The Amphipod Superfamily Corophioidea in the Northeastern Pacific Region. Family Ampithoidae: Systematics and Distributional Ecology

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ABSTRACT

The gammaridean family Ampithoidae of the boreal eastern Pacific coastal region (Alaska to Pt. Conception, California) is examined on a taxonomic, biogeographical and ecological basis. Keyed and described are fifteen species within the genera *Cymadusa* Savigny, *Ampithoe* (Leach, sens. str.) and ***Peramphithoe*** n.gen. This latter genus is erected for all species of *Ampithoe* bearing a transverse first gnathopod. *Ampithoe dalli* Shoemaker is reinstated as a species distinct from *A. simulans* Alderman. ***Ampithoe sectimanus*** n. sp., earlier confused as a variant of *A. pollex* Kunkel and *A. simulans* Alderman, is recognized as a distinct new species. The taxonomic status of *Peramphithoe mea* (Gurjanova), *P. tea* (Barnard), *P. plea* (Barnard) and *P. annenkovae* (Gurjanova) is clarified. For comparison, two anti-boreal eastern Pacific species, ***Peramphithoe lessoniophila*** n.sp. and *P. femorata* (Krøyer) are described. Thirteen of the fifteen North Pacific species are endemic to the boreal region and eight of these are restricted to the North American coast. Greatest diversity occurs on the central and Vancouver Island coasts (12 species) of British Columbia, pointing to this region as being the centre of distribution in the North-eastern Pacific.

RÉSUMÉ

La famille de gammares Ampithoidae de la partie septentrionale de la côte orientale du Pacifique (de l'Alaska à la Californie — Point Conception) a fait l'objet d'une étude taxinomique, biogéographique et écologique. L'auteur fournit des clés et des descriptions de quinze espèces des genres *Cymadusa* Savigny, *Ampithoe* (Leach, sens. str.) et ***Peramphithoe*** n. gen. Ce dernier regroupe toutes les espèces d'*Ampithoe* qui ont un premier gnathopode transversal. *Ampithoe dalli* Shoemaker reprend le rang d'espèce, distincte d'*A. simulans* Alderman. ***Ampithoe sectimanus*** n. sp. antérieurement considérée comme une variante d'*A. pollex* Kunkel et d'*A. simulans* Alderman est maintenant reconnue comme une nouvelle espèce distincte. On fournit des éclaircissements sur le statut taxinomique de *Peramphithoe mea* (Gurjanova), *P. tea* (Barnard), *P. plea* (Barnard) et *P. annenkovae* (Gurjanova). A des fins de comparaison, la description de deux espèces anti-boréales, ***Peramphithoe lessoniophila*** n. sp. et *P. femorata* (Krøyer), apparait dans ce travail. Parmi les espèces du Pacifique-nord, treize sur un total de quinze sont endémiques à la région boréale, tandis que huit d'entre elles sont restreintes à la côte de l'Amérique du Nord. La diversité la plus grande se rencontre en Colombie-britannique au centre de la côte et sur la côte de l'île de Vancouver, ce qui indique que cette région est le centre de la distribution dans le nord-est du Pacifique.

Introduction

Members of the corophioidean family Ampithoidae inhabit self-constructed tubes in coastal marine algae. The family was first described by Stebbing (1888), individuals being distinctive in the incision of the outer lobes of the lower lip and the possession of shortened pad-like rami on the third uropod, the outer ramus of which bears one or two large reverted uncini.

The Ampithoidae is a primarily warm water family but species extend into the boreal regions of both the Atlantic and Pacific. This paper examines the Ampithoidae of the boreal and anti-boreal eastern Pacific. To date, the boreal Pacific Ampithoidae has been studied in California and Oregon by Barnard (1954, 1964, 1965, 1969b, 1970), on the Pacific coast of the USSR by

Gurjanova (1938, 1955) and Kudryashov (1979), and in Japan by Nagata (1960). Only 2 of the 11 known genera have boreal representatives (*Cymadusa* and *Ampithoe*). The intent of this study is to extend our knowledge of the boreal northeastern Ampithoidae from the southernmost limits of the region (Point Conception, California) to the northernmost limits in Alaska. In addition, information on a new anti-boreal species from South America is given.

The specimens from which information was compiled were collected mainly by National Museum survey expeditions. Station data for the expeditions of 1955 (Vancouver Island and Georgia Strait, B.C.), 1957 (Queen Charlotte Islands, B.C.), 1959 (northern Vancouver Island), 1961 (southern Alaska coast) and 1964 (northern and central British Columbia coast) are published in Bousfield (1957 and 1963), Bousfield and McAllister (1962), and Bousfield (1968), respectively. Station data for 1966 (Washington and Oregon), 1970, 1975 and 1977 (Vancouver Island and southern British Columbia mainland coast) and 1980 (southern Alaska coast) are presented in Bousfield and Jarrett (1981).

In order to facilitate identification, the keys and descriptions are constructed with sex and age independent characters, except where stated. Mature males are recognizable by their relatively large size for the species, enlarged and usually differentiated second gnathopod, and by the presence of paired penial papillae on the sternum of peraeon 7. Mature females are recognizable by their relatively large size and the presence of setose brood plates attached to the inner margin of coxae 2-5, below the sternum. Immature specimens are recognizable by their relatively small size, lack of brood plates and undifferentiated second gnathopod. Terminology of the appendages is by vertical orientation in relation to the body.

SYSTEMATIC SECTION

Family Ampithoidae Stebbing 1888[1]

Ampithoidae Stebbing, 1906, p. 631; J.L. Barnard, 1969a, p. 141-143, fig. 61; Bousfield, 1982, p. 285.

Amphithoidae Stebbing, 1899, p. 211

Diagnosis: Body smooth, little compressed. Pair of short setae on the dorsum of urosomites 1 and 2. Head, rostrum lacking, anterior lobe short and blunt, inferior antennal sinus shallow; eyes lateral, rounded, medium to small. Antennae medium to large. Antenna 1 peduncular segment 3 short, accessory flagellum short, vestigial or lacking. Antenna 2 peduncle strong.

Buccal mass directed below the head. Upper lip rounded below. Mandible, molar strong, palp slender or lacking. Left lacinia mobilis with 5 or more cusps. Lower lip, outer lobes with characteristic medial notch or emargination. Maxilla 1, inner plate small, outer plate with 10 (rarely less or more) apical spine-teeth. Maxilla 2, plates apically and medially setose, outer plate somewhat broadened. Maxilliped plates large, palp slender and dactylate.

Coxae 1-4 overlapping, deep, smooth or lightly setose below. Gnathopods usually strongly subchelate, 2 larger and sexually dimorphic. Peraeopods 3 and 4 glandular, segment 2 expanded, distal segments short, dactyls with gland duct. Peraeopods 5-7 dissimilar, distal segments may be reversed, segment 6 may expand and form a weak subchela with the dactyl; coxae 5, 6 and sometimes 7 strongly anterolobate, coxa 5 often as deep as coxa 4. Pleopods normal, retinacula more than 2.

Urosome segments separate, not shortened. Uropods 1 and 2 normally biramous. Uropod 3 biramous, rami very short, quadrate, inner setose, outer with 2 (occasionally 1) strong apical uncini. Telson short, apex usually with cusps. Brood plates with hook-tipped marginal setae (on peraeopods 2-5). Gills laminar, plate-like, short pedunculate on peraeopods 2-6.

Genera: *Amphithoides* Kossman 1880, *Amphitholina* Ruffo 1953, *Ampithoe* (Leach 1814), *Cymadusa* Savigny 1816, *Exampithoe* K.H. Barnard 1925, *Macropisthopous* K.H. Barnard 1916, *Paradusa* Ruffo 1969, *Peramphithoe* new genus, *Paragrubia* Chevreux 1901, *Pleonexes* Bate 1857, *Sunamphitoe* Bate 1857, *Pseudoamphithoides* Ortiz 1976

Animals are medium to large (5-35 mm) and

1. Some doubt exists concerning the orthography of the family name. Leach (1814) dedicated his genus to the Nereid 'Amphithoe' of Homer but erroneously transliterated the greek 'phi'. This has led to a confusion of spelling in subsequent publications. Although the authors agree with Ruffo (1969) and Myers (personal communication) that the philologically better form '*Amphithoe*' is preferable, it is felt that formal alteration by the International Commission on Zoological Nomenclature is first necessary.

spin isolated tubes (with the cement glands of peraeopods 3 and 4) on algae, eelgrass, stones and detritus, or in the case of *Amphitholina*, burrow into kelp stipes and holdfasts. All are littoral and shallow-water marine or epibiontic, tropical, warm temperate to arctic-boreal in both northern and southern hemispheres.

Key to Genera of the Ampithoidae of the Northeastern Pacific (Alaska to Northern California)

1. Antenna 1, accessory flagellum multi-segmented; palm of gnathopod 1 oblique; peduncular spinous process projecting distally below the rami of uropods 1 and 2. ..... *Cymadusa* Savigny 1816 (p. 43)
   Antenna 1, accessory flagellum vestigial or absent; palm of gnathopod 1 transverse or oblique; peduncular spinous process well developed if palm transverse but absent if palm oblique 2
2. Gnathopod 1, palm oblique, coxa 1 produced forward; peraeopods 3 and 4, segment 2 slender, less than $^3/_4$ the width of its coxa; uropod 1 peduncular spinous process absent ..... *Ampithoe* Leach 1813-14 (sens. str.) (p. 45)
   Gnathopod 1, palm transverse, coxa 1 not produced forward; peraeopods 3 and 4, segment 2 strongly inflated, more than $^3/_4$ the width of its coxa; uropod 1 peduncular spinous process present ..... *Peramphithoe* n. gen. (p. 60)

Genus *Cymadusa* Savigny 1816, Barnard 1969a
Cymadusa Savigny, 1816
Grubia Czerniavski, 1868
Acanthogrubia Stout, 1912

Type species: *Cymadusa filosa* Savigny 1816 (Monotypy). See Chevreux and Fage, 1925 (as *Grubia hirsuta*), Shoemaker, 1935 (as *Grubia filosa*).

Diagnosis: Head lobe produced, inferior antennal sinus moderate. Antenna 1, accessory flagellum with $1^1/_2$ to $6^1/_2$ segments. Mandibular palp moderately strong. Maxilla 1 palp broad. Gnathopod 1, palm oblique, coxa 1 produced forward; gnathopod 2 subchelate, equal to or larger than 1. Peraeopods 3 and 4, segment 2 moderately inflated. Peraeopods 5-7, segment 6 not strongly widened apically, spines not restricted to the antero-distal region. Uropod 1, peduncle extended postero-distally into a long spinous process between the rami. Uropod 3, outer ramus with two hooked uncini. Telson with two small apical cusps. About 10 species, generally tropical to subtropical to cool temperate; littoral.

Northeastern Pacific species: *Cymadusa uncinata* (Stout 1912)

Cymadusa uncinata (Stout 1912, Barnard 1969b) Figure 1.

Acanthogrubia uncinata Stout, 1912, p. 146, figs. 81-83
Paragrubia uncinata Shoemaker, 1941, p. 188; Hewatt, 1946, p. 199
Cymadusa uncinata J.L. Barnard 1965, p. 40, figs. 26-28
J.L. Barnard, 1969b, p. 86

Material examined: Alaska — Puffin Bay, Baranof Island: 12 immature specimens from Bousfield and McAllister 1961, stn. A171. British Columbia — Queen Charlotte Islands: 4 immature specimens from Bousfield 1957 stn. W8. Northern mainland: 48 specimens from Bousfield 1964 stns. H53, H65 and the collection of D.E. McAllister, 1965. Vancouver Island and southern mainland: 78 specimens from collections of Bousfield 1977 (stn. B6a), 1959 (stns. O5, O11, V4b, cat. 2606), 1955 (stns. P7, F2) and the collections of J.F.L. Hart 1934, 1939, 1941. Washington and Oregon — 54 specimens from Bousfield 1966 stns. W40, W42 and the collection of R.I. Smith, 1955. Smithsonian collections (USNM): Bousfield 1966 Stn. W40, 1 ♂, 1 ♀ subadult, 6 immatures.

Distribution: Baranof Island, Alaska (56°16′N, 134°48′W) to Laguna Beach, California (33°5′N, 117°8′W).

Ecology: Occurs amongst kelp and *Phyllospadix* in high salinity waters of exposed coasts at low tide, in the shallow subtidal or in tide pools. Females brood young May-August. Large overwintered females which have not developed setae on the brood plates can be found in the spring.

Diagnosis: Antenna 1 longer than 2, peduncular segments weakly setose, peduncle 1 bearing spines on postero-distal edge. Antenna 2 peduncle not

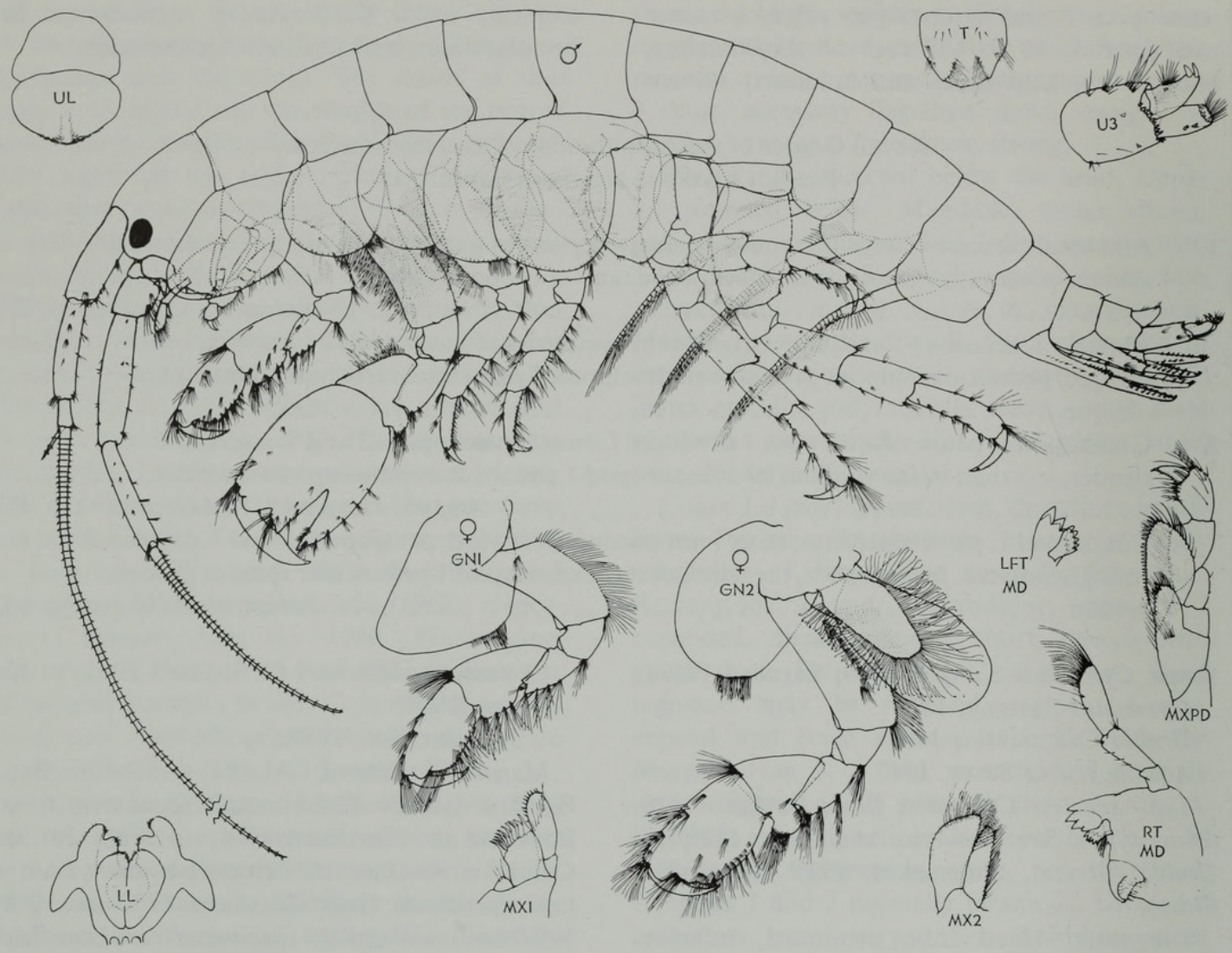

Figure 1. *Cymadusa uncinata* Stout ♂ 20.0 mm, Trial Island Point, Victoria, B.C. 18 May 1977; ♀ 23.0 mm, Shipwreck Point, Clallam County, Washington. 1 Aug. 1966

greatly stouter, flagellum equal in length to peduncle segments 4 and 5 together. Mandible, incisor with 9 teeth, 11 spines; lacinia mobilis with 6 teeth; palp segment 1 bare of setae, segment 2 setose on distal and inner margins, segment 3 longer than 2, distally rounded and strongly setose on distal and ventral margins. Lower lip outer lobes, apical somewhat longer than medial. Maxilla 1, inner plate with 3 setae; palp more than half the width of the outer plate, tipped with 10 spines and 8 setae. Maxilliped inner plate apically spinous; outer plate inner edge smooth, teeth smooth. Coxae 1-4 setose on lower margin. Coxa 1 produced forward, anterior edge straight; coxae 1 and 2 not shallower than 3-5. Gnathopod 1, both sexes, segment 2 with a small antero-distal lobe; segment 3 not lobed, segment 5 narrowed below into a shallow forward produced lobe; palm oblique, well defined, dactyl serrated. Gnathopod 2 (♂) much larger than 1, segment 2 bearing long plumose setae on the anterior, medial and posterior margins; neither segment 2 nor 3 lobed; segment 5 bearing feathery setae on the upper margin; at about 15 mm body length, hand splitting into two large teeth, the ventral tooth much the longer, approaching half the length of the hand; dactyl slightly sinuous, projecting beyond the hand. Gnathopod 2 (♀) somewhat larger than gnathopod 1, lacking plumose setae or teeth as in the male. Peraeopod 3 similar to, though slightly longer than 4, segment 2 expanded, but less than the width of its body segment, segment 4 slightly less than half the width of segment 2; male peraeopod 3, anterior edge of segment 2 bearing plumose setae. Peraeopods 5-7, anterior edge of segment 2 spinous, segment 4 longer than 5, segment 6 bearing 5-7 groups of strong spines.

Epimeral plates, lower hind corners acute but not notched and lacking a lateral ridge. Pleopod outer rami slightly shorter than inner, bearing 5-6 anchor-shaped coupling hooks. Urosome 1 sternum setose. Uropods 1 and 2 bearing lateral tufts of setae on the peduncle and outer ramus, peduncular process well developed, outer ramus shorter than inner, spines small and abundant, 2-4 at tip. Uropod 2 reaching somewhat beyond 1. Uropod 3 long, peduncle bearing 2 central spines and 12 distal "crown" spines, inner ramus with 2 central and 5 distal spines, outer ramus with 1 central and two well developed hooked uncini. Telson with a row of 10-15 apical setae. Female brood plates relatively small, reaching not more than two-thirds the length of peraeopod segment 2. Body length at maturity: ♂ 15-35 mm, ♀ 20-35 mm. This is the largest species of *Cymadusa* and one of the largest amphipods on this coast.

Remarks: *Cymadusa uncinata* can be distinguished from the North Atlantic species *C. filosa* and *C. compta* by its much greater body size (up to 35 mm as opposed to 15 mm), the unequal sizes of gnathopods 1 and 2 and the deeply incised palm of gnathopod 2 (♂). *Cymadusa* most closely resembles *Ampithoe* (sens. str.) but differs mainly in the presence of a distinct accessory flagellum, long peduncular process of uropod 1 and more setose maxilla 1 plate (3-6 setae as opposed to 0-2 setae). These characteristics are considered plesiomorphic, and suggest that *Cymadusa* is ancestral to *Ampithoe*.

Genus *Ampithoe* (Leach 1813-14) emend. (sens. str.)

Ampithoe Leach, 1813-14, p. 403, 432; Stebbing, 1906, p. 631-632;
J.L. Barnard, 1969a, p. 143, 144, fig. 61

Type species: *Ampithoe rubricata* (Montagu 1808) (type by original designation).

