RELATIONSHIP OF BENTHIC AMPHIPODA TO INVERTEBRATE COMMUNITIES OF INSHORE SUBLITTORAL SANDS OF SOUTHERN CALIFORNIA

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ABSTRACT

Amphipods and their environment on inshore sands of southern California are assessed. Amphipods are the most abundant macrocrustaceans on these bottoms. Several new species are described and several nomenclatural problems are reviewed. Faunas of inshore sands are impoverished, when compared with offshore siltier sands. The previously undescribed *Nothria-Tellina* community of intermediate depths is assessed as a point of reference for a discussion of the changes in community dominance, of species impoverishment and of declining animal density in sands near the surf zone.

INTRODUCTION

Sand bottoms just seaward of the strand and surf-line form a special environment noted for its coarse and unconsolidated substrate, where neither epifaunas nor extensive sub-surface, gallery-forming faunas live, and where the environment is characterized by oscillating movements caused by swell or by linear motions of longshore currents. Unlike epifaunal regions of the wave-dashed intertidal zone, inshore sand bottoms afford little or no protection for small animals by large sessile organisms or by fixed algae, and the substrate is not sufficiently compact to permit the deep burrowing of many organisms. Such environments can be considered rather harsh and restrictive, especially in view of extensive erosion and deposition that takes place there (Emery 1960:30).

Despite their nearness to shore and ready accessibility for exploration, sandy bottoms seaward of the surf zone and shallower than 5 fathoms (10 meters) have received little attention in southern California. The rich algal-covered and epifaunal zones of the intertidal area have been attractive to biologists, and shallow submarine reefs and outcrops, covered with their striking sessile inhabitants, have been attractive to skin-divers, but the relatively barren-looking sands have appeared to be a biological desert to the casual observer.

That these "desert"-like areas really are relatively barren of species, especially larger ones, will be seen in the comparisons with silty sand bottoms.

METHODS AND MATERIALS

Thirty-one localities were selected along the coast of southern California, from Santa Barbara to San Diego, where the research vessel *Velero IV* of the University of Southern California could anchor safely and launch its small boats for the survey.

The minimum water depth of sampling, about 12 feet (2 fathoms) was determined by the outer edge of the surf zone on calm days, and each of the 31 transects was limited seaward to a depth of 5 fathoms. One to eight samples were taken on each of the 31 transects, (table 7), using a small Van Veen grab of 0.1 square meter areal capacity. Each sample was screened through mesh of 0.5 mm square openings (Tyler Screen 32 mesh/inch) and the animals preserved and sorted in the laboratory. A total of 100 samples was taken; all were analyzed for Crustacea, Mollusca and Echinodermata and 52 were analyzed for Polychaeta.

The screen mesh was smaller than the 0.7 mm mesh used in other surveys in deeper water (see below) for it was suspected that the animals would be smaller. Thus in comparing statistics between shallow and deep surveys it must be noted that more small animals were collected in the shallow than in the deep explorations. Nevertheless the inshore sands revealed fewer species and fewer specimens per square meter.

The "deep" survey used in this comparison consisted of a loose grid of 348 samples taken with an orange-peel-grab in depths of 5 to 100 fathoms. This grid covers the 1061 square miles of coastal shelf from Pt. Conception to the northern border of Mexico, in southern California (see Barnard 1962a). Each sample comprises an area of bottom of 0.25 square meters and was washed through screens of 0.7 mm mesh.

The pictorial representations of benthic communities shown herein have been criticized by biologists (pers. communications) as unrealistic because of the relatively even spacing of the animals. Coefficients of aggregation could be calculated and the animals clumped to fit the results but a single picture of that type is no more realistic because it suggests that such spacing is replicative in nature. If such manipulations are to be included one should also determine the interspecific indices of association and exclusion and attempt to portray these figuratively. Generally, initial exploratory efforts base the first description of a community on a small number of samples, just as taxonomists often base a species on a few specimens. Hence, overmanipulation of sparse data should not be attempted. These initial portrayals are simply shortcuts in building a world-dispersed literature on the dominant members of level bottom communities, as called for by Thorson (1957 and papers quoted by him therein). They serve to impress the reader with the comparative density and size of organisms in equal areas of bottom and such impressions are better served by dispersal of the organisms.

ACKNOWLEDGEMENTS

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THE BASIC ENVIRONMENT: THE TELLINA BUTTONI-NOTHRIA ELEGANS SHELF COMMUNITY AT 5 to 15 FATHOMS

Figs. 1-3, Tables 4-5

One must first describe the basic community below the level of wave action at depths of 5 to 15 fathoms, in order to point out the distinctive community dominated by the polychaete *Prionospio malmgreni* in a portion of the shallow sands near the surf. Two species dominate sandy bottoms in these 5-15 fm depths, the tube-building worm *Nothria elegans* and the small, thin-shelled clam, *Tellina buttoni*. Of the 348 samples in the shelf grid, 98 comprise the 5-20 fm depths covering the *Nothria-Tellina* community. As seen in tables 2 and 3, there is a difference in the depth distribution of the two species, the *Tellina* occurring in greater densities than *Nothria* on shallower bottoms. Depthwise the two species are not mutually exclusive, so that there is no logic in separating the community into two bands. On a sample-to-sample basis in depths of 5 to 20 fathoms there is mutual exclusion of the two species in 52% of the samples, strong dominance by one or the other species in 27% of the samples and roughly equal densities of the two species in only 21% of the samples.

The two species are strongly separated on sediment types as seen in table 1. Sediments dominated by *Nothria* are much coarser on the average than samples dominated by *Tellina* or those in which the two species are heavily mixed.

Species associated with and forming conspicuous subdominants in the *Nothria-Tellina* community are seen in tables 4 and 5. Of course, the community supports several hundred other non-dominant species. Although many small crustaceans such as amphipods are more abundant than most of the dominants they form a negligible standing crop.

THE INSHORE SAND BOTTOM FAUNA AT 2-5 FATHOMS

Sands at depths of less than 5 fathoms are dominated largely by polychaete worms, especially *Prionospio malmgreni*, and by mollusks, especially the clam *Tellina buttoni*. Domination is an expression of the relative aggregate weight of these organisms in the standing crop. Although no actual weights were determined it was obvious that these two species by their great preponderance of numbers (*Prionospio*) and large size (*Tellina*) form the principal standing crop. On sand bottoms from 5 to 15 fathoms *Tellina* also forms the principal standing crop, but its codominant is another polychaete, *Nothria elegans*, of much larger size than *Prionospio* but of course considerably less frequent. *Nothria elegans* is not a conspicuous member of sand bottoms at less than 5 fms. It is proposed that the sands at greater depth be characterized as a *Nothria-Tellina* community and those at lesser depth but with high silt content be considered a *Tellina* facies of that community. The inshore sand faunas are not continuous (Table 8) in that *Tellina* and *Prionospio* dominate only 72 of the 100 samples.

Table 1

Relationship of *Nothria* and *Tellina* to median diameters of sediments. Based on a 348 sample grid, for depths greater than 5 fms. Domination is determined in the sense used by Thorson (1957).

	Samples dominated by		
	Tellina	Nothria	Mixed Domination
Median diameter, mm	.071	.163	.066
Number of samples	25	15	21

Table 2

Density per square meter of *Nothria* and *Tellina* in two depth classes, based on a 348 sample grid. Only positive samples are tallied and the density per square meter is calculated only for positive samples. In each case the two species occurred in about half of the samples located in the two depth classes.

	Individuals per square meter	
Depth class, fathoms	Tellina	Nothria
6-10	148	37
11-20	87	63

Table 3

Differences in density of *Nothria* and *Tellina* with depth, based on the 16 samples in tables 4 and 5.

	Individuals per square meter	
Depth range, feet	Tellina	Nothria
38-54	385	48
76-92	100	132

Samples dominated by *Prionospio* are so distinctly separable from those dominated by *Tellina* that they should be considered a distinct sand community (Fig. 4).

