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A PRELIMINARY EXAMINATION OF EUTHECOSOMATOUS PTEROPODS OFF THE CENTRAL COAST OF WESTERN AUSTRALIA

FRED E. WELLS*

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ABSTRACT

Twenty-one species of euthecosomatous pteropods were collected in plankton tows and dredge hauls made off the western coast of Western Australia. All species except *Limacina helicina* were tropical. *Limacina trochiformis* and *L. inflata* were the most abundant species in both the plankton and the sediment. Small individuals dominated the populations of both species.

INTRODUCTION

Euthecosomatous pteropods are a very poorly known group of opisthobranch gastropods. In contrast to the vast majority of marine gastropods, euthecosomes are holoplanktonic; they deposit free-floating egg masses from which veligers hatch and develop into free-swimming adults without ever touching the bottom. The group is highly modified for planktonic existence in several ways; the shell is reduced and the animals have a small body size; the foot is modified into a pair of swimming wings, or parapodia; all species are ciliary mucous feeders; and reproduction is highly specialised. Euthecosomes are the animals whose shells form the pteropod oozes found in some areas of the ocean floor.

Euthecosome species are widely distributed in temperature zones. The tropical species are found over the warm water areas of the Atlantic, Pacific, and Indian Oceans. Broad distributional patterns of the various species are known, but distribution in localised areas is largely unstudied. Recent work in the Atlantic Ocean has shown two genera — *Limacina* (*Spiratella*) and *Creseis* to be more important numerically than has been previously thought (Wells, 1976). This is because the small individuals of

*Western Australian Museum, Perth, W.A.

these genera readily slip through the large meshed nets used by most investigators (Wells, 1973).

Euthecosome distributions in the Indian Ocean are not as well known as in the two larger oceans. Tesch (1948) showed the broad distributional patterns of a number of the most common species based on the Dana collections and on records made by merchant ships. Frontier (1963) made a detailed study of the distribution of euthecosomes in several areas of the northwestern Indian Ocean: the Arabian Sea, Persian Gulf, and Gulf of Aden.

The availability of ship time on dredging cruises of the MV *Sprightly* in February 1976 and the HMAS *Diamantina* in March 1976 offered an opportunity for a preliminary examination of euthecosomatous pteropods off the central west coast of Western Australia.

MATERIALS AND METHODS

Two oblique plankton hauls were made at night on 15 February 1976 at Sprightly Station 1M (30°21'S; 114°38'E) with a ¾ m diameter open plankton net equipped with #20 (80μ) nylon mesh. Tows were made from 150 m to the surface in an area where the water depth was 165 m. After the net was lost further tows were made at the same station with a 50 cm square open net equipped with a mesh of approximately #8 (200μ) nylon. The station was revisited on 20 February 1976 and oblique hauls were made during daylight hours with the #8 net. A bathythermographic record was made at this station on 20 February.

Plankton samples were initially preserved in 10% formalin buffered with borax. Upon returning to shore hexamethylene tetramine was substituted as the buffer. The entire #20 tows were examined for euthecosomes and all euthecosome species were identified and counted. Maximum shell diameter of all individuals of *Limacina inflata* and maximum shell length of *L. trochiformis* were measured with a microscope equipped with an ocular micrometer. The #8 samples were searched for species not present in the #20 tows.

As part of the general dredging programme sediment samples were made at Station 1M with a pipe dredge; this and all other sediment samples were preserved in 10% formalin buffered with borax. On shore the sediment sample from Station 1M was subsampled and all euthecosomes identified and counted. Again all available individuals of *Limacina inflata* and *L. trochiformis* were measured. Sediment samples from the other 'Sprightly' stations were searched for species not found at Station 1M.

The *Diamantina* cruise made three transects along the continental slope at depths of 150 to 400 fathoms. The transects were made at latitudes 31°00′, 31°30′ and 32°00′S between longitudes 114°46′ and 115°12′E. Large numbers of empty euthecosome shells were collected from the sediment during the dredging operations conducted from 15 to 17 March 1976. The shells were identified and several species not collected on the *Sprightly* were found.