Species contained in the genus *Ampithoe* have recently been found by the authors to be of three basic types. These differ on a significant basis in several prime morphological characters, hence justifying subdivision into the genera *Ampithoe* (sens. str.), *Peramphithoe* and *Pleonexes*. Details of this analysis are to be published separately. (Conlan, 1982).

Diagnosis: Head lobe produced, antennal sinus present. Antenna 1 accessory flagellum minute, one-segmented. Mandibular palp moderately weak to strong. Maxilla 1 palp relatively broad. Gnathopod 1, palm oblique, coxa 1 produced forward. Gnathopod 2 subchelate, equal to or larger than 1. Peraeopods 3 and 4, segment 2 moderately inflated. Peraeopods 5-7, segment 6 little distally expanded, spines usually not restricted to the antero-distal region. Uropod 1, peduncular process vestigial or absent. Uropod 3, outer ramus with two apical hooked spines or uncini. Telson with two small apical cusps. About 37 species, arctic-boreal to tropical, littoral.

Northeastern Pacific species: *Ampithoe valida* Smith 1873, *A. lacertosa* Bate 1858, *A. simulans* Alderman 1836, *A. volki* Gurjanova 1938, *A. dalli* Shoemaker 1938, *A. plumulosa* Shoemaker 1938, *A. rubricatoides* Shoemaker 1938, *A. kussakini* Gurjanova 1955, *A. sectimanus* n.sp.

Key to Species of *Ampithoe* of the Northeastern Pacific

1. Gnathopod 1, lower lobe of segment 5 broad, more than half the length of the full segment. Peraeopods 3 and 4 slender, segment 4 less than half the width of segment 2. Gnathopod 2 (♂), both segments 2 and 3 produced into a large anterodistal lobe 2
   Gnathopod 1, lower lobe of segment 5 less than half the length of the full segment. Peraeopods 3 and 4 strong, segment 4 more than half the width of segment 2. Gnathopod 2 (♂), only segment 2 produced into an anterodistal lobe 4
2. Antenna 2 with dense plumose setae on peduncle 5 and flagellum. Epimeron 3, hind margin evenly rounded. Gnathopod 1 (♂), segment 5 shorter than segment 6. Gnathopod 2 (♂), palm sinuous, slightly oblique ..... *Ampithoe plumulosa* Shoemaker 1938 (p. 50)
   Antenna 2 lacking dense plumose setae. Epimeron 3, hind margin slightly to strongly notched. Gnathopod 1 (♂), segment 5 longer than segment 6. Gnathopod 2 (♂), palm transverse 3
3. Antenna 1 peduncle 1 setose but lacking ventral spines. Coxae 1-4 with a group of long setae on the lower hind margin. Epimeron 3, hind margin only faintly notched and lacking a lateral

ridge. Gnathopod 1 (♂), front margins of segments 5 and 6 bearing long overhanging simple setae. Gnathopod 2 (♂), palm with a median quadrate tubercle, hind margin not produced ..... *Ampithoe valida* Smith 1873 (p. 49)

Antenna 1 peduncle 1 setose and bearing one to several spines on the ventral margin. Coxae 1-4 lacking a group of long setae on the lower hind margin. Gnathopod 1 (♂), front margins of segments 5 and 6 bearing upright plumose setae. Epimeron 3, hind margin with a strong notch, from which radiates a lateral ridge. Gnathopod 2 (♂), palm sinuous, hind corner produced downwards with age, lacking median tubercle ..... *Ampithoe lacertosa* Bate 1858 (p. 47)

4. Antenna 1 subequal to antenna 2. Antenna 2, peduncle moderately to strongly setose; flagellum shorter than segments 4 and 5 together. Uropods 1 and 2, rami tipped by several spines. Coxae 1 and 2 (♂) same depth as coxae 3-5 5

Antenna 1 shorter than antenna 2. Antenna 2, peduncle weakly setose; flagellum as long as segments 4 and 5 together. Uropods 1 and 2, rami tipped by a single heavy spine. Coxae 1 and 2 (♂) shallower than 3-5 8

5. Antennae 1 and 2, peduncles strongly setose; antenna 1 peduncle 1 without a posterodistal spine. Anterior margin of segment 2 of peraeopods 3-5 strongly setose. Maxilliped outer plate teeth serrated. Gnathopod 2 (♂), palm strongly incised to form a pointed tooth ..... *Ampithoe sectimanus* n. sp. (p. 54)

Antennae 1 and 2, peduncles not strongly setose; antenna 1 peduncle 1 with a spine on the posterodistal angle. Anterior margin of segment 2 of peraeopods 3-5 bare. Maxilliped outer plate teeth smooth. Gnathopod 2 (♂), palm not strongly incised, defining tooth small and square or minute 6

6. Mandibular palp, segment 3 distally pointed and oblique, setae apical; segment 2 with 1 setae. Gnathopod 2 (♂), segment 5 as long as deep; palm incised to form a square tooth at posterior corner ..... *Ampithoe volki* Gurjanova 1938 (p. 53)

Mandibular palp segment 3 rounded, apically and laterally setose; segment 2 with more than 1 seta. Gnathopod 2 (♂), segment 5 longer than deep; palm oblique, small rounded tooth at posterior corner ..... *Ampithoe kussakini* Gurjanova 1955 (p. 52)

7. Antenna 2, peduncle 5 and flagellum with conspicuous groups of setae on hind margin. Uropod 1 strongly spinose, with about 15 spines on the outer margin of the peduncle and about 25 on the outer ramus. Uropod 3 peduncle with mid-dorsal spines in addition to the usual distal crown spines. Gnathopod 2 (♂), hand not greatly enlarged, less than twice the size of the hand of gnathopod 1, palmer teeth absent ..... *Ampithoe rubricatoides* Shoemaker 1938 (p. 56)

Antenna 2 weakly setose. Uropod 1 with less than half as few spines on peduncle and rami. Uropod 3 with distal crown spines only. Gnathopod 2 (♂), hand greatly enlarged, more than twice the size of the hand of gnathopod 1, with a strong tooth at the hind corner of the palm and at the dactyl hinge 8

8. Mandibular palp, terminal segment acutely oblique, distal margin demarcated by a definite angle from the inner margin and setose for about half the length. Gnathopod 1 (♂), developing (at about 8 mm size) plumose setae on segments 2-5. Gnathopod 2 (♂), palm barely concave, hind margin produced into a small tooth which in the full adult does not meet the dactyl ..... *Ampithoe dalli* Shoemaker 1938 (p. 56)

Mandibular palp, distal margin of segment 3 very oblique, rounding smoothly into the inner margin and setose for nearly the full length. Gnathopod 1 (♂), developing (at about 12 mm size) plumose setae on segment 2 only. Gnathopod 2 (♂), palm strongly concave, hind margin produced into a long tooth which meets the dactyl ..... *Ampithoe simulans* Alderman 1936 (p. 58)

The northeastern Pacific species of *Ampithoe* may be clustered into three subgroups which, on further study, may warrant formal taxonomic recognition:

1. *A. lacertosa*, *A. valida*, *A. plumulosa*
2. *A. kussakini*, *A. volki*, *A. sectimanus*
3. *A. rubricatoides*, *A. dalli*, *A. simulans*.

Characteristics which order the species are: reduction in size of the antennal sinus, shortening of antenna 1 with concurrent strengthening of antenna 2, increasing obliqueness of mandibular palp segment 3, increasing roundness of the coxae, narrowing of the segment 5 lobe of gnathopod 1, increasing obliqueness and concavity of male gnathopod 2, increasing glandularity of peraeopods 3 and 4, strengthening of the uropod 3 uncini, loss of the lateral ridge on the epimera, an overall deepening of the body and shallowing of the coxae. The functional significance of these morphological changes suggest a trend towards greater domicoly.

Group of *Ampithoe lacertosa*, *A. valida*, *A. plumulosa*

Head, lateral lobe and antennal sinus prominent, eye medium. Antenna 1 equal to or longer than antenna 2, peduncle poorly setose. Antenna 2 very little stronger than antenna 1, flagellum equal to or shorter than peduncular segments 4 and 5 combined. Mandibular palp segment 3 apically blunt, distally setose. Coxa 1 anterior margin straight or slightly upcurved; coxae 1 and 2 (♂), shallower than 3-5; coxa 5 in both sexes, lower corners acutely rounded. Gnathopod 1, posterior lobe of segment 5 broad, more than half the length of the full segment and in the male, produced distally under segment 6. Gnathopod 2 (♂), both segments 2 and 3 produced into a prominent antero-distal lobe, palm transverse or slightly oblique. Peraeopods 3 and 4 slender, segment 4 less than half as wide as segment 2. Peraeopods 5-7 slender, spines weak. Uropods 1 and 2, rami ending in a group of 2-4 spines. Epimera 1-3 with a lateral ridge. Pleopods with 8-11 coupling hooks. Uropod 3 long, apical uncini of outer ramus weak.

The species trend phyletically in the increased shortening of antenna 1 relative to antenna 2, increasing obliqueness of mandibular palp segment 2 and increasing obliqueness of the male palm of gnathopod 2. *Ampithoe japonica* Stebbing 1888 and *A. cavimana* Sivaprakasam 1970, seem referable to this group.

Ampithoe lacertosa Bate 1858, Barnard 1965
Figure 2.

Amphithoe lacertosa Bate 1858, p. 362; 1862, p. 236-237, pl. 41, fig. 5; Gurjanova, 1951, p. 895-897, fig. 622.

Ampithoe lacertosa Stebbing, 1906, p. 633-634; J.L. Barnard, 1954, p. 31-33, pls. 29-30; J.L. Barnard, 1965, p. 9-12, figs. 4, 5; Nagata, 1960, p. 175-176, pl. 16, figs. 95-96; Heller, 1968, p. 1-132; J.L. Barnard, 1969b, p. 83

Amphithoe macrurus Stephensen, 1944, p. 80-83, figs. 30-31

Dexamine scitulus Harford, 1877, p. 116

Amphithoe scitulus Holmes, 1904, p. 314-315, pl. 36, figs. 21-24

? *Amphithoe stimpsoni* Boeck, 1871, p. 14-15, fig. 5; Stebbing, 1906

Material examined: Alaska — Aleutian Islands: 1 immature specimen from Izembek Lagoon, Unimak Is., 1969, N.A. Powell collector. Southeastern Alaska: 123 specimens from Bousfield and McAllister 1961 stations, A3, A7, A18, A27, A48, A87, A91, A92, A96, A107, A115, A131, A139, A147, A151, A174, A175; 5 specimens from Bousfield 1980 stns., S8B1 and S23F1.
British Columbia — Queen Charlotte Islands: 60 specimens from Bousfield 1957 stns., W3a, W4a, W14, H2, H2a, H8b, H9, H10, H11, E5, E9, E12, E14a, E14c, E24, E25. Northern mainland: 169 specimens from Bousfield 1964 stns., H1, H3, H8, H10, H23, H25, H26, H29, H30, H33, H47, H48, H50, H52, H56, H57, H65. Vancouver Island and southern mainland: 1336 specimens from the collections of Bousfield 1977, 1976, 1975, 1970, 1964, 1959, and 1955, and from the collections of C. Carl, K.E. Conlan, D.V. Ellis, J.F.L. Hart, D. Kittle, C.D. Levings, C. Lobban, R.J. Long, N.A. Powell.
Washington and Oregon — 77 specimens from Bousfield 1966 stns., W8, W10, W13, W30, W33, W42, W44, W47, W64 and 10 specimens from the collections of S. Helen, 1967 and N. McDaniel, 1977.
Smithsonian Collections (USNM): Bousfield 1975 stn. P16a, 1 ♂, 1 ♀.

Distribution: Aleutian Islands, Alaska (50°N, 163°W) to Magdalena Bay in Baja California (25°N,112°W); Japan, south to Shizuoka prefecture (35°N,138°E).

Ecology: Found amongst algae, eelgrass or woody debris, on mud, sand and gravel beaches, in tidepools or on wharf pilings at low water or

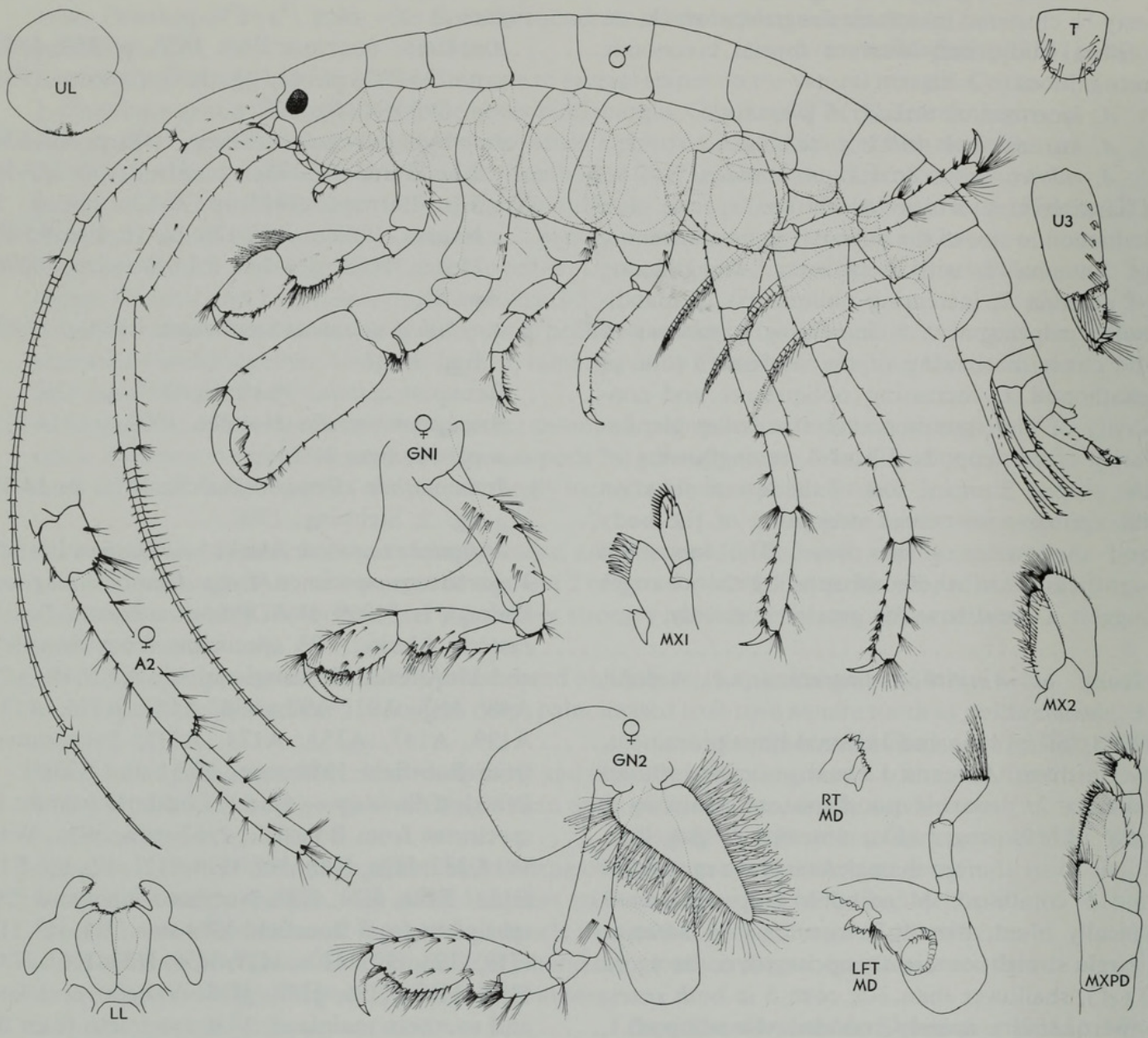

Figure 2. *Ampithoe lacertosa* Bate ♂ 21.5 mm; ♀ 30.0 mm, Friday Harbor, San Juan Is., Washington. April 1977

subtidally to about 10 m depth. It is equally abundant in high salinity exposed coastal waters and mesohaline shallow coastal waters but is rarely found in brackish water. Females are ovigerous from May to August.

Diagnosis: Antenna 1 longer than antenna 2, peduncle 1 with 1-4 posterior marginal spines (although absent in immatures). Antenna 2 peduncle not spinose, flagellum equal in length to peduncular segments 4 and 5 together. Mandibular palp segment 3 blunt, apically setose, 1 small seta on the distal corner of segment 2. Lower lip outer lobe, apical and medial lobes well separated, apical longer than medial. Maxilla 1 inner plate with 1 seta, palp strong, with about 12 marginal spines. Maxilliped palp segment 1 lacking setae. Coxae 1-4 lacking long setae on lower margin. Gnathopod 1 both sexes, segment 6 slender, width less than half the length. Gnathopod 1 (♂), segment 5 longer than 6, margins of segments 5 and 6 developing a growth of plumose setae when body length is 12 mm or more. Gnathopod 2 (♂), segment 2 poorly setose, palm transverse, sinuous, lacking a median tubercle, hind edge produced downwards progressively with age to form a wide thumb. Male sternum of peraeon 7 lacking a median keel between the penes. Epimera 1-3 with strong

notch in hind corner (in immatures as well) from which radiates anteriorly a lateral ridge. Uropod 3 peduncle bearing dorsal spines along its length in addition to a crown of spines on the distal margin.

Body colour in life is orange to brown, heavily speckled. Distinctive white spot on the dorsum of each segment; some white spotting also on the coxae. Body length at maturity: Male 12-24 mm, female 10-23 mm. The male gnathopod 2 becomes transverse at as small a size as 7 mm but gnathopod 1 does not become plumose until the body is about 12 mm in length. A plot of the body length of 81 specimens against geographic distribution indicates a northward trend towards increased body length at maturity. The average size of maturity in Vancouver Island, southern B.C., Washington and Oregon was 16 mm ♂, 14 mm ♀, while in Alaska and northern B.C. the average was 17 mm ♂, 17 mm ♀.

Remarks: Heller (1968) described extensively the biology and development of this species.

Ampithoe valida Smith 1873
Figure 3.

