The talitroidean amphipod family Najnidae in the North Pacific region: systematics and distributional ecology

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Abstract

Analysis of species of the talitroidean family Najnidae, endemic to coastal waters of the North Pacific Rim region, based on newly recognized characters (e.g., anterodistal setation and palmar spination of the propod of gnathopods 1 & 2) and those utilized elsewhere (e.g., urosomal bicarination, relative size of dactyl of maxillipedal palp) necessitated establishment of two generic concepts: (1) a relatively primitive genus *Najna* Derzhavin, 1937, encompassing three species that occur mainly in the western Pacific and Bering Sea to SE Alaska, and (2) a relatively advanced genus, ***Carinonajna***, n. g., containing nine species endemic to the North American Pacific coast. *Najna* includes *N. consiliorum* Derzhavin, 1937, ***N. amchitkana*** n. sp., and ***N. parva*** n. sp. ***Carinonajna*** encompasses three subgroups: (1) a relatively primitive *bispinosa* complex including *C. kitamati* (Barnard, 1979), ***C. lessoniophila*** n. sp., and ***C. bispinosa*** n. sp.; (2) an inter-mediate *barnardi* complex containing ***C. barnardi*** n. sp., ***C. carli*** n. sp., and ***C. longimana*** n. sp., and (3) an advanced *bicarinata* subgroup encompassing ***C. oculata*** n. sp., ***C. botanica*** n. sp. and ***C. bicarinata*** n. sp. The close relationship of the two genera, and apparent obligate association of member species with littoral marine vascular plants and algae of cold-temperate waters of the North Pacific may suggest a relatively recent origin of family Najnidae and/or inability of ancestral members to disperse across warm temperate and tropical regions and occupy counterpart antiboreal niches of the southern hemisphere.

Introduction

The amphipod family Najnidae was established by J. L. Barnard (1972) in demarcating *Najna consiliorum* Derzhavin, 1937, from other members of the talitroidean family Hyalidae. Earlier, this marine algal and kelp-associated species had been included within family Talitridae by Derzhavin (1937) and by Gurjanova (1951). Also, in reorganizing higher taxa within newly proposed superfamily Talitroidea, Bulycheva (1957) placed *Najna* within her newly recognized family Hyalidae. Species of *Najna* have also been recorded from waters of the northern Japan sea by Kudrjaschov (1972) and Hirayama (1985).

In the eastern Pacific region, *Najna ?consiliorum* was first recorded from the coast of central and southern California by Barnard (1962, 1972), later formally described as *N. kitamati* Barnard,1979. These species were variously listed by Barnard (1975), Austin (1985), and Staude (1996) from the American Pacific coast north to British Columbia.

Subsequent to the work of Barnard (loc. cit.), basic material from British Columbia and SE Alaska, was first treated by Bousfield (1981). Some 10 species were named and figured, and phyletic relationships diagramed, but descriptions were not detailed nor type localities provided. The treatment was similar to that of regional species of Hyalidae in the same paper, the taxonomic and nomenclatural limitations of which were detailed by Bousfield & Hendrycks (2002). An intended full treatise on family Najnidae (Bousfield MS), bearing essentially the same title as the present study, did not appear, thus rendering this paper in effect an "interrupted publication" (ICZN 1985, art-icle 23). Consequently, some names (1981) that were apparently considered unavailable *(nomina nuda)* by most subsequent authors, including definitive gammaridean amphipod treatments (e.g., Barnard & Karaman 1991; Ishimaru 1994) are herein validated by formal description (ICZN 1999).

The present study is intended, therefore, to complete formal description of these new taxa under taxonomically recognizable names, and to provide more complete descriptive, ecological and biogeographical information on Najnidae in the entire North Pacific coastal marine region.

Acknowledgements

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station lists elsewhere in the text references, and in the Material and Methods (below).

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Taxonomic work on amphipod collections of the Canadian Museum of Nature (CMN), Ottawa, was initiated during 1979-1981 by ELB, then a research scientist at the Holly Lane Laboratory of the National Museum of Natural Sciences (NMNS) in Ottawa. More recently, visiting scientist ELB and research assistant Pierre Marcoux have been grateful to the Canadian Museum of Nature for providing research facilities and study collections at the CMN laboratory in Aylmer, Quebec. Original lateral view illustrations, prepared with the capable assistance of Floy E. Zittin, Cupertino, California, were recombined with authors' more recent figures of the mouthparts and other appendages.

We greatly appreciate the help of CMN assistant collections manager Judith C. Price in retrieving, cataloguing and labeling of amphipod material; Ed Hendrycks for assistance in preparing slide mounts and providing commentary on early drafts of the manuscript; and Noel Alfonso, for assistance in computerized map preparation. We are indebted to Marjorie Bousfield for translations of pertinent Russian literature.

Material and Methods.

Station lists pertinent to NMNS and CMN field material are provided by Bousfield (1958, 1963, 1968); Bousfield & McAllister (1962); and Bousfield & Jarrett (1981). Numbers of specimens collected at each station are given in parentheses.

Analyses of possible phyletic relationships of genera and species of family Najnidae utilize a semi-phyletic modification of the UPGMA system of Sneath and Sokal (1973). Characters and character states are illustrated mainly in Figures 1-4. For analytical purposes, these are ordered phyletically by values of 0, 1, and 2 for plesiomorphic, intermediate, and apomorphic states, respectively. The phyletic placement of a given taxon is represented by a numerical sum of character state values termed the Plesio-Apomorphic (P.-A.) Index of which the maximum value is twice the number of characters utilized.

Table I. Abbreviations used in figures and tables:

A1-2	-	antenna 1, 2
BR SET	-	brood seta(e)
CLSP	-	clothes-pin spine
CX	-	coxal plate
DCTL	-	dactyl
EP 1-3	-	abdominal side plates 1,2,3
GN 1-2	-	gnathopods 1, 2
HD	-	head
LFT	-	left
LL	-	lower lip (labium)
MD	-	mandible
MX 1-2	-	maxilla 1, 2
MXPD	-	maxilliped
P3-7	-	peraeopods 3, 4, 5, 6, 7
PLPD	-	pleopod
PLP	-	palp
RET	-	retinacula
RT	-	right
SP	-	spine
T	-	telson
U1-3	-	uropods 1, 2, 3
UL	-	upper lip (labrum)
UROS	-	urosome
X	-	enlarged
br. I, II	-	brood plates 1, 2
im	-	immature
juv	-	juvenile
subad.	-	subadult

Systematics

Family Najnidae J. L. Barnard

Talitridae Stebbing, 1906 (part);—Derzhavin 1937: 97;—Gurjanova 1951: 826.

Hyalidae Bulycheva, 1957 (part): 76;—Barnard 1962 (part): 153;—Barnard 1969b (part): 130.

?Najninae Barnard 1969a: 469.

Najnidae Barnard, 1972: 190;—Barnard 1975: 343;—Barnard 1979: 118;—Bousfield 1981: 80, figs. 15-16;—Bousfield 1982: 271;—Hirayama 1985: 36;—Barnard & Karaman 1991: 545;—Ishimaru 1994: 69;—Bousfield & Shih 1994: 129;—Staude 1996: 380;—Bousfield 2001a: 105.

Type genus: *Najna* Derzhavin, 1937 (original designation). Gender feminine.

Genera: ***Carinonajna*** n. g. (p. 21)

Diagnosis: Body medium small, laterally compressed, not bulging; abdomen dorsally smooth or weakly bicarinate on urosome 1 (occasionally on pleon 3). Urosome segments 2 & 3 short, free, but may appear telescoped dorsally into urosome segment 1.

Head compressed and rounded frontally, with slight anterodorsal flattening; lower margin incised at base of mandible. Eyes small, rounded. Antennae slender; antenna 1 attached below eye level; flagellar segments each broadened distally (male), with posterdistal marginal aesthetascs (more numerous in males); peduncles short, weak, usually nearly bare.

Buccal mass large, often slightly prognathous. Upper lip slightly lobate (notched) apically. Lower lip tall, mandibular lobes large. Mandible, body slender; molar flat, vestigial, proximal molar seta (large spine of Barnard, 1972) present; incisors and left lacinia strong, multidentate; right lacinia unicuspate; blades 2-3. Maxilla 1, palp minute, 1-segmented, subproximal to apical spines of outer plate; inner plate short, narrowing distally, apex with two unequal setae. Maxilla 2, plates narrow, apical setae stiff, spine-like, inner plate with enlarged proximal seta. Maxilliped, basal segments elongate; inner plate narrowing apically, apex with 3 spine-teeth; outer plate large, broad, with inner cutting edge, surface coated with small scales; palp short, dactyl short, not unguiform.

Coxae 1-3 variously (or not) separated distally, rounded below, lacking posterior marginal cusps; coxa 1 normal, coxa 2 and 3 subquadrate to pyriform. Coxa 4 produced and attenuated posteriorly. Coxae 5 & 6 variously posterolobate.

Gnathopods 1 & 2 short to medium, weakly subchelate or nearly simple, slightly to moderately dissimilar, slightly (or not) sexually dimorphic; basis stout, with posteromedial and posterodistal clusters of long setae; carpal lobe distinct, inner margin with comb setae; dactyls with large unguis. Peraeopods 3-4, segment 4 produced anterodistally, overhanging short segment 5; dactyls short, curved. Peraeopods 5-7 regular, subsimilar in form, peraeopod 5 shortest; bases of peraeopods 5-7 variously rounded and crenulate behind; segments 4 & 5 often broadened; segment 5 of peraeopod 5 with cluster of 3-4 posterodistal stout spines; dactyls short, strongly curved, with distinct unguis.

Pleon plates small, hind corners not produced, hind margin weakly crenulate. Pleopods slender, regular; peduncles with 4-8 retinacula. Uropods 1 & 2 short, stout; peduncles with outer marginal spines; rami lanceolate, curved distally, principal apical spine large, heavy, embedded, marginal spines few or lacking. Uropod 3, peduncle short, deep; ramus short to vestigial, apex setose. Telson short, broad, apex notched or emarginate (male).

Coxal gills on peraeopods 2-6 medium to large, plate-like; those of peraeopods 5 & 6 largest, each with smaller posteroproximal accessory lobe.

Brood plates large, broad, rhomboidal or attenuated distally, marginal setae short to medium, curl-tipped.

Distributional Ecology: Burrowing in, or forming galls on, stipes and holdfasts of *Egregia, Lessoniopsis* and other large kelp species, and in root masses of *Phyllospadix*. Circumboreal North Pacific (including southern Bering Sea), south on the Asian coast to the northern Sea of Japan, and in North America to southern California. Some najnids may be host-specific on particular algal species, but little is known of the ecology or feeding behaviour of individual species.

Remarks: The present diagnosis incorporates basic characters and character states of Barnard (1972) and Barnard & Karaman (1991) with modifications of Bousfield (1982) and some features newly proposed.

The ancestry of family Najnidae is obscure. In the primitive genus *Najna*, gnathopod 1 is simple and similar to most genera of family Hyalidae, not modified as in the more advanced Hyalellidae. However, the balance of character states, including a minute palp of maxilla 1, well developed carpal lobes of gnathopods 1 & 2 in both sexes, lack of posterior marginal cusps in coxae 1-3, rhomboidal brood plates with short marginal setae, minutely uniramous uropod 3, and plate-like or apically notched telson, suggest an ancestry near *Allorchestes* (Hyalellidae).

Characters and Character States of Family Najnidae

Some taxonomically significant characters and states of genera and species, utilized in keys (p. 6) and semi-phyletic analysis (p. 40), are compared in Figures 1-4. The character states are arranged in overall phyletic fashion, the most plesiomorphic of which are typical of species within *Najna* and within the *kitamati* subgroup of *Carinonajna*. Except for those of the telson and uropod 3, character states of Figs. 1-4 are readily visible at magnifications of a binocular microscope.

Key to North Pacific Species of *Najna* and *Carinonajna* (adult males & females)

1. Urosome segment 1 dorsally smooth, not bicarinate; gnathopods 1 & 2 regularly subchelate, subsimilar; gnathopods 1 & 2 , propod, posterodistal palmar spines present, slightly unequal in size (Figs. 1 A, B); peraeopods 5-7, bases with deep posterodistal lobes; uropod 3, ramus relatively large, distinctly longer than deep (Fig. 1F); maxilliped palp segment 4 distinct, longer than wide ..... *Najna* Derzhavin . . 2.
   Urosome 1 dorsally bicarinate; gnathopods 1 & 2 variously subchelate, unlike in form; gnathopods 1 & 2, propod with single or two markedly unequal posterodistal spines (Figs. 2-4, A-B); uropod 3, ramus relatively small, deeper than long (Figs. 2-4F); maxilliped palp segment 4 small, not longer than wide ... ***Carinonajna*** n. g. 4.

2. Peraeopod 7, segment 4 narrow; gnathopod 2 dactyl short; western N. Pacific . . *N. consiliorum* Derzh. (p. 12)
   Peraeopod 7, segment 4 broadened; gnathopod 2, palm exceeded by dactyl; Bering Sea & E. Pacific ..... 3.

3. Mandible, right incisor 11-dentate; uropod 1, outer ramus spinose ..... ***N. amchitkana*** n. sp. (p. 17)
   Mandibular right incisor 9-dentate; uropod 1, outer ramus smooth ..... ***N. parva*** n. sp. (p. 19)

4. Gnathopod 2, posterodistal palmar spines markedly unequal (outer much smaller); uropods 1 and 2, inner ramus usually with 2-3 marginal spines ..... *kitamati* subgroup . 5.
   Gnathopod 2, palmar posterodistal angle with single large spine only; uropods 1 & 2, inner ramus with 0-1 marginal spines only ..... 7.

5. Gnathopod 2, anterodistal margin of propod with setal bundles (Fig. 2B); hind margins of bases of peraeopods 5-7 and of epimeral plate 3 strongly crenulate..... *C. kitamati* (Barnard) (p. 21)
   Gnathopod 2, propod lacking anterodistal marginal setae (except apically) (fig. 2B); bases of peraeopods 5-6 and posterior margin of epimeral plate 3 weakly or indistinctly crenulate..... 6.

6. Gnathopod 2, carpal lobe short , margin with 8-10 pectinate setae; peraeopod 5, segment 5 longer than wide; peraeopod 7, segment 6 heavily setose ..... ***C. lessoniophila*** (p. 23)
   Gnathopod 2, carpal lobe long, margins with 15-20 stiff setae; peraeopod 5, segment 4 wider than long; peraeopod 7, segment 6 normally setose ..... ***C. bispinosa*** (p. 25)

7. Gnathopod 2, propod, palmar margin concave; mandiular left lacinia 7-dentate ..... *barnardi* subgroup . 8.
   Gnathopod 2, propod, palmar margin small, convex ; left lacinia usually 8-dentate..... *bicarinata* subgroup .10.

8. Gnathopod 2, propod narrowing distally, with a few anterodistal marginal setae (fig. 3B); palmar margin relatively short, shallowly concave; uropod 3 with 8-10 apical setae(Fig. 3F)..... ***C. longimana*** (p. 31)
   Gnathopod 2, propod regular, anterodistal margin bare (except apically) (Fig. 3B); palmar margin long, distinctly concave; uropod 3 with 2-5 apical setae (Fig. 3F) ..... 9.

9. Gnathopod 2, palmar excavation strongly concave, set at angle to posterior margin; gnathopod 2, propod regular, little narrowing distally..... ***C. barnardi*** (p. 27)
   Gnathopod 2, palmar excavation shallowly concave, nearly continuous with posterior margin, short; propod short, broadest basally, narrowing distally..... ***C. carli*** (p. 29)

10. Gnathopod 2, anterodistal margin of propod bare (except apically) (Fig. 4B); eye large; mandibular left lacinia 7-dentate ..... ***C. oculata*** (p. 33)
    Gnathopod 2, anterodistal margin of propod with 2-5 clusters of setae (Fig. 4B); eye small to regular; mandibular left lacinia 8-dentate ..... 11.

11. Gnathopod 1, carpal lobe large, extending beyond merus; antenna 2 and peraeopod segments often bearing fungal filaments; urosome 1 singly bicarinate ..... ***C. botanica*** (p. 34)
    Gnathopod 1, carpal lobe short, not extending beyond merus; antenna 2 and peraeopods 5-7 devoid of filaments; urosome 1 appearing doubly bicarinate ..... ***C. bicarinata*** (p. 36)

Other character states,especially of mouthparts that require higher magnifications,are provided in descriptive accounts of individual species (Figs. 5-18).

Gnathopods 1 & 2 of Najnidae are relatively small and little or not sexually dimorphic. Character states of the carpus, propod and dactyl are here considered especially useful (Figs. 1-4, A & B).

Within species of *Najna,* the propod of gnathopod 1 is subrectangular and the palmar margin is relative large, vertical, and gently convex (Fig. 1A). The simple dactyl overlaps little (or not) a pair of distinct but unequal-sized posterodistal palmar spines. The anterodistal margin of the propod bears a cluster of setae at the apex only. The carpal lobe is medium short, little or not exceeding the merus, and bears few(<10) stiff inner marginal comb setae. Within *Carinonajna* the propod of gnathopod 1 is slightly arched, narrows distally, and its anterodistal margin bears numerous clusters of fine setae (Figs. 2-4A). The relatively small gently convex palm and large dactyl that strongly overlaps the subapical posterodistal palmar spine (single in the advanced *barnardi* and *bicarinata* subgroups) forms a weak "parachela". The carpal lobe tends to be more strongly developed, often exceeding the merus, and bears more numerous comb setae.

Character states of gnathopod 2 are readily species-distinctive. Within *Najna,* the propod is also subrectangular and, with the dactyl, is otherwise similar to that of gnathopod 1. However, the carpus is very much larger, always exceeding the merus, and may extend along half the length of the propodal posterior margin. The distal margins of the carpal lobe bear numerous (10-20) slender comb setae. Within species of *Carinojna,* character states differ markedly. The propod is generally deeper and narrows distally. In the primitive *kitamati* and *barnardi* subgroups, the palmar margin is relatively large, variously concave, and slightly overlapped by the dactyl (Figs. 2-3B), but in the *bicarinata* subgroup the palmar margin is small, obliquely convex, and strongly overlapped by the dactyl (Fig. 4B). The inner posterodistal palmar spine is large, the outer minute in the *kitamati* subgroup (Fig. 2B) and lacking in the other two subgroups. In each subgroup, the anterodistal margin of the propod may bear subapical as well as apical setal clusters. The carpal lobe tends to be large in the *kitamati,* intermediate in the *barnardi,* and small in the *bicarinata* subgroup.

Coxal plates 1-4 (Figs. 1-4C) are medium deep, and rounded below; coxa 4 is very broad with a prominent posterior cusp that underlies the anterior lobe of coxa 5. The process tends to be more strongly produced and sharply acute in advanced species. In genus *Najna* (Fig. 1C), coxae 1-3 are regular, relatively narrow, and subsimilar, with slight distal separation. Peraeon segments 1-4 are tightly adjacent ventrally. In genus *Carinonajna* (Figs. 2-4C), segments 1-3 are broader, with stronger distal separation, and coxa 2 is pyriform in shape. Peraeon segments 1-4 are more or less separated ventrally, markedly so in members of the advanced *bicarinata* subgroup (Fig. 4C).

Unlike most other talitroidean amphipods, the rami of uropods 1 & 2 of Najnidae are relatively short, curved, and lanceolate (Figs. 1-4D). In species of *Najna,* each embedded apical spine is accompanied by a pair of small supernumerary spines (Fig. 1D). In uropod 1, the spines of the outer margin of the peduncle and outer ramus are more numerous than those of the inner margin of the peduncle and inner ramus. In species of *Carinonajna,* supernumerary spines of the rami are lacking. In uropod 1 (Figs. 2-4D), outer marginal spines are less numerous on the peduncle, lacking on the outer ramus, and reduced to a single spine or lacking on the inner ramus, especially in the advanced *bicarinata* group (Fig. 4D).

In uropod 2 of *Najna* (Fig. 1E), marginal spines are relatively numerous along the outer margin of the peduncle and outer ramus, but are few or lacking on the inner margin of the peduncle and inner ramus. Within *Carinonajna* (Figs. 2-4E), the peduncle is relatively short and stout and the outer margin armed distally with stout spines in the *kitamati* and *barnardi* subgroups, but in the advanced *bicarinata* subgroup, the peduncle is more slender, with fewer marginal spines. In all subgroups the outer ramus is devoid of marginal spines. Marginal spines of the inner ramus are most numerous (1-3) in the primitive *kitamati* subgroup, intermediate (1) in the *barnardi* subgroup, and least (0-1) in the advanced *bicarinata* subgroup (Figs. 2-4E).

Within family Najnidae, uropod 3 is short and uniramous. In *Najna,* the peduncle is not wider (deeper) than long (Fig. 1F). The ramus is variously longer than wide, and bears 2-5 short apical setae. In *Carinonajna* (Figs. 2-4F), the peduncle is short and deep, often with a distal row of marginal setae. The ramus is very short, distinctly wider than long, and bears 2-5 (up to 10 in *C. longimanus*), somewhat longer, apical setae.

The telson lobes are fused into a short rectangular plate. In mature animals, the subapical penicillate setae are grouped typically in clusters of four on each side. In *Najna,* the telson is squarish or slightly longer than wide, the apical margin of which may be medially subacute (females) or shallowly cleft (males) (Fig. 1G).

