ABSTRACT

Four species (three new) of Ostracoda belonging to the family Cytherellidae, collected in the vicinity of Bimini, Bahamas, are described. The influence of water depth, salinity, substrate, and temperature on the distribution of cytherellids is discussed. It is tentatively concluded that cytherellids are restricted to water having salinities above 25 parts per thousand and depths less than 2000 meters.

Ecology and classification of Bahamian Cytherellidae (Ostracoda)

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INTRODUCTION

This paper is the fourth in a series describing Bahamian Ostracoda and considering ostracode ecology. Previous papers are "Ecology and taxonomy of Recent marine ostracodes in the Bimini area, Great Bahama Bank" (Kornicker, 1958), "Distribution of the ostracode suborder Cladocopa, and a new species from the Bahamas" (Kornicker, 1959), and "Ecology and taxonomy of Recent Bairdiinae (Ostracoda)" (Kornicker, 1962). Collections were made in the vicinity of the Bimini Islands, which are situated in the northwestern part of the Great Bahama Bank. The collecting localities are shown in text-figure 1.

The ostracode family Cytherellidae has within it two genera, *Cytherella* and *Cytherelloidea*, that range from Jurassic to Recent. These two genera are represented by four species in the Bimini area. Knowledge of the ecology of living ostracodes whose ancestors have a long geologic history may be useful to paleontologists using ostracodes as a means of interpreting ancient environments. Ecological studies in the Bahamian area have especial significance because the Bahamas may have similarities with depositional environments widespread in the past.

ACKNOWLEDGMENTS

The base for the field work in Bimini was the Lerner Marine Laboratory of the American Museum of Natural History. Summer collections were made by the writer while a member of a field group making a biogeologic survey of the northwestern part of the Great Bahama Bank under the direction of Professors Norman D. Newell and John Imbrie. The writer is indebted for field assistance to Dr. Edward Purdy, Mr. Robert Adlington, and Dr. Robert J. Menzies. Field collections were made within the framework of a project supported by financial grants-in-aid from Columbia University, the Humble Oil and Refining Company, and the Shell Development Company. The writer was assisted in the initial phases of the present study by a grant from the Esso Educational Foundation. He wishes to express his appreciation to Mr. I. G. Sohn and Dr. Harbans S. Puri for helpful criticism of the manuscript. Figured specimens have been deposited at the U. S. National Museum, Washington, D. C. This paper is a contribution from the Department of Oceanography and Meteorology of the Agricultural and Mechanical College of Texas.

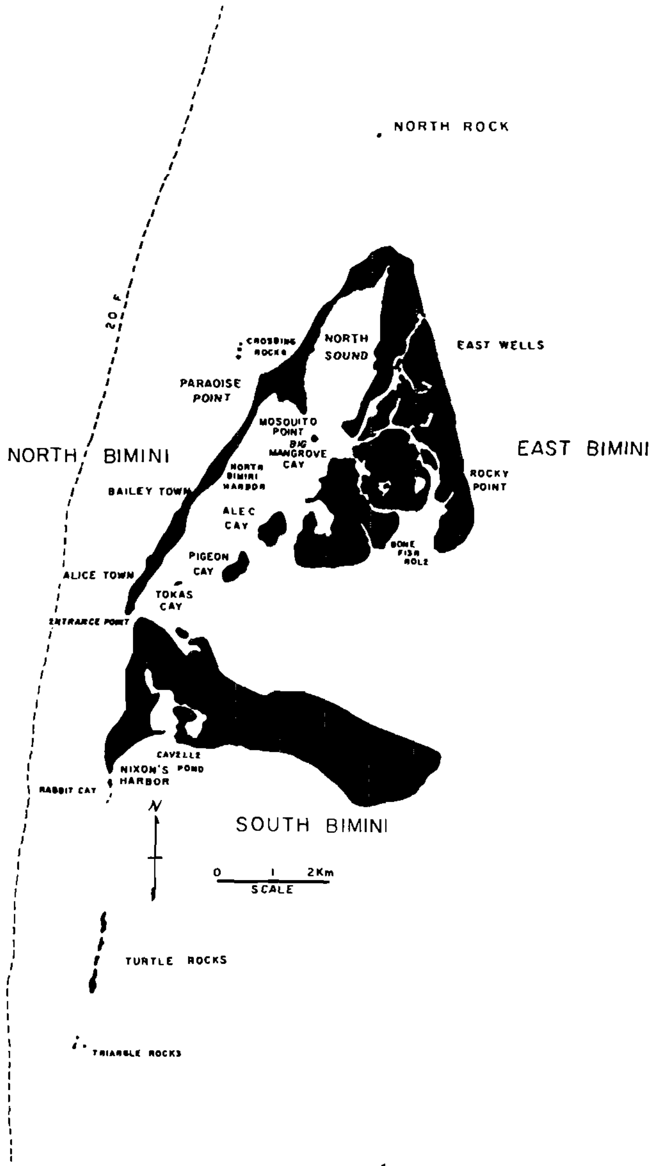
OSTRACODE ECOLOGY

Distribution of cytherellids in the diverse environments of Bimini is shown in text-figure 2. Environmental factors of water depth, salinity, substrate and temperature that may influence the distribution of Ostracoda are considered below.

