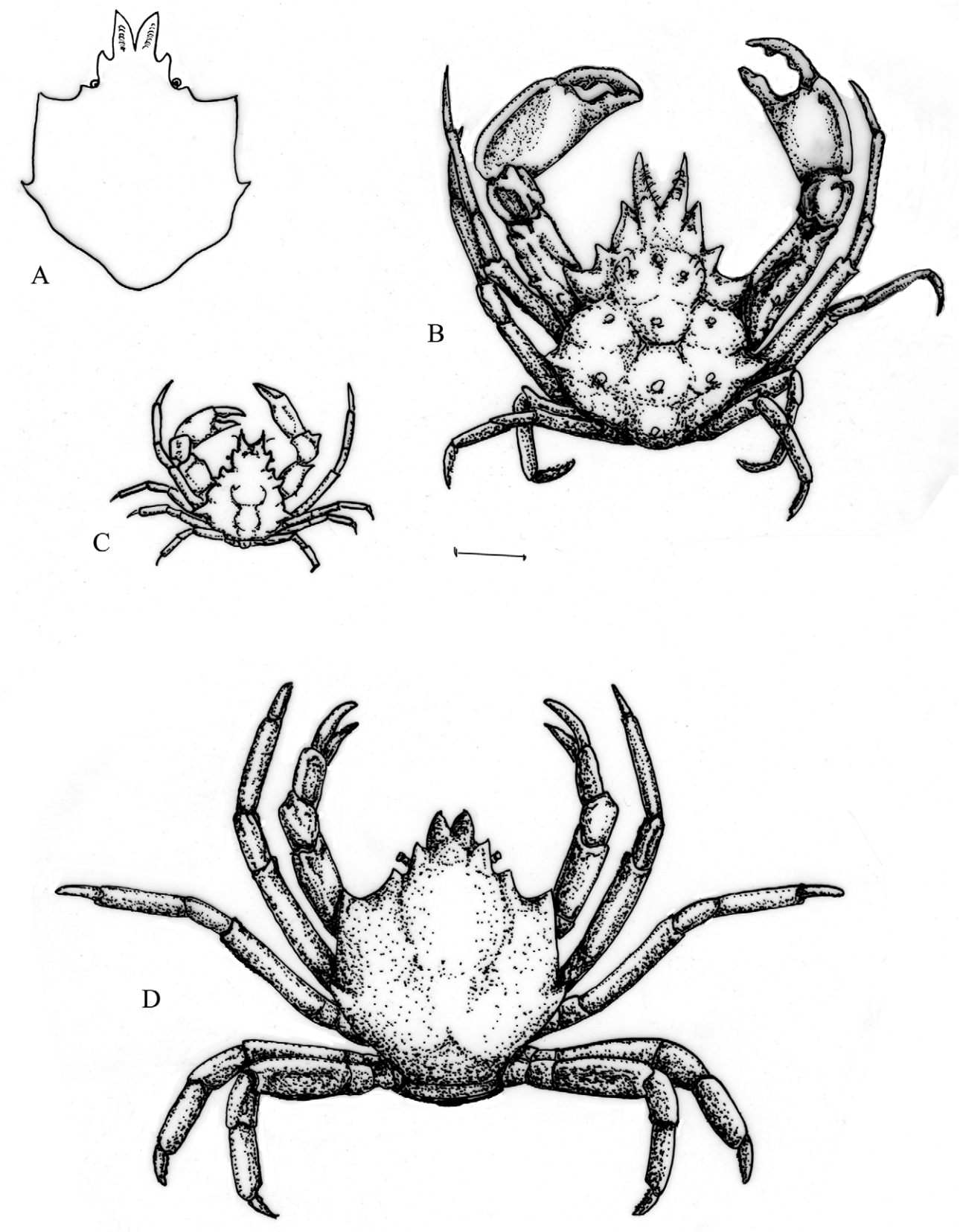

FIGURE 48. Family Epialtidae. A, *Pugettia gracilis* Dana, 1851; carapace. B, *Pugettia richii* Dana, 1851; adult male. C, *Pugettia dalli* Rathbun, 1893. D, *Pugettia producta* (Randall, 1839); juvenile. Scale =10 mm. A, after Garth, 1958; B, drawn from crab from Monterey Bay; C, drawn from crab from Santa Catalina I.; D, drawn from crab from Princeton, San Mateo County.

merus with tubercles, ridge along inner side in adult; carpus with 2 or 3 ridges, especially in adult, hands compressed, fingers gaping in adult. Female chelipeds more slender, fingers not gaping. Pereopods 2–5 subcylindrical, dactyls sharp. Male carapace length 44 mm, width 36 mm; female 33 mm, width 26.5 mm.

Color in life. Bright to dark red, matching red algae. Pereopods 2–5 banded with dark red, tan. The color notes are from crabs from Monterey Bay, California.

Habitat and depth. Tide pools, docks, pilings, among algae or sea grasses; intertidal zone to 98 m but usually in shallow areas near shore.

Range. Prince of Wales I., Alaska to San Geronimo I. and Asuncion Bay, Baja California. Type locality "California", possibly San Diego or San Francisco, from which Dana received specimens.

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 venetiae Rathbun, 1924

(Fig. 49D, E)

Pugettia venetiae Rathbun, 1924: 2; 1925: 180, pl. 59, figs. 57, text figs. 68, 69. — Garth 1958: 204, pl. L, fig. 5, pl. 21, fig. 2. — Hendrickx 1999: 113, fig. 66.

Diagnosis. Rostral horns long, acute, divergent. Carapace tuberculate, spinous; with 4 gastric, 2 lateral, one cardiac, 3 intestinal, 4 or 5 branchial tubercles, one branchial, 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 antero-external spine, 2 smaller spines. Male chelipeds about as long as carapace, ischium with spine on inner margin, merus with spines on inner, upper, outer margins; carpus with 2 spines on inner margin, 4 on outer margins, palm with spinules on upper surface, fingers narrow, deflexed, toothed, narrow gape at base. Female cheliped shorter, similar, fingers not gaping. Pereopods 2–5 subcylindrical, dactyls with two rows sharp spinules. Much of dorsal surface of both sexes setose. Male carapace length 16.2 mm, width 10.7 mm; female length 23.9 mm, width 17.3 mm.

Color in life. Rostrum, frontal region, chelae dull orange. Carapace gray-tawny brown with white, lavender marks. Fingers of chela purple-brown at base, becoming orange-red, fading to white at apices. Pereopods 2–5 brownish orange, banded. Ventral surface dull lilac on abdomen, orange on front (Garth 1958).

