1981 - 17

ECOLOGICAL INVESTIGATIONS OF PETROLEUM PRODUCTION PLATFORMS IN THE CENTRAL GULF OF MEXICO

VOLUME II—THE ARTIFICIAL REEF STUDIES

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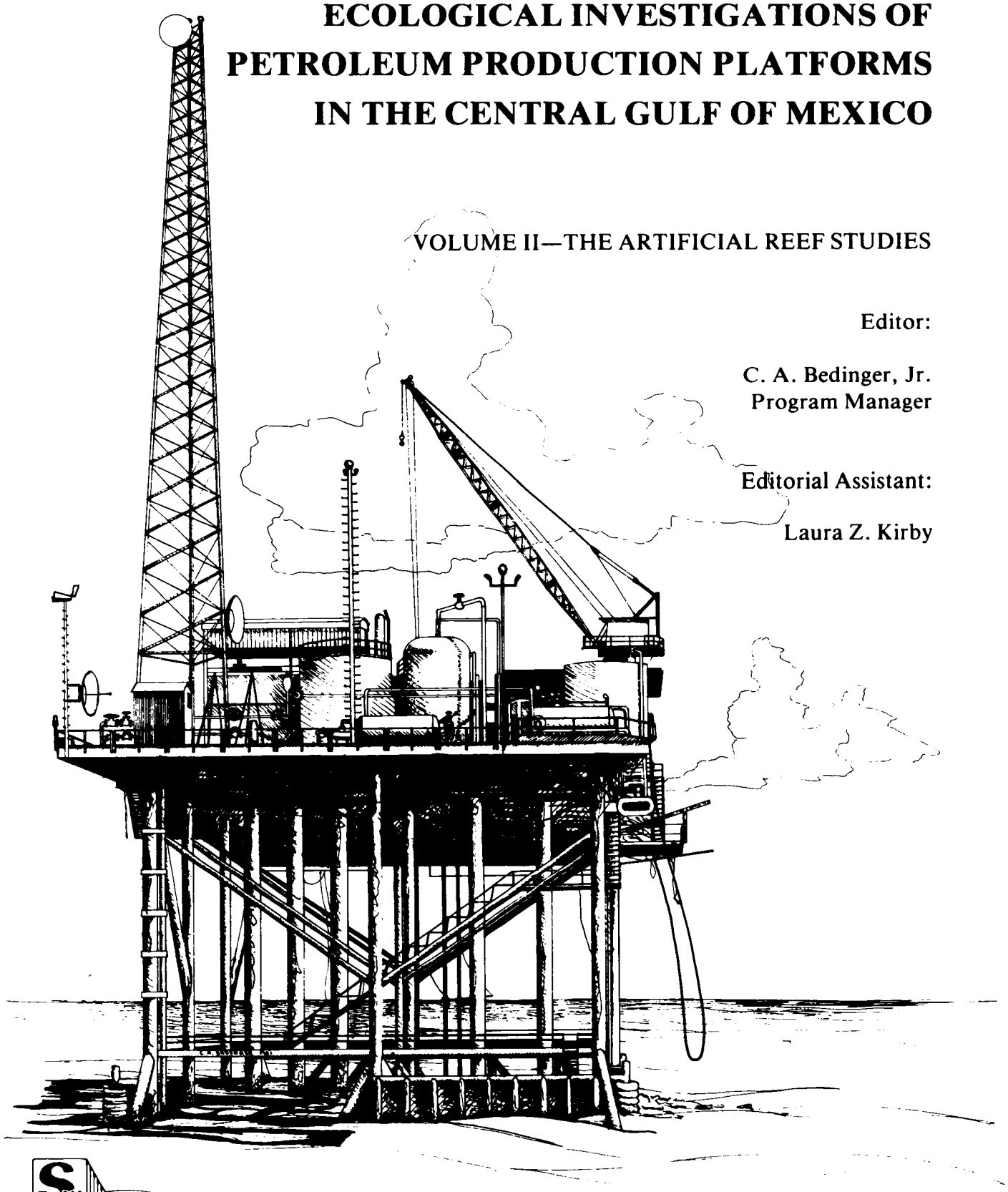

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ECOLOGICAL INVESTIGATIONS OF PETROLEUM PRODUCTION PLATFORMS IN THE CENTRAL GULF OF MEXICO

Submitted to:

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SwRI Project 01-5245

In fulfillment of Contract
AA551-CT8-17

by:

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1981

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VOLUME II—THE ARTIFICIAL REEF STUDIES

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ABSTRACT

Surveys of biofouling macroepibiota and fishes were made in June 1978 at four production platforms offshore Louisiana and were supplemented by limited observations made at an additional 15 platforms in August and September of 1978. Biofouling communities of nearshore platforms were dominated by barnacles in terms of biomass, whereas the communities on offshore platforms were dominated by bivalves. Primary production was largely restricted to surface zones of nearshore platforms but at some offshore platforms primary producers were abundant to depths of 30 m.

Platform habitats offshore Louisiana were classified into three zones using depth and faunal characteristics---Coastal (shore to 27-m bottom contour), Offshore (37 to 64 m) and Blue Water (> 64 m). A transitional area between the Coastal and Offshore Zones was considered to have been represented between the 27- and 37-m depth contours. Platforms in the Coastal Zone were dominated by barnacles and shorefishes. Bivalves and shorefishes were abundant at platforms in the Offshore Zone but were supplemented by a rich Caribbean fauna. The Caribbean fauna was dominant at platforms in the Blue Water Zone.

Taxonomic findings of significance include documentation of the presence of four species of oysters (*Crassostrea virginica, Ostrea equestris, Lopha frons,* and *Hyotissa thomasi*) on Louisiana platforms and the occurrence of two other bivalves (*Pinna carnea, Kellia suborbicularis*) new to the area. Species represented on production platforms that had formerly been recorded only from natural banks of the northern Gulf included the sea urchin, *Eucidaris tribuloides*, and the spiny lobster, *Panulirus* sp.

Results of this study, as well as those from many previous studies, document that structures concentrate large numbers of epibiota and fishes which would not be as abundantly represented in the same area in the absence of structures. In contrast to some previous studies, produced water discharges were observed to have a detrimental effect on platform macroepibiota. The magnitude and significance of this effect have yet to be well defined.

I. INTRODUCTION

Under contract to the Bureau of Land Management (BLM), Southwest Research Institute (SwRI) has directed during 1978-1979 a large program in offshore ecology in an area of the central Gulf dominated by production platforms. The primary goals of the program were to:

- Assess long-term cumulative effects of production platform operations on the outer continental shelf environment.
- Further define the "artificial reef" effect of production platforms.

The results of the program will be used by the BLM as a basis from which to formulate new research, develop appropriate monitoring techniques, and evaluate results of "benchmark" studies.

Program research done by representatives of LGL Ecological Research Associates was directed primarily towards definition of the artificial reef characteristics of production platforms in the study area. LGL's specific assignment was to quantitatively characterize and contrast each of four predetermined production platforms in terms of their associated biofouling communities and fish populations. The selection of study sites was such that the results of the field research could be used to elucidate the nature and value of the artificial reef resource at each of the various platforms with respect to certain environmental variables including temperature, salinity, depth, distance from shore, petroleum product being exploited, and contaminant discharges.

The quantitative research program done by LGL was complemented by LGL diving scientists providing technical level field sampling services for other work groups participating in the program. This sampling of organisms for hydrocarbon, trace metal and histopathological analyses enabled LGL to observe biota at 19 of the 20 platforms being investigated. This project was further benefited by the underwater research technology and previous experience developed over the past three years in the ongoing Buccaneer Oil Field (BOF) studies offshore Galveston, Texas. The latter program is under the direction of the National Marine Fisheries, Service, Southeast Fisheries Center, Galveston Laboratory.

The project proceeded through a series of distinct milestones. Following contract award, a reconnaissance site review was made during the period 29 April—5 May 1978. Quantitative field surveys of the four Primary Platforms were conducted during the course of the cruise between 11 and 21 June 1978. Qualitative observations were made at 19 of the 20 platforms under investigation (including the four Primary Platforms) during the course of a special sampling cruise between 21 August and 6 September 1978. Sample and data analyses were done during the period July 1978—February 1979; March and April 1979 were dedicated to report preparation.

Results of a literature review, descriptions of the study area and methods employed, and the results and interpretation of data gathered as part of this program are presented below. These sections are followed by overview characterizations of the types and nature of reef communities associated with production platforms in the Central Gulf and observations relative to the effects of structures and contaminant discharges on those communities.

II. LITERATURE REVIEW

Prior to the proliferation of oil and gas structures in the offshore continental shelf, the main interest in marine organisms which colonize hard substrates centered around their nuisance characteristics. Such organisms were considered to "foul" structures and vessels placed in the sea; hence the term "biofouling" or "fouling" community. Recently, the focus of interest in organisms comprising this community has shifted because of their apparent role in the transformation of sterile structures into reefs, artificial only to the extent that the base substrate is a man-made metal alloy as opposed to a naturally-occurring material. Thus, for offshore oil and gas structures, a more appropriate term for this community might be the "epiferron." Additional recent interest in the biofouling community relates to the role of the organisms in the possible accumulation and consequent trophic transfer of oil field contaminants to organisms of direct importance to man (e.g., red snapper).

A. Fouling Community Descriptions

Studies on fouling organisms associated with offshore structures in the northern Gulf of Mexico have been reported by Gunter and Geyer (1955), Pequegnat and Pequegnat (1968), George and Thomas (1974), Humm (1974), Fotheringham (1977), and Gallaway et al. (1978). These studies describe the zonation and composition of organisms growing on oil platforms in the northern Gulf. Gunter and Geyer (1955) not only described platform biota but also discussed colonization of steel pipe experimentally placed at different depths. On these substrates, *Balanus improvisus*, hydroids, *Corophium* sp., and anemones dominated the composition of the fouling mat; additionally, *Crassostrea virginica*, *Thais* sp., and *Menippe* sp. were found at upper levels, while *Ostrea equestris*, *Arca* sp., *Crepidula* sp., serpulid worms and corals were growing at lower levels.

Pequegnat and Pequegnat (1968) noted diverse assemblages and large standing stocks on both experimental fouling surfaces and platform legs in the northeastern Gulf of Mexico near Panama City, Florida. They reported that sponges, corals and tunicates dominated the fouling communities.

Humm (1974) studied the effect of the offshore oil and gas wells on benthic marine plants. He observed an increase in quantity of benthic algae which he attributed to the presence of platforms, because they provided additional substrate for attachment. He indicated that there were no significant differences in the variety and community structure of benthic algae between production platforms and control areas.

George and Thomas (1974) described vertical and seasonal variations in the species composition and density of the fouling community at a platform offshore Louisiana. Numerous sessile and motile animals were found interspersed throughout algal mats near the surface. Among those organisms were hydroids, amphipods, xanthid crabs, pycnogonids and barnacles. The barnacles *Balanus reticulatus (= Balanus amphitrite)* and *B. improvisus* were biomass dominants and, in near surface zones, were found in a 55:45 ratio. At depths from 2.4 to 5.9 m, the near-surface algae-hydroid zone was replaced by anemones; barnacles became larger in size with *B. reticulatus* representing 70% of the barnacle population. Motile components included amphipods (*Corophium* sp., *Stenothoe* sp., *Caprella* sp.), xanthid crabs, and blennies. From 7.6 m to 12.2 m, hydroids dominated and barnacles became less dense. Below 12.2 m hydroids completely dominated with only a few dead barnacles and some serpulid worm tubes present. George and Thomas (1974) concluded that barnacles and hydroids were the dominant organisms on Louisiana structures. They also noted that seasonal changes were characterized by maximum densities of fouling organisms during summer with decreases observed in fall. Changes in amphipod species composition, biomass, and density were noted. Algal biomass was lowest in winter and highest in summer.

Fotheringham (1977) reported that the most conspicuous structural feature of the BOF fouling community offshore Galveston, Texas, was the abundance of the large barnacle *Balanus tintinnabulum*. It was estimated to occupy as much as 60% of the original substrates on BOF structures. Twenty years ago this species was incidental on Texas offshore structures and has apparently remained so on similar structures off the Louisiana coast. Fotheringham's results suggested that the BOF fouling community was intermediate in diversity between the Louisiana and Florida Gulf coast structures.

Results of the 1978 BOF Studies (Gallaway et al., 1978) confirmed Fotheringham's observations and showed that the structures supported a rich and diverse biofouling community. However, in direct contrast to the observations of George and Thomas (1974), community biomass was considerably higher in winter than in summer. Further, recolonization rates of microcryptic forms during a 90-day fall to winter experiment and a 180-day summer to winter experiment were considerably higher than the rates observed for the 90-day summer to fall period. This indicates a considerably higher recruitment rate during fall to winter. Net seasonal production of the fouling community during the summer to winter period was estimated to range from 29 to 39 g/m^2 per day at the surface, 36 to 85 g/m^2 per day at mid-water depths (8 m) and 4 g/m^2 at the bottom (18 m).

The fouling organisms associated with the oil platforms off the California coast also have been described. Wolfson et al. (undated) reported that the sea star population at a Southern California oil platform was approximately three orders of magnitude greater than natural levels in the surrounding area. They also noted that the platform-associated species were not typical residents of the sand upon which the structure was constructed. The platform was considered to have had a positive influence on the tube-dwelling polychaete *Diopatra ornata*, but a negative effect on the bivalve *Tellina carpenteri*. Bascom, Mearns, and Moore (1976), and Simpson (1977) observed an abundant and diverse fouling community at platforms Hazel and Hilda in the Santa Barbara Channel. Simpson (1977) reported that the intertidal zone of these structures was dominated by various species of mussels, barnacles, and starfish. The California mussel *Mytilus californianus* and various starfishes of the genus *Pisaster* occurred at all depths on

the platforms. In all, over 200 invertebrate species were seen on or near the platforms.

B. Fish Community Descriptions

Shinn (1974), Sonnier, Teerling, and Hoese (1976), Jackson, Baxter, and Caillouet (1978), and Gallaway and Martin (in prep.) have described fish populations around oil platforms in the northwestern Gulf of Mexico. Hastings, Ogren, and Mabry (1976) described fish populations around U. S. Navy Research Platforms in the northeastern Gulf. Shinn (1974) described the vertical zonation of fishes around Louisiana platforms. He listed spadefish (*Chaetodipterus faber*), barracuda (*Sphyraena barracuda*), lookdown (*Selene vomer*), and sheepshead (*Archosargus probatocephalus*) to be characteristic of the upper water layers; red snapper (*Lutjanus campechanus*) and large groupers (*Epinephelus nigritus, Epinephelus itajara*) were described to be largely bottomfish that spent some of their time in the mid-water layers; and restricted to the bottom were speckled trout (*Cynoscion nebulosus*), sand trout (*Cynoscion* sp.), and flounders (*Paralichthys* sp.).

Sonnier et al. (1976), working in the Gulf Offshore Louisiana, compared fish faunas of natural reefs to those around oil platforms. Although a number of species were common to both habitats, 12 species were found only around platforms. They were: *Epinephelus nigritus, Rypticus maculatus, Caranx crysos, Chloroscombrus chrysurus, Vomer setapinnis, Ocyurus chrysurus, Chaetodipterus faber, Pomacanthus arcuatus, Hypleurochilus geminatus, Acanthurus coeruleus, Aluterus schoepfi, Monacanthus hispidus.* In the areas farther offshore (90 to 180 m), a tropical fauna was characteristic of the reefs,and at inshore reefs and platforms, the tropical fauna was replaced by more temperate species such as sheepshead, lookdown, and gray snapper (*Lutjanus synagris*). The most distinctive platform fishes were soapfish (*Rypticus maculatus*), warsaw, jewfish, and spadefish. Crested blenny (*Hypleurochilus geminatus*) and two filefishes (*Aluterus schoepfi* and *Monacanthus hispidus*) were also observed only at platforms. Jacks, spadefish, and king mackerel were pelagic species common to both artificial and natural reefs. Fifty-six species were found only at natural reefs. Sonnier et al.(1976) believe that representatives of the reef and the platform-associated communities may be year-round residents rather than seasonal migrants. They reported Felder (1971) as finding that benthic fishes closely associated with reefs fed on reef organisms but the nektonic species did not.

Jackson et al. (1978) reported that BOF structures in the northwestern Gulf of Mexico served as artificial reefs attracting fish that used the area for spawning, feeding and shelter. They considered the dominant pelagic and reef fishes to be red snapper, king mackerel (*Scomberomorus cavalla*), dolphin (*Coryphaena hippurus*), Atlantic spadefish, bluefish (*Pomatomus saltatrix*), little tunny (*Euthynnus alletteratus*), and cobia (*Rachycentron canadum*). The most abundant demersal fin fishes were reported to be bay whiff (*Citharichthys spilopterus*), longspine porgy (*Stenotomus caprinus*), dwarf sandperch (*Diplectrum bivittatum*), Atlantic croaker (*Micropogon undulatus*) and pancake batfish (*Halieutichthys aculeatus*). The predominant resident fishes associated with the structures were Atlantic spadefish, tomtate (*Haemulon aurolineatum*), sheepshead, crested blenny, cubbys (*Equetus umbrosus*) and red snapper.

The ongoing studies of fish populations in the BOF during the period 1977-1979 being performed by Gallaway and Martin (in prep.) have included quantitative population dynamics and trophic dependency studies, as well as overall community descriptions and effects of produced water effluents. Major findings have been that (1) some fish (e.g., red snapper, Atlantic spadefish, sheepshead) are "structure faithful" and once recruited, do not move long distances; (2) most or all of the annual recruitment of red snapper to the structures is harvested by man; (3) some of the resident populations (e.g., sheepshead) cannot withstand much fishing pressure because of very low recruitment rates; and (4) dependency of dominant fishes on the biofouling community as food is surprisingly low. The dominant fishes around the platforms fed mainly on plankton and particulate material in the water column, or for bottom species, on soft bottom organisms from adjacent habitats. A great many fish (e.g., Atlantic spadefish, king mackerel, tomtate) may be attracted to structures for reasons other than food, including cover, escape from predators, etc. Other fish, however, rely upon the fouling community for food and cover (e.g., blennies).

Hastings et al. (1976) found that in the northeastern Gulf of Mexico, platform pilings and cross-members with their encrusting organisms and associated motile fauna provided food and shelter for numerous fish species. Organisms that were observed grazing on the fouling community included spadefish, filefish, chubs, sparids and some grunts. Surprisingly, they found spadefish normally associated with the bottom water layers. Most of the fish grazers on the fouling community were diurnal and became inactive at night. During the day several diurnally-schooling species were found to be abundant beneath the platforms where they were afforded some protection from predation. These fishes dispersed into surrounding open areas at night to feed. Examples of this feeding behavior were clupeids, carangids, lutjanids, and grunts. Large numbers of piscivorous fish appeared attracted to the platform habitat to feed on the numerous small fishes associated with the structure. Many species migrated away from the platform during the colder months, and repopulation by these forms occurred during spring and summer.

The effectiveness of artificial structures in attracting fish has also been demonstrated off the California coast. Carlisle, Turner,and Ebert (1964) reported that the fish population increased rapidly at the oil platforms Hazel and Hilda in the Santa Barbara Channel in the first year after construction. Bascom et al. (1976) studied the same platforms in 1975 and observed 20 to 50 times more fish than they saw before platform construction. Johnson et al. (1978) remarked that the artificial Rincon Island in the Santa Barbara Channel had a major beneficial effect on local ecological conditions. It offered habitats not found on the natural sedimentary bottom. The high diversity of encrusting biota attracted many species of fish seldom encountered over sedimentary bottoms.

As noted above, some fishes are attracted to platforms for reasons other than food. Klima and Wickham (1971) and Wickham, Watson, and Ogren (1973) documented the effectiveness of mid-water artificial structures per se in attracting fishes. In the former

investigations, the authors found that two general species groupings were associated with artificial structures deployed in the Gulf: "baitfish," and "jacks." Baitfish consisted of round scad (*Decapterus punctatus*), Spanish sardine (*Sardinella anchovia*) and scaled sardine (*Harengula pensacolae*). The "jack" category included amberjack (*Seriola* sp.), rainbow runner (*Elagatis bipinnulatus*) and the blue runner (*Caranx crysos*). Incidental species were always represented by few individuals; included were remora (Echeneidae), filefish (Balistidae) and others. Large variations in daily numbers of fish were observed but an estimated 10,000 fish were seen around the structure one day after it was positioned. Another significant finding was that the congregations of fishes were transient in nature with schools constantly moving to and away from structures.

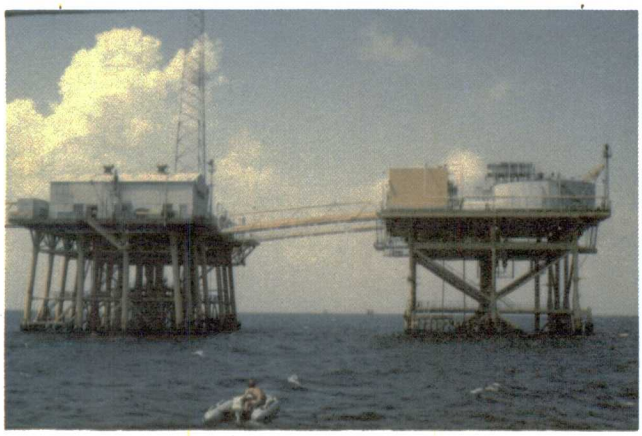
Baitfish and jacks maintained different spatial relationships with the structures. Baitfish were normally in the upper half of the water column either around the structure or up current from it. Jacks stayed either at the level of the mid-water structure or below it, seldom swimming above. Baitfish preferred mid-water structures and jacks preferred surface structures. Feeding was observed among baitfish but never among jacks. Although large predators were infrequently observed, considerable evidence of their presence and feeding was noted in the form of mutilated jacks and baitfish. The authors interpreted their data as evidence that the initial attraction of fishes to structures is probably the result of a visual stimulus provided by a structure in the optical void of the pelagic environment.

Wickham et al. (1973) observed that pelagic game fish are also attracted to artificial structures and the attraction seems to involve species-specific behavioral mechanisms. King mackerel and little tunny were seldom observed unless baitfish were present, but dolphin, cobia and great barracuda were attracted to the structures per se.These authors presented evidence that baitfish are able to use artificial structures for predator avoidance. They believe that the competing visual stimulus of structures disrupts the predator's visual fix on the prey, a fix that is required for a successful attack.

III. STUDY AREA

The biofouling study was performed at four Primary Platforms (Platforms P1-P4, Plate 1) and additional observations were made at 15 of the 16 Secondary Platforms (Platforms S5-S8 and S10-S20 selected by the BLM in the Central Gulf of Mexico offshore Louisiana (Fig. 1). The study sites extend from nearshore the Mississippi River Delta in the West Delta block, to approximately 161 km offshore and west over 322 km to a line south of Marsh Island. Characteristics of each platform including operator, structure designation,location, depth, and distance from shore are shown in Table 1. The eastern portion of the study area is characterized by a rapid increase in depth within a relatively short distance from shore, whereas at the western end, depth increases gradually with distance offshore (Fig. 1). For example, Platform S6 in the eastern part of the study area is located some 41.9 km offshore in water 52 m in depth. In contrast, Platform S19 on ship shoal in the western portion of the study area is 27 km offshore, but in water only 6 m in depth.

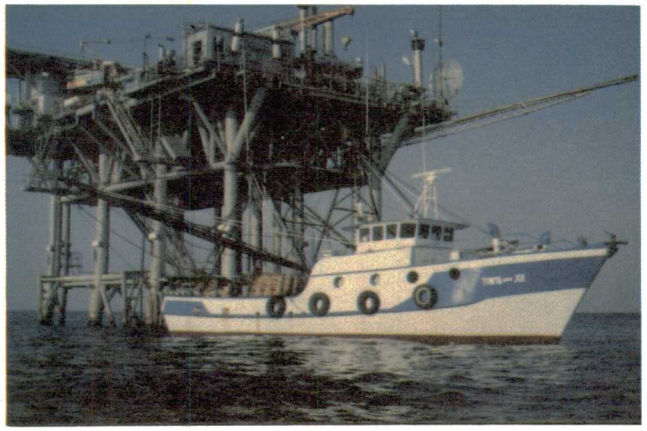
A diagrammatic representation of the array of 13 stations deployed on the four primary platforms for quantitative sampling of the biofouling community is shown in Fig. 2. Samples were taken at each of the two near- and off-shore platforms at depths of 1 m and at intervals of 10 m, down to the regulatory limits for SCUBA diving, 30 m. At all but Platform P1, only one leg was sampled at each platform. At Platform P1, the leg on which produced-water was discharged, as well as a leg representing a previous discharge leg, was sampled. Platform P4 was also characterized by a produced-water discharge; the discharge leg was sampled.



PLATFORM 1: WD32A (Left),
and WD32E (Right).
OPERATOR: Shell
LOCATION: 29° 07'42 by 89° 41' 25"
DATE INSTALLED: 1962

PLATFORM 2: BM3KN
OPERATOR: Chevron
LOCATION: 29° 02' 50" by 90° 09' 46"
DATE INSTALLED: 1954

PLATFORM 3: ST128A
OPERATOR: Gulf
LOCATION: 28° 40' 02" by 90° 14' 43"
DATE INSTALLED: 1956



PLATFORM 4: ST161A
OPERATOR: Amoco
LOCATION: 28° 34' 09" by 90° 24' 32"
DATE INSTALLED: 1964
PROJECT RESEARCH VESSEL

PLATE 1: THE FOUR PRIMARY STUDY PLATFORMS.

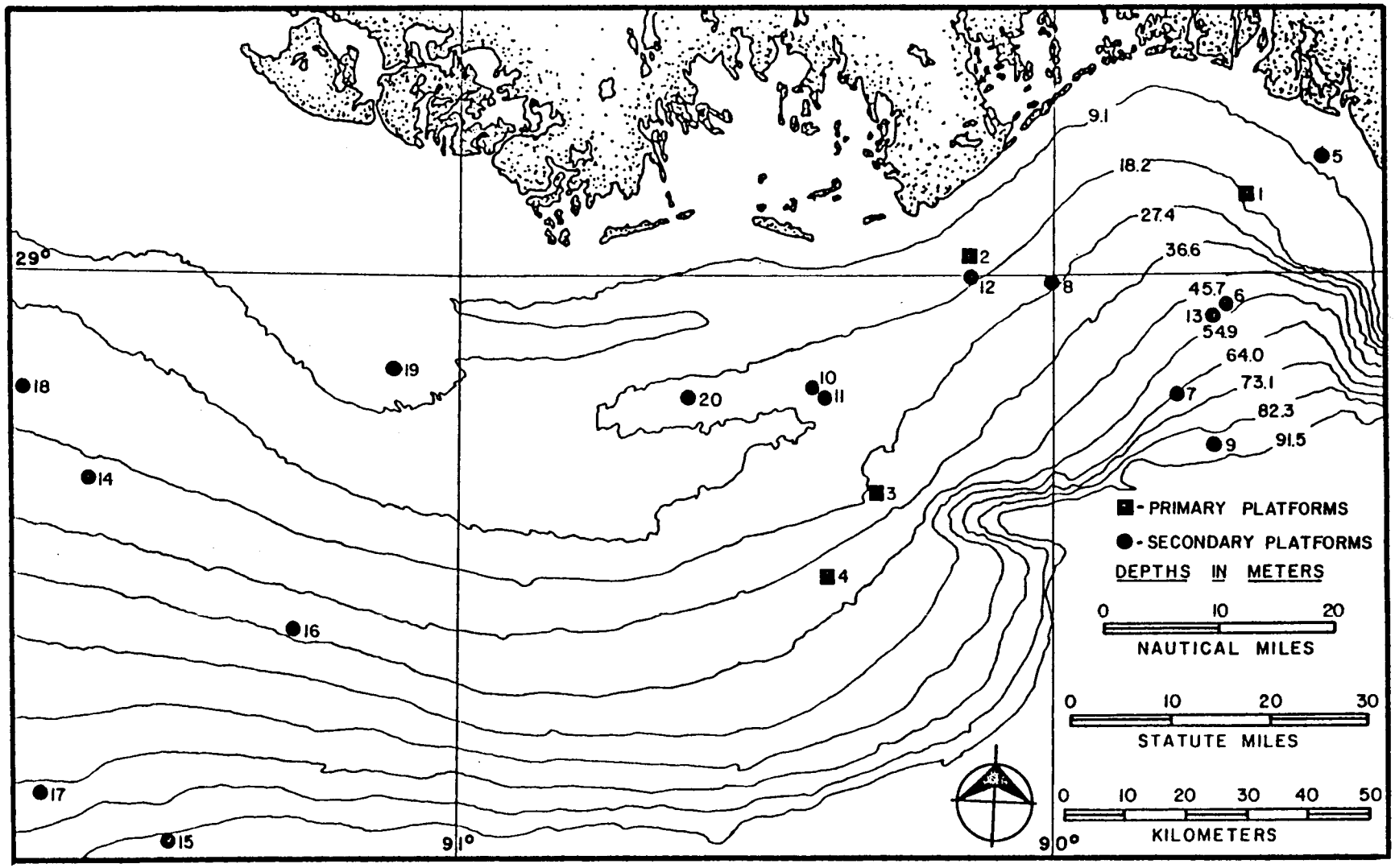


FIG. 1. Location of study platforms offshore Louisiana investigated in this project. Depth contours are shown in meters.

TABLE 1. List of study platforms and pertinent characteristics.

Platform	Operator	Structure	Latitude	Longitude	Depth (m)	Distance from shore (km)
P01	Shell	West Delta 32A	29°07'42"	89°41'25"	18	19.3
P02	Chevron	Bay Marchand 3KN	29°02'50"	90°09'46"	12	4.8
P03	Gulf	South Timbalier 128A	28°39'25"	90°14'08"	35	42.0
P04	AMOCO	South Timbalier 161A	38°34'09"	90°24'32"	46	53.0
S05	Gulf	West Delta 24SAT-4	29°12'32"	89°32'23"	9	6.4
S06	Exxon	West Delta 74F	28°57'08"	89°41'02"	52	41.9
S07	Gulf	West Delta 117C	28°48'34"	89°47'17"	65	56.4
S08	Continental	Grand Isle 47C	28°57'37"	90°01'25"	27	27.4
S09	Shell	West Delta 134D	28°44'04"	89°44'07"	85	64.4
S10	Exxon	South Timbalier 54A	28°49'53"	90°23'18"	20	20.0
S11	Exxon	South Timbalier 66D	28°49'33"	90°22'36"	20	20.9
S12	Shell	South Timbalier 26A	28°59'07"	90°09'41	17	11.0
S13	Exxon	West Delta 73A	28°56'48"	89°42'23"	51	41.0
S14	Texaco	Eugene Island 196C	28°41'51"	91°37'21"	29	67.6
S15	Marathon	Eugene Island 349A	28°10'02"	91°29'39"	98	115.0
S16	Southern Natural Gas Co.	Ship Shoal 225B	28°28'28"	91°16'45"	45	96.6
S17	Pennzoil	Eugene Island 330C	28°13'35"	91°41'05"	75	120.0
S18	Shell	Eugene Island 158B	28°48'50"	91°44'20"	25	51.5
S19	Chevron	Ship Shoal 108SAT-94	28°51'34"	91°07'52"	6	27.0
S20	Shell	South Timbalier 72B	28°48'19"	90°36'29"	18	15.0

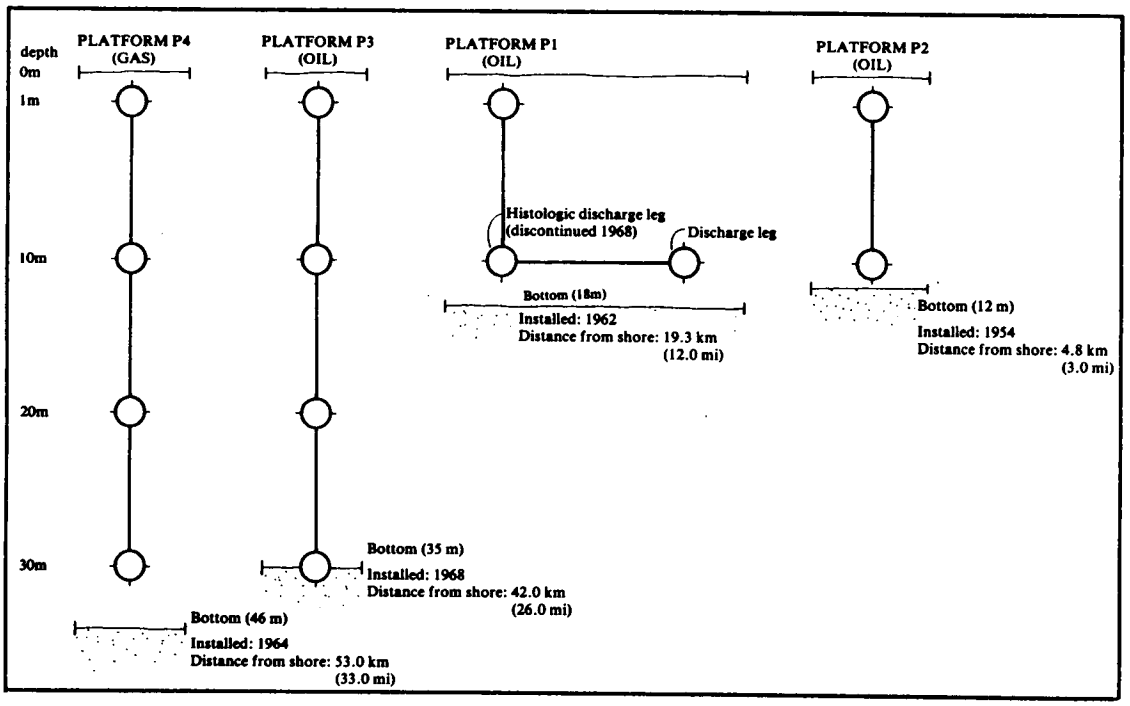


FIG. 2. Diagrammatic representation of the biofouling sampling station array at the four primary study platforms. This diagrammatic format is used throughout this report.

IV. METHODS AND MATERIALS

Descriptions of the research vessel, weather and wave observations and methods of field sampling, laboratory sample analysis and data analysis are presented below.

A. Research Vessel

The biofouling research activities were performed from a 24.4-m steel-hulled, double-rigged trawler using a Zodiac inflatable boat equipped with an outboard motor as an additional diving-support platform. The vessel utilized was the *Tonya and Joe* of Freeport, Texas, owned and captained by Pete Smirch. The *Tonya and Joe* is an exceptionally stable vessel which was ideally suited for diving activities, partially because of her unique design (Plate 1). The quarters and galley are built as a part of the hull, lower and forward of the typical Texas or Florida shrimp boat design. This allows the bridge to be situated more aft than normal and immediately forward of the winches and work area. The design results in good observation and communication from the wheelhouse to on-deck activities, as well as a forward deck space utilizable for work. Because of the steel hull of the vessel and the skills of Captain Smirch, the vessel was capable of operating safely even in close proximity to the platforms.

B. Weather and Wave Observations

A daily record of weather and wave observations made during the primary cruise was recorded in the log of the Chief Field Scientist. Entries included cloud cover, precipitation, wind speed and direction, sea state, and direction and strength of diver perceived currents. Data were stored in a clean dry place and were available to all investigators upon their publication in the First Quarterly Report (Bedinger, 1978).

C. Field Sampling

As described below, sampling for the artificial reef study depended entirely on the efforts of professional diving scientists, who also served as underwater photographers. Dives were made to photograph, gather discrete samples, scrape biofouling samples, establish and census underwater transects for cryptic organisms, and to place and recover an underwater television system (Plate 2). After each dive, the scientists debriefed by (1) recording a description of their dive on audio tape and (2) transcribing underwater observations recorded on slates to appropriately labeled data note books.

1. Fouling Macrobiota

Four (25 cm × 25 cm) replicate scraping samples were taken at each of the 13 stations deployed on selected leg supports of the four Primary Platforms (Fig. 2). Of these, three replicates were for animal biomass and taxonomic purposes and one was used to determine algal composition and abundance. Each of the four cells scraped was photographed before collection using a Nikonos camera and framing device designed to yield a standard photographic product of a known area. Curved templates (0.5 m × 1 m) consisting of eight cells (25 cm × 25 cm) and constructed of welder's brazing rods as depicted in Fig. 3 were used to delineate the scraping sampling sites at each depth. To avoid statistical analysis problems (i.e., contagion) associated with sampling adjacent quadrats, the four replicates were arranged in a checkerboard fashion with the two possible sampling arrays selected by coin toss prior to installation of the templates (Fig. 3).

Two divers were required, one to scrape the samples and the other to collect the material in plastic Ziploc bags. A support diver shuttled appropriate tools and samples between the collector and storage bags. Storage bags for holding samples and tools were raised and lowered from the surface to the depths the divers were working by surface-support personnel. To make optimum use of depth-time restrictions, the deepest samples were taken first, with work progressing toward the surface.

The initial sampling involved picking and bagging slow-moving organisms such as sea urchins. Large shellfish were next removed by scraping with a hatchet. The support diver caught these negatively buoyant forms as they came loose and began to settle in the water column. Except for blennies and large xanthids, most of the macrocryptic species did not desert the dislodged habitat provided by the shellfish and were caught as the "habitat" was bagged. The remaining "mat" was removed using a flexible-bladed putty knife. The experienced collectors were able to remove this material in large, intact patches or strips. This material was neutral or slightly negative in buoyancy and was easily bagged.

It was recognized that not all important forms associated with the platforms would be sampled using the above techniques. To provide more comprehensive lateral coverage and more information relative to zonation, time was allowed for additional visual, photographic and discrete sampling. Selected larger organisms or unique forms encountered were photographed individually using Nikonos cameras, their positions noted, and then they were collected (when possible) for purposes of identification and documentation.

On board, most biofouling samples from each sample site were placed in plastic garbage cans containing a solution of magnesium sulfate mixed to be isotonic with seawater and left for approximately 30 minutes to narcotize the animals. These samples were then transferred to plastic garbage cans containing 5% seawater-buffered formalin solution. The exception to this procedure was that one of the four scraping samples at each station was selected at random, wrapped in heavy aluminum foil, and frozen for later identification of primary producers and pigment analyses to estimate standing crop biomass of producers. All samples were clearly and indelibly labeled. At the minimum, labels included platform number, sample location, depth, date, and replicate number.

2. Platform-Associated Macrobiota

Sampling of platform-associated macrobiota consisted of a census of large, motile cryptic species at selected depths, as well as videotaping and direct observation of pelagic fishes.

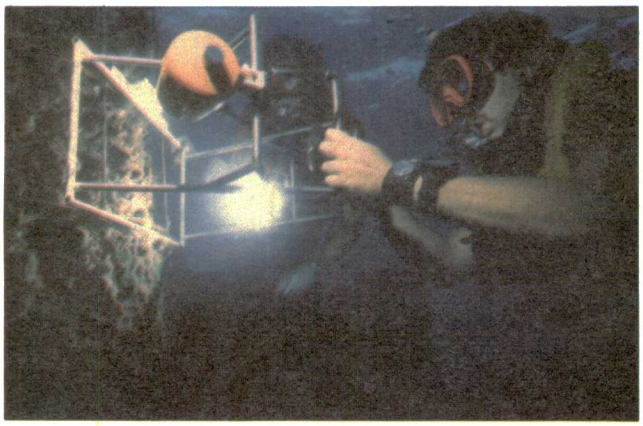
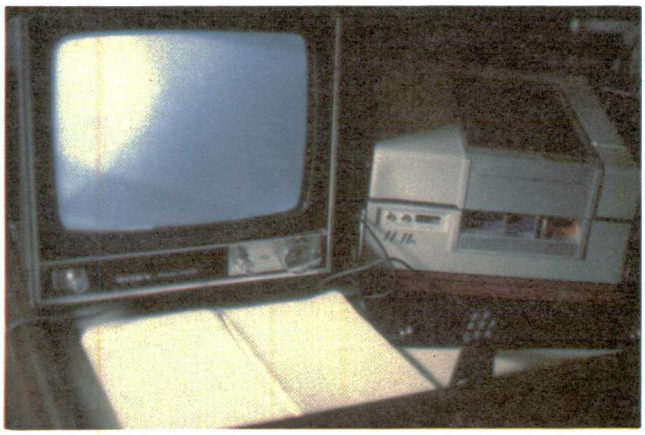


Photo documentation of biofouling sampling

Quantitative sampling of biofouling community

Underwater videotaping of pelagic and structure associated fishes



Audio, visual and tabular recording of data and information products.

PLATE 2: A PICTORIAL SUMMARY OF UNDERWATER METHODS.