Depth

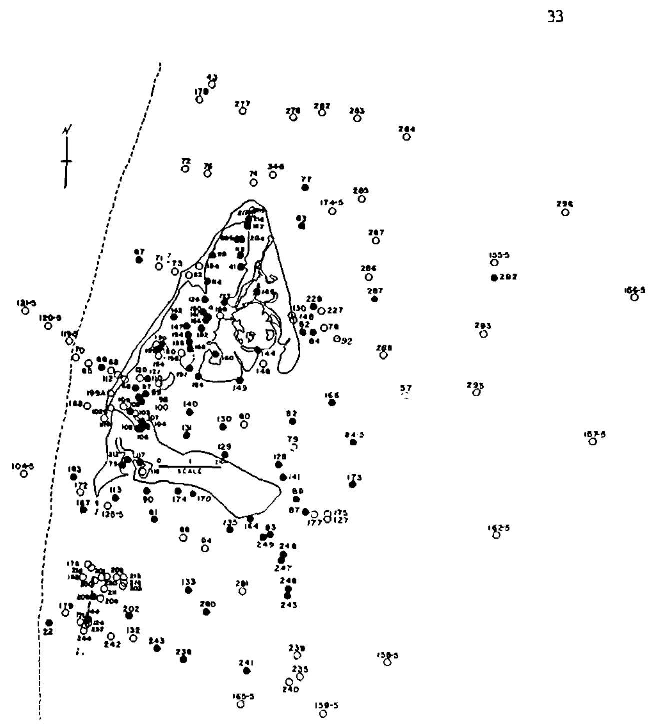
Collections from Bimini were obtained in shallow water less than 24 meters deep, with few samples collected in water deeper than 17 meters. Cytherellids were present in samples from all depths, but they were more abundant in samples collected in water less than 3 meters deep. Roughly 35 per cent of samples from water less than 3 meters deep contained cytherellids, compared with only 23 per cent from water 3–6 meters deep and 15 per cent from water 6–17 meters deep.

The collections from the early exploration of the *Challenger* Expedition (Brady, 1880) indicate that cytherellids are absent from abyssal depths (table 1). Cytherellids were also absent from deep-sea cores obtained in the North Atlantic in water ranging in depth from 1380–4820 meters (Tressler, 1941). Why the ostracode suborder Platycopina, containing genera ranging from Jurassic to Recent, with species abundant



TEXT-FIGURE 1

LOCALITY MAP OF BIMINI ISLANDS



TEXT-FIGURE 2

DISTRIBUTION OF CYTHERELLIDAE AT BIMINI

Cytherellidae were collected at stations indicated by filled-in circles and were absent at those shown by open circles. Sample stations are numbered.

in shelf and slope waters of modern seas, is not represented at abyssal depths is a question not answerable at the present time. Its absence at abyssal depths, where environmental conditions have remained relatively constant, suggests that the suborder did not occupy this region during past ages.

Some species appear to be restricted to certain depths. Kruit (1955, p. 475) collected *Cytherella laevis* Brady only at depths greater than 10 meters, with the maximum occurrence at a depth of 20 meters, in the Golfe de Fos (Rhone delta). This species had previously been recorded from depths between 100 and 700 meters off the west coasts of Africa and Europe (Brady, 1866; Brady, 1868; Brady and Norman, 1896). Kruit (in Andel and Postma, 1954) found *Cytherella lata* Brady and *Cytherella pulchra* Brady confined to depths exceeding 20 meters in the Gulf of Paria. Puri and Hulings (1957) reported *Cytherella* sp. to be restricted to 14–21 meters in the Gulf of Mexico off the Panama City area, Florida. Curtis (MS., 1958) found *Cytherelloidea* sp. cf. *C. obtusata* (Müller) to be restricted to 15–25 meters, *Cytherella polita* Brady to be rare in depths less than 15 meters, and *Cytherella lata* Brady to be characteristic of a depth zone of 5–15 meters in the Gulf of Mexico off the Mississippi delta. Hulings (1959, p. 159) found the genus *Cytherella* to be one of the genera characterizing a zone between 200 and 760 meters off the southern Atlantic coast of the United States, between Cape Hatteras, North Carolina, and south of Cape Canaveral, Florida.

Salinity

Some typical salinity values from the vicinity of Bimini reported by Turekian (1957) are listed below:

Area	Salinity (parts per thousand)
Florida Straits (near Bimini)	35.85–35.92
Great Bahama Bank (near Bimini)	37.50
North Bimini Harbor	36.10–39.40
North Sound	40.00–46.50
Cavelle Pond, South Bimini (one sample)	31.52

A series of samples collected on June 6, 1955, from North Sound showed the salinity to increase from 39 parts per thousand at the lower end to 45 parts per thousand at the upper end. Specimens of *Cytherella arostrata* n. sp. and *Cytherella harpago* n. sp. with appendages inside were abundant in dried samples collected from North Sound, indicating that these species are able to live where salinity is higher than normal marine. A few specimens of *C. arostrata* were also collected alive in this area. Collections included juveniles, gravid females, and mature males; however, males were more abundant than females in North Sound, which is the opposite of the female-to-male ratio observed in other areas of Bimini. The fact that some cytherellids are able to live where salinities are higher than normal marine (30–40 parts per thousand) is supported by the investigations of Kruit (1955), who collected *Cytherella laevis* Brady in the Golfe de Fos, where surface salinities were recorded as 39–45 parts per thousand.