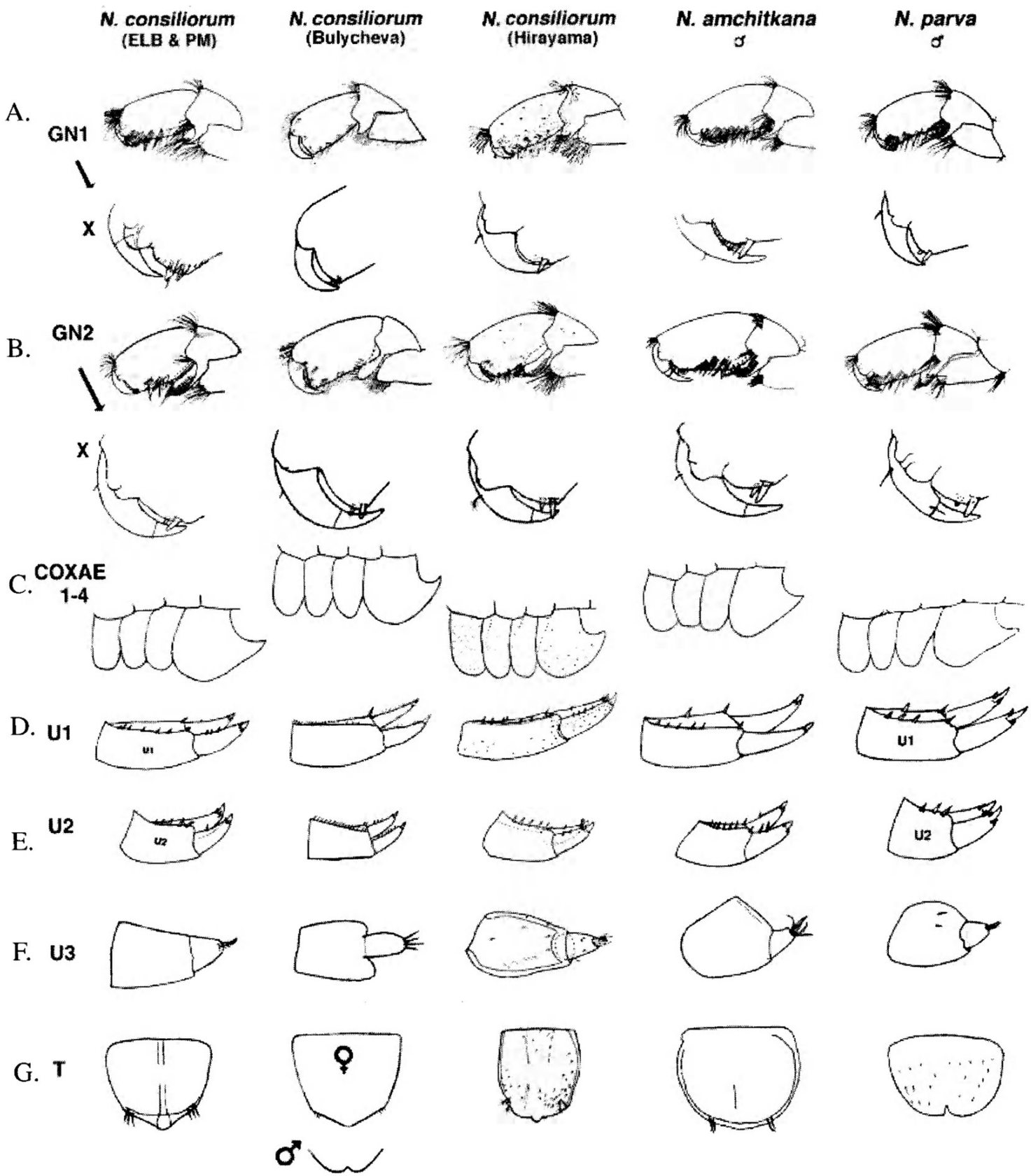


Fig. 1. Characters and character states of *Najna* species

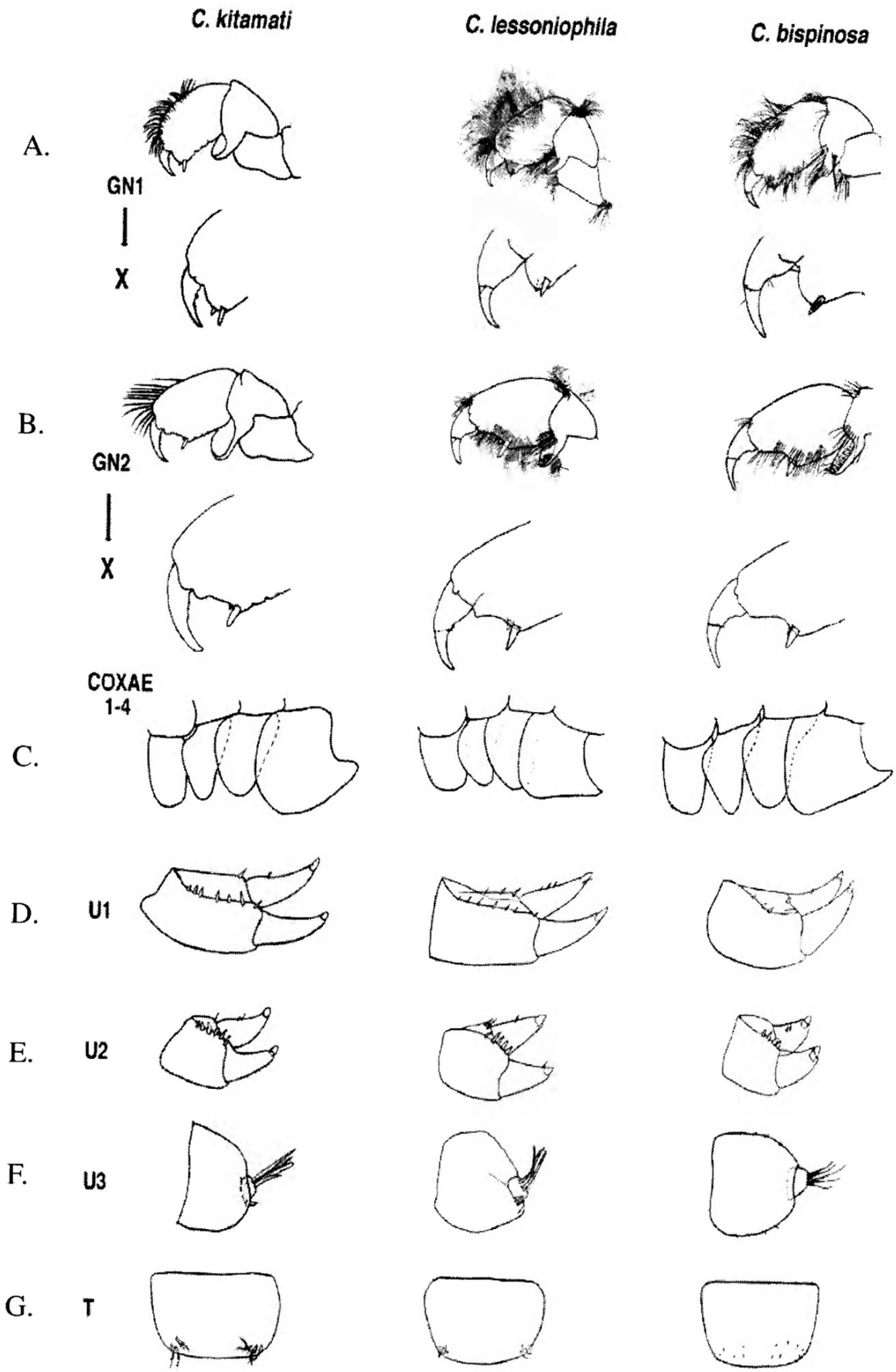


Fig. 2. Characters and character states: *Carinonajna kitamati* subgroup

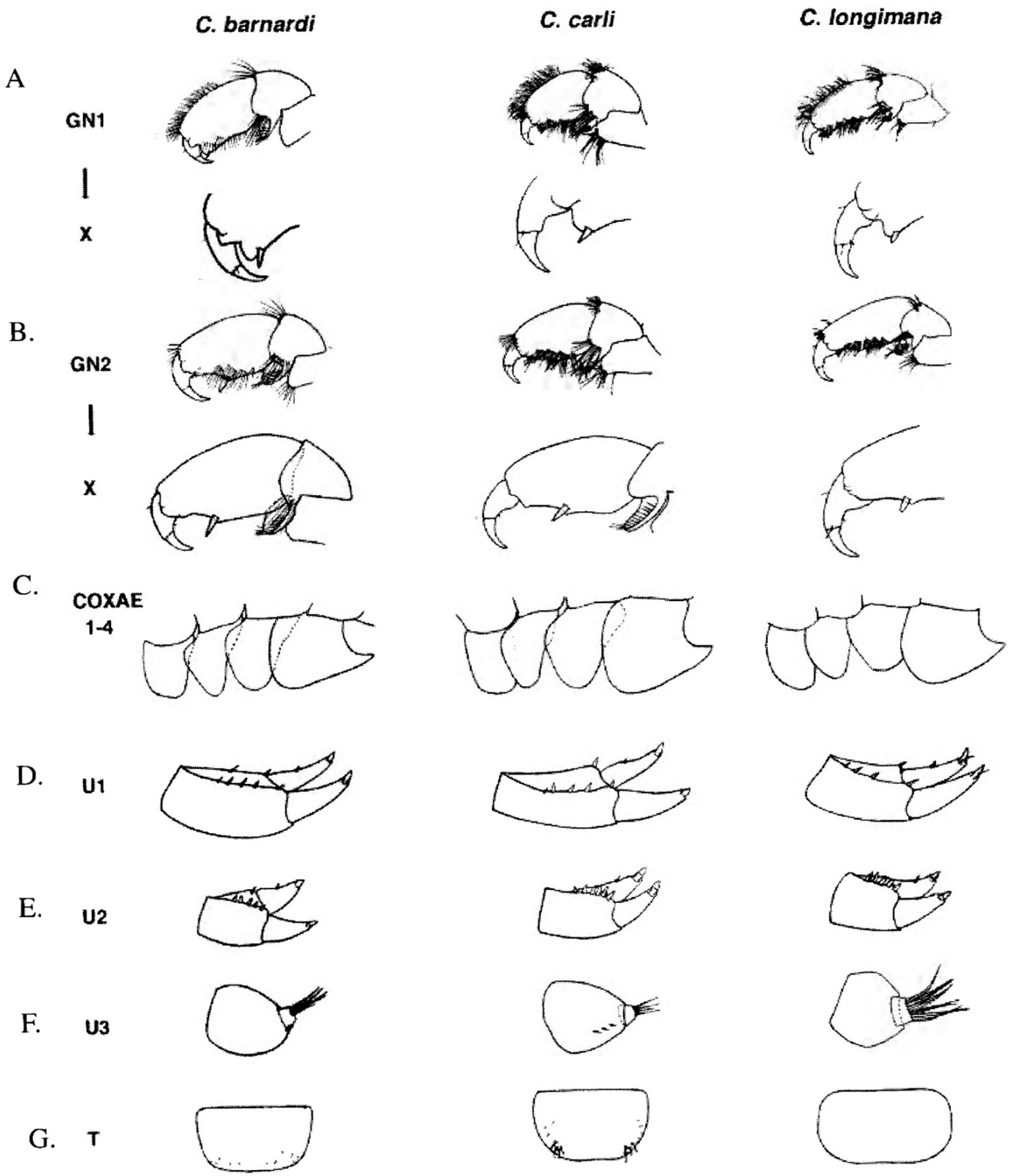


Fig. 3. Characters and character states: *Carinonajna barnardi* subgroup

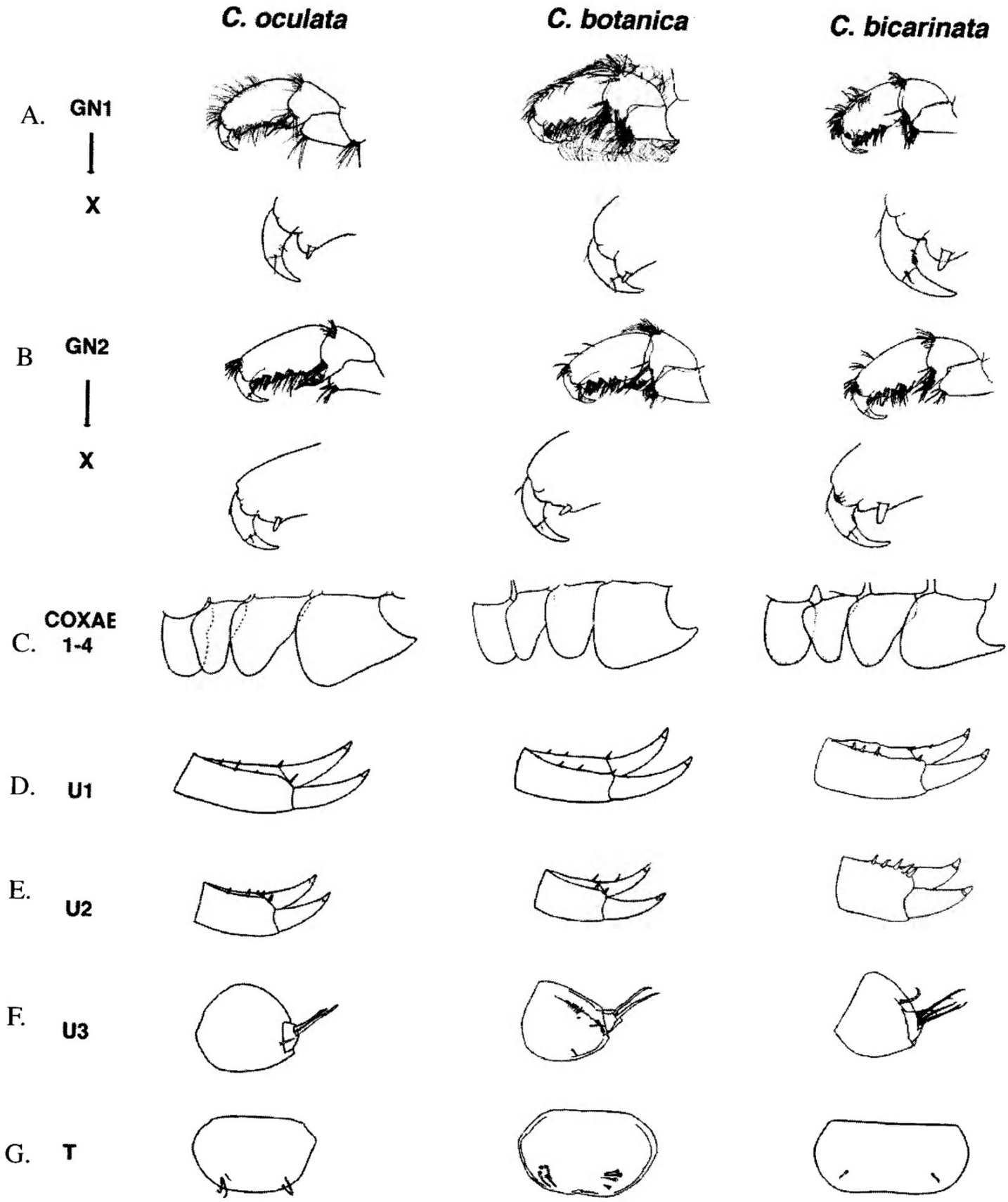


Fig. 4. Characters and character states: *Carinonajna bicarinata* subgroup.

By contrast, in all subgroups of *Carinonajna* the telson is broadly subrectangular (Figs. 2-4 G), with greatest width/length ratio in the most advanced *bicarinata* subgroup. The apical margin may be shallowly convex, straight, or only very slightly indented, even in males, and lateral margins are more strongly convex.

Najna Derzhavin, 1937

Najna Derzhavin, 1937: 97;—Gurjanova 1951: 825;—Bulycheva 1957: 120;—Barnard 1979: 118;—Bousfield 1982: 271;—Barnard & Karaman 1991: 545.

Type species: *Najna consiliorum* Derzhavin, 1937.

Species: ***N. amchitkana***, n. sp. (p. 17);
N. parva n. sp. (p. 19)

Diagnosis: Abdomen dorsally smooth, lacking distinct carinations on pleon 3 and urosome 1. Antennae slender; flagellum of antenna 1 usually elongate (> 9 segments); posterior clusters of aesthetascs (males) not strongly conspicuous. Antenna 2, margins bare or very weakly setose.

Mandibular lacinia 7-dentate; incisor 9-10 dentate. Maxilliped outer plate usually short, broader than long; palp segment 4 conspicuous, longer than broad.

Coxal plates 1-3 overlapping, little separated distally; coxae 2-3 regular, not distinctly pyriform; coxa 4 regularly attenuated posteriorly, width little greater than depth; coxae 5 & 6 variously postero-lobate.

Gnathopods 1 & 2 regularly subchelate, subsimilar, slightly sexually dimorphic (slightly larger in male); propods usually subrectangular, anterodistal margins with apical cluster of setae only); palms distinct, convex, nearly vertical; carpal lobe of gnathopod 2 relatively large, protruding anteriorly beneath propod.

Peraeopods 3 & 4, segment 4 regularly widening distally, not strongly arched anteriorly. Peraeopods 5-7, bases with deep posterodistal lobes; segment 4 of peraeopod 7 not broader than long.

Epimeral plate 3, hind margin minutely crenulate, hind corner obtuse. Pleopods slender, peduncles with 4-5 retinacula.

Uropods 1 & 2, peduncular outer marginal strongly spinose; rami usually marginally spinose. Uropod 3, peduncle longer than deep; ramus distinct, longer than deep.

Telson subquadrate, little (or not) wider than deep, apex subacute (female), or medially notched or emarginate (male).

Coxal gills on peraeopods 5 & 6 smaller, posterior accessory lobes relatively short and narrow.

Brood plate (gnathopod 2, female) elongate, apex acute.

Distributional Ecology: Western Pacific: northern Sea of Japan, southern Sea of Okhotsk, Bering Sea to SE Alaska. Burrowing in kelp stipes and holdfasts, intertidal to 50 m depth.

Etymology: The name *Najna* is derived from that of a small bay between the Bay of the Peter the Great and DeKastry Bay, NW Sea of Japan. It is listed by Derzhavin (1937) as a collecting locality for the type species *Najna consiliorum.* Gender feminine (fide Alexey Golikov).

Remarks: In view of the limited species diversity of *Najna* in the Bering Sea and Aleutian region detected in this study, and taxonomic differences in various populations noted by previous authors, we antipate that additional species may be found along western Pacific shores.

Najna consiliorum Derzhavin
(Figs. 5, 6, 7)

Najna consiliorum Derzhavin, 1937: 97 table 6, fig. 7; also figs. 46 & 47 [text pp. 122-123];—Gurjanova 1951: 826, fig. 578;—Bulycheva 1957: 122, figs. 46, 47a, 47b?;—Bousfield 1981: figs. 15, 16;—Hirayama 1985: 27, figs. 1-5;—Barnard & Karaman 1991: 546 (non figs. 70I, 71A = *Carinonajna kitamati*).
non: *Najna consiliorum* Barnard, 1962: 157: figs. 21, 22 (= *Carinonajna kitamati*).

Material Examined:
Sea of Japan.
Russia, Sea of Japan, intertidal, E. F. Gurjanova coll., July 27, 1934 - ♂ (9.0 mm) (slide mount); ♀ (br. I) (9.5 mm) (slide mount), Zool. Inst., St. Petersburg, # 85/ 33384. CMNC 2003-1135.
Additional: Dr. Nina Tzvetkova, Zoological Museum, St. Petersburg, kindly checked 3 vials of syntype specimens examined initially by Derzhavin (1937):
Najna consiliorum: det. A.N. Derzhavin, Japan Sea, near Cape Mongolia, 5-6 m depth, stones with silt, N. I. Tarasov Sta. 301/76., August, 1929, 1 specimen, **syntype,** N 79/ 33378. *Najna consiliorum*: det. A.N. Derzhavin, Japan Sea, Nelma Bay, depth 20 (15) m, W. Wedensky Sta. 4., 26.07.1929 - 2 specimens, **syntypes,** N 87/33386. *Najna consiliorum:* det. A.N. Derzhavin, Japan Sea, Laperusa Bay, in *Zostera*, 3-

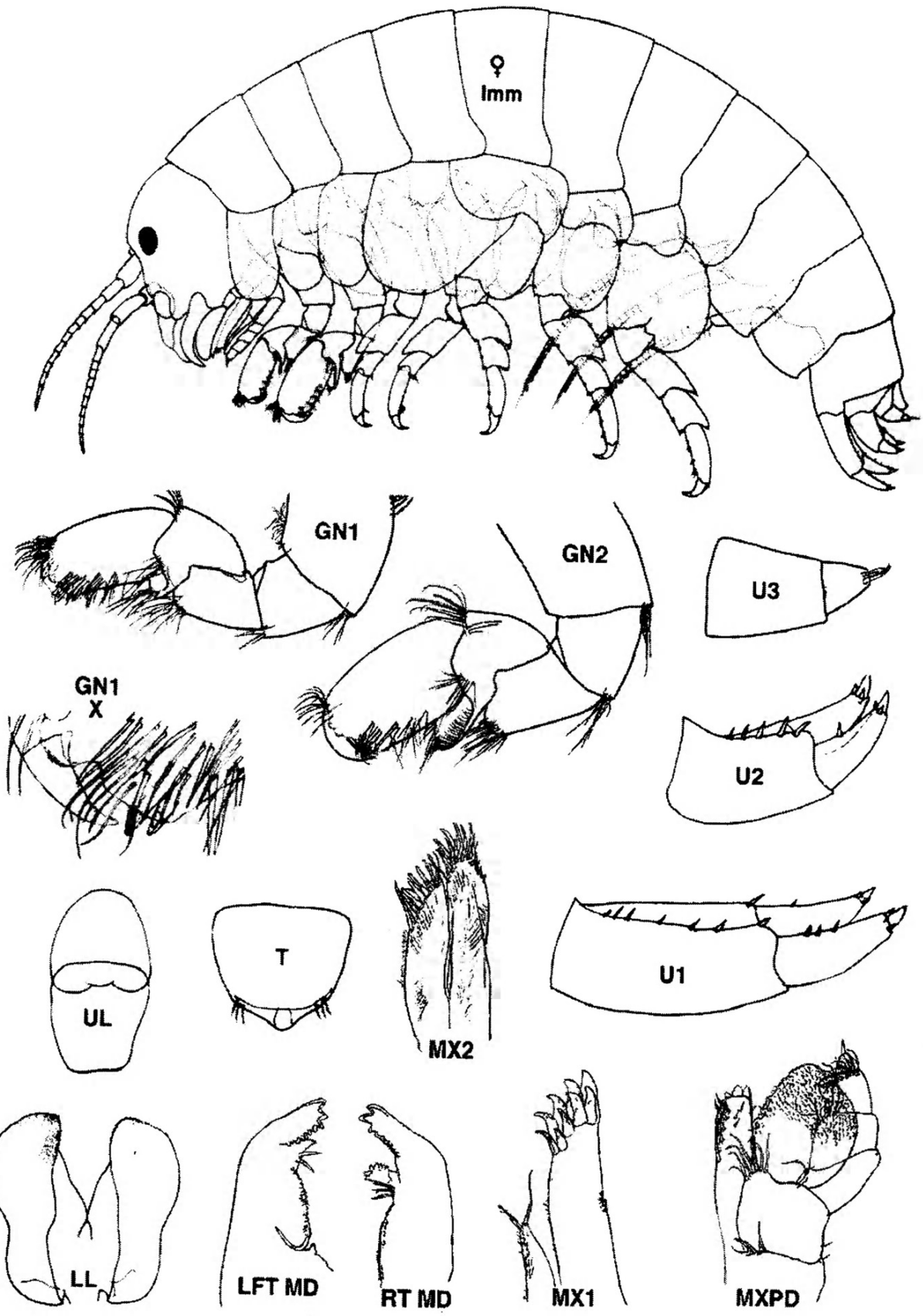


Fig. 5. *Najna consiliorum* Derzh. Female im (5.5 mm). NW Sea of Japan.