RESULTS

The bathythermograph slide from Sprightly Station 1M showed a surface water temperature of 23.0°C. The upper layer was homogeneous to depth of 70 m, where the temperature was still 22.5°C. Below 70 m the temperature declined rapidly to 20.0°C at 95 m. There was very little variation below the thermocline; the temperature at 140 m, the maximum depth measured, was 19.0°C.

Table 1: Relative abundances of euthecosomatous pteropods in the plankton and sediments at 'Sprightly' Station 1M (30°21′S; 114°38′E) off Western Australia in February 1976.

	Plankton %	Sediment %	Sediments from other Stations
Cavolinia gibbosa (d'Orbigny, 1836)	-	-	Present
Cavolinia inflexa (Lesueur, 1813)	4.3	1.2	Present
Cavolinia longirostris (Blainville, 1821)	-	-	Present
Cavolinia tridentata (Niebuhr, 1775)	-	-	Present
Cavolinia uncinata (Rang, 1829)	-	-	Present
Clio balantium (Rang, 1834)	-	-	Present
Clio cuspidata (Bosc, 1802)	-	-	Present
Clio pyramidata (Linnaeus, 1767)	2.8	2.1	Present
Creseis acicula (Rang, 1828)	2.4	0.8	Present
Creseis virgula conica (Rang, 1828)	1.0	1.6	Present
Creseis virgula virgula (Rang, 1828)	0.4	0.4	Present
Cuvierina columnella (Rang, 1827)	0.2	0.2	Present
Diacria quadridentata (Blainville, 1821)	1.2	0.2	Present
Diacria trispinosa (Blainville, 1821)	0.4	1.0	Present
Hyalocylix striata (Rang, 1828)	0.2	0.0	Absent
Limacina bulimoides (d'Orbigny, 1836)	0.8	1.0	Present
Limacina helicina (Phipps, 1774)	0.2	0.0	Absent
Limacina inflata (d'Orbigny, 1836)	31.6	38.4	Present
Limacina lesueuri (d'Orbigny, 1836)	0.6	0.8	Present
Limacina trochiformis (d'Orbigny, 1836)	52.5	51.5	Present
Styliola subula (Quoy and Gaimard, 1827)	1.4	1.2	Present
Total	100.0	100.4	
n	514	510	

Plankton samples

Fifteen species and subspecies of euthecosomes were collected in the plankton at Station 1M (Table 1). The most abundant species were *Limacina trochiformis*, with 52.5% of all euthecosome individuals collected, and *L. inflata*, with 31.6%. In all, the 5 species of *Limacina* collected comprised 85.7% of all the whole euthecosome catch. The remaining 10 species and subspecies of other genera were present only in small numbers. This is particularly true of the 3 species and subspecies of *Creseis*[1], which together constituted only 3.8% of the total euthecosome numbers.

The size frequency histogram of *Limacina trochiformis* collected in the plankton is shown on Fig. 1. *Limacina trochiformis* collected off Western Australia ranged from 0.10 to 1.16 mm in shell length; the mean size was 0.33 $\pm$ 0.20 mm. Most individuals (56.9%) were veligers 0.16 to 0.24 mm in shell length. Individuals of *L. inflata* ranged from 0.08 to 1.00 mm in shell diameter; the mean shell diameter was 0.19 $\pm$ 0.06 mm.

Sediment samples

Limacina trochiformis was also the most abundant species in the sediment samples (Table 1). The percentage of individuals of this species (51.5%) in the euthecosome count of the sediment sample is very close to the 52.5% recorded in the plankton. *Limacina inflata* was relatively more abundant in the sediment (38.4%) than in the plankton (31.6%). The relative abundance of the genus *Limacina* as a whole was greater in the sediment (91.7%) than in the plankton (85.7%), due entirely to the higher proportion of *L. inflata* in the sediment. All other species were represented by small numbers of individuals in the sediments, giving similar relative abundance to those exhibited in the overlying water column. Specimens of three species and subspecies of *Creseis* composed 2.8% of all euthecosomes collected in the sediments.

Empty shells of 6 species not found in the plankton were recorded from the complimentary dredge samples. They were *Cavolinia gibbosa*, *Ca. longirostris*, *Ca. tridentata*, *Ca. uncinata*, *Clio balantium*, and *C. cuspidata*.