Carapaces of *Cytherella arostrata* n. sp. containing appendages were collected in Cavelle Pond, where a salinity of 31 parts per thousand was reported by Turekian (1957). Cytherellids apparently do not populate water having a salinity much lower than 30 parts per thousand, which is considered by Hedgepeth (1951) to be the lower limit of normal marine water. Benson (1959) reported *Cytherella banda* Benson and *Cytherelloidea californica* LeRoy from the Todos Santos Bay area, where salinities as low as 33 parts per thousand were recorded, but these species were absent from the brackish water in Río San Miguel Lagoon. Cytherellids were not reported in the extensive collections in San Antonio Bay (Swain, 1955), where the salinity did not exceed 14 parts per thousand, or in collections from the Solomons Island, Maryland, region, where salinities did not exceed 20 parts per thousand (Tressler and Smith, 1948). No instances of cytherellids being collected in water having a salinity much below normal marine were found in a brief survey of the literature. Hulings (MS., 1958) collected cytherellids in Apalachee Bay, Florida, from water having a salinity of 27 parts per thousand, which is probably very close to the lower limit of salinity for the group. Cytherellids seem to be marine forms with some species able to adapt to higher-than-normal marine salinities. Sohn (1951) lists *Cytherella* sp., *Cytherella muensteri*, and *Cytherelloidea williamsoniana* as fossil ostracodes having an inferred marine habitat.

Substrate

The substrate in the Bimini area consists generally of bioclastic sediment, rock covered by a thin film of sand, or oolite; in the upper part of North Sound, fecal pellets of the snail *Batillaria minima* form a large part of the surface sediment (Kornicker, 1958; Kornicker and Purdy, 1957). Cytherellids were collected on all substrates encountered at Bimini but were rare in oolite areas, where ostracodes were generally scarce. They have been reported from many substrates; Brady (1880), for example, reported them from coral rock, sand, mud, gray ooze, and hard ground, but did not collect any in *Globigerina* ooze, red clay, or volcanic sand, which were mostly restricted to abyssal depths, where cytherellids were not found. Müller (1894, p. 386) collected *Cytherella sordida* Müller in the Gulf of Naples on shell detritus. At the species level, the substrate may limit the distribution; e.g., Benson (1959, p. 39) found *Cytherella banda* Benson restricted to a very fine sand to coarse silt, and Hulings (MS., 1958) found species of *Cytherella* and *Cytherelloidea* restricted to certain substrates.

Temperature

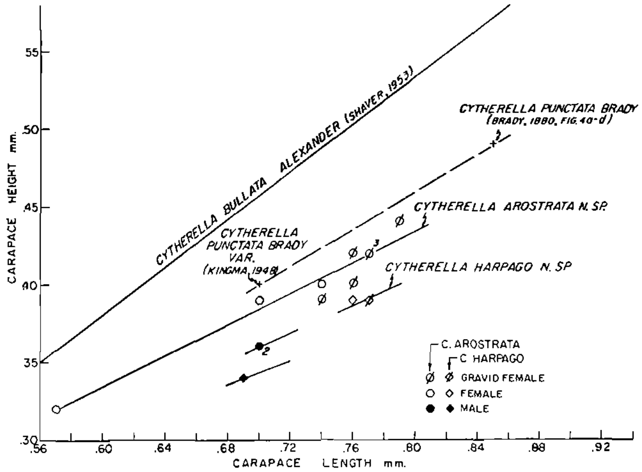
Water temperatures in the Bimini area, during the time when collections were made in the present study, ranged from 24° to 32°C. A low temperature of 14°C. was recorded in the Bimini Lagoon by Dr. Louis A. Krumholtz (personal communication, 1956) on January 12, 1956, at which time dead fish were observed floating in the lagoon. Cytherellids were found alive in the Bimini area in sediments collected in water having a temperature of 24°–32°C. Cytherellids have been reported from much lower temperatures, e.g., Brady (1880, p. 23) collected *Cytherella punctata* Brady and *Cytherella lata* Brady in water at 4.9°C. off Ki Island, and *Cytherella abyssorum* has been found in cold, deep waters off Norway (Sars, 1923). Elofson (1941) considered *Cytherella abyssorum* to have a temperature range of 0° to 11°–13°C.

Behavior under ecologic stress

Cytherella and *Cytherelloidea* are crawling and burrowing forms that are unable to swim. A few specimens collected at Bimini were observed in the laboratory under various conditions of salinity, temperature and pH (table 2). Although the observations in table 2 are insufficient for drawing statistically valid conclusions concerning the tolerance limits of Bimini cytherellids, the writer believes that it is not unlikely that the inactivity of specimens at a salinity of 12.6 parts per thousand or at a temperature of 13°C. indicates that the tested species would not survive these conditions for extended periods. The low temperature of 14°C. in the Bimini Lagoon in January, 1956, mentioned above as reported by Krumholtz, killed many fish in the lagoon. It is likely that some cytherellids became inactive at that time.