3.5 m depth, N. I. Tarasov Sta. 264/39, 9.08.1929 - 1 specimen, **syntype,** N 78/33377.

Diagnosis: Male (9. mm). Body medium-sized. Pleon with slight posterior mid-dorsal ridge (Bulycheva). Eye medium, subovate. Antenna 1, flagellum with 9-11 segments, median segments posteriorly each with 5-7 aesthetascs per bundle. Antenna 2, peduncular segments 4 & 5 slender, smooth; flagellum smooth, 12-13 segmented.

Buccal mass relatively shallow, slightly prognathous. Upper lip with slight apical indentation. Lower lip regular. Mandibular incisor 10-12 dentate; left lacinia 7-dentate. Maxilla 1, palp minute, positioned a spine-length proximad of spines of outer plate; inner plate with medial basal lobe. Maxilla 2, outer lobe distinctly the longer. Maxilliped, inner plate relatively broad, outer plate slightly longer than broad; palp segments 1-3 slightly broader than long; dactyl small, slightly longer than broad.

Coxae 1-3 regular rounded below. Coxa 4, posterior process acute. Coxal gills large, subovate; accessory lobes of gill 5 & 6 short, (<1/2 length of primary lobes).

Gnathopods 1 & 2 subsimilar but 2 distinctly larger than in female (Derzhavin, Bulycheva). Gnathopod 1, carpal lobes short, not exceeding merus; propod slender, subrectangular, palm nearly straight and vertical, separated posterodistal spines not exceeded by dactyl. Gnathopod 2, carpal lobe elongate, tip attaining 1/2 propod; propod rectangular-subovate; palm short, shallowly convex, nearly vertical, postero-distal spines not exceeded by dactyl.

Peraeopods medium stout. Peraeopods 3 & 4, segment 4 scarcely broadening distally, slightly overhanging short segment 5; segment 6 with 1 group of posterior marginal spines. Peraeopods 5-7, bases broad, wider than deep, with deep posterodistal lobes; segment 6, anterior margin with 3-4 groups of stout spines but few setae; dactyls short, regularly sharply curved. Peraeopod 5, segment 5 with posterodistal line of 4 heavy spines. Peraeopod 6, segment 4 normally broadened, about as wide as long, posterodistal process bearing 1-2 short spines..

Epimeral plate 3, hind corner obtuse, or slightly acuminate. Pleopods slender, peduncles with 5 retinacula. Uropod 1, peduncle with 9-10 outer marginal spines (may be accompanied by many short fine filaments in spine row) and 2-3 inner marginal spines; outer ramus with 3-5 proximal outer marginal spines, inner ramus with 0-1 marginal spines. Uropod 2, peduncle with 5-7 outer marginal spines; outer ramus with 2 marginal spines, inner ramus with 1 marginal spine, terminal spines large, supernumerary spines large, unequal. Uropod 3, peduncle longer than basally deep; ramus slightly longer than deep, with 3-5 apical setae.

Telson slightly wider than long, apex flat or medially notched.

Female (Br. I & II.): No ovigerous females (14 mm) examined. Gnathopods 1 & 2, propods more slender than in male (Derzhavin, loc. cit.; Bulycheva, loc. cit.). Brood plate of gnathopod large, narrowing to acute apex (Bulycheva). Telson apically truncate or with small median protruberance. Reproductive period in summer.

Distributional ecology: Sea of Japan, western shore of South Sakhalin, Sea of Okhotsk and the Kuriles. Found in samples from the Seas of Japan and Okhotsk, western shores of South Sakhalin (Rakuma) and the island of Shikotan. Not gregarious, encountered in small numbers, most often 1-3 individuals and very rarely more, occupying depths from 5 to 20 m, but encountered down to 45 m, inhabiting stony and pebbly sediments in stands of algae and eel grass.

Remarks: Differences between the Illustrations of *Najna consiliorum* provided by Derzhavin (1937), Bulycheva (1957), and Hirayama (1985) suggest that more than one species may be present in the western North Pacific region. Derzhavin (loc. cit.) provided a number of collecting localities and depths, but did not specify the locality (Najna Bay, Peter-the-Great Bay?) of his limited figures of an ovigerous female (14 mm), and a mature male (10 mm). His figures and diagnosis conform with generic character states of the genus *Najna* as redefined herein, but are not considered sufficiently complete to define the species critically nor compare with many of the character states of other text figures of *N. consiliorum,* or other species within family Najnidae.

Bulycheva (loc. cit.) has fully described and figured a large ovigerous female (14. mm) and variations in shape of telson of two other females (Fig. 6). She also included figures of gnathopods 1 & 2 and telson of a mature male (9 mm), and variations in shape of telson of two other males. Her figure of the entire animal appears to be a direct trace from Derzhavin's type specimen. However, the distal segments of peraeopod 3-7 are slender and relatively elongate in Bulycheva's lateral view of the whole animal, unlike her enlarged figures of the corresponding appendages. Although

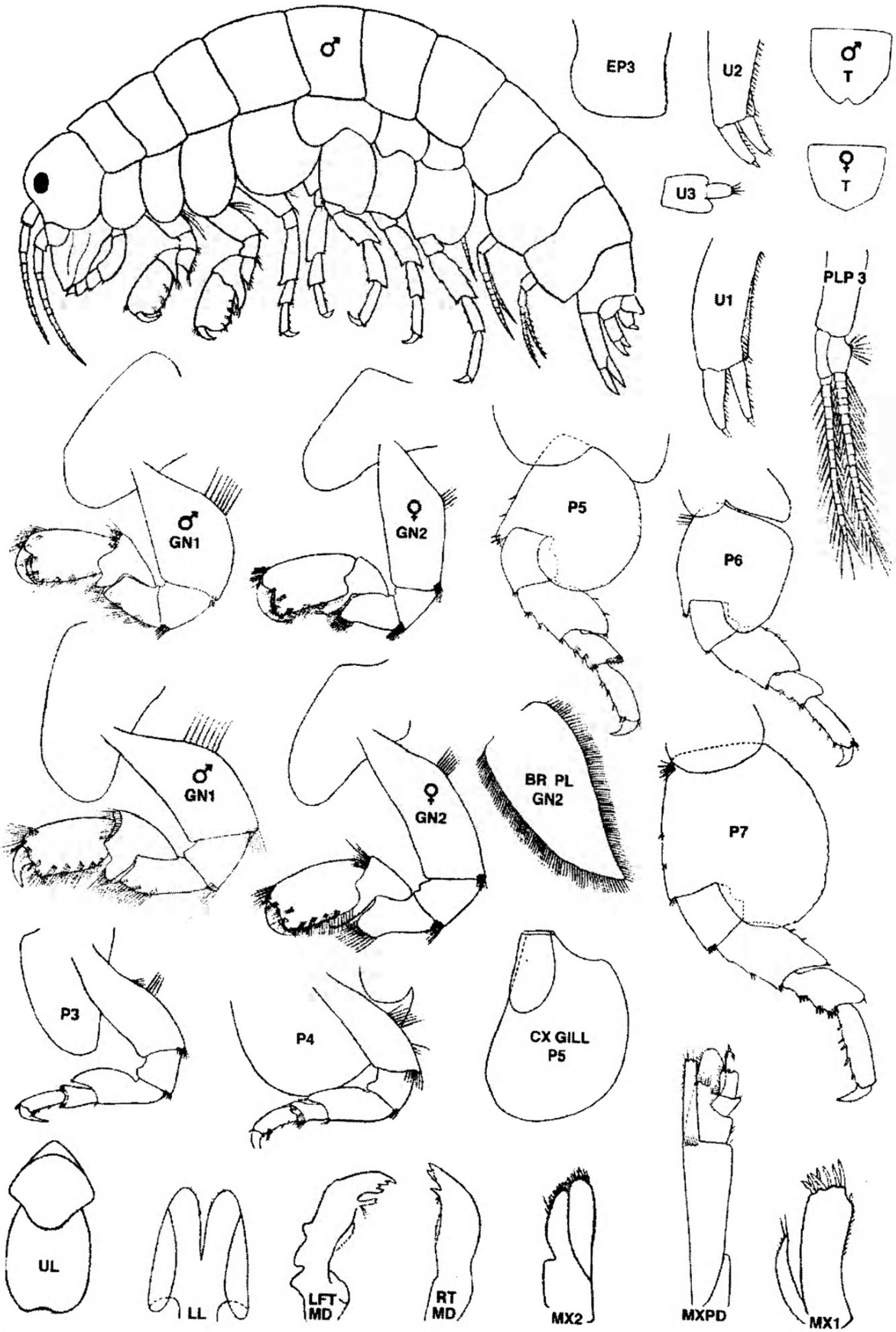


Fig. 6. *Najna consiliorum* Derzh. Male (9 mm); female ov (14 mm). Russian coast, NW Sea of Japan (modified from Buly cheva, 1957)

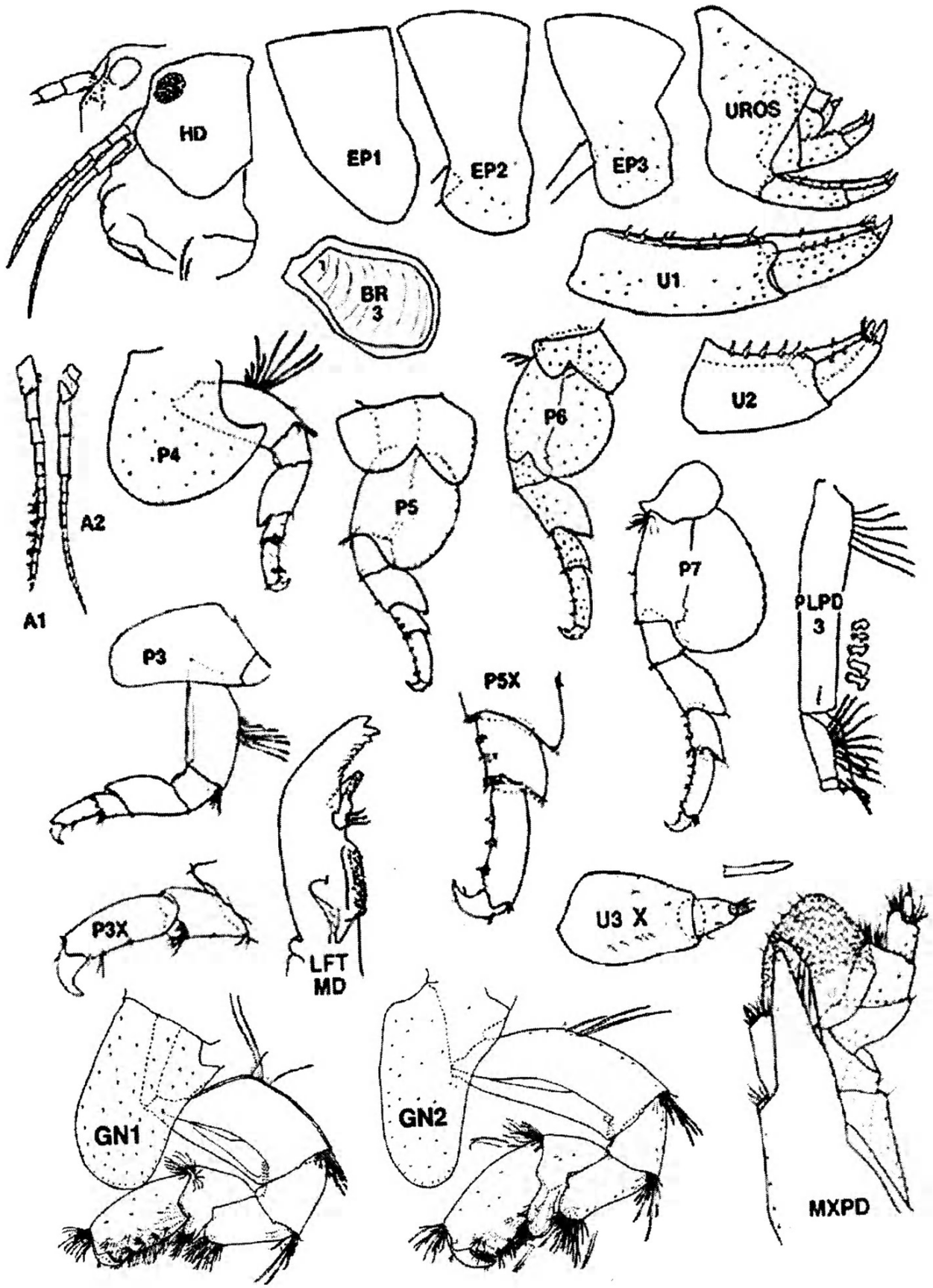


Fig. 7. *Najna consiliorum* Derzh. Male (8.5 mm) Otsuchi, Japan (modified from Hirayama 1985).

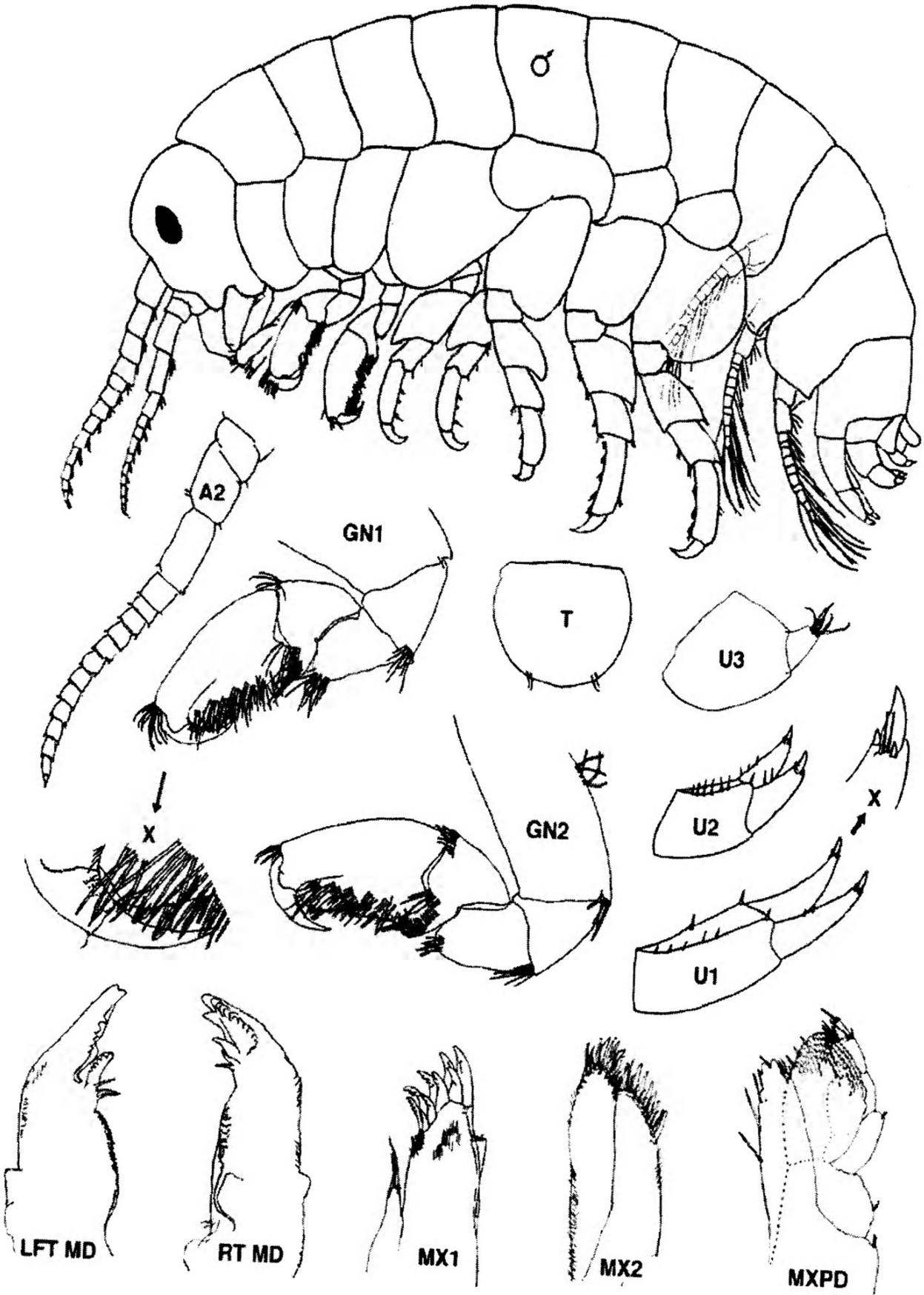


Fig. 8. *Najna amchitkana* n. sp. Male (5.5 mm) + Mxpd, Rt Md;

she correctly figured the bilobate coxal gill on peraeopod 5, she did not comment on its similarity to coxal gill 6 nor corresponding difference with the single plate gills on coxae 2-4. Bulycheva mentions the "first segment of the urosome with a small dorsal keel". However, this feature is not mentioned in Hirayama's description of urosome 1, nor visible in Gurjanova's male specimen examined here (Fig. 5).

Although the species range is given as western Japan Sea, southern Sakhalin, Okhotsk Sea and the Kurile Islands, localities are not specified for the material illustrated. Drs. Nina Tzvetkova and Alexey Golikov have re-examined all materials examined by Derzhavin (1937) and Bulycheva (1957) (pers. comunic., and in prep.). They have concluded: "it is nearly impossible to reveal which specimens were used by Bulycheva for her figs. 46, 47A and 47B".

Hirayama (loc. cit.) has provided a more complete description and figures of a male specimen (8.5 mm) of *Najna consiliorum* from Otsuchi Bay, northeastern Japan (Fig. 7). His figures are generally similar to those of a male specimen (5 mm) from Peter the Great Bay, Russia, kindly provided by Dr. Nina Tzvetkova, Zool. Inst. Hirayama noted several differences between his material and the large female (14 mm) figured by Bulycheva, including several discrepancies in the mouthparts, uropod 3, and the smaller number of outer marginal spines on the peduncle and rami of uropods 1 & 2. He also figured but did not comment upon the single coxal gill on peraeopod 3, nor the presumed bilobate gills on coxae 5 & 6.

The significance of these differences in material from the western Pacific ascribed to "*Najna consiliorum*" awaits further examination of all specimens not viewed by us.

Najna amchitkana n. sp.

(Fig. 8)

Material Examined:
Alaska, Aleutian Islands, Amchitka I.
Constantine Harbor (51° 24' 11" N, 179° 17' 49"W), from algae on dock pilings, P. Slattery coll. , Sept. 7, 1969 - ♂ (11.3 mm) **Holotype** (slide mount), CMNC 2003-0626 + 1 male (5.5 mm) + 12 juv (2-4 mm), **paratypes,** CMNC 2003-1331; Constantine Harbor, near Kirilof Pt. (51° 24' 30"N, 179° 19' W), intertidal, P. Slattery coll., Oct. 10, 1971 - 2 ♂♂ (6.5 mm & 5.5 mm), CMNC 2003-1176.

Diagnosis: Male (11.3 mm). Pleon with very slight posterior mid-dorsal ridge. Eye medium, subovate. Antenna 1, flagellum with 8-11 segments, median segments posteriorly each with 5-6 aesthetascs per bundle. Antenna 2, peduncular segments 4 & 5, with small posterodistal tufts of setae; flagellum 12-13 segmented.

Buccal mass relatively shallow, not prognathous. Upper and lower lips regular. Mandibular incisor 9-12 dentate; left lacinia 7-dentate. Maxilla 1, palp minute, positioned near base of spines of outer plate. Maxilliped, inner plate relatively broad, outer plate distinctly longer than broad; palp segments 1- 3 relatively slender; dactyl small, slightly longer than basally broad.

Coxae 1-3 regular rounded below. Coxa 4 deep, posterior process acute. Coxal gills large, narrowly heart-shaped; accessory lobes of gill 5 & 6 small (< 0.5x length of primary lobes).

Gnathopods 1 & 2 subsimilar; carpal lobes relatively short; propods subovate, somewhat narrowing distally; palms short, shallowly convex, nearly vertical, posterodistal spines separated, distinctly exceeded by dactyl.

Peraeopods relatively short and stout. Peraeopods 3 & 4, segment 4 broadening distally, slightly overhanging short segment 5; segment 6 with 3-4 groups of posterior marginal spines. Peraeopods 5-7, bases regular, not wider than deep, with deep posterodistal lobes; segments 4 & 5, posterodistal lobes overhanging successive segments; segment 6, anterior margin with 4-5 groups of stout spines but few setae; dactyls regularly sharply curved. Peraeopod 5, segment 5 with posterodistal line of 4-5 heavy spines. Peraeopod 6, segment 4 much broadened, wider than long.