Amphithoe valida Smith, 1873, p. 563; Paulmier, 1905, p. 164-165, fig. 34

Ampithoe valida, Stebbing, 1906, p. 635; Alderman, 1936, p. 68; J.L. Barnard, 1954, p. 34-35, pl. 31; Nagata, 1960, p. 176, pl. 16, figs. 97-98; J.L. Barnard, 1965, p. 34-36, figs. 22, 23; Bousfield, 1973, p. 180-181, pl. LV.1

Ampithoe shimizuensis Stephensen, 1944, p. 77-80, figs. 27-28

Material examined: British Columbia — Vancouver Island and southern mainland: 67 specimens from the collections of Bousfield 1976 (stns. B3, B11a, B13); 1975 (stns. P6a, P6b, P6c, P18a), 1970 (stns. P706, P709), 1959 (stn. N17), 1955 (stns. F1, F2a, F10, G11, G13, G22,

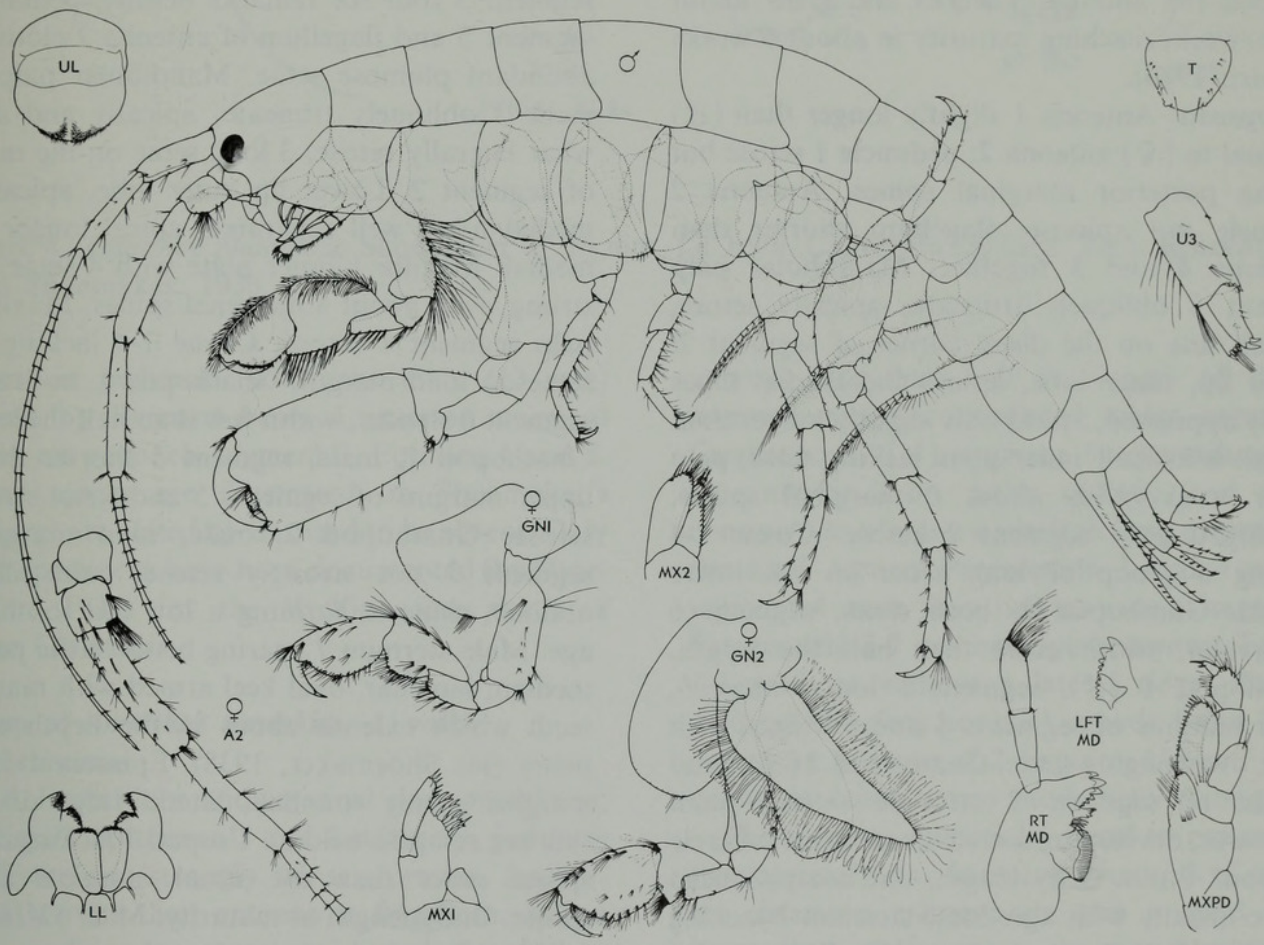

Figure 3. *Ampithoe valida* Smith ♂ 12.0 mm, Sarita Bay, Barkley Sound, Vancouver Is., B.C. 2 July 1977; ♀ 12.0 mm Brady's Beach, Barkley Sound, Vancouver Is., B.C. 31 July 1975

M1a, M2, M4, M5, M8, M10, M11). Four specimens also examined from the collections of M.A. Bousfield, K.E. Conlan, D.V. Ellis and R.J. Long.

Washington and Oregon — 12 specimens from Bousfield 1966 stns. W28, W47 and W64. Smithsonian collections (USNM): Bousfield 1975 stn. P6a, 2 ♂♂, 2 ♀♀.

Distribution: Pacific Ocean: British Columbia and Vancouver Island at 51° latitude south to Newport Bay, California (45°N,124°W), ? Japan at Shizuoka Prefecture (35°N,138°E). Atlantic Ocean: Piscataqua estuary, New Hampshire (43°N,70°W) south to Chesapeake Bay, Virginia (37°N,76°W).

Ecology: A warm temperate species occurring along sheltered coasts and estuaries, mainly in mesohaline to brackish waters. It builds tubes on algae and eelgrass on muddy, gravelly beaches in saltmarshes, tidepools and log fouling communities, at low water level to 30 m depth. Females brood from May to August. Immatures are brooded for about 2-5 weeks and grow about 1 mm/week, reaching maturity in about 6 weeks (Nicotri, 1980).

Diagnosis: Antenna 1 slightly longer than (♂) or equal to (♀) antenna 2; peduncle 1 setose but lacking posterior marginal spines. Antenna 2 peduncle not spinose, flagellum shorter than segments 4 and 5 together. Mandibular palp segment 3 obliquely truncate, apically setose, 1 small seta on the distal corner of segment 2. Lower lip, outer lobe, apical and medial lobes closely appressed, apical only slightly longer than medial. Maxilla 1 inner plate lacking setae, palp rather weak, with about 6 marginal spines. Maxilliped palp segment 1 setose. Coxae 1-4 bearing a group of long setae on the lower margin. Gnathopod 1, both sexes, segment 6 subcircular, width more than half the length. Gnathopod 1 (♂), segment 5 longer than 6, upper margins of segments 5 and 6 fringed with dense overhanging setae. Gnathopod 2 (♂), hind margin of segment 2 strongle setose, palm transverse, developing a median quadrate tubercle at about 6 mm body length, but not produced antero-distally with age. Male sternum 7 lacking a median keel between the penes. Epimera 1-3 with lateral ridge, hind margins rounded, with one short seta at hind corner. Uropod 3 lacking dorsal spines other than the usual marginal crown spines.

In life, body olive green to brown, and heavily speckled. Body length at maturity: Male 6-12 mm, female 5-12.5 mm.

Ampithoe plumulosa Shoemaker 1938

Figure 4. (after Shoemaker 1938)

Ampithoe plumulosa Shoemaker 1938, p. 16-19, fig. 1; 1942, p. 39; J.L. Barnard, 1959, p. 37; 1964, p. 111; 1965, p. 20, figs. 11, 12; 1969b, p. 84.

Material examined: No material available. Information compiled from Shoemaker (1938), Barnard (1964, 1965 and 1969b).

Distribution: Patos Island, British Columbia (48°48.7'N) to Salinas, Ecuador; Galapagos Island (0°N,90°W).

Ecology: A warm water species found amongst algae and *Phyllospadix* on pilings, floating docks, mud beaches and in tidepools, intertidal to a depth of about 15 m.

Diagnosis: Antenna 1 slightly longer than 2, peduncle 1 with up to 6 ventral spines. Antenna 2 peduncle may bear a few dorsal spines on segment 3 (but see remarks below); peduncular segment 5 and flagellum of antenna 2 clothed in abundant plumose setae. Mandibular palp segment 3 obliquely truncate, apically and somewhat laterally setose, 3 long setae on the margin of segment 2. Lower lip outer lobe, apical and medial lobes well separated, apical longer than medial. Maxilla 1 inner plate with 4 setae, palp strong, with about 8 marginal spines. Maxilliped palp segment 1 setose. Coxae 1-4 lacking long setae on hind margin. Gnathopod 1, both sexes, segment 6 slender, width less than half the length. Gnathopod 1, male, segment 5 shorter than 6, upper margins of segments 5 and 6 not strongly setose. Gnathopod 2, male, hind margin of segment 2 not strongly setose, palm slightly oblique, sinuous, forming a low flat tooth with age. Male sternum 7 bearing between the penes a median, lamellar, oval keel armed with marginal teeth which extends about $^2/_3$ the depth of the penes (see Shoemaker, 1938). Epimera 1-3 hind margins evenly rounded, lateral ridge on each (but see remarks below). Uropod 3 lacking dorsal spines other than the usual marginal crown spines. Body length at maturity: Male 13-16 mm, female 12 mm.

Remarks: The illustrations of *Ampithoe plumulosa* collected in Bahia de San Quintin by Barnard (1965) differ in some respects from Shoemaker's type collected on Catalina Island, California. Antenna 2: type male (16 mm) lacks

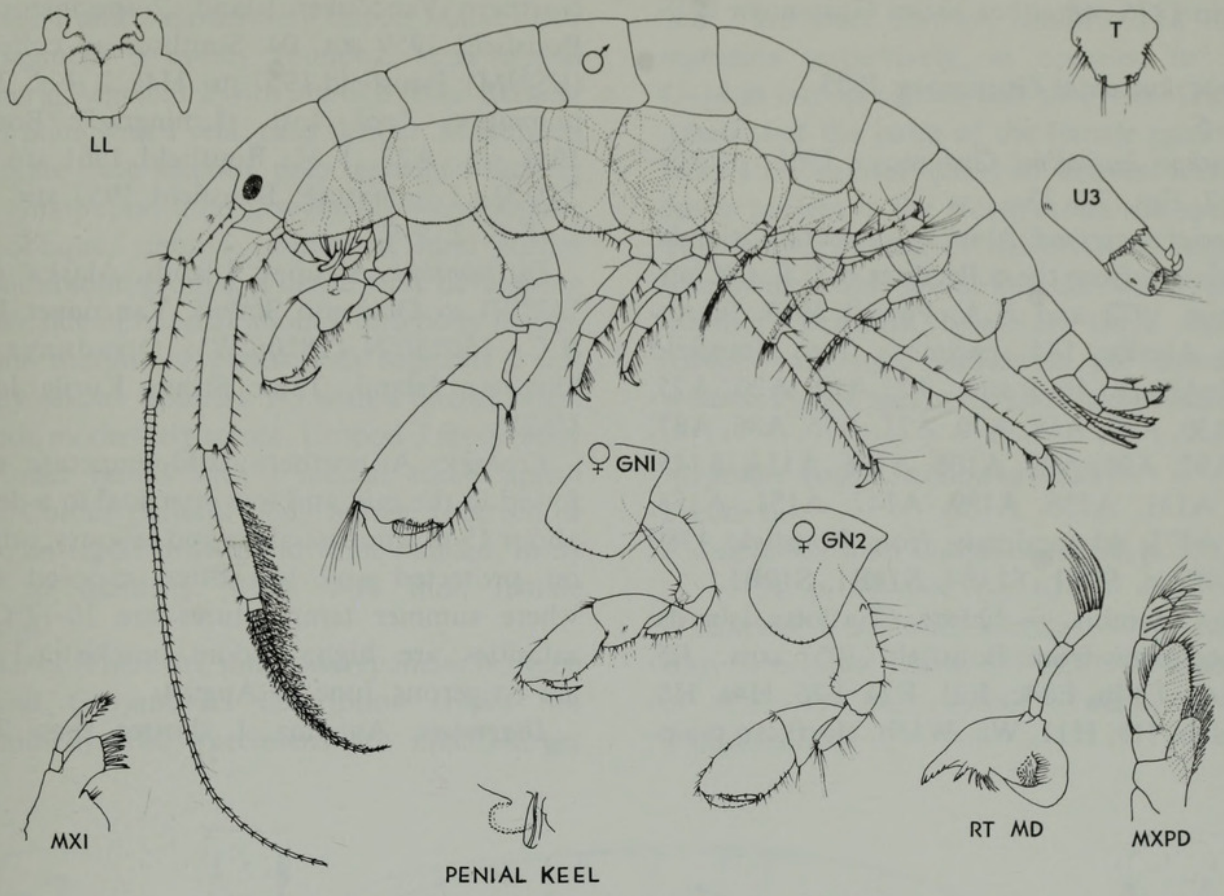

Figure 4. *Ampithoe plumulosa* Shoemaker ♂ 16 mm, La Jolla, California. 20 Sept. 1918. Reconstructed from Shoemaker, 1938

spines on peduncle, while the male (13 mm) figured by Barnard bears 4 anterior marginal spines on peduncle segment 3. Epimera 1 and 2: lateral ridges are illustrated on Shoemaker's type, yet are stated by Barnard to be absent. Only three specimens have been documented (by Shoemaker, 1938) for the Pacific coast north of lower California.

Group of *Ampithoe kussakini*, *A. volki*, *A. sectimanus*

Head, lateral lobe and antennal sinus prominent; eye small. Antennae 1 and 2 subequal, peduncle moderately to strongly setose. Antenna 2 somewhat heavier than antenna 1, flagellum shorter than peduncular segments 4 and 5 together. Mandibular palp segment 3 oblique, laterally setose. Coxa 1 produced forward, anteriorly upturned; coxae 1 and 2 (♂) as deep as 3-5; coxa 5 in both sexes, lower corners evenly rounded. Gnathopod 1, lower lobe of segment 5 narrow, less than half the length of the full segment and not produced under segment 6. Gnathopod 2 (♂), segment 3 not produced into an anterior lobe, palm oblique and weakly concave, developing a small to long projection at the hind corner. Peraeopods 3 and 4 normal, segment 4 more than half as wide as segment 2. Peraeopods 5-7 normal, spines strong. Epimera 1-3 with or without a lateral ridge. Pleopods with 6-9 coupling hooks. Uropods 1 and 2, rami tipped by a group of 2-4 spines. Uropod 3 long, uncini of outer ramus moderately strong.

The species sequentially trend to reduction of the antennal sinus, increasing strength of setation on antennae, peraeopods and uropod 1, the increasing obliqueness in mandibular palp segment 1, increasing degree of incision of the male gnathopod 2 palm and a loss of the lateral ridge of epimeron 3.

Other species exhibiting affinities with this group: *Ampithoe djakonovi* Gurjanova 1938,

Ampithoe longimana Smith 1873, *Ampithoe platycera* Sivaprakasam 1970, *Ampithoe ramondi* Audouin 1826, *Ampithoe zachsi* Gurjanova 1938.

Ampithoe kussakini Gurjanova 1955
Figure 5.

Ampithoe kussakini Gurjanova 1955, p. 215-217, figs. 22, 23

Material examined: Alaska — Aleutian Islands: 63 specimens from the collections of C.E. O'Clair, 1970 and 1972 and N.A. Powell 1969. Southeastern Alaska: 144 specimens from Bousfield and McAllister 1961 stns. A7, A19, A20, A25, A27, A30, A43, A68, A70, A71, A75, A86, A87, A91, A92, A98, A99, A105, A106, A114, A115, A121, A131, A136, A139, A147, A151, A153, A164, A175; 40 specimens from Bousfield 1980 stns. S4B1-4, S8B1, S13B1, S18B1, S19B1.
British Columbia — Queen Charlotte Islands: 131 specimens from Bousfield 1957 stns., E5, E9, E14a, E14b, E14c, E21, E24, E25, H4a, H5, H8a, H8b, H9, H11, W5, W15b. Northern mainland: 35 specimens from Bousfield 1964 stns., H8, H12, H13, H17, H32, H33, H50, H56. Northern Vancouver Island: 7 specimens from Bousfield 1959 stn. 04. Smithsonian collections (USNM): Bousfield 1957 stn. H4a, 2 ♂♂, 2 ♀♀, immature. Zool. Inst. (Leningrad): Bousfield 1961 stn. A27, 1 ♂; Bousfield 1961 stn. A25, 2 ♀♀, 1 immature; Bousfield 1957 stn. E14a, 2 ♂♂, 2 ♀♀.

Distribution: Aleutian Islands, Alaska, (55°N, 163°W) to Quatsino Sound, Vancouver Island, B.C. (50°30′N,128°06′W). Otradnaya Bay, Shikotan Island, Tatar Strait, Kurile Islands, USSR.

Ecology: A northern cold-temperate species found in the mid and low intertidal to a depth of about 15 m amongst algae and eelgrass, primarily on protected and less often exposed coasts, where summer temperatures are 10-17°C, and salinities are high, seldom brackish. Females are ovigerous June to August.

Diagnosis: Antenna 1 shorter than 2 (♂),

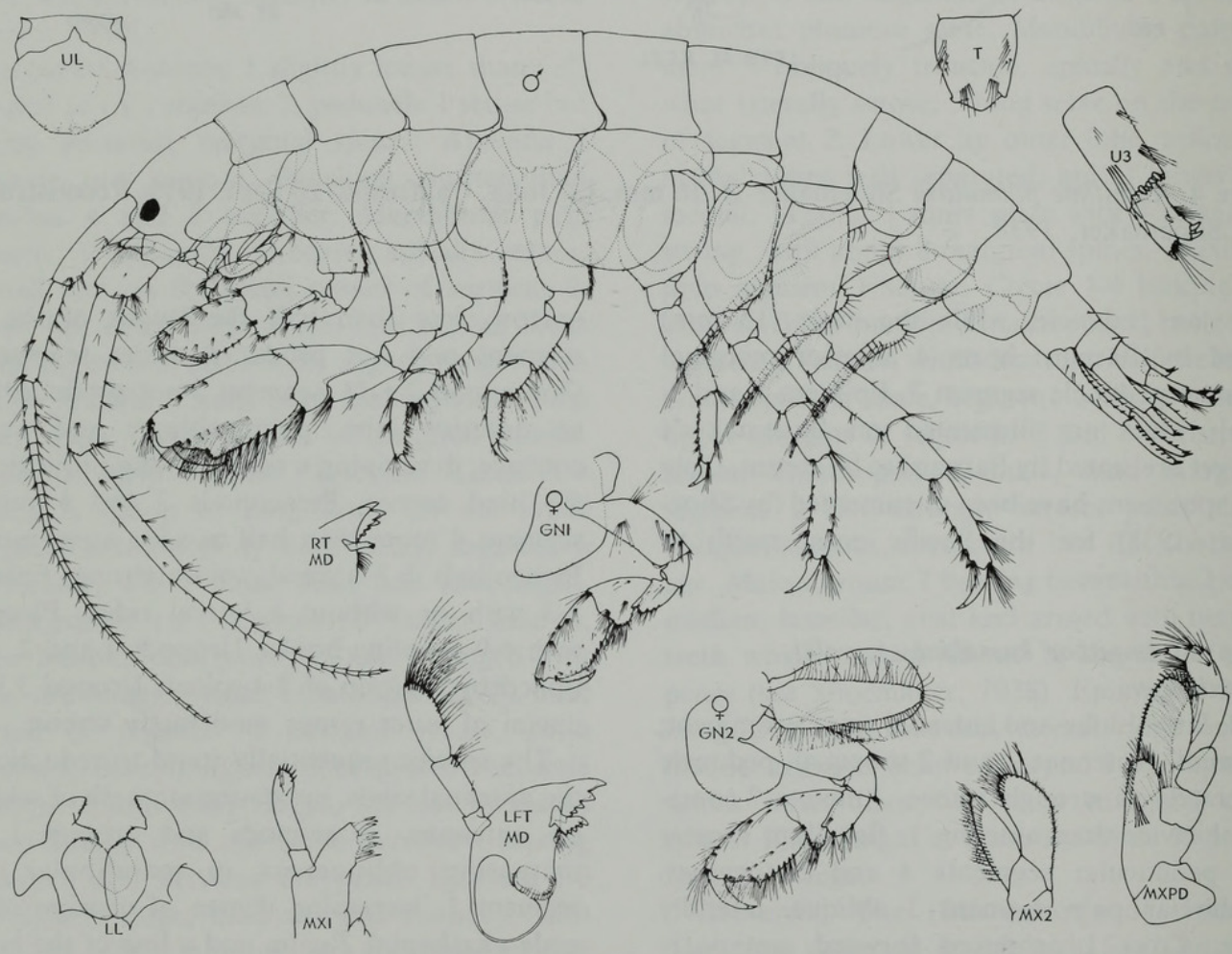

Figure 5. *Ampithoe kussakini* Gurjanova ♂ 17.5 mm; ♀ 13.0 mm, Yakoun Bay, Masset Inlet, Queen Charlotte Is., B.C. 27 August 1957

longer than 2 (♀); antenna 1 peduncle 1 with a distal ventral spine (present also in immatures); antennae 1 and 2 moderately setose. Mandibular palp segment 3 evenly rounded, setae apical and lateral; segment 2 with about 8 setae. Maxilla 1 inner plate with 1 seta, palp slender. Maxilliped outer plate teeth smooth, palp segment 2 lacking setae. Gnathopod 2 (♂), segments 4-6 elongate, palm oblique, sinuous, thumb at hind corner small or absent, groups of dense setae developing on inner side of hand at about 9 mm body length. Anterior margin of peraeopods segment 2 not strongly setose. Epimera 1-3 with a lateral ridge. Pleopods moderately setose. Uropod 3 moderately long, inner ramus with 1 medial and 4 apical spines. Colour pattern: body orange to green or brown; antennae brown and white banded. Body length at maturity: Male 9-18 mm, female 9-20 mm.

Remarks: There are some discrepancies between this and Gurjanova's description (types not re-examined). Her specimens are much larger than those examined here, the male being 31 mm, the female 29 mm, yet the flagella of antennae 1 and 2 are much shorter, comprised of 15 and 6 segments respectively, as opposed to 30 and 13-14 in our specimens half their size. Gurjanova stated that the palm of the female gnathopod 2 lacks an obturator spine, an unusual feature, yet one is present in the North American specimens. The number of setae on the telson of Gurjanova's specimens is only about half the North American number. Perhaps, however, these characters reduce with age. Otherwise the eastern and western Pacific specimens show close resemblance.