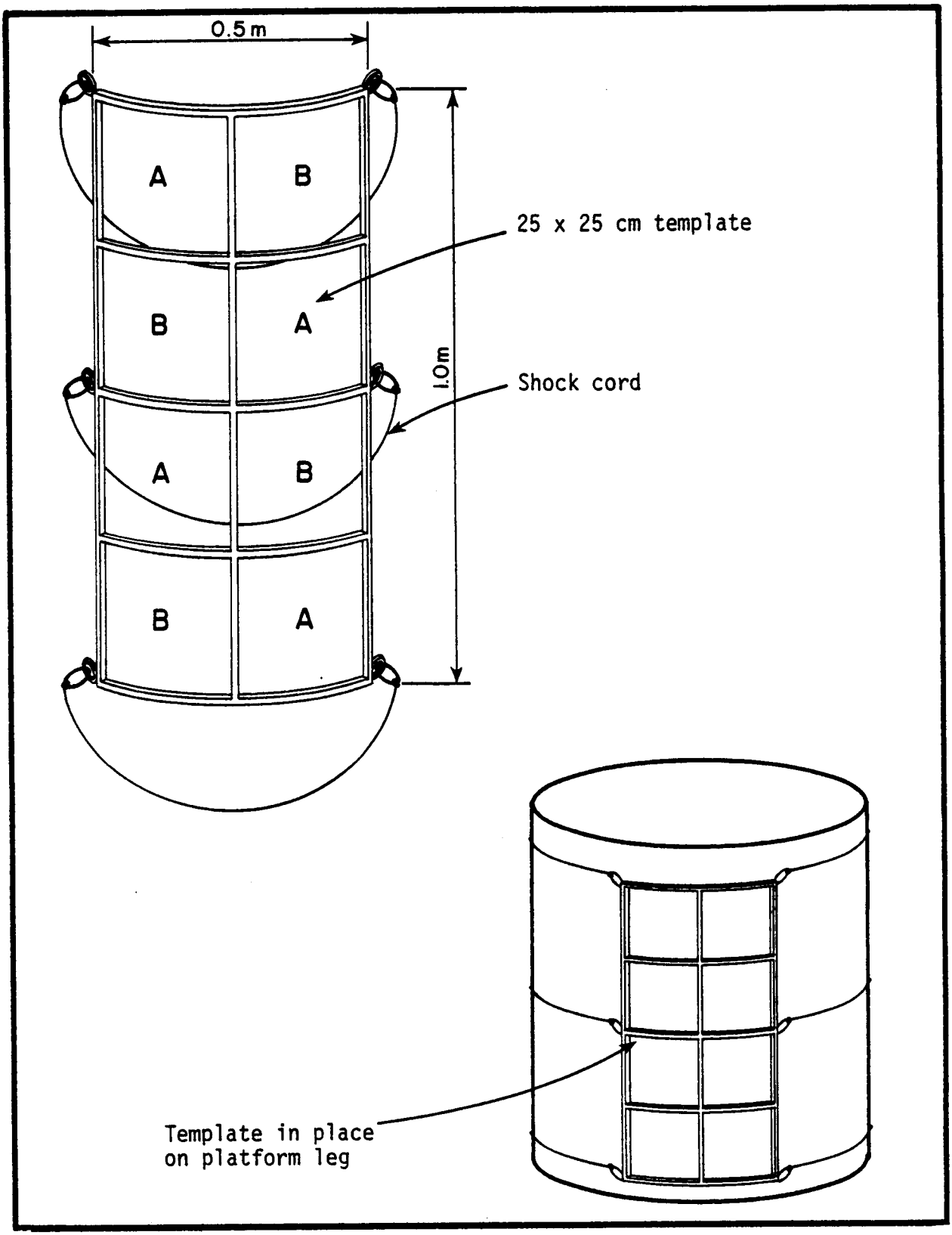


FIG. 3. Diagrammatic representation of scraping templates. Cells labeled A and B represent the two possible sampling schemes.

a. Quadrat Counts

The abundance of large, motile cryptic species was expected to be highest in the upper layer of the water column where the density of shellfish is generally greatest. To census these organisms, the above-described template was employed at 2- to 3-m and 8- to 9-m depths on each structural support sampled. The cells of the template provided reference points for the divers making the census. At an appropriate time interval after emplacement of the template (a subjective determination made by the diving scientists that sufficient time had elapsed for "things to have returned to normal"), three divers made independent counts of motile organisms represented in the census grid. Identification of the censused organisms was to the level possible and attempts were made to collect voucher specimens upon completion of the census effort.

b. Observation, Photography and Videotaping of Pelagic Fishes

A characterization of pelagic fish communities with impressions of the relative abundance of species was generated through a combination of direct *in situ* observations and underwater photography. The latter included use of a baited underwater television system (Plate 2) placed at two depths at Platforms P1 and P2, and at three depths at Platforms P3 and P4. Two-hour videotaped observations of fishes attracted to the bait were made at each of the 10 video stations. Locations for video observations were selected to coincide with horizontal supports of the platforms. The actual depths sampled at each platform using the underwater television system were:

Platform P1:	3 m, 10 m
Platform P2:	3 m, 6 m
Platform P3:	1 m, 14 m, 23 m
Platform P4:	5 m, 17 m, 26 m

In addition, as many fishes as possible were photographed in the time available for purposes of documentation of diver observations. Exposed photographic film and videotape of the fouling and pelagic fish communities were stored on-board the vessel in a cool dry location. Photographic film was developed by commercial laboratories.

D. Laboratory Sample Analysis

Laboratory analyses for this study were sorting, enumerating, and weighing organisms contained in the biofouling scraping samples; identification of discrete organisms collected from areas outside the standard station array at each station; and analysis of videotapes for the relative abundance of fishes.

1. Biofouling Flora

As planned, a total of 13 frozen samples wrapped in individually labeled packets of heavy aluminum foil were returned to the laboratory for taxonomic characterization and measurement of pigment biomass. These analyses were provided by a consultant, Dr. E. Cox of Texas A&M University. In summary, the samples were initially weighed to the nearest 0.01 g using a Mettler P1210 top-loading balance. The frozen samples were then divided into two roughly equal parts, one for taxonomic purposes, one for pigment analysis. The taxonomic sample was preserved in 5% formalin in seawater for later analysis.

Samples for pigment analyses were allowed to thaw in the dark for one hour. Each sample was then patted dry with paper towels to remove excess seawater, placed in plastic containers, and covered with a solution of 90% spectrophotometric grade acetone and 1% $MgCO_3$ to extract the pigments. Upon extraction, the pigment-containing solutions were poured through a plankton net into a graduated cylinder to a volume of 150 ml of sample. Samples were stored in a refrigerator in aluminum foil-covered Erlenmeyer flasks until analyzed with a spectronic 200 UV Bausch and Lomb Shimadzu Double Beam Spectrophotometer.

The spectrophotometer was calibrated using a 90% acetone blank and each set of experimental readings was verified using a 1 mg/liter-chlorophyll *a* standard, prepared by dissolving 1 mg chlorophyll *a* from spinach in one liter of 90% acetone. An aliquot of 10 ml from each sample was centrifuged and the supernatant poured into a 4-ml cuvette for spectrophotometric determinations and resulting estimates of pigment biomass following Strickland and Parsons (1972). Pigment concentrations were converted from concentrations per unit volume to estimated concentrations per unit area.

Taxonomic characterization of the algae samples was made by spreading the preserved samples on a flat laboratory tray, examining them carefully and picking clusters of algae for identification using a microscope. Voucher samples were prepared and preserved in 5% formalin in seawater.

2. Biofouling Fauna

Initially, total wet weight of each biofouling sample was determined to the nearest 0.1 g using a top-loading Mettler balance after the sample had been allowed to drain for 15 min on paper towels to remove excess water. All macroinvertebrates were removed from the sample, sorted by taxa and enumerated. Individuals representing each taxon which had not been vouchered in a previous collection were selected, weighed (0.1 g), placed in appropriate containers, preserved and labeled as part of the reference collection. Wet weights of the remaining macroinvertebrates were determined after removal of excess water (and for shelled organisms, removal of all encrusting material using a wire brush). Dry weight was next determined by heating the organisms at 100 C until a constant weight was obtained.

As limitations of time and resources precluded complete analysis of the small invertebrate fauna in the samples, subsampling was necessary. The size of the subsample was determined as follows. One of the replicate samples representing each depth of each platform was randomly selected for preliminary analysis and spread evenly in a 10 × 10 gridded laboratory tray. Ten of the 100 squares were randomly selected by lots for complete analysis of the discrete microinvertebrates contained in the biofouling material covering each square. Results of this exercise showed that for samples from 1- and 10-m depths analysis of four squares and for 20- and 30-m depths, five squares would yield 85% of the taxa. Based upon these results, 4% and 5% of the total samples were analyzed for shallow (1-, 10-m) and deep (20-, 30-m) stations, respectively.

Relative abundance of colonial taxa contained in biofouling samples was estimated visually. The

estimates were expressed as percent cover "in lab tray". This can be related to *in situ* cover by comparing appropriate tables and respective color plates. Barnacles were further separated into live and dead categories.
The voucher collection was sent to the following taxonomic specialists for verification: Dale R. Calder, Hydrozoa; Darryl L. Felder, Decapoda; Donald E. Harper, Polychaeta; Harold W. Harry, Cirripedia, Echinodermata, Mollusca; Arthur J. J. Leuterman, Bryozoa; Larry D. McKinney, Amphipoda.

3. Platform-Associated Macrobiota

In the laboratory, debriefing tapes and field notes were used to compile a characterization of each platform in terms of associated macrobiota, particularly fishes. All videotapes were viewed with frequency of observations of a given species or species category recorded for each 5-min segment of the film. The data not only allow for characterization of relative abundance in terms of observation rates, but also allow estimate of residence in the field of view over the 2-hr interval.

Data from the quadrat counts were transcribed from the field notes and tabulated in the laboratory.

E. Data Analysis

Data analysis consisted of (1) tabulating the data and comparing communities using cluster analysis and diversity indices, (2) selecting appropriate transformations for the abundance data in order to perform analysis of variance tests, and (3) where significant differences were indicated, performing predesigned orthogonal contrasts. Statistically significant groups of similar means of the transformed abundance values were also evaluated using Duncan's Multiple Range Test.

1. Cluster Analysis

Cluster analysis was used to characterize and contrast the communities represented at each platform. Cluster analysis involves the use of a dissimilarity measure to determine the degree of association between pair-wise combinations of data units based on some variables (Clifford and Stephenson, 1975). For our application, the data units consisted of stations while a measure of the abundance of taxa comprised the variables. The clustering of stations based on the variables (taxa composition) is referred to as normal analysis. An inverse analysis, clustering variables (taxa) based on data units (stations) was also performed. The Bray-Curtis dissimilarity measure was utilized for analysis using a flexible sorting strategy with the cluster intensity coefficient set at -0.25 following the recommendations of Clifford and Stephenson (1975). To reduce the bias of a few disproportionately high values, a root transformation was performed on the data for the normal analysis, such that the maximum value was reduced to about 20. For the inverse analysis, a norm standardization was applied in addition to the root transformation. The results of the cluster analysis are displayed as dendrograms, one for the normal and one for the inverse analysis. A two-way contingency table is used to show the relationship between station and species clusters. Since no satisfactory statistical methods are presently available, major clusters or groups are separated based upon the degree of dissimilarity exhibited in the dendrograms and characteristics of the two-way table. Cluster analysis was performed using the program CLASS developed and installed at the Texas A&M University Data Processing Center by Dr. Robert Smith of the University of Southern California.

2. Species Diversity

Characterization of community structure at each station was made using indices of diversity. Pielou (1969) considers diversity to be a single statistic of a collection that compounds the number of species present with species evenness. A collection is said to have high diversity if it has many species and the species abundance is fairly even. Conversely, diversity is low when the species are few and their abundance uneven. The value, however, is ambiguous, since a collection with few species and high evenness could have the same diversity as another collection with many species and low evenness. Diversity, per se, is not very informative unless its components, evenness and richness, are identified separately.

Diversity was calculated using the Shannon-Weaver index as suggested by Pielou (1966*a*). The index (H″) was calculated by the formula:

$$H'' = -\sum_{i=1}^{n} \frac{n_i}{N} \ell_n \frac{n_i}{N}$$

where: n = the number of individuals in the ith species
N = total number of individuals in the collection

The index is reasonably independent of sample size (Odum, 1971) and is normally distributed (Bowman et al., 1970). Because natural logarithms are used in the computations, the diversity unit is expressed as a "natural bel" (Pielou, 1969).

The evenness component of diversity was computed using Pielou's (1966*b*) index as follows:

$$J = \frac{H''}{H''_{max}} = \frac{H''}{\ell_n S}$$

where: H″ = observed diversity computed in the Shannon-Weaver index
H″ max = the maximum diversity value for the number of species present (ℓ_n S)
S = number of species present in the collection

Evenness, therefore, represents a ratio of the observed diversity to the maximum diversity for the number of species present in the collection.

An additional component of diversity is species richness or variety. This is a measure of the number of species occurring in the community relative to the total number of individuals. Species richness was calculated by the Dahlberg and Odum (1970) model as follows:

$$D'' = \frac{S-1}{\ell_n N}$$

where: S = number of species in the collection
N = number of individuals in the collection

The index, of course, is dependent upon sample size. However, it provides a useful measure of variety between communities.

3. Data Transformations and Analysis of Abundance Patterns

If sample data are to be analyzed using Normal Theory statistics (e.g., Analysis of Variance, etc.) then certain assumptions concerning the statistical properties of the data must be made (Steel and Torrie, 1960). Most importantly, the observations are supposed to be independent of one another and chosen in a random fashion. Such considerations should be incorporated as integral aspects of the field sampling design. After data are collected a third assumption becomes important: sample variances should be homogeneous regardless of the magnitude of the means. However, as described below, the variances of most biological data usually increase either proportionately (Poisson) or explosively (negative binomial) with an increase in mean. Under these circumstances, it is generally necessary to apply a transformation to the data in order to stabilize the variances.

The statistical properties of samples from biological communities may have the characteristics of one of several statistical distributions (Pielou, 1966*b*). Quite often, however, the statistical properties of biological data will approximate either a Poisson or negative binomial distribution. Data with Poisson-like properties arise when individuals are located randomly within the sampling area. Negative binomial-like properties arise when individuals are located in patches or clusters. These clusters may be the result of either heterogeneity of environment (e.g., depth of water) or social grouping of the individuals (e.g., fish schools). The Poisson distribution is characterized by a variance which increases proportionately to the mean. The variance of a negative binomial distribution increases at a greater rate with increasing mean. Thus, a simple test for determining the statistical distribution of data is to plot sample means against sample variances. If variances and means increase proportionately (i.e., at a 1:1 ratio), then the data are Poisson; if variances increase at a much greater rate than the means, then the data probably better fit the negative binomial distribution.

Means to variance plots for numerical abundance and biomass data indicated explosive variances; therefore, a log transformation was applied to those data (Steel and Torrie, 1960). To avoid the problem of taking the log of zero, one (1) was added to each observation. In order to statistically analyze the percent coverage data, a square-root transformation was applied following Steel and Torrie (1960).

Following transformation, the data were subjected to Analysis of Variance (ANOVA) techniques. Results of cluster analysis suggested several important comparisons among sampling stations. These comparisons were made by establishing various contrasts and partitioning them into several analysis groups within which all contrasts were orthogonal (Fig. 4-6). Duncan's Multiple Range tests were also performed on station means to further explore possible station relationships. The ANOVAs were performed using the Statistical Analysis System (SAS) available at the Texas A&M University Data Processing Center.

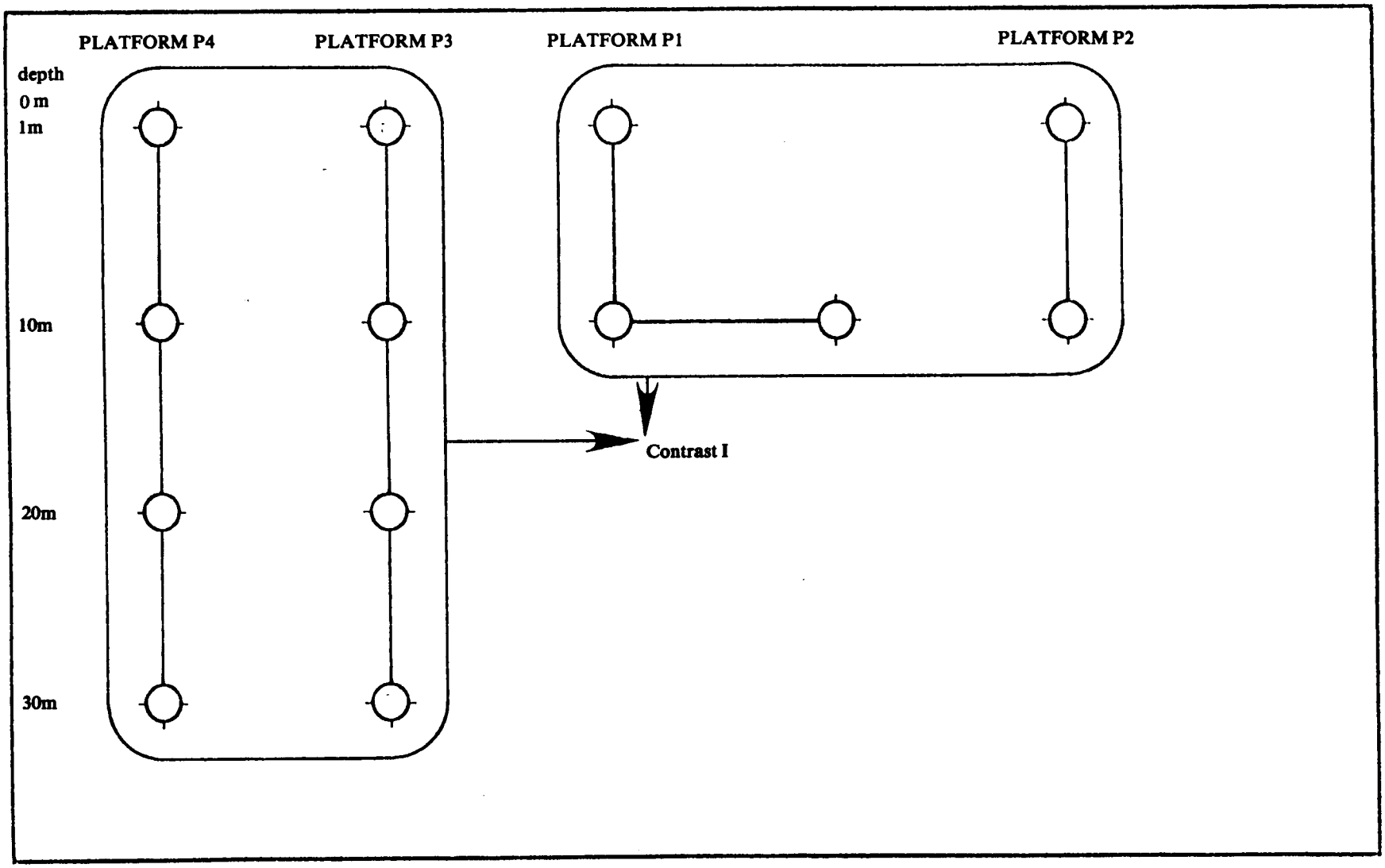


FIG. 4. Orthogonal Contrast I. P4 and P3 stations were considered collectively as an offshore group compared to P1 and P2 stations as an inshore group.

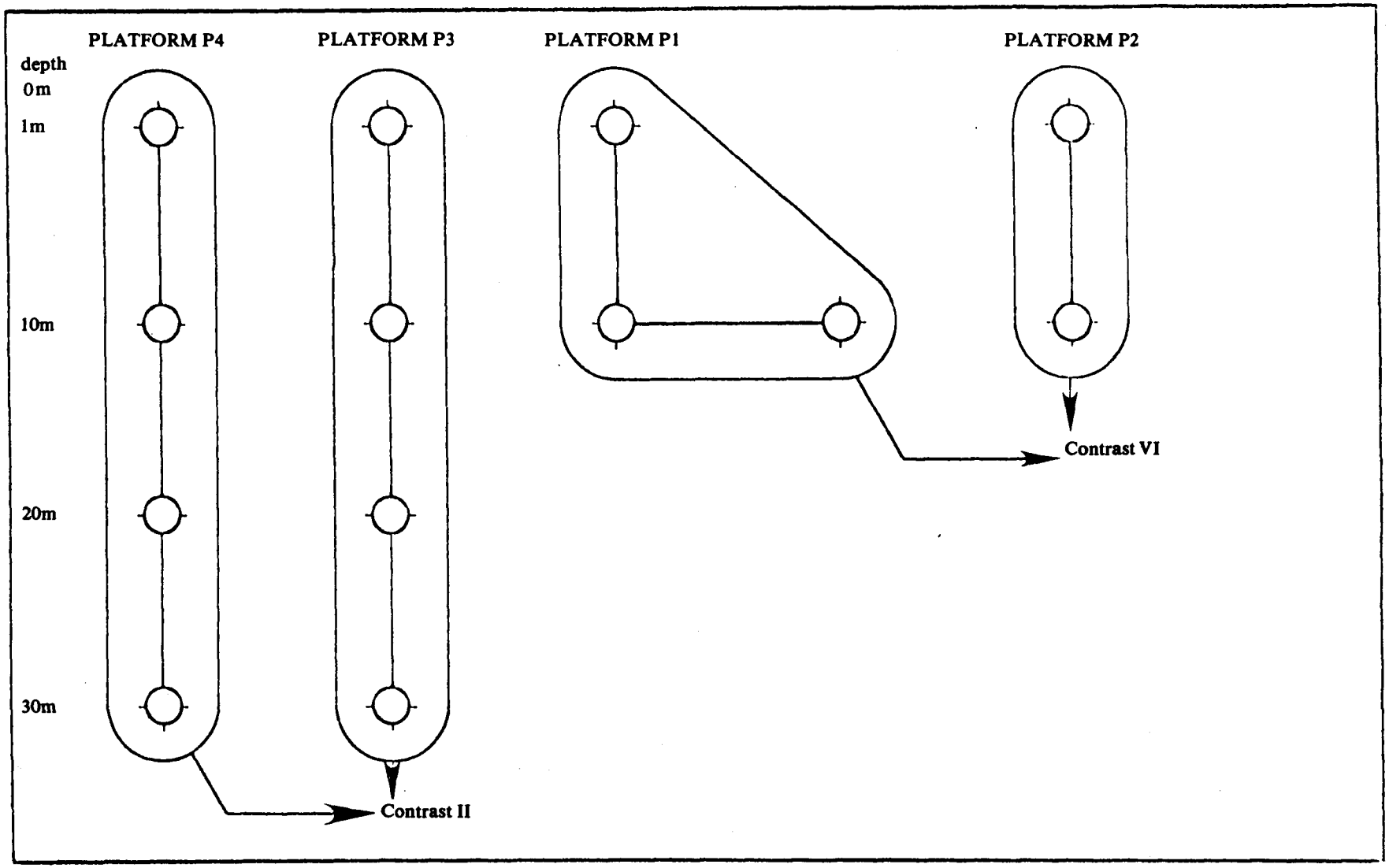


FIG. 5. Orthogonal Contrasts II and VI. As shown the objective of these contrasts is to compare different platforms within a given region to one another.

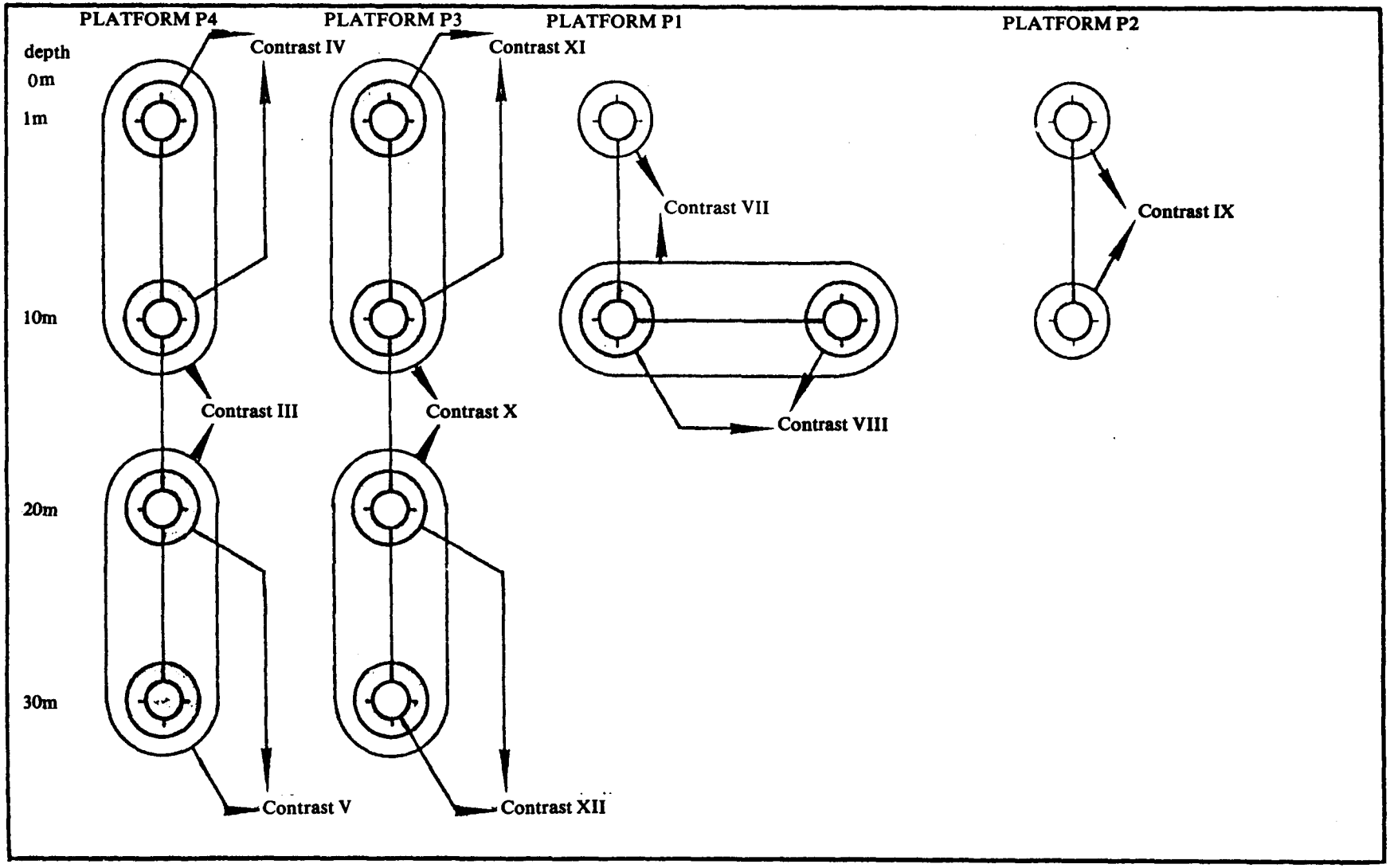


FIG. 6. Orthogonal Contrasts III—XII, Contrast VI shown by FIG. 5. The purpose of the above contrasts was to make comparisons with respect to depth and location on a given platform.

V. DESCRIPTIONS OF PLATFORM COMMUNITIES

All planned samples were obtained and analyzed. Data collected from each platform investigated are presented and discussed below. Data tables (Appendix I) other than summaries are not included in the text. The consultant report of Dr. Harold Harry is included in its entirety as Appendix II. The report represents a significant contribution to the taxonomy of several difficult groups.

A. Primary Platform 1: P1

Platform P1, installed in 1962, is sited 19.3 km from the Louisiana coast at 29°07'42" North and 89°41'25" West. Data on the biofouling community at this platform were obtained from one leg at depths of 1 and 10 m (Stations P1-1m and P1-10m), and at 10 m on another platform leg (Station P1-10mDL), from which produced water was being discharged. Although the produced water was discharged at a depth of approximately 17 m, the sampling station was established at 10 m in order to eliminate depth as a variable in the comparison of historic and active discharge sites.

1. Fouling Macroepibiota

The total wet weight biomass levels of the biofouling community at Platform P1 ranged from an average of approximately 5 to 9.7 kg/m^2 with biomass levels at Stations P1-10m and P1-10mDL exceeding those observed at Station P1-1m (Appendix I, Table A1). Most of the biomass at Stations P1-1m and P1-10m, on the "old discharge leg," was attributable to the barnacle *Balanus amphitrite niveus*. Although the total biomass levels at P1-10mDL, on the currently active discharge leg, were similar to levels at P1-10m, on the "old discharge leg," Ostreacea* (as opposed to barnacles) was the biomass dominant at the active discharge. In other studies (Gallaway et al., 1979) barnacles have been found to be particularly susceptible to produced water discharges.

a. Flora

Macroalgae were rare in samples from this platform. The green macroalga *Derbesia* sp., although sparse, was represented in samples collected at Station P1-1m but no macroalgae were found in samples collected at Station P1-10m (Appendix I, Table A2). Red algae *Polysiphonia* sp. were represented in the sample taken near the produced water discharge (Station P1-10mDL). Blue-green algae, diatoms, and microalgae were common at all stations. Chlorophyll *a* (present in all algae) showed a greater concentration at P1-10m and P1-10mDL than at P1-1m (Appendix I, Table A3). Concentration of chlorophyll *a* at P1-10m, on the old discharge or "control" leg, was approximately twice the level observed at P1-10mDL, on the leg characterized by a currently active discharge of produced water.

The concentration of chlorophyll *b* (present in green algae only), was higher at P1-1m than at P1-10m and P1-10mDL. The presence of chlorophyll *b* at P1-10m and P1-10mDL where no green algae were reported indicates that either green microalgae were present or that green macroalgae were in the sample split used for pigment analysis, but were not contained in the sample split used for taxonomic analysis. The observed levels of chlorophyll *c* (representative of diatoms and brown algae) indicates that the diatoms were common and approximately equally distributed between 1-and 10-m depths.

b. Discrete Fauna

Numerical and biomass densities of the discrete (as opposed to colonial) fouling fauna at Platform P1 and various data summary indices are presented in Appendix I (Tables A4, A6, and A7). At P1-1m, numerical density of discrete organisms was 82,949 individuals/m^2 distributed among 18 taxa. The dominant organisms in these collections were amphipods, particularly *Stenothoe* sp. The barnacle *Balanus improvisus*, anemones (Actiniaria) and caprellid amphipods (*Caprella equilibra*) were also common. At P1-10m, density was estimated to be only 21,104 individuals/m^2, but 37 taxa were represented. Numerical dominants at P1-10m were the barnacle *Balanus amphitrite niveus* and the polychaete *Brania* sp. The greater number of taxa and more even distribution of species in samples at P1-10m, as compared to samples at P1-1m, account for the higher levels of species diversity (H''), species richness (D) and evenness (J) recorded at P1-10m (Appendix I, Table A4).

P1-10mDL, exposed to produced water discharge, had similar numbers of individuals and taxa as P1-10m on the non-affected leg. Species diversity, species richness and evenness also were similar. However, the dominant organisms differed at the two stations. Whereas *B. amphitrite niveus* and *Brania* sp. were dominant at P1-10m, nemerteans and the polychaete *Typosyllis* sp. were dominant at P1-10mDL.

Determination of the live/dead ratio of barnacles at this platform showed that most *B. amphitrite niveus* and *B. improvisus*, the dominant barnacles, were dead (Appendix I, Table A5). There was no marked difference in the live/dead ratio of barnacles between P1-10m and P1-10mDL.

Data on biomass for discrete organisms at Platform P1 are shown by Tables A6 and A7 (Appendix I). At P1-1m, the wet and dry weights of the discrete fouling fauna were 3,924 and 2,624 g/m^2, respectively. The barnacle *B. amphitrite niveus* accounted for over 80% of the biomass at this station. Species diversity and evenness values based upon weight were thus very low because almost all of the weight was contributed by two species (*Balanus amphitrite niveus* and *B. improvisus*). The greater biomass levels observed at P1-10m and P1-10mDL as opposed to P1-1m were attributable to the abundance of *B. amphitrite niveus* and oysters at these stations. As noted above, *B. amphitrite niveus* and other

*All the oysters in the scraping samples were originally identified as *Ostrea equestris* based upon voucher collection material. Upon review of additional material obtained late in the study, the taxonomic consultant demonstrated that the oysters *Hyotissa thomasi* and *Lopha frons* (= *L. folium*) also were present in some scraping samples (Appendix II). The superfamily name, Ostreacea, which includes the three aforementioned species, is used.

barnacles accounted for most of the biomass at P1-10m on the control leg. Oysters (Ostreacea) were dominant at P1-10mDL on the active discharge leg. Species diversity, species richness and evenness levels were greater at P1-10m and P1-10mDL than at P1-1m, and similar at the two 10-m stations.

c. Colonial Fauna

Data describing Platform P1 in terms of colonial organisms are shown in Appendix I, Table A8. Colonial organisms are treated as a separate group of the biofouling community because of the obvious difficulties in determining numbers of individuals and their specific weights. At Platform P1, eight and 13 taxa were recorded at P1-1m and P1-10m, respectively. The hydroid *Clytia* sp. and the stolonate bryozoan *Aeverillia setigera* were the dominant colonial taxa at P1-1m, whereas *Aeverillia setigera* and the hydroid *Turritopsis nutricula* were dominant at P1-10m. Species diversity, species richness and evenness levels were higher at P1-10m than at P1-1m. At P1-10mDL, the number of taxa, species diversity, species richness and evenness values were similar to those observed at P1-10m. However, there were differences in the dominant colonial taxa between the two stations. *Turritopsis nutricula* was dominant at P1-10m on the "old discharge leg," whereas the dominant colonial organism at P1-10mDL on the discharge leg was the encrusting bryozoan, *Parasmittina munita*.

d. Supplementary Observations

Not all the biofouling fauna collected at Platform P1 were contained in the scraping samples. A listing of the other taxa documented to be present and the approximate depth from which they were collected are included in Table 2. Among these organisms were the hydroid *Corydendrium parasiticum*; the bivalves *Diplodonta* cf. *soror* and *Chama congregata*; and the polychaete *Chaetopterus variopedatus*. These taxa were not documented to occur at other sites. Representative assemblages and biofouling organisms observed at P1 are shown in Plate 3.

2. Platform-Associated Macrobiota

a. Quadrat Counts

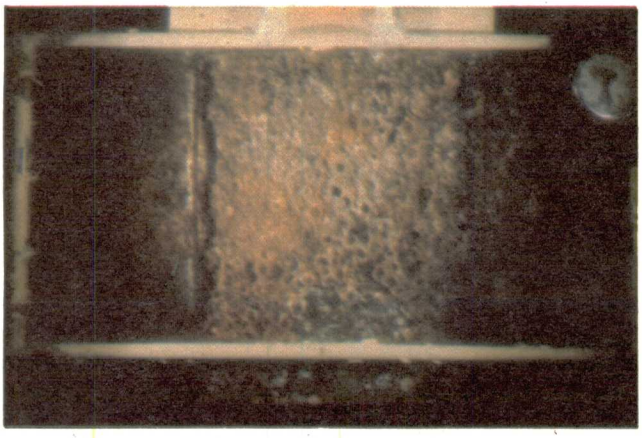
Blennies, presumably mostly representatives of *Hypleurochilus geminatus*, were the only macrocryptic organisms observed in the sample quadrats on the vertical support sampled at Platform P1; density estimates for near-surface areas ranged between 8 and 16 individuals/m^2. None of the three diving scientists observed any large, cryptic organisms on the vertical support at the 8- to 9-m deep sampling site. The low densities of macrocryptic organisms in the quadrats correlated with the uniform, low-relief structure of the habitat provided by the dominant shelled organisms on the vertical supports of this platform.

b. Observational Data

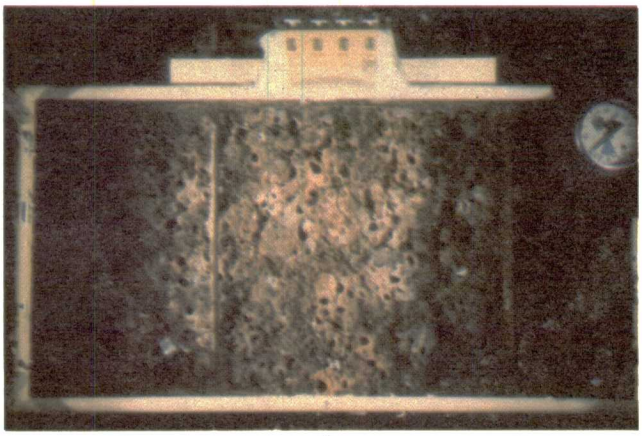
During the period 17-18 June when Platform P1 was initially sampled, the water column was characterized by high turbidity from the surface to about 3-m deep, a clear zone between about 3 and 13 m, and another turbid zone extending from 12 m to the bottom. A sharp thermocline was present at about 9 m. Most of the fish appeared to be concentrated in the clear zone in the vicinity of the thermocline. The dominant fishes observed at this platform were, in order of abundance, (1) mixed schools of moonfish and lookdown (formed vertical "walls" in the water column), (2) sheepshead, (3) spadefish, (4) gray triggerfish and (5) mixed schools of

TABLE 2. Location of collection of taxa not reported in the 25 × 25 cm scraping samples.

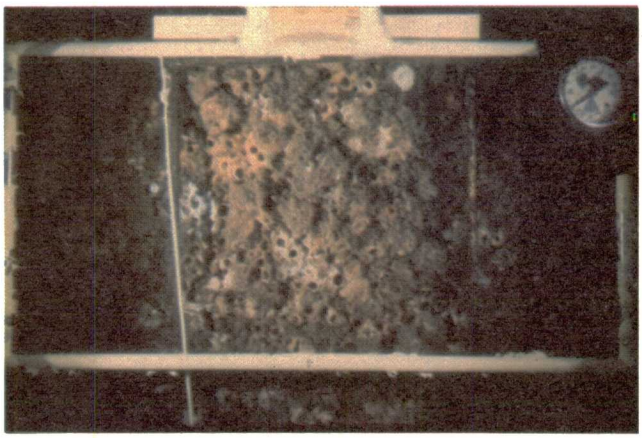
Species	Platform and Depth (m)			
	P1	P2	P3	P4
Corydendrium parasiticum	10			
Astrangia sp.	<9-18	10		3-6
Phyllangia americana	14-18		30	15-26
Oculina diffusa?			30	3-6
Aetea truncata		<6		
Conopeum comensale		≤6		
Crepidula plana		<6		
Murex fulvescens			15	3-6, 15-17
Arca zebra				17
Pinna carnea				3-6
Pinctada radiata				3-6, 17
Spondylus americanus				15-18
Crassostrea virginica	3-9	6		
Diplodonta cf. *soror*	<9			
Chama congregata	<9			
Pseudochama radians				17
Gastrochaena hians				17
Chaetopterus variopedatus	10			
Hermodice carunculata			30	
Terebella rubra		6		
Cronius ruber				6
Stenorhynchus seticornis	<9		17-23	17
Eucidaris tribuloides				3-6, 17
Diadema antillarum				17
Ophiothrix angulata			17	



Biofouling at approximately 1m-depth WD32A. Small acorn barnacles predominate, very little algae present.



Biofouling at approximately 10m-depth WD32A. Acorn barnacles, molluscs and hydroids were the dominant organisms in terms of biomass.



Biofouling at approximately 10m-depth, WD32E. Molluscs, acorn barnacles and hydroids were the dominant organisms in terms of biomass. Note the small coral, *Astrangia*, in the upper right corner of quadrat. This area is sited 8m above a produced water discharge.

Close-up of acorn barnacles at WD32 and evidence of grazing by fishes.

PLATE 3: CHARACTERIZATION OF THE BIOFOULING COMMUNITIES AT PLATFORM 1, SHELL WD32A and E STRUCTURES.

bluefish (mostly) and blue runner. For the latter, 2 to 3 schools each consisting of 30 to 40 individuals were believed present. Sheepshead were considered particularly abundant; both they and gray triggerfish were observed grazing on fouling macroepifauna. Considerable evidence of their grazing was evident. Incidental pelagic fish observed included crevalle jack (*Caranx hippos*), greater amberjack (*Seriola dumerili*), and, at the surface, needlefish, (*Strongylura* sp.).

In addition to sheepshead and triggerfish, several structure- or reef-associated species of fishes and invertebrates were represented at Platform P1. Reef fishes observed included belted sandfish (*Serranus subligarius*), rock hind (*Epinephelus adscensionis*), flamefish (*Apogon maculatus*), sergeant major (*Abudefduf saxatilis*) and juvenile cocoa damselfish (*Pomacentrus variabilis*). Reef-associated invertebrates observed included the stone crab (*Menippe mercenaria*), arrow crab (*Stenorhynchus* sp.) and sea urchins (*Arbacia* sp.). The distribution of reef organisms was generally restricted to the junctions of platform suppports (e.g., "corners") and collar-like flanges or guides which were used to direct drilling and casing from the platform. The biofouling community supplemented the artificial habitat very little as they did not provide much in the way of the relief required as shelter for reef organisms.

The snapper-grouper component of the ichthyofauna at P1 did not appear to be a major one. A few gray snapper (*Lutjanus griseus*), were noted. A few small groupers (some believed to have been warsaw grouper *Epinephelus nigritus*, but the scamp, *Mycteroperca phenax*, may have also been seen) were observed on nearly every dive and were noted by the diving scientists to be extremely curious.

Results of the analysis of the videotapes taken over 17-18 June yielded confirmatory information (Table 3). More observations and kinds of fish were documented at 10-m depths than at 3 m, with sheepshead being the overall dominant in terms of frequency of observation. Grouper, based upon the videotapes, is indicated to be the most abundant fish (1.18 grouper observations/min). However, most of the observations represent a single individual having a high level of curiosity or interest in the bait.

Platform P1 was revisited on 31 August to collect samples of fish and bivalves for chemical analysis. No additional organisms were observed; the community appeared much as described above.

B. Primary Platform 2: P2

Platform P2, installed in 1954, is sited 4.8 km from the Louisiana coast at 29°02'50" North and 90°09'46" West. Samples of the biofouling community from this platform were taken at 1m (Station P2-1m) and at 10 m (Station P2-10m) (Fig. 2). Water depth at this platform was only about 12 m.