Epimeral plate 3, hind corner obtuse. Pleopods slender, peduncles with 5 retinacula. Uropod 1, peduncle with 4-5 outer marginal and 2 inner marginal spines; outer ramus with 3 proximal outer marginal spines, inner ramus lacking marginal spines. Uropod 2, peduncle with 8-9 outer marginal spines; outer ramus with 2 proximal marginal spines, inner ramus with 1 marginal spine, terminal spines large, supernumerary spines unequal. Uropod 3, peduncle nearly as deep as long; ramus longer than deep, with 4-5 apical setae.

Telson slightly wider than long, apex not medially notched.

Female: No identifiable females present.

Etymology: The species name reflects its known distribution on Amchitka Island, Aleutian Islands.

Distributional Ecology: Among algae at LW level and on dock pilings, Amchitka Island.

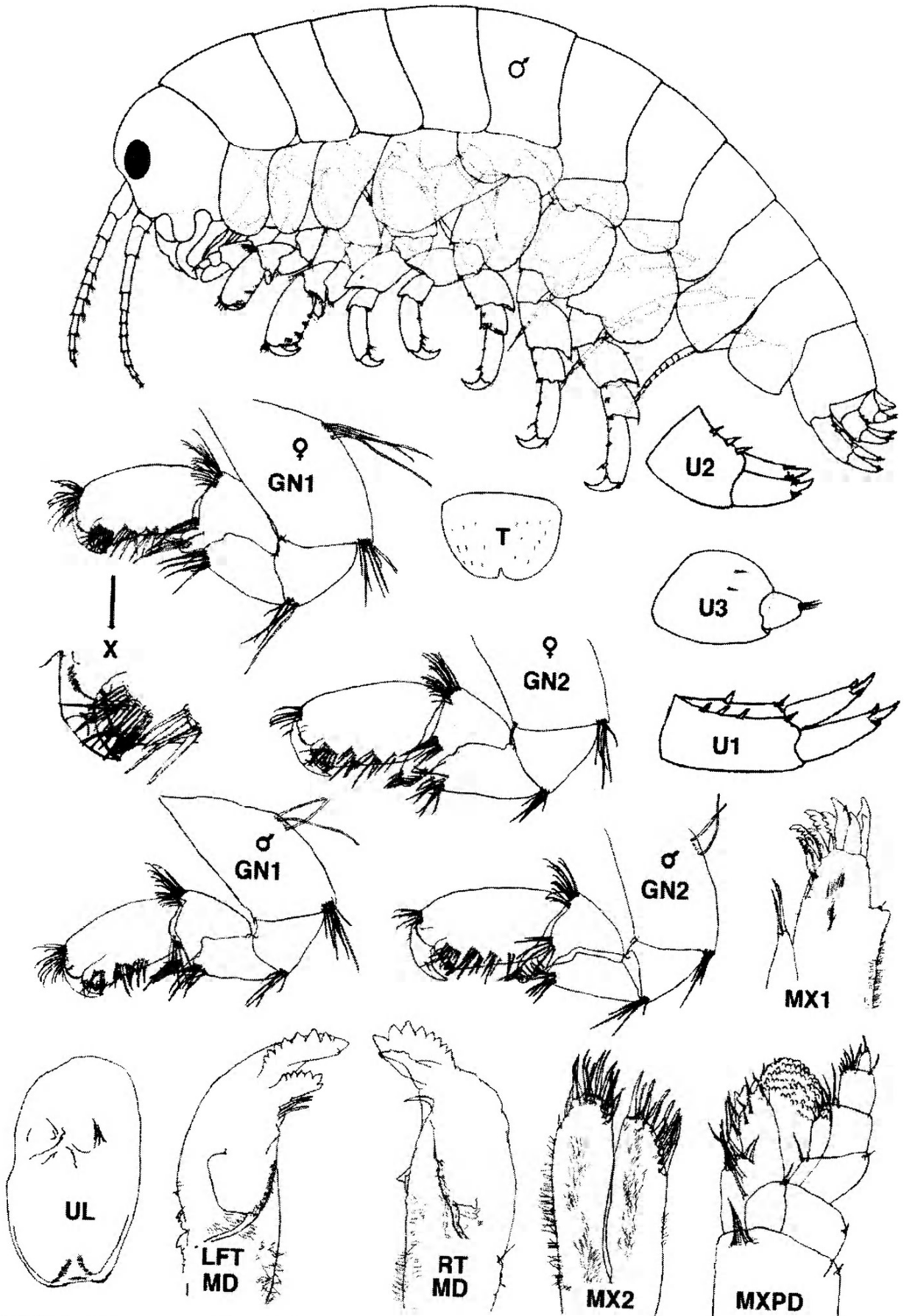


Fig. 9. ***Najna parva*** n. sp. Female br. I (4.0 mm); male (4.0 mm). Johnston Pt., southeastern Alaska.

Remarks: The relatively large body size of *N. amchitkana* and the overlapping dactyls of the gnathopods are similar to those features of *N. consiliorum* described by Bulycheva (Fig. 6).

Najna parva n. sp.
(Fig. 9)

Najna parvum Bousfield 1981, figs 15, 16.

Material Examined:
ALASKA
Aleutian Islands
Amchitka I., Constantine Harbor, 400 yds. south of Kirilof Pt., on subtidal algae., P. Slattery coll., Oct. 31, 1971 - 1 ♂ (5.0 mm), 2 imm (~2 mm)., CMNC 2003-1184; Square Bay, C.E. O'Clair Stn CT0 1769 C-6 (51° 27' 12"N, 179°11'30"E), Sept. 19, 1969 - 1 ♂ (5.5 mm), 2 ♀♀ br. I (~5.0 mm), CMNC 2003-1181. Amchitka Ids., West Census area, intertidal?, C. E. O'Clair Stn II.1.4.4.1.10.1, 1969? - 1 ♂ (5.2 mm), CMNC 2003-1182.

SE Alaska, ELB Stns, 1961
A131, cove on NE side of Renard I., Blying Sound, Resurrection Bay (59° 56'N, 149° 19'W), in beds of *Laminaria* over boulders and cobble, LW level, July 11 - 1 ♂ (4.2 mm) **Holotype** (slide mount) CMNC 2003-1177, 1 ♀ (br. I) (4.2 mm) **Allotype** (slide mount), CMNC 2003-1178, 1 ♀ imm. **Paratype** CMNC 2003-1882; A151, Islet at mouth of Double Bay, Hinchinbrook I., (60° 28'N, 146° 28'W); bedrock, boulders, mud, sand, eel grass. LW levels, July 15 - 2 imm (~2.5 mm), CMNC 2003-1180; A3, Little Daykoo Harbor., Dall I. (54° 42'N, 132° 42'W), in tide pools over slate bedrock, LW level, May 31 - 1 imm (~1.5 mm). CMNC 2003-1179.

British Columbia
Northern Vancouver Island
Quinsam, Campbell River (50° 01' N, 125°16' W), intertidal, E. Black coll., May 27-31, 1982 - 1 ♀ br. II (4.5 mm), CMNC 2003-1183.

Diagnosis: Male (4.2 mm). Body small. Pleon lacking dorsal carination. Eye relatively large, round. Antenna 1, flagellum with 8-11 segments, median segments posteriorly each with 5-6 aesthetascs per bundle.

Buccal mass relatively shallow, not prognathous. Upper lip with shallow apical notch. Mandibular incisor 9-10 dentate; left lacinia 7-dentate. Maxilla 1, palp minute, positioned more than a spine length from bases of spines out outer plate. Maxilliped, inner plate relatively broad, outer plate nearly as broad as long, palp segment 2 & 3 relatively slender, dactyl small, slightly longer than basally broad.

Coxae 1-3 regular rounded and slighly separated below. Coxa 4, broader than deep, posterior process acute. Coxal gills large, narrowly heart-shaped; accessory lobes of gill 5 & 6 small, (< 1/2 length of primary lobes).

Gnathopods 1 & 2 regular; carpal lobes relatively short; propods subrectangular, palms shallowly convex, nearly vertical posterodistal spines slightly exceed by dactyl.

Peraeopods relatively short and stout. Peraeopods 3 & 4, segment 4 broadening distally, slightly overhanging short segment 5. Peraeopods 5-7. bases regular, not wider than deep, with deep posterodistal lobes; segment 5, posterodistal lobe strongly overhanging segment 6; segment 6, anterior margin with a few weak spines and setae; dactyls regularly sharply curved. Peraeopod 5, segment 5 with posterodistal cluster of 3-4 spines. Peraeopod 6, segment 4 much broadened, width about equal length.

Epimeral plate 3, hind corner subquadrate. Pleopods slender, peduncles with 4-5 retinacula. Uropod 1, peduncle with 3-4 outer marginal and 1-2 inner marginal spines; inner ramus with single marginal spine, outer ramus lacking marginal spines. Uropod 2, peduncle with 2-3 outer marginal spines, inserted distally; rami lacking marginal spines, terminal spines large. Uropod 3, peduncle about as deep as long; ramus about as deep as long, with 2-3 apical setae.

Telson slightly wider than long, apex medially notched.

Female (Br. I & II) (5.5 mm): Telson apically truncate. Mature brood plates unknown (no ovigerous females present).

Etymology: From the Latin *parvus* (small), with respect to the small size of mature specimens.

Distributional Ecology: Aleutian Islands, Alaska, through southeastern Alaska to northern British Columbia, associated with kelp and marine algae, from LW level to immediate subtidal depths, summer temperatures 7.2-13.4°C., salinities ~26 -32.5 ‰.

Remarks: Distinctive features of this small species are the weakly marginally spinose uropods 1 & 2, and broadened segment 4 of peraeopods 5-7, especially peraeopod 6.

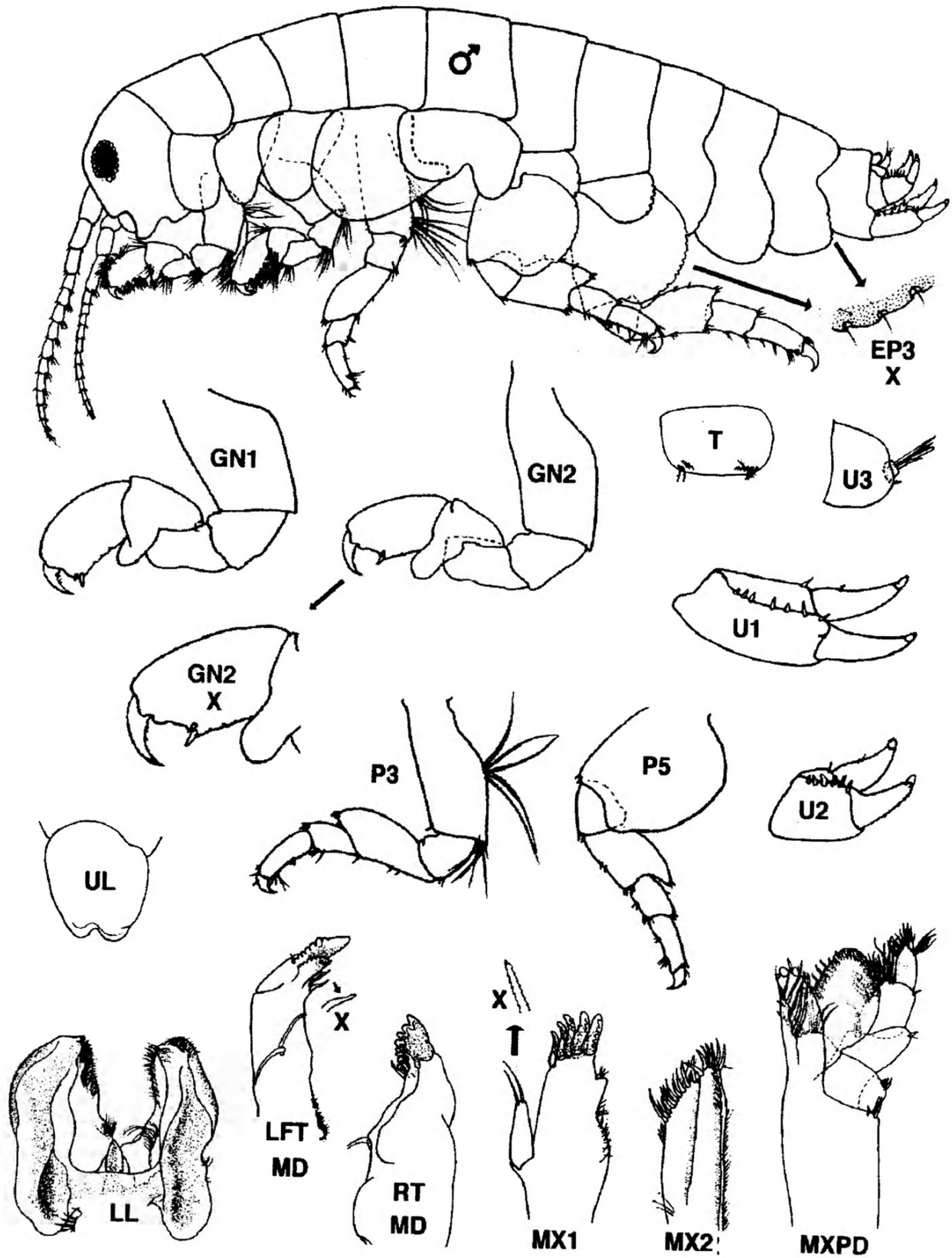


Fig. 10. *Carinonajna kitamati* (Barnard, 1979). Male (8.0 mm). Barnard Stn. 4822, off S. California. (modified from Barnard 1962)

Carinonajna n. g.

Najna Barnard 1962: 157 (part);—Barnard 1972: 190 (part);—Barnard 1975: 343 (key), pl. 71.8;—Barnard 1979: 118 (part);—Bousfield 1981: 80 (part);—Barnard & Karaman 1991: 545 (part).
non *Najna* Derzhavin, 1937: 97;—Gurjanova 1951: 825;—Bulycheva 1957: 120;—Hirayama 1985: 27.

Type species: ***Carinonajna bicarinata*** n. sp. (original designation).

Species: ***Carinonajna barnardi*** n. sp.: (p. 27); ***C. bispinosa*** n. sp. (p. 25); ***C. botanica*** n. sp. (p. 34); ***C. carli*** n. sp. (p. 29); *C. kitamati* (Barnard, 1979) (p. 21); *C. lessoniophila* n. sp. (p. 23); ***C. longimana*** n. sp. (p. 31); and ***C. oculata*** n. sp. (p. 33).

Diagnosis: Abdominal pleosome 3 and urosome 1 variously dorsally bicarinate. Antenna 1 relatively short (<9 segments); flagellar segments with conspicuous posterior marginal tufts of aesthetascs, more strongly developed in males.

Mandible, lacinia 7-8 dentate; incisor 9-11 dentate. Maxilliped, outer plate relatively narrow, variously longer than broad; palp segment 4 small or minute, not longer than broad.

Coxal plates 1-3 unlike, barely overlapping, coxa 2 pyriform; coxa 4 acutely attenuated posteriorly; peraeon segments 1-4 more or less separated ventrally, occasionally dorsally. Coxae 5 & 6 shallowly posterolobate.

Gnathopod 1 & 2 weakly subchelate, dissimilar. Gnathopod 1, propod distally narrowing, anterodistal margin strongly setose; palmar margin short, with 1 (2) prominent posterodistal spine(s), overlapped by dactyl. Gnathopod 2, propod narrowing distally, anterior margin variously setose or bare; palm oblique, convex or concave, with 1 (2) posterodistal spines; carpal lobe variable in size.

Peraeopods 3 & 4, segment 4 variously arched anteriorly, widest medially. Peraeopods 5-7, bases with shallow posterodistal lobes; segment 4 often broadened. Dactyls short, strongly curved.

Abdominal size plate usually weakly crenulate behind; pleopod retinacula 5-8. Uropods 1 & 2, peduncular outer marginal spines few (2-6); outer ramus marginally bare, inner ramus with 1-3 marginal spines. Uropod 3, peduncle short, deep; ramus very short to minute, not longer than deep; with 2-10 slender apical setae.

Telson short, broader than long, often slightly emarginate apically, lateral margins slightly convex.

Etymology: From the Latin "*carinatus*" (keeled), with reference to the posterodorsally bicarinate abdominal segments, and the root place name "*Najna* ". Gender: feminine.

Distributional Ecology: Eastern North Pacific: southern from Bering Sea and southeastern Alaska to southern California, burrowing in stipes and holdfasts of kelps (*Alaria, Egregia, Lessoniopsis, Macrocystis*) or in roots of *Phyllospadix*; from the low intertidal and shallow subtidal to 50 m. depth.

Remarks: In nearly all character states *Carinonajna* is more advanced than *Najna*. *Carinonajna* overlaps it distributionally in the eastern North American Pacific, from the Aleutian islands to northern British Columbia.

Carinonajna kitamati (Barnard)
(Fig.10)

Najna kitamati J. L. Barnard, 1979: 118;—Austin 1985: 595;—Barnard & Karaman 1991: 546, fig 71A;—Bousfield 2001a: 105.
Najna ?consiliorum Barnard 1962: 157, figs. 21, 22.
Najna sp. Barnard 1972: 190;—Barnard 1975: 342 (key), 362;—Staude, 1996: 352 (key), 380, fig. 18.20.

Material Examined: None

Diagnosis (updated from Barnard 1962, 1979):
Male (to 8.0 mm). Peraeon segments 1-4 not separated distally. Urosome 1 weakly dorsally bicarinate.

Antenna 1, flagellum 10-segmented, flagellar segments with strong posterodistal clusters of aesthetascs. Antenna 2 less robust, flagellum 12-segmented, posterior marginal setae inconspicuous; fine filaments lacking.

Upper lip with distinct apical notch. Mandible, left lacinia 8-dentate; incisors with 9-10 teeth; molar seta short. Maxilliped, inner plate slight narrowing apically, outer plate longer than wide; palp segment 4 very small.

Coxae 1-4 slightly overlapping, separated distally. Coxa 2 pyriform. Coxa 4, posterior process relatively short, apex subacute. Coxae 5 & 6 posterolobate. Coxal gills not described.

Gnathopod 1, propodal palm short, convex, two posterodistal spines markedly unequal, slightly exceeded by closed dactyl. Carpal lobe relatively large, exceeding merus. Gnathopod 2, propodal palm steep, slightly concave, with minute outer, and strong inner, posterodistal spines that are not exceeded by the closed

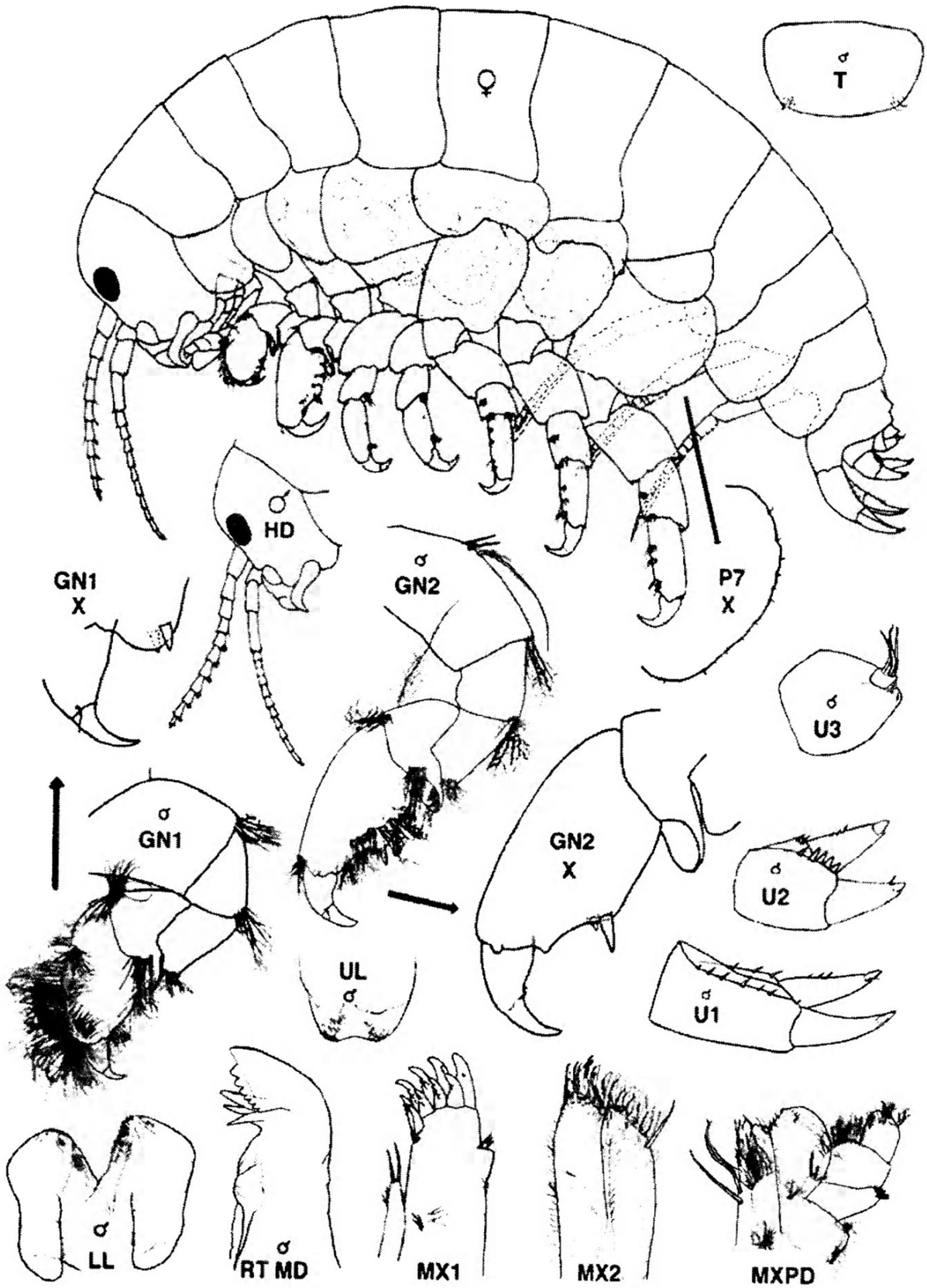


Fig. 11. ***Carinonajna lessoniophila*** n. sp. Male (9.2mm); female (8.0 mm). Patrick's Pt., Humboldt Co., CA.

dactyl; anterodistal margin of propod with subapical and apical setal clusters figured by Barnard (1962). Carpal lobe large, extending halfway along lower margin of propod.