Habitat and depth. Sand, shell, rock, 9–120 m, usually at 90 m or less.

Range. San Miguel I., 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.

Taliepus A. Milne-Edwards, 1878

Taliepus nuttallii (Randall, 1840)

(Fig.49 F, Pl. 10 F)

Epialtus nuttallii Randall, 1840: 109. — Holmes 1900: 23. — Rathbun 1904: 173. — Schmitt 1921: 202, text fig. 125. — Johnson & Snook 1927: 367, fig. 319.

Taliepus nuttallii. — Rathbun 1925: 162, pls. 50, 51; text fig. 61. — Garth & Abbott 1980: 597, fig. 25.3. — Ricketts *et al*. 1985: 136. — Jensen 1995: 24, fig. 24.

Taliepus nuttalli. — Garth 1958: 208, pl. L, fig. 8; pl. 22. — Hendrickx 1999: 117, pl. 2D, 3A, B.

Diagnosis. 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. Male cheliped stout, unarmed, fingers gaping, margins of fingers with row of low teeth; female cheliped more slender, fingers not gaping. Pereopods 2–5 stout, subcylindrical, dactyls strongly curved, with 2 rows of spinules on dactyls. Seven free abdominal segments in both sexes. Male carapace length 106 mm, carapace width 92 mm; female approximately half this size.

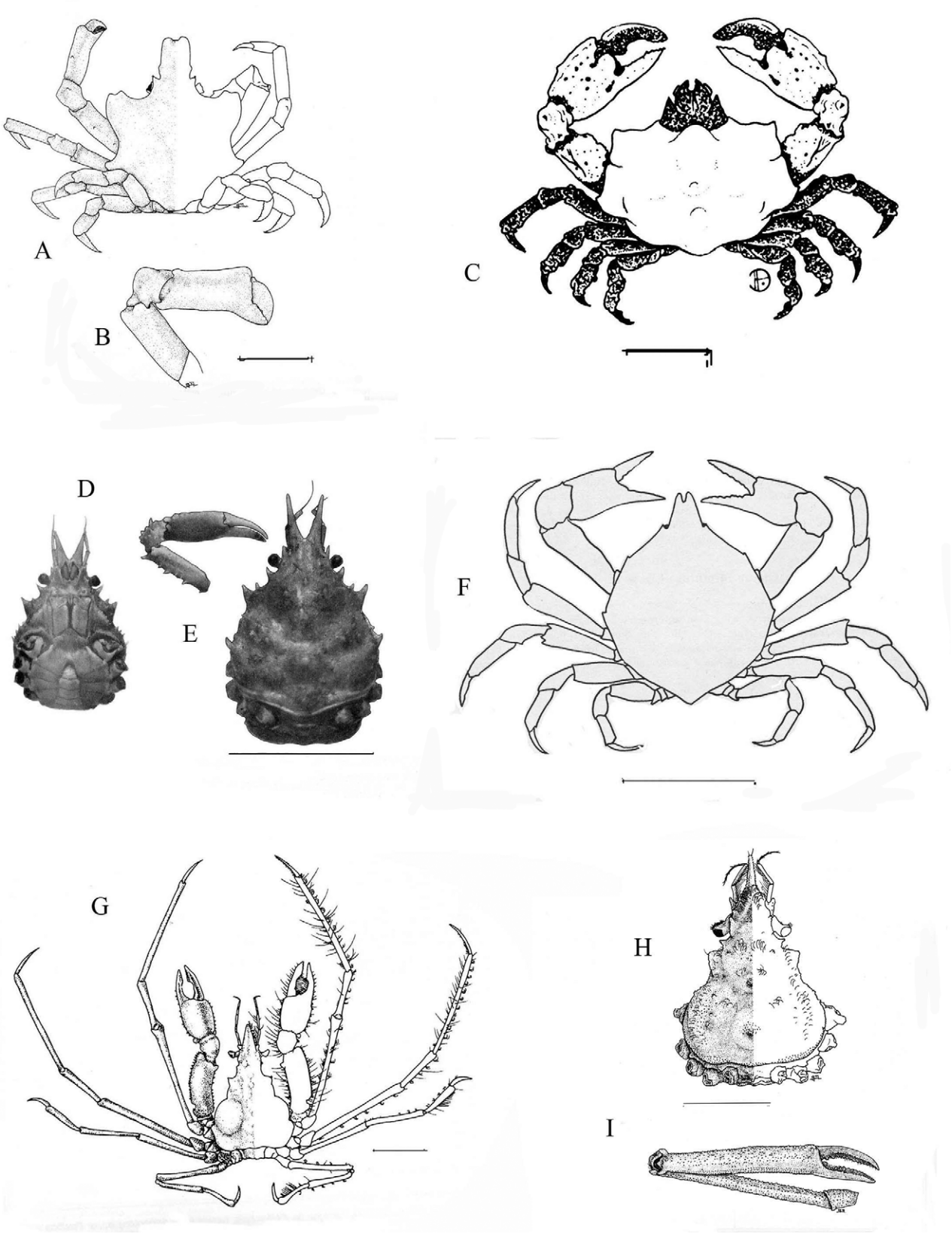

FIGURE 49. Families Epialtidae and Inachidae. A, B, *Epialtoides hiltoni* (Rathbun, 1923); A, dorsal view; B, cheliped. C, *Mimulus foliatus* Stimpson, 1860; adult male. D, E, *Pugettia venetiae* Rathbun, 1924; D, ventral view; E, dorsal view of cephalothorax with detached cheliped. F, *Taliepus nuttalli* (Randall, 1839). G, *Ericerodes hemphilii* (Lockington, 1877); adult male. H, I, *Erileptus spinosus* Rathbun, 1893; H, dorsal view of cephalothorax; I, cheliped. Scales: A= 5mm; C–E, G–I = 10 mm. F = 60 mm. A, B, H, I from Hendrickx 1999; C from Wicksten 1983c, D, E from Rathbun 1925, F, G from Schmitt 1921.

Color in life. Juvenile camouflaged like algae, olive-green to reddish; adults red-brown to dark purple. The color notes are from crabs from Point Fermin, Los Angeles County, California.

Habitat and depth. Rocky shores, kelp beds, especially among brown algae, intertidal to 92 m, but usually less than 50 m.

Range. Santa Barbara, California to Magdalena Bay, Baja California. Type locality "Upper California."

Family Inachidae MacLeay, 1838

Only three species of these, the most spider-like of the spider crabs, are regularly reported from the area. Coelho (2006) revised species of the genus *Podochela* and changed the generic classification of one local species. The Panamic arrow crab, *Stenorhynchus debilis* (Smith, 1871), was reported from Huntington Beach and Santa Catalina I. in 1998, during an El Niño period and might be expected to return again during periods of unusually warm waters (Montagne & Cadien 2001).