Tellina and *Prionospio* are almost mutually exclusive as co-dominants. *Tellina,* when dominant, is usually accompanied by large numbers of the cumacean *Diastylopsis tenuis* (see Barnard and Given 1961) forming sufficient standing crop to be considered codominant with *Tellina.* The cumacean also forms a codominant at times with *Prionospio* and in two

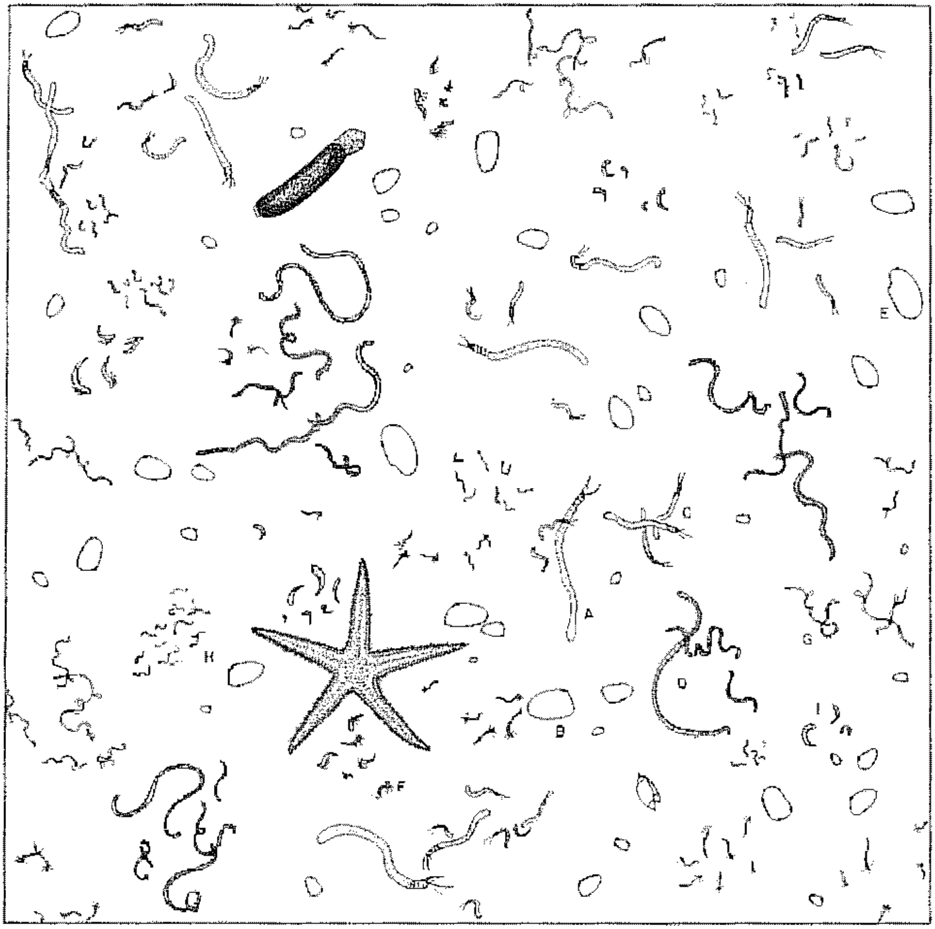

Fig. 1. Pictorial representation of the *Nothria-Tellina* community in depths of 30-95 feet as outlined in table 5, showing the average composition of 8 samples heavy in *Nothria,* arranged on a quarter square meter plot and drawn to scale. A, *Nothria;* B, *Tellina,* C, *Prionospio;* D, *Nephtys;* E, *Macoma;* F, *Chaetozone;* G, *Goniada;* H, *Magelona;* I, *Haploscoloplos.*

Table 4

Representative samples of the *Nothria elegans-Tellina buttoni* community from 38-92 foot depths in southern California to show frequencies of principal associated species when *Tellina* counts are high and *Nothria* counts are low. Compare with Table 5

Station of *Velero IV*	5965	4867	4758	5966	6059	5373	5043	5752
Depth in feet	38	45	54	38	51	54	54	92
Number of species	82	130	108	81	93	87	93	78
Number of specimens	1508	1799	2115	731	446	424	1119	494
Tellina buttoni M	251	100	60	46	36	35	33	31
Nothria elegans P	3	9(i)	1	5	6	5	8	8
Magelona spp. P	14	3	47	—	1	10	72	—
Goniada sp. P.	18	18	3	10	14	11	21	3
Thalenessa sp. P.	—	—	17	—	16	4	—	2
Chaetozone sp. P.	351	45	9	12	5	17	75	15
Haploscoloplos elongatus P.	153	84	4	35	2	7	8	20
Spiophanes bombyx P.	6	—	—	2	1	2	—	—
Spiophanes missionensis P	—	—	8	—	1	4	8	4
Aricidea spp. P.	13	6	3	10	5	1	7	35
Nephtys sp. P.	40	67	15	—	10	3	12	11
Prionospio spp. P.	319	35	64	149	79	28	14	103
Macoma yoldiformis M.	1	4	—	1	8	1	—	—
Solen sp. M.	—	—	—	—	—	—	4	6
Olivella spp. M.	4	7	17	2	1	—	—	15
Astropecten californicus E.	1	—	—	—	—	1	—	0

i=*Nothria iridescens;* P=polychaete; M=mollusk; C=crustacean; E=echinoderm

Table 5

Representative samples of the *Nothria elegans-Tellina buttoni* community from 39-95 foot depths in southern California to show frequencies of principal associated species when *Nothria* counts are high and *Tellina* counts are low. Compare with Table 4.

Station of *Velero IV*	5831	6155	4771	5758	4844	4762	5835	4719
Depth in feet	89	95	81	54	39	90	76	85
Number of species	101	116	102	77	101	106	62	64
Number of specimens	796	694	923	852	1055	466	378	231
Nothria elegans	46	36	35	29	21	20	20	20
Tellina buttoni	62	17	16	105	27	8	5	2
Magelona spp.	30	5	7	26	210	7	102	2
Goniada sp.	15	23	2	25	22	2	24	2
Thalenessa sp.	5	6	27	18	13	12	1	—
Chaetozone sp.	2	1	7	17	62	—	—	10
Haploscoloplos elongatus	3	2	9	15	62	—	1	2
Spiophanes bombyx	—	—	—	15	5	—	1	—
Spiophanes missionensis	9	2	4	23	4	3	5	5
Aricidea spp.	24	29	6	14	3	2	3	2
Nephtys sp.	12	6	52	19	10	7	13	1
Prionospio spp.	54	46	34	7	8	32	38	20
Macoma yoldiformis	2	8	3	10	—	3	2	1
Solen sp.	4	2	1	5	—	—	—	—
Olivella spp.	0	0	0	0	1	1	2	0
Astropecten californicus	0	2	0	2	0	6	0	1

samples was the only dominant (table 8). Each of the three mentioned species, the polychaete, clam, and cumacean is relatively independent of each other: (1) *Tellina* and *Prionospio* are almost mutually exclusive; (2) *Tellina* and *Diastylopsis* are strongly associated, but *Diastylopsis* also may join *Prionospio* or occur alone. That any one sample represents a large surrounding area of specific domination by the combinations mentioned is probably false; one can visualize that a sample dominated only by *Diastylopsis* may have been taken, by chance, just at the edge of a patch heavily dominated by either *Tellina* or *Prionospio*.

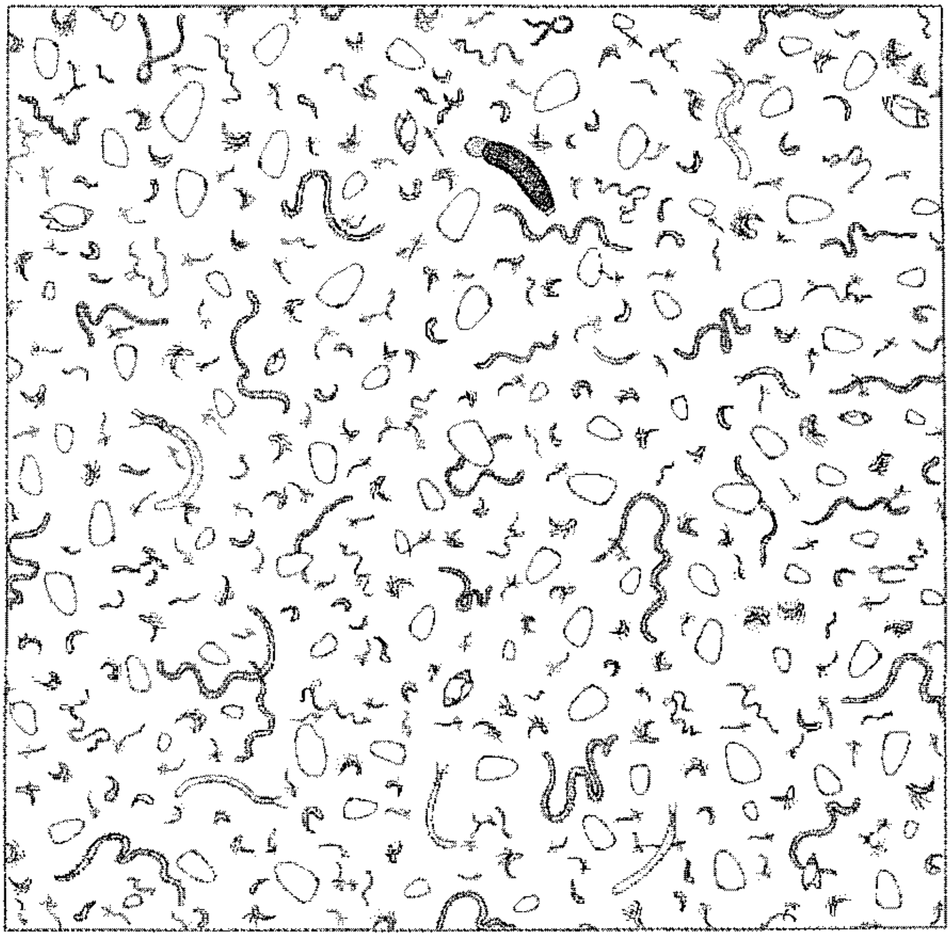

Fig. 2. Pictorial representation of the *Nothria-Tellina* community in depths of 38-92 feet as outlined in table 4, with high density of *Tellina* and low density of *Nothria*. Drawn to scale on a quarter square meter plot. The largest clam is *Solen* sp.