1. Fouling Macroepibiota

Biomass levels of the biofouling community at P2 (Appendix I, Table A1) were estimated to range from about 8 to 16 kg/m^2 with values at P2-1m ($\bar{x}$ = 9.5 kg) observed to be lower than levels at P2-10m ($\bar{x}$ = 13.5 kg). A major portion of the total biomass at both stations was contributed by the barnacle, *Balanus amphitrite niveus*.

a. Flora

The green alga *Derbesia* sp. and four species of red algae, although sparse, were recorded at Station P2-1m (Appendix I, Table A2). Average percent cover of samples by algae at this station was estimated to have been 27 % (Appendix I, Table A13). No macroalgae occurred in samples at Station P2-10m, but diatoms and blue-green algae were common at both depths. Primary production was indicated to have been greatest at P2-1m where 0.0169 mg chlorophyll *a*/m^2 was measured (Appendix I, Table A3). There was considerable reduction in chlorophyll *a* at P2-10m, probably as a result of the turbidity of the water at this near-shore station. The presence of a trace amount of chlorophyll *b* at Station P2-10m, where no green macroalgae were reported in the taxonomic sample split, suggests that either or both green flagellate microalgae and green macroalgae were represented in the sample split used for pigment analysis. Results of the chlorophyll *c* determination indicate that diatoms were similarly abundant at both depths.

TABLE 3. Number of fish observed per minute of videotape recorded at each of the primary Platforms P1-P4.

Platform	P4			P3			P2		P1	
Depth (m)	5	17	26	1	14	23	3	6	3	10
TAXA										
"Grouper"						0.03	0.38		0.02	1.18
Bluefish								0.11		0.04
Blue runner	0.07	0.97		0.03	0.49					
Lookdown				0.53	0.03		0.01			
Atlantic moonfish		0.18					0.01	0.01		0.01
"Jack"	0.22	0.43	0.02		0.08	0.05		0.03		0.01
"Snapper"	3.65	0.18		0.24	0.34	0.14	0.04	0.47		0.02
Sheepshead	0.05	0.01				0.04	0.15	0.51	0.53	0.71
Bermuda chub				0.02						
Atlantic spadefish	10.71	4.40	0.04	0.76	1.82	0.01	1.47	10.70	0.11	0.26
Blue angelfish		0.01								
"Blenny"	0.24		1.43	0.01						
Gray triggerfish	0.41	2.29			0.11		23.56	1.42		0.01
Unknown		0.01						0.01		

b. Discrete Fauna

Station P2-1m samples contained representatives of 27 taxa of discrete species and were characterized by high density levels (152,773 individuals/m^2). Numerical dominants included anemones (Actiniaria), the acorn barnacle (*Balanus amphitrite niveus*) and two amphipods (*Stenothoe* sp. and *Caprella equilibra*, Appendix I, Table A9). Density levels at Station P2-10m dropped to 67,125 individuals/m^2 and 22 taxa were recorded. As at Station P2-1m, anemones were the numerical dominants. Each of the measures of taxa diversity based upon numbers was higher for Station P2-1m than for Station P2-10m collections.

Two species of barnacles (*Balanus amphitrite niveus* and *B. improvisus*) were represented and abundant at each station. At P2-1m, *B. amphitrite niveus* outnumbered *B. improvisus* about 6 to 1 and 90% of the individuals were alive when collected (Appendix I, Table A10). At P2-10m, *B. amphitrite niveus* outnumbered *B. improvisus* by only 3 to 1 and an average of 67% were alive when collected. *Balanus improvisus* was similarly abundant at each depth; average percent-live values were 71 (P2-1m) and 72 (P2-10m).

Biomass data describing the discrete invertebrate fauna are shown in Appendix I (Tables A11-A12). Wet and dry weight densities at Station P2-1m were estimated to have been 6,795 g/m^2 and 4,406 g/m^2, respectively. The biomass level of discrete species at Station P2-10m was estimated at 8,951 g wet weight/m^2 (5,760 g dry weight). *Balanus amphitrite niveus* was the biomass dominant at each station. With the exception of richness, species diversity indices based upon weight values were similar between stations, primarily because each collection was strongly dominated by one or two species.

c. Colonial Fauna

Eleven and five taxa of colonial species were contained in samples from Station P2-1m and Station P2-10m, respectively (Appendix I, Table A13). A boring sponge (Clionidae) and two stolonate bryozoans (*Aeverillia setigera* and *Aetea anguina*) were dominant at Station P2-1m, while at Station P2-10m, *Aeverillia setigera* and the hydroid *Obelia dichotoma* were the dominant colonial organisms. Species diversity and richness of colonials were higher for collections obtained at Station P2-1m, whereas evenness was somewhat greater for collections taken at Station P2-10m.

d. Supplementary Observations

Six additional biofouling taxa were collected at P2 by the underwater scientists (Table 2). Of these, four species (the bryozoans *Aetea truncata* and *Conopeum comensale*; Crepidula plana, a gastropod; and a polychaete, *Terebella rubra*) were not documented to occur at other platforms sampled. Representative biofouling assemblages of P2 during summer 1978 are shown in Plate 4.

2. Platform-Associated Macrobiota

a. Quadrat Counts

Macrocryptic organisms at P2 were sparse to absent in the areas censused during the June, 1978 sampling period. Blennies were the only forms represented; at the near-surface zones density was estimated to be between 8 and 16 fish/m^2. As at P1, the biofouling community provided little habitat for macrocryptic forms because of its low relief.

b. Observational Data

Observational dives and photography of platform associated macrobiota were made at P2 on 19 June 1978. From the surface to about 9 m, visibility was restricted to approximately 2 m and the water became increasingly more turbid with depth. Dominant fishes at this platform were sheepshead and spadefish. Sheepshead were particularly abundant and concentrated around vertical leg supports. Interestingly, most of the sheepshead were very small individuals. Spadefish schools were occasionally seen; both blue fish and blue runner schools were also glimpsed. Lookdown were not schooled, but a few individuals were present.

Reef and structure-dependent organisms were not abundant. White spotted soapfish and an unidentified butterfly fish were seen. Small oysters and the stone crab were present but were abundant only in restricted, protected areas, such as those formed by open pipes and the corners and angles of structural supports. A small sea urchin (*Arbacia* sp.) was found in similar habitat. The low-relief of the biofouling community at P2 offered poor quality habitat for cryptic species.

The gray snapper was the only representative of this family sighted at P2 and, although common, was not believed abundant. At least two species of grouper were seen. One was a 6 to 10 lb. warsaw grouper and the other is believed to have been a comb grouper, *Mycteroperca rubra* (see Plate 9). Although seldom collected, Hoese and Moore (1977) believe this species is probably more common in Texas and Louisiana waters than reports have indicated.

Videotape sampling added two expected but not seen fishes, the gray triggerfish and the Atlantic moonfish (Table 3). At the 3-m depth, a gray triggerfish was seen at a rate of 23.6 observations/min. This individual greatly depleted the bait within the 2-hr filming sample.

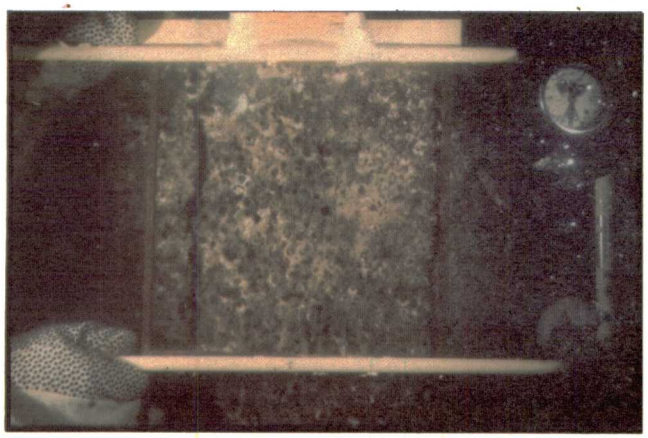
The platform was again observed on 30 August 1978. Platform fish communities were as described above; the diving scientists were particularly impressed by the numbers of sheepshead present.

C. Primary Platform 3: P3

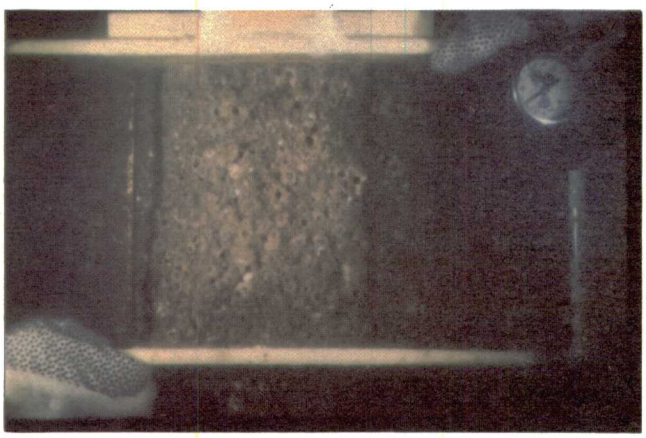
The petroleum platform P3 was installed in 1968 and is 42 km from the Louisiana coast at 28°39'25" North and 90°14'08" West. Data describing the biofouling community at this platform were taken at depths of 1, 10, 20, and 30m (Stations P3-1m, P3-10m, P3-20m, P3-30m) (Fig. 2). Water depth at P3 was in excess of 30 m.

1. Fouling Macroepibiota

Total biomass of fouling macroepibiota at P3 averaged between 8.5 and 11 kg/m^2 from P3-1m to P3-20m, and dropped to an average of about 2 kg/m^2 at P3-30m (Appendix I, Table A1). There was considerable variation in the weight of replicates taken at each station, primarily as a function of the amount of shelled organisms in the respective sampling templates. The tree oyster, *Isognomon bicolor*, comprised most of the sample biomass at P3-1m, oysters (Ostreacea) dominated at P3-10m and P3-20m, and, at P3-30m, colonial forms dominated (hydroids, demosponges and colonial anemones).

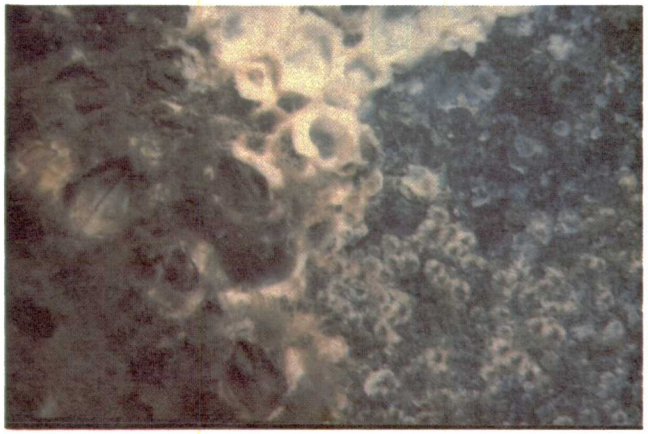


Bay Marchand 3KN sample
Replicate 1m Depth



Bay Marchand 3KN sample
Replicate 10m depth

Close up view of typical
biofouling community at
Bay Marchand 3KN



Representative barnacle dynamics
at Bay Marchand 3KN; clockwise
starting at upper right corner, (1) bare pipe,
(2) recent set, (3) mature barnacles, and
(4) grazed barnacles.

PLATE 4: CHARACTERIZATION OF BIOFOULING COMMUNITIES
AT PLATFORM 2, CHEVRON BM3KN.

a. Flora

At P3, macroalgae were abundantly represented in samples from the surface to 10 m (Stations P3-1m and P3-10m), but were absent from samples taken at the deep stations (Station P3-20m and Station P3-30m). Total percent coverage by macroalgae at P3-1m and P3-10m averaged 45% and 52%, respectively (Appendix I, Table A18). Red algae were represented by four species at Station P3-1m and two species at Station P3-10m (Appendix I, Table A2). Brown and green algae were each represented by a single species at Station P3-1m. Based upon diver observation and photography, coralline algae were represented at depths >10 m in some areas of P3. Diatoms and blue-green algae were represented in samples from all stations.

Concentrations of each of the pigments (chlorophyll *a, b* and *c*) were highest at Station P3-10m, and with the exception of chlorophyll *b*, a sharp drop in concentration was not evident until P3-30m (Appendix I, Table A3). Green algae (chlorophyll *b*) were indicated to have been represented at P3-30m, but to markedly decline in abundance between P3-10m and P3-20m. In contrast to the near-shore platforms in turbid water, light penetration to depths of 20 and 30 m in offshore waters allows for primary production to these depths. Results of the sample analysis indicates most of the producers at the greater depths were diatoms, but coralline algae probably are also important.

b. Discrete Fauna

A total of 53,893 individuals representing 58 taxa of discrete fauna were collected at Platform P3 (Appendix I, Table A14). Numerical density of discrete organisms at Station P3-1m (150,352 organisms/m^2) was approximately three times higher than at the station with the next highest abundance (Station P3-10m), primarily because of the relative abundance of the brittle star *Ophiactis savignyi*. Forty taxa were represented in collections from Station P3-1m; additional numerical dominants included a polychaete (*Syllis* sp.), pycnogonids, nemerteans, an amphipod (*Stenothoe* sp.) and the tree oyster (*Isognomon bicolor*).

Results of analysis of collections from Station P3-10m indicated a numerical density of 53,547 solitary organisms/m^2 representing 36 taxa. A solitary anemone (Actiniaria) and *Stenothoe* sp. were the numerical dominants. At Station P3-20m, the amphipod *Erictho-nius brasiliensis*, (not represented at P3-1m and a minor component of the P3-10m collections) was the marked numerical dominant in the collections which, collectively, contained 33 taxa. A caprellid amphipod (*Paracaprella pusilla*) which was not collected at either of Stations P3-1m or P3-10m was the next most abundant species. Numerical density of solitary organisms at Station P3-20m was estimated to have been in excess of 39,000 organisms/m^2. The octocoral *Telesto* sp. was represented in collections at P3-20m and was observed to be sparse.

At P3-30m, numerical density of discrete organisms remained high (44,309/m^2) but only 17 taxa were represented (Appendix I, Table A14). Nearly 72 % of the total collection was represented by one species, the aforementioned *Paracaprella pusilla*.

Indices of species diversity of the discrete fauna based upon numbers were lower at the bottom and surface stations (P3-30m, P3-1m) than at the mid-water stations (P3-10m, P3-20m). Station P3-30m was characterized by relatively few species and strongly dominated by a few species. Station P3-1m collections, although characterized by many species, were strongly dominated by the brittle star. Stations P3-10m and P3-20m contained relatively high numbers of species and collections were less dominated than those at P3-1m and P3-30m.

Only 308 of the 53,893 specimens of discrete taxa collected at P3 were barnacles (Appendix I, Table A14). Of these 237, 40, and 29 represented *Balanus amphitrite niveus, B. improvisus* and *B. tintinnabulum* respectively. Another species, *B. eburneus*, was represented in the collections by two empty shells, one at Station P3-10m and the other at Station P3-20m. Although *B. amphitrite niveus* occurred to a depth of 20 m, 203 of the 237 were collected at Station P3-1m. The percentage of specimens of this species which were alive when collected was 39 at P3-1m, 4 at P3-10m and none of the 8 collected at Station P3-20m was alive (Appendix I, Table A15). All 40 *B. improvisus* were taken at P3-1m; an estimated 73% were alive when collected. All but one of the *B. tintinnabulum* were collected at P3-1m; 89% were alive. This species was represented in the P3-10m deep collection by an empty shell. Barnacles were not observed at P3-30m.

Wet and dry weights of the respective discrete fauna are shown in Appendix I (Tables A16 and A17), and the following discussion is based upon wet weight values. Discrete fauna represented 63, 56, 73 and 1 % of the total wet weight biomass collected at Stations P3-1m, P3-10m, P3-20m, and P3-30m respectively. Their proportional increase in relative biomass with depth down to 20 m is inversely correlated with the decrease in algae, and at 30 m, although discrete forms were abundant, most were small amphipods. The biomass dominant at Station P3-1m was the tree oyster (594 g) followed by barnacles (329 g), and the bivalve *Chama macerophylla* (114 g). The numerical dominant at Station P3-1m, the brittle star, comprised only 91 g of the total 1,234 g discrete fauna collected at that station. Oysters (575 g) and *Chama macerophylla* (234 g) were the dominant contributors to the 898 g of discrete fauna collected at Station P3-10m. At Station P3-20m, 1,154 of the 1,492 g of total discrete faunal weight were represented by oysters. Discrete forms contributed very little ($\bar{x}$ = 22 g/m^2) to the total biofouling biomass collected at Station P3-30m ($\bar{x}$ = 1,956 g/m^2).

Species diversity values for discrete epifauna based upon weight ranged from 0.89 (Station P3-20m) to 1.63 (Station P3-1m) (Appendix I, Table A16). The relatively high value for Station P3-1m was attributable to a high number of species and the lack of dominance by a single organism. The Station P3-30m value of 1.41 was second highest, even though only 17 taxa were represented. More than 30 taxa were represented at all other stations.

c. Colonial Fauna

The colonial dominants at P3 changed markedly with depth (Appendix I, Table A18). A hydroid, *Obelia dichotoma*, was dominant at P3-1m; the branching bryozoans *Bugula neritina* and *Crisia eburnea* were the respective dominants at P3-10m and P3-20m, and the hydroid *Eudendrium carneum* was the

dominant in two of the three faunal sample replicates taken at P3-30m. A colonial anemone (Zoanthidea) was dominant in the remaining sample. The dominant discrete organism at 30 m was a caprellid amphipod (*Paracaprella pusilla*). All of these individuals were taken in the replicates dominated by the hydroid as opposed to the anemone-dominated sample. Diversity of colonial fauna was markedly greater at Station P3-20m than at any other station (Appendix I, Table A18).

d. Supplementary Observations

In addition to the observations of coralline algae, the diving scientists collected six additional taxa not represented in the scraping samples at P3 (Table 2). Of these the polychaete *Hermodice carunculata* and the ophiuroid *Ophiothrix angulata* were not taken at other platforms. Representative biofouling assemblages at P3 during summer 1978 are shown in Plate 5.

2. Platform-Associated Macrobiota

a. Quadrat Counts

The sea urchin *Arbacia* sp. was represented in the transects at both depths censused at P3. At 8- to 9-m depths, pistol shrimp (*Synalpheus fritzmuelleri*), xanthid crabs and brittle stars were also represented. *Arbacia* sp. was estimated by each of the three diving scientists to have a density of four individuals/m^2 at each of the two depths. In the near-surface zone, density of blennies was estimated to range from 8 to 12 fish/m^2. At the 8- to 9-m depth, xanthid crab density was estimated to range between 60 and 64 crabs/m^2; brittle star and pistol shrimp densities were each estimated to have been four individuals/m^2.

b. Observational Data

During 15-16 June 1978, the fish population at P3 was characterized by a high abundance of fishes and relatively low diversity. Dominant fishes included bluefish (estimated to be present in the "thousands"), spadefish and mixed schools of moonfish and lookdowns. Scattered small schools of blue runner were common; other jacks sighted included crevalle jack, greater amberjack and a few almaco jack, *Seriola rivoliana*. Large specimens of pinfish, *Lagodon rhomboides*, were observed at depths below 15 m. Sheepshead and gray triggerfish were notable because of their low abundance. Atlantic croaker, *Micropogon undulatus*, all large (≃30 cm), were caught by angling.

Barracuda and cobia (*Rachycentron canadum*) were structure-associated large predators represented at P3. A nurse shark (*Ginglymostoma cirratum*) was also in residence at this platform (see Plate 9). The nurse shark is a common inhabitant of offshore reefs but is also known for its occasional inshore sojourns.

The reef-fish component of the fauna at P3 was neither diverse nor abundant. The ubiquitous cocoa damselfish was the most commonly observed species; cubbyu and whitespotted soapfish were also sighted by divers. A specimen of the bigeye, *Priacanthus arenatus*, was obtained by angling. A few chub (probably Bermuda chub, *Kyphosus sectatrix*) were reported near the surface.

The snapper-grouper assemblage was a major component of the ichthyofauna at this platform. Large schools of gray snapper supplemented by medium to large schools of red and lane snapper (*Lutjanus synagris*) were present at P3 during the June sampling. Grouper were represented by a small species of *Mycteroperca*. Most of those seen are believed to have been scamp, *Mycteroperca phenax*.

Videotapes of fishes at P3 in June, 1978 contained representatives of six, six and five species at each of the respective depths of 1, 14 and 23 m (Table 3). Spadefish, lookdown and gray snapper dominated the surface collections; spadefish, blue runner and gray snapper were dominant at 14 m; snapper observations were the most frequent at 23 m.

Platform P3 was visited again on 3 September 1978. With the exception of spadefish and snapper species, fish were generally not abundant. Only two sheepshead were sighted; the nurse shark was searched for and not found. Barracuda were present, but bluefish and ling were not observed. The general impression in September was one of low fish abundance and diversity.

D. Primary Platform 4: P4

Petroleum platform P4, installed in 1964, is 53 km from the Louisiana coast at 38°34'09" North and 90°24'32" West. Data on the biofouling community were obtained at depths of 1, 10, 20 and 30 m. These depths are represented by Stations P4-1m, P4-10m, P4-20m, and P4-30m on Fig. 2.

1. Fouling Macroepibiota

Average biomass levels at Stations P4-1m to P4-30m ranged from about 8.5 kg/m^2 at P4-1m to less than 2 kg/m^2 at P4-30m. Values increased from an 8.5 kg/m^2 surface level to a maximum observed value of 15.5 kg/m^2 at P4-10m. The biomass at P4-20m was estimated to have been 9.6 kg/m^2 and a pronounced break in biomass occurred between P4-20m and P4-30m (Appendix I, Table A1).

The bivalve *Chama macerophylla* was the dominant biomass contributor at all stations. However, at P4-10m, this species was a co-dominant along with oysters (Ostreacea), most of which were probably *Hyotissa thomasi*. The rather patchy distribution of these bivalves accounted for much of the variance observed among the biomass replicates.

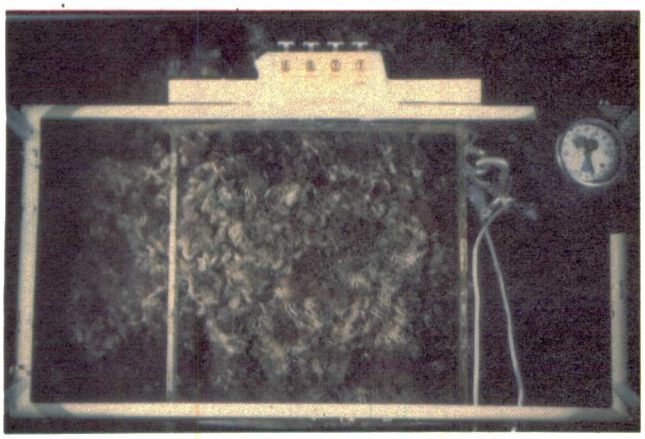
a. Flora

Based upon estimates of percent coverage of samples, macroalgae dominated collections taken at Station P4-1m (62%) and at P4-10m they comprised 37% of the coverage. A sharp break in algal coverage was observed between P4-10m and P4-20m (6% coverage at Station P4-20m). Macroalgae were not contained in scraping samples from P4-30m.

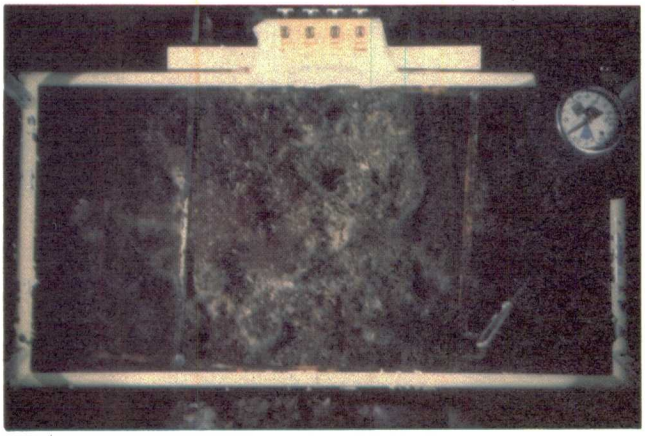
Although *Derbesia* sp., a green alga, was dominant at Station P4-1m, six species of red algae and one brown alga were also represented (Appendix I, Table A2).

Derbesia sp. was also the dominant macroalga at P4-10m whereas at P4-20m, two red algae comprised most of the 6% algae cover. Diatoms and blue-green algae occurred at all depths sampled.

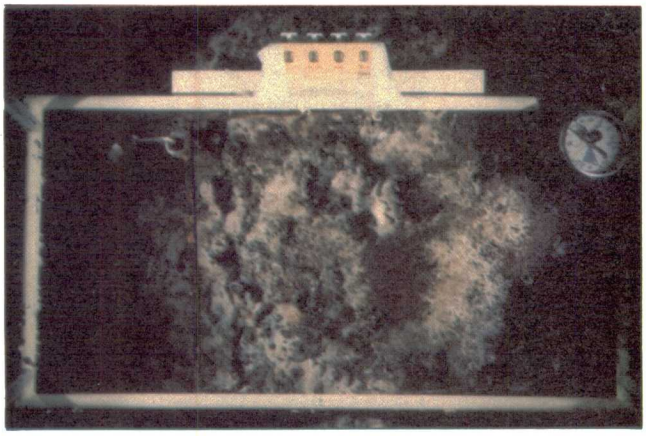
Based upon chlorophyll *a* concentrations (Appendix I, Table A3), primary productivity was evidently high at all depths sampled. Chlorophyll *b* concentrations were similar at all stations, indicating the



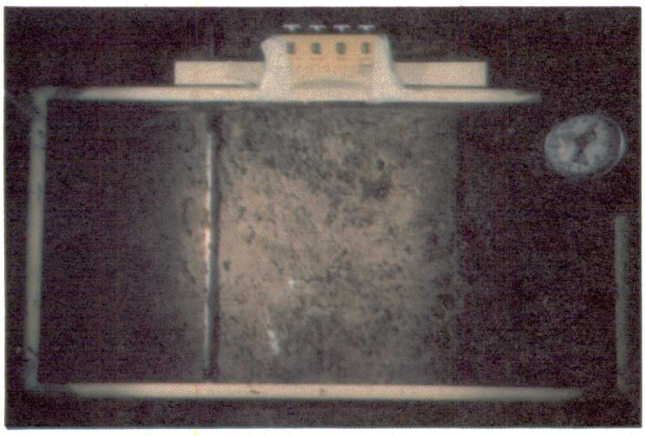
South Timbalier 128A
Sample Replicate
1m Depth



South Timbalier 128A
Sample Replicate
10m Depth



South Timbalier 128A
Sample Replicate
20m Depth



South Timbalier 128A
Sample Replicate
30m Depth

PLATE 5: CHARACTERIZATION OF BIOFOULING COMMUNITIES
AT PLATFORM 3, GULF ST128A.

presence of green flagellate microalgae at depths of 20 and 30 m. Diatoms (chlorophyll *c*) were indicated to increase in abundance as depth increased.

b. Discrete Fauna

Numerical and biomass data for the discrete fouling fauna collected at Platform P4 are presented in Tables A19, A21 and A22 (Appendix I). At Station P4-1m, 100,464 individuals/m^2 representing 38 taxa were recorded. The brittle star, *Ophiactis savignyi*, caprellid amphipods (*Caprella equilibra*), and polychaetes (*Brania* sp.) were dominant. Other polychaetes common at this station were *Eusyllis* sp., *Odontosyllis* sp., *Haplosyllis spongicola* and *Typosyllis* sp. At Station P4-10m, 72,229 individuals/m^2 represented by 37 taxa were present. The dominant species were *Caprella equilibra*, *Stenothoe* sp. and *Ophiactis savignyi*. Among the 24,491 individuals/m^2 and 27 taxa collected at Station P4-20m, the amphipod *Ericthonius brasiliensis* was dominant. At P4-30m, 23,541 individuals/m^2 representing 20 taxa occurred in the collections which were dominated by *Caprella equilibra* and *Ericthonius brasiliensis*. Species diversity of discrete fauna based upon numbers was highest at Station P4-1m where both the numbers of individuals and taxa were greatest and distribution of individuals by species was most even.

Some 88 of the total 99 barnacles collected at this platform were *Balanus amphitrite niveus* and 81 were taken at P4-1m. Most (67 of 81) individuals of this species were dead (Appendix I, Table A20). Barnacles were rare at P4-10m and absent at P4-20m and P4-30m.

The total wet and dry weights of discrete fauna were, respectively, 5,793 and 4,477 g/m^2 at P4-1m, 11,315 and 9,107 g/m^2 at P4-10m, 5,320 and 3,836 g/m^2 at P4-20m, and 221 and 140 g/m^2 at P4-30m. The dominant fouling organism at all stations in terms of weight was the bivalve *Chama macerophylla*. This species accounted for approximately 50 to 90% of the biomass collected at each station. At Station P4-10m, oysters (Ostreacea) were co-dominant with *C. macerophylla*. Species diversity and evenness for biomass collections were greatest at Station P4-10m, whereas the level of species richness was highest at Station P4-1m.

c. Colonial Fauna

Colonial fauna were represented by 11 taxa at P4-1m, 17 taxa at P4-10m, and 15 taxa each at P4-20m and P4-30m (Appendix I, Table A23). Among the colonial fauna represented at Station P4-1m, an encrusting calcareous sponge (*Calcarea, Homocoelidae*) was the most common form. At P4-10m, the stalked bryozoan *Bugula neritina* was as abundant as the codominant algae. At P4-20m, *B. neritina* was dominant in two of the three replicates. Colonial anemones (Zoanthidea) and the encrusting bryozoan *Cleidochasma contractum* were dominant in the third sample. Each of the replicates collected at P4-30m differed in terms of their respective colonial dominants. Two species of demosponges were most abundant in one sample; colonial anemones (Zoanthidea) dominated the second replicate, and ascidians (Ascidiacea 2) were dominant in the third sample. Species diversity and evenness were greatest at P4-20m whereas species richness was highest at P4-10m.

d. Supplementary Observations

Fourteen taxa not contained in the scraping samples were collected by the diving scientists. Of these, six were bivalves, one was a portunid crab (*Cronius ruber*) and two were the sea urchins *Eucidaris tribuloides* and *Diadema antillarum* (Table 2).

Some deeper areas of this platform were characterized by luxuriant growths of the octocoral, *Telesto* sp. Some colonies were as much as 0.5-m tall and had basal areas as much as 1 m in circumference. Caprellid amphipods and blennies were abundant among the branches of this visually dominant species. Representative biofouling assemblages at P4 during 13-16 June 1978 are shown in Plate 6.

2. Platform-Associated Macrobiota

a. Quadrat Counts

Macrocryptic fauna, particularly blennies (mostly seaweed blennies)and xanthid crabs were abundant at P4. The density of blennies at 2- to 3-m depths was estimated to range between 36 (1 diving scientist) and 60 fish/m^2 (2 diving scientists). Gastropods and nudibranchs were also represented in the near-surface zone with an estimated density of 4 individuals/m^2. Populations of cryptic organisms in near-surface zones of this platform were thus represented by a density of about 68 organisms/m^2.

At 8- to 9-m depths on the sampled leg of P4, blenny density ranged from 4 to 12 fish/m^2, pistol shrimp were present at an estimated density of 4/m^2 and xanthid crabs were represented by 56 crabs/m^2. These data result in a maximum density of 72 organisms/m^2 most of which are xanthid crabs.

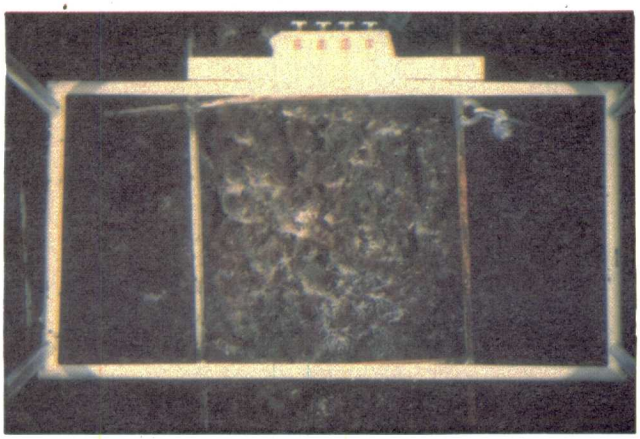
b. Observational Data

Based upon the 13-15 June observations, this platform was the most diverse of the primary platforms in terms of fish fauna. Large, solitary predatory species represented included the barracuda, jack crevalle, cobia, and hammerhead shark (*Sphryna* sp.). Abundant schooling pelagic fishes were the spadefish (dominant species at platform), lookdown and blue runner. Other pelagic fishes sighted included almaco jacks, greater amberjack, bar jack (*Caranx ruber*), moonfish and rainbow runner (*Elagatis bipinnulata*).

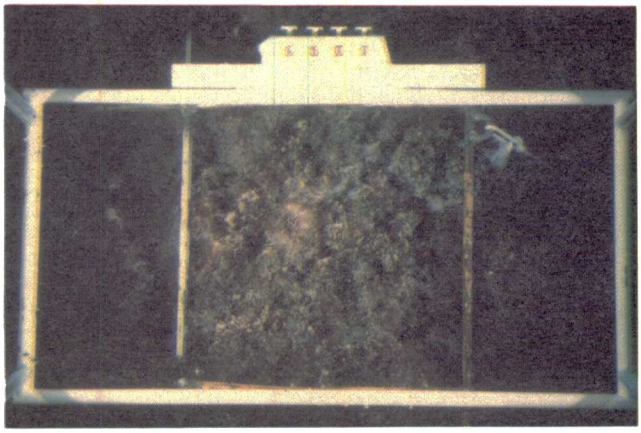
Structure-associated fish included sheepshead, gray triggerfish, blennies (mostly seaweed blenny), soapfish, Bermuda chub, and a diversity of tropical species. The latter included cocoa damselfish, blue angelfish, juvenile French angelfish, sergeant major, brown chromis, filefish (Monacanthidae), "tangs" (Acanthuridae), flamefish and creole fish (*Paranthias furcifer*).

Gray snapper were one of the more abundant species represented at P4. Schools of gray snapper were present inside the structure and around its periphery. They deserted the structure when alarmed or approached by a diver. Red snapper were also abundant. A photograph showed over 90 individuals in a single school. A mycteropercid, probably scamp, was the only grouper observed at Platform P4. No census was made of the bottom water layer at this deep water platform due to diving limitations.

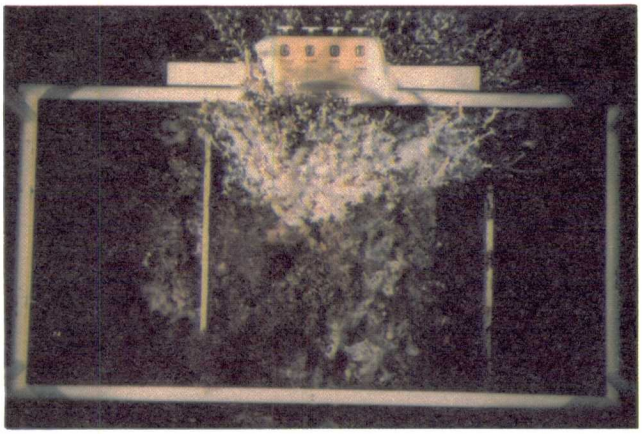
A total of seven, nine and three species of fish were represented on the June videotapes taken at P4 at 5-, 17-and 26-m depths, respectively (Table 3). Spadefish were dominant at 5- and 17-m depths and a blenny monopolized the film at the 26-m depth. Gray



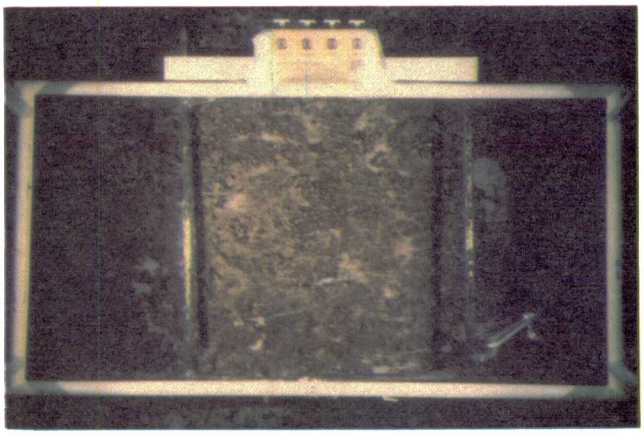
South Timbalier 161A
Sample Replicate
1m Depth



South Timbalier 161A
Sample Replicate
10m Depth



South Timbalier 161A
Sample Replicate
20m Depth



South Timbalier 161A
Sample Replicate
30m Depth

PLATE 6: CHARACTERIZATION OF BIOFOULING COMMUNITIES
AT PLATFORM 4, AMOCO ST161A.

snapper were second most abundant at 5 m, and gray triggerfish were the second most abundant species at 17 m.

We observed fish populations at P4 again on 3 September while collecting specimens for other investigators. The fish populations were very much as described above. One habitat described in a June debriefing tape in terms of location and the presence of an adult blue angelfish and two juvenile French angelfish was located again in September. Three angelfishes (one adult blue and two juvenile French) were in residence. Two large redfish (*Sciaenops ocellata*) were added to the P4 checklist.

E. Secondary Platforms

The objective of the second diving cruise was primarily to obtain specimens for analysis by other investigators rather than surveying platform biota. Although the first objective was demanding, significant observations were made. Some of the more pertinent of these observations with respect to platform biota are discussed below. Results of the survey of the primary platforms are used as a standard for evaluating the additional, but limited, observations.

Collectively, the biota of Platforms S5, S8, S10, S11, S19 and S20 were much as described above for Primary Platforms P1 and P2. Each of these platforms was inside the 27-m bottom contour (Fig. 7), and was largely characterized by "coastal" faunal assemblages. Algae were scarcely represented and, typically, the fouling communities were dominated by small acorn barnacles covered by an assemblage of hydroids, bryozoans, and encrusting sponges. Because of this, they were characterized by low structural relief. Oysters were usually present but seldom abundant except in the protected areas of the angles and joints of the platforms. Aside from these areas, little habitat was available for cryptic macrofauna. Habitat quality for cryptic forms associated with the fouling macrobiota of these platforms appeared to increase with distance offshore and, perhaps, with distance west.

The fish faunas of the Coastal grouping of platforms (Fig. 7) were typically dominated by spadefish, sheepshead, lookdown, blue runner, bluefish, and various jacks. Reef fishes were often encountered but seldom comprised a major component of the fauna. Snapper, particularly gray snapper, were abundant at some of the more offshore of these platforms.

Platforms S14 and S18 greatly resembled Platform P3 in terms of biofouling and fish communities. The biofouling community was characterized by higher relative abundance of bivalves as opposed to barnacles and, characteristically, because of high relief, provided good habitat for macrocryptic organisms. Near-surface areas were characterized by the presence of a green and red algal zone among which the tree oyster was often present in high densities. Biomass levels of fouling macrobiota were typically high to depths of 20 m but dropped markedly in deeper areas. Sparse growths of the octocoral *Telesto* sp. were typical.

The fish faunas of these platforms were usually dominated by coastal forms such as spadefish, lookdown, bluefish, sheepshead and gray triggerfish. These species were supplemented by large numbers of gray snapper, blue runner and moonfish. Large predatory species such as barracuda, ling and jack crevalle were common. In comparison to Coastal Platforms, these structures had a much richer tropical fish fauna. Bermuda chub were characteristically present and associated with the algae zone; blennies of several species were abundant and several species of damselfishes, butterfly fishes and tangs were usually common. Based upon overall faunal characteristics, these platforms seem to represent an ecotone between the Coastal and the next major grouping of platforms, the "Offshore" (Fig. 7). Within the speculated ecotone, the fauna at Platform P3, installed in 1968, appeared more diverse and productive than Platforms S14 and S18, installed in 1973 and 1970, respectively (Fig. 7).

Offshore platform assemblages were represented by Platforms P4, S6, S13 and S16 (Fig. 7) with Platforms P4 and S16 seemingly much more diverse and productive than Platforms S6 and S13. All were installed during a 7-year time period ranging from 1964 (Platform P4) to 1971 (Platform 16). Platforms S6 and S13 were the easternmost of this grouping (closest to the Mississippi River discharge) and, although deeper than the westerly Platforms P4 and S16, they were much closer to shore.

The biofouling communities at Platforms P4 and S16 were dominated at the surface by red and green algae (abundant to 20 m at Platform P4) and at depth by pelecypods. Density of *Telesto* sp. colonies was high and growth of individual colonies was often luxuriant. Hard corals (*Astrangia* sp. and *Phyllangia* sp.) were abundant and formed large colonies. The biofouling assemblage characteristic of these platforms provided good habitat for macrocryptic fauna including blennies, arrow crabs, stone crabs, oyster drills and sea urchins. Although spadefish were sometimes abundant (as at Platform P4), sheepshead were scarce, apparently replaced by the gray triggerfish. Blue runner and almaco jack were abundantly represented as were gray and red snapper. Barracuda and ling, particularly the former, were the common large predators at the offshore platforms. Representatives of all the reef- fishes mentioned above were usually present and were supplemented by (1) juvenile and adult angelfishes (common) and (2) creole fish (uncommon).

We believe Platforms S7, S15, S17 and probably Platform S9 (not observed *in situ*), also constitute a distinct assemblage which we choose to call the "Bluewater" or "Coral Reef" assemblage (Fig. 7). Algae and stalked barnacles were represented at the surface of some of those structures and, at depth, pelecypods and hydroids dominated the biofouling community. Spiny lobster (*Panulirus* sp.) were taken at Platforms S7 and S15.