Ampithoe volki Gurjanova 1938 ?
Figure 6.

Amphithoe volki Gurjanova 1938, p. 359, fig. 52; 1951, p. 899-901, fig. 624.

Material examined: Alaska — St. Makarius Bay, Amchitka Island (51°N,179°W), collection of C.E. O'Clair, 1968. 1 male, 1 female, 2 immatures.

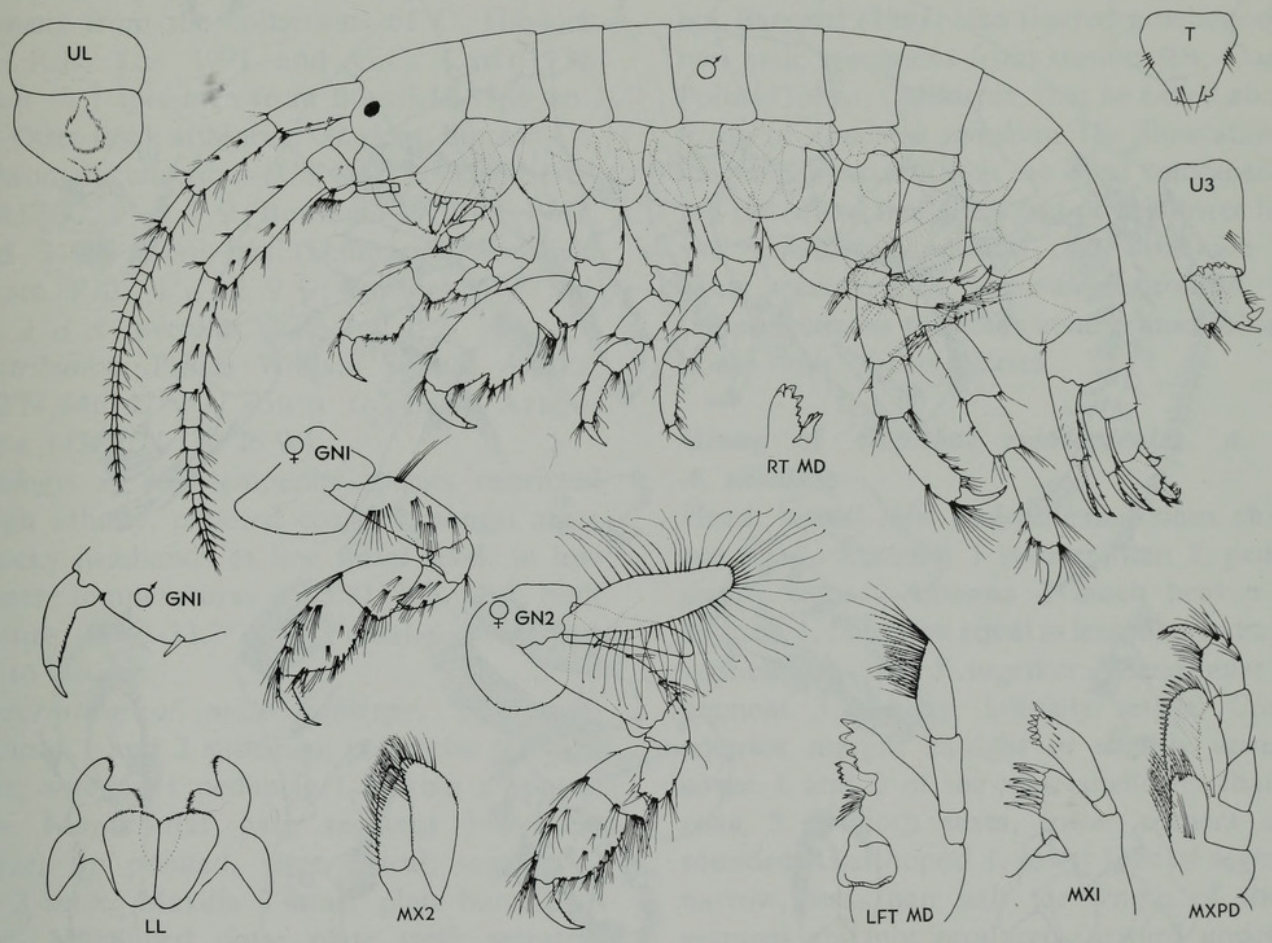

Figure 6. *Ampithoe volki* Gurjanova? ♂ 8.0 mm; ♀ 8.0 mm, St. Makarius Bay, Amchitka, Is., Aleutian Is., Alaska. 20 July 1968

Distribution: Amchitka Island, Alaska; Sea of Japan, Prebrazheu'e Bay region, USSR (45°N, 130°E), Tatar Strait and northern Kurile Islands.

Ecology: A cold temperate species inhabiting exposed coasts in tidepools overgrown with algae and in beds of *Laurencia*, intertidal and subtidal to 3 m depth.

Diagnosis: Antenna 1 shorter than 2 (♂), or subequal (♀); antenna 1 peduncle 1 with a postero-distal spine (absent in immatures); antennae 1 and 2 moderately setose. Mandibular palp segment 3 acutely oblique, tip pointed, setae apical; segment 2 with 1-2 setae. Maxilla 1 inner plate with 1 seta, palp moderately widened. Maxilliped outer plate teeth smooth, palp segment 2 setose. Gnathopod 2, male, segments 4-6 not greatly elongate, hand laterally incised to form a short truncate thumb which is not long enough to reach to the end of the hand. Anterior margin of peraeopods segment 2 not strongly setose. Epimera 1-3 with a slight lateral ridge. Pleopods moderately setose. Uropod 3 not greatly elongate, inner ramus with 3 apical and no medial spines. Body colour in life translucent yellowish-grayish-brownish (Gurjanova 1951). Body length at maturity: Male 8 mm, female 8 mm.

Remarks: Table 1 illustrates that there are several differences between these specimens and Gurjanova's types which may warrant designation of a new species name.

Ampithoe sectimanus n. sp.

Figure 7.

Ampithoe pollex: J.L. Barnard 1954, p. 29-31, pls. 27-28 (not Kunkel 1910)

? *Ampithoe simulans*: J.L. Barnard 1965, p. 27-30, fig. 18 (not Alderman, 1936)

Material examined: Point east of Point Marsh,

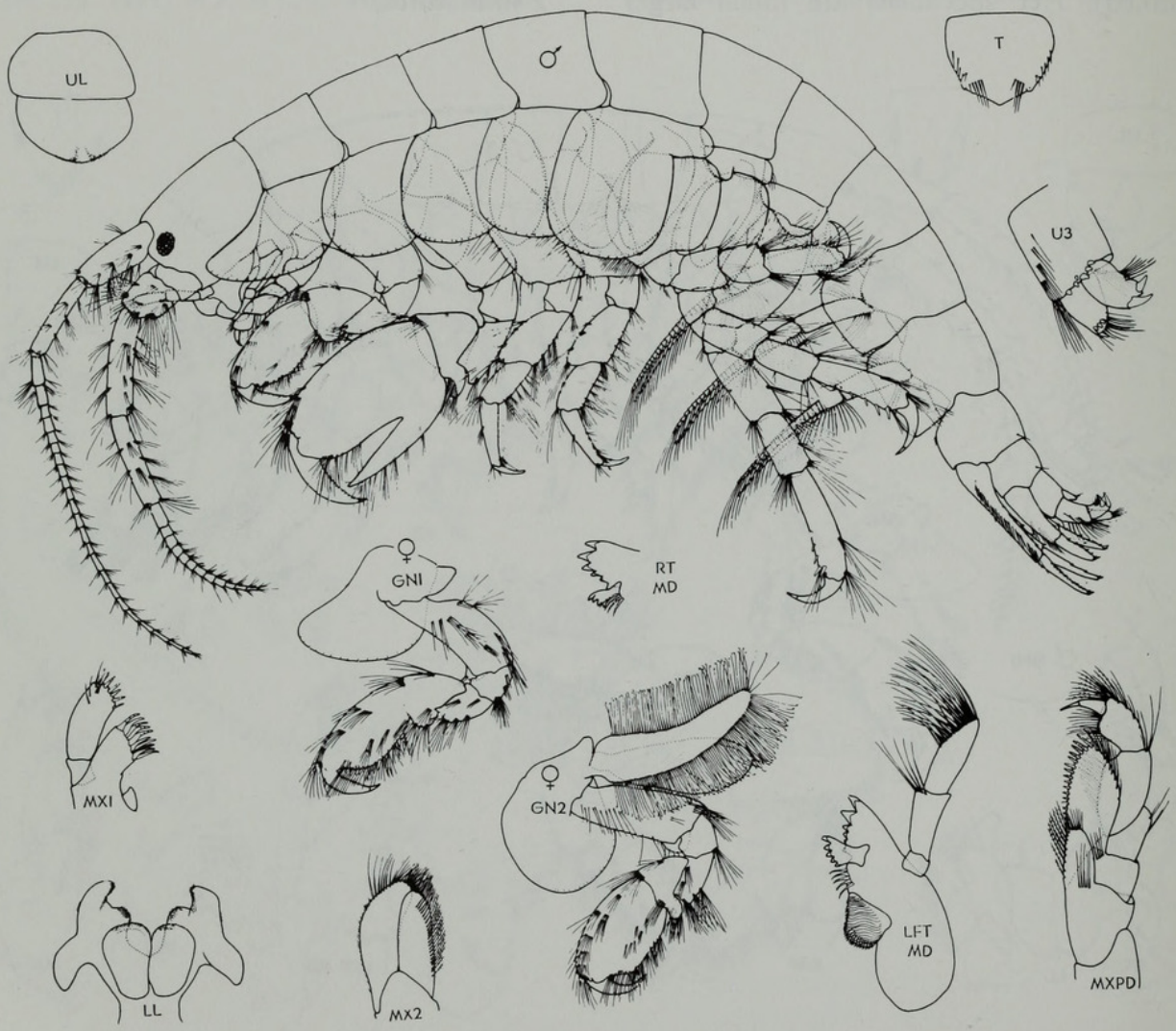

Figure 7. *Ampithoe sectimanus* n.sp. ♂ 11.0 mm; ♀ 11.5 mm, Point Marsh, Prince of Wales Is., Alaska. 1 June 1961

Prince of Wales Island, Alaska (54°43′N, 132°17′W). Bousfield stn. A6, 1 June 1961. Tidepools and under stones. LW to MW. 9.5°C, 30.0°/₀₀. Holotype ♂ (NMC-C-1981-961); allotype ♀ (NMC-C-1981-962); paratypes (NMC-C-1981-963).

Additional material: Alaska — Southeastern coast: About 40 specimens from Bousfield & McAllister 1961 stns. A6 (holotype, allotype, paratypes), A98, A171-2; 5 specimens from Bousfield 1980 stns. S4B5 and S11B1.
British Columbia — Queen Charlotte Islands: About 55 specimens from Bousfield 1957 stns., W4a, W8, W12. Northern mainland: 66 specimens from Bousfield 1964 stns. H12, H50, H53. Vancouver Island and southern mainland: 9 specimens from Bousfield 1977 stns., B6a, B11b, B19a, B19b; about 30 specimens from Bousfield 1976 stns., B7, B28; 3 specimens from Bousfield 1975 stns., P5c, P17d; 174 specimens from Bousfield 1970 stns., P702, P710, P711, P712, P719; 18 specimens from Bousfield 1959 stns., 01, 03, 05, 07b, V4B, V5, N6 and cat. #2606; 6 specimens from Bousfield 1955 stn., P7; also 3 specimens from the collections of C. Haylock 1975, R.K. Lee 1971 and G.C. Carl 1934. Oregon — 1 specimen from Bousfield 1966 stn., W60, Otter Rock at Marine Gardens, Lincoln Co. Smithsonian collections (USNM): Bousfield 1961 stn. A171-2, 1 ♂, 1 ♀; Bousfield 1970 stn. P712, 3 ♂♂, 3 ♀♀, Zool. Inst. (Leningrad); Bousfield 1970 stn. P702, 1 ♂, 2 ♀♀; Bousfield 1957 stn. W12, 2 ♂♂ juveniles, 2 ♀♀.

Distribution: Prince William Sound, Alaska, (60°2′N,146°47′W), south to Cape Arago, Oregon (43°30′N,124°26′W).

Ecology: A cold-temperate species restricted to high salinity, exposed coasts, amongst algae on rocky headlands at low water level, in low summer temperatures (9.5°-15°C) and high salinities (23.3-33.7°/₀₀). Females ovigerous May to August.

Description of male holotype, 11.0 mm: Antennae 1 and 2 subequal, peduncles strongly setose; antenna 1 peduncle 1 lacking a ventral spine. Mandibular palp segment 3 acutely oblique, tip pointed, setae apical; segment 2 with 3 setae. Maxilla 1 inner plate bare, palp broad. Maxilliped outer plate teeth serrated, palp segment 2 setose. Gnathopod 2, segments 4 and 5 not greatly elongate, segment 6 enlarged, palm distally incised (beginning at 7 mm body length), to form a pointed thumb which splits increasingly with age to more than half the length of the hand. Anterior margin of peraeopods 3-7 segment 2 strongly setose (degree and extent varies with age). Epimeron 3 with a faint indication of a lateral ridge. Pleopods strongly setose. Uropod 3 short, inner ramus with 4 apical and no medial spines. Body colour in life: mottled orange to chestnut, legs and antennae orange and white banded. Body length: male 7-10 mm, female 8.5-12.5 mm.

Description of female allotype, 11.5 mm: Body and appendages as in the male, except gnathopod 2 which is similar in form and somewhat larger than gnathopod 1.

Etymology: (L.: secti = split; manus = hand), referring to the strongly cleft palm of the male second gnathopod.

Remarks: *Ampithoe sectimanus* was figured by Barnard (1954) as *Ampithoe pollex* Kunkel 1910. The latter species differs in many features — smaller body size, weaker setation of antennae and peraeopods (yet stronger setation of peraeopods 3 and 4), different shape of gnathopods and near occlusion of the inner lobes of the lower lip. Barnard (1965) also figured gnathopod 2 of two male specimens from station 40a, Coal Oil Point, Goleta, California, that he called aberrant forms of *Ampithoe simulans*. The illustration of a longer palmar tooth on the hand combined with the statement that the lobes of the lower lip are well separated, indicates that these are more likely specimens of *Ampithoe sectimanus*. If so, these specimens mark the southernmost distributional limit of this species.

Group of *Ampithoe rubricatoides*, *A. dalli*, *A. simulans*

Head, lateral lobe and antennal sinus shallow; eye small. Antenna 1 shorter than 2, peduncle poorly setose. Antenna 2 much heavier than antenna 1, flagellum equal in length to peduncular segments 4 and 5 together. Mandibular palp segment 3 oblique, laterally setose. Coxa 1, anterior margin straight or slightly upcurved, coxae 1 and 2 of the male shallower than 3-5; coxa 5 in both sexes, lower corners evenly rounded. Gnathopod 1, lower lobe of segment 5 narrow, less than half the length of the full segment and not produced forward under segment 6. Gnathopod 2 (♂), segment 3 not produced into an anterior lobe, palm strongly concave, with or without a small "thumb" on the hind corner. Peraeopods 3 and 4 normal, segment

4 more than half as wide as segment 2. Peraeopods 5-7 strong, slightly expanded distally, spines strong. Epimera 1-3 without a lateral ridge. Pleopods with 6-11 coupling hooks. Uropods 1 and 2, rami tipped by a single strong spine. Uropod 3 short, uncini of outer ramus strong. *Ampithoe corallina* Stout 1913, which might also be found in the northeastern Pacific, seems referable to this group.

Ampithoe rubricatoides Shoemaker 1938

Figure 8. (reconstructed from Shoemaker, 1938)

Ampithoe rubricatoides Shoemaker 1938, p. 22, figs. 3, 4

Amphithoe rubricatoides Gurjanova 1951, p. 878-880, fig. 613

Material examined: No material available. Information extracted from Shoemaker (1938).

Distribution: Alaska — Aleutian Islands: Pribilof Islands (57°N,172°W).

Ecology: A cold water species found subtidally at 10-18 m depth in sand and mud sediments.

Diagnosis: Head, antennal sinus absent, eye small. Antenna 2 moderately setose. Mandibular palp segment 2 short, less than twice the length of segment 1; one corner and a group of 4 lateral setae; segment 3 oblique, apically setose for about $^3/_4$ its length. Gnathopod 1 palm very oblique, passing by a scarcely perceptible angle into the hind margin; male segment 2 lacking plumose setae. Gnathopod 2 (♂), segment 5 lacking a dorsal tubercle; hand not greatly enlarged, less than twice the size of the hand of gnathopod 1; palm concave, lacking teeth, other than the normal obturator spine. Peraeopod 7 segment 6 with 5 marginal spine groups. Epimeron 3 hind margin evenly rounded. Uropods very spinose, uropod 1 peduncle with about 15 outer spines, outer ramus with about 25 spines. Uropod 3 peduncle with about 15 crown spines and 2 dorsal spines. Body length: Male 24 mm, female length not stated.

Ampithoe dalli Shoemaker 1938

Figure 9.