A distinct relationship exists between domination and the coarseness of the substrate, as seen in Tables 9 and 10. *Prionospio* is related to nearly pure sands, whereas both *Tellina* and *Diastylopsis* are associated with sands bearing high percentages of silt up to 80%. Other species are shown in Table 10 for comparison and to demonstrate that some show a distinct relationship to substrate, whereas others show little.

Another dominant of considerable importance is the snail, *Olivella boetica* and related varieties. Its average density per square meter is 38 individuals but it is a codominant in only 12 of the 100 samples, where its frequency is higher than 130 per square meter.

RELATIONSHIP OF THE TELLINA COMMUNITY

Four kinds of sand-dwelling assemblages have been described herein, three of which are considered facies of a *Tellina* community and the fourth a distinct community of polychaetes, *Prionospio*. Thorson (1957) has summarized the descriptions of four other *Tellina* communities, from the North

Table 6

Comparison of shallow water communities dominated by *Nothria*, *Tellina*, and *Prionospio*. Numerals for species indicate density per square meter.

	Nothria elegans-Tellina buttoni comm.	Tellina facies of "deep water" *Nothria-Tellina* comm.	Tellina facies of "shallow-water" *Nothria-Tellina* comm.	*Prionospio* comm.
Number of samples	8	8	11	28
Depth in feet	39-95	38-92	12-30	12-30
Average number of species per 0.2m²	91	94	77	35
Average density of individuals per square meter	3370	5400	3600	2830
Median diameter of substrate particles, mm	.073	.077	.063	.105
Percent sand in substrate	43	68	48	88
Nothria elegans	142	28	0.2	0
Tellina buttoni	152	370	477	26
Prionospio malmgreni	131	495	190	1790
Nephtys sp.	75	99	55	53
Haploscoloplos elongatus	59	196	23	33
Magelona spp.	244	92	14	6
Goniada sp.	72	62	111	48
Chaetozone sp.	62	331	6	44
Aricidea spp.	52	50	7	6
Diastylopsis tenuis C	30	211	586	86
Olivella boetica M	4	28	75	35

Sea, the Mediterranean, the northwestern Atlantic and New Zealand. These are dominated by species of *Tellina* other than *T. buttoni* and in two cases are dominated by pairs of *Tellina* species. None of them has a polychaete, such as *Nothria*, for a principal subdominant. Two of them have the sea-star *Astropecten* as a principal subdominant. This genus forms a sizeable bulk of standing crop in the inshore sand communities of southern California. In 110 grabs of 0.25 square meter capacity in depths of 5 to 25 fathoms, representing all of the sand samples in the 348 station grid, *Astropecten californicus* had a density of 5.0 per square meter.

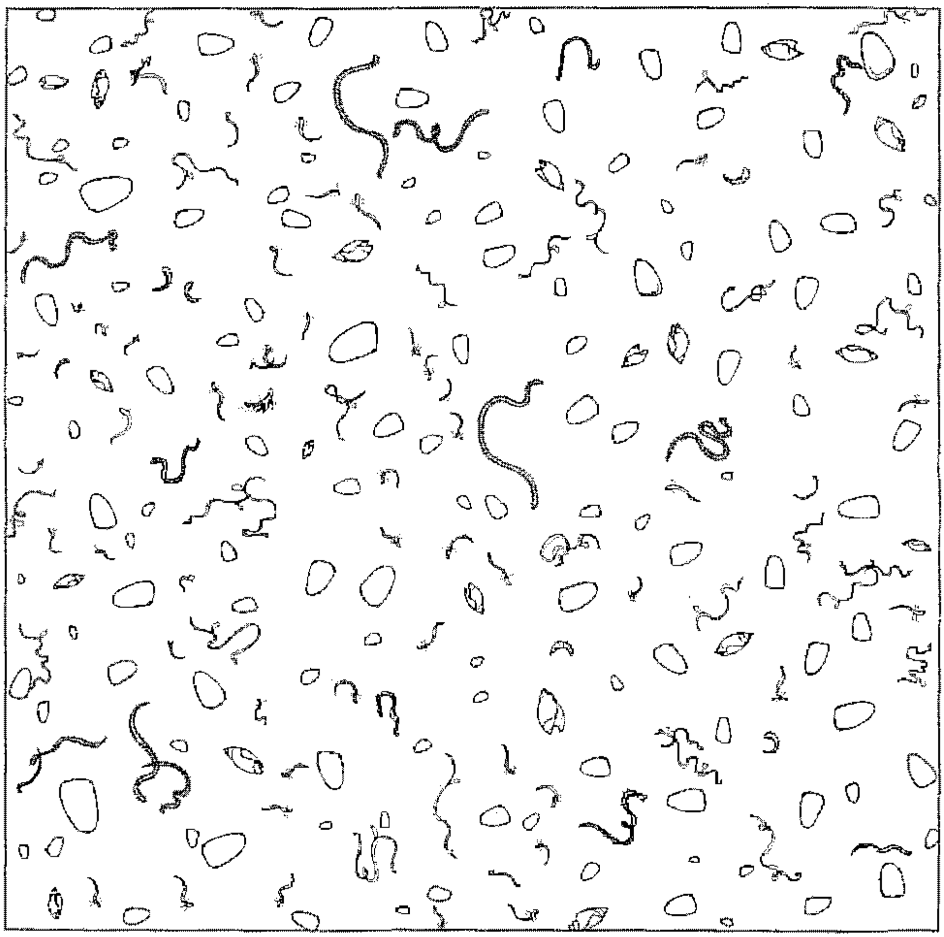

Fig. 3. Pictorial representation of the *Nothria-Tellina* community in depths of 12-30 feet as represented in column 3 of table 6. The snail is *Olivella* sp. Drawn to scale on a quarter square meter plot.

Three of the other known *Tellina* communities of the world support a species of bean-clam *Donax*, which in southern California occurs in intertidal sands but has not been found in our samples. I do not consider that the communities described herein continue into the surf zone to include organisms such as *Donax* or the sand-crab *Emerita analoga*. Sandcrabs of the genus *Emerita* appear to be confined to the narrow surf belt in southern California, whereas those known as *Lepidopa myops* are a conspicuous element in depths of 2-5 fathoms along with the larger and rarer *Blepharipoda occidentalis*.

Terebrid snails are a dominant element in other *Tellina* communities but in southern California the snail *Olivella* is a conspicuous subdominant in the inshore sand communities. Ophiuroids and sea urchins are not important in southern California inshore sands; the sand-dollar *Dendraster*

Table 7

Distribution of samples from inshore sands of southern California showing sediment classes in terms of percentages of sand. Zeros indicate samples not analyzed for sediment.

5 fms	<					>	2 fms		
80		80						1	Ellwood
80		80		80				2	Goleta Pt.
		80		80				3	Goleta
60		80		80				4	2 Mi N. Sta. Barbara Pt.
0	0	20	40	20	20	40	80	5	Santa Barbara
				40				6	Summerland
40		0		40		80		7	Carpinteria
60		80		80				8	Las Pitas
40		40		40		40	80	9	2 Mi S. Las Pitas
						80		10	Ventura River
80				80				11	Ventura
80		0		60		80		12	Paradise Cove
80				80				13	2 Mi E. Paradise Cove
80				80				14	4 Mi E. Paradise Cove
		0				80		15	Santa Monica
40		20		40		80		16	Pacific Ocean Park
80		60				80		17	Sunset Beach
80		80		80		80		18	2 Mi S. Sunset Beach
60		60		80		80		19	Huntington Beach
20		60		60		80		20	Costa Mesa
		0		0				21	San Mateo Pt.
60		80		80		80		22	Arroyo San Onofre
60		60		0		80		23	San Onofre Pt.
80		80		80		80		24	Barn
40		60		80		80		25	Santa Margarita R.
80				80		80		26	San Luis Rey R.
80		80		80				27	Oceanside
80		80		60		80		28	San Diego Area
80		80		80		80		29	San Diego Area
0		0		60				30	San Diego Area
				80		80		31	San Diego Area

occasionally forms small beds and the small echinoid *Lytechinus anamesus* occurs in a density of only 4.0 per square meter. Thorson (1957) has not used polychaetes as characteristic species in his summary of other *Tellina* communities, but in southern California, as far as standing crop is concerned, several species must be recognized as characterizing *Tellina* communities, as shown in the accompanying tables.