Key to species of family Inachidae

1. Merus of outer maxilliped as broad as ischium, palp of moderate size. Carapace with supraocular spine, surface spinous. Leg span rarely more than 30 mm, found on shell hash, gravel or coarse sand. . . . . *Erileptus spinosus*
– Merus of outer maxilliped narrower than ischium, palp large. Carapace without supraocular spine, surface with tubercles. Leg span often more than 30 mm, usually found on pilings, among algae or on rocks 2
2. Only one tubercle on first abdominal segment. No strap-shaped hepatic spine . . . . . *Ericerodes hemphilli*
– Two tubercles on first abdominal segment. Strap-shaped hepatic spine. . . . . *Podochela lobifrons*

Ericerodes Rathbun, 1897

Ericerodes hemphilli (Lockington, 1877)

(Fig. 49G, Pl.11)

Microrhynchus hemphillii Lockington, 1877a: 30.
Podochela hemphillii. — Holmes, 1900: 17. — Rathbun 1904: 1717, pl. 10, fig. 2; 1925: 49, pl. 18, pl. 209, fig. 2. — Weymouth 1910: 26, pl. 2, fig. 6. — Schmitt 1921: 195, text fig. 120.
Podochela hemphilli. — Garth 1958: 104, pl. H, fig. 6, pl. 7. — Ricketts *et al.* 1985: 420. — Jensen 1995: 25, fig. 26. — Hendrickx 1999: 28, fig. 15. — Kuris *et al*. 2007: 641.
Ericerodes hemphilli. — Coelho 2006: 7.

Diagnosis. Rostrum broad to acutely triangular, variable in length, ending in spine, with hooked setae. Carapace pyriform; gastric region prominent, rounded, bearing hooked setae; hepatic regions bearing 2 pointed tubercles; cardiac region separated by shallow grooves from branchial, 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. Eyestalk constricted at middle. Basal antennal article with longitudinal ridge on posterior 0.5–0.66 with groove on either side. Male with robust chelipeds, merus incurved, 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. Pereopods 2–5 long, slender, furnished with hooked setae, dactyls slender, curved. Abdomen of male six-segmented, narrow; female abdomen with five segments, rounded; female sternum, ventral surface of abdomen concave. Male carapace length 34 mm, width 22.4 mm; 18.5 mm, width 11.5 mm.

Color in life. Dorsal surface of carapace pale olive buff with band of carmine along each side, two patches of carmine on cardiac region, two smaller patches on intestinal region. Chelipeds yellowish cream. Pereopods 2–5 marked with carmine. Lower body surface creamy white (Garth 1958).

Habitat and depth. 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 I., Gulf of California to Cape Corrientes, Colombia. Rarely reported north of San Miguel I., California. Type locality San Diego Bay, California.

Remarks. *Ericerodes hemphilli* frequently is covered by algae, hydroids or bryozoans which may be attached perpendicular to the axis of pereopods 2–5. The crab may store edible material among the hooked setae and then remove and eat it later.

Erileptus Rathbun, 1893

Erileptus spinosus Rathbun, 1893
(Fig. 49 H, I)

Erileptus spinosus Rathbun, 1893: 227. — Holmes 1900: 21. — Rathbun 1904: 171, pl. 10, fig. 1; 1925: 68, pls. 212, 213, text fig. 18. — Weymouth 1919: 27, pl. 3, fig. 7. — Garth 1958: 91, pl. E, fig. 8, pl. 5, fig. 2. — Wicksten 1980c: 361. —Jensen 1995: 26, fig. 28. — Hendrickx 1999: 12, fig. 5.
Anasimus spinosus.—Schmitt 1921: 196, text figs. 121a, b.

Diagnosis. Rostrum strongly sexually dimorphic. Male with slender, spinulous rostrum, about 0.5 times length of postfrontal portion of carapace. Carapace spinulous: 2 spines on median line, one long spine on branchial region with small spine in front of it, 2 on margin; spine on margin of hepatic region, 2 very small ones arranged transversely on gastric region; slender spine on orbital arch. Prominent supraorbital spine, postorbital spine small, distant from eye. Abdomen with spine on segment 1. Chelipeds nearly 3 times as long as carapace, granulate; merus with one spine at anterior margin, hand slender, slightly flattened vertically, fingers gaping. Pereopods 2–5 slender, decreasing regularly in length from anterior to posterior. Female with slender, upcurved, spinulous rostrum. Carapace with 2 median spines, 2 spines on each branchial region, spine on each protogastric region, lateral margins spinulous, surface pubescent. Prominent suprorbital spine. Abdomen with spine on segment 1, smaller spine on segment 2. Chelipeds weak, margins of merus spinulous, slender spine near carpus, hand slender, granulous, fingers in contact. Pereopods 2–5 slender, pubescent, decreasing in length from anterior to posterior. Dactyls of pereopods 2–5 slender, spinulous in both sexes. Male carapace length 11 mm, female 5.7 mm

Color in life. Dull brown to grayish. The color notes are from crabs taken at Santa Catalina I.

Habitat and depth. Usually shelly sand, often in steeply sloping areas, 4–554 m.

Range. San Miguel I., California to Magdelana Bay, Baja California; Gulf of California from Rocky Point, Sonora south to Cardones I., Panama. Type locality off San Diego, California.

Remarks. This small crab is especially common on "shell hash" bottoms along the islands of southern California.

Podochela Stimpson, 1860

Podochela lobifrons Rathbun, 1893
(Fig. 50A, B)

Podochela (*Coryrhynchus*) *lobifrons* Rathbun, 1893: 226.
Podochela lobifrons. — Garth 1958: 116, pl. H, fig. 1; pl. 8, fig. 1. — Hendrickx 1999: 34, fig. 19.
Podochela barbarensis Rathbun,1924: 1; 1925: 54, pl. 20, figs. 3, 4, text fig. 13.

Diagnosis. Rostrum long, slender, 0.5–0.6 postrostral carapace length. Carapace setose, cardiac region with large conical elevation, 2 median gastric tubercles, prominent strap-shaped spine on hepatic region, small, similar one on pterygostomian ridge, small postorbital spine, orbital arch finely spinulous. Antenna overreaching rostrum, movable articles of penduncle slender, basal article with spinulous outer margin. Two blunt median tubercles on abdomonal segment 1. Chelipeds spinulous, 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. Pereopod 2 as much as 3 times carapace length, very slender, with slender dactyl. Pereopods 3–5 with curved dactyls. Male carapace length 21.5 mm, female 18.3 mm.