The most striking feature of these platforms, however, was the dominance of the fish community by coral reef forms. Barracuda were abundant large predators and almaco jack and blue runner were the dominant schooling pelagic species. The creole fish may have been the dominant structure-associated fish. Spadefish and sheepshead were absent or virtually absent; gray triggerfish were abundant. Each vertical member of these platforms was surrounded by a swarm of tropical species. The damselfishes, angelfishes and tangs mentioned above were abundant, but were overshadowed by the abundance of certain wrasses, particularly creole wrasse (*Clepticus parrai*) and Spanish hogfish (*Bodianus rufus*). Other species which were observed here but not

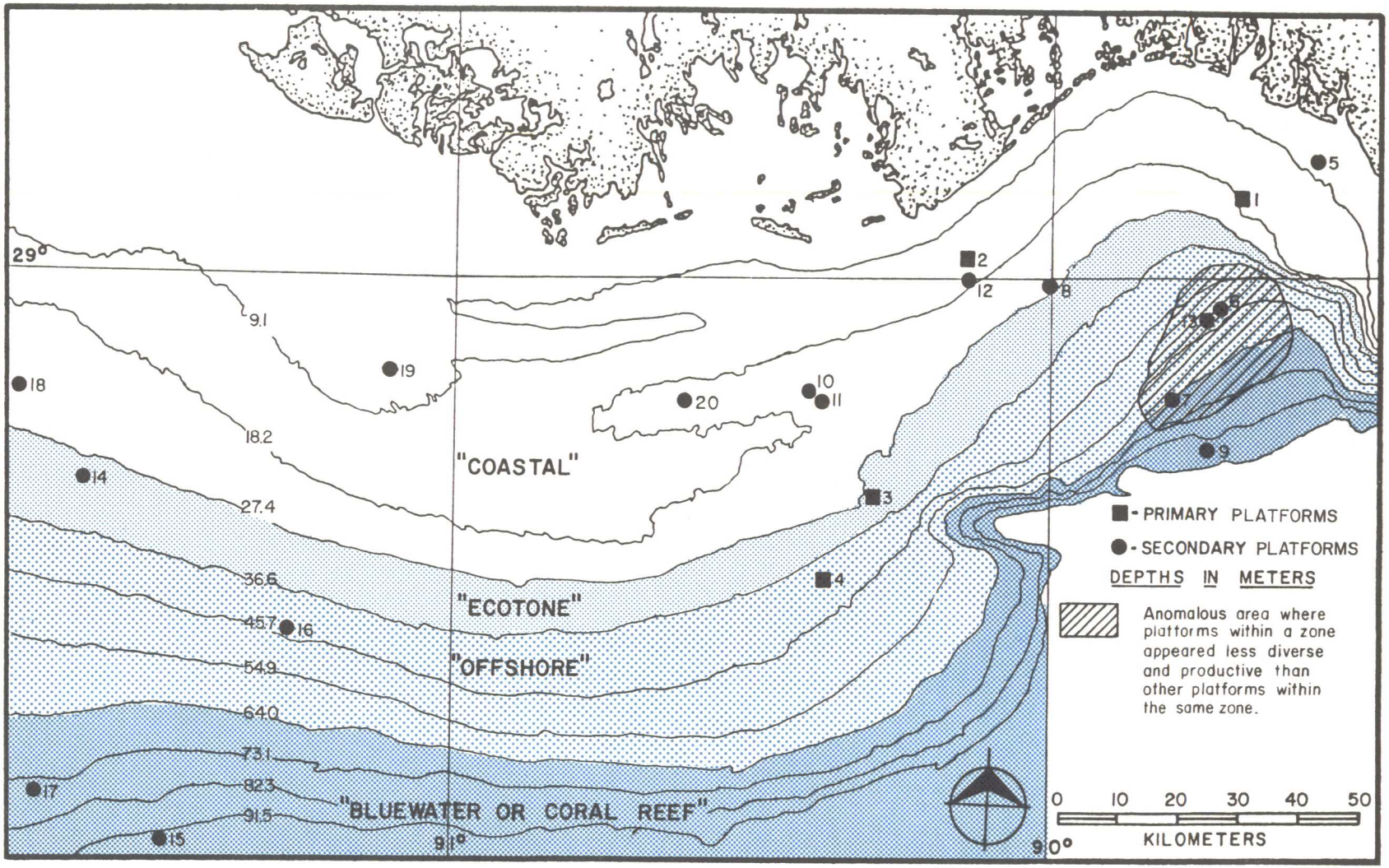


FIG. 7. Zonation of production platform habitat types represented in the northern Gulf of Mexico offshore Louisiana.

at any inshore platforms included the rock beauty (*Holacanthus tricolor*), redspotted hawkfish (*Amblycirrhitus pinos*) and red hogfish (*Decodon puellaris*). Two large amberjack were caught by bottom fishing at Platform S17.

Our impression was that Platform S7 (installed in 1965) was less rich in terms of fauna than either Platforms S15 (1974) or S17 (1972). Platform S7 is closer to the Mississippi River Delta than Platforms S15 or S17 and is also in somewhat shallower water (Fig. 7).

Representative invertebrates, vertebrates, and assemblages of organisms at production platforms offshore Louisiana are shown in Plates 7-12. The aesthetic value of the offshore production platform resource is evident and a potential commercial and recreational fishery value is implicated.

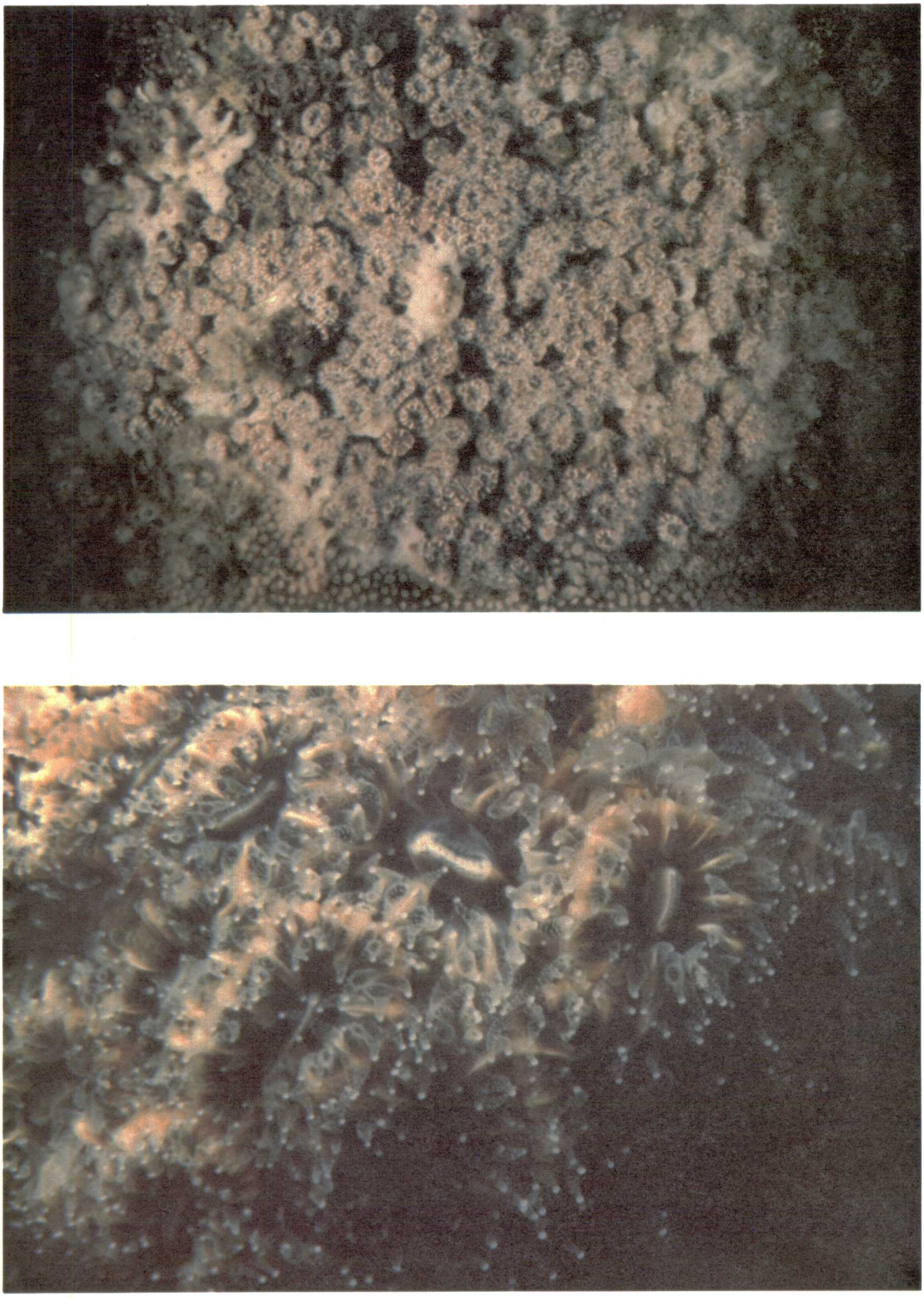
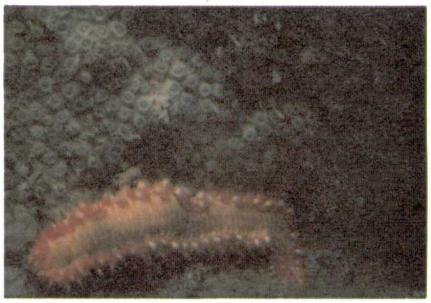


PLATE 7: PLATFORM ASSOCIATED MACROBIOTA, THE HARD CORAL *PHYLLANGIA*

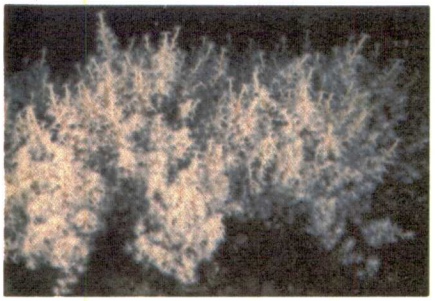
Surface algae mat

Fireworm



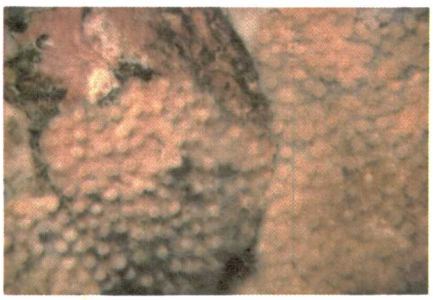
Colonial tunicate

Brittle stars



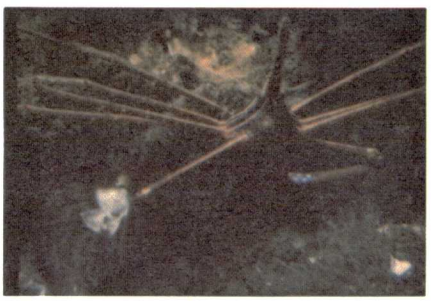
Octacoral

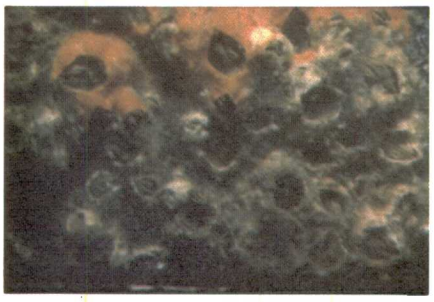
Nudibranch



Colonial anemone

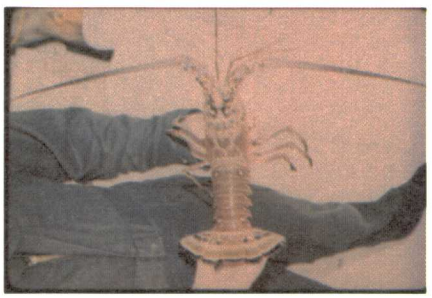
Arrowcrab

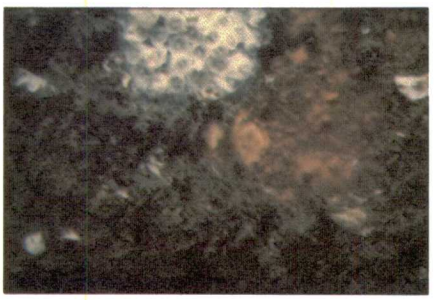




Barnacle close-up

Spiny lobster





Hard coral, red sponge and hydroid mat

Oyster drill

PLATE 8: PLATFORM ASSOCIATED MACROBIOTA, INVERTEBRATES.

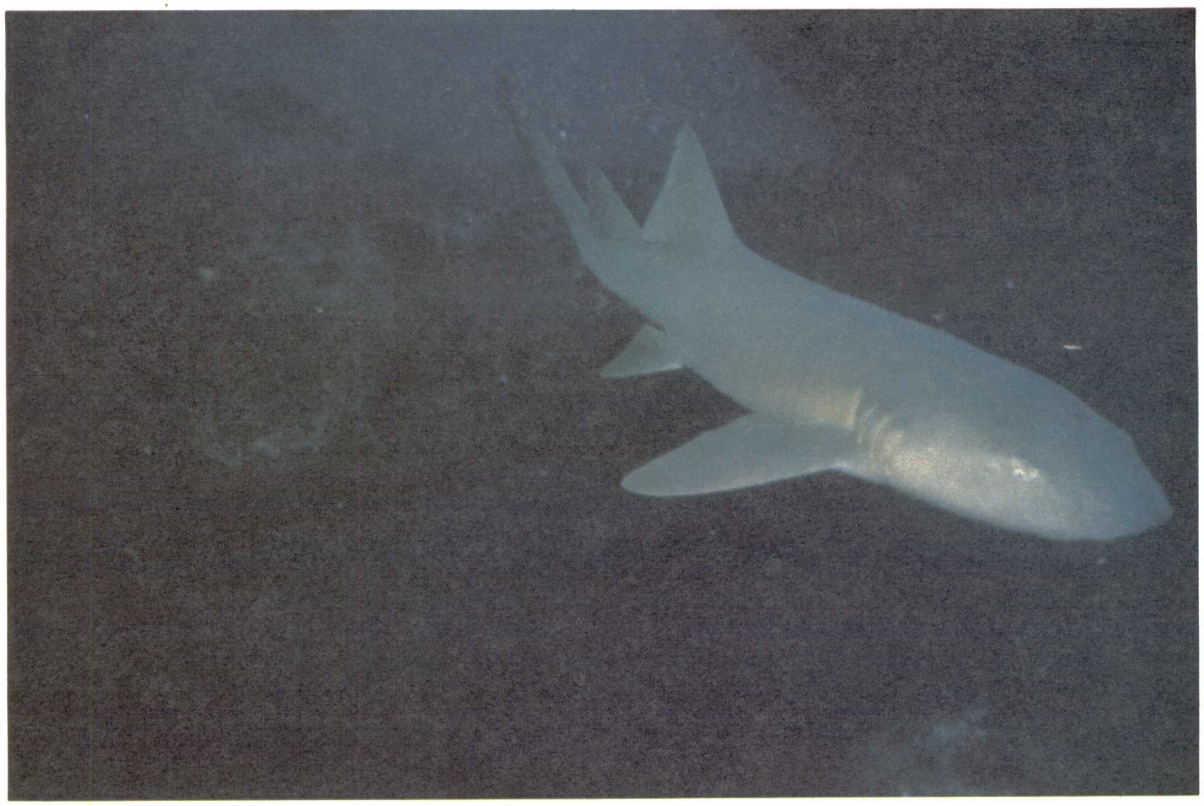
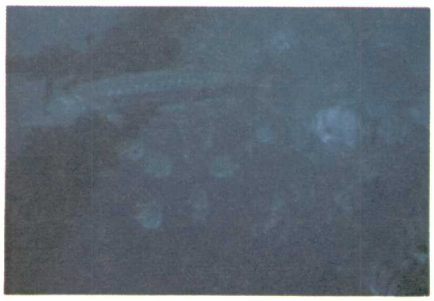


PLATE 9: PLATFORM ASSOCIATED MACROBIOTA, NURSE SHARK, *GINGLYMOSTOMA CIRRATUM* (ABOVE); COMB GROUPER, *MYCTEROPERCA RUBRA* (BELOW).

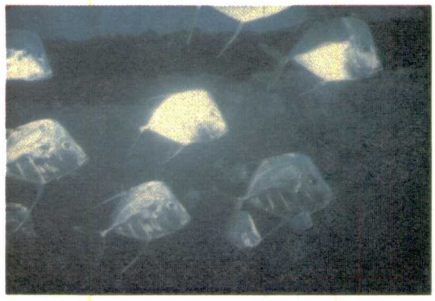


Barracuda

Blue runner

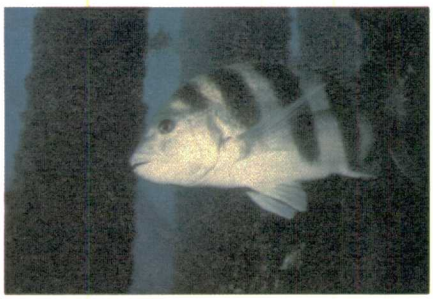
Atlantic spadefish

Bluefish



Lookdown

Gray snapper



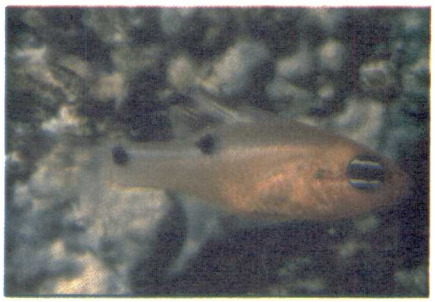
Sheepshead

Red snapper

Gray triggerfish

Grouper

PLATE 10: PLATFORM ASSOCIATED MACROBIOTA. COMMON AND USUALLY DOMINANT FISHES.

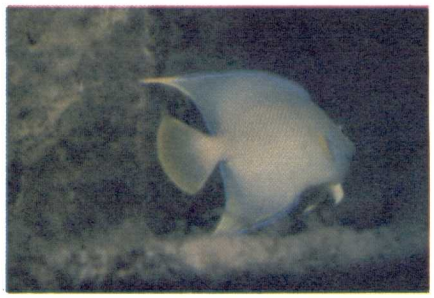


Flame fish

Juvenile french angelfish

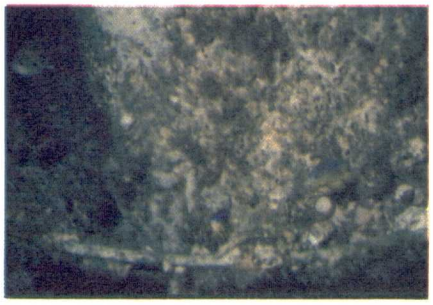
Cocoa damselfish

Juvenile angelfish



Adult blue angelfish

Brown chromis



Sergeant major

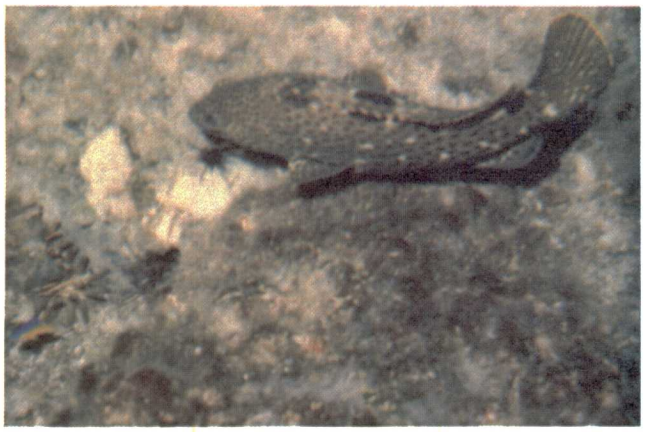
White spoted soapfish

Crested blenny

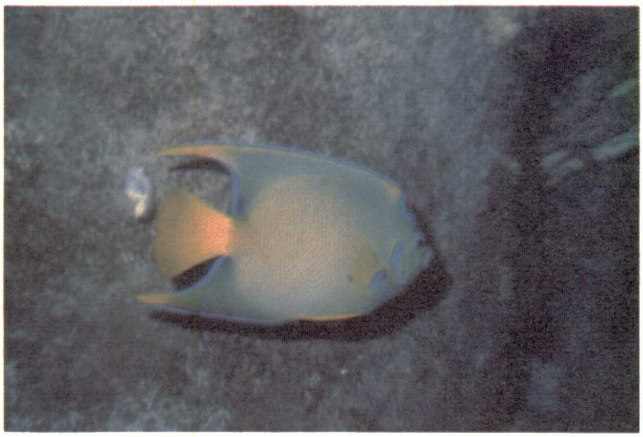
Seaweed blenny

Creolefish

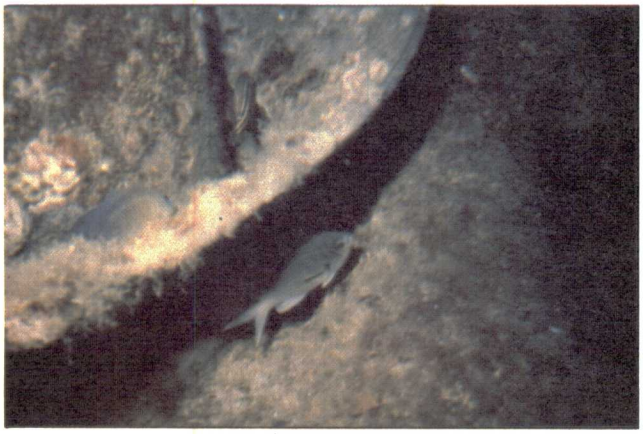
PLATE 11: PLATFORM ASSOCIATED MACROBIOTA, REEF FISHES



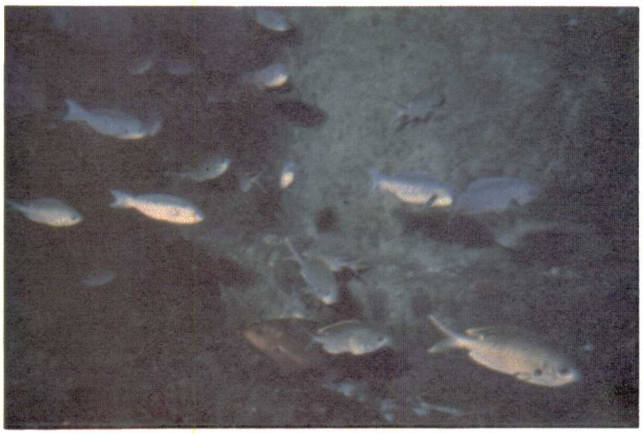
A rock hind on a shallow cross member. Note low relief of the biofouling community and the presence of two species of urchins, *Diadema* sp. and *Eucidaris* sp.



Queen angel fish. Note the presence of red and green algae and a large oyster.



Close up view of an area of the biofouling community. A brown chromis, damselfish, and a file fish in typical habitat.



The dominance of tropical fishes. Brown chromis, creolefish and creole wrasse are represented in the photograph.

(Photographs by C. A. Bedinger)

PLATE 12: BIOFOULING AND FISH ASSEMBLAGES ASSOCIATED WITH MARATHON OIL PLATFORM EUGENE ISLAND G2322.

VI. QUANTITATIVE COMPARISONS OF PLATFORMS

The data for discrete macroepifauna obtained from the scraping samples provide the only basis for quantitative comparisons of the four primary platforms. We believe that the samples are "good," i.e., the sampling technique was close to 100% effective. The material which was analyzed in the laboratory was an accurate representation of what was growing in a sample quadrat. Further, we believe that the total area sampled was adequate to yield representative samples of the patchily distributed biofouling fauna growing at a station. Finally, replication of samples allowed for estimation of sample variances.

A. Total Biomass

Results of the analysis of variance tests performed on the total biomass data indicated significant differences ($\alpha = 0.01$) in wet weight biomass levels among stations (Fig. 8). Orthogonal constasts shown to be significantly different are indicated in Table 4.

Average biomass was indicated to have been higher on nearshore than on the offshore platforms. This difference is attributable to the distributional patterns of their biomass contributors, barnacles and pelecypods. Shelled organisms were abundant to the maximum depths (10m) sampled at the nearshore platforms (P1 and P2), whereas at offshore platforms (P3 and P4) their biomass was significantly lower at 20-m and 30-m depths than at 1- and 10-m depths (Contrasts III and X). On the offshore platforms, biomass levels were typically higher at 20-m depths than at 30-m depths. These differences were significant at Platform P3 (Contrast XII).

At Platform P3, the biomass levels at P3-1m were significantly greater than the levels at P3-10m (Contrast XI). At Platform P4, which in contrast to Platform P3 had a surface discharge of produced water, biomass levels were significantly less at P4-1m than at P4-10m. This apparent inhibitory effect, restricted to only a few meters around the point of discharge, has been observed at other platforms in the northern Gulf with surface discharges. In contrast, biomass levels at Stations P1-10m and P1-10mDL at Platform P1 (Station P1-10mDL was about 8m above a submerged produced water discharge, Station P1-10m was a control) were not significantly different. As described in a later section, zones beneath, as opposed to above, the discharge at Station P1-10mDL were characterized by low biomass (see Plate 13).

B. Species Diversity

The index of diversity varied largely as a function of the evenness component as well as with the number of species present. In some instances, totally different samples in terms of number and kinds of species and structural composition yielded nearly identical indices (e.g., compare diversity values for Stations P3-1m and P2-1m of Fig. 9). Much of this bias was attributable to taxonomic ambiguity. Although many taxa were identified to species, some of the more abundant forms were identified only to the phylum level (e.g., Nemertea). Another factor contributing to the problem, however, is undoubtedly related to life history effects. The influence of life history phenomena (e.g., "blooms") upon community summary statistics is often great enough to override all other factors affecting this index (e.g., Gallaway and Strawn, 1975). In order to be able to make an accurate assessment of communities based upon diversity indices, classification should be at the species level and samples should be collected through time with the rise and fall and averaged values of the statistics correlated with observed biological events.

1. Numbers of Discrete Fauna (H'n)

Species diversity levels based upon numbers of discrete organisms at stations (H''n) ranged from a low of 1.41 at Station P3-30m to a high of 2.81 at Station P1-10m (Fig. 9). Results of the analysis of variance performed on species diversity indices indicated significant differences.

The orthogonal contrasts shown to be significantly different are indicated in Table 5. Of these, only one contrast (VII) involved a nearshore platform. At Platform P1, collections taken at 10-m depths were characterized by the highest diversity levels observed at any station (Fig. 9). At Platform P3, Stations P3-1m and P3-10m, when considered collectively, were less diverse than Stations P3-20m and P3-30m considered collectively (Contrast X). Although Station P3-1m collections contained more species than Station P3-10m collections, the diversity index was significantly higher at Station P3-10m (Contrast XI). The difference in diversity between Stations P3-1m and P3-10m was mainly due to the relative lack of evenness at Station P3-1m (Fig. 9) resulting from the marked dominance of the surface-dwelling tree oyster. In contrast, diversity at Station P3-30m was significantly lower than diversity at Station P3-20m due to the low number of species represented in the P3-30m collections (Fig. 9).

TABLE 4. Total biomass orthogonal contrasts which showed significant differences by analysis of variance.

Source		d.f.[1]	Mean Square	F[2]	Pr > F[3]
Contrast I	(Fig. 4)	1	3.7801	29.65	0.0001
Contrast III	(Fig. 6)	1	0.8556	6.71	0.0158
Contrast IV	(Fig. 6)	1	0.8532	6.69	0.0156
Contrast X	(Fig. 6)	1	9.8327	77.13	0.0001
Contrast XI	(Fig. 6)	1	1.2408	9.73	0.0044
Contrast XII	(Fig. 6)	1	0.6150	4.82	0.0372

[1]df = degrees of freedom
[2]F = F value
[3]Pr > F = probability of a greater F value

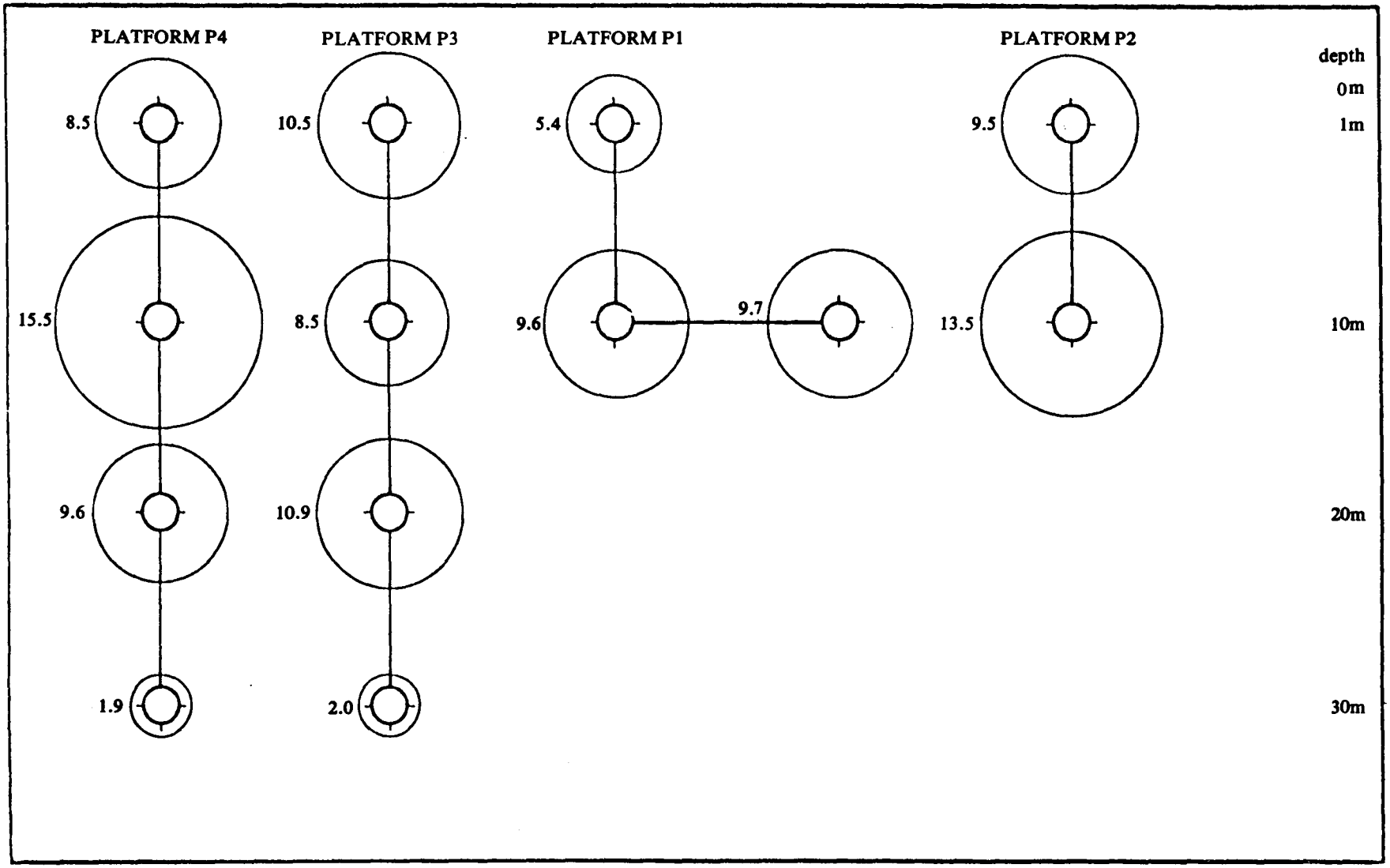


FIG. 8. Comparisons of average total biomass (kg/m^2; number adjacent to each circle) taken at sampling stations of the four primary platforms.

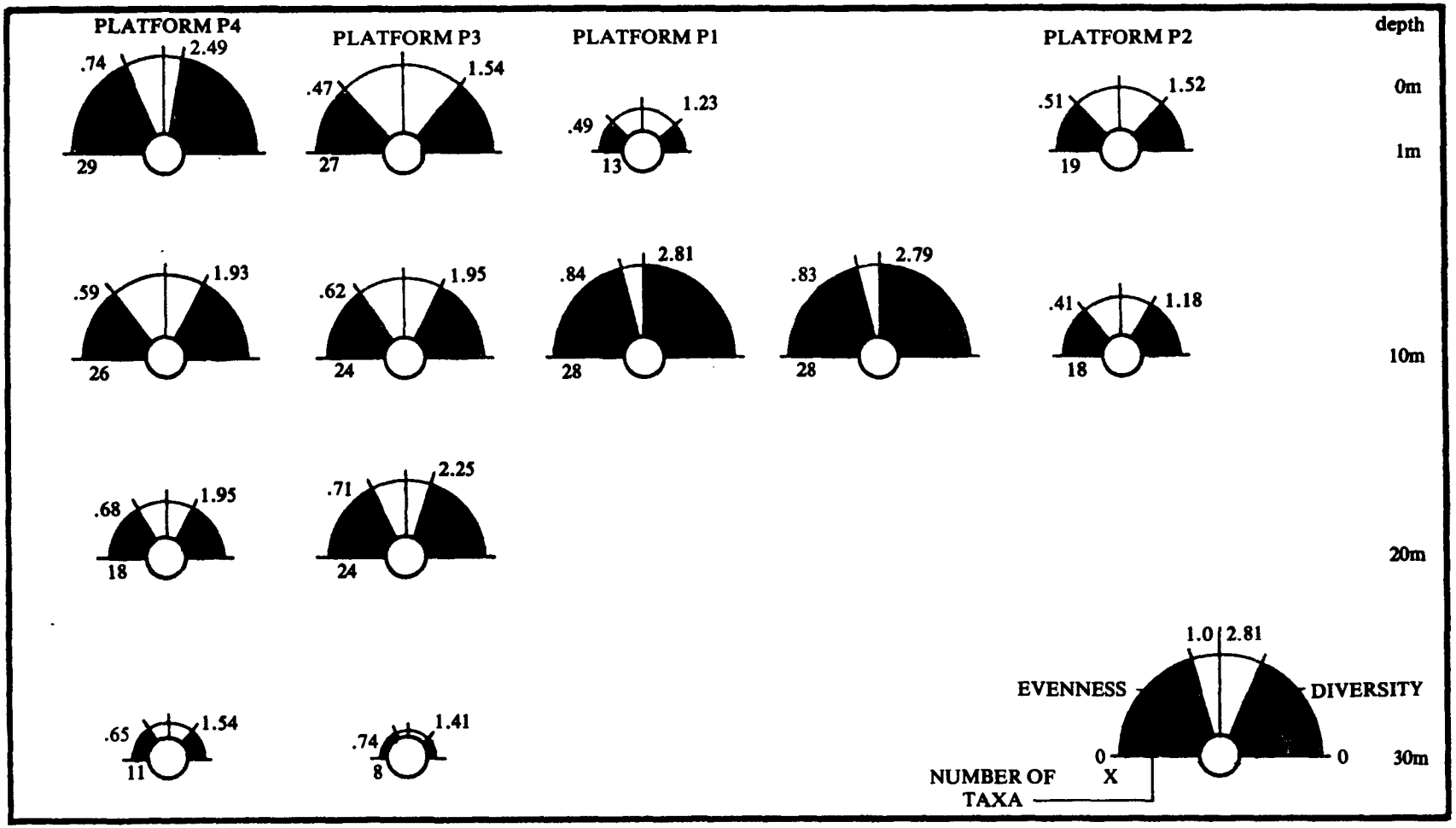


FIG. 9. Comparisons of relative species diversity and evenness (based on numbers) for discrete epifaunal scraping samples taken at four primary platforms. Scale on left shows evenness (observed diversity divided by maximum diversity log $_e$S, number at top left of each graph). Scale on right shows observed diversity (number at top right) at a station as a proportion of the maximum observed diversity at a station. Number at lower left shows average number of species.

TABLE 5. Species diversity orthogonal contrasts which showed significant differences by analysis of variance.

Source		d.f.[1]	Mean Square	F[2]	Pr > F[3]
Contrast III	(Fig. 6)	1	0.6832	12.52	0.0015
Contrast IV	(Fig. 6)	1	0.9773	17.91	0.0003
Contrast VII	(Fig. 6)	1	5.1372	94.16	0.0001
Contrast X	(Fig. 6)	1	0.4902	9.98	0.0059
Contrast XI	(Fig. 6)	1	0.9230	16.92	0.0003
Contrast XII	(Fig. 6)	1	0.4937	9.05	0.0058

[1]df = degrees of freedom
[2]F = F value
[3]Pr > F = probability of a greater F value

As shown in Fig. 9, collections taken at the P4-1m and P4-10m were significantly more diverse than collections taken at P4-20m and P4-30m (Contrast III), and collections at Station P4-1m were more diverse than those from Station P4-10m (Contrast IV). Station P4-1m collections contained an average of 29 species and none was markedly dominant.

2. Biomass of Discrete Fauna (H'' w)

Diversity levels based upon biomass values were typically lower than the calculated levels based upon numbers (Fig. 9 and 10). Results of analysis of variance and orthogonal contrasts showing significant differences are indicated in Table 6.

Diversity of biota at Platforms P3 and P4 considered collectively was indicated to be significantly higher than that at Platforms P1 and P2 considered collectively. Level of diversity at 1-m depth (P3-1m) on Platform P3 (without a discharge) was higher than diversity at P3-10m. There were no significant differences between 1- and 10-m stations (P4-1m and P4-10m) on Platform P4 which had a surface discharge. In contrast to diversity values based upon numbers, H''w for Station P4-30m was higher ($\alpha = 0.05$) than H''w for Station P4-20m. The diversity indices for Stations P1-10m and P1-10mDL of Platform P1 were higher ($\alpha = 0.05$) than the value observed at P1-1m (Fig. 10).

3. Colonial Fauna (H''$\sqrt{\%\ cover}$)

Seven of the 12 orthogonal contrasts of colonial faunal diversity showed signficant differences (Fig. 11). Platform P2 was lower in terms of diversity of colonial fauna than Platform P1 with Station P2-10m being less diverse than Station P2-1m (Fig. 11). In contrast, P1-1m had a significantly lower diversity than P1-10m and P1-10mDL.

Platform P3 was characterized by a more diverse colonial fauna in deep zones as opposed to surface zones and diversity was significantly higher at P3-20m than at P3-30m. Diversity of colonials was greater at P4-10m than at P4-1m, and greater at P4-20m than at P4-30m. Typically, low diversity values for colonial fauna related both to the lack of evenness as well as the presence of only a few species.

C. Community Structure

Comparison of platforms in terms of community structure was performed using two analytical techniques. One was an analysis of the distributional patterns of the dominant major groups and species, whereas the second was cluster analysis based upon data for all species. In the analysis of dominants, particular emphasis was placed upon the relatively long-lived shelled organisms, barnacles and pelecypods. This suite of six species comprised over 99% of the total biomass represented by discrete organisms even though from a numerical standpoint they represented only about 6% of the individuals in the total collections. Although barnacles and pelecypods are characterized by temporal and spatial variability, life history information is known for some species and turnover rates are on the order of months as opposed to days.

The distribution of numerical and colonial dominant organisms among platforms and depths was also addressed, but comparisons based upon these ephemeral species must be viewed with caution because of life history phenomena. Most of these species are known to be characterized by great temporal and spatial variations in abdundance related directly or indirectly to life history phenomena (e.g., increases in abundance due to reproduction or increases related to the abundance levels of another species required as shelter from predation or food). The life cycles and turnover rates of most of these marine invertebrate species are poorly known except that turnover rates are rapid. The time scale required to build an accurate picture of a species' temporal variability may be on the order of months, or even years. In summary, the time at which the samples containing numerical and colonial dominant organisms were taken was critical to their values. Samples taken within a period of weeks, or even days, before or after sampling, might have given a completely different

TABLE 6. Discrete fauna diversity, based on biomass, orthogonal contrasts which showed significant differences by analysis of variance.