In other parts of the world *Tellina* communities merge at greater depths and on siltier bottoms with *Venus* communities, but this does not occur in southern California. Rather, the merging takes place with *Amphiodia*, *Amphioplus* or *Listriolobus* communities (see Barnard and Hartman,

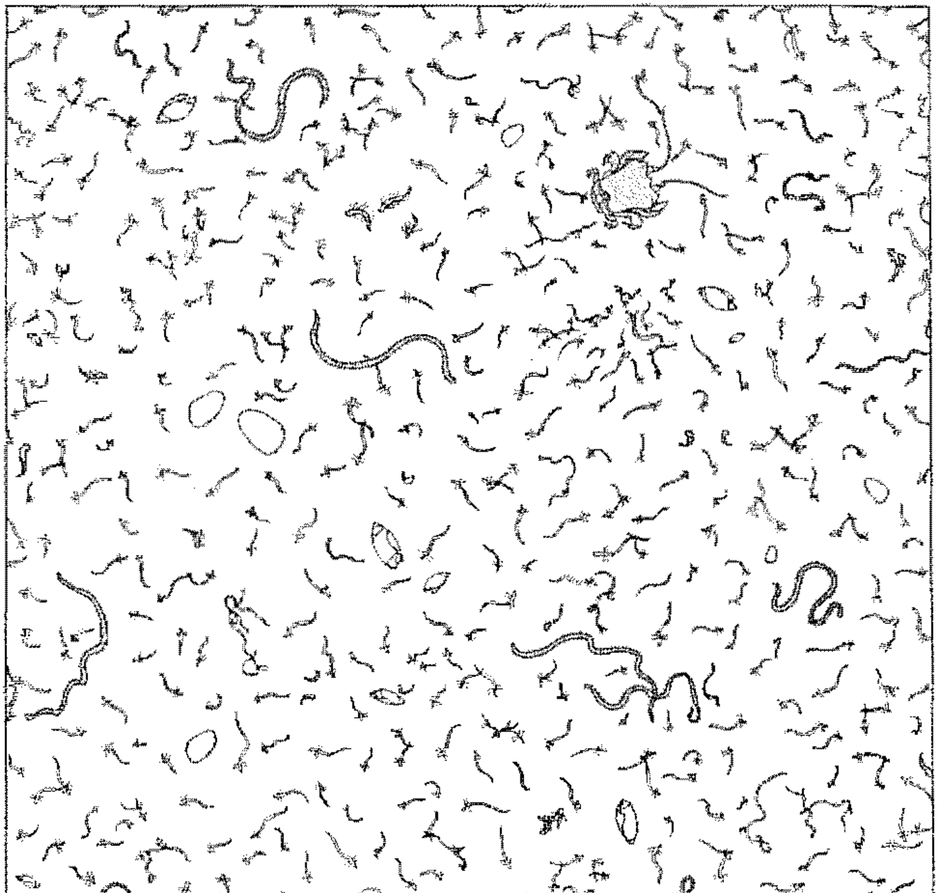

Fig. 4. Pictorial representation of the *Prionospio* community in depths of 12-30 feet as represented in column 4 of table 6. The sand crab is *Lepidopa* sp. Drawn to scale on a quarter square meter plot.

1959, and Barnard and Ziesenhenne, 1961). *Macoma* communities, associated with estuarine conditions, are not found in southern California, since embayments are of lagoonal hydrography. The genus *Macoma* occurs in the open-sea of southern California but in low numbers. In depths of 5 to 25 fathoms in the 110 sand samples mentioned above, *Macoma* occurs in a density of 15 per square meter, but because of its small body size it is not considered a principal subdominant by weight.

Still to be described for southern California are the following communities: (1) areas of very coarse sand where the polychaetes *Nothria stigmatis* and *Spiophanes bombyx* dominate, with patches of the lancelet, *Branchiostoma*, and the sipunculid, *Sipunculus nudus;* (2) coarse rubbly shallow bottoms dominated by the polychaete *Diopatra ornata* and red algae; (3) deep-water slope communities in depths of 50 to 100 fathoms where the following assemblages have been identified but their relationships not yet deduced; *Chloeia* and *Pectinaria, Amphiacantha, Amphiodia digitata;* (4) shaley semi-epifaunal bottoms in depths of 30 to 50 fathoms where the nesting clam *Amygdalum* dominates; (5) gravel bottoms at 50 fathoms where *Ampelisca* dominates; (6) assemblages of *Pinnixa*; (7) others of *Capitella*; and (8) the *Chaetopterus* community of shallow rubbly bottoms.

THE LARGE ORGANISMS

The inshore sand faunas are composed mostly of small organisms less than 5 mm in length. Except for *Tellina*, only 10 of the more than 275 species of animals identified from the samples may be considered large or conspicuous. Most of these are comparatively rare organisms in the sense that few were collected in the samples but their size probably accounts for the bulk of the standing crop in the area considered. Nevertheless, their sparsity precludes their use as keys to the identification of the *Prionospio* and *Tellina* facies since most of them occur in only a fraction of the samples and only a few per square meter. Smaller animals that are collected in more than 50% of the samples are more useful indicators. Furthermore, it must be remembered that the smaller species probably have a greater turnover than the large ones so that the principal biomass (growth of protoplasm per year) may reside in the small rather than the large organisms.

The largest organisms are the sand crabs, *Blepharipoda occidentalis* and *Lepidopa myops*, two unidentified species of hermit crabs, the sand dollar *Dendraster excentricus*, large snails *Polinices lewisi* and *Olivella boetica*, the clam *Tellina buttoni*, the sandworm polychaete *Nephtys caecoides*, the tube-dwelling farmer-worm *Diopatra ornata* and the sandy-tubed worm *Owenia fusiformis collaris*. A few other large but very sparse species in our samples are not listed but may be characteristic of the area. Still other large species have not appeared in our samples but may also be characteristic of the area, such as the deep burrowing razor clam *Solen* sp., and the large polychaete *Loimia* sp. Occasionally the polychaete

Table 8

Dominant species and combinations in the inshore sand fauna of southern California, with assignment to communities. Based on 100 samples from less than 5 fms.

	Number of samples dominated
Prionospio community	
Prionospio malmgreni	47
Prionospio malmgreni-Diastylopsis tenuis	6
Prionospio-Diastylopsis-Tellina buttoni	1
Tellina buttoni facies of *Nothria elegans* -*Tellina buttoni* community	
Tellina buttoni	2
Tellina buttoni-Diastylopsis tenuis	15
Diastylopsis tenuis	2
Dendraster excentricus community (sand dollar)	2
Miscellaneous dominants	
Tharyx sp.-*Goniada littorea*	4
Scoloplos armiger	4
Onuphis eremita	2
Diopatra ornata	2
No dominant	13
	100

Table 9

Relationship of dominance in the samples to substrate characteristics. Based on 100 samples from less than 5 fms depth.

Dominant species	Average Percent sand	Average Median diameter, microns
Tellina	51	65
Prionospio	86	102

Table 10

Density per square meter of various animal classes and important species according to percent of sand in samples.

Group	80	60	40	20
All animals, total	2300	3400	4300	3300
Polychaetes	1690	1780	1660	970
Mollusks	72	240	250	450
Crustaceans	290	490	780	630
Prionospio malmgreni	1180	1050	340	70
Tellina buttoni	20	63	135	300
Diastylopsis tenuis	36	110	177	153
Olivella spp.	20	38	60	36
Nephtys caecoides	28	51	130	50
Haploscoloplos elongatus	25	14	72	55
Goniada littorea	39	46	15	10
Paraphoxus epistomus	54	48	35	44
Paraphoxus bicuspidatus	10	60	41	42
Lepidopa myops	6	2	0	0
Edotea sublittoralis	2	5	29	23
Ancinus daltonae	6	2	0	0

Chaetopterus variopedatus builds tubes on sand and rubble bottoms, especially in the Channel Islands and off the Palos Verdes highlands, but along the rest of the mainland shelf, *Chaetopterus* is not conspicuous.

The polychaete *Diopatra ornata* is not considered characteristic of sand bottoms, although it is occasionally found in marginal situations, for it is characteristic of rubble, shale or gravel bottoms around rocky headlands and indeed forms the most conspicuous element in a community to be named for it (see *Diopatra* ecotones in Shelford *et alia* 1935).

Table 11

Densities of various groups of invertebrates in several depth classes on the coastal shelf of southern California. Data for 2-5 fms class based on 100 samples of 0.1 square meter (Hartman, Barnard and Jones, 1960). Data for other classes based on 176 samples of 0.25 square meter.

Depth, fms	2-5	6-10	11-20	21-30	31-40	41-50	51-60	61-100
Polychaeta	1292	1634	1730	1225	1515	1425	947	1090
Crustaceans	437	1435	1060	1185	1885	1685	1670	1190
Echinodermata	36	135	215	590	1100	970	740	465
Mollusca	172	320	440	335	830	725	342	340
Others*	51	154	225	120	125	49	50	9
Total	1988	3678	3670	3455	5455	4854	3749	3094

* less nematodes, but including nemerteans, coelenterates, bryozoans, sponges, flatworms, phoronids, and chordates.