Color in life. Brown, chelipeds banded with red, fingers of the chelae mostly cream with patches of red. The color is based on a crab photographed in the La Jolla Submarine Canyon, San Diego County, California.

Habitat and depth. Sand, rocks, among alge, 2–230 m.

Range. Point Mugu, California to San Cristobal Bay, Baja California; Angel de la Guardia I. to outer Gorda Bank, Gulf of California. Type locality off Abreojos Point, Baja California.

Remarks. In southern California, *P. lobifrons* usually occurs deeper than *E. hemphilli*. Freshly caught crabs often are coated with mud, foraminiferans and debris.

According to the revision of the species of *Podochela* by Coelho (2006), it seems that this species should be transferred to the genus *Coryrhynchus* Kingsley, 1879, but the species is not mentioned in this work. Rathbun (1893) used *Coryrhynchus* as a subgenus without explanation. Specimens should be examined to determine if a change in the generic designation is warranted.

Family Inachoididae Dana, 1851

Members of the family Inachoididae live on sand, mud or pilings in harbors. Although proposed as a distinct family by Dana (1851), the group had been considered as part of the family Majidae until a revision by Drach & Guinot (1983) provided evidence to support their differentiation from other majoid families. Inachoidids have the lateral edges of the carapace set in a groove of the pleural (gill chamber) walls, with the external part visible as pleural plates. The first pleonite (abdominal segment 1) is jointed to the carapace. The pereopods are relatively long and slender. There are nine genera of this family along both coasts of the Americas, but only one species is reported from Oregon to northern Baja California.

Pyromaia Stimpson, 1871

Pyromaia tuberculata tuberculata (Lockington, 1877)

(Fig. 50C, D)

Inachus tuberculatus Lockington, 1877: 30.

Dasygius tuberculatus. — Holmes 1900: 27. — Rathbun 1904: 172, pl. 10, figs. 3, 3a, text fig. 92. — Weymouth 1910: 27, pl. 3, fig. 8.

Inachoides tuberculatus. — Schmitt 1921: 199, text figs. 123a. — Johnson & Snook 1927: 365, fig. 317.

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. — Ricketts *et al*. 1985: 334.—Jensen 1995: 25, fig. 27. — Hendrickx 1999: 75, fig. 42 (extensive synonymy). — Lemaitre *et al*. 2001: 771. — Kuris *et al*. 2007: 641.

Pyromaia tuberculata tuberculata. — Garth & Abbott 1980: 597, fig. 25.1.

Diagnosis. Rostrum acute, apices 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, tuberculate, with fine pubescence, especially in small individuals. Male chelipeds short, stout, granulate; chela inflated, fingers nearly as long as palm, gaping at base; female chelipeds more slender, margins of hand parallel, fingers slightly gaping. Pereopods 2–5 slender, similar, diminishing in length from anterior to posterior, dactyls moderately curved, almost smooth. Male carapace length 15.7 mm, carapace width 12.3 mm, female not reported.

Color in life. Dull green-brown, ventral surface dirty white. The color notes are from a crab from Princeton Harbor, San Mateo County, California.

Habitat and depth. Pilings, sandy bottoms, sand, shell, among seaweeds, extreme low intertidal zone to 415 m.

Range. Tomales Bay, California to Cape Corrientes, western Colombia. Introduced into Japan, New Zealand, and Australia (Lemaitre *et al*. 2001). 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 may associate with the sea star *Pisaster brevispinus* (Stimpson, 1857). Garth (1958) recognized two subspecies, *P. tuberculata mexicana* and *P. tuberculata tuberculata*. The typical subspecies is the one present in the area of coverage. Hendrickx (1990: 79) considered that this division was unjustified.