Source		d.f.[1]	Mean Square	F[2]	Pr > F[3]
Contrast I	(Fig. 4)	1	0.4690	4.23	0.0499
Contrast V	(Fig. 6)	1	0.6419	5.79	0.0235
Contrast VII	(Fig. 6)	1	0.5557	5.01	0.0339
Contrast XI	(Fig. 6)	1	0.5744	5.18	0.0313

[1]df = degrees of freedom
[2]F = F value
[3]Pr > F = probability of a greater F value

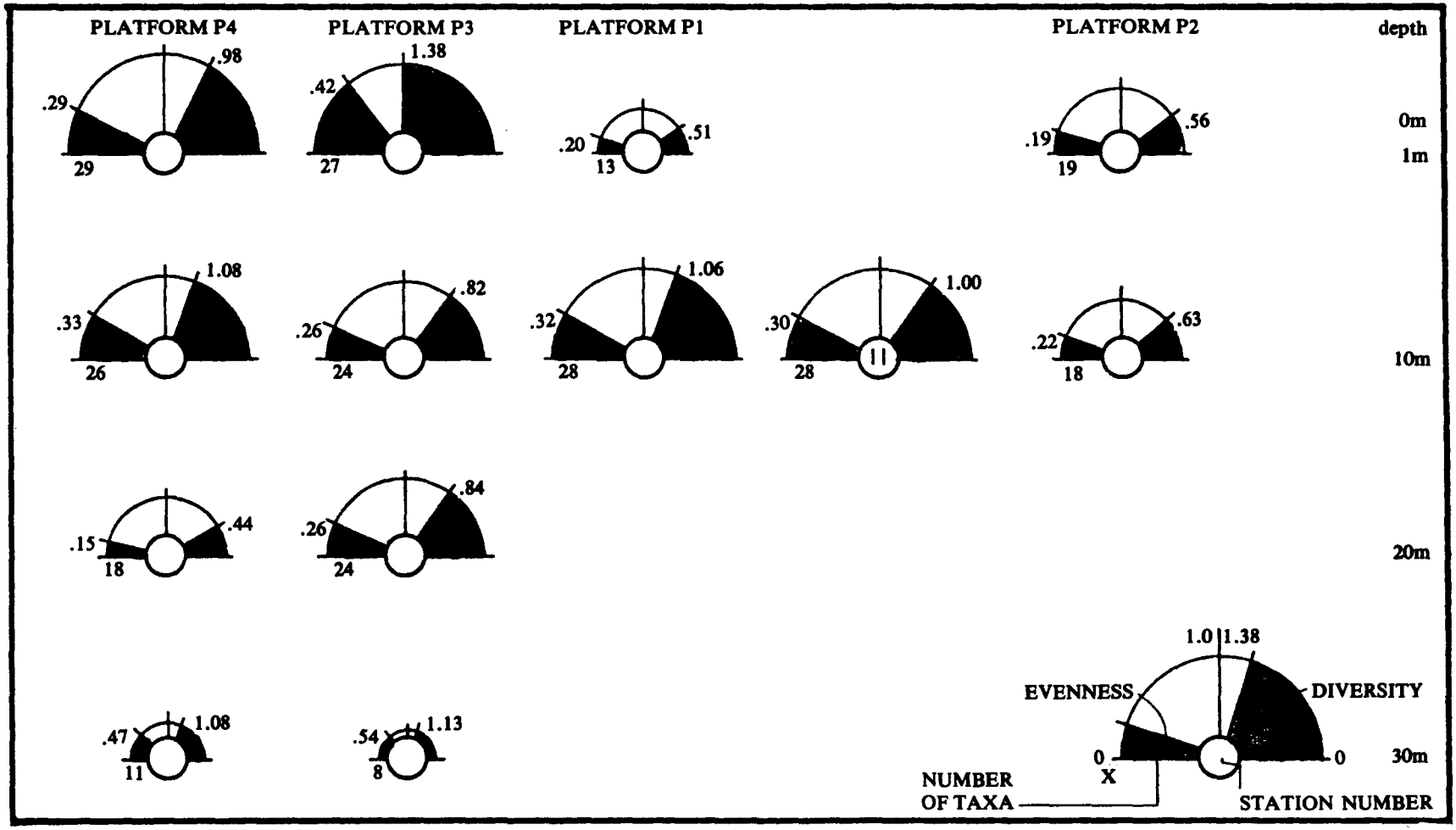


FIG. 10. Comparisons of relative species diversity and evenness (based on weights) for discrete epifaunal scraping samples taken at four primary platforms. Scale on left shows evenness (observed diversity divided by maximum diversity log $_e$S, number at top left of each graph). Scale on right shows observed diversity (number at top right) at a station as a proportion of the maximum observed diversity at a station. Number at lower left shows average number of species.

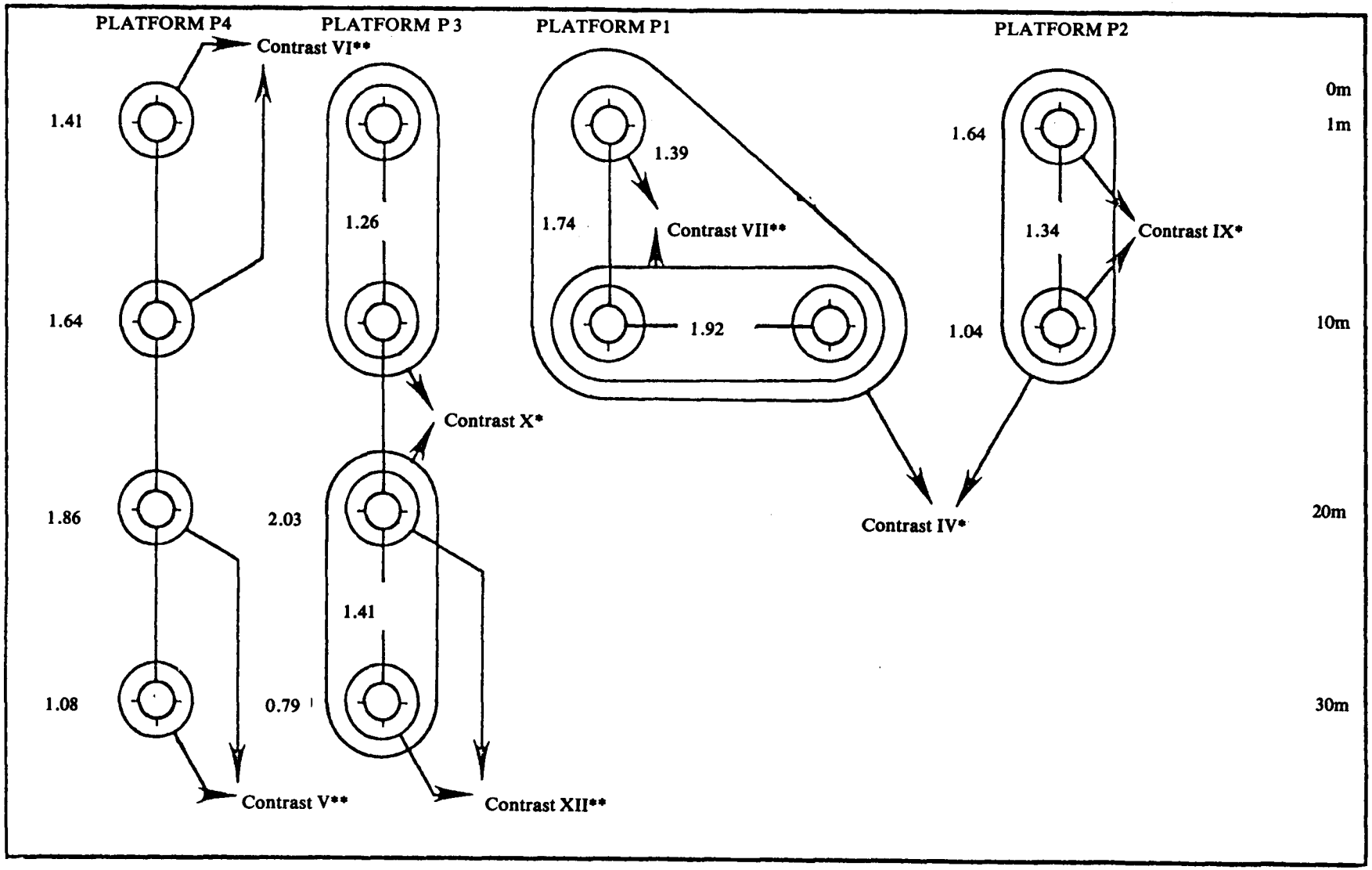


FIG. 11. Orthogonal contrasts showing significant differences (* = 0.05; ** = 0.01) in species diversity indices (H'') for colonial organisms.

picture with respect to community structure based upon relative abundance.

Using the same rationale as above, more emphasis is placed on the results of cluster analysis based upon biomass distribution. The results of these analyses based upon relative abundance of discrete and colonial dominant forms provide an accurate picture of the observed situation, but that picture might be considered as a single frame in a long and changing filmstrip.

1. Biomass Dominants

Barnacles dominated the collections at all stations of inshore platforms, whereas at offshore platforms, bivalves or pelecypods were dominant at all stations except at the bottom (P3-30m) of Platform P3 (Fig. 12). Station P3-30m was characterized by a total biomass of only 2 kg. Amphipods were the biomass dominant and were associated with a luxuriant growth of the hydroid, *Eudendrium carneum.*

At inshore Platforms P1 and P2, barnacles comprised over 90% of the biomass at both surface stations (P1-1m and P2-1m), whereas at 10-m depths, 52 and 88% of the respective platform's biomass consisted of barnacles. Pelecypods comprised an additional 10% of the biomass at Platform P2 Station P2-10m, but at P1-10m and P1-10mDL they contributed 48% of the biomass (Fig. 12). The greater relative abundance of bivalves at P1-10m and P1-10mDL as compared to P2-10m is believed to represent an effect of the produced water discharge; i.e., barnacles are particularly susceptible to produced water discharges.

Similar evidence of the effects of produced water on barnacles is evident from comparisons of the relative abundance of barnacles and bivalves among offshore stations. Although pelecypods dominated in all but one offshore collection, barnacles represented 27% of the total biomass at P3-1m (Platform 3, no discharge), whereas at P4-1m (surface discharge) they comprised only 6% of the total biomass.

a. Barnacles

Representatives of the Cirripedia are found worldwide and are generally represented whenever a suitable substrate for attachment is available. Many species have been translocated by shipping activities. Species of *Balanus* are self-fertilizing hermaphrodites which produce planktonic nauplii and cyrpid larvae. Cyrpid larvae settle on substrates and metamorphose into adults. Settlement rates up to 70/cm^2 have been reported (Connell, 1959). Pyefinch (1950) stated that only one or two of every 13,000 barnacle larvae survive to become an adult. Johnson and Snook (1955) report that studies have shown barnacles reach sexual maturity in about 80 days.

Balanus amphitrite is a widespread species somewhat restricted to warmer seas. It is reported to not be tolerant of low salinities and not normally occur in estuarine conditions (Moore and Frue, 1959). Henry (1959) states that the numerous subspecies of *B. amphitrite* have varying ranges of salinity tolerance. *B. a. niveus*, the subspecies identified in this study, is apparently restricted to higher salinities. Variations in vertical distribution have also been observed for the different subspecies. Pilsbry (1953) found that *B. a. niveus* generally occurred from below low tide to 40 fathoms. Moore and Frue (1959) report that, in Hawaii, *B. amphitrite* growth rates were 0.53mm/day in a 28-day study and 0.070mm/day in a 342-day study. They also indicated that spawning first occurs at 12-15 mm sizes.

Results of this study showed that *B. a. niveus* was predominantly an inshore species, although it did occur offshore where it was mostly restricted to the surface (Appendix III, Figs. 1 and 2). Abundance of this species at Platform P2 was significantly higher than at all other platforms (Appendix III, Fig. 1). At Platform P1 abundance (Station P1-10mDL) and biomass (Stations P1-1m and P1-10mDL) levels were similar to abundance and biomass levels of this species at P3-1m and P4-1m (Appendix III, Fig. 1 and 2).

Balanus improvisus is found worldwide in a wide range of salinities and temperatures. It occurs in a 30 degree range (near 0C to over 30C) of seawater temperature (Moore and Frue, 1959) and, probably, intermediate salinities are optimal (Bousfield, 1973). Near Miami Beach, Florida, this was the dominant species recorded on fouling test plates. Settlement of larvae peaked in spring and fall with a small peak occurring in summer (Moore and Frue, 1959). This settlement resulted in densities of 2 adult barnacles/cm^2. Moore and Frue suggested that either *B. improvisus* may have spawned three times during the year or that three successive generations settled, matured and spawned. Pequegnat and Pequegnat (1968) recorded *B. improvisus* in samples taken at depths above 17 m at 2, 11 and 25 mi offshore Panama City, Florida.

Results of this study showed that although *B. improvisus* was much less abundant than *B. a. niveus*, it had a similar distribution. *B. improvisus* was basically an inshore species (Appendix III, Figs. 3 and 4). Abundance, and to some extent biomass, were somewhat lower at the 10-m deep stations (p1-10m and P1-10mDL) on the nearshore platform with a near-bottom discharge of produced water (Platform P1) than at the same depth (P2-10m) on the nearshore platform without a discharge (Platform P2).

Balanus tintinnabulum is a large and conspicuous barnacle with several subspecies described. Gunter and Geyer (1955) reported the occurrence of this species from a ship which had been anchored off the Louisiana coast in the vicinity of the area sampled in this study. This was the dominant fouling species found by Gallaway et al. (1979) in the Buccaneer Oil Field, Texas, but was only rarely encountered by George and Thomas (1974) offshore Louisiana. In California, *B. tintinnabulum* passed through two generations in a year (Coe, 1932). Smith and Harderlie (1969) calculated the life span of *B. tintinnabulum* to be 16 months.

In contrast to the other species of acorn barnacles contained in our samples, *B. tintinnabulum* was predominantly an offshore species which appeared more successful in near-surface than in deep zones (Appendix III, Figs. 5 and 6). This species would have to be considered an incidental barnacle on the platforms investigated.

b. Ostreacea

Lumping of three species in this category results in a confused picture of distributional patterns (Appendix III, Figs. 7 and 8). In terms of numbers, this group was more abundant at P1-10m, P1-10mDL and P2-10m than at any other grouping of stations. In terms

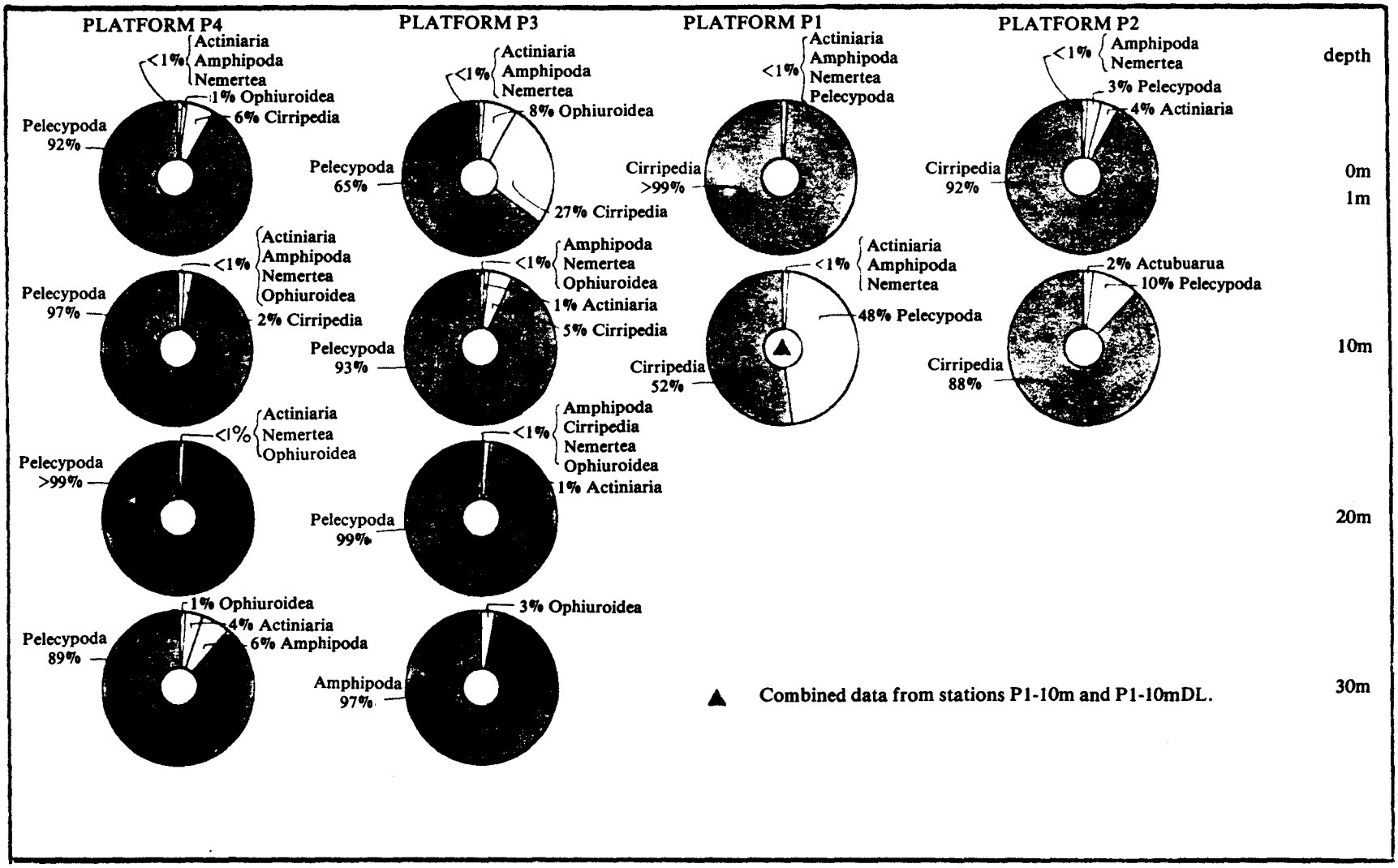


FIG. 12. Relative distributions of the major groups of dominant discrete organisms in terms of biomass by platform and depth.

of weight, all the 10-m deep stations and one 20-m deep station comprised the zone of highest abundance. The offshore representatives of Ostreacea were less abundant, but larger, than the inshore representatives. This group is in need of more work from a taxonomic standpoint (see Appendix II). Although the commercial oyster (*Crassostrea virginica*) occurred at both Platforms P1 and P2, it was not represented in the sample areas.

Chama macerophylla, the leafy jewel box, is a Gulf of Mexico and Caribbean species commonly reported from depths of 1 to 30 m (Abbott, 1968). The observed zone of the greatest numerical abundance of leafy jewel box at platforms investigated was at Stations P4-1m to P4-20m (Appendix III, Fig. 9). The zone of greatest biomass of *Chama macerophylla* included P3 and P4 stations down to 20-m depths and Station P1-10mDL (Appendix III, Fig. 10).

Isognomon bicolor, the bicolor tree oyster, is a warm tropical species found in the Gulf of Mexico and Caribbean (Abbott, 1968; Andrews, 1977). Andrews (1977) reported that the species occurs in "clusters on rocks in inlet-influenced areas." The bicolor tree oyster was most abundant at P3-1m and P4-1m, particularly at P3-1m (Appendix III, Figs. 11 and 12). Additionally, this species was well represented at P3-10m and P4-10m, at all P1 stations , and at P2-1m. It was scarcely represented at 20- and 30-m stations.

Arca imbricata, the mossy ark, is a common clam in moderately shallow water ranging from North Carolina to the Gulf of Mexico and Caribbean (Abbott, 1968; Andrews, 1977). It requires a firm substrate for attachment and has been referred to by Andrews (1977) as a "byssate epifaunal nestler." The mossy ark was most abundant at P3-1m and P4-10m (Appendix III, Figs. 13 and 14). Its relative absence at the surface (P4-1m) on Platform P4 suggests an inhibitory effect of the produced water discharge.

2. Numerical Dominants

As expected, there was considerable variation among platforms and depths in terms of numerical dominants (Fig. 13). Solitary anemones (Actiniaria) dominated all collections taken at Platform P2 and comprised over 57% of the collections taken at Station P3-10m. Amphipods were dominant at Station P1-1m and comprised over 70% of the collections taken at Stations P4-10m, P4-20m, P4-30m, P3-20m, and P3-30m. The group Amphipoda was co-dominant with Actiniaria at Station P3-10m, and with brittle stars (Ophiuroidea) at Station P4-1m. Brittle stars comprised over 80% of the collections of the near-surface Station P3-1m.

Representatives of Actiniaria were the single most abundant taxa (19% of the total collections) and were followed in abundance by the brittle star, *Ophiactis savignyi* (14%). Four species of amphipods-*Stenothoe* sp. (13.9%), *Caprella equilibra* (9.3%), *Paracaprella pusilla* (4.4%) and *Ericthonius brasiliensis* (4.1%)- collectively represented about 32% of the total collections. Thus, six species represented 65% of the total collections.

a. Actiniaria

Representatives of solitary anemones were ubiquitous in the study area (Appendix IV, Fig. 1). Density was particularly high at Platform P2 and at Station P3-10m. Greater taxonomic resolution than that obtained would be necessary in order to evaluate the observed distributional pattern.

b. Ophiactis savignyi

Brittle stars are circumtropical in distribution and occur from the littoral zone to a depth of 146 m. *Ophiactis savignyi* has been found to be common on Buccaneer Oil Field structures (Gallaway et al., 1979) and at the West Flower Garden Bank offshore Texas (Burke, 1974). In the former habitat it is commonly associated with dense growths of bryozoans, whereas in the latter habitat, it inhabited holes and crevices in sponges. This brittle star was predominant at P3-1m, P3-10m, P4-1m, and P4-10m (Appendix IV, Fig. 2). The brittle star was associated with dense growths of algae and tree oysters at Station P3-1m, and was also found abundant in sponges (see Plate 8).

c. Stenothoe sp.

McKinney (1977) reported that two species of *Stenothoe* occur in the Gulf of Mexico: *Stenothoe gallensis* and *S. minuta*. Of these *S. minuta* was described by Bousfield (1973) as an estuarine species and McKinney (1977) found *S. gallensis* associated with coral reefs offshore Mexico. Fotheringham (1977) found *S. gallensis* was the only species represented in samples from the Buccaneer Oil Field.

Samples from offshore Louisiana contained individuals representing both species. At Platform P3, *S. gallensis* to *S. minuta* ratios of 25 to 1 were observed in the combined collections. This group was not separated to species because of time and resource limitations. Species-level identification of *Stenothoe* requires dissection of each individual. Literally hundreds of specimens were contained in most samples with the typical individual being about 2-mm in length.

Stenothoe sp. was ubiquitous in the study area. It was most abundant at Stations P1-1m and P2-1m with the zone of next highest abundance including Stations P3-10m and P4-10m (Appendix IV, Fig. 3).

d. Caprellid amphipods

These forms are commonly found associated with hydroids, bryozoans, algae and seagrasses (Gosner, 1971). They feed primarily on diatoms, but can also utilize small invertebrates and detritus for food (McCain, 1968). *Caprella equilibra* was particularly abundant at Stations P4-1m, P4-10m, and P4-30m, with the zone of next highest abundance including P1-1m and P2-1m (Appendix IV, Fig. 4). This species was scarcely represented at P1-10m, P1-10mDL, and P2-10m. In marked contrast, *Paracaprella pusilla* was an offshore species apparently preferring deep water (Appendix IV, Fig. 5). It was relatively abundant at P1-10m and P1-10mDL.

e. Ericthonius brasiliensis

This corophiid amphipod is found in tropical and warm temperate seas (McKinney, 1977). It is a tube-building species generally associated with hydroids and bryozoans. *Ericthonius brasiliensis* is a polyhaline species which has been found in bays and mouths of estuaries in salinities down to 15%. Bousfield reports this species has an annual life cycle with ovigerous females found from May to September. Several broods per year

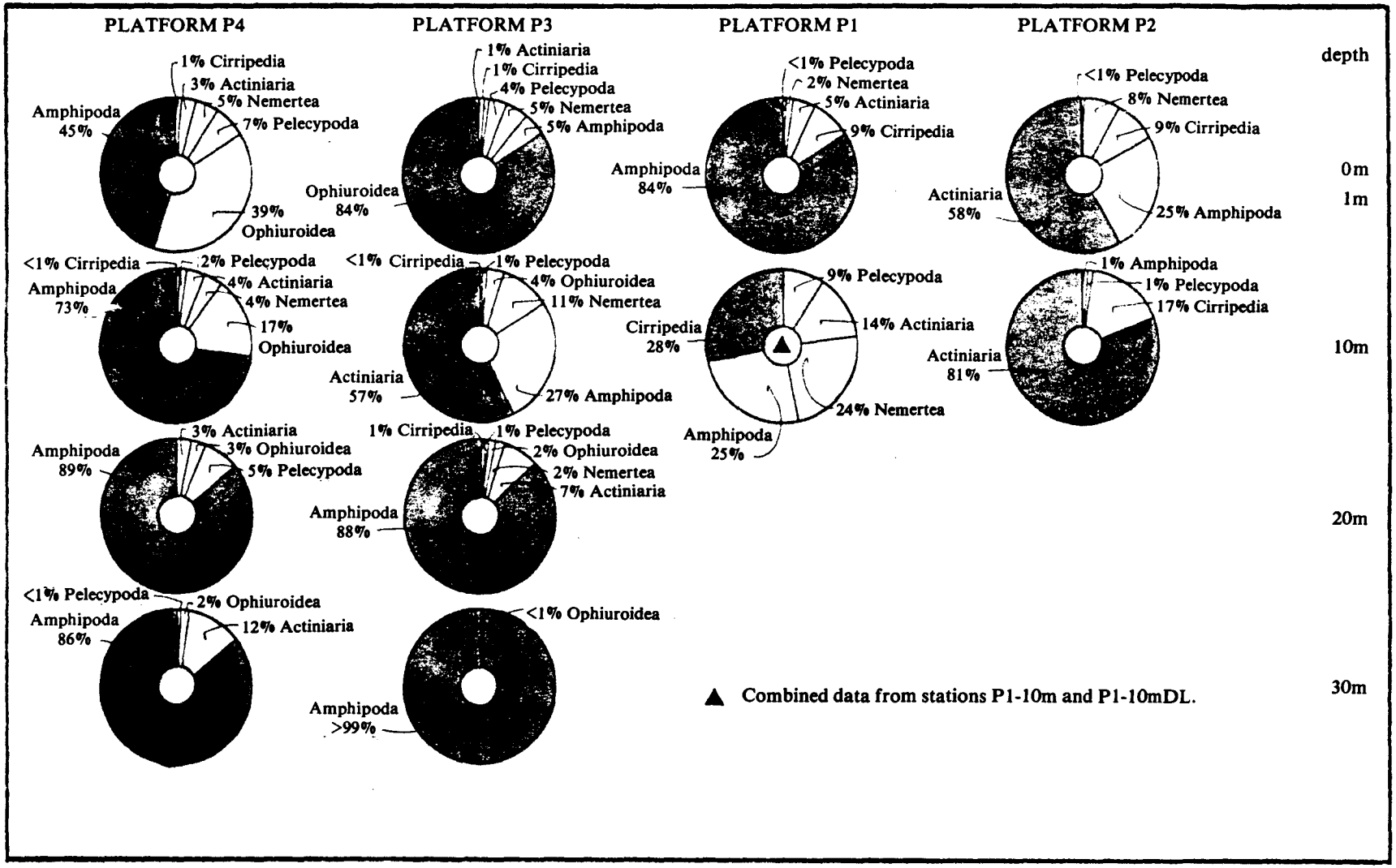


FIG. 13. Relative abundance (numbers) of the major groups of dominant discrete organisms by platform and depth.

occur. Feeding by this species is probably accomplished by scraping food material from substrates with setose antennae (Bousfield, 1973).

Ericthonius brasiliensis was found most abundant at the deep (20 to 30-m) stations of P3 and P4 (Appendix IV, Fig. 6). It was least abundant at near-surface (1 to 10-m) stations of P3 and P4 and at P1 and P2.

3. Colonial Dominants

The relative abundance of colonial dominants varied both among platforms and depths on platforms (Fig. 14). At Platform P2 sponges, hydroids and bryozoans were about equally represented at both P2-1m and P2-10m, although there was a slight shift from sponge-dominance at the P2-1m to bryozoan dominance at P2-10m. Bryozoans and hydroids dominated at P1-1m and were supplemented at P1-10m and P1-10mDL by tunicates and sponges (Fig. 14).

At Platform P3, hydroids comprised over 90% of the colonial fauna at P3-1m and P3-30m but bryozoans dominated at P3-10m and P3-20m (Fig. 14). In contrast, bryozoans dominated at Platform P4 from P4-1m to P4-20m and at P4-30m a colonial tunicate comprised about 88% of the collection.

The distributional patterns of the nine most common colonial taxa (clionid sponge; the hydroids *Obelia dichotoma, Turritopsis nutricula* and *Eudendrium carneum;* the bryozoans *Bugula neritina, Aeverillia setigera, Crisia eburnea,* and *Parasmittina spathulata;* and the colonial tunicate called Ascidiacea 1, are shown in Appendix V. The clionid boring sponges were indicated to be successful in turbid water, being most abundant on shelled organisms at Platform P2 (Appendix V, Fig. 1). Of the hydroids, *Obelia* was ubiquitous; *Turritopsis* was most abundant at P1-10m and P1-10mDL and *Eudendrium* was particularly abundant at P3-30m (Appendix V, Fig. 2-4).

The distributional pattern of the stalked bryozoan, *Bugula neritina,* indicates that this species is most successful at mid- water (10-20 m) depths on offshore structures in deep water. It was also relatively abundant at Station P4-1m and Station P1-10mDL, both of which are characterized by the presence of a produced water discharge (Appendix V, Fig. 5). *Aeverillia setigera* and *Crisia eburnea* had contrasting distributional patterns. The former was indicated to be primarily an inshore species tolerant of turbid water and *Crisia* was an offshore species most abundant at P3-20m (Appendix V, Figs. 6 and 7). *Parasmittina spathulata,* an inshore species, was mostly found on Platform P1, particularly at P1-10mDL (Appendix V, Fig. 8).

The colonial tunicate, Ascidiacea 1, was indicated to have a zone of abundance at P1-10m, P1-10mDL, and P3-10m and from P4-10m to P4-30m (Appendix V, Fig. 9).

4. Cluster Analyses

a. Biomass of Discrete Organisms

Wet weight data for solitary biofouling fauna were subjected to cluster analysis to better define station and species associations (Figs. 15-17). Stations clustered into three groups with the greatest degree of dissimilarity observed between nearshore stations (group I) and offshore stations (groups II & III, Fig. 15). Among the nearshore group, Stations P1-10m and P1-10mDL formed a separate subset from the other nearshore stations; i.e., P1-1m collections were more similar in terms of community biomass structure to collections taken at both P2-1m and P2-10m than to collections taken at P1-10m and P1-10mDL. These differences are likely attributable to a combination of turbidity differences and the presence of a produced water discharge at a 17-m depth on Platform P1. The water was generally turbid throughout the water column at Platform P2 during June, whereas at Platform P1, water at 10-m depths was less turbid than overlying surface waters and deeper bottom waters.

Group II included all collections from P3 and P4 taken at 1-, 10- and 20-m depths. Samples taken at P3-1m formed a distinct subset, probably mainly attributable to the pronounced biomass of the tree oyster at that station. Collections taken at P3-30m and P4-30m (group III) were more similar to one another than to samples taken at other depths on the same platform. Group III collections separated from group II collections primarily because of their characteristically low biomass and numbers of species.

The taxa clustered into five groups based upon wet weight (Fig. 16). The two-way contingency table (Fig. 17) illustrates that groups 1 and 2 consisted of taxa that contributed little biomass. Group 3 contained taxa which were present at both nearshore and offshore stations, but were most important nearshore (e.g., the barnacle *Balanus amphitrite niveus*). The organisms in group 4 were predominately offshore species, although a few (e.g., the bivalve, *Isognomon bicolor*) were represented at some nearshore stations. Group 5 consisted of organisms which were represented at all platforms but had higher biomass at offshore stations than at inshore stations (e.g., the bivalve *Chama macerophylla,* oysters [Ostreacea] and the crab *Pseudomedaeus agassizii*).

b. Numbers of Discrete Organisms

Results of cluster analysis based upon numerical distribution of solitary fauna (Fig. 18-20) again grouped the sampling stations into three groups with the greatest degree of dissimilarity observed between nearshore (group I) and offshore collections (groups II and III). The basic grouping of the nearshore collections was the same as that indicated by the biomass analysis; i.e., collections taken at P1-10m and P1-10mDL comprised a distinct subset (Fig. 18).

In contrast to the results obtained from the cluster analysis of biomass data, the major groupings of offshore collections based upon numbers of individuals showed that collections from P3-1m, P4-1m and P4-10m formed a distinct assemblage (group II) different from the remaining collections and group III (Fig. 18). These differences again are correlated to turbidity. Evidence of greater water clarity to depth at Platform P4 as opposed to Platform P3 was provided by the primary productivity data described above. Within group III, the three replicates from P3-30m and one from Platform P4 comprised an evident subset.

Based upon the numerical data the taxa clustered into eight groups (Fig. 19). The two-way contingency table (Fig. 20) illustrates that groups 1, 2, 3 and 8 were small groups comprised of rare organisms. Group 4 consisted of a large assemblage of rare organisms which were scattered throughout the study area.

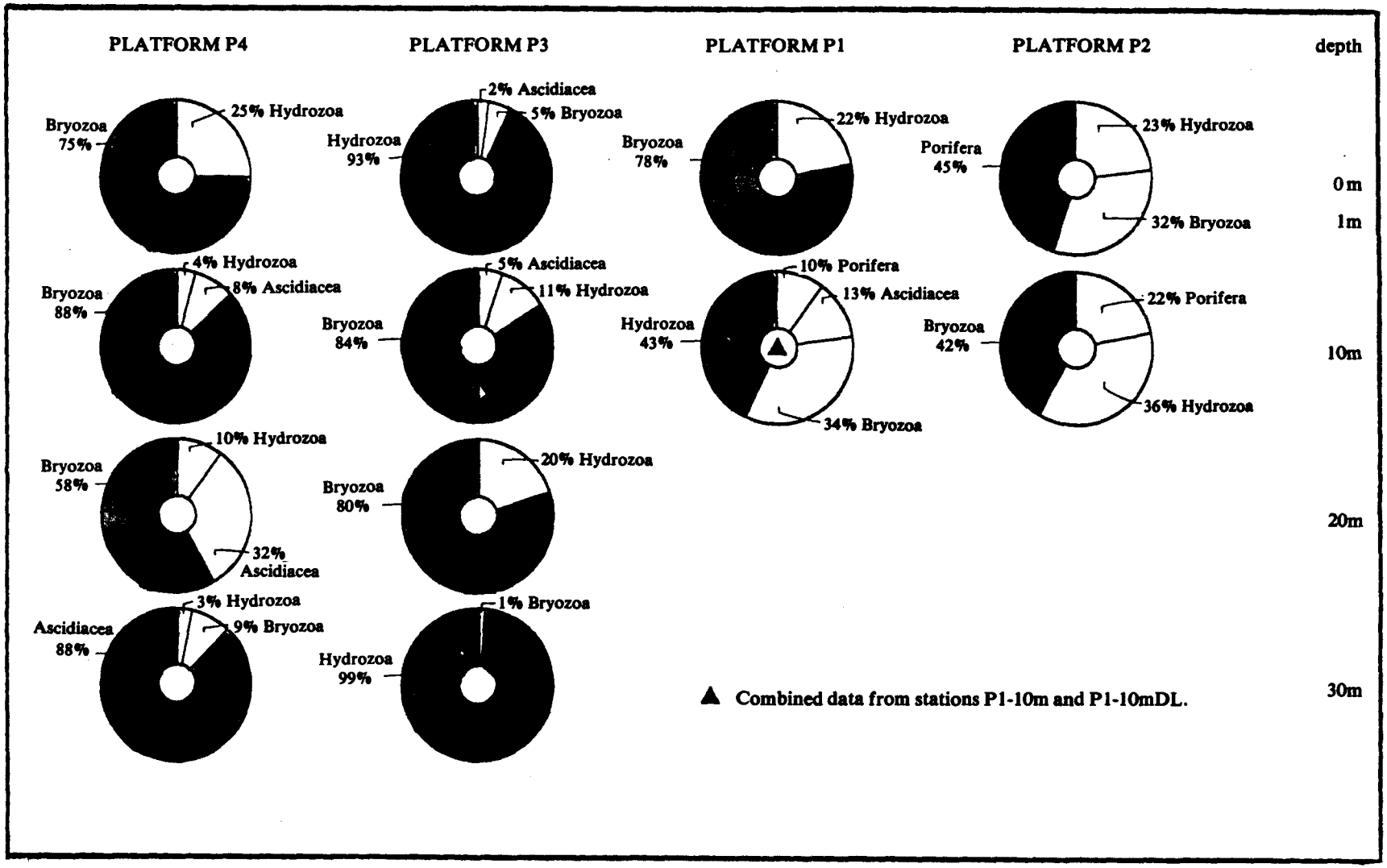


FIG. 14. Relative abundance of the major groups of dominant colonial organisms by platform and depth.

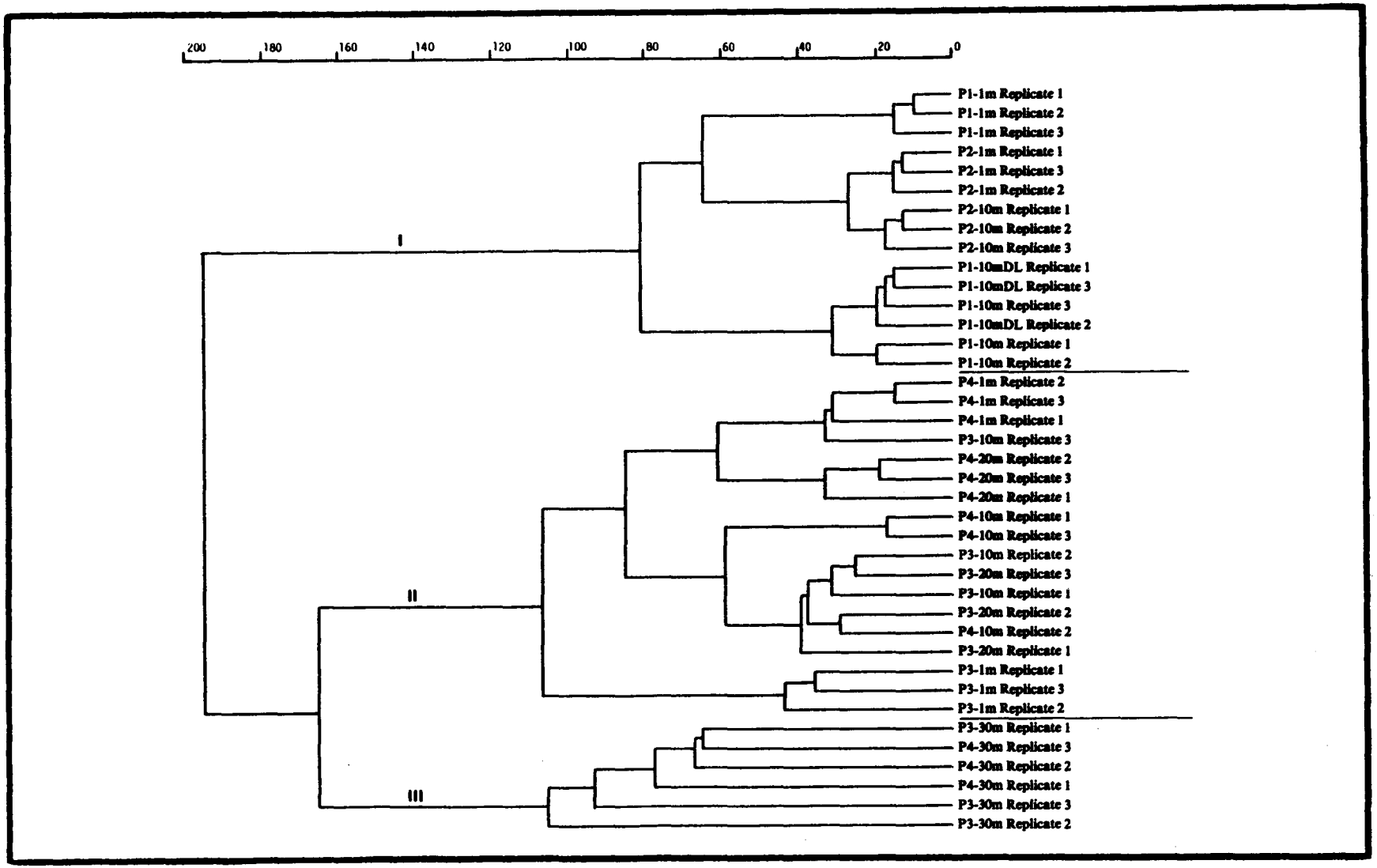


FIG. 15. Cluster analysis dendrogram for stations based on wet weight of discrete biofouling fauna.

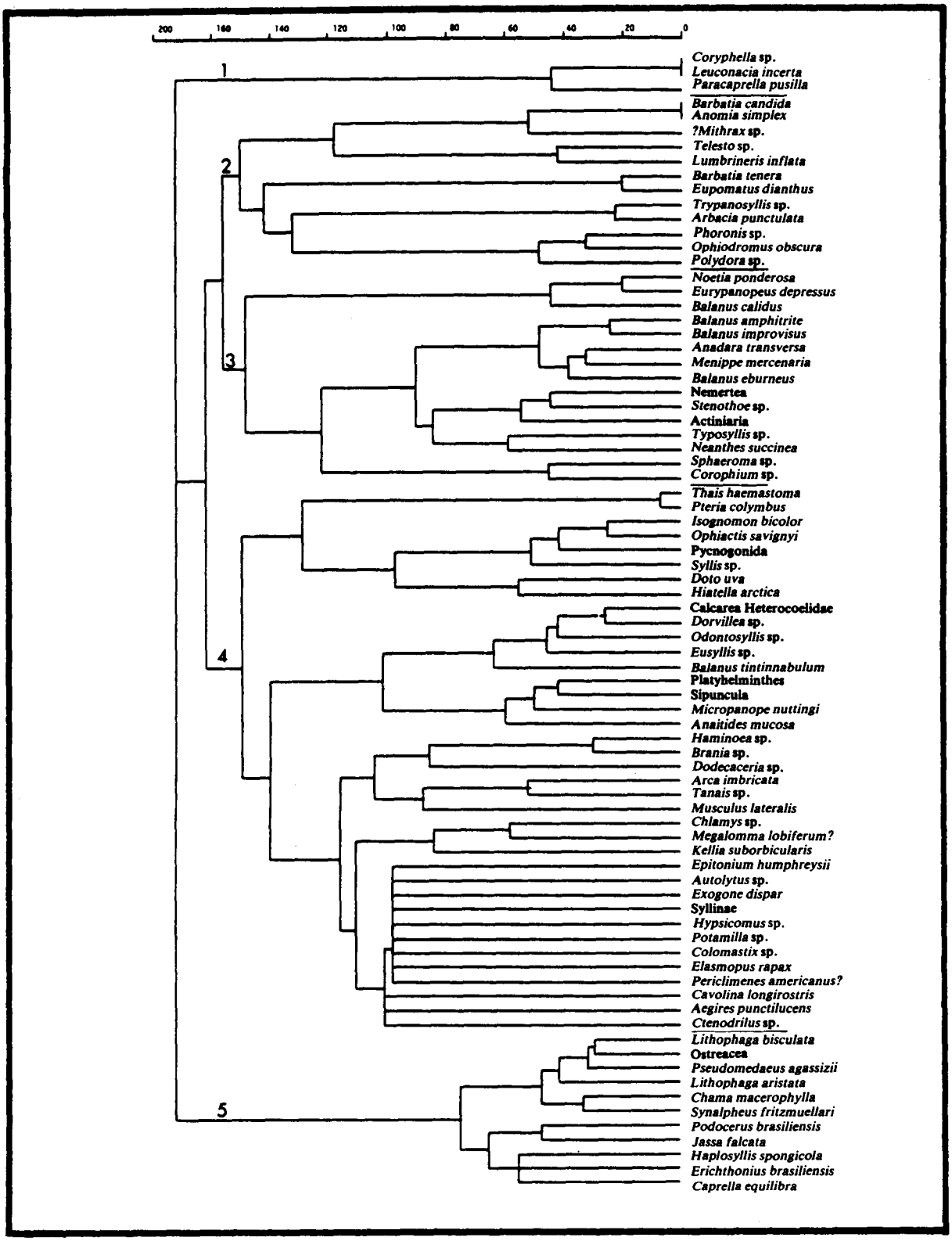


FIG. 16. Cluster analysis dendrogram for discrete biofouling fauna based on wet weight by platform, depth and sample replicates.