Table 12

Numbers of animal species per 0.20 square meter on inshore sands compared with those from deeper shelf.

	Number of species per 0.20 square meter	
	Inshore sands, 2-5 fms	Deeper shelf 6-50 fms
Polychaeta	20	39
Crustacea	14	28
Mollusca	6	15
Echinodermata	1	5

Table 13

Total numbers of animal species on inshore sands compared with those from deeper shelf. (See Hartman, Barnard and Jones 1960 for species lists on shallow sands.) Deeper shelf values are estimates.

	Inshore sands, 2-5 fms	Deeper shelf, 6-50 fms
Polychaetes	95	700
Crustaceans	97	350
Mollusks	64	300
Echinoderms	14	70
Others	15	200
Total	277	1620*

* About halfway through the anaylses in 1959 the Hancock survey team had identified 1106 species.

The sea-star *Astropecten californicus* occurs conspicuously in depths of 5 to 20 fms as evidenced by the 0.25 square meter grab samples but was only sparsely recovered in 2-5 fm depths probably because of the small size of the 0.1 square meter grab.

ABUNDANCE OF ORGANISMS

It might be expected, because of their relatively smaller body sizes, that the animals encountered on the inshore sands would be more abundant than those found on bottoms of higher silt percentages in greater depths. However, the statistics presented in Tables 11-13 show that bottoms in deeper water have more animals per square meter and more species per unit area, even though the screen mesh used to collect the animals was somewhat coarser. That this abundance is in part directly associated with the coarser grain size of the inshore sands is shown in the fact that more than 5000 animals per square meter were found on *fine* sands below 5 fms depth (data from offshore samples reported in Barnard, Hartman and Jones 1959) and more than 2500 animals per square meter on *coarse* sands below 5 fms depth.

Factors other than grain size also may be related to reduced animal frequencies on the inshore sands, perhaps swell action and the erosional-depositional cycle. It may be expected that food supplies in the form of debris are available in quantity on the inshore sands although it may also be expected that a large portion of this material is carried across the inshore sands and deposited in deeper quieter water. Nevertheless, during transit, debris should be available for food to inshore sand dwelling organisms.

Comparison of the abundant members of the inshore fauna and the offshore fauna is made in tables 14 and 15. Twice as many species of frequencies greater than 24 per square meter are found on offshore deep bottoms as inshore sands. Of the species on inshore sands only three, *Prionospio malmgreni*, *Paraphoxus bicuspidatus* and *Haploscoloplos elongatus* are among the most abundant animals on deeper shelf bottoms. The remaining species are characteristic only of the inshore sands.

Polychaetes: Inshore sands are dominated by an abundance of the polychaete *Prionospio malmgreni*, a species that is more numerous than the next by an order of magnitude. Standing crop is dominated by polychaetes because of the large sand worms and numerous individuals of small worms but crustaceans form a considerable bulk of the standing crop because of the giant sand crabs. Polychaete frequency in the inshore sands diminishes only slightly from its value on deeper bottoms mainly because of the great abundance of *Prionospio malmgreni* which composes almost 90% of the polychaete population.

Mollusks: These animals diminish in frequency from 476 per square meter on the offshore deep shelf to 172 on the inshore sands, although *Tellini buttoni* is a co-dominant and species of *Olivella* are prominent on

Table 14

The most abundant animal species on inshore sandy bottoms arranged by density per square meter. Compare with Table 15 for the most abundant animals in deeper shelf samples.

Name of Animal	Individuals Per Square Meter
Prionospio malmgreni P	930
Diastylopsis tenuis C	101
Goniada littorea P	69
Tellina buttoni M	65
Paraphoxus epistomus C	55
Nephtys caecoides P	53
Chaetozone nr. *spinosa* P	40
Olivella boetica & spp. M	32
Mandibulophoxus uncirostratus C	31
Haploscoloplos elongatus P	31
Dendraster sp., juveniles E	27
Paraphoxus bicuspidatus C	25
**Photis lacia* C	25
Scoloplos armiger P	24

P=polychaete; C=crustacean; M=mollusk; E=echinoderm; B=brachiopod.

* The high number possibly influenced by the few samples containing algae - not a strictly sand-dwelling species. See text.

Table 15

The most abundant animal species of the deeper shelf from 6 to 50 fathoms. Based on 176 samples.

	Name of Animal	Individuals per square meter
1.	*Amphiodia urtica* E	422
2.	*Prionospio malmgreni* P	112
3.	*Axonopsis serricatus* M	66
4.	*Paraphoxus bicuspidatus* C	56
5.	*Prionospio pinnata* P	55
6.	*Pectinaria californiensis* P	53
7.	*Tharyx tesselata* P	52
8.	*Ampelisca brevisimulata* C	47
9.	*Amphipholis squamata* E	44
10.	*Haploscoloplos elongatus* P	42
11.	*Lumbrineris cruzensis* P	39
12.	*Bittium* sp. M	37
13.	*Chloeia pinnata* P	36
14.	*Paraonis gracilis* P	35
15.	*Ampelisca cristata* C	32
16.	*Rochefortia* sp. M.	30
17.	*Heterophoxus oculatus* C	29
18.	*Glottidea albida* B	28
19.	*Dorvillea articulata* P	28
20.	*Cossura candida* P	27
21.	*Aoroides columbiae* C	25
22.	*Spiophanes missionensis* P	25

the inshore sands. The deep shelf fauna is dominated by such abundant species as *Cardita ventricosa*, *Bittium subplanatum* and *Saxicavella pacifica*, each of which in their special communities has a higher frequency than *Tellina*.

Echinoderms: A most significant reduction of species and individuals occurs in this group on nearshore sands when compared with deeper shelf bottoms, mainly because the deeper half of the shelf is dominated by the *Amphiodia urtica* community (see Barnard and Ziesenhenne, 1961) where frequencies of that animal surpass 700 per square meter. Only 14 species of echinoderms were found on the inshore sands. The largest is *Astropecten californicus*, a starfish probably appearing abundant to skin divers because of its occasionally dense patches. The sand dollar, *Dendraster excentricus* is conspicuous as juveniles but adults occur only in rare patches. Why they mature only in a few places is of interest for further exploration.

CRUSTACEANS

Crustaceans are reduced considerably in frequency on the inshore sands to 437 per square meter from an average 1444 specimens per square meter on deeper muddier bottoms (table 11). The number of species per benthic plot of 0.2 (not 0.25) square meters is reduced to half (table 12) and the number of species in the whole environment is less than a third of that on deeper bottoms.

The cumacean, *Diastylopsis tenuis*, is the most abundant and characteristic crustacean followed by the amphipods *Paraphoxus epistomus*, *Mandibulophoxus uncirostratus* and others shown in table 16.

Other crustaceans characteristic of the inshore sands are the sand-crabs *Lepidopa* and *Blepharipoda*, the isopod *Ancinus daltonae*, hermit crabs, the cumacean *Diastylopsis*, and the amphipods shown to be restricted to inshore sands in table 18.

A number of other crustaceans are more characteristic of compact sands between the depths of 6 and 20 fms but penetrate into the nearshore sands; these are the isopod *Edotea sublittoralis* and the other amphipods of table 18.

Most of the species of amphipods are clearly sand dwellers (except those marked with an asterisk in table 16 that generally build tubes on algal surfaces or nestle on and chew algae). The high count of *Photis lacia* below the algal zone and its absence from the intertidal, however, indicate that it is not necessarily oriented to algae. The only algae recovered in the samples were from the transect off Santa Barbara, where the inshore sediments are rather more silty than in other parts of the coast, probably an indication of an area of deposition and stranding of algal fragments. Other photids such as *Eurystheus thompsoni* and *Aoroides columbiae* and apparently the genera *Amphideutopus*, *Rudilemboides*, *Acuminodeutopus* and *Ericthonius* are believed to be builders of tubes on hard surfaces, possibly shell particles.

Table 16

Comparison of densities per square meter of inshore amphipod species with their densities in greater depths. Species arranged by rank of inshore abundance. Data partly from Barnard 1961. * Algal dweller.