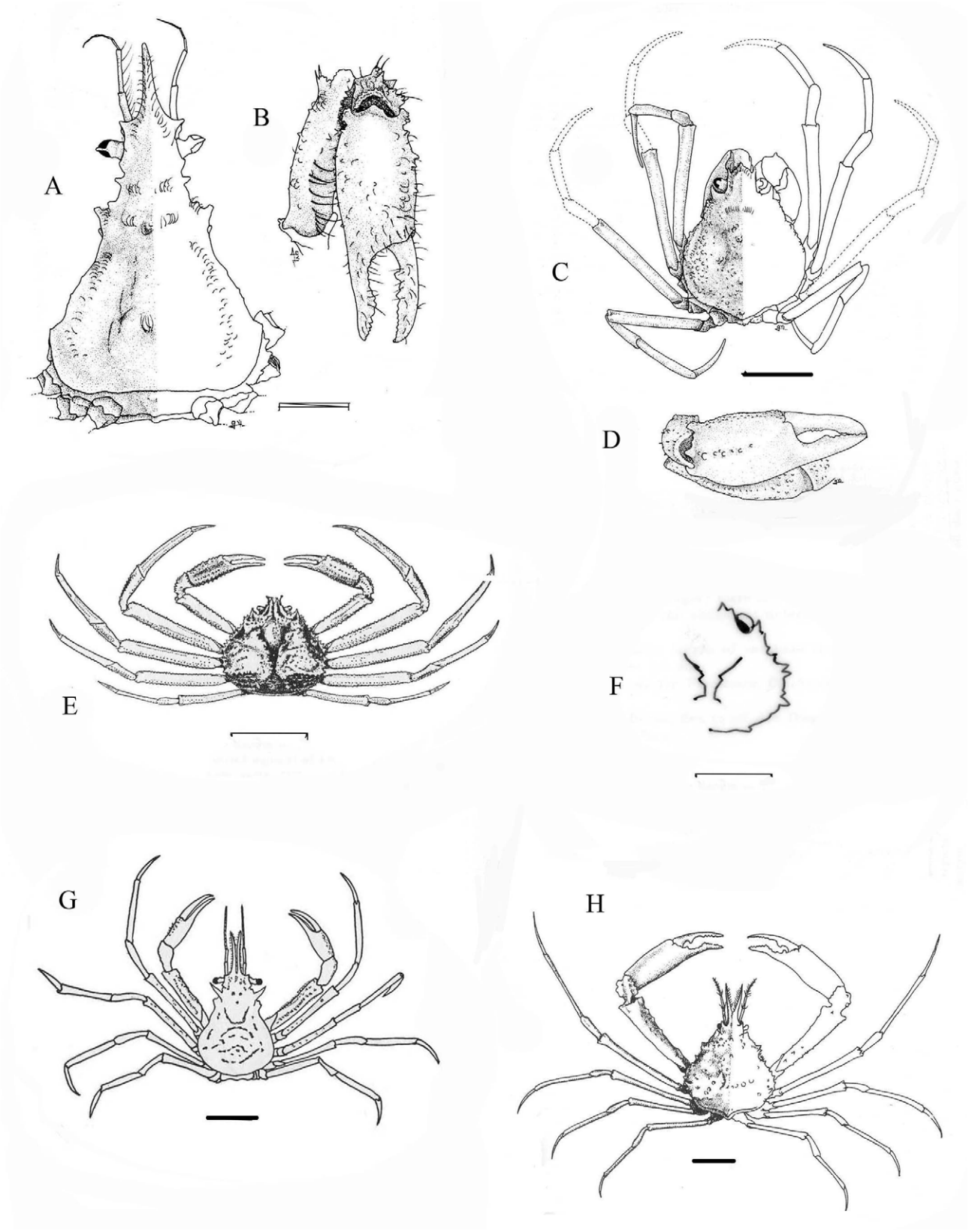

FIGURE 50. Families Inachidae, Inachoididae, Oregoniidae and Pisidae. A, B, *Podochela lobifrons* Rathbun, 1893; A, cephalothorax in ventral view; B, cheliped. C, D, *Pyromaia tuberculata* (Lockington, 1877); C, dorsal view, D, cheliped. E, *Chionoecetes tanneri* Rathbun, 1893. F, *Chionoecetes angulatus* Rathbun, 1893; dorsal view of right side of carapace. G, *Oregonia gracilis* Dana, 1851; H, *Chorilia longipes* Dana, 1851. Scales: A, B = 5 mm, C, D, G=10 mm, H =20 mm, E, F = 37 mm. A-D from Hendrickx 1999, E, G, H from from Schmitt 1921; F after Garth 1958.

Family Oregoniidae Garth, 1958

Confined to the northern hemisphere, oregoniids inhabit cold temperate, boreal and deep-sea environments. Barry *et al*. (1996: 1746) reported *Chionoecetes bairdi* Rathbun, 1924 from the Monterey Submarine Canyon. This species has not been reported previously from anywhere south of Washington. If this identification is correct, this record constitutes a significant southern range extension for the species. Garth (1958: pl. 15) and Jensen (1995: fig. 11) illustrated this species.

Key to species of family Oregoniidae

1. Carapace longer than broad, rostrum elongate . . . . . *Oregonia gracilis*
– Carapace either broader than long, or very little longer than broad; rostrum short 2
2. Interspace between branchial regions of carapace deep. Two small subequal spines at curve made by intersection of two dorsal branchial ridges . . . . . *Chionoecetes tanneri*
– Interspace between branchial regions of carapace shallow. Large spine at angle made by intersection of two dorsal branchial ridges . . . . . *Chionoecetes angulatus*

***Chionoecetes* Kröyer, 1838**

***Chionoecetes angulatus* Rathbun, 1924**

(Fig. 50F)

Chionoecetes angulatus Rathbun, 1894: 76 (part). — Rathbun 1925: 247, pls. 90, 91. — Garth 1958: 159, pl. I, fig. 7; pl. 16, fig. 1.

Chionoecetes tanneri. — Rathbun 1894: 76 (part).

Diagnosis. Rostrum small, teeth wide and inclined upward. Carapace broad, spinulous, pubescent, lateral margins partially concealed by expanded branchial regions; space between branchial regions shallow. Dorsal ridges of branchial region converging in straight lines, meeting in acute angle marked by large spine. Male cheliped longer than that of female; palm inflated, fingers narrow, curved. Pereopods 2–5 flattened, meri little dilated; dactyls long and slender. Male carapace length 24.6 mm, width 23.3 mm; female 26.4 mm, width 24.8 mm.

Color in life. Not reported.

Habitat and depth. Green mud, fine black sand; 90–3000 m but usually on continental slope, depth greater than 200 m.

Range. Bering Sea off Pribilof Is., Alaska to northwest of Cape Blanco, Oregon. Type locality south of Pribilof Is.

***Chionoecetes tanneri* Rathbun, 1894**

(Fig. 50E, Pl. 10E)

Chionoecetes tanneri Rathbun, 1894: 76, pl. 4, figs. 1–4 (part); 1904: 174; 1925: 243, pls. 88, 89, 234. — Holmes 1900: 40. — Weymouth 1910: 35, pl. 7, fig. 19. — Schmitt 1921: 210, text fig. 131. — Garth 1958: 156, pl. I, fig. 8; pl. 16, fig. 2. — Hart 1982: 196, fig. 79. — Hendrickx 1999: 49, pl. 1A, C.

Diagnosis. Rostrum short, 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, directly in front of it, another row of spines forming lateral supramarginal border of branchial region; spines continuing of pterygostomian region, branchial region; irregular row of small spines crossing gastric region. Orbits, outer margin of postorbital teeth, inferolateral, 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, curved. Pereopods 2–5 flattened, armed with spines, dactyls long, flat. Male carapace length 31 mm, width 29 mm; female 31 mm, width 29.1 mm.

Color in life. Bright scarlet, apices of appendages yellow. The color notes are from a crab trapped off San Clemente I., California.

Habitat and depth. 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 Is., Baja California. Type locality Gulf of Farallones, California.

Remarks. The Tanner crab is edible and is the object of a fishery off Oregon. Species of *Chionoecetes* have a relatively thin and flexible exoskeleton in relation to their musculature, which allows easier extraction of their meat than in other spider crabs.

Oregonia Dana, 1851

Oregonia gracilis Dana, 1851
(Fig. 50G)

Oregonia gracilis Dana, 1851: 270. — Holmes 1900: 19. — Rathbun 1904: 171; 1925: 71, pls. 24, 25, text figs. 19, 20. — Schmitt 1921: 198, text figs. 122a, b. — Johnson & Snook 1927: 365, fig. 315. — Garth 1958: 136, pl. I, fig. 2, pl. 10, pl. 11, fig. 1. — Hart 1982: 176, fig. 69. — Ricketts *et al*. 1985: 298, 334. — Jensen 1995: 20. — Komai & Yakovlev 2000: 309, fig. 2 (extensive synonymy). — Kuris *et al*. 2007: 641.

Diagnosis. Rostrum with two long, slender contiguous spines, length, shape of rostral spines variable; and rows of hooked setae. Carapace subtriangular, setose, 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 pereopods 2–5, merus subcylindrical, tuberculate; carpus rounded, hand long, slender; fingers slender, smooth, incurved. Pereopods 2–5 cylindrical, decreasing in length posteriorly, dactyls long, tipped by claws. Male carapace length 65.7 mm, width 39 mm; female 27.5–44.6 mm, width 165 mm.