Peraeopods 3 & 4 slightly arched anteriorly. Peraeopods 5-7, bases broad (broadest in 7), hind margins rounded and finely but distinctly crenulate; segment 4 broadened; segment 6 normally spinose and setose anteriorly.

Epimeral plates slightly convex and crenulated behind, hind corners rounded or obtuse. Pleopods not described.

Uropod 1, peduncular outer margin with 6-7 stout spines; inner ramus with single small marginal spine; outer ramus bare. Uropod 2, peduncle short and thick, with 6 stout outer marginal spines; inner ramus with two small marginal spines; outer ramus bare. Uropod 3, peduncle short, deep; ramus minute, scale-like, with 4 medium long apical setae.

Telson short, broad, subrectangular, outer margins slightly convex, hind margin nearly straight, subapically with 3 penicillate setae on the right side, 4 setae on the left.

Female: not described.

Distributional Ecology: Central California, but "quite rare"in southern California; subtidal on algal bottoms to 16.5 m. depth. At Carmel, the species occurred in algal holdfasts, mainly on *Egregia,* rarely on *Polstelsia* and *Macrocystis* (Barnard 1969b).

Remarks: Although Barnard (1962, 1979) did not formally describe nor clearly figure the dorsally bicarinate abdomen, he depicted the propod of gnathopod 2 with anterodistal marginal setae. In most character states, especially of the gnathopods (Figs. 1-4), *C. kitamati* most closely resembles *C. lessoniophila* and *C. bispinosa.* As the oldest described taxon, *kitamati* is here designated as nominate species of the subgroup within genus *Carinonajna.*

Carinonajna lessoniophila n. sp.
(Fig. 11)

Najna lessoniophilum Bousfield, 1981: fig. 15.

Material Examined:
OREGON.
Sunset Bay, S. of Charleston, Coos Co. (43° 20'N, 124° 22'W), in sessile *Hedophyllum* over bedrock, LW level, K. E. Conlan coll., July 8, 1986 - 1 ♀ ov. (6.2 mm), 1 ♀ subad. (6.5 mm), 1 ♂ imm., CMNC 2003-1201.

CALIFORNIA
Whitesboro Cove, Mendocino Co. (39° 13'N, 123° 46. 54' W), in *Laminaria*, LW level, T. Chess coll., Apr. 20, 1981 - 2 ♂♂ (9.2 mm), CMNC 2003-1245.
Patricks Pt., Humboldt Co. (41° 08' 10"N, 124° 09' 30"W), from galls on stipes of *Lessoniopsis littoralis*, J. R. Chess & R. J. Rosenthal colls., Sept. 8, 1969 - 1 ♂ (8.0 mm), **holotype** (slide mount), CMNC 2003-1198; Ibid.,- 1 ♀ (8.0 mm) **allotype** (slide mount), CMNC 2003-1199; Ibid., - 1 ♂ (8.0 mm), 2 ♀♀ imm., **paratypes,** CMN 2003-1200 (1 ♀ removed for K. Halcrow).

Diagnosis: Female ov (8.0 mm). Abdomen occasionally with fine downy filaments posterodorsally on pleon 3 and dorsomedially on urosome 1. Peraeon segments 1-4 very slightly separated ventrally.

Antenna 1 short, slender; flagellum with 7 segments, few aesthetascs per bundle. Antenna 2 slender; flagellum with 10 segments, each nearly bare of setae.

Upper lip with shallow distal notch. Mandibular left lacinia 7-8 dentate; incisor with 9-10 teeth. Maxilla 1, palp minute, protruberant. Maxilli- ped, inner plate little narrowing distally, outer plate slightly longer than wide; palp segment 4 small, not longer than wide.

Coxae 1-4 moderately overlapping, slightly separated distally. Coxa 2 subpyriform. Coxa 4, posterior process relatively short, acutely tipped. Coxae 5 & 6 shallowly posterolobate.

Gnathopods 1, propodal palm small convex, with 2 unequal posterodistal spines slightly overlapped by closed dactyl; anteriordistal margin strongly setose and filamentous. Carpal lobe short, margin with 6-7 comb setae. Gnathopod 2, propod much stouter but lacking anterodistal marginal setae; palmar margin oblique, slightly concave, with very small outer, and stout inner, marginal posterodistal spines, little overlapped by the closed dactyl. Carpal lobe medium large, extending beyond merus.

Peraeopods 3 & 4, segment 4 broad, anteriorly arched. Peraeopods 5-7, bases not very broadly expanded, hind margins very weakly crenulate; segment 4 short, broad; segment 5 very short; segment 6 with 3-4 anterior marginal spine clusters.

Epimeron 3, hind margin faintly crenulate, hind corner nearly square. Pleopod rami with 12-15 segments; peduncle with 5-6 retinacula.

Uropod 1, peduncle stout, with 6-7 outer marginal spines and 2-3 inner marginal spines; inner ramus with 3 inner marginal spines; outer ramus smooth. Uropod 2, peduncle short, with 2-3 stout outer marginal spines; inner ramus with single marginal spine outer ramus smooth. Uropod 3, peduncle very deep with 2-3 short

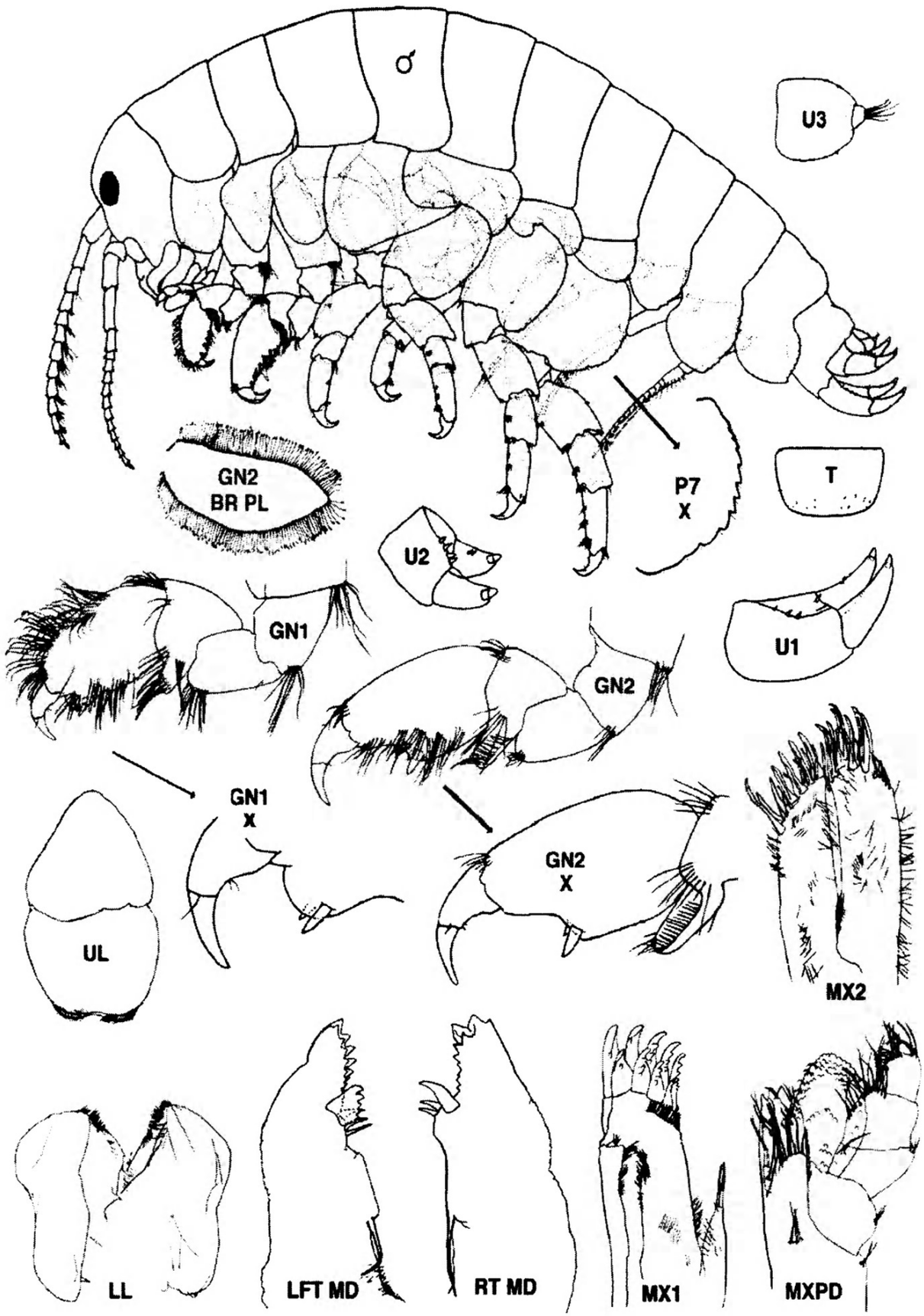


Fig. 12. ***Carinonajna bispinosa*** n. sp. Male (7.0 mm); female ov (7.5 mm). San Juan I., WA.

spines at base of ramus; ramus very short, not longer than deep, with 3-4 slender apical setae.

Telson wider than long; lateral margins convex, narrowing slightly; apical margin very slightly convex.

Coxal gills large, subovate of spade-shaped; accessory lobes of 5 & 6 extending about half length of main lobe.

Brood lamellae relatively broad, apex subacute.

Male (to 9.2 mm): Appendages differing little from female. Antenna 1, flagellar segments with 4-6 aesthetascs per posterior marginal bundle. Gnathopod 2, propod with fewer anterodistal marginal setae.

Etymology: The name is compounded from *Lessoni* + *philos,* meaning thriving in *Lessoniopsis,* the principal host kelp species.

Distributional Ecology: Known from southern Oregon to central California; forming galls on stipes of *Lessoniopsis littoralis.*

Remarks: *C. lessoniophila* is a member of the *kitamati* group, having bicarinate urosome segment 1, paired posterodistal palmar spines of gnathopods 1 & 2, and concave palmar margin of gnathopod 2. The type male specimen bears numerous filamentous threads on the margins of distal segments of gnathopods 1 & 2. The threads do not occur on all specimens, and their structure of uniform thickness suggests that they are fungal filaments rather than a type of setation.

Carinonajna lessoniophila differs from *C. kitamati* in lacking anterodistal setae on the propodof gnathopod 2, and less strongly crenulated margins of peraeopod bases and abdominal side plates. *C. bispinosa* has a much larger carpal lobe on gnathopod 2 and less strongly spinose uropods 1 & 2.

Carinonajna bispinosa n. sp.
(Fig.12)

Najna rugosum Bousfield, 1981

Material Examined
BRITISH COLUMBIA
North Central Mainland, ELB Stns, 1964:
H23, Deadman Inlet, Banks I, Hecate Strait (53° 38'N, 129° 28'W), in kelp over fine sand, LW level, July 18 - 1 im (5.6 mm), CMNC 2003-1225.
1
Southern Vancouver I.,
ELB Stns, 1970: P715, Gonzales Bay, Victoria, (48° 25'N, 123° 20'W), among *Alaria, Egregia,* bedrock, pebbles, fine sand, LW; level, July 29 - 1 ♂, CMNC 2003-1227; P719, Botanical Beach, San Juan Pt., Juan de Fuca Strait (48° 33'N, 124° 25'W), in kelp and algae, vertically bedded slate and boulders, LW level, Aug. 1- 1 ♀ (7.5 mm), CMNC 2003-1226.
ELB Stns 1975: P5a, Taylor I., Trevor Channel (48° 49.5' N, 125° 12'W), kelp and *Phyllospadix* over bedrock, LW, July 25, - 1 ♀ im., CMNC 2003-1228.
Pachena Bay, LW level, J. M. Green coll., summer, 1975 - 2 ♂♂ (7.3 mm), 2 im, CMNC 2003-1233.

WASH-ORE
Pillar Pt., Clallam Co., Juan de Fuca Strait (48° 12' 51"N, 124° 06' 03"W), LW level, T. Suchanek coll., June 15, 1976 - 1 ♀ ov (7.5 mm) **holotype** (slide mount), CMNC 2003-1236; Ibid., - 1 ♂ (7.0 mm) **allotype** (slide mount), CMNC 2003-1237; Ibid., - 1 ♂ (7.0 mm) (slide mount), 11 im (**paratypes**), CMNC 2003-1238.
ELB Stns., 1966: W51, Seaside, m. of Necanicum R., Clatsop Co., Ore. (46° 01' N, 123° 55' W) fine flat sand of outer estuarine beach, LW, Aug. 6 - 1 ♂ (5.6 mm), CMNC 2003-1241.

Diagnosis: Male (7.5 mm). Abdomen bicarinate, dorsomedially on urosome 1. Peraeon segments 1-4 separated ventrally.

Antenna 1, flagellum with 9-10 segments, 7-10 aesthetascs per bundle. Antenna 2, peduncle 4 slightly shorter than 5; flagellum with 12-15 nearly bare short segments.

Upper lip, slightly indented apically. Mandibular left lacinia 7-dentate; incisor with 9-10 teeth; molar seta regular. Maxilla 1, palp minute, slightly protruberant. Maxilliped, inner plate little narrowing distally; outer plate ~1.2 X longer than wide; palp segment 4 small not longer than wide.

Coxae 2 distally narrow and pyriform. Coxa 4, posterior process medium acute. Coxae 5 & 6 shallowly posterolobate. Coxal gills medium large, subovate, accessory lobes of gills 5 & 6 medium.

Gnathopod 1, propod elongate,anterodistal margin strongly setose, not filamentous; palm small, convex, with 2 unequal posterodistal spines overlapped by closed dactyl. Carpal lobe short, margin with ~6-8 comb setae. Gnathopod 2, propod deeper but lacking anterodistal marginal setae; palmar margin oblique, sharply concave, with very small outer, and stout inner, marginal posterodistal spines, little overlapped by the closed dactyl. Carpal lobe large, extending halfway along propod, margins with 20-25 comb setae.

Peraeopods 3 & 4, segment 4 broadened, anteriorly arched. Peraeopods 5-7, bases not very broadly ex-

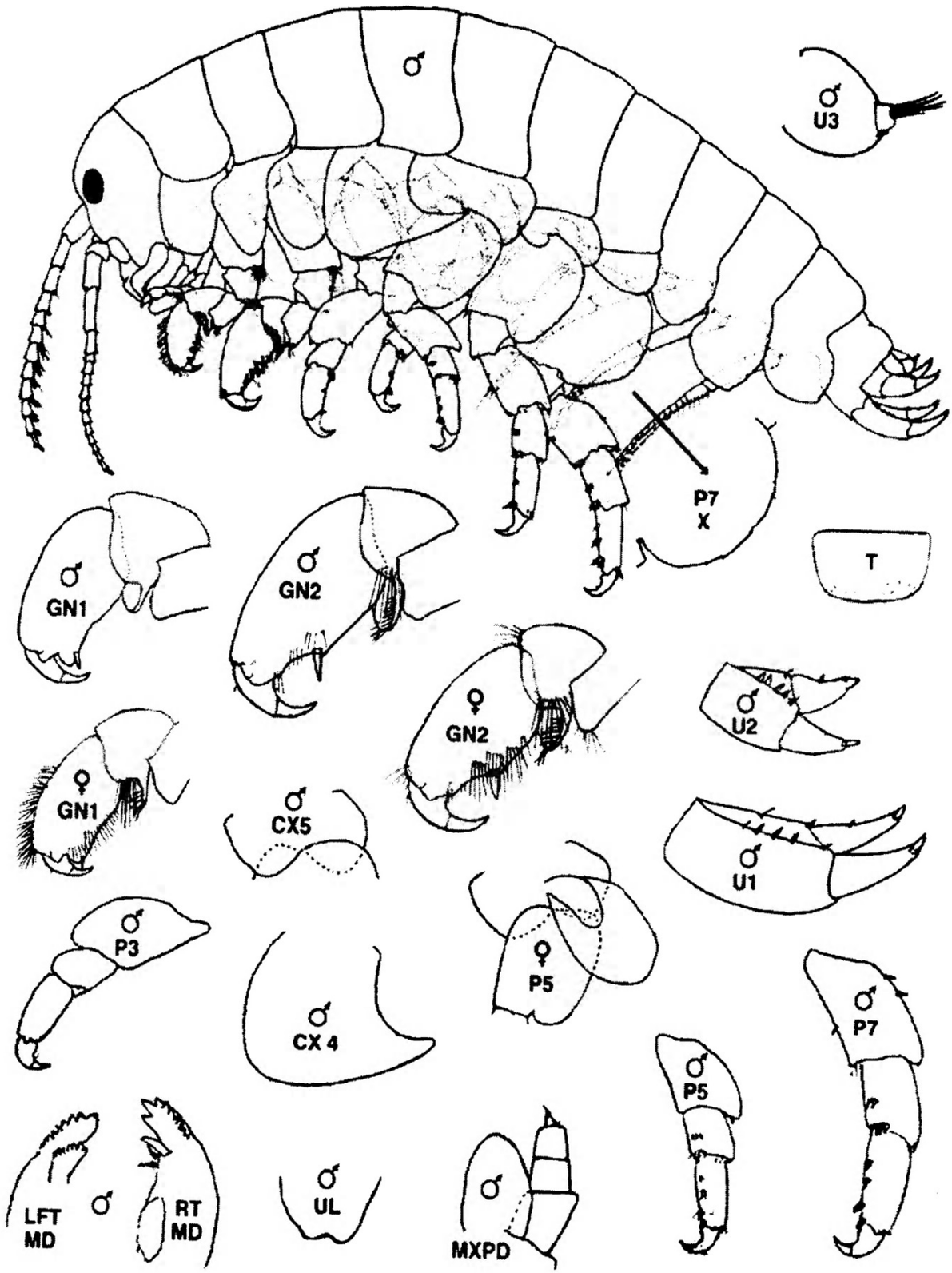


Fig. 13. ***Carinonajna barnardi*** n. sp. Male (9.0 mm). Stn A149, Port Chalmers, SE Alaska. Female (9.5 mm) br. II. Nesto Pt., Queen Charlotte Islands, B. C.

panded, hind margins irregularly crenulate; segment 4 longer than broad; segment 5 regular; segment 6 with 3- 4 anterior marginal spine clusters.

Epimeral plate 3, hind margin crenulate; hind corner subacute. Pleopod rami with 14-15 segments; peduncle with 5-6 retinacula.

Uropod 1, peduncle with 3-4 outer marginal spines; inner ramus with one marginal spine, lacking in outer ramus. Uropod 2, peduncle with 4 distal outer marginal spines; inner ramus with 1-2 marginal spines; outer ramus bare. Uropod 3, peduncle deep; ramus small, deeper than long, with 5-6 medium long apical setae.

Telson wider than long, lateral margins slightly converging distally, apical margin straight.

Female: Brood plate on gnathopod 2 elongate subovate, apex broadly acute.

Etymology: From the Latin *"bi"* (two) and *"spinosa"*, with reference to the two posterodistal spines of the propod palmar margin of gnathopods 1 & 2.

Distributional Ecology: Ranging from northern British Columbia southward to central Oregon; associated with *Phyllospadix* and kelp, over sand and boulders, LW and subtidal levels.

Remarks: *C. bispinosa* is a member of the *kitamati* subgroup, having a small outer, and a large inner, marginal spine at the posterior palmar angle of gnathopod 2. It is distinguished from *C. lessoniphila* by the large carpal lobe of gnathopod 2 and lack of fine filaments among the gnathopod setae. It differs from *C. kitamati* in the lack of anterodistal setae, and more strongly concave palm, on the propod of gnathopod 2. Except for the bispinose gnathopod palms, the species is also closely similar to *C. barnardi* (below).

Carinonajna barnardi n. sp.
(Fig. 13)

Najna rugosa Bousfield 1981
Najna bispinosa Bousfield MS
Najna intermedia Bousfield MS (part).

Material examined: 16 specimens in 13 lots, as follows:
SE Alaska, ELB Stns, 1961.
A115, Little Bay, Knight I. (60° 10'N, 147° 48'W), July 8 - 1 ♂ subadult. (6.5 mm), CMNC 2003-1217; A147, Port Chalmers, Island 2 .5 miles S. of Pt. Gilmour (60° 13'N, 147°17'W), among *Laminaria* and *Cladophora*, mud and gravel flats, July 14 - 1 ♂ (9.0 mm) **allotype** (slide mount not found), CMNC 2003-1218; A151, Islet 4.25 miles E. Johnstone Pt. (60° 28'N, 146° 28'W), July 15 - 3 im (5.5 mm), CMNC 2003-1219; A164, NW side Hogan I., Imperial Passage (57° 43'N, 136° 16'W), July 23 - 1 im (5 mm), CMNC 2003-1220; A171, Baranof I., Puffin Bay (56°16'N, 134° 48'W), July 25 - 1 subadult. ♀ br. II (headless), CMNC 2003-1221.
ELB Stns., 1980: S5B7, NW end Hogan I. (57°43' N, 136° 15.5'W), July 28 - 1 im. (4.5 mm), CMNC 2003-1222.

British Columbia:
Queen Charlotte Islands; ELB Stns, 1957:
W4a, Nesto Pt ., Graham I., opposite. Hippa I. (53° 27'N, 132° 48'W), among kelp and *Phyllospadix* , over boulders and bedrock, Aug. 11 - 1 ♀ br II (9.5 mm) **holotype** (slide mount), 1 imm. (4 mm), CMNC 2003-1202; Ibid. - 1 ♂ im. (4 mm), **paratype** CMNC 2003-1203; H11, Harbour, 0.8 km S. Old Massett (54° 02' N, 132° 10' W), among *Fucus*, kelp, *Zostera*, over boulders and coarse sand, Aug. 27 - 1 ♂ (7.6 mm), CMNC 2003-1224.