Ampithoe dalli Shoemaker 1938, p. 19-22, fig. 2; Gurjanova, 1951, p. 887-890, fig. 618

Ampithoe simulans Barnard, 1965, p. 27-30, fig. 17 (not Alderman 1936)

Material examined: Alaska — Aleutian Islands: 9 specimens from the collections of C.E. O'Clair, 1972-74. Southeastern Alaska; 207 specimens

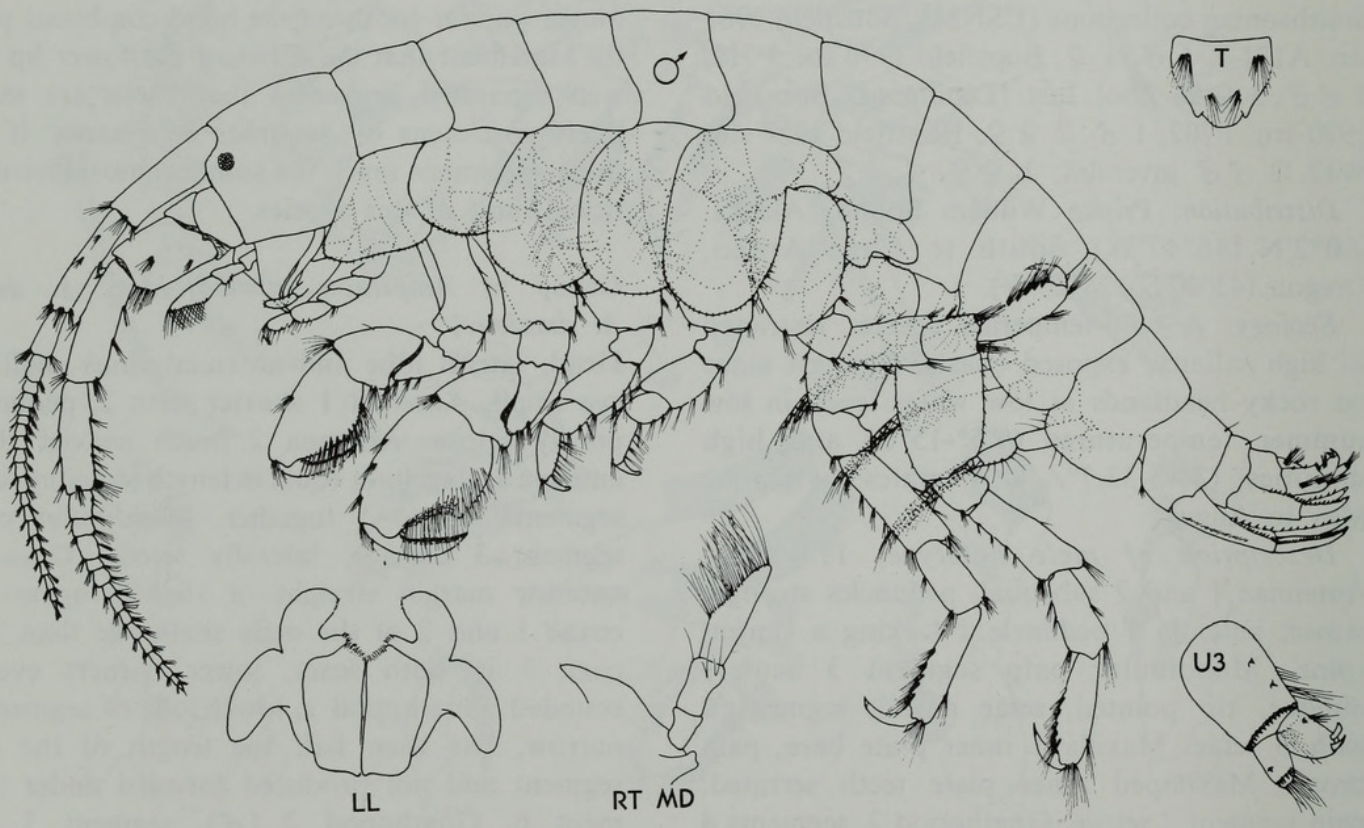

Figure 8. *Ampithoe rubricatoides* Shoemaker ♂ 24.0 mm, Kyska Is., Aleutian Is., Alaska. 1873. Reconstructed from Shoemaker, 1938

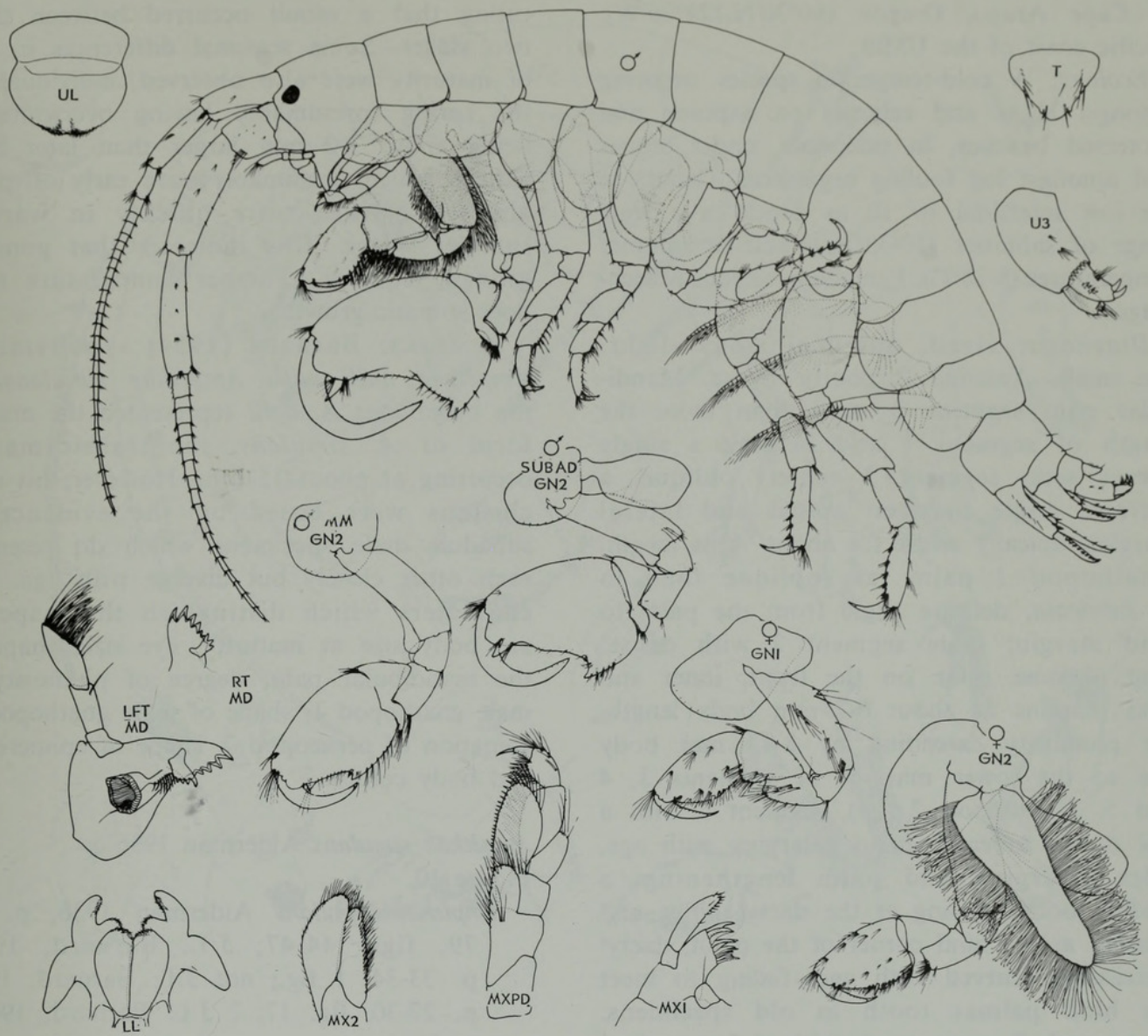

Figure 9. *Ampithoe dalli* Shoemaker ♂ 18.0 mm; ♂ subadult 11.0 mm, ♀ 20.0 mm, Kakul Narrows, Baranof Is., Alaska. 9 June 1961

from Bousfield and McAllister 1961 stns., A2, A5, A7, A18, A23, A25, A27, A33, A37, A43, A48, A68, A71, A98, A105, A115, A121; 50 specimens from Bousfield 1980 stns., S1L1, S7B4, S7B5, S8B1, S11B1, S13B1, S18B1, S20B2, S20B4, S20B5, S20B6.

British Columbia — Queen Charlotte Islands: 40 specimens from Bousfield 1957 stns., E25, H8b, H14, H15, W1, W5a, W9b, W12, W15. Northern mainland: 191 specimens from Bousfield 1964 stns., H1, H13, H29, H33, H35, H40, H44. Vancouver Island and southern mainland: 1 specimen from Bousfield 1977 stn. B12c; 33 specimens from Bousfield 1976 stns., B2, B3, B12a, B13, B14b; 5 specimens from Bousfield 1975 stns., P5d, P18; 25 specimens from Bousfield 1970 stns., P703, P704, P705, P714, P715, P719; 2 specimens from Bousfield 1959 stns., 03, 04; 115 specimens from Bousfield 1955 stns., P2, P4, P7, F2a, F5, G1, G11, G13, M2, M5, M11; in addition, 464 specimens from the collections of J.C. Carl, S. Cross, D.V. Ellis, D. Kittle, R.K.S. Lee, C. Levings, C. Lobban, D.E. McAllister and R.I. Smith.

Washington and Oregon — 3 specimens from Bousfield 1966 stns., W5, W34, W64. Smithsonian collections (USNM): Bousfield 1961 stn. A27, 1 ♂, 1 ♂ juvenile, 1 ♀.

Distribution: Known authentically from Aleutian Islands, Alaska (51°N,179°W) south to Cape Arago, Oregon (60°30'N,124°26'W). Pacific coast of the USSR.

Ecology: A cold-temperate species occuring amongst algae and eelgrass on exposed and protected beaches, in tidepools, under stones and amongst log fouling organisms. Occurs in the low intertidal to 10 m depth in a wide range of salinities (10-33‰), and in summer temperatures (8-18°C). Females ovigerous March-August.

Diagnosis: Head, antennal sinus slight, eye small. Antenna 2 poorly setose. Mandibular palp segment 2 more than twice the length of segment 1 and bearing a single corner seta; segment 3 acutely oblique, a definite angle between apical and lateral margins, apically setose for about ½ its length. Gnathopod 1 palm less oblique than in *A. rubricata*, definite angle from the palm to hind margin; male segment 2 with dense, long plumose setae on the front, inner and hind margins at about 6-7 mm body length, the plumosity extending by 8-12 mm body size to the lower margins of segments 3, 4 and 5. Gnathopod 2 (♂), segment 5 with a low dorsal tubercle; hand enlarging with age, sides diverging and palm lengthening, a medial tooth forming at the dactyl hinge and another at the hind corner of the palm; dactyl increasingly curved with age, failing to meet the hind palmar tooth in old specimens. Peraeopod 7 segment 6 with 5-7 marginal spine groups (depending on age). Epimeron 3 rounded, hind corner with slight indentation holding a small seta. Uropod 1 with not more than 6 spines on the outer peduncle and 10 spines on the outer ramus. Uropod 3 with 6 crown spines and no central spines. Body colour in life: uniformly green to brown speckled. Body length at maturity: male 8-18 mm, female 7-20 mm.

A plot of the body length of 272 specimens against geographic distribution showed a general increase in body size with latitude. In latitude 45°-52°, mean length was 10.8 mm (♂) (range 8-17mm), 10.5 mm (♀) (range 7-15 mm). In latitudes 53°-65°, mean length was 12.2 mm (♂) (range 7-19 mm), 14.1 mm (♀) (range 7-20 mm). In the female, the presence of brooding immatures was found to occur at a size at least 1.5 mm greater than in the condition where the brood pouch was empty but brood lamellae were setose, indicating that a moult occurred between these two stages. Some seasonal differences in size of maturity were also observed, individuals in the spring (presumably having overwintered) being about 1-2 mm larger than later individuals which presumably were early offspring able to mature more quickly in warmer summer water. This indicates that gonadal growth requires a higher temperature than does somatic growth.

Remarks: Barnard (1954) synonymized *Ampithoe dalli* with *Ampithoe simulans*, in the belief that *A. dalli* represented the mature form of *A. simulans*, the transformation occurring at about 15 mm. However, his conclusions were based on the evidence of subadult male specimens which do resemble each other closely but diverge with age. The characters which distinguish these species are body size at maturity, eye size, shape of the mandibular palp, degree of plumosity of male gnathopod 1, shape of male gnathopod 2, spination of peraeopod 7, shape of epimeron 3 and body colour.

Ampithoe simulans Alderman 1936

Figure 10.

Ampithoe simulans Alderman 1936, p. 68-79, figs. 44-47; J.L. Barnard, 1954, p. 33-34, 1 fig.; not J.L. Barnard, 1965, p. 27-30, fig. 17; ? J.L. Barnard, 1969b, p. 85

Material examined: Alaska — Aleutian Islands: 1 specimen from the collection of C.E. O'Clair, 1972 (St. Makarius Bay, Amchitka Island). Southeastern Alaska: 23 specimens from Bousfield and McAllister 1961 stns., A99, A114, A147, A168; 2 specimens from Bousfield 1980 stn. S18B1.

British Columbia — Queen Charlotte Islands: 3 specimens from Bousfield 1957 stns., W1, W9a. 1 specimen from collection of M. Frazer, 1935. Northern mainland: 9 specimens from Bousfield 1964 stns., H12, H16. Vancouver Island: 2 specimens from Bousfield 1975 stns., P5a; 25 specimens from Bousfield 1970 stns., P702, P710, P712, P715; 2 specimens from Bousfield 1959 stn., N1; 4 specimens from the collections of R.K. Lee, 1973 and N.A. Powell, 1966. Washington and Oregon — 10 specimens from Bousfield 1966 stns.,

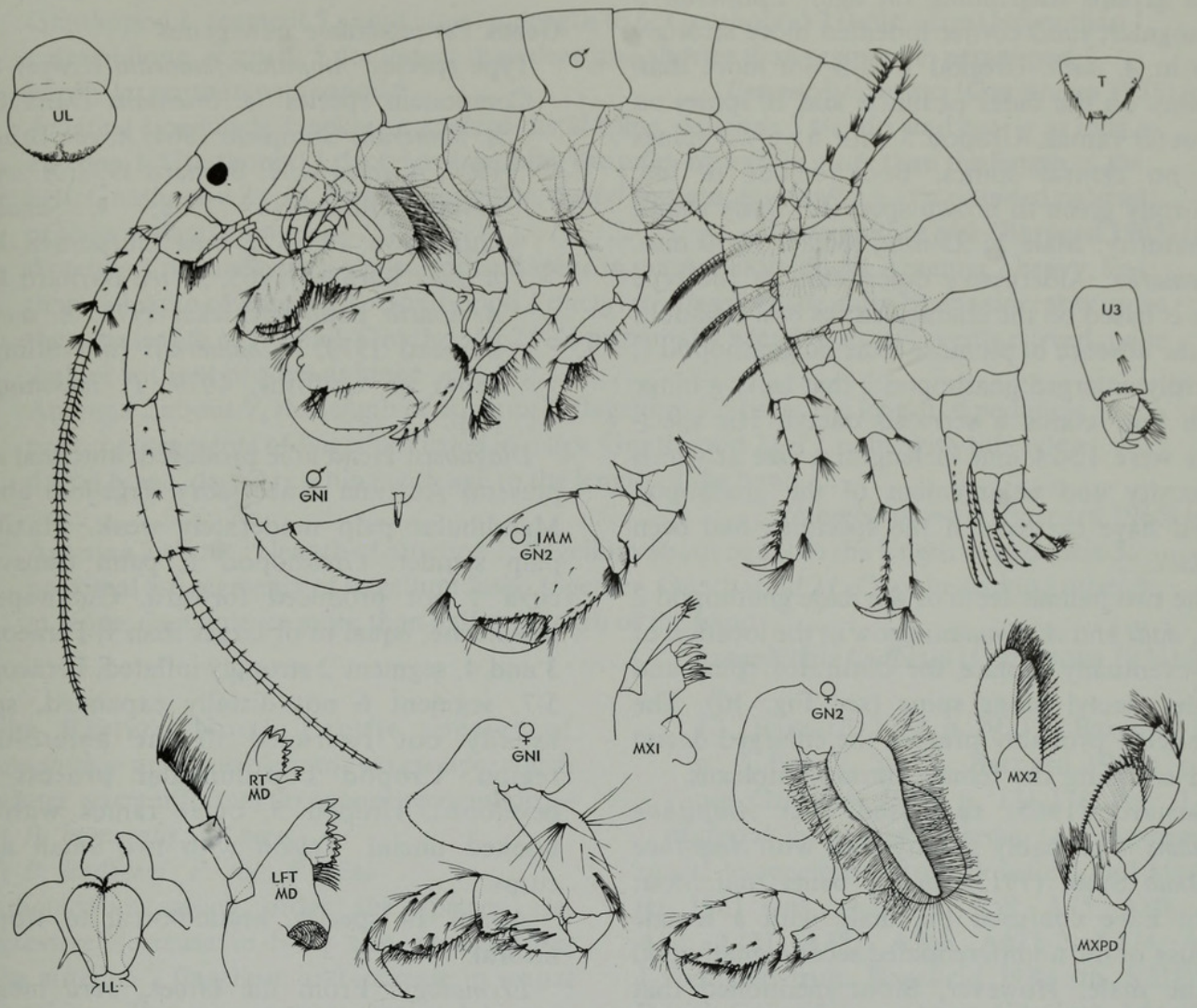

Figure 10. *Ampithoe simulans* Alderman ♂ 18.0 mm; ♂ subadult 13.0 mm; ♀ 15.5 mm, Gonzales Bay, Victoria, B.C. 29 July 1970

W34, W35, W50; 1 specimen from the collection of N. McDaniel.
Smithsonian collections (USNM): R.K. Lee stn. 150E, 1 ♂, 1 ♀.

Distribution: Known authentically from St. Makarius Bay, Amchitka Island, Alaska (51°N, 179°W) south to Cannon Beach, Clatsop Co., Oregon (45°54.5′N,123°58′W).

Ecology: A cold temperate species occurring from low water level to 4 m depth, amongst algae and eelgrass on semi-protected and exposed coasts in summer temperatures 10-16°C, salinities 29-34°/$_{oo}$, occasionally in brackish water.

Diagnosis: Head, antennal sinus slight, eye larger than in *A. dalli*. Antenna 2 poorly setose. Mandibular palp segment 2 more than twice the length of segment 1 and bearing 1 or 2 setae; segment 3 very oblique, passing by a barely perceptible angle into the lower margin and setose for nearly the full length. Gnathopod 1 palm less oblique than in *A. rubricata*, palm verging into the hind margin at a definite angle; male segment 2 with a few plumose setae on the hind margin only (beginning at 11-15 mm body length), but plumosity not extending to other segments. Gnathopod 2 (♂), segment 5 with a low dorsal tubercle; hand enlarging with age and sides diverging, palm becoming increasingly concave, hind corner lengthening to form a broad tooth, a smaller medial tooth developing at the dactyl hinge; dactyl increasingly curved

with age but always meeting the long hind tooth. Peraeopod 7 segment 6 with 6-8 marginal spine groups (depending on age). Epimeron 3 rectangular, hind corner indented more strongly than in *A. dalli*. Uropod 1 with not more than 6 spines on the outer peduncle and 10 spines on the outer ramus. Uropod 3 with 6 crown spines and no central spines. Body colour in life: uniformly green to brown speckled. Body length at maturity: Male 11-23 mm, female 12-30 mm.

Remarks: Alderman's description of the type male is based on the characteristics of a subadult: viz. the absence of plumose setae on gnathopod 1, a hardly enlarged gnathopod 2 that lacks a hinge tooth but retains a serrated dactyl. His specimens were 12-24 mm in length, a size at which plumosity and enlargement of the gnathopod would have occurred if the specimen had been *A. dalli*.

The two palmar teeth of the male gnathopod 2 of *A. dalli* and *A. simulans* grow at the location of and eventually replace the obturator spine and slender dactyl hinge spine (see Fig. 10). The large teeth probably prevent the enlarged dactyl from crimping the female during amplexus.

Barnard (1965) suggested that *Ampithoe simulans* is probably synonymous with *Ampithoe corallina* Stout (1913), in the belief that Stout might have confused the male with a female because of the undifferentiated second gnathopod of the male. However, Stout mentioned that females of 6-8 mm were carrying eggs, indicating that this species matures at a much smaller size than *A. simulans*. *A. corallina* differs also in the following: head very deep and broad, relatively strongly setose antennae, large number of segments in antennal flagella, lower lip outer lobes subequal in size, mandibular palp obliquely acute with only 6 setae.

The two aberrant specimens of *A. simulans* shown by Barnard to have a deeply incised hand of gnathopod 2 are indeed not this species but males of *Ampithoe sectimanus* n.sp.

Genus *Peramphithoe* new genus

Type species: *Ampithoe femorata* Krøyer 1845

Component species: *A. orientalis* Dana 1853, *A. humeralis* Stimpson 1864, *A. eoa* Brüggen 1907, *A. falsa* K.H. Barnard 1932, *A. annenkovae* Gurjanova 1938, *A. lindbergi* Gurjanova 1938, *A. mea* Gurjanova 1938, *A. plea* Barnard 1965, *A. tea* Barnard 1965, *A. spuria* Krapp-Schickel 1978, *A. aorangi* Barnard 1979, *P. humeralis* (not Stimpson 1864) of Griffiths, 1979, ***P. lessoniophila*** n.sp.

Diagnosis: Head lobe produced, antennal sinus present. Antenna 1 accessory flagellum absent. Mandibular palp moderately weak. Maxilla 1 palp slender. Gnathopod 1, palm transverse, coxa 1 not produced forward. Gnathopod 2 subchelate, equal to or larger than 1. Peraeopods 3 and 4, segment 2 strongly inflated. Peraeopods 5-7, segment 6 not distally expanded, spines usually not restricted to the antero-distal region. Uropod 1 peduncular process well developed. Uropod 3, outer ramus with two hooked uncini. Telson with two small apical cusps.

About 14 species, arctic-boreal to tropical, littoral.

Etymology: From the Greek, *pera* meaning beyond or across, referring both to the transverse form of the first gnathopod and the advanced form in relation to *Amphithoe*. The correct spelling of '*Amphithoe*' is herein applied as derived from the Greek amphi = around, both, and thoë = quick.

Northeastern Pacific species: *Peramphithoe humeralis* (Stimpson 1864), *P. mea* (Gurjanova 1938), *P. lindbergi* (Gurjanova 1938), *P. tea* (Barnard 1965), *P. plea* (Barnard 1965).