Color in life. Tan or gray, red mark on chela (Garth 1958).

Habitat and depth. Among algae, eel grass and pilings, intertidal zone to 390 m but usually subtidal in California and Oregon.

Range. Off Choshi, Chiba Prefecture, Japan to Comander Is.; Bristol Bay, Bering Sea to Monterey Bay, California; 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. Komai & Yakovlev (2000) noted that there are two morphs of this species, one with long chelipeds and pereopods 2–5 and the other with short chelipeds and pereopods 2–5 but with longitudinal rows of long stiff setae on the propodi of those pereopods. The two morphs occur sympatrically and thus are considered to belong to the same species. These authors also note that there is considerable sexual dimorphism in the species. Females have relatively shorter rostral spines and more dense setae on the dorsal surface of the carapace than do the males, as well as differing in the shape of the abdomen and the chelipeds.

Family Pisidae Dana, 1851

Pisids generally are found on rocky sea floors but *Loxorhynchus* spp. may cross open sand or areas with worm tubes, especially at night. The group includes some of the most heavily decorated of the spider crabs and *Loxorhynchus grandis*, the largest crab in the area. Ng *et al*. (2008: 102) and De Grave *et al*. (2009) considered this group to be a subfamily of the Epialtidae. They noted that either the pisids and epialtids have poorly developed or no orbits, yet commented that "the need to separate obviously related genera...does seem logical." The pisids, if one includes "unusual genera" (Ng *et al*. 2008: 98), seem to be a heterogeneous group. Garth (1958: 249) noted that the shape of the male first pleopod, a diagnostic feature of many brachyuran families, is highly diverse in the pisids. The shape of the first maxilliped, broad basal segment of the antenna and bifurcate rostrum seem to be consistent within the group in the northeastern Pacific (Hendrickx & Cervantes, 2003).

Northeastern Pacific pisids generally are setose, at least as juveniles. Many species possess club-shaped setae on the carapace and pereopods. The carapace has lateral spines and raised knobs, bosses or prominences. Their pereopods are relatively more heavily calcified than those of the inachids.

Key to species of family Pisidae

1. Body, pereopods flattened, legs with small lateral spines. Spine present on orbital margin between supraocular eave and postocular cup . . . . . *Herbstia parvifrons*
– Body, pereopods not flattened, legs with or without spines. No spine on orbital margin between supraocular eave and postocular cup 2
2. Rostrum bifid for not more than half its length. Pereopods 2–5 with broad, flat segments . . . . . *Pelia tumida*
– Rostrum bifid for more than half its length. Pereopods 2–5 with rounded segments 3
3. Rostrum with slender horns. Continental shelf and slope . . . . . *Chorilia longipes*
– Rostrum with broad horns. Intertidal to continental shelf. 4
4. Rostrum flat, horizontal; horns shaped like feathers of arrow . . . . . *Scyra acutifrons*
– Rostrum deflexed; horns not shaped like feathers of arrow 5
5. Carapace with many small spines; 2 spines on hepatic region. Front strongly deflexed. Adult male, female with few setae and without camouflaging material . . . . . *Loxorhynchus grandis*
– Carapace with large tubercles or raised areas; one spine on hepatic region. Front less strongly deflexed. Adult male, female setose, adult male usually with camouflaging material on rostrum only, female covered by material . . . . *Loxorhynchus crispatus*

Chorilia Dana, 1851

Chorilia longipes Dana, 1851

(Fig. 50H, Pl. 12D)

Chorilia longipes Dana, 1851: 269. — Rathbun 1904: 174; 1925: 203, pl. 224, figs. 1–3. — Weymouth 1910: 33, pl. 6, fig. 16. — Schmitt 1921: 209, text fig. 130. — Garth 1958: 263, pl. P, figs 45; pl. 30. — Hart 1982: 180, fig. 71. — Jensen 1995: 2, fig. 19.

Hyastenus (*Chorilia*) *longipes*. — Holmes 1900: 33.

Chorilia longipes turgida Rathbun, 1924: 3. — Garth 1958: 263. — Wicksten 1980c: 363. — Hendrickx 1999: 120, fig. 69, pl. 6A.

Diagnosis. 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 sub-basal tooth, distal ends of fingers meeting. Pereopods 2 about as long as chelipeds, pereopods 3–5 shorter; merus of each with short sharp point; dactyls slender, curved. Male carapace length 50.4 mm, width 30.2 mm; female 54 mm, width 40 mm.

Color in life. White to reddish or dirty brown. The color notes are from crabs from Monterey Bay, California.

Habitat and depth. Among boulders or on mud, 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. Three subspecies are recognized. Of these, *C. longipes japonica* (Miers, 1879) is reported from temperate waters of the western Pacific, in Japan from Tohoku province south to Sagami Bay and the Korean Channel (Sakai 1965). *Chorilia longipes longipes* Dana has a blunt ridge on the hepatic region; *C. longipes turgida* Rathbun has a spine on the hepatic region. *Chorilia longipes longipes* occurs from Alaska to off Santa Catalina I., California; *C. longipes turgida* had 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 (Garth 1958). Water temperatures either were not reported at all or were reported at the surface when most of these crab specimens were collected. It would be useful to perform a more rigorous correlation analysis between the shape of the hepatic protrusion and the water temperature and geographical location of collection. The geographical distribution of the two supposed subspecies overlaps, so they may in fact be ecophenotypes instead of reproductively isolated populations.

Herbstia H. Milne-Edwards, 1834

Herbstia parvifrons Randall, 1840
(Fig. 52A, Pl. 12F)

Herbstia parvifrons Randall, 1840: 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 & Abbott 1980: 602, fig. 25.13. — Jensen 1995: 21, fig. 14. — Hendrickx 1999: 124, pl. 4B, D. — Kuris *et al*. 2007: 641.
Rhodia parvifrons. — Rathbun 1904: 175. — Weymouth 1910: 34, pl. 7, fig. 18.

Diagnosis. Rostral horns short, notch shallow. Carapace ovate, tuberculate, flattened, setose, gastric region with 4 inconspicuous tubercles in transverse row, median tubercle on posterior portion; 3–4 small tubercles on cardiac region, 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, postorbital spines; anterolateral margin of carapace provided with postorbital spine, 5 other spines, several smaller spines above these on posterior margin. Three subhepatic spines, row of 5–6 pterygostomian spinules. First movable segment of antenna short, not reaching rostrum apex. Male cheliped more robust than pereopods 2–5, exceeding length of pereopod 2; female cheliped more slender. Merus with 5 larger spines on superior inner margin, numerous smaller external spines; carpus with 10–11 spinules; hand with 5–6 blunt spines on superoproximal border, male dactyl with ridge in gape, female chela without gape. Pereopods 2–5 elongate, setose; meri with 7–9 spinules on anterior margins; no more than 3 on posterior margins; carpi with single distal spinule; propodi long, unarmed; dactyls spinulous. Male carapace length 33.0 mm, width 30.0; female length 19.5 mm, width 17.1 mm.