S. Vancouver I., ELB Stns,1977:
B19b, Brady Beach, east end (48°49'42"N, 125° 09'12" W), fine shelly sand, June 1 - 1 juv. (4.2 mm), CMNC 2003-1234.

WASH-ORE: ELB Stns, 1966:
W50, Cannon Beach, opposite.Bird Rocks (45° 54.5'N, 123° 58' W), in kelp over fine sand and bedrock, Aug. 6 - 1 ♂ subadult (6.8 mm), CMNC 2003-1242; W61, Neskowin Beach (45° 05.5' N, 123° 59' W), in algal holdfasts over shelly sand and volcanic bedrock, Aug. 15 - 1 im (3.4 mm), CMNC 2003-1244; W63 Cape Kiwanda, N. side (45° 13.5' N, 123° 58.5' W), fine sand, sandstone and shale, Aug. 16 - 1 im. (3 mm), CMNC 2003-1243; W57, Cape Perpetua, at Devil's Churn (44°17'N, 124° 07'W), bedrock pools, MW level, Aug. 12 - 1 ♀ (8.0 mm), CMNC 2003-1205 (formerly *C. intermedia*).

Diagnosis: Male (9.0 mm). Abdomen bicarinate, posterodorsally on pleon 3 and dorsomedially on urosome 1. Peraeon segments 1-4 slightly separated ventrally.

Antenna 1, flagellum with 9-10 segments, 7-10 aesthetascs per bundle. Antenna 2, peduncle 4 slightly shorter than 5; flagellum slender, with 12-15 short segments.

Upper lip obtusely indented apically. Mandibular left lacinia 6-7 dentate, incisor with 9-10 teeth. Maxilla 1, palp minute, protruberant. Maxilliped, inner plate not narrowing distally; outer plate distinctly (1.5 X) longer than wide; palp segment 4 small, not longer than wide.

Coxae 2 and 3 distally narrowing; coxa 2 pyriform. Coxa 4, posterior process relatively long, acute. Coxae

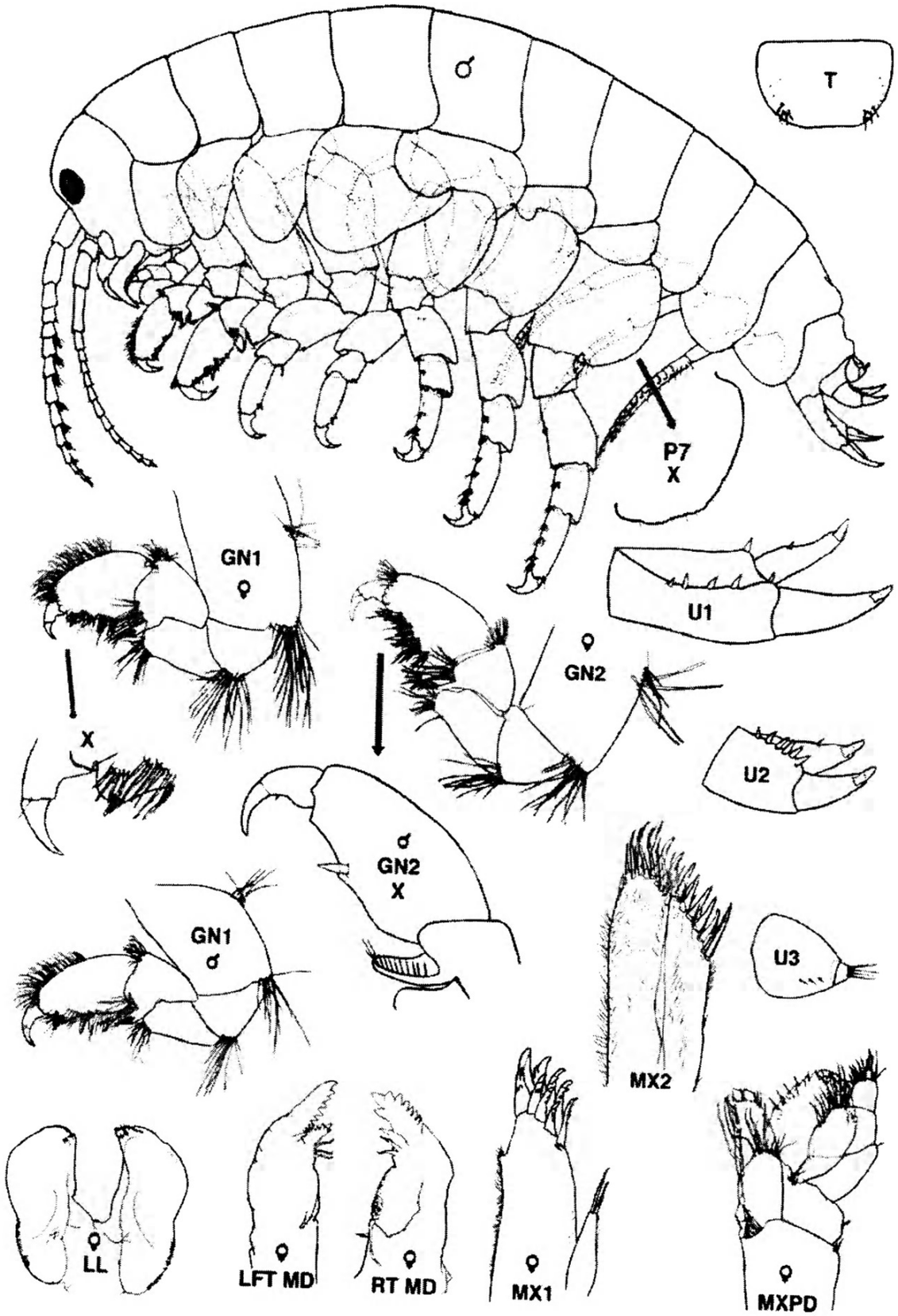


Fig. 14. ***Carinonajna carli*** n. sp. Female ov (8.0 mm); male (7.0 mm). Pt. Renfrew, B. C.

5 & 6 shallowly posterolobate.

Gnathopod 1, propod elongate rectangular, slightly arched,anterodistal margin strongly setose; palm small, weakly parachelate, with single subapical posterodistal spine distinctly overlapped by closed dactyl. Carpal lobe medium short, margin with ~6-8 comb setae. Gnathopod 2, propod deeper, narrowing distally, and lacking anterodistal marginal setae; palmar margin oblique, strongly concave, with single large inner marginal posterodistal spine, slightly overlapped by the closed dactyl. Carpal lobe medium large, extending beyond merus, margins with 12-15 comb setae.

Peraeopods 3 & 4, segment 4 broadened and arched anteriorly. Peraeopods 5-6, bases not very broadly expanded; Peraeopod 7 basis broad, hind margin convex and very weakly crenulate; segment 4 short, little longer than wide and not longer than segment 5; segment 6 with 3- 4 anterior marginal spine clusters.

Epimeron 3, hind margin crenulate, hind corner obtuse, weakly acuminate. Pleopod ramae with 14-15 segments; peduncle with 5-6 retinacula.

Uropod 1, peduncle stout, with 4-5 outer marginal spines; inner ramus with one marginal spine, lacking in outer ramus. Uropod 2, peduncle short, with 5 distal outer marginal spines; inner ramus with 1 marginal spine; outer ramus marginally bare. Uropod 3, peduncle short, deep, with 1-2 marginal seta at base of ramus; ramus small, deeper than long, with 4-6 medium apical setae.

Telson wider than long, lateral margins slightly converging distally, apical margin nearly straight.

Coxal gills medium large, subovate, accessory lobes of gills 5 & 6 medium.

Female ov. (9.5 mm): Gnathopods differing little from male. Antenna 1, flagellar segments with 3-5 aesthetascs per posterior marginal bundle. Brood lamellae relatively broad, apex broadly subacute.

Etymology: The species is named in honour of the late Dr. J. L. Barnard who pioneered description of the North American species and established family Najnidae.

Distributional Ecology: From SE Alaska to Oregon, mainly in roots and culms of *Phyllospadix,* on sandy shelly substratum, usually over bedrock and boulders, LW to shallow subtidal in depth.

Remarks: *Carinonajna barnardi* is one of the most frequently encountered and more widely ranging species on the North American Pacific coast. At individual collecting sites, however, it was taken in small numbers only.

This species is selected as the nominate species of the *C. barnardi* subgroup. It differs from the closely related *C. carli* in its longer less distally attenuated propod of gnathopod 1 and the more stongly concave palm of gnathopod 2 that is set at a distinct angle to the posterior margin of the propod. From the more distantly related *C. longimana* it differs in several character states, as outlined in the key (p. 6) and p. 31.

Material from Cape Perpetua, Oregon (southern end of its range), was initially considered a variant because of the very weakly separated peraeon segments 1-4, very strongly arched segment 5 of peraeopods 3 & 4, and its 71/2-dentate mandibular left lacinia. However, the main character states of the gnathopods, uropods, and peraeopods most closely fit those of *C. barnardi.*

Carinonajna carli n. sp.
(Fig. 14)

Najna setosus Bousfield, 1981: figs. 15, 16.

Material Examined:

SE Alaska, ELB Stns, 1961.

A6, East of Pt. Marsh, Brownson Bay Prince of Wales I. (54° 43'N, 132°17'W), *Phyllospadix* roots and *Laminaria* holdfasts, stony bottom, June 1 - 1 ♂ (7 mm), CMNC 2003-1209; A75, Wingham I., S. Point of Controller Bay, Kayak Entrance (59° 59' N, 144° 22'W), in *Phyllospadix* roots and kelp holdfast, muddy gravel, boulders, LW level, June 27 - 1 ♀ ov (8 mm) (slide mount), CMNC 2003-1224.

British Columbia

North Central Mainland coast, ELB Stns, 1964.

H33, Kipp I., Laredo Sd., Higgins Passage (52° 28'N, 128° 48'W), bedrock boulders, stones, LW level, July 21 - 1 ♂ (7.5 mm), CMNC 2003-1210.

Northern Vancouver Island

Locality indeterminate [Campbell River (Quinsam)? (50°01'N, 125°16'W)], E. Black coll., May 5, 1981 - 2 ♀♀ ov, 1 im, CMNC2002-2014.

Southern Vancouver Island

Botany Beach, Point Renfrew (48° 31' 30"N, 124° 26'30"W) LW, R. K. Lee coll., 7 July, 1971. - ♂ (7.0 mm) **Holotype** (slide mount), 1 ♂, 1 ♀ ov. **Paratypes** CMNC 2003-1213; Ibid., -♀ ov. (8.0 mm) **Allotype** (slide mount), CMNC 2003-1211; Ibid. - 2 ♂♂, 1 ♀, 2 im **Paratypes** CMNC 2003-1212; Cable Beach, Mills peninsula, Trevor Channel (48° 50'N, 125° 09'W), LW level, D. Kittle coll., July, 1972 - 1 ♂, CMNC 2003-1215; Bordelais Ids., n. side, Barkley Sd. (49° 49'N, 125° 13'W), LW level, R. J. Anderson coll., June 25,

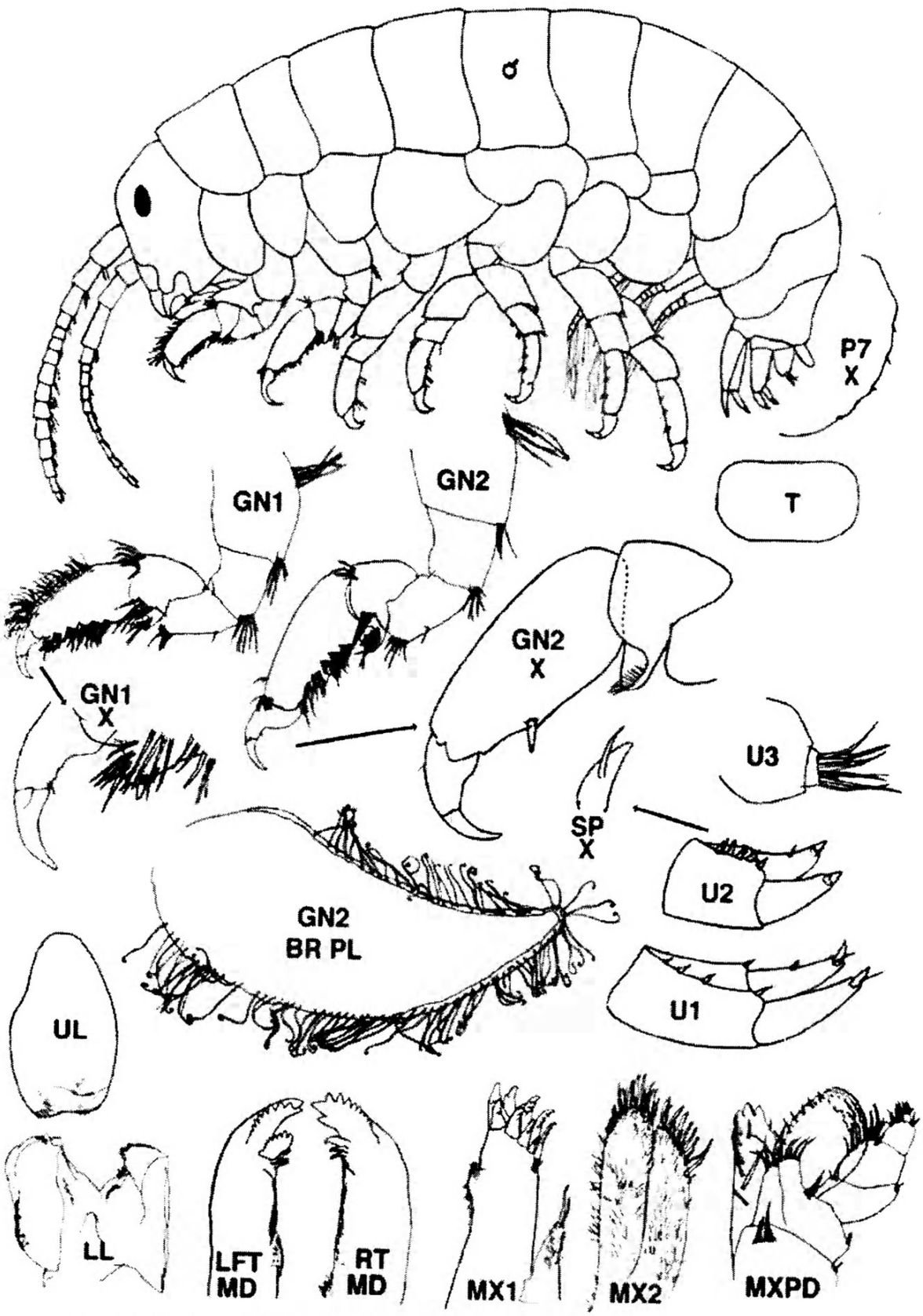


Fig.15. ***Carinonajna longimana*** n. sp. Male (5.5 mm); female ov (5.5 mm).
Friday Harbor, San Juan Co., WA
Female ov (5.5 mm). Pillar Pt. Clallam Co. Wa.

1926 - 1 ♀ br. III (slide mount), CMNC 3002-1229.

WASH-ORE
Sunset Bay, Coos Co., Ore (43° 20' N, 124° 22'W) among sessile *Hedophyllum*, bed-rock, LW, K. E. Conlan coll., July 8, 1986 - 1 ♀ ov (8.2 mm), 4 ♀♀ im, 2 ♂♂ (5.2 mm), CMNC 2003-1239.

Diagnosis: Male (7.0 mm). Abdominal pleon 3 and urosome 1 weakly bicarinate. Peraeon segments 1-4 slightly separated ventrally. Eye relatively large, protruding, near anterior head margin.

Antenna 1, flagellum 10-segmented, each with 8-12 aesthetascs per bundle. Antenna 2, flagellum slender, with 11-12 nearly bare segments.

Lower lip, mandibular lobes tapering proximally. Mandibular left lacinia 7-dentate, incisor with 9-10 teeth. Maxilla 1, palp minute, not protruberant. Maxilliped, inner plate narrowing distally; outer plate broad, slightly longer than wide; palp segment 4 very small, not longer than wide.

Coxae 2 and 3 distally narrowing and separated distally; coxa 2 pyriform. Coxa 4, posterior process medium long, acute. Coxae 5 & 6 shallowly posterolobate. Coxal gills very large, broadly ovate, accessory lobes of gills on peraeopods 5 & 6 medium.

Gnathopod 1, propod relatively short and thick, slightly arched, tapering distally, anterodistal margin strongly setose; palm small, convex, with single subapical posterodistal spine distinctly overlapped by closed dactyl. Carpal lobe short, not exceeding merus, margin with ~6-8 comb setae. Gnathopod 2, propod short, slightly deeper than 1, narrowing distally, lacking anterodistal marginal setae; palmar margin oblique, shallowly concave, almost continuous with posterior margin, with single large inner marginal posterodistal spine that is slightly overlapped by the closed dactyl. Carpal lobe medium large, extending beyond merus, margins with 10-12 comb setae.

Peraeopods 3 & 4, segment 4 broadened and markedly arched anteriorly; segment 5 short. Peraeopods 5-6, bases medium broad; segment 4 little broadened. Peraeopod 7, basis broad, hind margin convex and very weakly crenulate, posterodistal lobe very shallow; segment 4 not shortened, distinctly longer than segment 5; segment 6 with 3- 4 anterior marginal spine and setal clusters.

Epimeron 3, hind corner obtuse, lower margin gently convex. Pleopod rami with 12-15 segments, inner ramus basally with simple "clothespin" spines; peduncle with 6-7 inner distal retinacula.

Uropod 1, peduncle with 5-6 outer marginal spines; outer ramus lacking marginal spine. Uropod 2, peduncle with 5-6 stout outer marginal spines; outer ramus lacking , inner ramus with single marginal spine.

Uropod 3, peduncle deep, with row of 3-4 marginal setae towards base of ramus; ramus short, not longer than deep, apex with 4-5 slender medium setae.

Telson wider than long, lateral margins distally convex, apical margin very slightly incised, with 3-4 subapical penicillate setae on each side.

Female ov (8.0 mm). Antenna 1, flagellar aesthetascs in bundles of 5-7. Gnathopods not differing significantly in size or form from male. Brood plates typical of the genus.

Etymology: Named in honour of the late Dr. G. Clifford Carl, former Director, RBC Museum, who contributed very significantly to development and dissemination of knowledge of the marine fauna of British Columbia.

Distributional Ecology: Occurring on kelps (*Hedophyllum, Laminaria*), and in *Phyllospadix* root mass communities, at LW level and subtidally on semi-protected beaches, from extreme southeastern Alaska to southern Oregon.

Remarks: *C. carli* is a member of the *barnardi* subgroup. The species is similar and most closely related to *C. barnardi*, but differs mainly in its smaller size, slightly weaker dorsal abdominal carination, broader outer plate of the maxilliped, less concave and more shallow palm of gnathopod 2, and more slender peraeopods.

Carinonajna longimana n. sp.
(Fig. 15)

Material examined:
WASH-ORE
Friday Harbour, San Juan Island (48° 32'07"N, 123° 00' 19"W), LW, Craig Staude coll., May 15, 1976. - 1 ♂ (5.5 mm), **holotype** (slide mount), CMNC 2003-1206; Ibid., - ♂ (5.0 mm) **paratype** (slide mount), CMNC 2003-1207; Ibid., 2 ♂♂, 2 ♀♀ (5-5.5 mm), 10 im (3.5 mm) (1 slide mount), CMNC 2003-1230; Pillar Pt., Clallam Co., Strait of Juan de Fuca (48°12' 51"N, 124° 06' 03"W), LW (?), T. Such anek coll., May 15, 1976 - 1 ♀ ov. (5.5 mm) **allotype** (slide mount), CMNC 2003-1208 (note: specimen missing from vial).

Diagnosis: Male (5.5 mm). Abdominal pleon 3 and urosome 1 weakly bicarinate. Peraeon segments 1-4 little separated ventrally. Eye small, remote from anterior head margin.