Associated biota

Cytherellids were collected at virtually all the areas in the vicinity of Bimini described by Kornicker (1958). It was noted in the present study that the distribution of cytherellids was similar to that of the ostracode family Bairdiidae, with the exception of the upper part of North Sound, where cytherellids were abundant but Bairdiidae absent (compare Kornicker, 1962, text-figure 5, with text-figure 2 of this paper). The absence of Bairdiidae and presence of cytherellids in North Sound is attributed to the ability of cytherellids to live in higher salinities than Bairdiidae.



TEXT-FIGURE 3

Graph of length-height measurements of *Cytherella arostrata* n. sp., *Cytherella harpago* n. sp., *Cytherella punctata* Brady, and *Cytherella bullata* Alexander.

Consideration of the distribution of Bairdiidae and Cytherellidae in samples collected by the *Challenger* Expedition (Brady, 1880) shows that *Bairdia* occurred with cytherellids in almost half the samples obtained at shelf and slope depths, that *Bairdia* without cytherellids was present in about one-quarter of the samples at shelf, slope, and abyssal depths, and Cytherellidae without *Bairdia* were present in only 4–5 per cent of the samples at shelf and slope depths (table 3). Although data are still too few for drawing firm conclusions, a hypothesis that is suggested is that the Cytherellidae and Bairdiidae content of samples might be used to set environmental limits in the following manner:

	Salinity limits (parts per thousand)	Depth limits (meters)
Samples with both *Bairdia* and Cytherellidae	27*–40	0–2000
Samples with *Bairdia* and no Cytherellidae	27–40	all depths
Samples with Cytherellidae and no *Bairdia*	above 25	0–2000

* Hulings (MS., 1958) found living *Bairdia* in Apalachee Bay in water having a salinity of 27.2 parts per thousand, which is probably close to the lower limit of salinity tolerance for the genus.

ONTOGENETIC DEVELOPMENT

Graphic presentation of carapace length vs. width is useful for establishing the growth curve of a species and also for separating different species. Differences in length are not as meaningful when comparing ostracodes as are differences in their length-height curves, because length is affected more than the ratio of length to height by environment and growth stage.

As an aid in the taxonomic differentiation of several species compared in this study, plots of their length-height ratios are shown in text-figure 3. The slope of the line is not exact because too few specimens were used, but it is considered to be sufficiently accurate for the present purpose. Text-figure 3 shows quite clearly that *Cytherella harpago* n. sp. differs from *Cytherella arostrata* n. sp. and from *Cytherella punctata* Brady in length-height ratio.

Sexual dimorphism is apparent in most cytherellids, and the subject has been reviewed by Shaver (1953). The females of the last three or four instars are generally more obese in the posterior half of the carapace than the males, and the length-to-height ratio is smaller In the present study it was noted that the carapace of the female of *Cytherella arostrata* n. sp. has more surface punctations than the male; so far as I know, sexually dimorphic ornamentation differences have not previously been reported for this group. Differences between the length-height ratios of the males and females of some of the new species described in this paper are shown in text-figure 3.

TABLE 1

DEPTH DISTRIBUTION OF CYTHERELLIDS COLLECTED BY THE *Challenger* EXPEDITION (BRADY, 1880)

	Shelf (0—200 m.)	Slope (200—2000 m.)	Abyssal (over 2000 m.)
Number of species	8	6	0
Per cent of samples containing cytherellids	50.0	45.9	0
Maximum number of cytherellid species per sample	3	3	0
Number of samples with ostracodes	22	24	23

SYSTEMATIC DESCRIPTIONS

Subclass OSTRACODA Latreille, 1806
Order PODOCOPIDA Sars, 1866
Suborder PLATYCOPINA Sars, 1866
Family CYTHERELLIDAE Sars, 1866
Genus CYTHERELLOIDEA Alexander, 1929

Cytherelloidea sarsi Puri, 1960
Text-figures 4–12, 33–34

Cytherelloidea sarsi PURI, 1960, Trans. Gulf Coast Assoc. Geol. Soc., vol. 10, p. 133, pl. 5, figs. 1–2.

Male carapace subrectangular in lateral view. Dorsal border slightly convex, ventral border slightly concave

TABLE 2

LABORATORY OBSERVATIONS OF BIMINI CYTHERELLIDS

Species	Experimental condition	Observation time (hr.)	Behavior of specimen
Cytherella pandora, n. sp.	45.6‰ S.	24	Active
Cytherella sp. (2 specimens)	45.6‰ S.	53	Active
Cytherella arostrata, n. sp.	45.6‰ S.	3	Active
	53.9‰ S.	2	Active
Cytherella sp. (female)	12.6‰ S.	1	Inactive
	38.1‰ S.	1	Active
Cytherella sp.	pH 6–7	43	Active
Cytherella sp. (2 specimens)	35°C.	24	Active
Cytherella sp. (2 specimens)	13°C.	28	Inactive