Color in life. Tan mottled with dark brown to reddish, legs barred with reddish brown. The color notes are from crabs from Santa Catalina I.

Habitat and depth. 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. Kuris *et al*. (2007) gave the northern range of this species as "Monterey and north" without any records or exact locations. I know of no records of this species from north of Monterey. It is common in rock falls off the islands of southern California.

Holmes (1900) reported *Herbstia camptacantha* (Stimpson, 1871) from San Pedro, San Clemente I. and Santa Catalina I., California, but Garth (1958: 318) determined that these records belong to *H. parvifrons*.

Loxorhynchus Stimpson, 1857

Loxorhynchus crispatus Stimpson, 1857
(Fig. 51A, Pl. 13B, D)

Loxorhynchus crispatus Stimpson, 1857b: 453, pl. 22, figs. 2–4. — Holmes 1900: 30. — Rathbun 1904: 175. — Weymouth 1910: 32, pl. 5, fig. 15. — Schmitt 1921: 213, text figs. 133a b. — Rathbun 1925: 200, pls. 66, 67. — Johnson & Snook 1927: 374, fig. 328. — Garth 1958: 260, pl. P, fig. 3, pl. 27, fig. 2; pl. 28, fig. 1. — Wicksten 1975: 35; 1977b: 122; 1978c: 217; 1979b: 37. — Garth & Abbott 1980: 601, fig. 25.11. — Ricketts *et al*. 1985: 168, fig. 136. — Jensen 1995: 24, fig. 22. — Hendrickx 1999: 140, pl. 5C. — Kuris *et al*. 2007: 641, pl. 320 E.

Diagnosis. Rostrum with more divergent horns than in *L. grandis*, not as deflexed, separated for more than 0.5 length of rostrum, with rows of hooked setae. Carapace somewhat triangular, more rounded in females than males, with few large tubercles: prominent tubercle on cardiac region connected by prominent ridge with tubercle on intestinal region; two tubercles on branchial regions, large tubercle, dome-like prominence on hepatic region; tubercle on anterior, 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, 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. Pereopods 2–5 rather short, with hooked setae; pereopod 2 shorter than chelipeds of adult male but longer in female, merus grooved above, dactyls of all legs short, stout. Male carapace length to 196 mm, width to 140; female 105 mm, width 68 mm. (Largest male exceptionally big for this species).

Color in life. Light brown, freshly-molted individuals with dark bands on legs, fingers of chelae white, with red marks in adult male. The color notes are from crabs from Monterey Bay and San Pedro, California.

Habitat and depth. Rocks, jetties, pilings, kelp beds, rocky reefs, worm tube beds; extreme low tidal zone to 200 m.

Range. Orford Reef, Oregon to Natividad I., Baja California, but rarely found north of San Francisco, California. Type locality San Miguel I., 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 (in one instance in Carmel Bay, with leaves from a tree). The decorating behavior remains in adult females but is lost in mature males, which at most decorate the rostrum. Large adults of both sexes also may bear barnacles, tunicates, tubeworms and other organisms that settle on them in situ.

Loxorhynchus grandis Stimpson, 1857

(Fig. 51B, Pl. 13C)

Loxorhynchus grandis Stimpson, 1857a: 85. — Holmes 1900: 29. — Rathbun 1904: 175. — Weymouth 1910: 31, pl. 5, fig. 14. — Schmitt 1921: text figs. 132a, b. — Rathbun 1925: 198, pls. 64, 65, text fig. 80. — Johnson & Snook 1927: 372, fig. 328. — Garth 1958: 257, pl. P, fig. 2; pl. 29. — Wicksten 1979b: 37. — Garth & Abbott 1980: 600, fig. 25.10. — Jensen 1995: 24, fig. 23. — Hendrickx 1999: 141, pl. 5D. — Hobday & Rumsey 1991: 1. — Kuris *et al*. 2007: 641.

Diagnosis. Rostrum slightly longer than broad, much deflexed, horns convex above, below and separated for more than half their length, with rows of hooked setae except in mature adults. Carapace rounded, inflated, covered with small, conical tubercles which may be worn in mature adults; juveniles with abundant hooked setae. Stout spine on margin of hepatic region, another just below margin. Preorbital spine large, often double pointed; postorbital spine subconical, acute. Basal antennal segment with anteroexternal spine, 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, with narrow fingers in juveniles. Pereopods 2–5 subcylindrical, with few tubercles, propodi with grooves above, dactyls short, stout. Male carapace length 190 mm, width 145 mm; female length 114 mm, width 86 mm.

Color in life. Brown, becoming bluish-gray to chalky white in aging adults; ventral surface white. The color notes are from crabs from San Pedro and Santa Catalina I., California. Stimpson's color notes as given by Garth (1958: 259) surely were of a dead or preserved crab.

Habitat and depth. Rocks, pilings, subtidal sand flats, 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. A dense coat of bryozoans, sponges, algae, hydroids, and pieces of gorgonians or other materials covers their bodies. As the animals grow and mature, the hooked setae are lost or worn off. Mature males and females do not decorate at all.

Divers have seen adult *L. grandis* congregating into mating "pods" in subtidal areas near the Redondo Submarine Canyon and La Jolla. There is a fishery for them in southern California. *Loxorhynchus grandis* is the largest and heaviest crab found in California.