Name of species	Depth class, fms		
	2-5	6-20	21-50
Paraphoxus epistomus	55	30	8.2
Synchelidium spp., 2 species	31	—	14.8
Mandibulophoxus uncirostratus	30	2.3	0
Photis lacia	25	2.8	17
Paraphoxus bicuspidatus, aberrant form	25	no data	0
Paraphoxus abronius	9.7	53	0
Eohaustorius washingtonianus	9.5	3.5	0
Ampelisca compressa	9.2	21	5.4
**Aoroides columbiae*	7.5	27	3.5
Monoculodes hartmanae	4.9	3.0	0.9
**Ampithoe* sp.	4.4	Negl.	0
Paraphoxus variatus	4.1	13.9	0.9
**Batea transversa*	4.1	6.4	0
Paraphoxus heterocuspidatus	3.8	5.8	0.2
Ischyrocerus pelagops	3.0	8.9	0
**Photis juveniles*	2.9	—	—
Photis brevipes	2.7	33	13.3
Atylus tridens	2.6	0	0
Megaluropus longimerus	2.3	4.3	0
Paraphoxus jonesi	2.0	1.3	0
Argissa hamatipes	1.4	10.6	1.2
Ampelisca cristata	1.0	50	15.2
Paraphoxus lucubrans	1.0	2.9	3.8
Tiron biocellata	1.0	2.9	0.1
Acuminodeutopus heteruropus	0.9	28	0.8
**Amphilochus picadurus*	0.6	0.9	0
Paraphoxus stenodes	0.6	30	3.2
Paraphoxus obtusidens	0.5	25	10.5
Ericthonius brasiliensis	0.5	7.2	0.2
Parapleustes pugettensis	0.5	7.5	0.3
Uristes entalladurus	0.4	2.5	0
**Eurystheus thompsoni*	0.4	15.0	2.9
Cerapus tubularis	0.4	2.3	0.1
Species of sparse occurrence on nearshore sands			
Podocerus cristatus		3.3	2.6
Corophium baconi		0.7	0.9
Listriella diffusa		1.5	
Listriella melanica		2.4	0.5
**Amphilochus neapolitanus*		0	0
**Batea lobata*		0	0
**Hyale nigra*		0	0
Rudilemboides stenopropodus		4.3	0.4
**Cheiriphotis megacheles*		0.2	0
Paraphoxus spinosus		4.2	0.2
lysianassid		0	0
Amphideutopus oculatus		30	17.8
Paraphoxus bicuspidatus, normal form		5.4	101

Table 17

Density per square meter of amphipods, other crustacean groups and their important species on the inshore sands, compared with greater depths. Number of species refers only to those tallied for inshore sands. Deepwater individuals have been counted but not as yet fully identified as to species. See Table 13 for estimates of total Crustacea in deepwater.

	2-5 fms	6-50 fms
Amphipods, 46 species	257	695
Crabs, all groups, about 10 species	12.8	23
Blepharipoda occidentalis	0.3	0
Cancer sp., juveniles	0.6	2.8
Hermit crabs	5.3	0.8
Lepidopa myops	5.3	0
Pinnixids	0.4	12
Shrimps, all groups, about 6 species	4.5	13
Callianassa sp.	1.6	11
Mysids	1.9	2.7
Isopods, total about 7 species	16.4	26
Ancinus daltonae	4.4	0
Edotea sublittoralis	7.4	1.9
Munna sp.	3.4	1.3
Cumaceans, total about 9 species	135	78
Diastylopsis tenuis	101	19
Caprellids, 2 species	10.1	9
Tanaids, 2 species	1.8	46
Copepods, 4 species	9.8	no data
Ostracods, 8 species	37	437
Nebalinceans, 1 species	0.5	9
Barnacles, *Balanus* sp.	0.2	negl.
(Pycnogonids = arachnids)	0.6	2.5

Table 18

Faunal groupings of Amphipoda on shallow bottoms, 2-5 fathoms

RESTRICTED TO INSHORE SANDS
- *Atylus tridens*
- *Eohaustorius washingtonianus*
- *Mandibulophoxus uncirostratus*
- *Megaluropus longimerus*
- *Monoculodes hartmanae*
- *Paraphoxus jonesi*
- *Paraphoxus bicuspidatus* aberrant form

PRIMARILY ON INSHORE SANDS BUT OCCURRING ABUNDANTLY ON MUDDIER SANDS TO DEPTHS OF 20 FATHOMS
- *Paraphoxus epistomus*
- *Paraphoxus heterocuspidatus*
- *Photis lacia* (20-50 fathoms)

PRIMARILY INTERTIDAL
- *Ericthonius brasiliensis*
- *Parapleustes pugettensis*
- *Cerapus tubularis*

PRIMARILY ON MUDDIER SANDS IN DEPTHS OF 6 to 20 fathoms
- *Acuminodeutopus heteruropus*
- *Ampelisca compressa*
- *Ampelisca cristata*
- *Argissa hamatipes*
- *Paraphoxus obtusidens*
- *Paraphoxus variatus*
- *Paraphoxus stenodes*
- *Tiron biocellata*
- *Uristes entalladurus*

ALGAL INHABITANTS
- *Aoroides columbiae*
- *Ampithoe* spp.
- *Batea transversa*
- *Ischyrocerus pelagops*
- *Paraphoxus abronius* (sands of kelp beds)
- *Photis brevipes*

Phoxocephalids (genera with suffixes "phoxus") as well as *Eohaustorius* and probably *Monoculodes*, are distinctly burrowers, whereas species of *Ampelisca* build tubes inserted slightly into the substrate. The phoxocephalid *Paraphoxus abronius*, has always been found associated with dense living algal bottoms although it probably makes burrows in the substrate among the algae.

Although a number of amphipod species are more abundant in depths of 21-50 fathoms than in sands at 2 to 5 fathoms, no species of the inshore sands finds its highest frequency in the 21-50 fathom zone. This indicates a poor penetration of deep water species onto the inshore sands. *Paraphoxus bicuspidatus*, a deep water species, is represented on the inshore sands by a form requiring nomenclatural distinction.

AMPHIPOD SYSTEMATICS

Family LYSIANASSIDAE

Genus *Uristes* Dana

Uristes Dana, J. L. Barnard 1962f: 35-36 (with synonymy).

REMARKS: Barnard, by disregarding the degree of subchelateness in gnathopod 1, has fused a number of genera to form a new concept of this genus.

The following key is based mainly on ornamental characters, since the description in keys of small gnathopodal gradations is laborious.

This genus is very close to *Tryphosa* (including *Tmetonyx*, see J. L. Barnard (1962f), differing by the often subtle proportion between the fifth and sixth articles of gnathopod 1 and by the small head largely covered by coxa 1. In *Tryphosa*, article 5 is longer than article 6 and in *Uristes*, article 6 is longer than article 5. On this basis *Uristes natalensis* K. H. Barnard (1916) is transferred to the genus *Tryphosa*. *Uristes induratus* K. H. Barnard (1925) with its very small first coxa belongs near the genus *Eurythenes*, possibly requiring the erection of a new genus. *Hippomedon* differs from *Uristes* by the expanded coxa 1 which in *Uristes* narrows slightly distally as in *Tryphosa*.

Orchomenella (?) *abyssalis* Stephensen (1925) is transferred to the genus *Uristes* because its mandibular palp is attached over the molar.

KEY TO *URISTES*

1. Urosomal segment 1 with dorsally erect, terminally acute process, either conical, tent-shaped or keel-like 2
1. Urosomal segment 1 dorsally smooth or with rounded hump 7
    2. Third pleonal epimeron with tooth or prolongation at lower posterior corner 3
    2. Third pleonal epimeron rounded or quadrate behind 4
3. Urosomal segment 1 with keel ending acutely behind, keel not erect .... *typhlops*
3. Urosomal segment 1 with erect, acute conical process .... *cansada*

4. Article 6 of gnathopod 1 twice as long as article 5 5
4. Article 6 of gnathopod 1 less than 1.5 times as long as article 5 6
5. Peraeopod 4: article 2 with coarse teeth at lower posterior corner of lobe; third pleonal epimeron sharply quadrate; process of urosomal segment 1 symmetrical .... *velia*
5. Peraeopod 4: article 2 lacking coarse teeth at lower posterior corner of lobe; third pleonal epimeron rounded at lower posterior corner; process of urosomal segment 1 asymmetrical .... *abyssalis*
6. Process of urosomal segment 1 decumbent; lateral lobes of head acute; third pleonal epimeron bulbous behind: article 6 of gnathopod 2 more than ⅔ as long as article 5 .... *gigas*
6. Process of urosomal segment 1 reflexive; lateral lobes of head sub-obtuse; third pleonal epimeron scarcely convex behind; article 6 of gnathopod 2 less than ⅓ as long as article 5 .... *entalladurus*, n. sp.
7. Urosomal segment 1 with narrow, deep dorsal notch .... *falcatus*
7. Urosomal segment 1 with or without shallow dorsal depression 8
8. Third pleonal epimeron rounded or quadrate behind 9
8. Third pleonal epimeron with tooth or prolongation at posterior lower corner 13
9. Third pleonal epimeron with hind edge nearly straight 10
9. Third pleonal epimeron with hind edge strongly convex 11
10. Gnathopod 1 with very oblique palm, its article 7 long, greatly overlapping the palm .... *umbonatus*
10. Gnathopod 1 with nearly transverse palm, its article 7 short, fitting the palm .... Californian species to be descr. by Dr. Hurley
11. Article 5 of gnathopod 2 twice as long as article 6 .... *barbatipes*
11. Article 5 of gnathopod 2 less than 1.5 times as long as article 6 12
12. Lower edge of article 2 on peraeopod 3 oblique .... *subchelatus*
12. Lower edge of article 2 on peraeopod 3 rounded the full width of article 2 .... *antennibrevis*
13. Third pleonal epimeron prolonged at posterior lower corner .... *serratus*
13. Third pleonal epimeron with distinct posterior tooth 14
14. Gnathopod 1 simple 15
14. Gnathopod 1 subchelate 16
15. Article 2 of peraeopod 5 with acute posterior lower corner .... *calcaratus*
15. Article 2 of peraeopod 5 with rounded posterior lower corner .... *productus*
16. Article 5 of gnathopod 1 about 80% as long as article 6 .... *georgiana*
16. Article 5 of gnathopod 1 about 35% as long as article 6 .... *albina*