High-salinity water was obtained by evaporation of sea water. Low-salinity water was obtained by diluting sea water with distilled water. Low pH was obtained by allowing algae to decompose in sample. Except where noted, each observation was on one individual. Where two salinities are listed, the specimen was subjected to the second salinity immediately after being exposed to the first salinity listed. Temperature for the salinity and pH experiments was about 27°C. Salinity for the temperature experiments was about 38‰. Specimens were held in water of 38‰ salinity and approximately 27°C. for 24 hours prior to being subjected to experimental conditions.

near middle. Anterior end broadly rounded, rimmed; posterior end also rounded but slightly oblique. Surface reticulate, with reticulations tending to parallel carapace outline. Thirteen to fourteen large pits situated behind and parallel to anterior rim. Well-developed pit situated dorsal to center. Longitudinal ridge in lower portion of carapace well-defined ventrally but blending into surface dorsally and anteriorly; ridge curves abruptly upward at sharp angle near posterior end, then curves downward to almost meet outer rim near posterior ventral corner of carapace. A second ridge, which branches off previously described ridge near posterior ventral corner of carapace, runs parallel to posterior margin and then abruptly turns toward anterior at about two-thirds of carapace height. Second ridge more sharply defined on inner side and blends into carapace near lower part of central pit. Inward projections from the two ridges almost enclose a deeply pitted area in posterior central part of carapace.

In dorsal view, male carapace broadest about halfway between pit and posterior end of carapace. Female carapace broader than male at posterior end. Right valve projects slightly over left at hinge line just anterior to center. Left valve fits into right.

TABLE 3

DISTRIBUTION OF *Bairdia* AND CYTHERELLIDAE IN SAMPLES COLLECTED BY THE *Challenger* EXPEDITION (BRADY, 1880)

Occurrence	Shelf (0—200 m.)	Slope (200—2000 m.)	Abyssal (over 2000 m.)
Number of samples with both *Bairdia* and Cytherellidae (%)	45.5	41.7	0
Number of samples with *Bairdia* only (%)	22.7	25.0	26.0
Number of samples with Cytherellidae only (%)	4.5	4.2	0
Number of samples with neither *Bairdia* nor Cytherellidae (%)	27.3	29.1	74.0
Number of samples with ostracodes	22	24	23

Remarks: This species was described by Puri (1960) from specimens collected on the Florida Keys and along the west coast of Florida. The holotype is probably a female. The male carapace and appendages are described and figured for the first time in the present paper.

Material: Two males and two juveniles were collected alive in the Bimini area. One male was dissected.

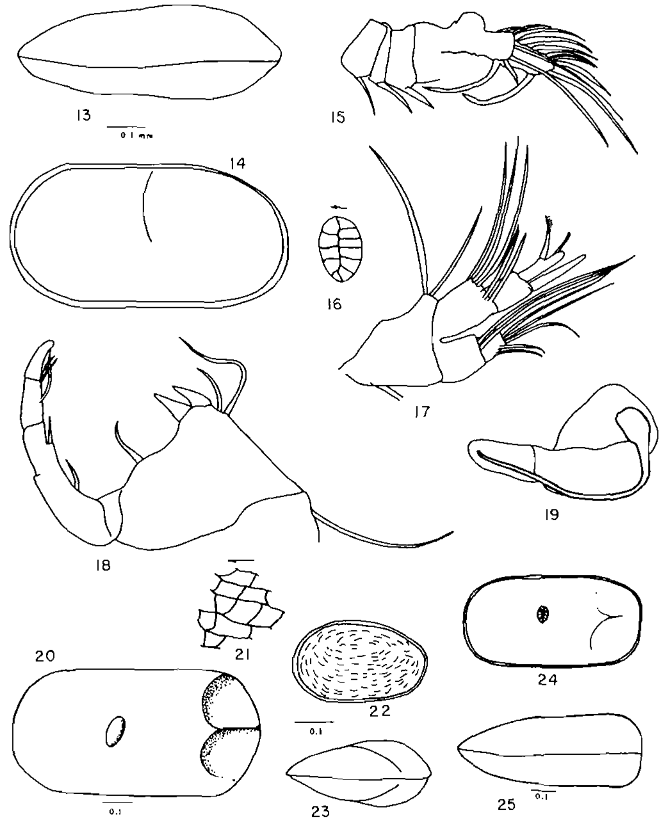
Measurements:

Specimen no.	Length (mm.)	Height (mm.)	Width (mm.)	Length/Height	Sex
141–1 (complete)	0.63	0.37	0.26	1.70	Male(?)
141–2 (complete)	0.60	0.34	0.23	1.76	Immature female(?)
247–x	0.52	0.31	—	1.68	—

Occurrence: Two living specimens were obtained on June 4, 1956, in the Bimini Lagoon about 65 feet north of South Bimini in 3 feet of water. The bottom here consists of about one foot of carbonate sand over rock and is perhaps 90 per cent covered with vegetation composed of about half *Thalassia* and half *Laurencia. Halimeda* and sponges also live in the area. A film of organic detritus covers sediment and plants. Another living specimen was collected southeast of the southeastern tip of South Bimini in 6 feet of water on June 12, 1956. The bottom here consists of about 2 feet of carbonate sand over rock. *Thalassia* and the algae *Laurencia* and *Rhipocephalus* are abundant, and sponges are fairly common. A current measurement of 0.24 meters/second was obtained in this area. Water temperature was about 28°C. and salinity about 37.5 parts per thousand. Additional specimens, mostly empty carapaces, were collected from the following sample stations shown in text-figure 2: 100, 141, 164, 77, 245, 244, 209, 241, 202, 22, 185, 247, 156.