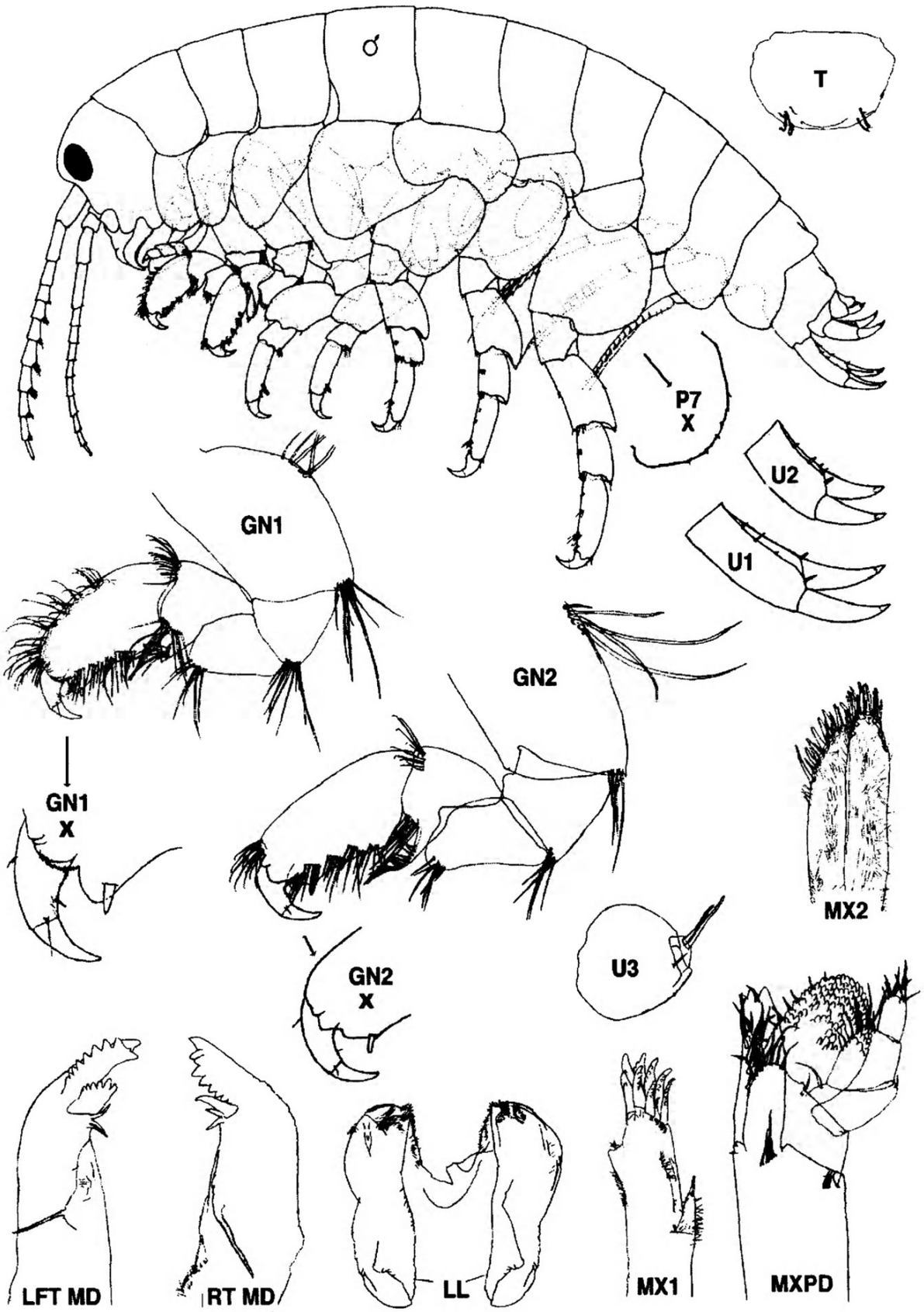


Fig. 16. ***Carinonajna oculata*** n. sp. Male (5.5 mm). Stn. P7, Quisitis Pt., Vancouver I., B. C.

Antenna 1, flagellum 12-segmented, each with 10-12 aesthetascs per bundle. Antenna 2, flagellum with 10-11 smooth slender segments.

Upper lip slightly emarginate. Lower lip, mandibular lobes nearly vertical. Mandibular left lacinia 7-dentate, incisor with 9-10 teeth. Maxilla 1, palp minute, not protruberant. Maxilliped, inner plate narrowing distally; outer plate distinctly longer than wide; palp segment 2, expanded medially; segment 4 (dactyl) very small, not longer than wide.

Coxae 2 broadly pyriform,coxa 3 broader, separated distally. Coxa 4, posterior process medium, acute. Coxae 5 & 6 shallowly posterolobate.

Gnathopod 1, propod elongate, distally narrowing, very slightly arched, anterodistal margin strongly setose; palm very small, weakly parachelate, with single subapical posterodistal spine distinctly overlapped by closed dactyl. Carpal lobe very short, not extending beyond merus, margin with ~6-8 comb setae. Gnathopod 2, propod similar but slightly larger, with 1-2 weak clusters of anterodistal marginal setae; palmar margin oblique, gently concave, nearly continuous with posterior margin, with single large inner marginal posterodistal spine, slightly overlapped by the closed dactyl. Carpal lobe small, extending little beyond merus, margins with 6-8 comb setae.

Peraeopods 3 & 4, segment 4 moderately broadened and arched anteriorly. Peraeopods 5-6, bases very broadly expanded, segment 5 broadening distally; segment 5 short. Peraeopod 7, basis very broad, hind margin convex and very weakly crenulate; segment 4 not broadened, longer than segment 5; segment 6 with 4 anterior marginal spine and setal clusters.

Epimeral plate 3, hind corner obtuse, lower margin convex. Pleopod rami with 12-15 segments; peduncle with 5-6 retinacula.

Uropod 1, peduncle with 3-4 outer marginal spines; inner ramus with single marginal spine; outer ramus bare. Uropod 2, peduncle short, deep, with 4-5 stout outer marginal spines; outer ramus lacking marginal spine. Uropod 3, peduncle very short and deep; ramus very short, not longer than deep, with apical cluster of 8-10 slender setae.

Telson markedly wider than long, lateral margins subparallel, apical margin very slightly incised. Coxal gills not examined.

Female ov (5.5 mm) Antenna 1, flagellar segments with 6-7 aesthetascs per bundle. Gnathopods differing little from those of male. Brood plate of gnathopod 2 subtriangular, attenuating towards subacute apex.

Etymology: From the Latin "longi-" + "manus", with reference to the elongate propod (hand) of the species.

Distributional Ecology: This small species is known only from two localities, at San Juan Island, WA, and the south side of Juan de Fuca Strait, WA; habitat (LW level) not specified.

Remarks: The second lot from San Juan I., contains one male (and slide mount) that lacks any trace of anterodistal setae on the propod of gnathopod 2. In this respect it is more similar to *C. barnardi.*

The *bicarinata* subgroup

In most character states, including the 8-dentate left lacinia mobilis, separation of anterior peraeon segments, weakly lobate gnathopod carpi, and reduced spination of the uropods, the *bicarinata* complex is considered the most advanced subgroup within genus *Carinonajna.*

Carinonajna oculata n. sp.
(Fig. 16)

Najna oculatus Bousfield, 1981: figs. 15, 16 (part)

Material Examined:
British Columbia: Southern Vancouver Island,
ELB Stns, 1955: P7, Bay just north of Quisitis Point (48° 59'N, 125° 40'W), among rocks, boulders, gravel, *Phyllospadix* and dense kelp beds, LW level, August 4, 1955 - ♂ (5.5 mm) **Holotype** (slide mount), CMNC 2003-1216.

Diagnosis: Male (5.5 mm)(subadult?). Abdominal pleon 3 and urosome 1 distinctly bicarinate. Peraeon segments 1-4 separated ventrally. Eye large, protruding, near anterior head margin.

Antenna 1 slender, flagellum 8-segmented, each with 5-6 aesthetascs per bundle. Antenna 2, flagellum slender, 9-segmented.

Lower lip, mandibular lobes tapering proximally. Mandibular left lacinia 7- dentate, incisor with 9-10 teeth; molar seta prominent. Maxilla 1, palp minute, slightly protruberant; apical spine teeth tall. Maxilliped, inner plate slightly tapering distally; outer plate ~25% longer than wide; palp segment 4 very small, not longer than wide.

Coxae 2 and 3 pyriform, distally separated. Coxa 4, posterior process medium, acute. Coxae 5 & 6 shallowly posterolobate. Coxal gills large, subovate; accessory

lobes of peraeopods 5 & 6 medium large.

Gnathopod 1, propod elongate-rectangular, slightly arched and narrowing distally, anterodistal margin with relatively thin setal bundles; palm small, convex, vertical, single subapical posterodistal spine distinctly overlapped by heavy dactyl. Carpal lobe medium short, margin with ~6-7 comb setae. Gnathopod 2, propod larger and deeper, narrowing distally,lacking anterodistal marginal setae; palmar margin oblique, essentially convex, with single large inner marginal posterodistal spine, distinctly overlapped by the closed dactyl. Carpal lobe medium, extending beyond merus, margins with 12-15 comb setae.

Peraeopods 3 & 4, segment 4 broadened and arched anteriorly. Peraeopods 5-6, bases not very broadly expanded; Peraeopod 7 basis broad, hind margin convex and very weakly crenulate; segment 4 short, little longer than wide and not longer than segment 5; segment 6 with 3- 4 anterior marginal spine clusters.Gnathopods 1 & 2, propods very weakly subchelate, that of Gn2 appearing nearly simple. Gnathopod 1, palms small, strongly convex, strongly overhung by dactyl; anterior margin of propod distally setose. Gnathopod 2, palm short, oblique; anterodistal margin of propod lacking setae (except apically); merus with posterodistal medium strong cluster of setae.

Peraeopod segments little modified. Peraeopods 3 & 4, segment 4 slightly arched; segment 5 short. Peraeopods 5-6, bases relatively little broadened; posterodistal lobes medium; segment 4 relatively short, broadened distally; segment 5 very short. Peraeopod 7 basis moderatly broad, hind margin weakly crenulate, posterodistal lobe small; segment 4 not broadened, longer than segment 5; segment 6, anterior margin with 4 spines, and few setae.

Epimeron 3, hind corner obtuse, lower margin convex. Pleopod rami with 12-15 segments; peduncle with 5 retinacula.

Uropod 1, peduncle with 3-4 slender outer marginal spines; both rami lacking marginal spine. Uropod 2, peduncle regularly deep, with 4-5 mainly distal outer marginal spines; both rami lacking marginal spine. Uropod 3, peduncle very short and deep, with distal seta at base of ramus; ramus very small, not longer than deep, with 2 unequal apical setae.

Telson wider than long, lateral margins convex, apical margin not incised, with 2-3 submarginal penicillate setae on each side.

Female: unknown.

Etymology: From the Latin "ocularis" with reference to the relatively large darkly pigmented eye.

Distributional Ecology: Known only from the type locality, on the outer coast of Vancouver Island, associated with *Phyllospadix* and kelp beds.

Remarks: *Carinonajna oculata,* as a member of the *bicarinata* subgroup, is closely similar to *C. botanica* in form of the mouthparts, gnathopods, uropods, and ventral separation of peraeonal plates 1-4. It differs mainly in the non-setose anterior margin of the propod of gnathopod 2, and total lack of filamentous threads on the peduncle of antenna 2, gnathopod 1, and dorsally on abdominal segments 3 & 4. Absence of a female specimen and occurrence within the range of *C. botanica* compromises a more exact placement of this species..

Carinonajna botanica n. sp.
(Fig. 17)

Najna plumulosa Bousfield, 1981: figs 15, 16.

Material Examined:
SE Alaska, ELB Stns, 1980.
Stn. S23F1, Taigud I., beach opposite Koka I. (56° 54' 30"N, 135° 24'), among kelp over sand, 6.1-9.1 m depth, Aug. 4 - 1 ♂ subad. (5.0 mm) (R. Long photo'd), CMNC 2003-1186; Ibid., - 1 ♂ (5.0 mm), 2 mm, CMNC 2003-1223.

British Columbia
North Central Mainland:
ELB Stn. H12 (1964), Stephens I., NW end, Dixon Entrance (54° 11'N, 130° 48'W) steep surf-exposed bed-rock, boulders; *Ulva* and *Enteromorpha* at MW level, kelp and *Phyllospadix* at LW level, 13 July - ♂ (4.5 mm) **Allotype** (slide mount), CMNC 2003-1190.
E. Black Stn., 1980, Malcolm Pt. NW tip Malcom I. (50° 36'N, 127° 06'W), among *Nereocystis* over cobbles and bedrock, 10 m depth, E. Black coll., Sept. 7, 1980 - 1 ♂ im. (4.0 mm), 1 ♂ im (4.5. mm), CMNC 2003-1187.

Southern Vancouver Island, ELB Stns., 1955.
Stn F3, Witty's Lagoon, outer shore at mouth (48° 22'N, 123° 31'W), sandy gravel and rock; LW-HW levels, 16 August - ♀ br. I (6.2 mm) **Paratype** (slide mount), CMNC 2003-1188; Stn F5, Victoria breakwater, outer side near shore (48o 25'N, 123° 23'W); among algae on solid granite blocks at LW, 20 August - ♀ ov (8.0 mm) **Holotype** (slide mount), CMNC 2003-1189.
ELB Stn. P170, Gonzales Bay, Juan de Fuca Strait, Victoria (48° 25'N, 123° 20'W), July 29 - 1 ♀ br. II (6.5 mm), CMNC 2003-1185.

Diagnosis: Female ov. (8 mm). Pleon 3 and urosome bicarinate, often with fine downy filaments posterodorsally on pleon 3 and dorsomedially on urosome 1. Peraeon segments 1-4 separated ventrally.

Antenna 1 slender, flagellum with 8-9 segments, 3-5 aesthetascs per bundle. Antenna 2, peduncle with numerous downy filaments attached ventrally and dorsally on segment 3 and dorsally on segment 4; flagellum slender, with 7-8 bare segments.

Upper lip sharply notched apically. Lower lip, mandibular lobes slightly diverging proximally. Mandibular left lacinia 8-dentate, incisor with 10-11 teeth; molar seta short. Maxilla 1, palp minute but protruberant. Maxilliped, inner plate narrowing distally; outer plate distinctly longer than wide; palp segment 4 very small, not longer than wide.

Coxae 1-4 unlike, slightly overlapping, separated distally; coxa 2 narrow, pyriform; coxa 3 broader; coxa 4 very large, posterior process thick, tip acute. Coxae 5 & 6 shallowly posterolobate.

Gnathopod 1, propod elongate rectangular, slightly narrowing distally, anterodistal margin strongly setose; palm small, weakly parachelate, with single subapical posterodistal spine distinctly overlapped by closed dactyl. Carpal margins usually with numerous elongate slender filaments; carpal lobe very short, margin with ~5-6 comb setae. Gnathopod 2, propod deeper, narrowing distally, anterodistal margin with 2-3 sparse groups of setae; palmar margin short, oblique, nearly straight, with single inner marginal posterodistal spine, overlapped by the closed dactyl. Carpal lobe medium, extending beyond merus, margins with 10-12 comb setae.

Peraeopods 3 & 4, segment 4 broadened and arched anteriorly; segment 5 short. Peraeopods 5-6, bases not very broadly expanded, 5 larger than 6, posterodistal lobes shallow; segment 4 medium broad, longer than short segment 5. Peraeopod 7 basis broad, hind margin convex and very weakly crenulate; segment 4 longer than wide and distinctly longer than segment 5; segment 6 with 3- 4 anterior marginal spine clusters, with accessory setae.

Epimeral plate 3, hind corner nearly square. Pleopod rami with 12-13 segments; peduncle with 4-5 retinacula.

Uropod 1, peduncle with 2-3 outer and inner marginal spines; rami lacking marginal spine. Uropod 2, peduncle with 2-3 distal outer marginal spines; inner ramus with single marginal spine. Uropod 3, peduncle short, very deep; ramus small, not longer than deep, with 2 medium long apical setae.

Telson wider than long, lateral margins convex, apical margin very slightly incised, with 4 submarginal penicillate setae on each side.

Coxal gills large, subovate; accessory lobes of peraeopods 5 & 6 short, slender.

Brood lamella (peraeopod 4) broadly rhomboidal, apex subacute.

Male (4.5 mm): Antenna 1, flagellar segment with 6-8 aesthetascs per bundle. Antenna 2, flagellum 6-7 segmented, each with short distal setae. Gnathopod 2, propod with fewer anterodistal marginal setae.

Etymology: The species name is derived from the Latin *botanicus* (plant), with reference to its close association with *Phyllospadix* and marine algae.

Distributional Ecology: Outer coast localities of southeastern Alaska and British Columbia, associated with *Phyllospadix* and kelp over sandy boulders; LW to shallow subtidal levels, summer temperatures 10.1-15°C., and salinities 30.5-31.6 ‰.

Remarks: *Carinonajna botanica* exhibits mainly advanced character states, and is most closely related to the very advanced species *C. bicarinata.* Its few plesiomorphic states include the simple segments of antenna 1, with small numbers of aesthetascs per cluster; the subsimilar gnathopods, and low numbers of pleopod peduncular retinacula.

The fine feathery filaments on proximal peduncular segments of antenna 2, and carpal segments of gnathopod 1, are invariably present in both sexes, even in juvenile stages. However, the filaments are very fine and of uniform thickness, suggesting a type of fungal parasite, rather than very fine ectodermal setae of the animal itself.

Carinonajna bicarinata n. sp.
(Fig. 18)

Najna bicarinatum Bousfield 1981: figs, 15, 16.

Material Examined:
British Columbia
Queen Charlotte Islands, ELB Stns, 1957:
W8, Gudal Bay, North Arm (53°14' N, 132° 34' W), stones, gravel, bedrock pools, in *Laminaria* holdfasts and *Phyllospadix* roots; LW level, July 27 - ♂ (6.0 mm.), **holotype,** (slide mount), CMNC 2003-1193; W11, head of Gudal Bay, south side (53°14'N, 132° 33'W), among *Phyllospadix* and *Laminaria* over sand, boulders, LW level, July 28. - 1 ♂ subad. (5 mm), **paratype,** CMNC 2003-1194.

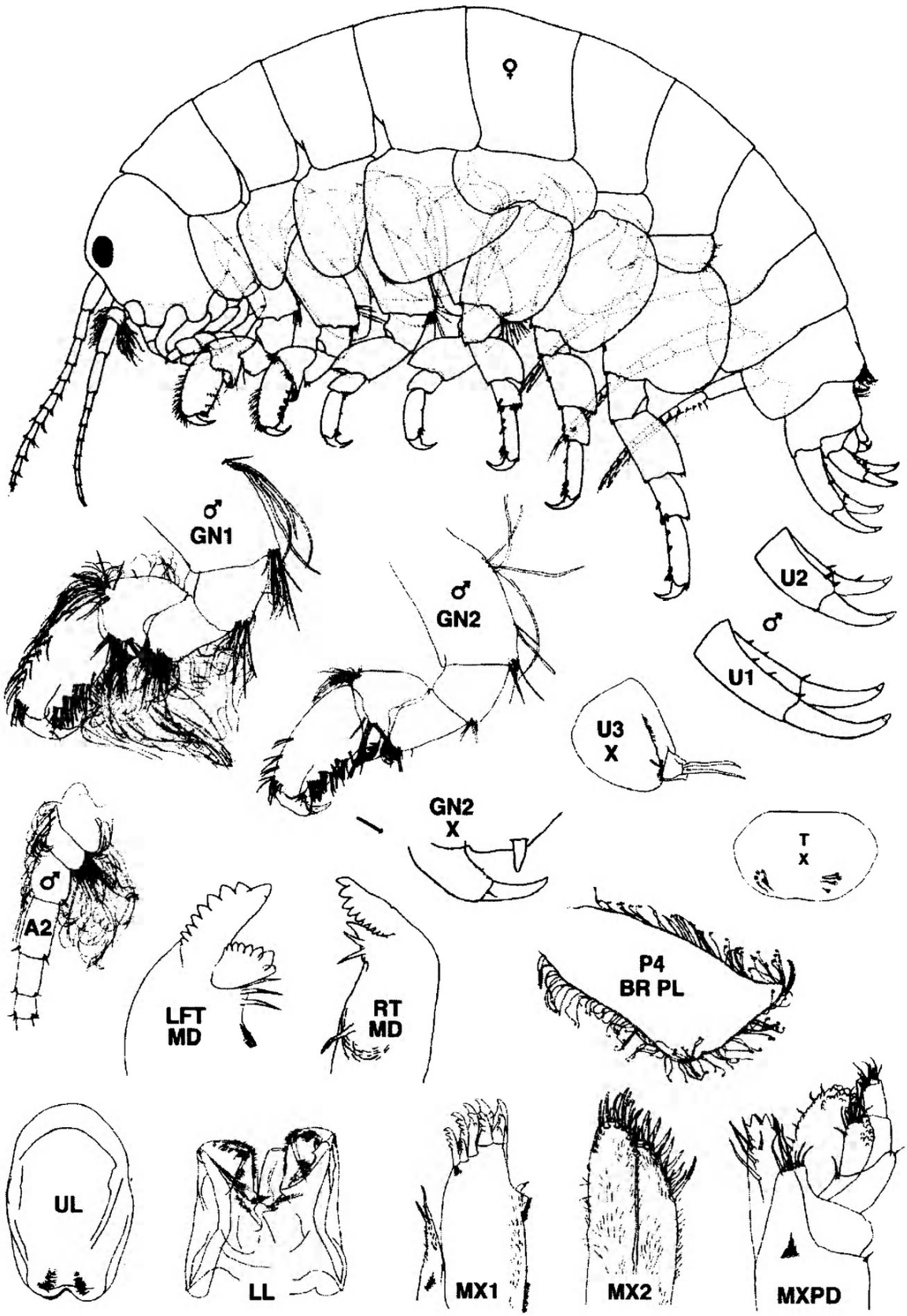


Fig. 17. ***Carinonajna botanica*** n. sp. Female ov. (8.0 mm). Stn. F5, Victoria, B. C. Male (4.5 mm). Stn. H12, Stephens I., B. C.

Northern Vancouver Island, ELB Stns, 1959:
V4b, Roller Bay, Hope I. (50° 56'N, 127° 56'W); boulders, bedrock, gravel, coarse sand; in *Phyllospadix* roots and kelp; LW level, 22 July - ♀ (8.5 mm), **allotype** (slide mount), CMNC 2003-1195.

Southern Vancouver I.
ELB Stn, 1955: P6b, Long Beach, SW end, at Webb's rocky point (49° 03'N, 125° 42'W) among *Laminaria* & fucoids, LW level, Aug. 3 - 2 ♀♀ subad. (6 mm), CMNC 2003-1191.
ELB Stn, 1970: P714, Clo-oose (48° 41' N, 124° 49' W), bedrock, gravel, kelp, at LW, July 24 - 1 ♀ br. I (5 mm), +1 imm. (3.5 mm), CMNC 20032-1192.

California
Seal Cove, Laguna Pt., Mendocino Co., subtidal?, J. R. Chess Sta 92-10, May 12, 1992 - 1 ♂ (5.5 mm subadult) (slide mount) +1 ♂ subadult (5 mm), 2 imm, CMNC 2003-1197.

Diagnosis: Male (6.8 mm). Pleon segment 3 and urosome segment 1 distinctly bicarinate. Peraeon segments 1-4 separated ventrally and weakly dorsally. Eye medium, round, protruding, near anterior head margin. Inferior antennal sinus marked.

Antenna 1, flagellum 8-9 segmented, segments with 5-10 aesthetascs per posterodistal marginal bundle. Antenna 2 , flagellum slender, with 8-9 unarmed segments.