The size frequency histogram of *Limacina trochiformis* collected in the sediment is also shown on Fig. 1. The mean of the shell length was 0.31 $\pm$ 0.08 mm. This was not statistically different (t-test, 0.05 confidence level) from the mean of 0.33 mm recorded in the plankton. Unbroken large shells of *L. trochiformis* were absent in the sediment. Several fragments of adult shells were found, but their total length could not be determined.

[1] The taxonomic positions of *Creseis virgula virgula* and *C. virgula conica* are uncertain. This paper follows the classification suggested by Chen and Bé (1964).

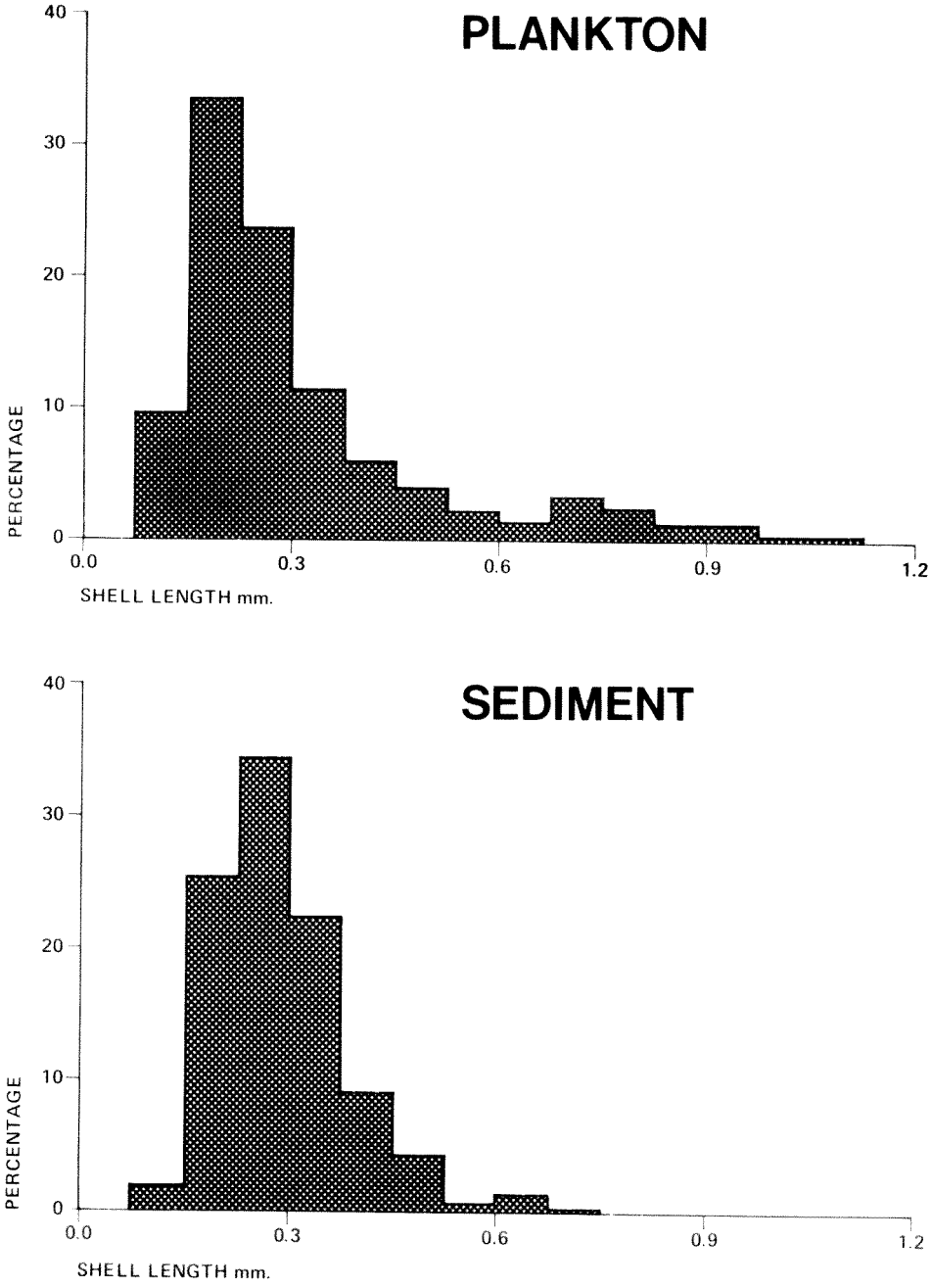

Fig. 1: Size-frequency histograms of *Limacina trochiformis* collected in the plankton and sediment at 'Sprightly' Station 1M (30°21'S; 114°38'E) off Western Australia in February 1976.

The mean diameter of *L. inflata* in the sediment was 0.36 ± 0.15 mm, significantly larger than in the plankton (t-test, 0.05 confidence level). The largest *L. inflata* found was an empty shell 1.52 mm in diameter taken from the sediment samples.

DISCUSSION

The most recent distributional maps (van der Spoel, 1967) have a paucity of data on species distributions along the west coast of Western Australia. The present data extend the known ranges of most of the species for several hundred miles eastward to the Western Australian coast. Van der Spoel (1967) reported only *Limacina helicina* and *Clio pyramidata* in the waters off South Australia. He was apparently unaware of the report by Cotton (1959) on the molluscs of South Australia which listed 9 additional species: *Cavolinia longirostris*, *C. inflexa*, *C. tridentata*, *Diacria trispinosa*, *Clio balantium*, *Creseis virgula*, *Limacina bulimoides*, *L. inflata*, and *Styliola subula*. Cotton (1959) actually lists *Cavolinia telemus* Linnaeus, 1758, but the correct designation of this species is *Cavolinia tridentata* (Niebuhr, 1775) (van der Spoel, 1967).

The isolated individual of *Limacina helicina* collected during this study off central Western Australia is the only cold water species recorded in this area. Rochfort (1967) described a West Australian Current flowing northward during the summer months. It is probable that the *L. helicina* was brought north by the West Australian Current to a latitude outside the normal range of the species.