TEXT-FIGURES 4–12

Cytherelloidea sarsi Puri. 4, left lateral view of complete carapace, specimen no. 141–1 (probably a male); 5–12, specimen no. 247–2–1 (a male): 5, maxilla, distal portion; 6, mandible; 7, sixth leg; 8, first antenna; 9, seventh leg, part; 10, lip; 11, copulatory apparatus and furca; 12, second antenna.



TEXT-FIGURES 13–25

Cytherella arostrata Kornicker, n. sp. 13–14, male, specimen no. 80: 13, dorsal view (anterior to left); 14, right lateral view; 15, 17–19, male, specimen no. 2: 15, caudal furca; 17, second antenna, distal end; 18, seventh leg; 19, penis; 16, 24–25, female, specimen no. 187–1: 16, muscle scar, right valve, from exterior (arrow points toward posterior); 24, left lateral view (sketch); 25, dorsal view (anterior to left) (sketch); 20, female, specimen no. 174, interior view of right valve (sketch); 21, male, specimen no. 164, portion of reticulate surface of carapace (arrow points toward posterior) (sketch); 22–23, juvenile, specimen no. 90: 22, left lateral view; 23, dorsal view (anterior to left).

Genus CYTHERELLA Jones, 1849

Cytherella arostrata Kornicker, new species
Text-figures 13–25, 35–38

Male carapace subrectangular in side view; dorsal and ventral margins parallel; posterior end obliquely rounded above, broadly rounded below; anterior end broadly rounded. Surface with delicate reticulate pattern. Shallow median sulcus situated in depressed area in dorsal part of carapace. In dorsal view, carapace broadest behind middle. Left valve fits within right.

Female carapace subrectangular in side view, widest behind middle. Posterior and anterior ends broadly rounded. Surface with delicate reticulate pattern. Shallow median sulcus. Dorsal area slightly depressed near center. In dorsal view, posterior end subrectangular and bulbous, anterior end acute. Viewed from inside, posterior portion with two round depressions separated by medial horizontal ridge. Each depression contains one egg in the gravid female (four eggs total per female).

Female carapace differs from male in having the dorsal posterior end less oblique in lateral view, the posterior end bulbous in dorsal view, and the round depressions for eggs. The mature female is larger than the male. Length-to-height ratio of male (1.94) greater than that of female (1.79–1.90).

Remarks: The species differs from *Platella muelleri* Puri, 1960, and *Cytherella punctata* Brady, 1895, in not having the distinct punctations of those species. It is also much larger than *Platella muelleri*.

Material: About 7 males and 14 females were collected alive in the Bimini area. Many females were gravid. A male and a female were dissected. The holotype is specimen no. 77–1, a female.

TABLE 4

ENVIRONMENTS OF STATIONS WHERE LIVING *Cytherella arostrata* WAS COLLECTED

Station	Date	Location	Type of bottom	Water depth (ft.)	Water temp. (°C.)	Associated biota
77	May 29, 1956	Northeast of northern end of North Bimini	One inch of clean carbonate sand on rock	15	—	Alcyonarians and sponges
80	May 30, 1956	East of southeastern tip of South Bimini	Carbonate sand	3	26.5	Dense *Thalassia* growth
82	May 30, 1956	East of southeastern tip of South Bimini	Carbonate sand	7	27.0	Dense *Laurencia* growth
90	June 2, 1956	East of entrance to Cavelle Pond	Carbonate sand	3	28.5	Sparse *Thalassia* growth
116	June 2, 1956	West of entrance to Cavelle Pond	Carbonate sand	2.5	30.5	Clean sand exposed at low tide
141	June 4, 1956	Sixty-five feet north of South Bimini	Carbonate sand	3	28.5	Dense growth of *Thalassia* and *Laurencia*
144	June 12, 1956	Bonefish Creek, East Bimini	Clean carbonate sand	3.5	27.0	Jellyfish *Cassiopea* common
164	June 19, 1956	South of South Bimini	Rock bottom with 0.25 inch or less sand cover	2	—	Alcyonarians abundant
174	June 19, 1956	South of South Bimini	Clean carbonate sand	1	—	Worm mounds common
187	June 7, 1956	Upper end of laggoon (North Sound)	Sand	2.5	—	The alga *Batophora* abundant
238	June 12, 1956	East of Turtle Rocks	Sand	15	—	Dense *Thalassia* growth

Measurements:

Specimen no.	Length (mm.)	Height (mm.)	Width (mm.)	Length/Height	Sex
164–1 (complete)	0.70	0.36	0.26	1.94	Male
164–2 (complete)	0.57	0.32	—	1.78	Male, immature
174–sp. 2 (rt. valve)	—	0.40	—	1.80	Female, gravid
142–K (complete)	0.76	0.42	0.32	1.80	Female, gravid
144 (complete)	0.77	0.42	0.32	1.83	Female, gravid
90 (complete)	0.32	0.21	—	1.52	Juvenile
77–1 (complete)	0.74	0.40	—	1.85	Female (holotype)
77–2 (complete)	0.70	0.36	—	1.94	Male
238 (complete)	0.70	0.44	0.31	1.79	Female, gravid
82 (complete)	0.77	0.42	—	1.83	Female, gravid
80–3 (complete)	0.70	0.39	—	1.79	Female, immature
116 (complete)	0.77	0.42	—	1.83	Female
187–1 (complete)	0.74	0.39	—	1.90	Female, gravid
187–2 (complete)	0.76	0.40	—	1.90	Female, gravid