Key to Species of *Peramphithoe* of the Northeastern Pacific

1. Body large, 19-35 mm at maturity. Antenna 2 flagellum slender, proximal segments not fused. Gnathopod 1, segment 5 shorter than segment 6. Peraeopod 5, segment 4 longer than 5. Male gnathopod 2 hardly enlarged, dactly less than twice the length of the dactyl of gnathopod 1 2

   Body small, 6-12 mm at maturity. Antenna 2 flagellum heavy, proximal segments fused. Gnathopod 1, segment 5 equal to or longer than segment 6. Peraeopod 5, segments 4 and 5 subequal. Male gnathopod 2 enlarged, dactyl more than twice the length of the dactyl of gnathopod 1 3

2. Gnathopod 1, segment 5 longer than 6. Gnathopod 2 (both sexes) subequal to 1, palm transverse; segment 5 longer than deep and as long as segment 6. Peraeopod 7 larger and about one third longer than peraeopod 6 ..... *Peramphithoe humeralis* (Stimpson 1864) (p. 61)
Gnathopod 1, segment 5 about equal in length to 6. Gnathopod 2 (both sexes) larger than 1, palm oblique; segment 5 not longer than deep and shorter than segment 6; peraeopod 7 hardly larger than peraeopod 6 ..... *Peramphithoe mea* (Gurjanova 1938) (p. 63)

3. Antenna 1 peduncle 1 lacking a postero-distal spine. Antenna 2 slender and nearly as long as antenna 1. Gnathopod 1 dactyl overlapping the palm by hardly more than the length of the nail. Gnathopod 2 (♂), hand rectangular, dactyl sinuous, palm with a low rounded palmar process at dactyl hinge ..... *Peramphithoe plea* (Barnard 1965) (p. 67)
Antenna 1 peduncle with a posterodistal spine in mature individuals. Antenna 2 heavy, less than ¾ length of antenna 1. Gnathopod 1 dactyl overlapping the palm by considerably more than the length of the nail. Gnathopod 2 (♂) proximally broader, dactyl evenly curved, palm with or without process at hinge 4

4. Antenna 2 about ¾ the length of antenna 1; flagellum 1½ times the length of peduncle 5, proximal segments of flagellum fused in pairs. Gnathopod 2 (♂), palm with tubercle at dactyl hinge, dactyl reaching with age to the length of the hand ..... *Peramphithoe tea* (Barnard 1965) (p. 65)
Antenna 2 about ½ length of antenna 1; flagellum about equal to the length of peduncle 5, proximal 5-6 segments of flagellum fused together. Gnathopod 2 (♂), palm lacking tubercle at hinge, dactyl never more than half the length of the hand ..... *Peramphithoe lindbergi* (Gurjanova 1938) (p. 64)

The Eastern North Pacific species of *Peramphithoe* are divisible into two groups, which may later warrant formal taxonomic recognition —
1) *P. humeralis*, *P. mea*
2) *P. lindbergi*, *P. tea*, *P. plea*
Characteristics which order the species are, progressive decrease in body size, compression of the antenna 2 flagellum and increase in sexual dimorphism. This may represent an evolutionary gradient.

Group of *Peramphithoe humeralis* and *P. mea*
Body large, 19-35 mm at maturity. Eye medium to small. Antenna 2 flagellum slender, proximal segments not fused. Lower lip outer lobes, apical longer than medial. Gnathopod 1, segment 5 longer than or equal to 6. Gnathopod 2 not greatly enlarged, scarcely sexually dimorphic. Peraeopods 3 and 4, segment 4 barely extending over segment 5. Peraeopod 5, segment 4 longer than 5. Peraeopods 6 and 7 anterior and posterior setae short, about equal in length. Pleopods with 8-9 coupling hooks.

Peramphithoe humeralis (Stimpson 1864)
Figure 11.

Amphithoe humeralis Stimpson 1864, p. 156; Calman, 1898, p. 271-273, pl. 33, fig. 4; Holmes, 1904, p. 241; Hewatt, 1946, p. 199, 204.

Ampithoe humeralis: Stebbing, 1906, p. 636; J.L. Barnard, 1954, p. 29; J.L. Barnard, 1965, p. 7, figs. 2, 3; J.L. Barnard 1969b, p. 83, not Griffiths, 1979, p. 131-138, figs. 1-3.

Material examined: Alaska — southeastern coast: 36 specimens from Bousfield and McAllister 1961 stns., A3, A6, A59, A75, A80, A81, A83, A131, A151, A168, A171-2, A174, A175; 1 specimen from Bousfield 1980 stn. S23F1. British Columbia — Queen Charlotte Islands: 11 specimens from Bousfield 1957 stns., E5, H2a, H3, H14, W1; 5 specimens from the collection of W. Spreadborough. Northern mainland: 6 specimens from Bousfield 1964 stns., H3, H7, H26, H30, H47, H65. Vancouver Island and southern mainland: 2 specimens from Bousfield 1977 stns., B6b, B8; 1 specimen from Bousfield 1975 stn., P5c; 18 specimens from Bousfield 1970 stns., P710, P711, P712, P715; 3 specimens from Bousfield 1959 stns., 015, V4b; 3 specimens from Bousfield 1955 stns., F8, P7; 23 specimens from the collections of J.F.L. Hart, D. Kittle, N.A. Powell, D.B. Quayle, D. Zittin. Washington — 1 specimen from Bousfield 1966 stn., W35; 4 specimens from the collection of R.M. O'Clair, 1974. Smithsonian collections (USNM): Bousfield 1961 stn. A75, 2 ♂♂, 1 ♀ subadult, 1 ♀ juvenile, 3 immatures; stn. A6, 1 ♀, 1 immature.

Distribution: Prince William Sound, Alaska (60°40'N,145°36'W), south to Guadalupe Island, Baja California.

Ecology: Occurs amongst eelgrass and kelp,

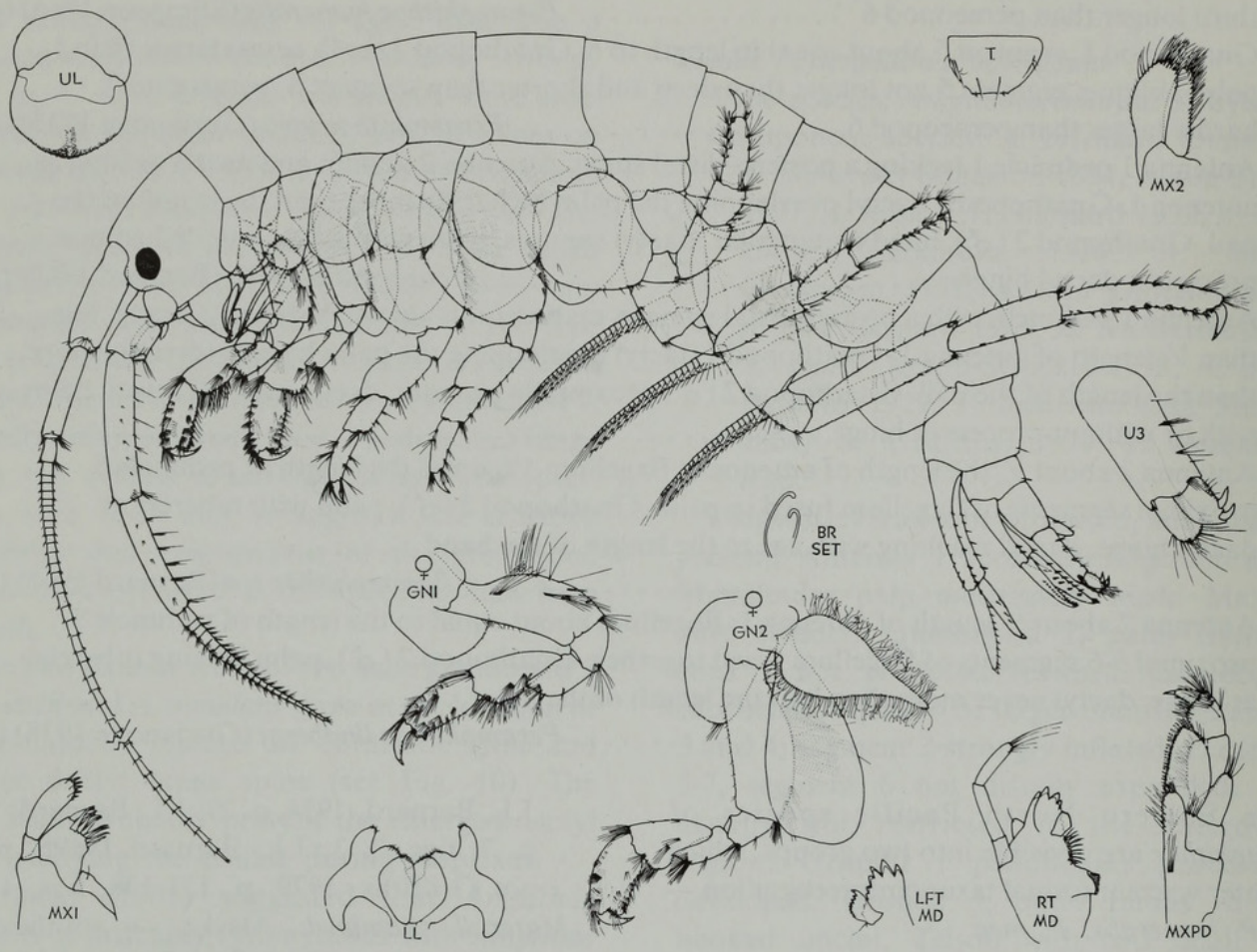

Figure 11. *Peramphithoe humeralis* (Stimpson) ♂ 15.0 mm; ♀ 19.0 mm, Trevor Channel, Barkely Sound, Vancouver Is., B.C. 25 May 1977

curling a frond around itself to form a tube. Several animals, such as a brood of young accompanying the parent may use the same tube (Jones, 1971). Mainly intertidal in the north, subtidal in California to a depth of 70 m. Usually in high salinity, exposed or semi-protected shores where summer water temperature is 9.5-14.5°C, salinity 14.3-32.7°/$_{oo}$. Females ovigerous June to August.

Diagnosis: Eye medium. Gnathopod 1, segment 5 longer than segment 6. Gnathopod 2, both sexes, not enlarged, palm transverse, segment 5 equal to or longer than 6, hind lobe broad and rounded. Peraeopod 5 segment 2 nearly as broad as long, lower hind edge concave. Peraeopod 7 much stronger than 6 and about a third longer, segment 6 with about 12 spine groups. Uropod 3 peduncle long, more than twice the length of the rami. Body colour in life: uniformly orange to brown. Body length at maturity: male up to 34.5 mm, penial papillae developing at 5 mm; female 19-35 mm.

Remarks: Superficially, an immature specimen may resemble the female or immature of another species. If the specimen is 8 mm or greater it can be recognized within the genus by the lack of brood plates and unaltered gnathopod 2. Other distinguishing features are the long segment 5 of gnathopods 1 and 2, slender antenna 2 and long peraeopod 7. The South African *Ampithoe humeralis* of Griffiths (1979) differs from the North American type in the form of the antennae, coxae, gnathopods, peraeopods 5-7, uropod 3, mandibular palp, lower lip and size of maturity. These differences are sufficient to designate the South African specimens as a new species. Its habits are similar to those of the North American *P. humeralis* in rolling a kelp blade into a tube and living in a colony. The upper walls of the tube are consumed by the

occupants, necessitating progressive extension of the tube downwards (Jones, 1971).

Peramphithoe mea (Gurjanova 1938)
Figure 12.

Amphithoe mea Gurjanova 1938, p. 361-364, fig. 53; 1951, p. 882-885, fig. 616; ? J.L. Barnard, 1966, p. 60

Material examined: Alaska — Aleutian Islands: Stag Point, Deer Island, 1 male from the collection of P. McRoy and P.A. Lebednik, 1970; Cold Bay, Amchitka Island, 1 male, 2 immature females from the collection of C.E. O'Clair 1970.

Distribution: Aleutian Islands, Alaska (51°N, 179°W); Japan Sea (45°N,130°E).

Ecology: A cold water species found amongst eelgrass and algae at 5-60 m depth, rarely intertidal.

Diagnosis: Eye small. Gnathopod 1, segment 5 about equal in length to segment 6. Gnathopod 2, both sexes, larger than 1, palm oblique; segment 5 shorter than 6, narrowed into an acute hind lobe. Peraeopod 5 segment 2 slender, longer than wide, lower hind edge evenly rounded. Peraeopod 7 little stronger than 6, segment 6 with about 9 spine groups. Uropod 3 peduncle normal, twice the length of the rami. Body length at maturity: male 18-22 mm, female probably about the same.

Remarks: The specimens examined closely resemble Gurjanova's holotype but lack a spine on the postero-distal margin of antenna 1, peduncle 1. In view of the large size reached by this species (18-22 mm), the probability, as suggested by Barnard (1965), that *P. mea* is simply an early growth stage of the much smaller (maximum 8 mm) *P. annenkovae* is highly unlikely.

Barnard's (1965) inclusion of his *Ampithoe* sp., within *P. mea* is unjustified. This species is only 8 mm yet has a more strongly developed second gnathopod resembling that of *P. lindbergi*, a very large eye, shorter segment 5 on the first

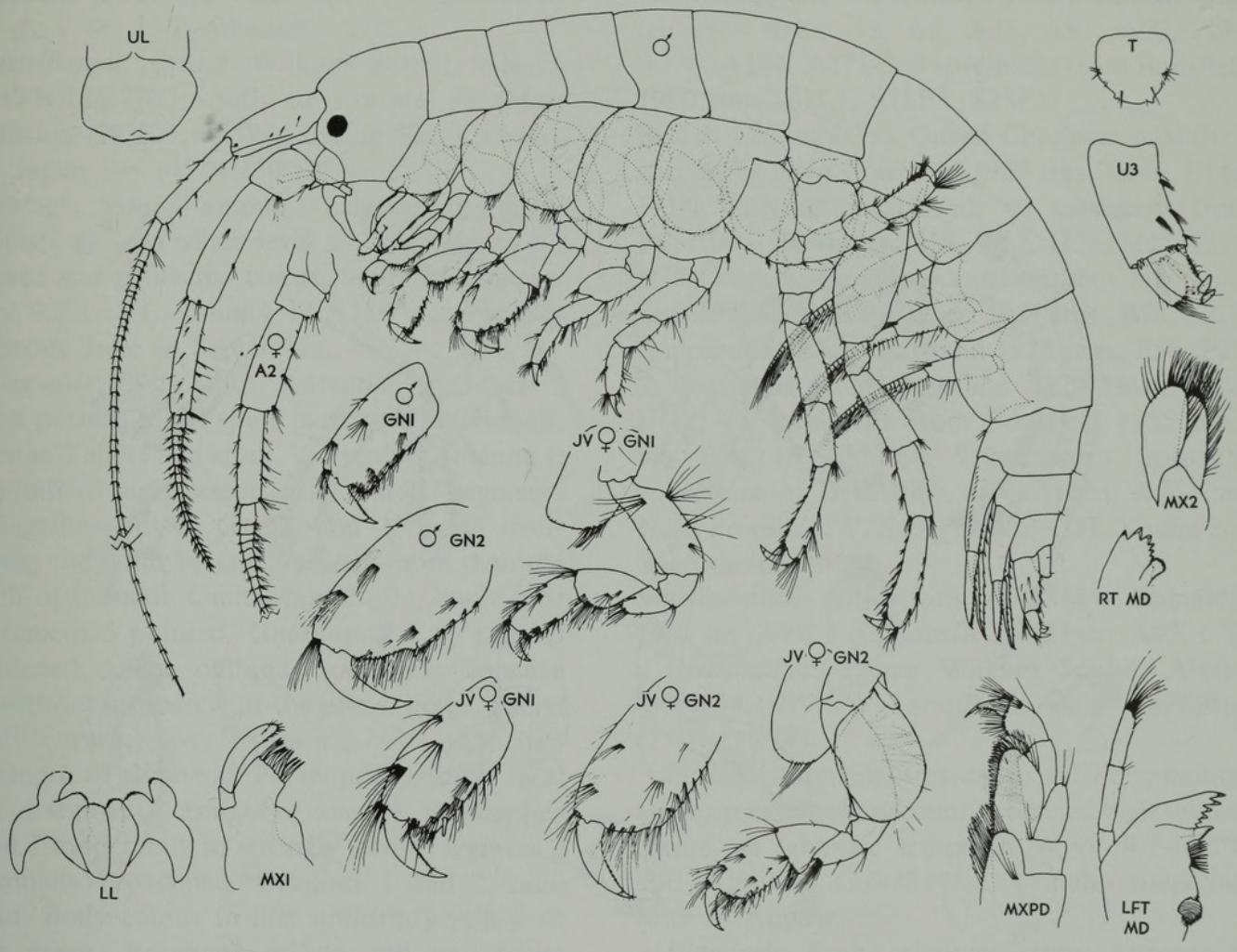

Figure 12. *Peramphithoe mea* (Gurjanova) ♂ 18.0 mm, Deer Is., Aleutian Is., Alaska. 17 Sept. 1970

gnathopod, much more expanded segment 2 and shortened segment 4 on peraeopod 5 and generally more setose appendages.

Barnard's (1969b) inclusion of his Oregon *Ampithoe eoa* (Barnard 1954, not *P. eoa* (Brüggen 1970)) is similarly not justified. At 10 mm the male gnathopod is greatly enlarged, similar in shape to that of *P. tea* with two palmar tubercles, segment 5 of the first gnathopod is shorter than segment 6 and more strongly lobed, segment 4 of peraeopods 3 and 4 are more strongly expanded, segment 2 of peraeopod 5 is broader than deep and segment 4 is subequal to 5, uropod 2 peduncular process is very small, uropod 3 peduncle bears a central spine, the appendages are more strongly setose, and the outer lobes of the lower lip are equal in length.

Peramphithoe eoa (Brüggen 1907) is probably also a separate species, rather than a later growth stage as Barnard (1965) suggested. In this species the apical lobes of the lower lip are much longer than the medial, the palp of maxilla 1 is broader and more spinose, the peduncle of uropod 3 is much longer, the gnathopod 2 of the female is less oblique and the palm crenulate, and in the male the hand of the second gnathopod is rectangular and the dactyl much longer, reaching back to segment 4.

Group of *Peramphithoe lindbergi*, *P. tea* and *P. plea*

Body small, 6-12 mm at maturity. Eye moderately large. Antenna 2 flagellum heavy, 5-6 proximal segments fused. Lower lip outer lobes, apical and medial subequal. Gnathopod 1, segment 5 shorter than 6. Gnathopod 2 enlarged, strongly sexually dimorphic. Peraeopods 3 and 4, segment 4 extending downwards over segment 5. Peraeopod 5, segments 4 and 5 subequal. Peraeopods 6 and 7, posterior setae longer than anterior setae. Pleopods with 5-6 coupling hooks.

Peramphithoe lindbergi (Gurjanova 1938)
Figure 13.