The plankton samples were spread over a period of only 5 days, and thus might not accurately reflect the relative abundances of the various species over a year. The most abundant species, *Limacina trochiformis*, is known to be particularly prone to variations in seasonal abundance (Wells, 1976). However euthecosome shells deposited in shallow sediments have been shown to accurately reflect the composition of living species in the overlying water column (Chen, 1964; Wells, 1975). Since shells deposited in the sediment represent a much longer time period, the sediment samples made off Western Australia offer a more reliable picture of the long term relative abundances of euthecosome species. Both the plankton and sediment samples show the tropical nature of the euthecosomatous pteropod fauna off the west coast of Western Australia. The relative proportions of species in the two were similar. *Limacina trochiformis* was 52.5% of all individuals collected in the plankton and 51.5% in the sediment. *Limacina inflata* was the second most numerous species in both provinces. In all, the 5 species of *Limacina* comprised 85.7% of all euthecosomes in the plankton and 91.7% in the sediment.

Although mesh size of the net is the most important factor in adequately sampling small species of euthecosomes (Wells, 1973), the only comparative quantitative data with an 80μ mesh was collected off Barbados, West Indies (Wells, 1976). In two years of sampling off Barbados the genus *Limacina* constituted 70.7% of the numbers of all euthecosomes collected; it was also the dominant genus off Western Australia. Individuals of the three species and subspecies of *Creseis* formed 27.3% of the euthecosomes collected off Barbados, but were only 3.8% of the catch numbers off Western Australia. The fact that members of the genus *Creseis* numbered only 2.8% of the shells in the sediment indicates that the relative paucity of this genus in the plankton was not a short term phenomenon. Though no figures for 80μ mesh are available for other areas of the Indian Ocean, Frontier (1963) showed *Creseis* to be abundant in collections made with larger meshed nets in the Arabian Sea and Gulf of Aden, but not in the Persian Gulf. The reasons for the rarity of *Creseis* off Western Australia are not known, and it would be interesting to know whether the genus is similarly rare in other parts of the Indian Ocean.

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