Occurrence: Cytherella arostrata is the most abundant cytherellid in the Bimini area, and the distribution of cytherellids shown in text-figure 2 is principally the distribution of this species. Environmental details of some of the collecting stations from which living specimens were collected are presented in table 4.

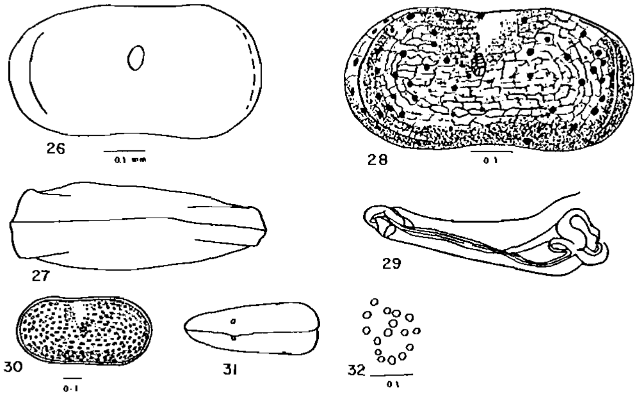
Cytherella harpago Kornicker, new species

Text-figures 30–32, 39–42

Female carapace subrectangular, greatest height behind middle. Dorsal border slightly concave in front of middle, ventral border concave at middle. Anterior and posterior ends broadly rounded. Surface of carapace with small circular to oval punctations. Left valve fits into right. Broad, median, subdorsal sulcus. In dorsal view, anterior narrowly truncated, posterior broadly blunted.

Male carapace subrectangular. Ventral border slightly concave near middle. Posterior end obliquely rounded above, broadly rounded below; anterior end broadly rounded. Surface of carapace punctate with circular to oval punctations near middle in lower half of carapace, elongate parallel to ventral border. Punctations more widely spaced than in female. Length-to-height ratio of male (2.00) greater than that of female (1.95–1.97).

Remarks: This species differs from *Platella muelleri* Puri, 1960, in having punctations more widely spaced, in being larger, and in not having distinct surface ridges forming a reticulate pattern. *C. harpago* differs from *C. punctata* (Brady, 1880, pl. 44, fig. 4a–d) in being smaller and in having a higher length-height ratio:



TEXT-FIGURES 26–32

26–29, *Cytherella pandora* Kornicker, n. sp.: 26–27, 29, male, specimen no. 117C–1: 26, right lateral view; 27, dorsal view (anterior to right); 29, copulatory organ; 28, female, specimen no. 117C–2 (holotype), lateral view of right valve. 30–32, *Cytherella harpago* Kornicker, n. sp., female, specimen no. 234: 30, left lateral view; 31, dorsal view (anterior to left) (distribution of punctation generalized); 32, detail showing spacing of surface pits.

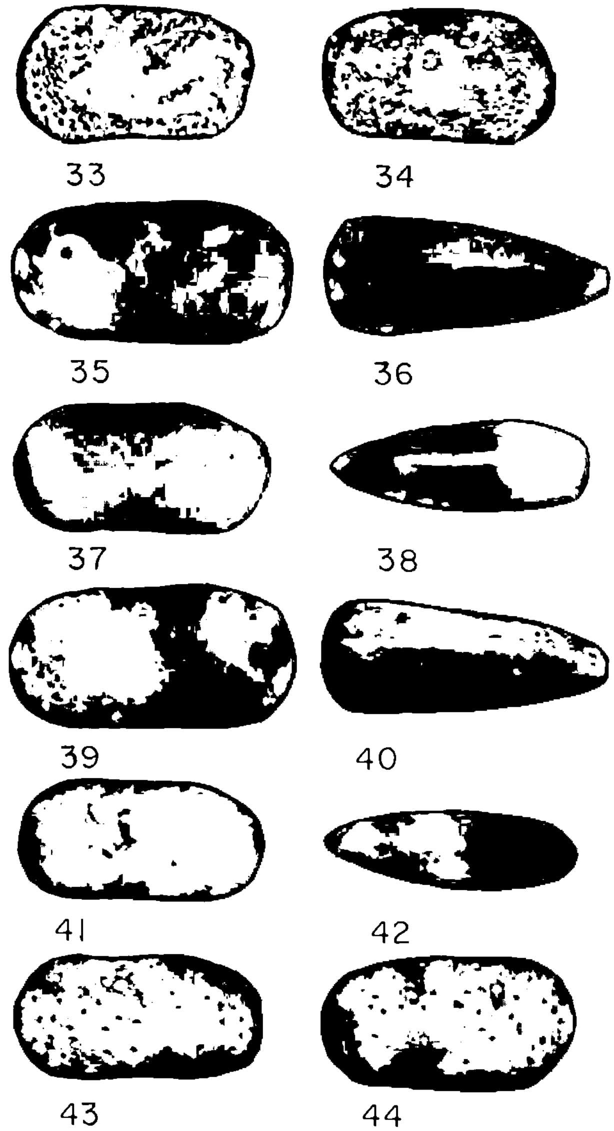
	Length (mm.)	Length / Height
C. punctata Brady	0.85	1.45
C. harpago Kornicker, n. sp.	0.76–77	1.95–1.97
P. muelleri Puri	0.501	1.72

Material: Two living females (one gravid) and one male were collected in the Bimini area. The holotype is specimen no. 243–1, a gravid female.