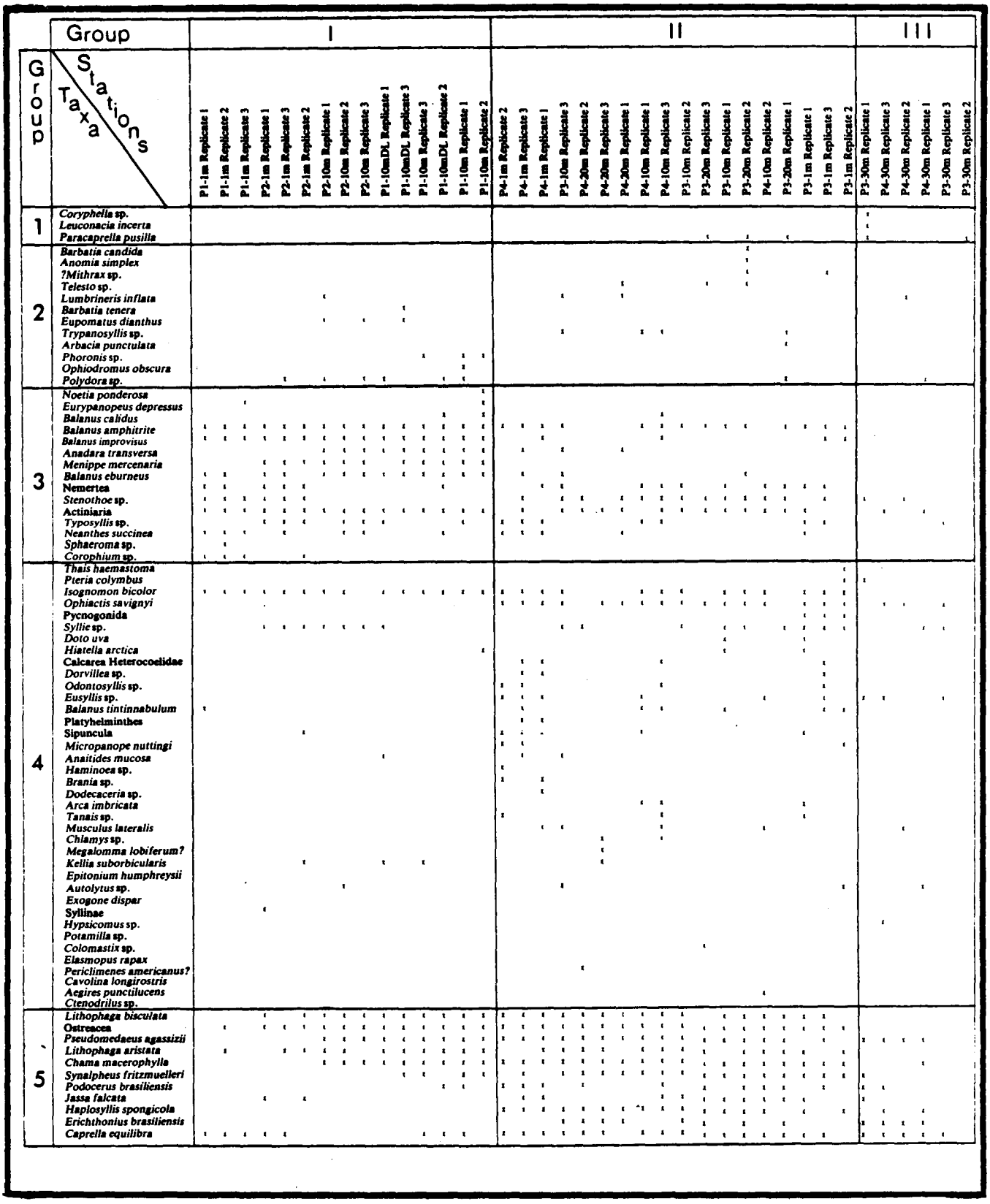


FIG. 17. Two-way contingency table illustrating the relationship between stations and discrete biofouling fauna based on wet weight (X indicates presence).

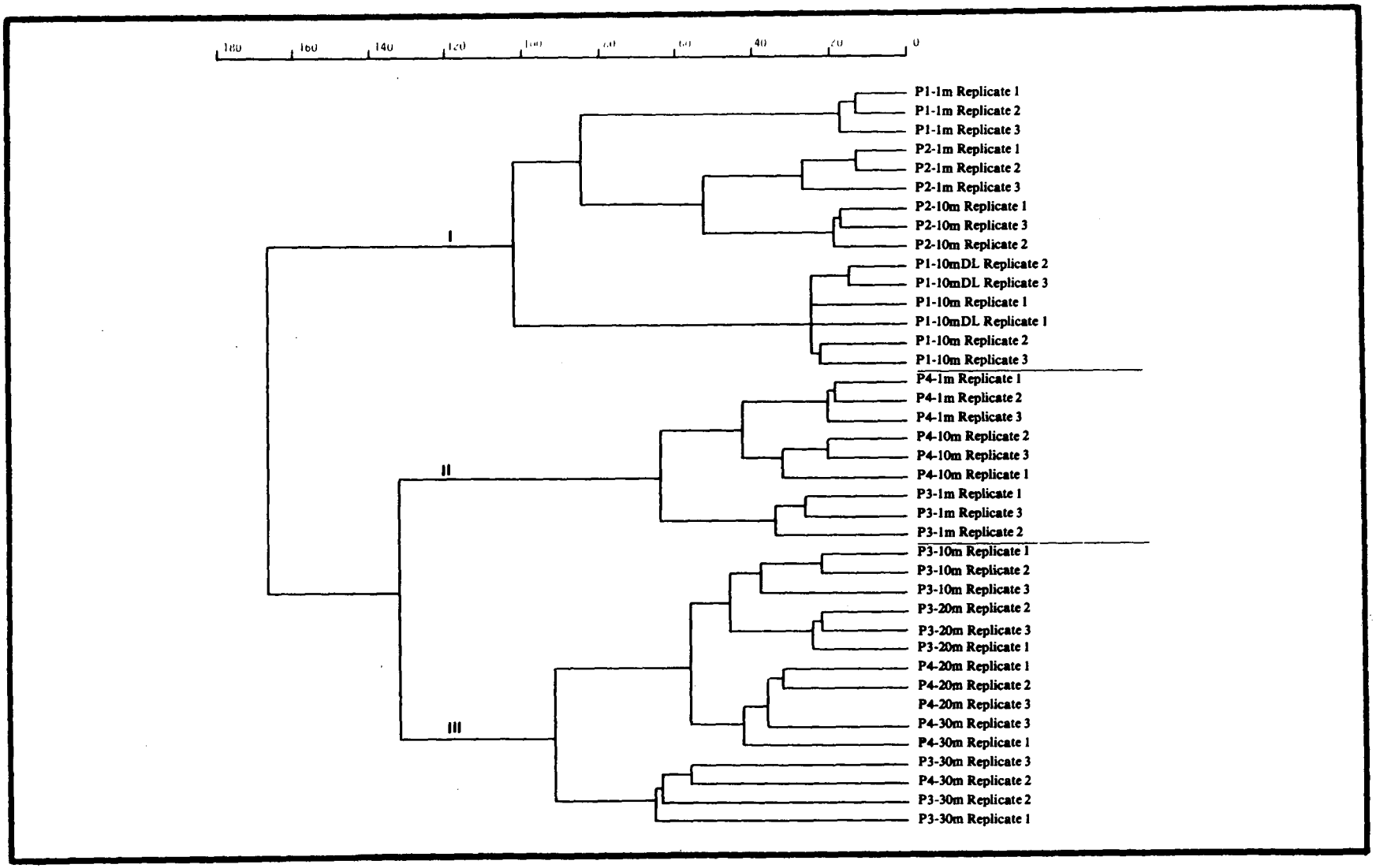


FIG. 18. Cluster analysis dendrogram for stations based on numerical abundance of discrete biofouling fauna.

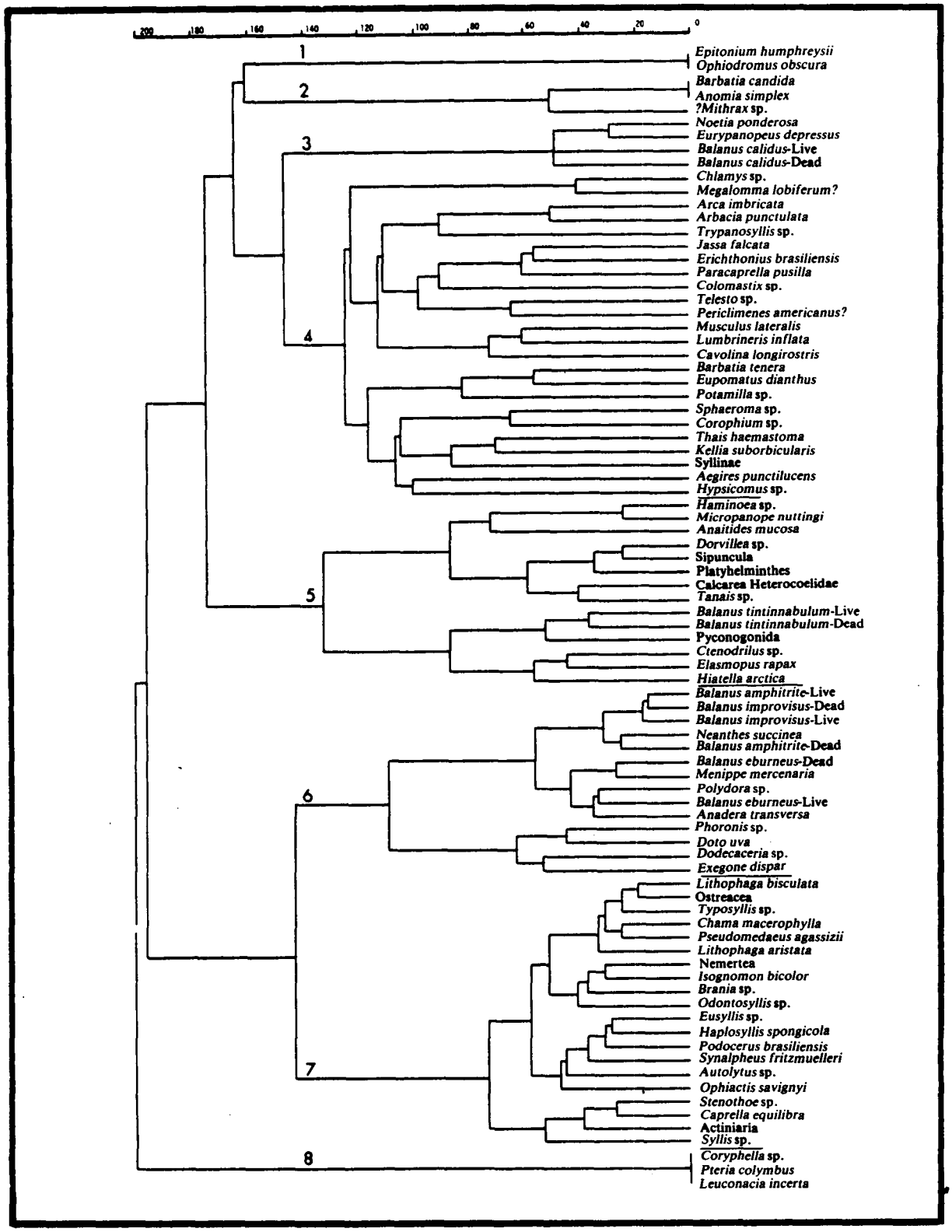


FIG. 19. Cluster analysis dendrogram for discrete biofouling fauna based on numerical abundance by platform, depth and sample replicate.

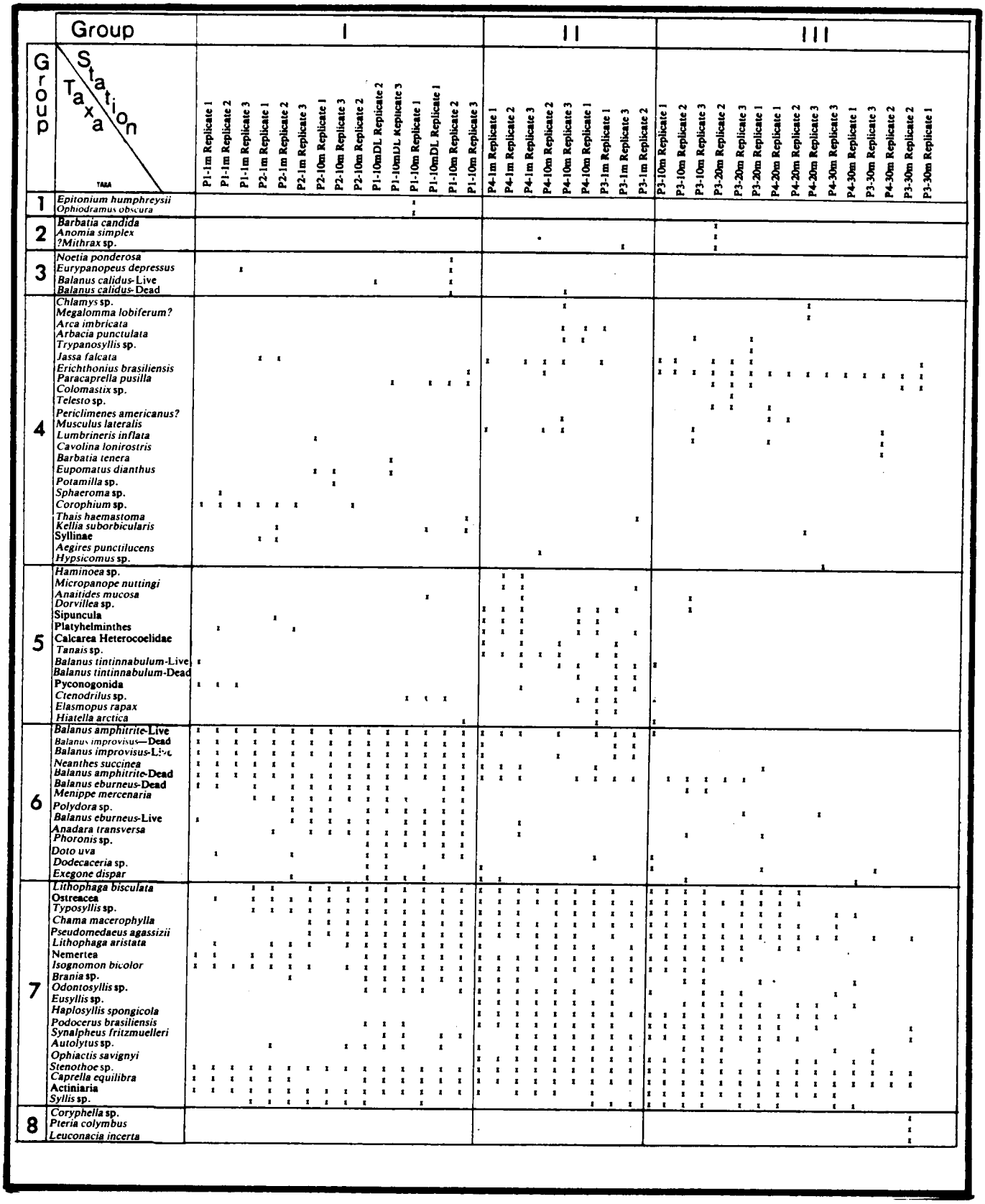


FIG. 20. Two-way contingency table illustrating the relationship between stations and discrete biofouling fauna based on numerical abundance. (X indicates presence).

Group 5 was represented by organisms found predominantly at shallow depths at the offshore platforms (e.g., *Balanus tintinnabulum*). Group 6 included the barnacles *Balanus amphitrite niveus* and *B. improvisus*, the crab *Menippe mercenaria* and the polychaete *Neanthes succinea*, all of which were most common at the nearshore platforms. Group 7 was composed of ubiquitous taxa including oysters (Ostreacea), the leafy jewel box (*Chama macerophylla*), the amphipod *Stenothoe* sp. and the crab *Pseudomedaeus agassizii*.

c. Colonial Taxa

Cluster analysis was applied to the percent cover data used to describe colonial organisms (Figs. 21-23). Since the percent of the area covered by colonial taxa was based on visual observation rather than quantitative methods, these results cannot be viewed as definitive. The stations clustered into four groups with the highest degree of dissimilarity, in general, between nearshore and offshore stations (Fig. 21). Group I included Stations P3-1m, P3-10m, P4-1m and P4-10m. Group II consisted of P4-20m and P4-30m as well as one of the replicates at P3-30m. Group III included the nearshore collections taken at P1-1m as well as all the Platform P2 collections. Group IV contained the samples taken at P1-10m and P1-10mDL, and those obtained from P3-20m, and two of the replicates taken at P3-30m.

The colonial taxa clustered into four groups (Fig. 22). The two-way contingency table (Fig. 23) shows that groups 1 and 2 contained rare organisms, group 3 represented mainly taxa at the deeper offshore stations, and group 4 included common taxa present at both nearshore and offshore platforms.

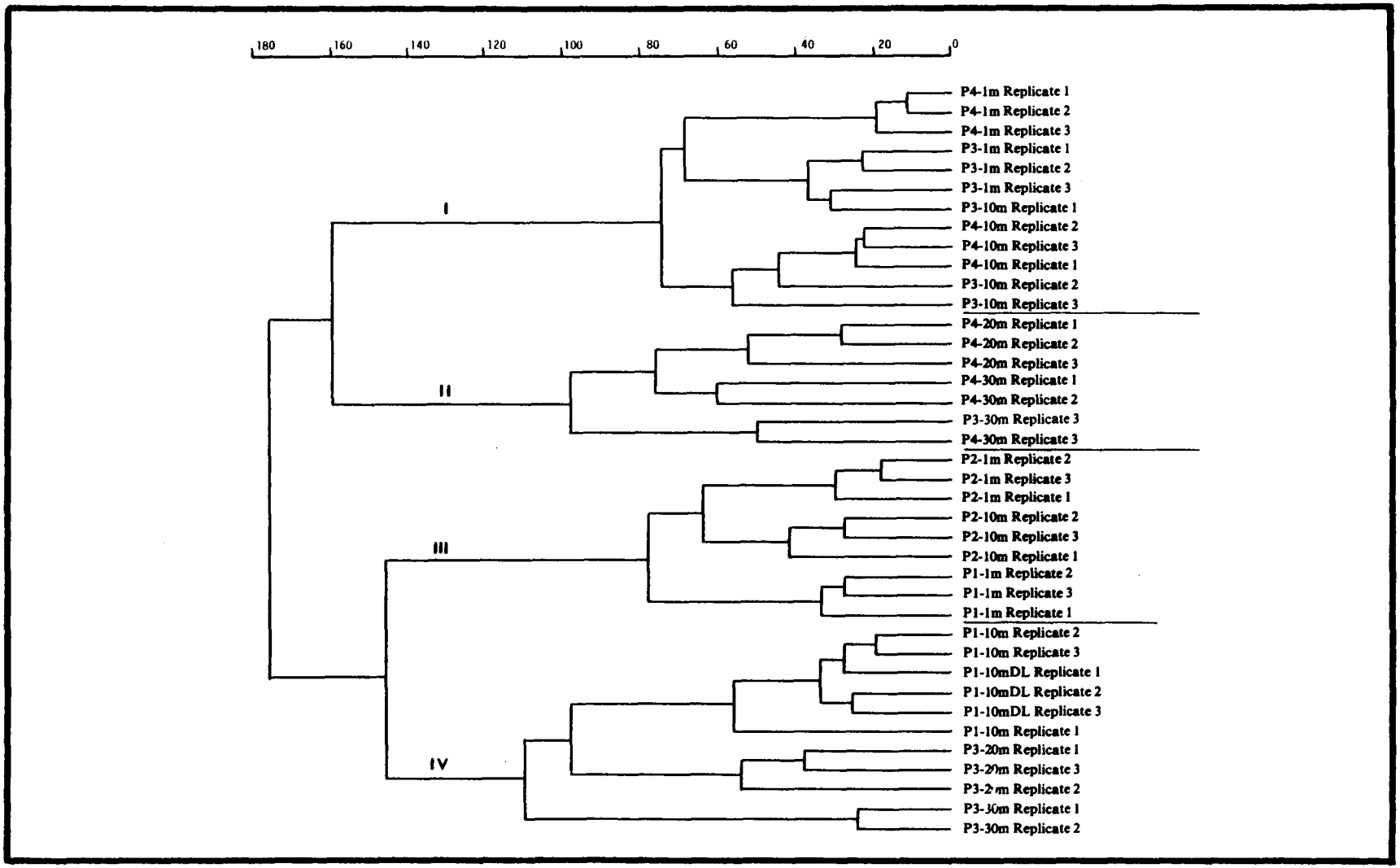


FIG. 21. Cluster analysis dendrogram for stations based on relative percent of area covered by colonial biofouling organisms.

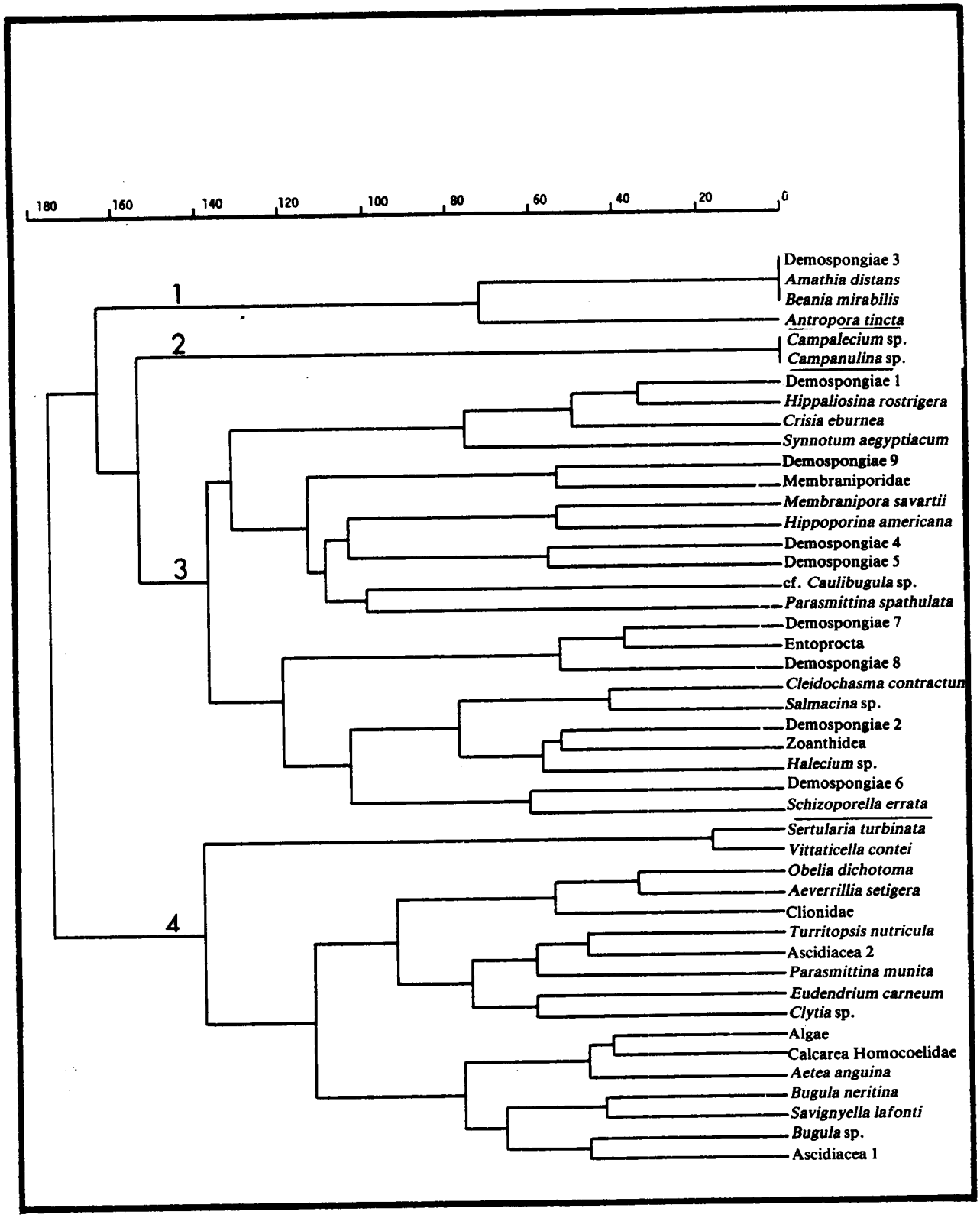


FIG. 22. Cluster analysis dendrogram for colonial biofouling organisms based on relative percent of area covered by platform, depth and sample replicate.

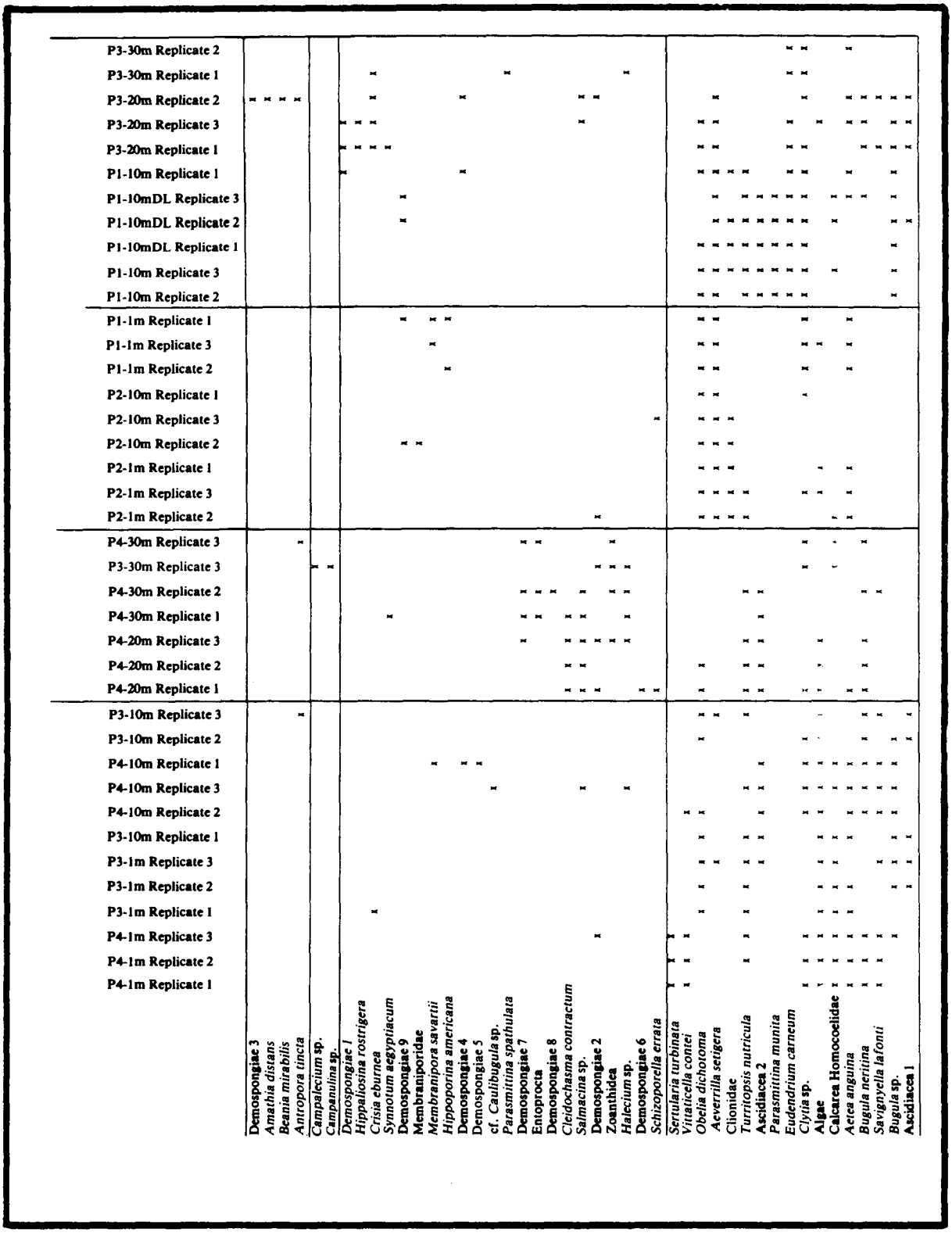


FIG. 23. Two-way contingency table illustrating the relationship between stations and colonial biofouling organisms based on relative percent of area covered. (X indicates presence)

VII. SIGNIFICANT ZOOGEOGRAPHIC AND TAXONOMIC FINDINGS

The biofouling communities of production platforms in the northwestern Gulf of Mexico off the Louisiana coast are largely derived from fauna characteristic of the Carolinian and Caribbean Provinces. Cosmopolitan forms are also represented. The Carolinian region extends from the Atlantic coast of Southeastern United States as far south as central Florida, is interrupted by peninsular Florida, resumes at about Tampa Bay on the west coast and extends north and westward to about Corpus Christi, Texas. Many Carolinian species gained access to the Gulf prior to the formation of the Florida peninsula. The eastern or Virginia oyster, *Crassostrea virginica*, is a representative Carolinian species found at the Louisiana production platforms.

Representatives of the Caribbean or tropical biofouling fauna are strongly represented in appropriate habitats of the Gulf, primarily due to larval transport in Caribbean water masses. Under normal conditions, at all seasons of the year, a great volume of Caribbean water passing northward through Yucatan Channel flows either (1) west and northwestward along the coast of Mexico toward Galveston and Port Arthur; (2) north-northwestward toward the Mississippi Delta and thence westward along the Louisiana coast toward Texas; or (3) eastward into the Straits of Florida. Representatives of the Caribbean fauna included a species new for this area (*Pinna carnea*, Appendix II, Plate 12) and several species heretofore described only from coral reefs and natural hard banks of the northern Gulf (e.g., the sea urchin *Eucidaris tribuloides* and the spiny lobster, *Panulirus* sp.)

Many of the cosmopolitan species represented in the northern Gulf may have been transported to this sea by ships. Barnacles, hydroids, serpulid worms and other sessile species are common fouling organisms on the hulls of ships. The Mediterranean barnacle, *Balanus tintinnabulum*, is a biomass dominant on Gulf of Arabia production platforms (Basson et al., 1977), some production platforms offshore Texas (Gallaway et al., 1979) and is represented on production platforms offshore Louisiana. The cosmopolitan bivalve *Kellia suborbicularis* (Appendix II, Plates 1 and 2) represents a new record for the Louisiana area.

The fish fauna of the Gulf of Mexico is to a great extent a continuation of the Caribbean Province with the exception that a temperate Atlantic element is present in the Gulf which is not represented in the Caribbean region. Our observational data indicate that coastal or shorefishes dominate communities at production platforms inside the 27-m bottom contour, an ecotone or transitional zone is present between the 27- and 37-m contours and, in depths ranging from 37 to 64 m, tropical Caribbean species are abundant. Production platforms seaward of the 64-m bottom contour have fish communities dominated by Caribbean reef forms.

Several factors contribute, probably in concert, to the observed zonational patterns. Foremost among these may be temperature. Based upon Harrington (1969), all platforms in the Coastal and Ecotone Regions, as well as Platforms S6 and S13 (Offshore) and Platform S7 (Bluewater or Coral Reef), are located in areas where the annual range in surface water temperature is about 15 C at the seaward limit and as much as 20 C nearshore. In the Offshore and Coral Reef zones, the annual range in surface water temperature is between 14 and 12 C, respectively.

Proximity to the Mississippi River may also be a factor contributing to the observed zonational patterns. On a qualitative basis, Platforms S6, S13 and S7 appeared to be less productive and diverse than other platforms located in the same zone but further west. Potential effects of turbidity and salinity were implicated as a factor in this zonational anomaly. Results of cluster analysis showed that surface (1-m) biofouling collections taken from an area characterized by turbid surface waters overlying a less turbid water mass (Platform P1) showed greater affinities with 10-m deep collections taken at a nearshore platform in water turbid throughout the water column (Platform P2) than they did with collections taken at 10 m in the "clear water zone" of the same platform (Platform P1). The turbid surface water is believed to have represented river discharge.

Probably the most significant taxonomic finding of our study is that four, as opposed to two, species of oysters are represented on offshore platforms in the northern Gulf. These include *Crassostrea virginica, Ostrea equestris, Lopha frons* and *Hyotissa thomasi. Crassostrea virginica*, the common commercial oyster of the east coast of North America, ordinarily is not abundant seaward of the coastal bays but it is found at the nearshore platforms where it grows to a large size (100 mm in length, or more). *Ostrea equestris*, the horse oyster, is a normal inhabitant of the shallow Gulf of Mexico waters and occasionally invades the bays. It appears to grow to a larger size (approximately 25 mm in length) on the offshore platforms than in the bays. *Lopha frons*, the leafy oyster, occasionally is present on Louisiana platforms, where it attains lengths of 35 mm. This species is characterized by a unique method of attachment. It attaches by cementing the ends of recurved spines to the substrate (Appendix II, Plates 15-18).

The most abundant oyster on the more seaward platforms appears to be *Hyotissa thomasi* (Appendix II, Plate 19), previously reported in the western Gulf of Mexico only from reefs at the margin of the continental shelf. Specimens of *H. thomasi* were often greater than 100 mm in length. Neither *Lopha frons* nor *Hyotissa thomasi* are found in bays in this area, and are apparently restricted to waters of high, constant salinity such as that found well offshore. The intact and well-preserved specimens of these four species of oysters, as well as some of the other molluscs, represent a valuable commodity which can and should be used to elucidate the taxonomy of this difficult group.

Production platforms serve as focal points for a rich and diverse biofouling community and a complex assemblage of platform-associated macrobiota. The platforms harbor sessile and motile invertebrates and fish which would not be present were it not for the existence of artificial substrate. In addition, fish which would normally be found scattered throughout a very large area (such as pelagic predators and baitfish) are concentrated in the immediate vicinity of platforms, attracted to the food and/or shelter they provide. Platforms are, therefore, equivalent in many respects to reefs and are important to the Gulf ecosystem in far greater measures than can be accounted for by their relative area.

On a relative basis, reef communities have often been considered to be "more productive" than many other offshore continental shelf habitats. The basis for this determination has typically been the observation that a greater abundance and diversity of organisms are associated with reefs than with other areas. Additionally, the structure of the reef community is such that cycling of food material, or energy, is rapid. Biological cycling does not imply that energy is being degraded more than once, but rather that energy can be "used" without being degraded. For example, energy associated with structural or storage elements (e.g., cellulose, protein, fats) of one ecosystem component can be catabolized or used as a structural element by the subsequent component to which it is transferred. In addition, the same organism may take-up energy that it earlier discarded in the form of cells or mucus; and, because assimilation efficiency of animals is considerably less than 100%, there is an amount of egested material that is digestible by other organisms.

Therefore, given the above, the reef community is most efficient in terms of trapping and serving as an energy sink. However, total productivity of the "oceans" is not necessarily increased because energy available to other systems is, theoretically, proportionately reduced. Offshore platforms result in a greater storage of energy in reef communities presumably at the expense of other communities, and the intensity of this impact on Gulf ecosystems may be far removed in terms of both time and space (see Holling, 1978, for a treatment of the relationship of impacts to the spatial and temporal features of ecosystems).

Production by Gulf of Mexico ecosystems may be increased by the discharge of nutrients from oil and gas platforms. Such nutrients include hydrocarbons, sulfur and particulate organic material such as food scraps and sewage. Often, however, the ultimate benefactors of these contributions are not organisms prized by man, e.g., the sea catfish.

Several scientists have raised the question of whether production platforms increase productivity of fish or simply dislocate and/or concentrate certain species (George and Thomas, 1974; Sonnier et al., 1976; Pequegnat, 1975). Gallaway and Martin (in prep.) have evidence that productivity of some species may be increased because of structure, but that populations of others are merely dislocated (Stone et al., 1979). Typically, examples of the former (increased production) are species whose populations appear limited by the scarcity of reef habitat during some stage of their life history when they are critically dependent upon reefs (e.g., barracuda, blennies, triggerfishes, damselfishes, angelfishes, spadefish [?], sheepshead [?]). Examples of species whose populations may be concentrated but not increased are bluefish, red snapper, jacks, groupers, spadefish (?) and sheepshead (?). Movement of some species (such as red snapper) from natural reefs to production platforms (which are easy to locate by fishermen) may cause the fishery to be over-exploited. On the other hand, if production platform populations represent surplus stocks, and recruitment of spawners to natural reefs is not being diminished, the presence of the structures may permit increased harvests without causing over-exploitation of the fishery.

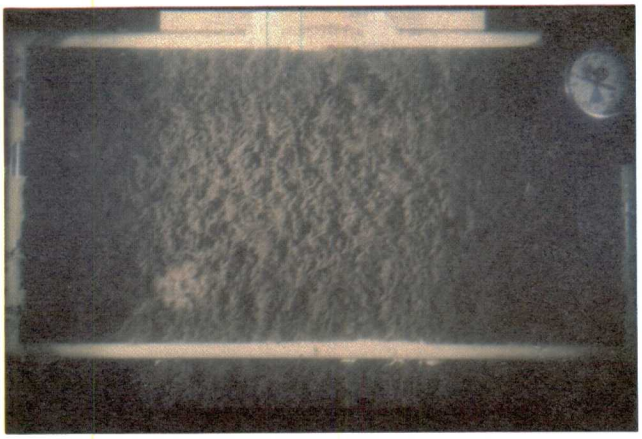
As described in the descriptions of the platforms, produced water discharges at Louisiana platforms were observed to have a detrimental effect on biofouling communities within a few meters of the point of discharges (Plate 13). These observations verify findings in the Buccaneer Oil Field offshore Texas, where Gallaway et al. (1979) have previously reported that produced water discharges have an adverse effect on the biofouling community. Evidence of the adverse effects include low biomass and density of most biofouling organisms, low survival rates of barnacles and low rates of production and recolonization. Community structure is greatly altered in the area of produced water discharges (Plate 13).

These findings should not be surprising since Mackin (1971) had previously reported that produced water effluents depressed the bottom fauna radially some 400 ft. in Texas bays and estuaries. He later reported, however, that in deep or large bodies of water, dilution of the brine was almost instantaneous (Mackin, 1973). In addition, Waller (1974) reported apparently normal epibiota on the legs of a production platform in the Timbalier area offshore Louisiana, and George and Thomas (1974) made no mention of the effects of produced water in their studies of platform epibiota. Koons, McAuliffe, and Weiss (1976) believed that the toxic components of produced water were in such low concentrations that natural forces such as dilution and evaporation and chemical and biological reactions rapidly reduced the concentrations of the toxic components to levels not harmful to marine organisms.

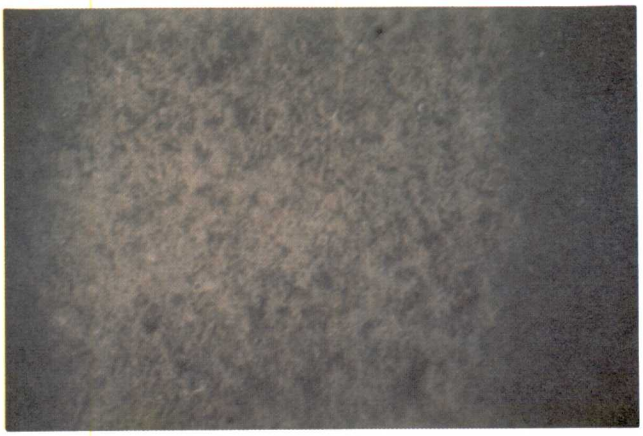
Produced water discharges have detrimental effects on Louisiana production platform epibiota; the only question in doubt is the magnitude and extent of this effect. Results of chemical analyses of tissues of organisms resident on and around production platforms at Buccaneer Oil Field in the Gulf of Mexico have shown that biological uptake of metals and petroleum hydrocarbons occurs (Jackson et al., 1978). Anderson and Schwarzer (1978) reported high concentrations of cadmium and strontium in barnacle tissues. Middleditch and Basile (1978) observed high concentrations of alkanes in barnacles collected at the surface near the produced water discharge, and weathered oil in some of the shrimps and fishes analyzed. Seasonal fish disease epidemics are characteristic of spadefish populations in the Buccaneer Oil Field and may be indirectly related to

Biofouling community beneath a surface produced water discharge in Buccaneer Oil Field, Texas.