List of Species Herein Assigned to *Uristes*

Orchomenella abyssalis Stephensen (1925)
Tryphosella albina K. H. Barnard (1932)
Uristes antennibrevis J. L. Barnard (1962e)
Tryphosella barbatipes (Stebbing 1888)
Centromedon calcaratus (Sars) (see Sars 1885)
Uristes cansada J. L. Barnard (1961)
Uristes species to be descr. by Hurley
Uristes entalladurus n. sp.
Tryphosoides falcatus Schellenberg (1931)
Tryphosoides georgiana Schellenberg (1931)
Uristes gigas Dana, see *Tryphosa antennipotens* Stebbing (1888)
Centromedon productus (Goës), see Gurjanova (1951)
Uristes serratus Schellenberg (1931)
Uristoides subchelatus Schellenberg (1931)
Centromedon typhlops (Sars), see Sars 1885
Uristes umbonatus (Sars) see *Pseudotryphosa umbonata* in Sars 1895
Uristes velia J. L. Barnard (1961)

Uristes entalladurus, new species

Figs. 5, 6

DIAGNOSIS: Urosomal segment 1 with an erect, reflexive, acute dorsal process; third pleonal epimeron slightly convex at posterior edge and quadrate at lower posterior corner; article 6 of gnathopod 1 scarcely longer than article 5, the palm oblique, short, the finger overlapping palm; article 6 of gnathopod 2 less than one third as long as article 5, slightly chelate, the finger very short, attached to middle end of article 6; lateral lobes of head not as acute as in most other species of the genus. Males and females similar.

HOLOTYPE: AHF No. 5620, female, 3.7 mm.

TYPE LOCALITY: Station 4758, off La Jolla, California, 32-51-50 N, 117-15-40 W, 9 fms, Dec. 8, 1956, bottom of fine green sand.

MATERIAL: 96 specimens from 11 stations in the open-sea off southern California.

RELATIONSHIP: This species may be distinguished from its relatives by the characters presented in the preceding key. It is most closely related to the type species, *U. gigas* Dana (see *Tryphosa antennipotens* Stebbing 1888: pl. 6), but differs by the more erect, actually reflexive process of urosomal segment 1, the less acute lateral lobes of the head and the short sixth article of gnathopod 2.

Ommatidea are absent, but a mass of diffuse red pigment soluble in alcohol is present on the head as shown in the figure.

ECOLOGY: In southern California this species is restricted to sand bottoms shallower than 10 fathoms where its frequency is 5.0 animals per square meter.

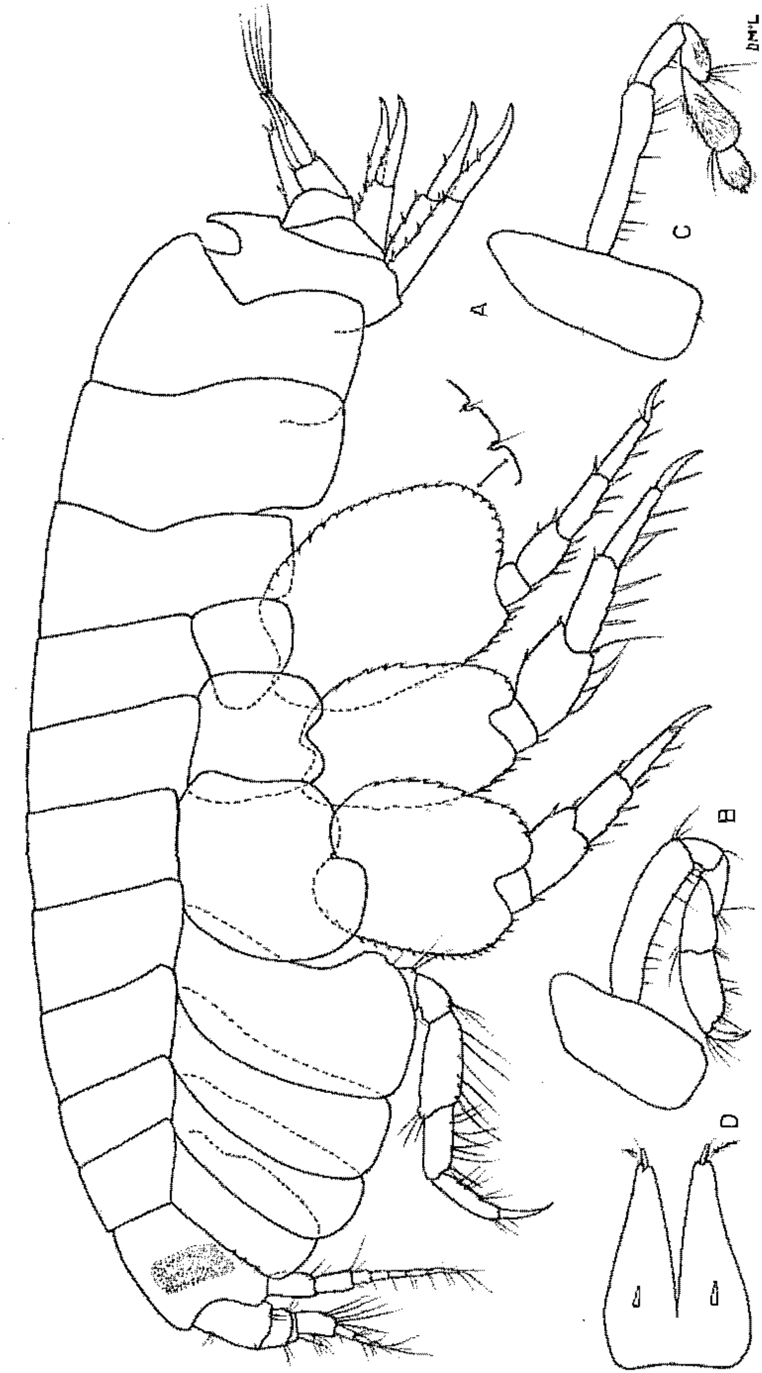

Fig. 5. *Uristes entalladurus*, n. sp. Female, holotype, 3.7 mm, sta. 4658: A, lateral view; B,C, gnathopods 1, 2; D, telson.

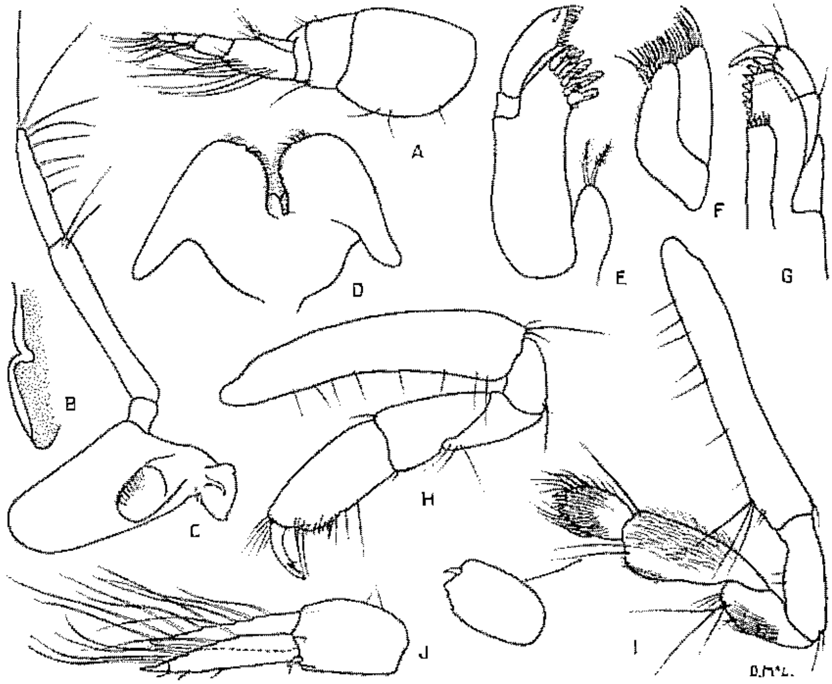

Fig. 6. *Uristes entalladurus*, n. sp. Female, holotype, 3.7 mm, sta. 4758: A, antenna 1; B, epistome and upper lip, lateral view; C, mandible; D, lower lip; E,F, maxillae 1, 2; G, maxilliped; H,I, gnathopods 1, 2; J, uropod 3.