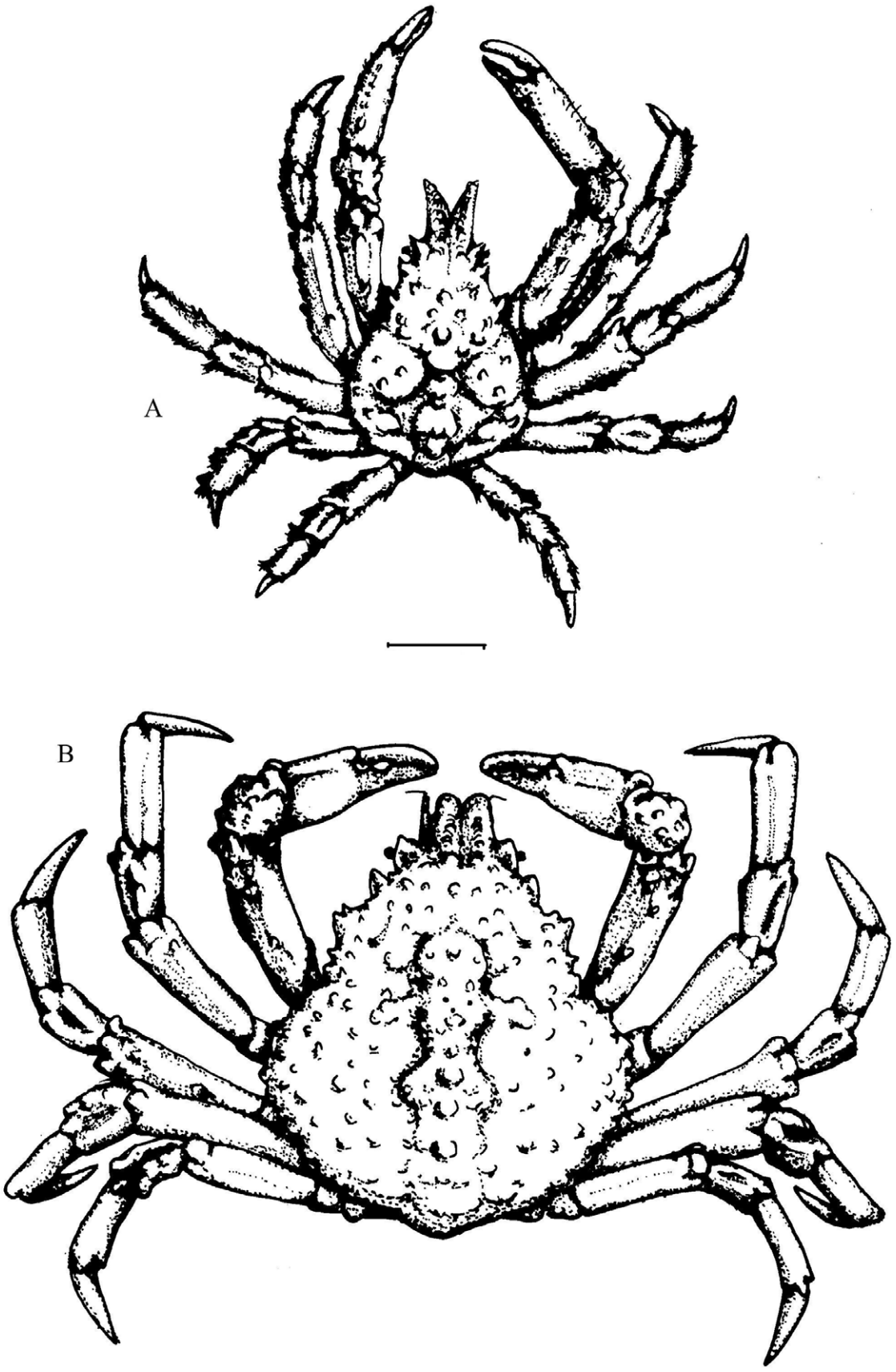

FIGURE 51. Family Pisidae. A, *Loxorhynchus crispatus* subadult. B, *Loxorhynchus grandis* adult female. Scale = 26 mm. A, drawn from crab from Monterey Bay; B, drawn from crab from Santa Catalina I.

Pelia Bell, 1835

Pelia tumida (Lockington, 1877)
(Fig. 52 B,C; Pl. 12E)

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. 23. — Johnson & Snook 1927: 369, figs. 321, 323. — Garth 1958: 271, pl. Q, fig. 1; pl. 31, fig. 2. — Garth & Abbott 1980: 601, fig. 25.12. — Jensen 1995: 23, fig. 21. — Hendrickx 1999: 150, fig. 86, pl. 6C.– Kuris *et al*. 2007: 641.
Pelia clausa Rathbun, 1907: 72. — Schmitt 1921: 211, pl. 34, figs. 1–4.

Diagnosis. Rostrum with shallow notch, rostral horns nearly parallel. Carapace pyriform, pubescent, without spines. Gastric region rounded, 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. Pereopods 2–5 flattened, pubescent, dactyls with sharp, curved apices. Male carapace length 21.2 mm, width 14.5 mm; female 20.5 mm, width 13.0 mm.

Color in life. Carapace buff, tan or orange, chelae white, mottled with brown, chela of adult male bright red, pereopods 2–5 with marks of orange, brown. The color notes are from crabs from San Pedro, California.

Habitat and depth. Rocks, rocky 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. Uncommon north of Point Conception, California.

Remarks. *Pelia tumida* always has an unidentified yellow sponge 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.

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.

Scyra Dana, 1851

Scyra acutifrons Dana, 1851
(Fig. 52D, E; Pl. 13A)

Scyra acutirons Dana, 1851: 269. — Holmes 1900: 41. — Rathbun 1904: 175; 1925: 195, pl. 79; pl. 224, figs. 4 5; text fig. 79. — Weymouth 1910: 33, pl. 6, fig. 17. — Schmitt 1921: 214, text figs. 134a, b. — Johnson & Snook 1927: 374, fig. 329. — Garth 1958: 252, pl. P, fig. 1; pl. 27, fig. 1. — Garth & Abbott 1980: 600, fig. 25.9. — Hart 1982: 190, fig. 76. — Ricketts *et al*. 1985: 169. — Jensen 1995: 21, fig. 13. — Hendrickx 1999: 156, fig. 90, pl. 6D, E. — Kuris *et al*. 2007: 641.

Diagnosis. Rostrum flattened, short, horns shaped like feathers or arrow; rows hooked setae on horns. Carapace pyriform; median region separated from cardiac, branchial regions by conspicuous depression; acute tubercle near center of median region, larger tubercle behind it. Branchial region with felt-like setae, bearing large, projecting tubercle; elevated prominence proximal to tubercle, usually bearing several small tubercles; large tubercle on cardiac region, smaller tubercle on intestinal region. Considerable variation among individuals, between sexes in width of carapace, degree of prominence, 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, somewhat flattened below, bearing pustules; carpus pustulate, ridges on outer side; hand long, narrow, compressed, palm often with inflated ridge; fingers deflexed, in older male, gaping, with tooth near base of dactyl. Pereopods 2–5 subcylindrical, pubescent, propodi bearing groove on either side; dactyls short, rounded at apex. Male carapace length 46.5 mm, width 33.7 mm; female 23.9 mm, width 15.9 mm.

Color in life. Dull tan to gray with red marks on chelipeds, walking legs.

Habitat and depth. Rocks, rocky reefs, pilings; intertidal zone to 114 m but usually less than 50 m. As noted by Kuris *et al.* (2007), the species is rare in the intertidal zone.