Amphithoe lindbergi Gurjanova 1938, p. 351-354, fig. 49; 1951, p. 892-895, fig. 620

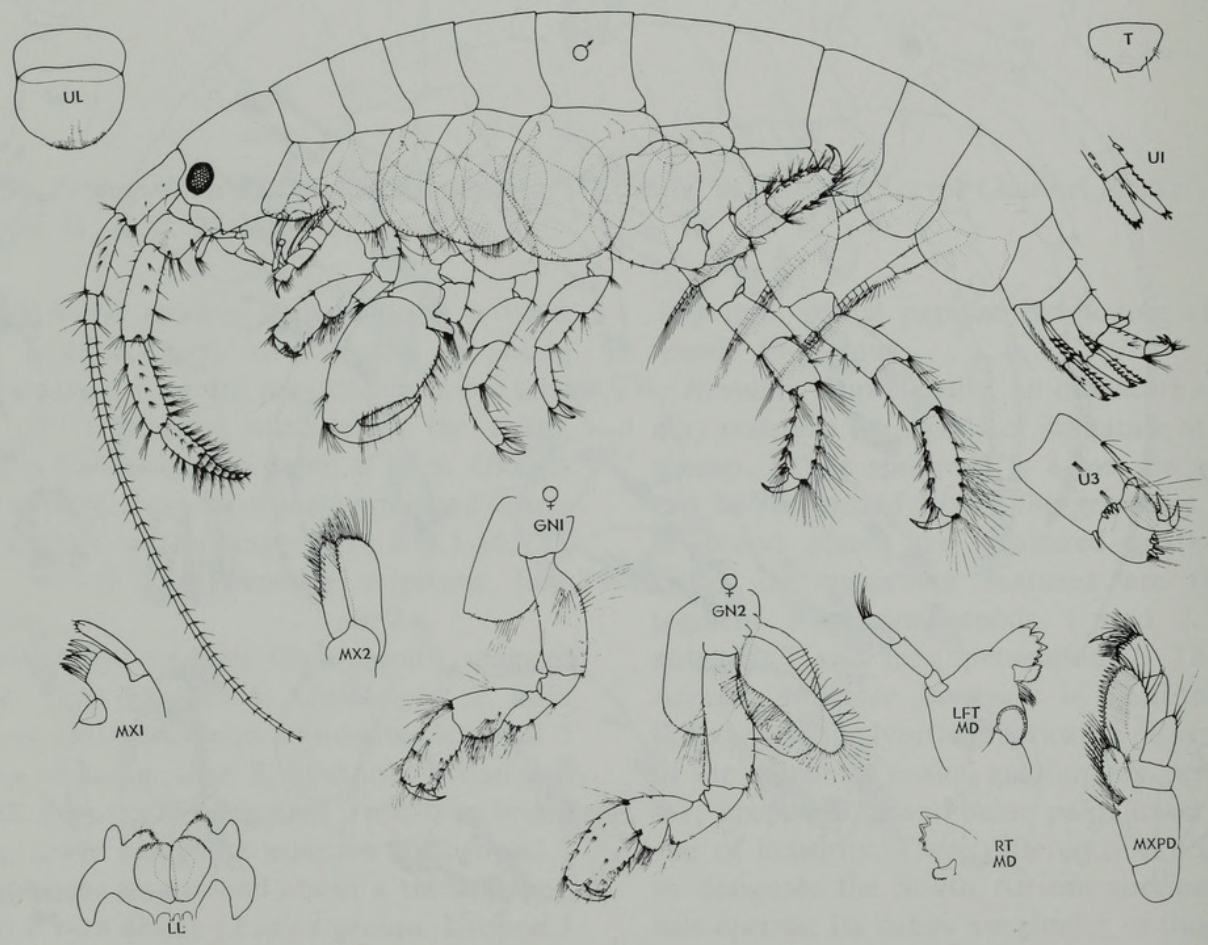

Figure 13. *Peramphithoe lindbergi* (Gurjanova) ♂ 11.0 mm; ♀ 10.0 mm, Haines Is., Barkley Sound, Vancouver Is., B.C. 8 August 1975

Ampithoe femorata Krøyer 1845: J.L. Barnard, 1952, p. 24-28, pls. 6, 7 (not Krøyer, 1845)
Ampithoe lindbergi: J.L. Barnard, 1965, p. 12-15, figs. 6, 7; 1969b, p. 83, 84

Material examined: Alaska — southeastern coast: 37 specimens from Bousfield and McAllister 1961 stns., A68, A70, A80, A86, A90, A92, A115, A131, A151, A174, A175.
British Columbia — Queen Charlotte Islands: 13 specimens from Bousfield 1957 stns., E25, H4a, H9, H11, W2. Northern mainland: 20 specimens from Bousfield 1964 stns., H4, H5, H17, H29, H33, H47, H53, H65. Vancouver Island and southern mainland: 4 specimens from Bousfield 1977 stn., E3; 1 specimen from Bousfield 1975 stn., P25; 2 specimens from Bousfield 1970 stns., P715, P721; 1 specimen from Bousfield 1964 stn., H43; 15 specimens from Bousfield 1959 stns., N1, 011, V5, V10, V17, V19, V20; 1 specimen from Bousfield 1957 stn. P2; 3 specimens from Bousfield 1955 stns., F2, F6; 15 specimens from the collection of L. Daniels 1975. Smithsonian collections (USNM): Daniels 1975 collection 2 ♂♂, 1 ♀, 1 ♀ subadult.

Distribution: Prince William Sound, Alaska (60°43′N,146°7′W) south to Corona del Mar, California (35°5′N,118°W); Bering Sea, Okhotsk Sea, Japan Sea (45°N,130°E).

Ecology: Found amongst eelgrass and algal holdfasts at low water level to 18 m depth on exposed and protected coasts. Summer temperatures: 9.8-17.5°C, salinity 14.8-33+‰. Females ovigerous June to September.

Diagnosis: Body stout. Antenna 1 peduncle 1 with a postero-distal spine in mature individuals. Antenna 2 short and stout, ½ length of antenna 1; flagellum strongly setose, proximal 4-7 segments of flagellum fused. Gnathopod 1 dactyl overlapping the palm by considerably more than the length of the nail. Gnathopod 2 (♀), lower lobe of segment 5 pointed. Gnathopod 2 (♂), hand broadened, palm oblique, somewhat concave but without a tubercle at the dactyl hinge, dactyl evenly curved, never extending more than half the length of the hand. Peraeopod 5, lower hind edge of segment 2 straight or concave. Peraeopods 6 and 7 moderately to strongly setose, segment 2 proximally broadened. Uropods 1 and 2, rami broad. Body colour in life: uniformly yellow to olive green. Antennae yellow, red and white banded. Body length at maturity: Male 6-10.5 mm, female 6.5-12.5 mm.

Remarks: The length of the flagellum of antenna 2 is quite variable and the loss of segments in the male as described by Barnard (1965) seems to represent a difference in the degree of segment fusion. A count of the number of setal bundles on flagellum 2 of 22 individuals gave a value of 8 in 7 mm specimens, to 12-14 in 10-12 mm specimens, consistently about 2 bundles less than in *Peramphithoe tea*. Immatures and females which lack antennae 2 are very difficult to distinguish from *P. tea*.

P. lindbergi cannot be a younger stage of *P. annenkovae* or *P. plea*, as Barnard (1965) suggested, in view of the differences stated herein, the nearly identical range in size at maturity of *P. plea* (7-10 mm), and the smaller size at maturity of *P. annenkovae* (max. 8 mm).

Peramphithoe tea (Barnard 1965)
Figure 14.

Ampithoe tea Barnard 1965, p. 30-34, figs. 19—21; ? 1969b, p. 85

Material examined: Alaska — southeastern coast: 10 specimens from Bousfield and McAllister 1961 stns., A3, A8, A18, A91, A92, A96, A136, A164, A171-2; 8 specimens from Bousfield 1980 stns., S1L1, S18F3, S23F1.
British Columbia — Queen Charlotte Islands: 7 specimens from Bousfield 1957 stns., H4a, E14a, W14. Northern mainland: 46 specimens from Bousfield 1964 stns., H8, H12, H22, H25, H26, H30. Vancouver Island and southern mainland: 3 specimens from Bousfield 1977 stns., B7a, B21b; 3 specimens from Bousfield 1975 stns., P5b, P25; 2 specimens from Bousfield 1970 stns., P706, P712; 11 specimens from Bousfield 1955 stns., F1, P6a. In addition, 9 specimens from the collections of D.V. Ellis, J.F.L. Hart, R.K. Lee, N.A. Powell, J.W. Scoggan and C.H. Young and W. Spreadborough.
Smithsonian collections (USNM): Bousfield 1961 stn. A91, 1 ♂; Bousfield 1961 stn. A92, 1 ♀.

Distribution: Prince William Sound, Alaska (60°46′N,146°31′W), south to Baja California (27°N,115°W).

Ecology: Intertidal to a depth of 67 m, amongst algae on exposed and semi-protected high salinity coasts, in summer temperatures of 9.7-14.5°C and salinities 17.0-33+‰. Females ovigerous May to August.

Diagnosis: Body relatively stout. Antenna 1, peduncle segment 1 with a postero-distal spine in mature individuals. Antenna 2 heavy, about ¾ the length of antenna 1, flagellum moderately

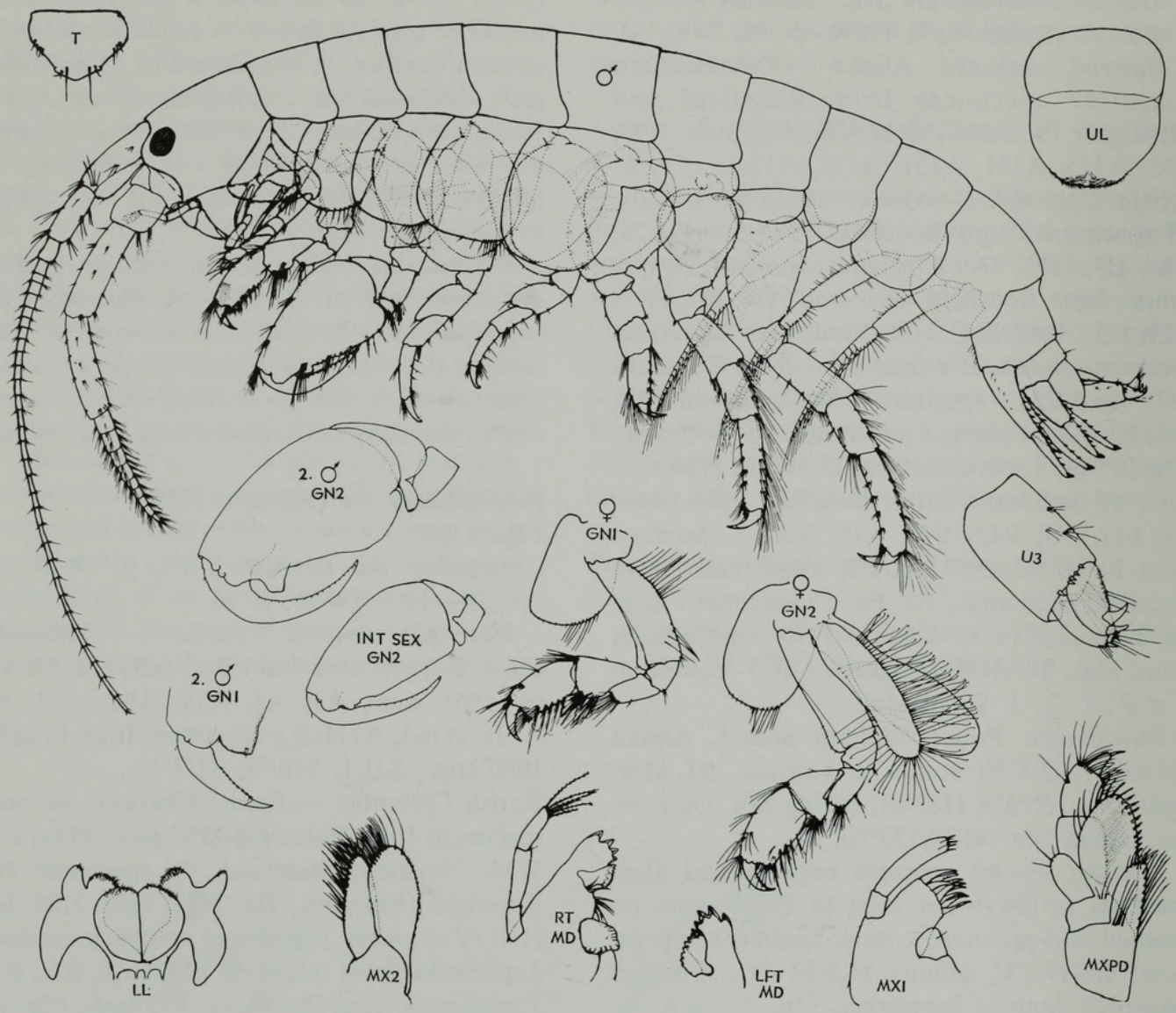

Figure 14. *Peramphithoe tea* (Barnard) ♂ 8.0 mm; ♀ 7.5 mm, Whiffen Spit, Sooke, Vancouver Is., B.C. 11 August 1969. Intersex, Yakoun Bay, Queen Charlotte Islands, B.C.

setose, proximal segments of flagellum fused in pairs. Gnathopod 1 dactyl overlapping the palm by considerably more than the length of the nail. Gnathopod 2 (♀), lower lobe of segment 5 pointed. Gnathopod 2 (♂), hand broadened, palm crenulate; at about 7.5 mm body length, palm developing a square or crenulate tubercle near the dactyl hinge. Dactyl evenly curved or slightly sinuous, increasing with age to the full length of the hand. Peraeopod 5, lower hind edge of segment 2 straight or concave. Peraeopods 6 and 7 moderately setose, segment 2 proximally broadened. Uropods 1 and 2, rami broad. Body length at maturity: male 7.5-12 mm, female 6-10 mm.

Remarks: The male illustrated herein, the same size as Barnard's holotype, has a much shorter dactyl on the second gnathopod and is less strongly setose. In no specimens in this collection is the dactyl more than $^3/_4$ the length of the palm, although body lengths are comparable.

The tubercle in the palm of the male second gnathopod of this species and *P. plea* probably arises from the obturator spine and may act to prevent the dactyl from closing too tightly. The first gnathopod sometimes appears to be parachelate, a tendency that Barnard (1970) noted in a new Hawaiian species.

Peramphithoe plea (Barnard 1965)
Figure 15.

Ampithoe plea Barnard 1965, p. 15-20, figs. 9, 10

Material examined: British Columbia — Queen Charlotte Islands: 2 immatures from Image Point, Skidegate Inlet (Bousfield, 1957 collection, stn. E5). Vancouver Island: Dodger Channel, Barkley Sound; mature male and female from the collection of D. Zittin, 1976.

Distribution: Queen Charlotte Islands, B.C. (53°15'N,132°00'W), south to Santa Barbara, California (34°N,120°W).

Ecology: Occurs amongst kelp holdfasts on high salinity exposed coasts, intertidally in the north and subtidally to 17 m in the south.

Diagnosis: Body slender. Antenna 1 peduncle 1 lacking a ventral distal spine. Antenna 2 long and slender, $^1/_3$ to $^3/_4$ length of antenna 1; flagellum weakly setose, proximal 2-4 segments fused. Gnathopod 1 dactyl overlapping the palm by only about the length of the nail. Gnathopod 2 (♀), lower lobe of segment 5 rounded. Gnathopod 2 (♂), hand rectangular, dactyl sinuous, increasing with age to the full length of the hand; palm smooth, with a low, rounded process near the dactyl hinge. Peraeopod 5, lower hind edge of segment 2 convex, evenly rounded. Peraeopods 6 and 7 weakly setose, segment 2 slender, margins parallel. Uropods 1 and 2, rami slender. Body length at maturity: Male 7-10 mm, female 7.5-12.5 mm.

Remarks: The individuals described here differ

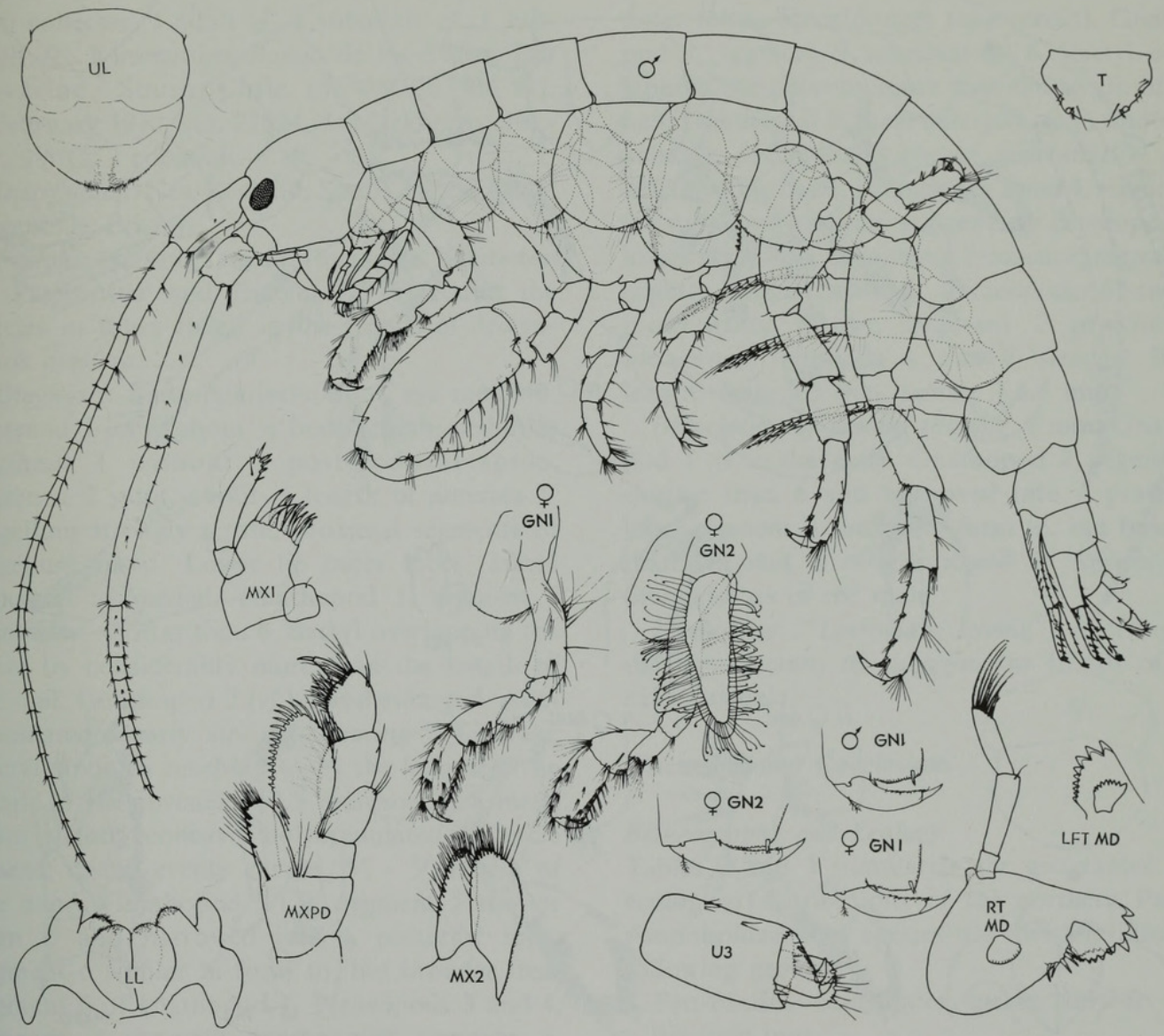

Figure 15. *Peramphithoe plea* (Barnard) ♂ 10.0 mm; ♀ 12.5 mm, Dodger Channel, Barkley Sound, Vancouver Is., B.C. 28 June 1976. Queen Charlotte Is., B.C. 19 August 1957

slightly from Barnard's holotype in that antenna 2 flagellum is less setose, the dactyl of gnathopod 1 is somewhat longer and the dactyl of the male gnathopod 2, although of a specimen 1.5 mm longer than the holotype, does not reach the full length of the hand.

The two species from the boreal coast of South America warrant inclusion in the monograph because their morphology verifies conclusions justifying the transfer of the transverse-handed *Ampithoe* to the new genus *Peramphithoe*. They meet all diagnostic criteria for the genus and most closely resemble members of the *P. lindbergi* group. The first appears to be, from the descriptions of Stebbing (1906) and Kreibohm de Paternoster & Escofet (1976), *Ampithoe femorata* Krøyer 1845 (herein re-described and assigned the new generic title). The second is a new species found in colonies amongst the fronds of *Lessonia* in self-constructed chambers (H.K. Schminke, pers. comm.). It is consequently assigned the name *Peramphithoe lessoniophila*.

Peramphithoe femorata (Krøyer 1845)
Figure 16.