Family PHOXOCEPHALIDAE

Genus **Paraphoxus** Sars

Paraphoxus bicuspidatus J. L. Barnard

J. L. Barnard 1960a: 218-221, pls. 15, 16.

MATERIAL: 2 specimens from 2 samples, with the normally short epistomal cusp.

Paraphoxus bicuspidatus, aberrant form

DIAGNOSIS: Like the stem species but the epistome is produced into a long conical process.

REMARKS: There is little difference between *Paraphoxus bicuspidatus* and *P. variatus* J. L. Barnard (1960a), except that *P. variatus* has a long epistome and 3 or more large cusps on article 2 of peraeopod 5, whereas *P. cuspidatus* has a short epistomal cusp and only 2 large cusps on peraeopod 5. The form described here intergrades these species by its long epistomal process, so that *P. variatus* and *P. bicuspidatus* differ only by the fifth pereaopod. It is problematical whether the new form is *P. bicuspidatus* with a long epistome or *P. variatus* with reduced teeth on pereaopod 5. Several taxonomic possibilities are evident here: (1) that *P. bicuspidatus* aberrant form is a hybrid; (2) that *P. bicuspidatus* and *P. variatus* are but phenotypes; (3) that the new form is an ecophenotype of either *P. bicuspidatus* or *P. variatus*. *Paraphoxus variatus* and *P. bicuspidatus* are not codistributive in the open sea of southern California according to the following scheme where it is shown that *P. variatus* is a shallow water species and *P. bicuspidatus* a deep-water species:

Depth, fathoms	10	20	30	40	50	100
Number per square meter of:						
P. variatus	20	7.7	1.0	0.5	1.4	0
P. bicuspidatus	0.3	10.5	44	134	125	98

When so separated both by morphology and depth the species are quite distinct, and the writer arbitrarily assigns the new form to *P. bicuspidatus* based on teeth of pereaopod 5 rather than to *P. variatus* based on the epistome.

The gnathopods of *P. variatus* are more slender than those of *P. bicuspidatus*, but the gnathopods of the new form vary between the two extremes.

Paraphoxus jonesi, new species

Fig. 7

DIAGNOSIS: Head with a very narrow, long rostrum, constricted in front of eyes; eyes large in female; lateral lobe of head distinctly produced; epistome quadrate in front; gnathopods 1-2 with article 6 shorter than 5, broad, the palm transverse, the ratio of lengths of article 5-6: gnathopod 1=35:25, gnathopod 2=30:23; articles 4-5 of peraeopod 3 broadly expanded, article 4 wider than article 2, the ratios of widths of articles 2, 4, 5, 6=42:50:40:15; peraeopod 4 with article 4 as wide as on peraeopod 3 but article 2 much wider, ratio of widths of articles 2, 4, 5, 6=70:50:28:12; article 2 of peraeopod 5 widely expanded, its ratio of width to length being 7:8, extending down to end of article 4, its lower edge rounded, sweep point (see Barnard 1960a for definition) near end of article 3, posterior edge convex and armed with 8-9 small teeth; uropod 1 with a strong distal peduncular spine, its outer ramus with 3 marginal spines, its inner ramus with one; peduncular margin of uropod 2 bearing 4 erect stout spines, the outer ramus naked, the inner with 3 marginal spines; inner ramus of uropod 3 as long as first article of outer ramus; telsonic apices subacute, laterally notched, each bearing a spine; third pleonal epimeron with straight setose posterior edge, produced into a large upturned tooth at the lower corner.

MALE: Sexual dimorphism typical.

HOLOTYPE: AHF no. 599, female, ovigerous, 3.75 mm.

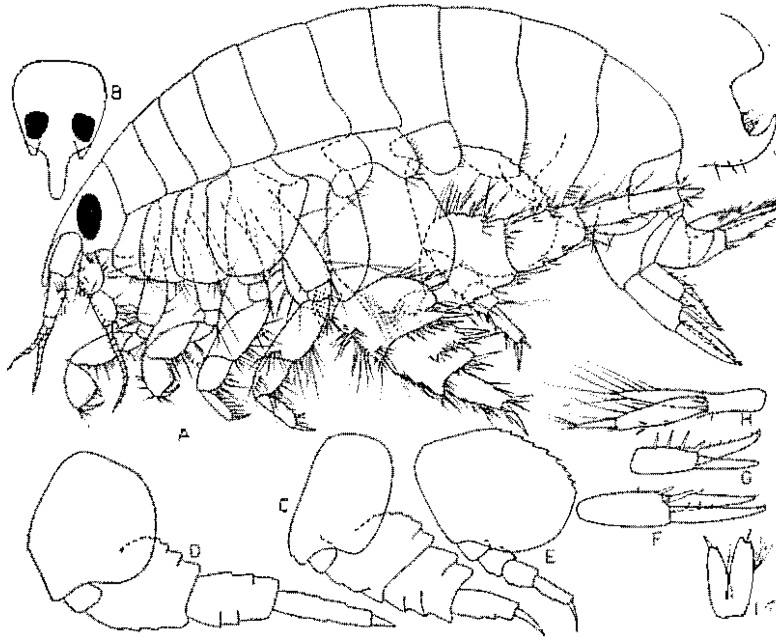

Fig. 7. *Paraphoxus jonesi*, n. sp. Female, holotype, 3.75 mm, stn. 6408; A, lateral view; B, head, dorsal view; C,D,E, peraeopods 3, 4, 5, minus setae; F,G,H, uropods 1, 2, 3; I, telson; J, third pleonal epimeron.

TYPE LOCALITY: Station 6408, off Del Mar, California, 32-57-50 N, 117-16-35 W, 8 fms, Sept. 2, 1959, medium gray sand.

RELATIONSHIP: This species is clearly not *Paraphoxus robustus* Holmes (1908) to which it bears great resemblance by the third pleonal epimeron, and which Holmes erroneously figured without a lateral epimeral flange. However, the third and fourth peraeopods of the new species are quite stout whereas they are very slender in *P. robustus*. The head of the new species is trichophoxid, with a narrow rostrum, hence differing from that of *P. robustus*.

The peculiarity of the produced lateral lobe of the head suggests relationship with *P. nasuta* (Gurjanova 1936), but the third pleonal epimeron is not described in that species. Otherwise, the species is unrelated to other trichophoxid members of the genus because of the large tooth on the third pleonal epimeron.

MATERIAL EXAMINED: 65 specimens from 9 stations.

DISTRIBUTION: This species lives exclusively in waters of less than 10 fms depth especially on sandy bottoms, where its frequency is 4.7 animals per square meter.

Recent References to Other Amphipod Species Listed in The Tables

Acuminodeutopus heteruropus in J. L. Barnard (1959)
Ampelisca compressa in J. L. Barnard (1960)
Ampelisca cristata in J. L. Barnard (1954)
Amphideutopus oculatus in J. L. Barnard (1959)
Amphilochus neapolitanus and *A. picadurus* in J. L. Barnard (1962c)
Aoroides columbiae in J. L. Barnard (1959)
Argissa hamatipes in J. L. Barnard (1962b)
Atylus tridens in Mills (1961)
Batea transversa and *B. lobata* in J. L. Barnard (1962b)
Cerapus tubularis in J. L. Barnard (1962a)
Cheiriphotis megacheles in J. L. Barnard (1962a)
Corophium baconi in J. L. Barnard (1959)
Eohaustorius washingtonianus in J. L. Barnard (1957)
Ericthonius brasiliensis in J. L. Barnard (1959)
Eurystheus thompsoni in Shoemaker (1955)
Hyale nigra in J. L. Barnard (1962c)
Ischyrocerus pelagops in J. L. Barnard (1962a)
Listriella diffusa and *L. melanica* in J. L. Barnard (1959a)
Megaluropus longimerus in J. L. Barnard (1962b)
Monoculodes hartmanae in J. L. Barnard (1962d)
Paraphoxus abronius, P. epistomus, P. heterocuspidatus, P. lucubrans, P. obtusidens, P. stenodes, P. spinosus, and *P. variatus,* all in J. L. Barnard (1960a)
Parapleustes pugettensis in Barnard and Given (1960)
Photis brevipes and *P. lacia* in J. L. Barnard (1962a)
Podocerus cristatus in J. L. Barnard (1962a)
Rudilemboides stenopropodus in J. L. Barnard (1959)
Tiron biocellata in J. L. Barnard (1962b)

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1962c. Ibid. Families Amphilochidae, Leucothoidae, Stenothoidae, Argissidae, Hyalidae. Pac. Nat. 3 (3): 116-163, 23 figs.

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