Biofouling community beneath a surface produced water discharge at ST161A (note area above divers.)



Biofouling community at 18m (60 ft.) depth on WD32A, historical discharge leg.



Biofouling community at 18m (60 ft.) depth on WD32E, produced water is discharged at 17m.

PLATE 13: EFFECTS OF PRODUCED WATER DISCHARGES.

contaminant discharge. It is vitally important to further delineate the magnitude of impacts occurring in the vicinity of the platforms, for it is here where potential uptake and transfer of contaminants is greatest and where man is most likely to interact with the organisms involved, e.g., red snapper. A major concern should be the long-range effects of continual injection of relatively small amounts of soluble petroleum components into the water column.

IX. RECOMMENDATIONS FOR FUTURE RESEARCH

A multitude of research projects, all meaningful, have been suggested from results of the artificial reef studies. For example, this study was particularly deficient from the standpoint of seasonality. It would seem important that the study be repeated for each season, or perhaps even on a monthly basis. However, the cost of such a program would be magnificent.

We have tempered our research recommendations based upon knowledge of the objectives, findings and direction of other programs (NOAA—EPA). The recommendations provided below are considered logical outgrowths from this project which are not being addressed by other programs.

A. Resource Evaluations for Coral Reef Platforms

A more intensive effort needs to be made at Platforms S7, S9, S15 and S17 in order to better define these resources. The studies should be performed during the summer season and designed to characterize biofouling and fish communities in a manner similar to that used for the four primary platforms of this study. Results of these studies would be particularly valuable if they were designed to delineate effects of drilling and production on the Caribbean reef biota. In other words, they represent a natural laboratory experiment, the results of which could be used to evaluate effects of oil and gas development on hard bank communities without having to subject the natural communities to the insult in order to make an assessment.

B. Taxonomic Studies

The importance of resolving some of the taxonomic findings should not be overlooked, particularly with respect to the molluscs, barnacles,and sponges. Some of these organisms may prove to be key indicators of effects of contaminants from oil and gas production platforms. We strongly urge that:

1 LGL be allowed to maintain possession of the biofouling voucher collection for taxonomic studies.
2 Drs. M.F. Johnson and H. Harry re-examine and provide species-level identifications and descriptions of the relationship of sponge, mollusc, and barnacle distribution with respect to contaminant discharges and the presence of the platforms.

We believe that the platforms may represent a new biotope heretofore not represented in the Gulf.

X. CONCLUSIONS

Petroleum production platforms offshore Louisiana are artificial reefs which have apparently expanded the available habitat for numerous fish and invertebrate species that are dependent on hard banks as habitat. Many species of fish (red snapper, spadefish, sheepshead and others) are much more abundant in areas with platforms than in similar areas without structures and the fouling biota would obviously not be present in the absence of hard substrates.

Effects of distance from shore and/or depth contributed to zonations in species composition and abundance of invertebrate and fish species. Three distinct zones were delineated on the basis of faunal assemblages—Coastal, Offshore and Coral Reef. The coastal platforms were characterized by barnacles and estuarine-dependent shorefishes. Bivalves replaced barnacles on the offshore platforms and Caribbean fish were more abundant. In the Blue Water Zone, species representing Caribbean fauna were characteristic at the platforms.

Produced water discharges have an observable detrimental effect on fouling biota. The areal extent and nature of the more subtle effects have not been well defined but seem to extend no more than 10 m.

XI. ACKNOWLEDGEMENTS

We wish to give particular credit to the persons who directed and performed much of the primary field sampling cruise during June. Specifically these are Larry R. Martin, Gregory S. Boland, and Lewis J. Haldorson. These scientists are unique in terms of their capabilities to design innovative underwater research equipment and methods that work. All have excellent taxonomic and diving skills. Their dedication to program objectives and performance under long and adverse conditions are exemplary. In the Principal Investigator's opinion, the highest compliment that they can be given is that, in every offshore project in which they have performed over the past three years for LGL, the sample inventory report has been introduced by the statement:

"All planned samples were obtained within the contract schedule."

We also wish to thank Dr. F. J. Margraf of LGL. His efforts have introduced many of our other biological staff to the benefits of computer analysis and the joys of statistics. The complex analysis, formerly shunned, has become the routine. Results have always been provided in a timely and efficient manner.

We are pleased with the performance of all the outside consultants used in this program. Deserving particular credit are Dr. Tom Bright and his cadre of graduate students. Dr. Bright participated in the design of the project, the field surveys and in sample analysis. His review of the manuscript is gratefully acknowledged. Dr. Bright has provided continued encouragement and support of LGL in offshore research activity, particularly in terms of turning out highly-qualified marine biologists. Students of Dr. Bright employed as diving scientists for the initial cruise were Russell E. Putt, Jr., Dr. Robert Abbott, Stephen Viada, and Richard Titgen. All performed in a professional manner.

Also deserving particular thanks is Dr. Charles G. Giammona. Without his contribution we would have probably been unable to provide sampling services for the special cruise of the second quarter. Dr. Giammona, a highly qualified professional in his own right, performed strenuous biological sampling at a level which would have been a credit to a professional athlete. He was largely responsible for the good attitude and cheerfulness that prevailed among the crew in spite of a demanding and difficult cruise.

For Captain Pete Smirch and his vessel the *Tonya and Joe*, there is nothing but praise. His navigational skills and seamanship are, perhaps, exceeded only by his patience and understanding of young scientists. Typically, he worked long after the scientific complement had retired for the day. A clue to his exceptional abilities is the fact that he was seldom given a challenge by any of the scientific party in the game of chess.

The work of Dr. Harold Harry (Mollusca, Echinodermata, Cirripedia) was the best ever provided to LGL by a taxonomic consultant. The outstanding quality of his general notes and drawings provides a disturbing reminder of the basic biological skills which are being lost because today's graduate is being neither taught nor encouraged to develop talents of this nature. Other consultants receiving our grateful thanks for their high quality efforts are Dr. Elenor Cox, algae identification and biomass determinations; Dr. Darryl L. Felder, Decapoda; Dr. Dale R. Calder, Hydrozoa; Dr. Donald E. Harper, Polychaeta; Dr. Larry D. McKinney, Amphipoda and Mr. Arthur J. J. Leuterman, Bryozoa.

Finally, the technical staff who transformed the "ugly duckling" of illegible and unorganized pencil draft of textual and illustrative materials into the final report are gratefully acknowledged. How they perform so well given the constant interruptions of other day-to-day activities and continual changes in priorities, is a subject worthy of study in itself. Deserving particular mention are Jean Erwin for coordinating, editing and typing much of the report, and Alice Doerge for typing and editing. Kyle Kuberski is greatly acknowledged for his graphic skills.

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APPENDICES

APPENDIX A

TABLE A1. Total wet weight (g/m^2) of replicate 25 × 25 cm scraping samples from P1, P2, P3, and P4.[1]

		TOTAL WET WEIGHT (g/m^2)			
		Replicate			
Platform	Depth (m)	1	2	3	Mean
P1	1	5,032.0	5,916.8	5,177.6	5,375.5
	10	9,433.6	11,972.8	7,470.4	9,625.6
P1-DL	10	9,577.6	9,854.4	9,726.4	9,719.5
P2	1	7,854.4	11,393.6	9,390.4	9,546.1
	10	16,020.8	13,844.4	10,670.4	13,512.0
P3	1	10,763.2	8,427.2	12,184.0	10,458.1
	10	6,147.2	10,179.2	9,334.4	8,553.6
	20	11,630.4	14,505.6	6,979.2	10,948.4
	30	2,510.4	2,729.6	654.4	1,964.8
P4	1	5,678.4	10,121.6	9,564.8	8,454.9
	10	19,344.0	14,576.0	12,505.6	15,475.2
	20	10,808.0	9,324.8	8,668.8	9,600.5
	30	3,484.8	1,238.4	966.4	1,896.5

[1]Includes all materials of biotic origin, live and dead.

TABLE A2. List of flora in 25 × 25 cm scraping samples from P1, P2, P3, and P4.

Platform	Depth (m)	Species	Division
P1	1	*Derbesia* sp.	Chlorophyta
		Diatoms	Chrysophyta
		Blue-Green Algae	Cyanophyta
P1	10	Diatoms	Chrysophyta
		Blue-Green	Cyanophyta
P1-DL	10	*Polysiphonia* sp.	Rhodophyta
		Diatoms	Chrysophyta
		Blue-Green	Cyanophyta
P2	1	*Acrochaetium* sp.	Rhodophyta
		Ceramium sp.	Rhodophyta
		Polysiphonia sp.	Rhodophyta
		Goniotrichum sp.	Rhodophyta
		Derbesia sp.	Chlorophyta
		Diatoms	Chrysophyta
		Blue-Green	Cyanophyta
P2	10	Diatoms	Chrysophyta
		Blue-Green	Cyanophyta
P3	1	*Polysiphonia* spp.	Rhodophyta
		Ceramium sp.	Rhodophyta
		Herposiphonia sp.	Rhodophyta
		Sphacelaria sp.	Phaeophyta
		Derbesia sp.	Chlorophyta
		Diatoms	Chrysophyta
		Blue-Green	Cyanophyta
P3	10	*Polysiphonia* spp.	Rhodophyta
		Pennate Diatoms	Chrysophyta
		Blue-Green	Cyanophyta
P3	20	Diatoms	Chrysophyta
		Blue-Green	Cyanophyta
P3	30	Diatoms	Chrysophyta
		Oscillatoria sp.	Cyanophyta

TABLE A2 (Cont'd).

Platform	Depth (m)	Species	Division
P4	1	*Ceramium* sp.	Rhodophyta
		Polysiphonia spp.	Rhodophyta
		Acrochaetium sp.	Rhodophyta
		Goniotrichum sp.	Rhodophyta
		Herposiphonia sp.	Rhodophyta
		Sphacelaria sp.	Phaeophyta
		Derbesia sp.	Chlorophyta
		Diatoms	Chrysophyta
		Blue-Green	Cyanophyta
P4	10	*Polysiphonia* sp.	Rhodophyta
		Ceramium sp.	Rhodophyta
		Derbesia sp.	Chlorophyta
		Diatoms	Chrysophyta
		Blue-Green	Cyanophyta
P4	20	*Agardhiella* sp.	Rhodophyta
		Polysiphonia sp.	Rhodophyta
		Diatoms	Chrysophyta
		Blue-Green	Cyanophyta
P4	30	Diatoms	Chrysophyta
		Blue-Green	Cyanophyta

TABLE A3. Chlorophyll content (mg/cm²) of flora in 25 × 25 cm scraping samples from P1, P2, P3, and P4.

Platform	Depth (m)	Mg Chlorophyll *a*/cm²	Mg Chlorophyll *b*/cm²	Mg Chlorophyll *c*/cm²
P1	1	0.0016	0.0013	0.0016
P1	10	0.0058	0.0001	0.0010
P1-DL	10	0.0030	0.0007	0.0014
P2	1	0.0169	0.0002	0.0040
P2	10	0.0059	0.0002	0.0030
P3	1	0.0182	0.0037	0.0040
P3	10	0.0208	0.0044	0.0064
P3	20	0.0133	0.0017	0.0044
P3	30*	0.0024	0.0005	0.0024
P4	1	0.0264	0.0066	0.0068
P4	10	0.0204	0.0051	0.0052
P4	20*	0.0434	0.0072	0.0147
P4	30*	0.0428	0.0040	0.0200

*Extracted in 300 ml acetone; all others 600 ml acetone.

TABLE A4. Number of individuals of discrete fauna in 25 × 25 cm scraping samples from P1.

Platform:	P1										P1-DL				
Depth (m):	1				10						10				
Replicate:	1	2	3	Subtotal	1	2	3	Subtotal	Total	%	1	2	3	Total	%
TAXA															
Actiniaria†	175	375	75	625	175	25	50	250	875	4.50	125	125	50	300	7.23
Platyhelminthes†		25		25					25	0.13					
Nemertea†	100	100		200	100	25	100	225	425	2.18	125	200	200	525	12.66
Phoronis sp.†					50	25	25	100	100	0.51	25	25	25	75	1.81
Epitonium humphreysii					1			1	1	0.01					
Thais haemastoma							1	1	1	0.01					
Doto uva†		25		25		50	50	100	125	0.64		25	25	50	1.21
Barbatia tenera													1	1	0.02
Anadara transversa					6	11	8	25	25	0.13	4	1	3	8	0.19
Noetia ponderosa						1		1	1	0.01					
Lithophaga bisculata					3	5	3	11	11	0.06	7	3	6	16	0.39
Lithophaga aristata		1		1	7	11	3	21	22	0.11	2	1	2	5	0.12
Isognomon bicolor	4	5	2	11	18	16	11	45	56	0.29	5	8	4	17	0.41
Ostreacea		1		1	28	42	18	88	89	0.46	37	36	25	98	2.36
Chama macerophylla					26	56	13	95	95	0.49	16	12	18	46	1.11
Kellia suborbicularis†							25	25	25	0.13	25			25	0.60
Hiatella arctica						1		1	1	0.01					
Ctenodrilus sp.†					50	25		75	75	0.38	25			25	0.60
Polydora sp.†					75	25	25	125	125	0.64	50	25	25	100	2.41
Dodecaceria sp.†											25	25	25	75	1.81
Anaitides mucosa†											25			25	0.60
Ophiodromus obscura†					25			25	25	0.13					
Autolytus sp.†					25	25		50	50	0.26		75	25	100	2.41
Brania sp.†					375	175	50	600	600	3.08	75	75	75	225	5.43
Exogone dispar†					50			50	50	0.26	25	50	25	100	2.41
Odontosyllis sp.†					100		100	200	200	1.03	150	25	75	250	6.03
Syllis sp.†											100	25		125	3.01
Typosyllis sp.†					150	75	25	250	250	1.28	475	75	125	675	16.28
Neanthes succinea†	50	100	25	175	50	50	25	125	300	1.54	50	25	25	100	2.41
Eupomatus dianthus†													25	25	0.60
Pycnogonida†	25	75	50	150					150	0.77					
Balanus amphitrite	145	169	119	433	152	204	116	472	905	4.65	143	92	147	382	9.21
Balanus calidus						2		2	2	0.01		1		1	0.02
Balanus eburneus	3	2		5	2	5	4	11	16	0.08	2	5	2	9	0.22
Balanus improvisus	205	204	261	670	26	133	27	186	856	4.40	29	23	18	70	1.69
Balanus tintinnabulum	1			1					1	0.01					
Sphaeroma sp.		5		5					5	0.03					
Podocerus brasiliensis†					50			50	50	0.26		100	100	200	4.82
Erichthonius brasiliensis†							25	25	25	0.13					
Corophium sp.†	1,000	1,250	500	2,750					2,750	14.13					
Stenothoe sp.†	2,900	4,200	2,800	9,900	175	50	50	275	10,175	52.28	25	75	25	125	3.01
Caprella equilibra†	175	250	150	575	150	25	100	275	850	4.37	50	100	25	175	4.22
Paracaprella pusilla†						25	25	50	50	0.26	25		75	100	2.41
Synalpheus fritzmuelleri					1	3	2	6	6	0.03			4	4	0.10
Menippe mercenaria					1	6	4	11	11	0.06		6	6	12	0.29
Pseudomedaeus agassizii					16	28	9	53	53	0.27	31	20	27	78	1.88
Eurypanopeus depressus			1	1		4		4	5	0.03					
TOTAL	4,783	6,787	3,983	15,553	1,867	1,128	894	3,909	19,462	100.00	1,676	1,258	1,213	4,147	100.00
Area Sampled (m^2)	0.0625	0.0625	0.0625	0.1875	0.0625	0.0625	0.0625	0.1875	0.0625		0.0625	0.0625	0.1875	0.3750	
Number/m^2	76,528	108,592	63,728	82,949	30,576	18,048	14,688	21,104	52,027		26,816	20,128	19,408	22,117	
Number of Taxa	12	16	10	18	28	29	27	37	42		27	28	30	35	
Species Diversity (H")	1.28	1.32	1.08	1.26	2.74	2.77	2.84	2.98	1.91		2.64	2.86	2.86	2.94	
Species Richness (D)	1.30	1.70	1.09	1.76	3.58	3.98	3.83	4.35	4.15		3.50	3.78	4.08	4.08	
Evenness (J)	0.52	0.48	0.47	0.44	0.82	0.82	0.86	0.82	0.51		0.80	0.86	0.84	0.83	

†Subsampled organisms (numbers have been multiplied by 25 at 1 and 10 m depths).

TABLE A5. Percent live barnacles in 25 × 25 cm scraping samples from P1.

Platform:	P1								P1-DL			
Depth (m):	1				10				10			
Replicate:	1	2	3	Mean	1	2	3	Mean	1	2	3	Mean
TAXA												
Balanus amphitrite	89	86	92	89	46	39	43	43	43	53	29	40
Balanus calidus						50		50		100		100
Balanus eburneus	67	0		40	100	40	50	55	100	40	0	45
Balanus improvisus	85	82	89	86	58	39	26	40	38	65	28	44
Balanus tintinnabulum	100			100								

TABLE A6. Wet weight (g) of discrete fauna in 25 × 25 cm scraping samples from P1.

Platform:	P1										P1-DL				
Depth (m):	1				10						10				
Replicate:	1	2	3	Subtotal	1	2	3	Subtotal	Total	%	1	2	3	Total	%
TAXA															
Actiniaria†	0.57	0.57	0.03	1.17	0.46	0.05	0.02	0.53	1.70	0.08	0.51	0.06	0.04	0.61	0.04
Platyhelminthes†		*		*					*						
Nemertea†	0.01	0.01		0.02	*	*	*	*	0.02	0.00	*	0.01	*	0.01	0.00
Phoronis sp.†					0.08	0.01	0.02	0.11	0.11	0.01	*	*	*	*	
Epitonium humphreysii					0.05			0.05	0.05	0.00					
Thais haemastoma							0.01	0.01	0.01	0.00					
Doto uva†		*		*		*	*	*	*			*	*	*	
Barbatia tenera													0.11	0.11	0.01
Anadara transversa					0.97	3.08	1.53	5.58	5.58	0.27	1.24	0.04	0.45	1.73	0.13
Noetia ponderosa						0.04		0.04	0.04	0.00					
Lithophaga bisculata					1.04	0.47	0.10	1.61	1.61	0.08	0.51	0.05	0.16	0.72	0.05
Lithophaga aristata		0.02		0.02	1.62	3.06	0.16	4.84	4.86	0.24	0.45	0.03	0.54	1.02	0.07
Isognomon bicolor	0.48	0.33	0.22	1.03	1.82	2.06	1.34	5.22	6.25	0.31	0.48	1.37	0.64	2.49	0.18
Ostreacea		0.09		0.09	56.79	114.89	136.59	308.27	308.36	15.10	190.39	344.19	245.79	780.37	57.38
Chama macerophylla					16.50	35.89	5.07	57.46	57.46	2.81	26.09	11.19	29.09	66.37	4.88
Kellia suborbicularis†							0.16	0.16	0.16	0.01	0.49			0.49	0.04
Hiatella arctica						0.14		0.14	0.14	0.01					
Ctenodrilus sp.†					*	*		*	*		*			*	
Polydora sp.†					0.95	*	*	0.95	0.95	0.05	0.02	0.01	*	0.03	0.00
Dodecaceria sp.†											*	*	*	*	
Anaitides mucosa†											0.91			0.91	0.07
Ophiodromus obscura†					0.04			0.04	0.04	0.00					
Autolytus sp.†					*	*		*	*			*	*	*	
Brania sp.†					*	*	*	*	*		*	*	*	*	
Exogone dispar†					*			*	*		*	*	*	*	
Odontosyllis sp.†					*		*	*	*		*	*	*	*	
Syllis sp.†											0.06	*		0.06	0.00
Typosyllis sp.†					0.01	*	*	0.01	0.01	0.00	0.08	*	*	0.08	0.01
Neanthes succi. .†	0.26	1.44	0.06	1.76	*	*	*	*	1.76	0.09	*	0.62	*	0.62	0.05
Eupomatus dianthus†													0.67	0.67	0.05
Pycnogonida†	*	*	*	*											
Balanus amphitrite	195.50	226.00	203.09	624.59	274.59	388.39	171.29	834.27	1.458.86	71.43	129.59	131.59	205.19	466.37	34.29
Balanus calidus						1.29		1.29	1.29	0.06		0.14		0.14	0.01
Balanus eburneus	3.28	3.15		6.43	18.00	23.18	10.50	51.68	58.11	2.85	7.59	2.92	9.32	19.83	1.46
Balanus improvisus	30.00	26.99	39.49	96.48	4.16	14.49	3.82	22.47	118.95	5.82	3.36	2.49	1.40	7.25	0.53
Balanus tintinnabulum	2.38			2.38					2.38	0.12					
Sphaeroma sp.		0.09		0.09					0.09	0.00					
Podocerus braziliensis†					0.01			0.01	0.01	0.00		0.04	*	0.04	0.00
Erichthonius brasiliensis†							*	*	*						
Corophium sp.†	0.09	0.25	0.08	0.42					0.42	0.02					
Stenothoe sp.†	0.37	0.43	0.20	1.00	*	*	*	*	1.00	0.05	*	*	*	*	
Caprella equilibra†	0.02	0.12	0.08	0.22	0.06	*	0.04	0.10	0.32	0.02	*	0.09	*	0.09	0.01
Paracaprella pusilla†						*	*	*	*		*		*	*	
Synalpheus fritzmuelleri					0.16	0.34	0.25	0.75	0.75	0.04			0.62	0.62	0.05
Menippe mercenaria					0.15	1.85	1.69	3.69	3.69	0.18		1.13	1.16	2.29	0.17
Pseudomedaeus agassizii					2.88	3.25	0.45	6.58	6.58	0.32	2.38	2.00	2.70	7.08	0.52
Eurypanopeus depressus			0.13	0.13		0.62		0.62	0.75	0.04					
TOTAL	232.96	259.49	243.38	735.83	380.34	593.10	333.04	1,306.48	2,042.31	100.0	364.15	497.97	497.88	1,360.00	100.00
Area sampled (m^2)	0.0625	0.0625	0.0625	0.1875	0.0625	0.0625	0.0625	0.1875	0.3750		0.0625	0.0625	0.0625	0.1875	
Wet Weight (g/m^2)	3,727.36	4,151.84	3,894.08	3,924.43	6,085.44	9,489.60	5,328.64	6,967.89	5,446.16		5,826.40	7,967.52	7,966.08	7,253.33	
Number of Taxa	12	16	10	18	28	29	27	37	42		27	28	30	35	
Species Diversity (H")	0.57	0.49	0.47	0.52	1.00	1.14	1.03	1.11	1.02		1.14	0.82	1.06	1.02	
Species Richness (D)	1.09	1.48	0.89	1.52	2.56	2.55	2.50	3.06	3.35		2.48	2.50	2.68	2.88	
Evenness (J)	0.23	0.18	0.20	0.18	0.30	0.34	0.31	0.31	0.27		0.34	0.25	0.31	0.29	

*Taxa with wet weight less than 0.01 g are not recorded.

†Subsampled organisms (wet weights have been multiplied by 25 at 1 and 10 m depths).

TABLE A7. Dry weight of discrete fauna in 25 × 25 cm scraping samples from P1.

Platform:	P1										P1-DL				
Depth (m):	1				10						10				
Replicate:	1	2	3	Subtotal	1	2	3	Subtotal	Total	%	1	2	3	Total	%
TAXA															
Actiniaria†	0.17	0.14	*	0.31	0.11	*	*	0.11	0.42	0.03	0.13	*	0.01	0.14	0.01
Platyhelminthes†		*		*					*						
Nemertea†	*	*		*	*	*	*	*	*		*	*	*	*	
Phoronis sp.†					0.02	*	*	0.02	0.02	0.00	*	*	*		
Epitonium humphreysii					*			*	*						
Thais haemastoma							*	*	*						
Doto uva†		*		*		*	*	*	*			*	*	*	
Barbatia tenera													0.07	0.07	0.01
Anadara transversa					0.69	1.90	0.98	3.57	3.57	0.24	0.79	0.02	0.28	1.09	0.10
Noetia ponderosa						0.02		0.02	0.02	0.00					
Lithophaga bisculata					0.52	0.19	0.04	0.75	0.75	0.05	0.23	0.03	0.06	0.32	0.03
Lithophaga aristata		*		*	0.80	1.54	0.07	2.41	2.41	0.16	0.23	0.02	0.25	0.50	0.05
Isognomon bicolor	0.27	0.20	0.14	0.61	1.03	1.36	0.89	3.28	3.89	0.26	0.33	0.87	0.50	1.70	0.16
Ostreacea		0.05		0.05	42.09	93.19	111.59	246.87	246.92	16.67	144.50	289.19	204.79	638.48	60.52
Chama macerophylla					11.79	26.09	3.85	41.73	41.73	2.82	19.39	8.89	21.59	49.87	4.83
Kellia suborbicularis†							0.07	0.07	0.07	0.00	0.36			0.36	0.03
Hiatella arctica						0.13		0.13	0.13	0.01					
Ctenodrilus sp.†					*	*		*	*		*			*	
Polydora sp.†					0.23	*	*	0.23	0.23	0.02	*	*	*	*	
Dodecaceria sp.†											*	*	*	*	
Anaitides mucosa†											0.16			0.16	0.02
Ophiodromus obscura†					*			*	*						
Autolytus sp.†					*	*		*	*			*	*	*	
Brania sp.†					*	*	*	*	*		*	*	*	*	
Exogone dispar†					*			*	*		*	*	*	*	
Odontosyllis sp.†					*		*	*	*		*	*	*	*	
Syllis sp.†											0.01	*		0.01	0.00
Typosyllis sp.†					*	*	*	*	*		0.01	*	*	0.01	0.00
Neanthes succinea†	0.04	0.25	*	0.29	*	*	*	*	0.29	0.02	*	0.11	*	0.11	0.01
Eupomatus dianthus†													0.02	0.02	0.00
Pycnogonida	*	*	*	*					*						
Balanus amphitrite	131.59	154.19	135.09	420.87	193.19	305.50	132.00	630.69	1,051.56	70.99	98.50	101.79	137.79	338.08	32.04
Balanus calidus						0.99		0.99	0.99	0.07		0.13		0.13	0.01
Balanus eburneus	2.43	2.75		5.18	12.39	18.72	8.11	39.22	44.40	3.00	5.39	2.56	8.30	16.25	1.54
Balanus improvisus	19.62	17.73	25.18	62.53	2.54	10.25	2.94	15.73	78.26	5.28	2.33	1.15	1.32	4.80	0.45
Balanus tintinnabulum	1.72			1.72					1.72	0.12					
Sphaeroma sp.		0.01		0.01					0.01	0.00					
Podocerus brasiliensis†					*			*	*			*	*	*	
Erichthonius brasiliensis†							*	*	*						
Corophium sp.†	0.02	0.04	0.01	0.07					0.07	0.00					
Stenothoe sp.†	0.08	0.12	0.06	0.26	*	*	*	*	0.26	0.02	*	*	*	*	
Caprella equilibra†	*	0.01	0.01	0.02	*	*	*	*	0.02	0.00	*	*	*	*	
Paracaprella pusilla†						*	*	*	*		*		*	*	
Synalpheus fritzmuelleri					0.03	0.05	0.04	0.12	0.12	0.01			0.08	0.08	0.01
Menippe mercenaria					0.05	0.51	0.48	1.04	1.04	0.07		0.33	0.30	0.63	0.06
Pseudomedaeus agassizii					0.93	1.08	0.12	2.13	2.13	0.14	0.80	0.67	0.74	2.21	0.21
Eurypanopeus depressus			0.02	0.02		0.17		0.17	0.19	0.01					
TOTAL	155.94	175.49	160.51	491.94	266.41	461.69	261.18	989.28	1,481.22	100.00	273.16	405.76	376.10	1,055.02	100.00
Area Sampled (m^2)	0.0625	0.0625	0.0625	0.1875	0.0625	0.0625	0.0625	0.1875	0.3750		0.0625	0.0625	0.0625	0.1875	
Dry Weight (g/m^2)	2,495.04	2,807.84	2,568.16	2,623.68	4,262.56	7,387.04	4,178.88	5,276.16	3,949.92		4,370.56	6,492.16	6,017.60	5,626.77	
Number of Taxa	12	16	10	18	28	29	27	37	42		27	28	30	35	
Species Diversity (H")	0.54	0.44	0.45	0.49	0.95	1.08	0.99	1.06	0.99		1.08	0.76	1.01	0.95	
Species Richness (D)	1.14	1.54	0.93	1.57	2.65	2.61	2.56	3.13	3.44		2.55	2.55	2.75	2.94	
Evenness (J)	0.22	0.16	0.19	0.17	0.29	0.32	0.30	0.29	0.26		0.33	0.23	0.30	0.27	

†Subsampled organisms (dry weights have been multiplied by 25 at 1 and 10 m depths).

*Taxa with dry weight less than 0.01 g are not recorded.

TABLE A8. Relative percent cover of colonial organisms in 25 × 25 cm scraping samples from P1.

Platform	P1						P1-DL		
Depth (m)	1			10			10		
Replicate	1	2	3	1	2	3	1	2	3
TAXA									
Algae			5.0						
Clionidae				20.0		2.5	20.0	5.0	
Demospongiae 1				5.0					
Demospongiae 4				2.5					
Demospongiae 9	2.5							5.0	5.0
Calcarea Homocoelidae						5.0		2.5	2.5
Turritopsis nutricula				10.0	30.0	50.0	15.0	10.0	20.0
Eudendrium carneum				15.0	10.0	10.0	15.0	5.0	10.0
Clytia sp.	10.0	50.0	40.0	10.0	5.0	2.5	5.0	5.0	2.5
Obelia dichotoma	2.5	5.0	20.0	5.0	2.5	2.5	2.5		
Aeverrillia setigera	40.0	40.0	20.0	20.0	20.0	10.0	5.0	2.5	2.5
Aetea anguina	25.0	2.5	5.0	10.0					2.5
Membranipora savartii	10.0		10.0						
Bugula neritina									2.5
Bugula sp.				2.5	2.5	5.0	5.0	5.0	2.5
Hippoporina americana	10.0	2.5							
Parasmittina munita					10.0	2.5	30.0	20.0	40.0
Ascidiacea 1								20.0	
Ascidiacea 2					20.0	10.0	2.5	20.0	10.0
Total %	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Area sampled (m^2)	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625
Number of taxa	7	5	6	10	8	10	9	11	11
Species diversity (H")	1.59	1.05	1.54	2.10	1.80	1.71	1.89	2.13	1.85
Species richness (D)	1.30	0.87	1.09	1.95	1.52	1.95	1.74	2.17	2.17
Evenness (J)	0.82	0.65	0.86	0.91	0.87	0.74	0.86	0.89	0.77

TABLE A9. Number of individuals of discrete fauna in 25 × 25 cm scraping samples from P2.

Platform:	P2									
Depth(m):	1				10					
Replicate:	1	2	3	Subtotal	1	2	3	Subtotal	Total	%
TAXA										
Actiniaria†	4,800	5,275	4,975	15,050	1,850	4,025	3,050	8,925	23,975	58.15
Platyhelminthes†			25	25					25	0.06
Nemertea†	350	725	1,000	2,075					2,075	5.03
Doto uva†			25	25					25	0.06
Anadara transversa		3		3	4	2	2	8	11	0.03
Lithophaga bisculata	1	1		2	8	3	5	16	18	0.04
Lithophaga aristata		5	1	6	2	1		3	9	0.02
Isognomon bicolor	3	7	8	18	1	1		2	20	0.05
Ostreacea	5	14	15	34	48	37	23	108	142	0.34
Chama macerophylla					3	2	1	6	6	0.01
Kellia suborbicularis†		25		25					25	0.06
Polydora sp.†			25	25	50		50	100	125	0.30
Autolytus sp.†		25		25		25		25	50	0.12
Brania sp.†			50	50					50	0.12
Exogone dispar†			25	25					25	0.06
Syllis sp.†	75	500	75	650	75	250	150	475	1,125	2.73
Typosyllis sp.†	100	500	150	750	150	225	200	575	1,325	3.21
Syllinae†	25	25		50					50	0.12
Neanthes succinea†	25	25	25	75		75	100	175	250	0.61
Lumbrineris inflata†					25			25	25	0.06
Potamilla sp.†							75	75	75	0.18
Eupomatus dianthus†					25		25	50	50	0.12
Sipuncula		1		1					1	0.00
Balanus amphitrite	660	655	692	2,007	521	488	333	1,342	3,349	8.12
Balanus eburneus	1		4	5	3	22	6	31	36	0.09
Balanus improvisus	117	101	92	310	262	135	95	492	802	1.95
Jassa falcata†	300	250		550					550	1.33
Corophium sp.†	50	100	100	250		25		25	275	0.67
Stenothoe sp.†	2,000	2,725	475	5,200	25	25	75	5,275	5,275	12.69
Caprella equilibra†	200	125	1,075	1,400					1,400	3.40
Menippe mercenaria	2	5	2	9	6	5	6	17	26	0.06
Pseudomedaeus agassizii					15	11	10	36	36	0.09
TOTAL	8,714	11,092	8,839	28,645	3,073	5,357	4,156	12,586	41,231	100.00
Area sampled (m^2)	0.0625	0.0625	0.0625	0.1875	0.0625	0.0625	0.0625	0.1875	0.3750	
Number/m^2	139,424	177,472	141,424	152,773	49,168	85,712	66,496	67,125	109,949	
Number of Taxa	17	21	20	27	18	18	17	22	32	
Species Diversity (H")	1.42	1.62	1.53	1.61	1.39	1.03	1.13	1.19	1.59	
Species Richness (D)	1.76	2.15	2.09	2.53	2.12	1.97	1.92	2.22	2.92	
Evenness (J)	0.50	0.53	0.51	0.49	0.48	0.36	0.40	0.39	0.46	

†subsampled organisms (numbers have been multiplied by 25 at 1 and 10 m depths)

TABLE A10. Percent live barnacles in 25 × 25 cm scraping samples from P2.

Platform:	P2							
Depth (m):	1				10			
Replicate:	1	2	3	Mean	1	2	3	Mean
TAXA								
Balanus amphitrite	93	89	87	90	64	74	61	67
Balanus calidus								
Balanus eburneus	0		75	60	67	59	50	58
Balanus improvisus	88	76	43	71	82	67	53	72
Balanus tintinnabulum								

TABLE A11. Wet weight (g) of discrete fauna in 25 × 25 cm scraping samples from P2.

Platform:	P2									
Depth (m):	1				10					
Replicate:	1	2	3	Subtotal	1	2	3	Subtotal	Total	%
TAXA										
Actiniaria†	15.30	21.20	19.69	56.19	9.84	14.52	9.88	34.24	90.43	3.06
Platyhelminthes†			*	*					*	*
Nemertea†	0.04	0.12	0.12	0.28					0.28	0.01
Doto uva†			*	*					*	*
Anadara transversa		1.42		1.42	0.62	0.95	0.15	1.72	3.14	0.11
Lithophaga bisculata	0.06	0.04		0.10	0.88	0.63	0.71	2.22	2.32	0.08
Lithophaga aristata		1.11	0.02	1.13	0.69	0.52		1.21	2.34	0.08
Isognomon bicolor	0.61	0.76	2.19	3.56	0.09	0.10		0.19	3.75	0.13
Ostreacea	4.18	17.00	17.00	38.18	74.50	46.59	40.00	161.09	199.27	6.75
Chama macerophylla					1.10	1.06	0.37	2.53	2.53	0.09
Kellia suborbicularis†		0.27		0.27					0.27	0.01
Polydora sp.†			0.01	0.01	0.05		0.03	0.08	0.09	0.00
Autolytus sp.†		*		*		0.01		0.01	0.01	0.00
Brania sp.†			*	*					*	*
Exogone dispar†			*	*					*	*
Syllis sp.†	0.10	0.47	0.06	0.63	0.03	0.20	0.03	0.26	0.89	0.03
Typosyllis sp.†	0.01	0.03	0.02	0.06	*	0.01	0.01	0.02	0.08	0.00
Syllinae†	0.03	*		0.03					0.03	0.00
Neanthes succinea†	*	*	0.02	0.02		0.05	0.27	0.32	0.34	0.01
Lumbrineris inflata†					0.67			0.67	0.67	0.02
Potamilla sp.†							*	*	*	*
Eupomatus dianthus†					0.06		0.02	0.08	0.08	0.00
Sipuncula		0.01		0.01					0.01	0.00
Balanus amphitrite	321.39	437.69	352.69	1,111.77	612.59	477.69	321.59	1,411.87	2,523.64	85.47
Balanus eburneus	0.28		5.94	6.22	14.68	1.81	0.28	16.77	22.99	0.78
Balanus improvisus	20.87	16.75	13.15	50.77	23.18	7.06	6.19	36.43	87.20	2.95
Jassa falcata†	0.08	0.02		0.10					0.10	0.00
Corophium sp.†	*	0.01	*	0.01		*		*	0.01	0.00
Stenothoe sp.†	0.25	0.26	0.02	0.53	*	*	*	*	0.53	0.02
Caprella equilibra†	0.04	*	0.37	0.41					0.41	0.01
Menippe mercenaria	0.19	1.58	0.65	2.42	0.74	1.66	0.89	3.29	5.71	0.19
Pseudomedaeus agassizii					2.54	1.38	1.45	5.37	5.37	0.18
TOTAL	363.43	498.74	411.95	1,274.12	742.26	554.24	381.87	1,678.37	2,952.49	100.00
Area Sampled (m^2)	0.0625	0.0625	0.0625	0.1875	0.0625	0.0625	0.0625	0.1875	0.3750	
Wet Weight (g/m^2)	5,814.88	7,979.84	6,591.20	6,795.31	11,876.16	8,867.84	6,109.92	8,951.31	7,873.31	
Number of Taxa	17	21	20	27	18	18	17	22	32	
Species Diversity (H")	0.49	0.56	0.63	0.57	0.70	0.58	0.61	0.65	0.63	
Species Richness (D)	1.52	1.85	1.79	2.21	1.52	1.56	1.52	1.75	2.46	
Evenness (J)	0.17	0.18	0.21	0.17	0.24	0.20	0.22	0.21	0.18	

†Subsampled organisms (wet weights have been multiplied by 25 at 1 and 10 m depths).

*Taxa with wet weight less than 0101 g are not recorded.

TABLE A12. Dry weight (g) of discrete fauna in 25 × 25 cm scraping samples from P2.

Platform:	P2									
Depth (m)	1				10					
Replicate:	1	2	3	Subtotal	1	2	3	Subtotal	Total	%
TAXA										
Actiniaria†	3.39	4.28	4.36	12.03	2.27	3.35	2.47	8.09	20.12	0.93
Platyhelminthes †			*	*					*	
Nemertea†	*	0.02	0.02	0.04					0.04	0.00
Doto uva†			*	*					*	
Anadara transversa		0.81		0.81	0.45	0.33	0.14	0.92	1.73	0.08
Lithophaga bisculata	0.02	0.02		0.04	0.36	0.07	0.30	0.73	0.77	0.04
Lithophaga aristata		0.63	0.01	0.64	0.31	0.02		0.33	0.97	0.04
Isognomon bicolor	0.39	0.62	1.48	2.49	0.08	0.10		0.18	2.67	0.12
Ostreacea	3.55	13.39	12.39	29.33	62.79	42.09	36.00	140.88	170.21	7.88
Chama macerophylla					0.68	0.85	0.27	1.80	1.80	0.08
Kellia suborbicularis†		0.19		0.19					0.19	0.01
Polydora sp.† †			*	*	*		*	*	*	
Autolytus sp.†		*		*		*		*	*	
Brania sp.†			*	*					*	
Exogone dispar†			*	*					*	
Syllis sp.† †	0.02	0.08	0.01	0.11	*	0.04	*	0.04	0.15	0.01
Typosyllis sp.†	*	*	*	*	*	*	*	*	*	
Syllinae†	*	*		*					*	
Neanthes succinea†	*	*	*	*		*	0.04	0.04	0.04	0.00
Lumbrineris inflata†					0.21			0.21	0.21	0.01
Potamilla sp.†							*	*	*	
Eupomatus dianthus†					0.01		*	0.01	0.01	0.00
Sipuncula		*		*					*	
Balanus amphitrite	223.89	274.79	237.09	735.77	472.00	393.09	272.00	1,137.09	1,872.86	86.70
Balanus eburneus	0.27		4.50	4.77	11.63	1.58	0.28	13.49	18.26	0.85
Balanus improvisus	15.28	13.38	10.18	38.84	16.06	6.05	5.72	27.83	66.67	3.09
Jassa falcata† †	0.01	*		0.01					0.01	0.00
Corophium sp.†	*	*	*	*		*		*	*	
Stenothoe sp.†	0.18	0.04	*	0.22	*	*	*	*	0.22	0.01
Caprella equilibra†	*	*	0.04	0.04					0.04	0.00
Menippe mercenaria	0.06	0.51	0.19	0.76	0.24	0.35	0.29	0.88	1.64	0.08
Pseudomedaeus agassizii					0.90	0.28	0.47	1.65	1.65	0.08
TOTAL	247.06	308.76	270.27	826.09	567.99	448.20	317.98	1,334.17	2,160.26	100.00
Area Sampled (m^2)	0.0625	0.0625	0.0625	0.1875	0.0625	0.0625	0.0625	0.1875	0.3750	
Dry Weight (g/m^2)	3,952.96	4,940.16	4,324.32	4,405.81	9,087.84	7,171.20	5,087.68	7,115.57	5,760.69	
Number of Taxa	17	21	20	27	18	18	17	22	32	
Species Diversity (H")	0.41	0.50	0.55	0.50	0.64	0.48	0.53	0.56	0.56	
Species Richness (D)	1.58	1.94	1.86	2.30	1.55	1.59	1.54	1.78	2.52	
Evenness (J)	0.14	0.16	0.18	0.15	0.22	0.17	0.19	0.18	0.16	

†Subsampled organisms (dry weights have been multiplied by 25 at 1 and 10 m depths).