Upper lip with slight apical notch. Lower lip, mandibular lobes slightly spreading proximally. Mandibular left lacinia 8-dentate, left and right incisors with 9-10 teeth. Maxilla 1, palp minute, slightly protruberant. Maxilliped, inner plate narrowing distally; outer plate ~1/3 longer than wide; palp segment 4 very small, not longer than wide.

Coxae 1-4 unlike, little overlapping; coxa 2 pyriform; coxa 3 wider, narrowing and rounded distally; coxa 4, posterior process slender, acute. Coxae 5 & 6 very shallowly posterolobate. Coxal gills relatively small, narrowly heart-shaped; accessory lobes of peraeopods 5 & 6 >1/2 length of gill.

Gnathopod 1, propod elongate rectangular, slightly arched, anterodistal margin moderately setose; palm small, weakly parachelate, with single subapical posterodistal spine distinctly overlapped by closed dactyl. Carpal lobe very short, margin with ~4-5 comb setae. Gnathopod 2, propod more elongate, narrowing distally, anterodistal margin armed with 2-3 sparse groups of setae; palmar margin very short, sharply convex, with single large inner marginal posterodistal spine, slightly overlapped by the closed dactyl. Carpal lobe medium, extending slightly beyond merus, margins with 9-10 comb setae.

Peraeopods 3 & 4, segment 4 broadened and arched anteriorly; segment 5 short. Peraeopods 5-6, bases not very broadly expanded, subsimilar, posterodistal lobes shallow; segment 4 broadend, little linger than wide; segment 5 short. Peraeopod 7 basis broad, hind margin convex and weakly crenulate, posterodistal lobe evanescent; segment 4 broadened, little longer than wide but longer than short segment 5; segment 6 with 4 anterior marginal spines and few accessory setae.

Epimeral plate 3, hind margin nearly smooth, corner obtuse, lower margin convex. Pleopod rami with 12-15 segments; peduncle with 4-5 retinacula.

Uropod 1, peduncle with 3-4 outer marginal spines; outer ramus lacking marginal spine. Uropod 2, peduncle short, deep, with 4-5 stout outer marginal spines; inner ramus with single small marginal spine. Uropod 3, peduncle short, very deep, with 1 supraramal seta; ramus small, not longer than deep, apical margin with 5-6 unequal slender setae.

Telson distinctly wider than long, lateral margins strongly convex, apex very slightly incised.

Female (8.5 mm). Gnathopod 2, propod with 4-5 anterodistal marginal setal groups. Brood lamellae (peraeopod 3) relatively broad, apex subacute.

Etymology: From the Latin "bi" (two) and "carinatus" (keel-shaped), with reference to the dorsally bicarinate form of pleon 3 and urosome 1.

Distributional Ecology: From northern British Columbia to northern California, among laminarian kelp holdfasts and *Phyllospadix* roots over coarse sand, LW level.

Remarks: *Carinonajna bicarinata* is, in balance of character states that includes the dorsally and ventrally separated anterior peraeonal segments and the strongly bicarinate abdomen, the most highly advanced species yet encountered on the Pacific coast of North America. The subsimilar gnathopods and regularly convex form of the propodal palm of gnathopod 2, might be considered among its few plesiomorphic character states.

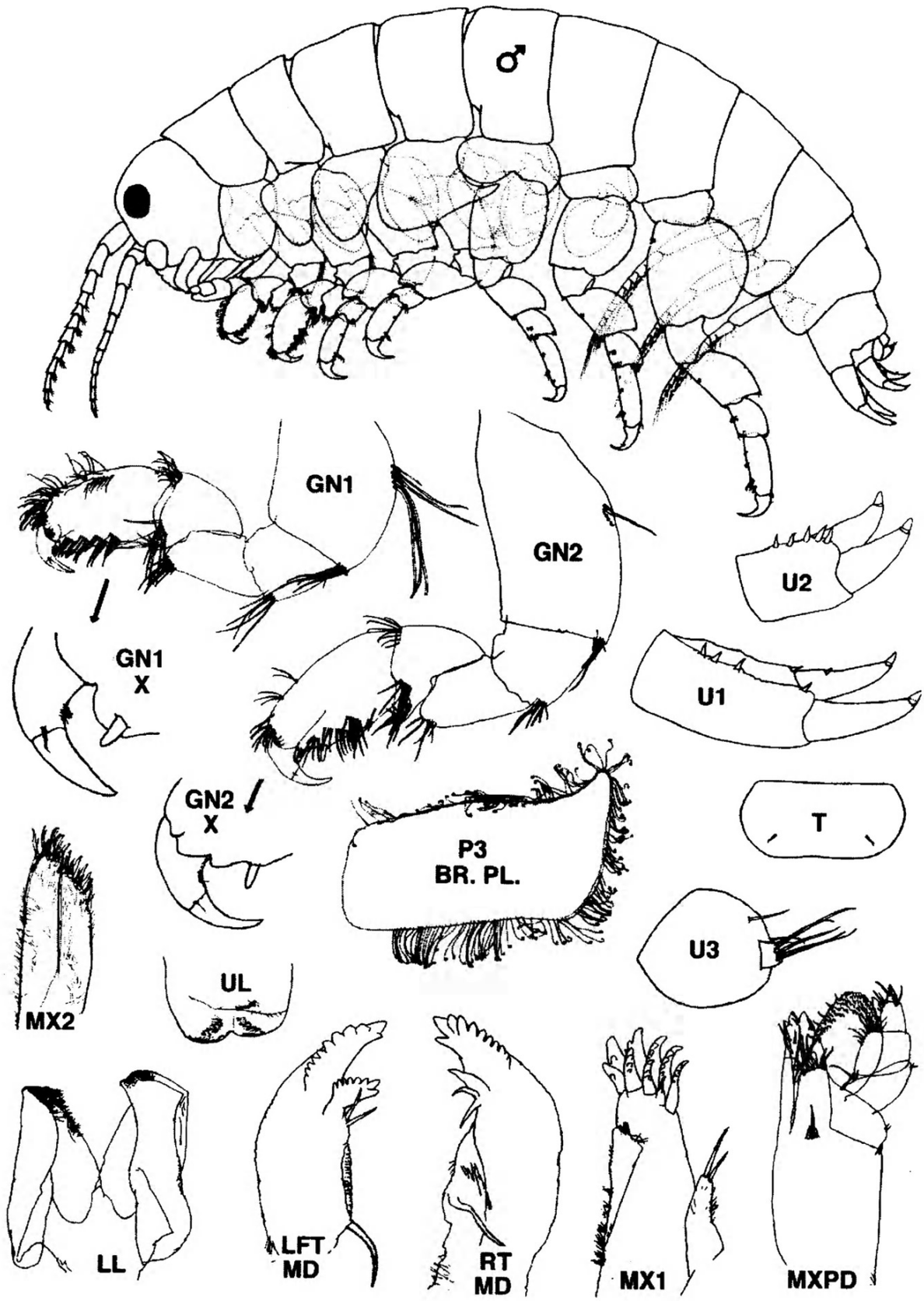


Fig. 18. ***Carinonajna bicarinata*** n. sp. Male (6.8 mm). Stn W8, Gudal Bay, Queen Charlotte Islands. Female (8.5 mm). Stn V4b, Roller Bay, Hope I., B. C.

Taxonomic Discussion

The talitroidean affinities of family Najnidae have been formally established by Barnard (1972, 1979), Bousfield (1982, et seq.), and the present study. Members of this specialized plant-associated family group may have originated in common ancestry with families Hyalidae and Hyalellidae whose members are mainly free-swimming. Basic najnid character states (e.g., of gnathopods, telson, brood plates, etc.) appear most similar to those of *Allorchestes* (Hyalellidae), the North Pacific species of which also co-occur biogeographically and to some extent ecologically with those of Najnidae (see Hendrycks & Bousfield 2001).

Species of Najnidae, however, are notably different from most free-swimming talitroideans. Aside from their uniquely specialized mouthparts,the antennae are slender and weakly developed, the gnathopods are subsimilar and little or not sexually dimorphic, the pleopods are relatively weak, with multiple peduncular retinacula, and the rami of uropods 1 & 2 are short and lanceolate, with embedded apical spines. Also, the external plates of body, coxae, and peraeopods exhibit relatively weakly developed lobes and other hydrodynamic features. On the other hand, the thickened basal segments of gnathopods 1 & 2 and strongly arched meral segments of peraeopods 3 & 4 are somewhat reminiscent of character states within ampeliscoideans and corophioideans, most species of which are tube-building or domicolous in life style.

A semiphyletic phenogram of species within Najnidae (Fig. 19) is based on 25 paired generic character states. The cluster analysis methodology (p. 4) emphasizes a presumed taxonomic and phyletic significance of gnathopods and uropods, as illustrated in Figs. 1-4 (pp. 8-11).

The twelve known species of Najnidae cluster into two distinct groupings (Fig. 19). These share major character state similarities of less than 50%, a principal basis for distinction at the generic level. On the left, and at the primitive end of the phyletic spectrum (P.-A. index values of 2-11) are three species comprising the type genus *Najna*. These species are closely similar and cluster at 80-90 percent levels of similarity. With respect to the type species "*Najna consiliorum*", as noted above (p. 12), the original de-scription of Derzhavin (1937) was taxonomically limited and considered unsuitable for analysis here. However, subsequent redescriptions by Bulycheva (BUL), and herein (B&M), based on original material in the Zoological Museum, and by Hirayama (HIR) based on material from Japan, do contain sufficient detail for numerical analysis. Character state differences revealed by these treatments suggest that at least three different species may be involved (p. 17 and fig. 19). Independent re-examination of original material, has led to similar conclusions (Tzvetkova & Golikov 2003). Counterpart species of *Najna* from the Bering Sea region are distinct, but the large *N. amchitkana* shows greater similarity to Derzhavin's Asiatic type than does the smaller N. American endemic species, *N. parva*.

In the centre and to the right of Fig. 19 are nine species that cluster in three main subgroupings within the more advanced new genus *Carinonajna*. This genus, exemplified by the type species *C. bicarinata*, is considerably more advanced in the character states utilized above (P.-A. Indices of 22-42). Within *Carinonajna*, the *kitamati* subgroup (centre) is most primitive (P.-A. indices of 22-24). This subgroup shares several plesiomorphic features of the gnathopods with species of *Najna* and, within genus *Carinonajna*, clusters with the two more advanced *barnardi* and *bicarinata* subgroups (to the right) at the 64% level of similarity only. These latter two advanced subgroups (P.-A. indices of 29-42) cluster at the 75% level of similarity. However, except for the sibling species pair of *C. barnardi* and *C. carli*, species within *Carinonajna* are somewhat more distantly related than species within genus *Najna* and share character state similarities at the lower levels of 74-86%.

Biogeographical Discussion

The twelve described species of family Najnidae are endemic to boreal and subarctic shores of the North Pacific region (Fig. 20). The two most primitive species of genus *Najna, N. consiliorum* and *N. amchitkana*, are confined to the western North Pacific and Bering Sea regions respectively. The most advanced species, *N. parva*, extends from the Bering Sea southeastward along the coast of Alaska to northern British Columbia.

By contrast, all species of the more advanced genus *Carinonajna* are restricted to the North American Pacific coast, from southeastern Alaska to southern California. A correlation between phyletic position of species and subgroups and degree of southeastward distribution, corresponding to that within genus *Najna*, is not demonstrable here. Thus, component species of all three subgroups range from SE Alaska to northern and central California, and the two most southerly species are members of the most primitive *kitamati* subgroup. By contrast, the more advanced *barnardi* and *bicarinata* subgroups range variously within mid-

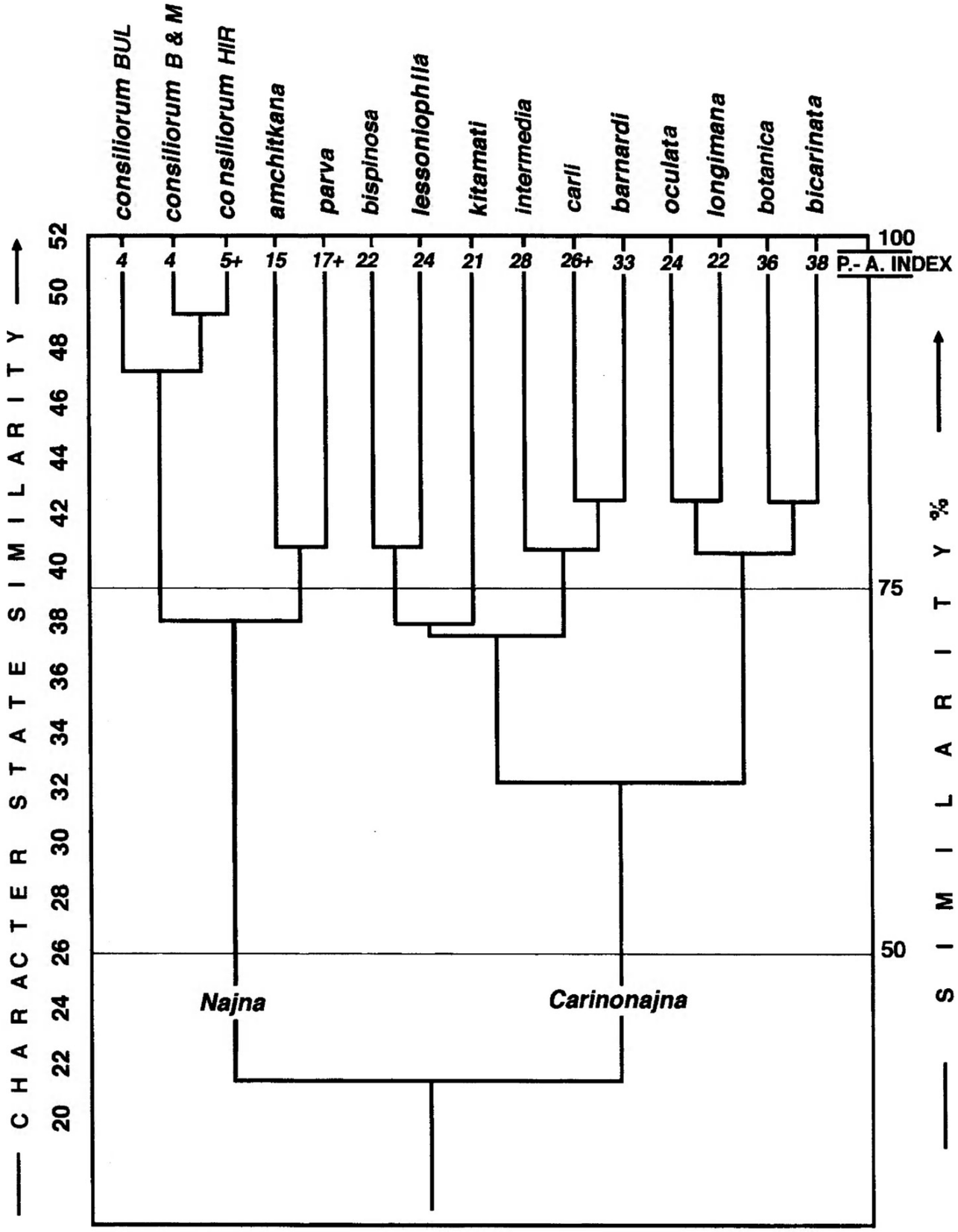
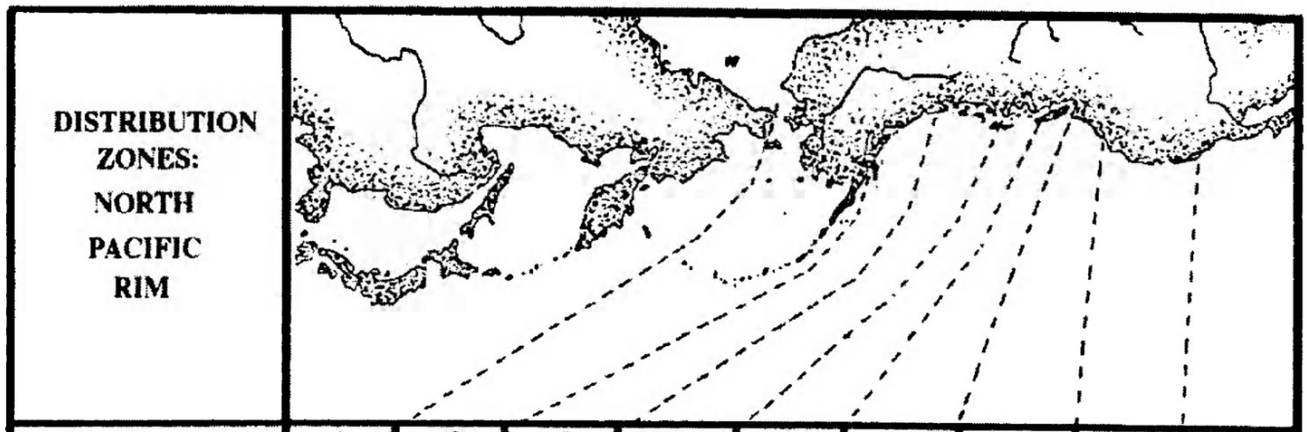


Fig. 19. Phenogram of morphological similarities and possible phyletic relationships within species of Najnidae.



Najnidae *Najna* and *Carinonajna*	1 Western Pacific	2 Bering Sea and Aleut-ians	3 Prince William Sound	4 Cross Sd to Dixon Entrance & Q. C. I.	5 Nor. B.C. to North Vanc. I.	6 Central B. C. to S. Vanc. I.	7 Washing-ton state	8 Oregon & North Californ	9 Southern Californ
Najna									
N. consiliorum	X	?							
N. amchitkana		X							
N. parva		X	X	X	x				
Carinonajna									
C. barnardi			X	X	X	X	X	x	
C. carli			x	X	X	X	X	X	
C. bispinosa				X	X	X	X	X	
C. botanica				X	X	X	?		
C. bicarinata					x	X	X	X	
C. oculata						X			
C. longimana							X	x	
C. lessoniophila								X	?
C. kitamati								X	X

Fig. 20. Geographical Distribution of Genera and Species of Najnidae in the North Pacific region.

dle and northern parts of the North American Pacific coast.

The significance of these distributional results is tempered by several factors, chief of which may have been limitations of field collecting methodology. Unspecialized and "opportunistic" sampling resulted in a species average of only 13 specimens at 6 collecting stations or slightly more than two specimens per station. In only one of the 131 station lots was more than one najnid species recorded. Barnard (1962) also obtained similarly low numbers: 5 specimens at 4 stations, or about one specimen per collecting station. Thus, the new species treated here are probably more abundant than these low numbers might suggest, and further undescribed species are likely to occur within the entire study region.

Other negative collecting factors include the authors' general unfamiliarity with the specific host algal or eel grass species, and/or optimal depth of occurrence. Of the eight species of *Carinonajna* obtained in

CMN expeditions, few species were taken in generalized sampling at subtidal depths, and only four species could be associated directly with root masses of *Phyllospadix* and one with root masses of *Zostera.* Although observed algal habitat associates of *Carinonajna* included species of *Laminaria, Nereocystis, Egregia, Hedophyllum* and *Lessoniopsis*, material of only two amphipod species, *C. lessoniophila* and *C. carli* were actually found within kelp stipes and/or holdfasts. Barnard (1969b) found that *C. kitamati,* mostly in small numbers, inhabitated holdfast communities of *Egregia, Polstelsia* and *Macrocystis*. However, because of taxonomic uncertainties at that time, more than one species of najnid may have been involved. With respect to *"Najna consiliorum"*, records of marine plant associates listed by Kudrjaschov (1972) include *Ceramium* and *Zostera*. Thus, future application of more intensive and host-specific collecting methodology would undoubtedly help clarify the speciation and ecology of these rarely encountered talitroidean amphipods.

By current systematic standards, *Najna* and *Carinonajna* may be considered fairly closely related genera. At present levels of study, a time frame for the degree of morphological differentiation and speciation within these two genera is largely speculative. The North Pacific Basin dates continuously back to the Jurassic Period (Graham 1981). However, an apparent obligate association of member species with littoral marine vascular plants and algae of cold-temperate waters of the North Pacific may suggest a relatively recent origin of family Najnidae. Thus, unlike the presumed *Allorchestes*-like ancestral amphipods, or several of the host algal genera (*Macrocystis, Nereocystis, Egregia)*, members of Najnidae have apparently been unable to disperse across warm temperate and tropical regions and occupy counterpart anti-boreal niches of the southern hemisphere.

On the other hand, talitroidean morpho-ecological counterparts of Najnidae may have dominated kelp-associated habitats, mainly in the southern hemisphere, since at least the "Gondwana" continental-breakup of the late Mesozoic Era. Talitroidean counterparts in the Australia-New Zealand region are mostly assignable to families Ceinidae, Eophliantidae, and possibly Phliantidae, the detailed systematics of which have been capably treated by Barnard (1972) and Barnard & Karaman (1991). These families share with Najnidae the following features: slender antennae, flagellum of antenna 1 with copious aesthetascs, similarly reduced and modified mouthparts, small subsimilar non-sexually dimorphic gnathopods,
peraeopods with broad posterorly crenulated bases, variously broadened "middle" segments and small strongly curved dactyls, and short, compact urosomes. The morphology of Najnidae appears somewhat intermediate between that of the laterally compressed, carinated, deep-plated Ceinidae, having relatively slight modification of mouthparts, pleopods, and uropods, and the cylindrical, smooth-bodied Eophliantidae, having spheroid heads, more highly modified mouthparts, medially expanded pleopod peduncles, and falcate uropods. Two eophliantid species (of *Ceinina* and *Wandelia*) occur in the southern Japan sea, and one, *Lignophliantis pyrifera* Barnard, 1969, having ventrally separated anterior peraeon segments, and exposed paddle-like pleopods, bores into rhizomes of *Macrocystis* in S. California. Generally similar modifications have been noted in the corophioidean families Biancolinidae and Amphitholinidae that burrow into stipes of *Alaria* and other marine kelp species (Barnard 1972). Further intensive study may reveal whether these taxonomical similarities have a basis in phylogeny, or represent "classical" cases of convergent evolution in phyletically unrelated animal groups that occupy similar niches.

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