Measurements:

Specimen no.	Length (mm.)	Height (mm.)	Length / Height	Sex
243–1	0.77	0.39	1.97	Female, gravid
184–1	0.76	0.39	1.95	Female
184–2	0.68	0.34	2.00	Male

Occurrence: One living female was collected on June 12, 1956, in 16 feet of water east of the southern end of Turtle Rock (station 243), on a bottom of carbonate sand with about 80 per cent cover of *Thalassia.* The alga *Rhipocephalus*, the coral *Manicina*, and black sponges were common in the area. The water temperature was about 28°C. and the salinity about 37.5 parts per thousand. A living female and an empty carapace of a male were collected on June 8, 1956, about 10 feet from the southern shore of the southwestern tip of East Bimini in water about one foot deep. The bottom consisted of carbonate sand with about 75 per cent coverage of *Thalassia* and *Laurencia.* Worm mounds and crab holes were abundant, and a film of organic detritus covered the bottom sediment and plants (station 184).



TEXT-FIGURES 33–44

All figures × 50

All photographs made with 3000 speed Polaroid film and unretouched. 33–34, *Cytherelloidea sarsi* Puri, complete carapace, specimen no. 141–1 (stained with silver nitrate solution): 33, left lateral view; 34, right lateral view. 35–38, *Cytherella arostrata* Kornicker, n. sp.: 35, left lateral view of female, specimen no. 187–1; 36, dorsal view (anterior to right) of female, specimen no. 77–1 (holotype); 37–38, male, specimen no. 77–2: 37, left lateral view; 38, dorsal view (anterior to left). 39–42, *Cytherella harpago* Kornicker, n. sp.: 39–40, female, specimen no. 243–1 (holotype): 39, left lateral view; 40, dorsal view (anterior to right); 41–42, male, specimen no. 184–2: 41, left lateral view; 42, dorsal view (anterior to left). 43–44, *Cytherella pandora* Kornicker, n. sp., female, specimen no. 117C–2 (holotype) (stained with water-soluble green dye): 43, exterior of left valve; 44, exterior of right valve.

Cytherella pandora Kornicker, new species
Text-figures 26–29, 43–44

Male carapace subrectangular in side view. Dorsal border slightly concave in front of middle; ventral border slightly concave at middle. Anterior end obliquely rounded above, broadly rounded below; posterior end broadly rounded. Surface with faint ridges that form a delicate reticulate pattern which parallels the outline of the carapace. Oval surface pits sparse or absent. A subdorsal, shallow, median sulcus is present; in addition to the median sulcus, two linear depressions parallel and lie inside the anterior and posterior rims; anterior depression shallow. In dorsal view, carapace broadest behind middle, anterior narrowly truncated, posterior broadly blunted. Male copulatory apparatus long and narrow, thickening at base. Female carapace surface with widely spaced oval pits in addition to delicate reticulate pattern.

Remarks: This species resembles *Cytherella abyssorum* G. O. Sars but does not possess the numerous well-marked pits ascribed to that species. *Cytherella pandora* also differs from *C. abyssorum* in having a delicate reticulate surface pattern and in being considerably smaller. Surface reticulations on *C. pandora* resemble those of *Cytherella venusta* Brady, 1880, but this species differs from *C. venusta* in having punctations on the female valve and in being broadest in front of the posterior end in both sexes.

Material: Three males and one female were collected alive in the Bimini area. One male and a gravid female were dissected. The holotype is specimen number 117C–2, a female.

Measurements:

Specimen no.	Length (mm.)	Height (mm.)	Length / Height	Sex
117C–1 (right valve)	0.63	0.32	1.97	Male
117C–2 (right valve)	0.68	0.36	1.88	Female (holotype)
117C–2 (left valve)	0.66	0.34	1.94	Female
243 (complete carapace, right side)	0.60	0.31	1.94	Male

Occurrence: Two living specimens were obtained in a bottom tow on December 7, 1956, in 2 feet of water in the Bimini Lagoon west of the southern tip of East Bimini. The bottom here is sand, about 40 per cent covered by *Thalassia* and *Laurencia*. Water temperature was about 24°C. and salinity about 37.5 parts per thousand. A living specimen was collected on June 12, 1956, east of Turtle Rock (station 243 in text-fig. 2). Water depth in this area is about 16 feet. The bottom here is sand, with about 80 per cent coverage by *Thalassia*. Sponges and the coral *Manicina* are common. Water temperature was about 28°C. and salinity 37.5 parts per thousand.

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