Ampithoe femorata Krøyer 1845, p. 335, figs. 4a-i

Amphithoe femorata: Stebbing, 1906, p. 636-637; Chilton, 1921, p. 88; Schellenberg, 1931, p. 245; Kreibohm de Paternoster & Escofet,

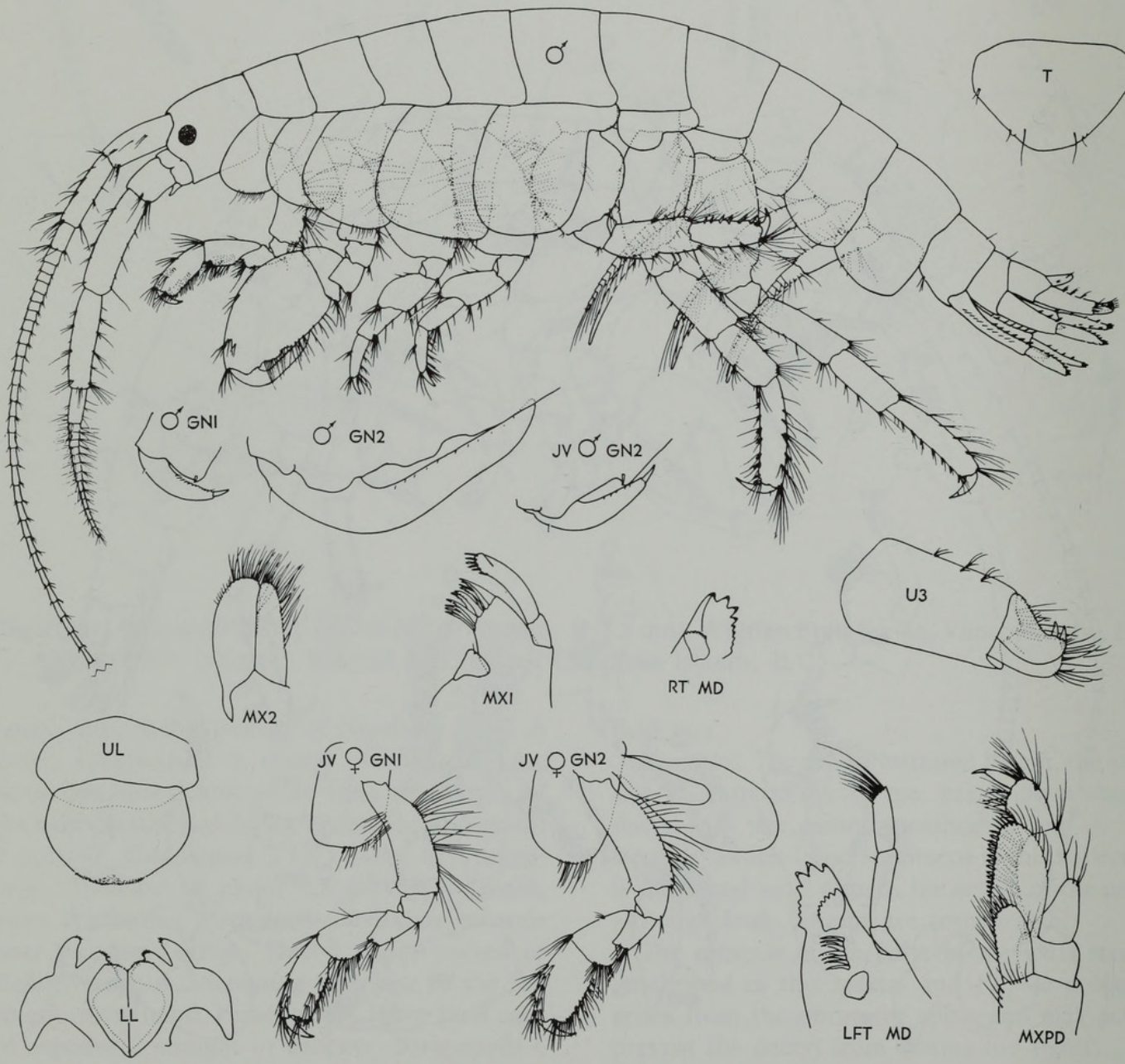

Figure 16. *Peramphithoe femorata* (Krøyer) ♂ 18.0 mm; ♂ subadult 12.5 mm; ♀ subadult 13.0 mm. Cape Horn Is., South America. 1970.

1976, p. 77-91, figs. 1-3; (not J.L. Barnard, 1952, p. 24-28, pls. 6-7); Alonso, 1980, p. 4-5, fig. 1.

? *Amphitoe gaudichaudii* H. Milne Edwards 1840, p. 31

Amphithoe brevipes Dana 1852, p. 216; 1853-55, p. 941, pl. 64, figs. 5a-n.

Ampithoe brevipes: Stebbing, 1906, p. 637; 1914, p. 371, ? K.H. Barnard, 1916, p. 255-256, fig. 34.

? *Amphithoe peregrina* Dana 1853-55, p. 940, pl. 64, figs. 4a-b; 1862, p. 247, pl. 43, fig. 1

? *Amphithoe falklandi* Bate 1862, pp. 237-248, figs. 1, 2, 6.

? *Amphithoe rubricata*: Della Valle, 1893, p. 456, 459 (not Montagu 1808)

? *Grubia crassicornis*: Della Valle, 1893, p. 456

Material examined: Cape Horn Island, South America (55°S,77°W), 1970 stn. 27896, J. Markham collector, 1 adult ♂, 1 subadult ♂, 1 subadult ♀, 1 immature; Banco de los Tacas, Isla Navarino, South Chile (55°05'S,67°04'W), 5 February 1970, stn. 27924, J. Markham collector, 9.5°C, 2 subadult ♂♂.

Distribution: New Zealand, South Africa, Chile, Argentina, Brazil?.

Ecology: No sampling data available. Kreibohm de Paternoster and Escofet (1976) found the species in tubes rolled in the fronds of *Macrocystis pyrifera*.

Diagnosis: Body relatively stout, eye medium. Antenna 1 long, about ½ body length; peduncle segment 1 without a posterodistal spine. Antenna 2 stout, about ½ length of antenna 1, flagellum strongly setose, proximal segments of flagellum fused. Lower lip outer lobes, apical subequal to medial. Gnathopod 1, segment 5 somewhat shorter than 6, dactyl overlapping the palm by considerably more than the length of the nail. Gnathopod 2 (♂), hand enlarged, palm crenulated, nearly straight, bearing a tubercle; dactyl sinuous, reaching to ⅔ the length of the hand; in the juvenile (10.5 mm and 12.5 mm), palm slightly concave, not crenulated, tubercle absent; dactyl evenly curved, ⅓ - ½ length of the hand. Gnathopod 2 (♀) segment 5 shorter than 6 and narrowed into a posterior lobe; segment 6 similar in form to, but broader than segment 6 of gnathopod 1. Peraeopods 3 and 4, segment 4 strongly overhanging segment 5. Peraeopod 5, lower hind edge of segment 2 evenly curved or slightly concave; segment 4 slightly longer than 5. Peraeopods 6 and 7 moderately setose, segment 2 proximally broadened. Uropods 1 and 2 slender. Body length reaching 22 mm.

Peramphithoe lessoniophila n.sp.

Figure 17.

Material examined: Near Coquimbo, Chile (30°S,71°W). A. Viviani, collector. Holotype ♂ (NMC-C-1981-964); allotype ♀ (NMC-C-1981-965); paratypes (NMC-C-1981-966).

Smithsonian collections (USNM): 1 ♂, 1 ♀.

Ecology: Found living in little chambers self-constructed in the fronds of *Lessonia* (H.K. Schminke, pers. comm.)

Description of male holotype, 9.5 mm: Body stout, eye medium. Antenna 1 short, less than ½ the body length; peduncle segment 1 without a posterodistal spine. Antenna 2 about ¾ the length of antenna 1, flagellum strongly setose, proximal segments of flagellum fused. Lower lip outer lobes, apical longer than medial. Gnathopod 1, segment 5 subequal to 6, dactyl overlapping the palm by more than the length of the nail. Gnathopod 2, hand enlarged, palm smoothly concave; dactyl evenly curved, reaching to ½ the length of the hand. Peraeopods 3 and 4, segment 4 strongly overhanging segment 5. Peraeopod 5, lower hind edge of segment 2 concave; segment 4 slightly longer than 5. Peraeopods 6 and 7 moderately setose, segment 2 proximally broadened. Uropods 1 and 2 slender. Body length: male 9.5 mm, female 7-8.5 mm.

Description of female allotype, 7 mm: Gnathopod 1 as in the male. Gnathopod 2, segment 5 shorter than 6 and narrowed into a posterior lobe; segment 6 similar in form to, but broader than segment 6 of gnathopod 1. Appendages otherwise as in the male.

Etymology: "*Lessonia* - loving", referring to the construction of tubes in the fronds of the kelp *Lessonia*.

Discussion and Conclusions

Biogeography and Ecology

Tables 2 and 3 summarize the geographic and ecological distributions of the northern Pacific Ampithoidae. The species are divisible into the following groups:

1. Pan-Pacific, cold water species further subdivisible into
   a) subarctic species *Ampithoe volki*, *Peramphithoe mea*, and
   b) subarctic and boreal species *Ampithoe*

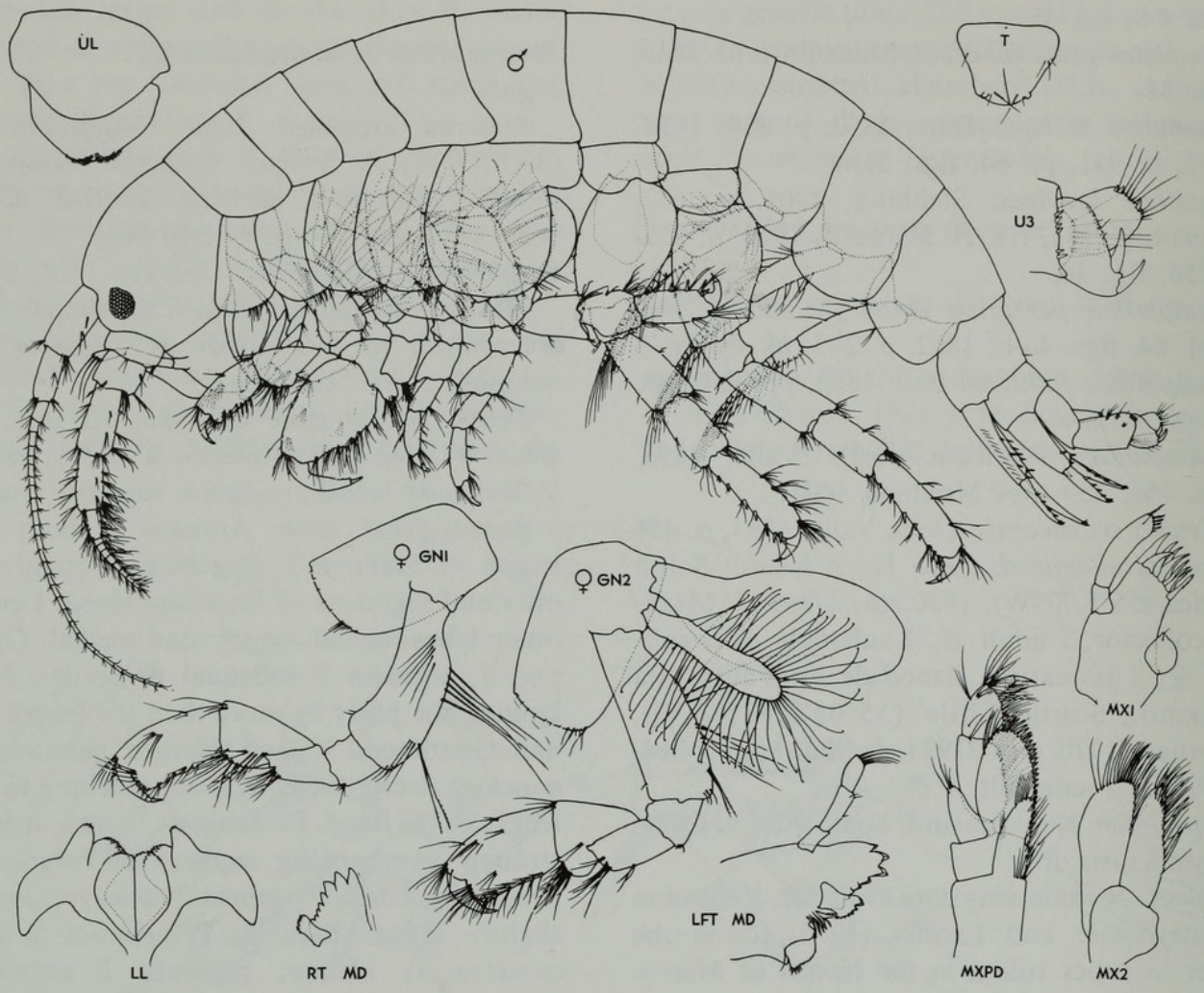

Figure 17. *Peramphithoe lessoniophila* n.sp. ♂ 9.5 mm; ♀ 7.0 mm. Near Coquimbo, Chile

kussakini, *A. lacertosa* and *P. lindbergi*, these occurring in a broader range from Alaska to California. The species generally occur in high salinity exposed and semi-protected coasts although *A. lacertosa*, having the broadest geographical and ecological range, occurs also in lower salinity protected embayments and estuaries.

2. Aleutian-endemic, subarctic species *Ampithoe rubricatoides* occuring in high salinity cold waters.
3. American-endemic, boreal species *Cymadusa uncinata*, *Ampithoe sectimanus*, *A. dalli*, *A. simulans*, *P. humeralis*, *P. tea* and *P. plea* occurring variously from southern Alaska to California in exposed and semi-protected meso- and polyhaline waters.
4. American-endemic, primarily warm water species *Ampithoe valida* and *A. plumulosa*. These occur south of central British Columbia. *A. valida* occurs also in the Atlantic and is restricted to low salinity protected coasts.

All species occur amongst algae and debris in tide-pools, the intertidal and subtidal coast, to the limits of the photic zone. Greatest diversity in the northeastern Pacific is achieved in the environs of Vancouver Island (12 species). Seven species occur as far north as the Aleutian Islands of Alaska and probably beyond.

Taxonomic Considerations

Table 4 shows that there are many differences between the northeastern Pacific *Cymadusa*, *Ampithoe* and *Peramphithoe* which, on further investigation by Conlan (in press) prove to be universal. All three genera are wide ranging in both hemispheres, although *Cymadusa* and *Ampithoe* concentrate in the tropics while

Peramphithoe predominates in boreal waters. The more apomorphic *Peramphithoe* is less diverse, and morphologically less variable than the more plesiomorphic *Cymadusa* and *Ampithoe*. This is demonstrated by the two South American species of *Peramphithoe* which little differ from the North American species. The alteration in palm configuration in *Peramphithoe*, coincident with strong development of the peraeopod spinning glands and uropod spinous processes must incur a measurable change in living and tube-building habits. An examination of the evolutionary relationships of these genera with other Amphithoidae is presented separately (Conlan, in press).

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Table 1. Comparative characters of the North American and type (USSR) specimen of *Ampithoe volki*

Character	Type specimen (as published) Gurjanova 1938	North American Specimens
Size at maturity	⩽ 6 mm	> 8 mm (♀ not ovigerous at this size)
Antenna 1 — length	1 slightly > 2	1 slightly to markedly < 2
flagellum	17-22 segments	14 segments
Lower lip	apical≃ medial	apical > medial
Maxilla 1 inner plate	lacking setae	bearing 1 seta
Maxilliped palp	segment 3 = segment 2	segment 3 < 2
Gnathopod 2 ♂	thumb triangular	thumb square (but not appearing to have been broken)
	segment 2 not lobate	segment 2 lobate
Epimeron 3 ♂	posterodistal angle forms an extended denticle	posterodistal margin smoothly angled
Uropod 3 — peduncle	stout, nearly as wide as long	slender, length 1-1/3 times the width
outer ramus	bearing a central spine	lacking a central spine

Table 2. Distribution of Northeastern Pacific Ampithoidae listed in geographic order

Species	Aleutian Is., Alaska	Prince William Sound Alaska	Cross Sd. to Dixon Entrance Alaska	Northern B.C. and Queen Charlotte Is. B.C.	Central B.C. and Vancouver Is., B.C.	Washington	Oregon	California	Other Records
Peramphithoe mea	X	—	—	—	—	—	—	—	USSR: Japan Sea
Ampithoe rubricatoides	X	—	—	—	—	—	—	—	
Ampithoe volki	X	—	—	—	—	—	—	—	USSR: Japan Sea Preobrazhen'e Bay
Ampithoe kussakini	X	X	X	X	O	—	—	—	USSR: Shikotan Is. (Otradnaya Bay)
Ampithoe dalli	X	X	X	X	X	X	X	—	
Ampithoe simulans	X	X	X	X	X	X	X	—	
Ampithoe lacertosa	O	X	X	X	X	X	X	X	Japan: Schizueka Prefecture
Ampithoe sectimanus	—	X	X	X	X	—	X	—	
Peramphithoe humeralis	—	X	X	X	X	X	X	X	
Peramphithoe lindbergi	—	X	X	X	X	X	X	X	USSR: Bering Sea, Okhotsk Sea, Japan Sea
Peramphithoe tea	—	X	X	X	X	X	X	X	
Cymadusa uncinata	—	—	O	O	X	O	—	X	
Peramphithoe plea	—	—	—	X	X	X	X	X	
Ampithoe valida	—	—	—	—	X	X	X	X	Japan, US mid Atlantic coast
Ampithoe plumulosa	—	—	—	—	O	—	—	X	Mexico, Ecuador, Galapagos Is.
Number of species	7	8	9	10	12	9	9	8	

X abundant, O occasional, — absent

Table 3. Habitats of Northeastern Pacific Ampithoidae

Species	Coastal Exposure: Open and semi-protected	Coastal Exposure: Protected	Salinity Range: Marine polyhaline (≥ 28°/₀₀)	Salinity Range: Meso-haline (10-27°/₀₀)	Salinity Range: Oligo-haline (1-9°/₀₀)	Salinity Range: Fresh-water (< 1°/₀₀)	Depth Range: Subtidal	Depth Range: LW-MW	Depth Range: MW-HW
Peramphithoe mea	X	—	X	—	—	—	to 60 m	0	?
Ampithoe rubricatoides	X	—	X	—	—	—	to 18 m	—	?
Ampithoe volki	X	—	X	—	—	—	to 15 m	X	in tidepools
Ampithoe kussakini	X	O	X	X	O	—	to 15 m	X	in tidepools
Ampithoe dalli	X	X	X	X	O	—	to 10 m	X	in tidepools
Ampithoe simulans	X	—	X	O	O	—	to 4 m	X	in tidepools
Ampithoe lacertosa	X	X	X	X	O	O	to 10 m	X	in tidepools
Ampithoe sectimanus	X	—	X	O	—	—	to 3 m	X	in tidepools
Peramphithoe humeralis	X	O	X	O	—	—	to 70 m	X	in tidepools
Peramphithoe lindbergi	X	O	X	O	—	—	to 18 m	X	in tidepools
Peramphithoe tea	X	O	X	O	—	—	to 67 m	X	in tidepools
Cymadusa uncinata	X	O	X	—	—	—	to 7 m	X	in tidepools
Peramphithoe plea	X	—	X	—	—	—	to 17 m	X	in tidepools
Ampithoe valida	O	X	O	X	X	—	to 32 m	X	in tidepools
Ampithoe plumulosa	NO DATA						to 75 m	X	in tidepools

X abundant, O occasional, — absent

Table 4. Character differences in the Northeastern Pacific *Cymadusa*, *Ampithoe* and *Peramphithoe*

Character	*Cymadusa* Savigny	*Ampithoe* (Leach)	*Peramphithoe* n.gen
Antenna 1, accessory flagellum	multisegmented	vestigial	absent
Mandible,			
incisor, no. teeth	7	5-9	6-17
lacinia mobilis, no. teeth	5-6	4-7	6-17
no. spines	6-10	5-9	6-14
palp setosity	strong	moderate to strong	weak
Maxilla 1,			
inner plate, no. setae	3	0-1	1
palp, no. spines	10	5-12	4-8
no. setae	5	3-7	1-4
Maxilliped,			
outer plate, inner margin	smooth	fringed	smooth
teeth	smooth	usually smooth	serrated
Gnathopod 1,			
sexual dimorphism	absent	present	absent
obturator spine	strong	strong	weak
coxa produced forward	yes	yes	no
Coxae 1-5,			
lower margin setose	yes	rarely	always
Peraeopods 3 and 4,			
segment 2	weakly inflated	weakly inflated	strongly inflated
segment 4	moderately inflated	moderately inflated	strongly inflated
Pleopods,			
no. coupling hooks	5-6	6-11	4-8
Uropod 1,			
spinous peduncular process	well developed	vestigial or absent	well developed
Uropod 3,			
no. peduncular marginal spines	11	0-13	1-6
outer ramus serrations	weak	weak	strong
uncini	medium	medium	strong
Telson,			
no. setae at cusp	many	1-many	1
No. species	1	12	5
Percentage of total	10	24	36