*Taxa with dry weight less than 0.01 g are not recorded.

TABLE A13. Relative percent cover of colonial organisms in 25 × 25 cm scraping samples from P2.

Platform	P2					
Depth (m)	1			10		
Replicate	1	2	3	1	2	3
TAXA						
Algae	40.0	20.0	20.0			
Clionidae	15.0	40.0	30.0		20.0	40.0
Demospongiae 2		5.0				
Demospongiae 9	10.0					
Calcarea Homocoelidae		5.0				
Turritopsis nutricula		2.5	5.0			
Clytia sp.			2.5	5.0		
Obelia dichotoma	10.0	5.0	20.0	60.0	30.0	10.0
Aeverrillia setigera	20.0	20.0	20.0	35.0	50.0	30.0
Aetea anguina	2.5	2.5	2.5			
Membraniporidae	2.5					
Schizoporella errata						20.0
Total %	100.0	100.0	100.0	100.0	100.0	100.0
Area sampled (m^2)	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625
Number of taxa	7	8	7	3	3	4
Species Diversity (H")	1.62	1.64	1.66	0.82	1.03	1.28
Species Richness (D)	1.30	1.52	1.30	0.43	0.43	0.65
Evenness (J)	0.83	0.79	0.85	0.75	0.94	0.92

TABLE A14. Number of individuals of discrete fauna in 25 × 25 cm scraping samples from P3.

Platform:	P3																	
Depth (m):	1				10				20				30					
Replicate	1	2	3	Subtotal	1	2	3	Subtotal	1	2	3	Subtotal	1	2	3	Subtotal	Total	%
TAXA																		
Calcarea Heterocoelidae†			50	50													50	0.09
Telesto sp.										13	1	14					14	0.03
Actiniaria†	150			150	575	900	2,925	4,400	100	60	180	340					4,890	9.07
Platyhelminthes†	50	50		100													100	0.19
Nemertea†	525	25	375	925	375	275	200	850	60	20	40	120					1,895	3.52
Thais haemastoma		1		1													1	0.00
Doto uva†	25			25	25			25									50	0.09
Coryphella sp.†													20		20	20	20	0.04
Arca imbricata	4			4													4	0.01
Anadara transversa							1	1									1	0.00
Barbatia candida										2		2					2	0.00
Musculus lateralis†							25	25									25	0.05
Lithophaga bisculata	1		5	6	1	2	1	4	3	2		5					15	0.03
Lithophaga aristata	4	1		5		2	3	5	7	13	3	23					33	0.06
Pteria colymbus		3		3									1			1	4	0.01
Isognomon bicolor	485	154	222	861	4	4	10	18		2		2					881	1.63
Anomia simplex										2		2					2	0.00
Ostreacea	2	4	3	9	5	3	2	10	3	4	3	10					29	0.05
Chama macerophylla	16	9	11	36	1	7	12	20	4	11	13	28					84	0.16
Hiatella arctica	1			1	1			1									2	0.00
Ctenodrilus sp.†	375		125	500	25			25									525	0.97
Polydora sp.†									20			20					20	0.04
Dodecaceria sp.†					25			25									25	0.05
Anaitides mucosa†							25	25									25	0.05
Autolytus sp.†	50	75	50	175			525	525		40	20	60					760	1.41
Brania sp.†	175	100	75	350			25	25		20		20			20	20	415	0.77
Exogone dispar							25	25							20	20	45	0.08
Eusyllis sp.†	50		425	475			100	100	20	40	20	80	20		60	80	735	1.36
Odontosyllis sp.†			175	175	25			25	40	20	60	120					320	0.59
Trypanosyllis sp.†									40			40					40	0.07
Haplosyllis spongicola†	225	475	75	775	150	50	475	675	100	160	60	320					1,770	3.28
Syllis sp.†	1,475	500	600	2,575	75	150	200	425	200	40		240			20	20	3,260	6.05
Typosyllis sp.†	600	50	75	725	25	75	50	150	60	40		100			40	40	1,015	1.88
Neanthes succinea†	25			25													25	0.05
Lumbrineris inflata†							25	25									25	0.05
Dorvillea sp.†	175		75	250			25	25									275	0.51
Sipuncula	6			6													6	0.01
Pycnogonida†	425	275	375	1,075													1,075	1.99
Balanus amphitrite	31	125	47	203	1	19	6	26	2	3	3	8					237	0.44
Balanus eburneus							1	1		1		1					2	0.00
Balanus improvisus		6	34	40													40	0.07
Balanus tintinnabulum		4	24	28	1			1									29	0.05
Tanais sp.†	50		25	75													75	0.14
Podocerus brasiliensis†	25		100	125	50	25	25	100	100	300	60	460	40			40	725	1.35
Jassa falcata†	25			25	25	50		75	180	260	360	800	60			60	960	1.78
Erichthonius brasiliensis†					25	200	100	325	920	620	520	2,060	840	20	80	940	3,325	6.17
Colomastix sp.†											20	20					20	0.04
Stenothoe sp.†	50	25	800	875	650	350	350	1,350	360	200	200	760	120	20	40	180	3,165	5.87
Elasmopus rapax†	25		50	75													75	0.14
Caprella equilibra†	75	25	25	125	50	75	250	375	280	20	300	600	540	20	40	600	1,700	3.15
Leuconacia incerta†													300			300	300	0.56
Paracaprella pusilla†									280	60	620	960	5,900	60		5,960	6,920	12.84
Synalpheus fritzmulleri	1	6	3	10	3	2	2	7	2	3	1	6	2			2	25	0.05
Pseudomedaeus agassizii			1	1	3	10	7	20	12	19	20	51	5			5	77	0.14
Micropanope nuttingi		1		1													1	0.00
?Mithrax sp.			1	1						1		1					2	0.00
Arbacia punctulata							1	1	1			1					2	0.00
Ophiactis savignyi†	7,025	4,150	6,150	17,325	125	50	150	325		40	40	80			20	20	17,750	32.94
TOTAL	12,151	6,064	9,976	28,191	2,245	2,249	5,546	10,040	2,794	2,016	2,544	7,354	7,848	120	340	8,308	53,893	100.00
Area Sampled (m^2)	0.0625	0.0625	0.0625	0.1875	0.0625	0.0625	0.0625	0.1875	0.0625	0.0625	0.0625	0.1875	0.0625	0.0625	0.0625	0.1875	0.7500	
Number/m^2	194,416	97,024	159,616	150,352	35,920	35,984	88,736	53,547	44,704	32,256	40,704	39,221	125,568	1,920	5,440	44,309	71,857	
Number of Taxa	31	22	28	40	24	19	29	36	23	29	21	33	12	4	9	17	58	
Species Diversity (H")	1.71	1.29	1.64	1.69	2.04	1.96	1.84	2.07	2.25	2.33	2.19	2.40	0.93	1.24	2.07	1.09	2.49	
Species Richness (D)	3.19	2.41	2.93	3.81	2.98	2.33	3.25	3.80	2.77	3.68	2.55	3.59	1.23	0.63	1.37	1.77	5.23	
Evenness (J)	0.50	0.42	0.49	0.46	0.64	0.67	0.55	0.58	0.72	0.69	0.72	0.69	0.38	0.90	0.94	0.38	0.61	

†Subsampled organisms (numbers have been multiplied by 25 at 1 and 10 m depths and by 20 at 20 and 30 m depths).

TABLE A15. Percent live barnacles in 25 × 25 cm scraping samples from P3.

Platform:	P3															
Depth (m):	1				10				20				30			
Replicate:	1	2	3	Mean	1	2	3	Mean	1	2	3	Mean	1	2	3	Mean
TAXA																
Balanus amphitrite	35	34	57	39	100	0	0	4	0	0	0	0				
Balanus calidus																
Balanus eburneus							0	0		0						
Balanus improvisus		33	79	73												
Balanus tintinnabulum		75	92	89												

TABLE A16. Wet weight (g) of discrete fauna in 25 × 25 cm scraping samples from P3.

Platform:	P3																	
Depth (m):	1				10				20				30					
Replicate:	1	2	3	Subtotal	1	2	3	Subtotal	1	2	3	Subtotal	1	2	3	Subtotal	Total	%
TAXA																		
Calcarea Heterocoelidae†			0.38	0.38													0.38	0.01
Telesto sp.†										11.17	0.05	11.22					11.22	0.31
Actiniaria†	0.14			0.14	2.10	3.04	8.10	13.24	0.27	0.42	12.20	12.89					26.27	0.72
Platyhelminthes†	*	*		*													*	*
Nemertea†	0.01	*	0.02	0.03	0.15	0.02	0.01	0.18	0.01	*	*	0.01					0.22	0.01
Thais haemastoma		1.25		1.25													1.25	0.03
Doto uva†	0.01			0.01	0.11			0.11									0.12	0.00
Coryphella sp.†													0.03			0.03	0.03	0.00
Aroa imbricata	10.85			10.85													10.85	0.30
Anadara transversa							0.04	0.04									0.04	0.00
Barbatia candida†										23.89		23.89					23.89	0.66
Musculus lateralis†							0.07	0.07									0.07	0.00
Lithophaga bisculata	0.02		0.64	0.66	0.10	0.78	0.50	1.38	3.83	1.75		5.58					7.62	0.21
Lithophaga aristata	0.78	0.38		1.16		2.24	2.24	4.48	17.41	18.48	1.11	37.00					42.64	1.18
Pteria colymbus		10.84		10.84									0.18			0.18	11.02	0.30
Isognomon bicolor	353.29	77.09	163.89	594.27	2.06	7.82	6.05	15.93		0.31		0.31					610.51	16.83
Anomia simplex										5.76		5.76					5.76	0.16
Ostreacea	3.89	22.49	46.52	72.90	220.79	304.29	49.59	574.67	644.64	352.89	156.19	1,153.72					1,801.29	49.65
Chama macerophylla	50.59	8.80	54.58	113.97	11.84	56.89	164.79	233.52	12.55	114.79	77.44	204.78					552.27	15.22
Hiatella arctica	0.24			0.24	0.06			0.06									0.30	0.01
Ctenodrilus sp.†	*		*	*	*			*									*	*
Polydora sp.†									0.09			0.09					0.09	0.00
Dodecaceria sp.†					*			*									*	*
Anaitides mucosa†							0.29	0.29									0.29	0.01
Autolytus sp.†	*	0.02	*	0.02			1.18	1.18		*	*	*					1.20	0.03
Brania sp.†	*	*	*	*			*	*		*		*			*	*	*	*
Exogone dispar†							*	*							*	*	*	*
Eusyllis sp.†	*		0.07	0.07			*	*	*	*	*	*	0.01		0.02	0.03	0.10	0.00
Odontosyllis sp.†			0.03	0.03	*			*	*	*	*	*					0.03	0.00
Trypanosyllis sp.									0.11			0.11					0.11	0.00
Haplosyllis spongicola†	0.03	0.17	*	0.20	0.07	0.01	0.06	0.14	*	0.01	0.01	0.02					0.36	0.01
Syllis sp.†	1.74	1.02	0.58	3.34	0.05	0.14	0.18	0.37	0.15	0.01		0.16			0.01	0.01	3.88	0.11
Typosyllis sp.†	0.09	*	0.01	0.10	*	*	*	*	*	*		*			0.01	0.01	0.11	0.00
Neanthes succinea†	0.07			0.07													0.07	0.00
Lumbrineris inflata†							0.09	0.09									0.09	0.00
Dorvillea sp.†	*		0.09	0.09			*	*									0.09	0.00
Sipuncula†	0.48			0.48													0.48	0.01
Pycnogonida†	0.24	0.20	0.12	0.56													0.56	0.02
Balanus amphitrite	23.69	90.83	20.55	135.07	1.13	30.50	9.63	41.26	3.21	4.81	4.81	12.83					189.16	5.21
Balanus eburneus							3.52	3.52		3.53		3.53					7.05	0.19
Balanus improvisus		0.64	3.53	4.17													4.17	0.11
Balanus tintinnabulum		1.70	188.17	189.87	0.05			0.05									189.92	5.23
Tanais sp.†	0.03		*	0.03													0.03	0.00
Podocerus brasiliensis†	*		0.05	0.05	*	*	*	*	0.06	0.20	0.02	0.28	0.03			0.03	0.36	0.01
Jassa falcata†	0.01			0.01	0.04	0.02		0.06	0.05	0.22	0.37	0.64	0.01			0.01	0.72	0.02
Erichthonius brasiliensis†					*	0.43	0.06	0.49	0.53	0.37	0.33	1.28	0.19	*	*	0.19	1.96	0.05
Colomastix sp.†											0.02	0.02					0.02	0.00
Stenothoe sp.†	*	*	0.16	0.16	0.24	0.07	0.05	0.36	0.10	0.11	0.06	0.27	0.02	*	*	0.02	0.81	0.02
Elasmopus rapax†	*		*	*													*	
Caprella equilibra†	0.02	*	0.02	0.04	0.03	0.02	0.33	0.38	0.34	0.06	0.97	1.37	0.38	*	0.03	0.41	2.20	0.06
Leuconacia incerta†													0.18			0.18	0.18	0.00
Paracaprella pusilla†									0.16	0.07	0.66	0.89	2.63	0.02		2.65	3.54	0.10
Synalpheus fritzmuelleri	0.08	1.00	0.37	1.45	0.18	0.10	0.21	0.49	0.13	0.17	0.04	0.34	0.03			0.03	2.31	0.06
Pseudomedaeus agassizii			0.10	0.10	0.47	1.39	0.48	2.34	0.43	2.15	1.07	3.65	0.28			0.28	6.37	0.18
Micropanope nuttingi		0.13		0.13													0.13	0.00
?*Mithrax* sp.			0.08	0.08						0.07		0.07					0.15	0.00
Arbacia punctulata†							0.14	0.14	10.62			10.62					10.76	0.30
Ophiactis savigmyi†	35.53	19.13	36.92	91.58	1.46	0.65	0.95	3.06		0.22	0.15	0.37			0.10	0.10	95.11	2.62
TOTAL	481.83	235.69	516.88	1,234.40	240.93	408.41	248.56	897.90	694.74	541.46	255.50	1,491.70	3.97	0.02	0.17	4.16	3,628.16	100.00
Area Sampled (m^2)	0.0625	0.0625	0.0625	0.1875	0.0625	0.0625	0.0625	0.1875	0.0625	0.0625	0.0625	0.1875	0.0625	0.0625	0.0625	0.1875	0.7500	
Wet Weight (g/m^2)	7,709.28	3,771.04	8,270.08	6,583.47	3,854.88	6,534.56	3,976.96	4,788.80	11,115.84	8,663.36	4,088.00	7,955.73	63.52	0.32	2.72	22.19	4,837.55	
Number of Taxa	31	22	28	40	24	19	29	36	23	29	21	33	12	4	9	17	58	
Species Diversity (H")	0.98	1.58	1.58	1.63	0.41	0.89	1.14	1.04	0.38	1.14	1.00	0.89	1.28	-	1.20	1.41	1.63	
Species Richness (D)	2.78	2.09	2.49	3.33	2.28	1.70	2.77	3.07	1.97	2.57	1.97	2.69	1.84	-	2.82	2.65	4.45	
Evenness (J)	0.29	0.51	0.47	0.44	0.13	0.30	0.34	0.29	0.12	0.34	0.33	0.25	0.51	-	0.55	0.50	0.40	

†Subsampled organisms (wet weights have been multiplied by 25 at 1 and 10 m depths and by 20 at 20 and 30 m depths).

*Taxa with wet weight less than 0.01 g are not recorded.

TABLE A17. Dry weight (g) of discrete fauna in 25 × 25 cm scraping samples from P3.

Platform:	P3																	
Depth (m):	1				10				20				30					
Replicate:	1	2	3	Subtotal	1	2	3	Subtotal	1	2	3	Subtotal	1	2	3	Subtotal	Total	%
TAXA																		
Calcarea He terocoelidae†			0.06	0.06													0.06	0.00
Telesto sp.†										3.31	0.01	3.32					3.32	0.13
Actiniaria†	0.04			0.04	0.52	0.69	1.78	2.99	0.05	0.11	0.59	0.75					3.78	0.15
Platyhelminthes†	*	*		*													*	
Nemertea†	*	*	*	*	*	*	*	*	*	*	*	*					*	
Thais haemastoma		1.00		1.00													1.00	0.04
Doto uva†	*			*	*			*									*	
Coryphella sp.†													0.01			0.01	0.01	0.00
Area imbricata	6.80			6.80													6.80	0.26
Anadara transverea							0.02	0.02									0.02	0.00
Barbatia candida										11.43		11.43					11.43	0.44
Musculus lateralis†							0.03	0.03									0.03	0.00
Lithophaga bisculata	0.01		0.32	0.33	0.03	0.31	0.29	0.63	1.88	0.82		2.70					3.66	0.14
Lithophaga aristata	0.43	0.18		0.61		1.05	1.08	2.13	8.51	8.44	0.53	17.48					20.22	0.78
Pteria colymbus		6.77		6.77									0.10			0.10	6.87	0.26
Isognomon bicolor	214.39	45.00	96.19	355.58	1.34	6.04	3.47	10.85		0.17		0.17					366.60	14.10
Anomia simplex										2.75		2.75					2.75	0.11
Ostreacea	3.19	18.28	37.71	59.18	176.39	265.59	43.57	485.55	446.89	313.50	125.29	885.68					1,430.41	55.00
Chama macerophylla	43.19	7.22	44.57	94.98	9.43	47.43	145.50	202.36	8.70	85.50	65.79	159.99					457.33	17.59
Hiatella arctica	0.22			0.22	0.01			0.01									0.23	0.01
Ctenodrilus sp.†	*		*	*	*			*									*	
Polydora sp.†									0.01			0.01					0.01	0.00
Dodecaceria sp.†					*			*									*	
Anaitides mucosa†							0.06	0.06									0.06	0.00
Autolytus sp.†	*	*	*	*			0.02	0.02		*	*	*					0.22	0.01
Brania sp.†	*	*	*	*			*	*		*		*			*	*	*	
Exogone dispar†							*	*							*	*	*	
Eusyllis sp.†	*		*	*			*	*	*	*	*	*	*		*	*	*	
Odontosyllis sp.†			0.01	0.01	*			*	*	*	*	*					0.01	0.00
Trypanosyllis sp.†									0.01			0.01					0.01	0.00
Haplosyllis spongicola†	*	*	*	*	0.01	*	*	0.01	*	*	*	*					0.01	0.00
Syllis sp.†	0.32	0.12	0.12	0.56	*	0.03	0.03	0.06	0.03	*		0.03			*	*	0.65	0.02
Typosyllis sp.†	0.04	*	*	0.04	*	*	*	*	*	*		*			*	*	0.04	0.00
Neanthes succinea†	0.02			0.02													0.02	0.00
Lumbrineris inflata†							0.01	0.01									0.01	0.00
Dorvillea sp.†	*		0.04	0.04			*	*									0.04	0.00
Sipuncula†	0.10			0.10													0.10	0.00
Pycnogonida†	0.02	*	0.01	0.03													0.03	0.00
Balanus amphitrite	18.59	25.90	13.55	58.04	0.77	22.38	7.06	30.21	2.35	3.50	3.53	9.38					97.63	3.75
Balanus eburneus							2.78	2.78		2.79		2.79					5.57	0.21
Balanus improvisus		0.17	2.14	2.31													2.31	0.09
Balanus tintinnabulum		0.48	126.09	126.57	0.03			0.03									126.60	4.87
Tanais sp.†	*		*	*													*	
Podocerus brasiliensis†	*		0.01	0.01	*	*	*	*	*	0.01	*	0.01	*			*	0.02	0.00
Jassa falcata†	*			*	*	*		*	*	0.02	0.05	0.07	*			*	0.07	0.00
Erichthonius brasiliensis†					*	0.05	*	0.05	0.08	0.06	0.06	0.20	0.05	*	*	0.05	0.30	0.01
Colomastix sp.†											*	*					*	
Stenothoe sp.†	*	*	0.02	0.02	0.02	*	*	0.02	*	*	*	*	*	*	*	*	0.04	0.00
Elasmopus rapax†	*		*	*													*	
Caprella equilibra†	*	*	*	*	*	*	0.03	0.03	0.02	*	0.11	0.13	0.04	*	*	0.04	0.20	0.01
Leuconacia incerta†													0.01			0.01	0.01	0.00
Paracaprella pusilla†									0.01	*	0.09	0.10	0.48	*		0.48	0.58	0.02
Synalpheus fritzmuelleri	0.01	0.16	0.10	0.27	0.03	0.06	0.03	0.12	0.03	0.02	*	0.05	*			*	0.44	0.02
Pseudomedaeus agassizii			0.02	0.02	0.17	0.43	0.16	0.76	0.16	0.72	0.29	1.17	0.11			0.11	2.06	0.08
Micropanope nuttingi		0.04		0.04													0.04	0.00
?*Mithrax* sp.			0.02	0.02						0.01		0.01					0.03	0.00
Arbacia punctulata							0.05	0.05	2.68			2.68					2.73	0.10
Ophiactis savignyi†	16.14	12.74	15.68	44.56	0.67	0.31	0.49	1.47		0.10	0.04	0.14			0.05	0.05	46.22	1.78
Total	303.51	118.06	336.66	758.23	189.42	344.37	206.66	740.45	471.41	433.26	196.38	1,101.05	0.80	0	0.05	0.85	2,600.58	100.00
Area Sampled (m^2)	0.0625	0.0625	0.0625	0.1875	0.0625	0.0625	0.0625	0.1875	0.0625	0.0625	0.0625	0.1875	0.0625	0.0625	0.0625	0.1875	0.7500	
Dry Weight (g/m^2)	4,856.16	1,888.96	5,386.56	4,043.89	3,030.72	5,509.92	3,306.56	3,949.07	7,542.56	6,932.16	3,142.08	5,872.27	12.80	0	0.80	4.53	3,467.44	
Number of Taxa	31	22	28	40	24	19	29	36	23	29	21	33	12	4	9	17	58	
Species Diversity (H")	1.01	1.67	1.56	1.61	0.32	0.78	0.93	0.92	0.28	0.90	0.78	0.71	1.27	-	-	1.42	1.43	
Species Richness (D)	2.91	2.24	2.59	3.47	2.34	1.72	2.82	3.12	2.04	2.62	2.02	2.76	2.51	-	-	3.60	4.57	
Evenness (J)	0.29	0.54	0.47	0.44	0.10	0.26	0.28	0.26	0.09	0.27	0.26	0.20	0.51	-	-	0.50	0.35	

†Subsampled organisms (dry weight have been multiplied by 25 at 1 and 10 m depths and by 20 at 20 and 30 m depths).

*Taxa with dry weight less than 0.01 g are not recorded.

TABLE A18. Relative percent cover of colonial organisms in 25 × 25 cm scraping samples from P3.

Platform	P3											
Depth (m)	1			10			20			30		
Replicate	1	2	3	1	2	3	1	2	3	1	2	3
TAXA												
Algae	55.0	50.0	30.0	75.0	70.0	10.0			5.0			
Demospongiae 1							5.0		2.5			
Demospongiae 2								10.0				25.0
Demospongiae 3								2.5				
Demospongiae 4								2.5				
Calcarea Homocoelidae	15.0	5.0	5.0	2.5								2.5
Turritopsis nutricula	2.5	15.0	5.0	2.5		2.5						
Eudendrium carneum							15.0		15.0	85.0	90.0	
Campalecium sp.												2.5
Halecium sp.										5.0		15.0
Campanulina sp.												2.5
Clytia sp.					2.5		5.0	5.0		5.0	5.0	2.5
Obelia dichotoma	20.0	15.0	40.0	2.5	2.5	2.5	5.0		2.5			
Zoanthidea												50.0
Amathia distans								2.5				
Aeverrillia setigera			2.5			2.5	10.0	2.5	2.5			
Aetea anguina	5.0	10.0		2.5				2.5	2.5		5.0	
Antropora tincta						5.0		5.0				
Synnotum aegyptiacum							2.5					
Beania mirabilis								2.5				
Bugula neritina					20.0	70.0	30.0	2.5	5.0			
Bugula sp.		2.5	5.0	5.0	2.5		10.0	5.0	2.5			
Savignyella lafonti			5.0			2.5	2.5	2.5				
Parasmittina spathulata										2.5		
Hippaliosina rostrigera							2.5		5.0			
Crisia eburnea	2.5						10.0	40.0	50.0	2.5		
Salmacina sp.								10.0	5.0			
Ascidiacea 1		2.5	5.0	5.0	2.5	5.0	2.5	5.0	2.5			
Ascidiacea 2			2.5	5.0								
Total %	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Area sampled (m^2)	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625
Number of taxa	6	7	9	8	6	8	12	14	12	5	3	7
Species Diversity (H")	1.27	1.48	1.66	1.03	0.94	1.15	2.15	2.07	1.78	0.62	0.39	1.35
Species Richness (D)	1.09	1.30	1.74	1.52	1.09	1.52	2.39	2.82	2.39	0.87	0.43	1.30
Evenness (J)	0.71	0.76	0.76	0.50	0.52	0.55	0.87	0.79	0.72	0.39	0.36	0.69

TABLE A19. Number of individuals of discrete fauna in 25 × 25 cm scraping samples from P4.

Platform:	P4																	
Depth (m):	1				10				20				30					
Replicate:	1	2	3	Subtotal	1	2	3	Subtotal	1	2	3	Subtotal	1	2	3	Subtotal	Total	%
TAXA																		
Calcarea Heterocoelidae†	50		125	175			25	25									200	0.48
Telesto sp.									136			136					136	0.33
Actiniaria†	50		175	225		150	250	400	20	40	20	80	180		240	420	1,125	2.72
Platyhelminthes†	150	75	350	575	25			25									600	1.45
Nemertea†	150	150	150	450	75	100	200	375									825	1.99
Haminoea sp.		1	1	2													2	0.00
Cavolina longirostris														1		1	1	0.00
Aegires punctilucens†						25		25									25	0.06
Arca imbricata					3		1	4									4	0.01
Anadara transversa			5	5					1			1					6	0.01
Musculus lateralis†	25			25		25	50	75						20		20	120	0.29
Lithophaga bisculata	5	5	6	16	6	2	5	13	1	2	2	5					34	0.08
Lithophaga aristata	4			4	6	5	3	14		1	2	3					21	0.05
Isognomon bicolor	84	127	136	347	11	4	8	23									370	0.89
Chlamys sp.							1	1			1	1					2	0.00
Ostreacea	3	4	7	14	6	9	8	23	1	1	1	3					40	0.10
Chama macerophylla	61	93	84	238	48	28	45	121	37	57	62	156	11			11	526	1.27
Kellia suborbicularis†											20	20					20	0.05
Ctenodrilus sp.†					25			25									25	0.06
Polydora sp.†													20			20	20	0.05
Dodecaceria sp.†	50			50					20			20		20		20	90	0.22
Anaitides mucosa†			25	25													25	0.06
Autolytus sp.†	100		50	150	50	50	225	325	100			100	60	20		80	655	1.58
Brania sp.†	1,200	675	500	2,375			50	50	40			40					2,465	5.96
Exogone dispar†	25	25		50													50	0.12
Eusyllis sp.†	350	375	775	1,500	225	275	200	700	120		60	180			40	40	2,420	5.85
Odontosyllis sp.†	375	325	450	1,150	50	50	200	300					20			20	1,470	3.55
Haplosyllis spongicola†	675	300	250	1,225	400	50	125	575	280	220	80	580	320		180	500	2,880	6.96
Syllis sp.†									20	160		180	40			40	220	0.53
Typosyllis sp.†	475	575	425	1,475	25		200	225	120	20		140	40			40	1,880	4.54
Neanthes succinea†	25	25	25	75					20			20					95	0.23
Lumbrineris inflata†									20			20		20		20	40	0.10
Dorvillea sp.†	225	50	100	375	50			50									425	1.03
Megalomma lobiferum?†											20	20					20	0.05
Hypsicomus sp.†															20	20	20	0.05
Sipuncula	3	1	6	10	1			1									11	0.03
Pycnogonida†			25	25													25	0.06
Balanus amphitrite	24	32	25	81	3		4	7									88	0.21
Balanus calidus							1	1									1	0.00
Balanus eburneus			1	1													1	0.00
Balanus improvisus	3			3			1	1									4	0.01
Balanus tintinnabulum			2	2	2		1	3									5	0.01
Tanais sp.†	25	100	50	175		25	125	150									325	0.79
Podocerus brasiliensis†	75	125	175	375	50	75	75	200	20	40		60			20	20	655	1.58
Jassa falcata†	25		250	275		50	25	75									350	0.85
Erichthonius brasiliensis†						25		25	880	600	420	1,900	220	180	920	1,320	3,245	7.84
Stenothoe sp.†	50	225	300	575	325	900	900	2,125	300	160	80	540	40	60	120	220	3,460	8.36
Caprella equilibra†	525	750	2,075	3,350	1,250	2,700	1,800	5,750	40	140	40	220	500	720	280	1,500	10,820	26.14
Periclimenes americanus?							1	1	1	1		2					3	0.01
Synalpheus fritzmuelleri			1	1	10	3	3	16	1	9	11	21					38	0.09
Pseudomedaeus agassizii	1	4	1	6	14	9	14	37	19	19	26	64	9	7	6	22	129	0.31
Micropanope nuttingi		1	6	7													7	0.02
Arbacia punctulata					1		1	2									2	0.00
Ophiactis savignyi†	650	350	2,425	3,425	775	375	625	1,775	20		60	80		60	20	80	5,360	12.95
TOTAL	5,463	4,393	8,981	18,837	3,436	4,935	5,172	13,543	2,217	1,470	905	4,592	1,460	1,108	1,846	4,414	41,386	100.00
Area Sampled (m^2)	0.0625	0.0625	0.0625	0.1875	0.0625	0.0625	0.0625	0.1875	0.0625	0.0625	0.0625	0.1875	0.0625	0.0625	0.0626	0.1875	0.7500	
Number/m^2	87,408	70,288	143,696	100,464	54,976	78,960	82,752	72,229	35,472	23,520	14,480	24,491	23,360	17,728	29,536	23,541	55,181	
Number of Taxa	30	24	33	38	25	22	31	37	23	15	16	27	12	10	10	20	54	
Species Diversity (H")	2.56	2.52	2.39	2.59	1.97	1.61	2.21	2.04	2.09	1.85	1.92	2.15	1.86	1.22	1.55	1.84	2.62	
Species Richness (D)	3.37	2.74	3.52	3.76	2.95	2.47	3.51	3.78	2.86	1.92	2.20	3.08	1.51	1.28	1.20	2.26	4.99	
Evenness (J)	0.75	0.79	0.68	0.71	0.61	0.52	0.64	0.56	0.67	0.68	0.69	0.65	0.75	0.53	0.67	0.61	0.66	

†Subsampled organisms (numbers have been multiplied by 25 at 1 and 10 m depths and by 20 at 20 and 30 m depths).

TABLE A20. Percent live barnacles in 25 × 25 cm scraping samples from P4.

Platform:	P4															
Depth (m):	1				10				20				30			
Replicate:	1	2	3	Mean	1	2	3	Mean	1	2	3	Mean	1	2	3	Mean
TAXA																
Balanus amphitrite	25	44	20	31	0		100	57								
Balanus calidus							0	0								
Balanus eburneus			100	100												
Balanus improvisus	67			67			100	100								
Balanus tintinnabulum			100	100	50		100	67								

TABLE A21. Wet weight (g) of discrete fauna in 25 × 25 cm scraping samples from P4.

Platform:	P4																	
Depth (m):	1				10				20				30					
Replicate:	1	2	3	Subtotal	1	2	3	Subtotal	1	2	3	Subtotal	1	2	3	Subtotal	Total	%
TAXA																		
Calcarea Heterocoelidae†	0.12		0.44	0.56			0.02	0.02									0.58	0.01
Telesto sp.†									61.38			61.38					61.38	1.45
Actiniaria†	*		0.31	0.31		0.11	1.48	1.59	0.15	0.20	0.01	0.36	0.62		0.92	1.54	3.80	0.09
Platyhelminthes†	0.01	*	0.02	0.03	*			*									0.03	0.00
Nemertea†	0.01	*	*	0.01	0.02	0.01	0.33	0.36									0.37	0.01
Haminoea sp.		0.01	*	0.01													0.01	0.00
Cavolina longirostris														*		*	*	*
Aegires punctilucens†						0.04		0.04									0.04	0.00
Arca imbricata					147.00		72.29	219.29									219.29	5.16
Anadara transversa†			0.54	0.54					0.18			0.18					0.72	0.02
Musculus lateralis†	0.06			0.06		0.03	0.20	0.23						1.84		1.84	2.13	0.05
Lithophaga bisculata	0.45	0.34	0.19	0.98	0.63	0.23	6.27	7.13	0.02	0.18	0.12	0.32					8.43	0.20
Lithophaga aristata	0.41			0.41	2.89	3.30	0.89	7.08		0.16	0.68	0.84					8.33	0.20
Isognomon bicolor	14.50	31.50	33.50	79.50	5.47	0.97	4.09	10.53									90.03	2.12
Chlamys sp.							0.40	0.40			0.13	0.13					0.53	0.01
Ostreacea	24.00	47.79	28.39	100.18	276.59	338.69	226.39	841.67	14.53	2.53	15.00	32.06					973.91	22.93
Chama macerophylla	87.89	362.53	367.00	817.42	313.89	254.69	400.79	969.37	230.29	368.19	283.59	882.07	33.29			33.29	2,702.15	63.63
Kellia suborbicularis†											0.09	0.09					0.09	0.00
Ctenodrilus sp.†					*			*									*	*
Polydora sp.†													0.02			0.02	0.02	0.00
Dodecaceria sp.†	0.02			0.02					*			*		*		*	0.02	0.00
Anaitides mucosa†			1.59	1.59													1.59	0.04
Autolytus sp.†	*		*	*	*	*	*	*	*			*	0.03	*		0.03	0.03	0.00
Brania sp.†	0.01	0.02	*	0.03			*	*	*			*					0.03	0.00
Exogone dispar†	*	*		*								*			0.01	0.01	0.16	0.00
Eusyllis sp.†	0.03	0.01	0.08	0.12	0.01	0.02	*	0.03	*		*						*	*
Odontosyllis sp.†	*	0.01	0.03	0.04	*	*	0.01	0.01					*			*	0.05	0.00
Haplosyllis spongicola†	0.01	0.01	0.02	0.04	0.02	0.01	0.01	0.04	0.05	0.10	0.03	0.18	0.32		0.10	0.42	0.68	0.02
Syllis sp.†									*	0.06		0.06	0.03			0.03	0.09	0.00
Typosyllis sp.†	0.07	0.08	0.07	0.22	0.02		0.05	0.07	*	*		*	*			*	0.29	0.01
Neanthes succinea†	0.35	0.48	0.26	1.09					0.11			0.11					1.20	0.03
Lumbrineris inflata†									2.83			2.83		0.19		0.19	3.02	0.07
Dorvillea sp.†	0.03	*	0.01	0.04	*			*									0.04	0.00
Megalomma lobiferum?†											6.55	6.55					6.55	0.15
Hypsicomus sp.†															0.05	0.05	0.05	0.00
Sipuncula	0.45	0.17	0.77	1.39	0.43			0.43									1.82	0.04
Pycnogonida†			*	*													69.88	1.65
Balanus amphitrite	23.59	13.83	26.33	63.75	0.26		5.87	6.13									*	*
Balanus calidus							0.51	0.51									0.51	0.01
Balanus eburneus			0.02	0.02													0.02	0.00
Balanus improvisus	0.08			0.08			0.04	0.04									0.12	0.00
Balanus tintinnabulum			1.13	1.13	33.21		5.84	39.05									40.18	0.95
Tanais sp.†	*	0.04	*	0.04		*	0.04	0.04									0.08	0.00
Podocerus brasiliensis†	0.04	0.01	0.06	0.11	*	0.02	0.02	0.04	*	0.01		0.01			0.01	0.01	0.17	0.00
Jassa falcata†	0.03		0.12	0.15		0.01	0.01	0.02									0.17	0.00
Erichthonius brasiliensis†						*		*	0.33	0.16	0.22	0.71	0.24	0.04	0.18	0.46	1.17	0.03
Stenothoe sp.†	*	*	0.01	0.01	0.03	0.01	0.07	0.11	0.11	0.02	*	0.13	*	0.01	*	0.01	0.26	0.01
Caprella equilibra†	0.15	0.45	0.74	1.34	0.50	1.23	1.18	2.91	*	0.23	0.05	0.28	0.62	1.03	0.27	1.92	6.45	0.15
Periclimenes americanus?							*	*	*	0.01		0.01					0.01	0.00
Synalpheus fritzmuelleri			0.16	0.16	0.29	0.65	0.64	1.58	0.02	0.97	0.57	1.56					3.30	0.08
Pseudomedaeus agassizii	0.09	0.29	0.19	0.57	1.56	1.67	2.10	5.33	2.02	2.32	2.95	7.29	0.73	0.31	0.06	1.10	14.29	0.34
Micropanope nuttingi		0.05	0.40	0.45													0.45	0.01
Arbacia punctulata†					0.63		0.33	0.96									0.96	0.02
Ophiactis savigny†	2.72	1.44	9.58	13.74	3.75	1.24	1.64	6.63	0.06		0.27	0.33		0.40	0.06	0.46	21.16	0.50
TOTAL	155.12	459.06	471.96	1,086.14	787.20	602.93	731.51	2,121.64	312.08	375.14	310.26	997.48	35.90	3.82	1.66	41.38	4,246.64	100.00
Area Sampled (m^2)	0.0625	0.0625	0.0625	0.1875	0.0625	0.0625	0.0625	0.1875	0.0625	0.0625	0.0625	0.1875	0.0625	0.0625	0.0625	0.1875	0.7500	
Wet Weight (g/m^2)	2,481.92	7,344.96	7,551.36	5,792.75	12,595.20	9,646.88	11,704.16	11,315.41	4,993.28	6,002.24	4,964.16	5,319.89	574.40	61.12	26.56	220.69	5,662.19	
Number of Taxa	30	24	33	38	25	22	31	37	23	15	16	27	12	10	10	20	54	
Species Diversity (H")	1.29	0.76	0.89	0.92	1.30	0.78	1.16	1.18	0.79	0.12	0.40	0.52	0.38	1.36	1.44	0.87	1.17	
Species Richness (D)	3.01	2.14	2.97	3.19	2.13	1.91	2.68	2.94	2.13	1.33	1.45	2.26	1.34	1.51	1.76	2.28	4.09	
Evenness (J)	0.38	0.24	0.26	0.25	0.40	0.25	0.34	0.32	0.25	0.05	0.15	0.16	0.15	0.59	0.63	0.29	0.29	

†Subsampled organisms (wet weights have been multiplied by 25 at 1 and 10 m depths and by 20 at 20 and 30 m depths).

*Taxa with wet weight less than 0.01 g are not recorded.

TABLE A22. Dry weight (g) of discrete fauna in 25 × 25 cm scraping samples from P4.

Platform:	P4																	
Depth (m):	1				10				20				30					
Replicate:	1	2	3	Subtotal	1	2	3	Subtotal	1	2	3	Subtotal	1	2	3	Subtotal	Total	%
TAXA																		
Calcarea Heterocoelidae†	0.03		0.04	0.07			*	*									0.07	0.00
Telesto sp.†									15.33			15.33					15.33	0.47
Actiniaria†	*		0.08	0.08		0.02	0.34	0.36	0.05	0.05	*	0.10	0.18		0.21	0.39	0.93	0.03
Platyhelminthes†	*	*	*	*	*			*									*	*
Nemertea†	*	*	*	*	*	*	0.03	0.03									0.03	0.00
Haminoea sp.		*	*	*													*	*
Cavolina longirostris														*		*	*	*
Aegires punctilucens†						*		*									*	*
Area imbricata					99.89		46.50	146.39									146.39	4.45
Anadara transversa			0.24	0.24					0.12			0.12					0.36	0.01
Musculus lateralis†	0.04			0.04		0.01	0.11	0.12						0.85		0.85	1.01	0.03
Lithophaga bisculata	0.20	0.15	0.08	0.43	0.29	0.11	2.85	3.25	0.01	0.09	0.06	0.16					3.84	0.12
Lithophaga aristata	0.17			0.17	1.30	1.64	0.40	3.32		0.08	0.31	0.39					3.88	0.12
Isognomon bicolor	7.79	17.19	19.29	44.27	3.81	0.65	2.75	7.21									51.48	1.56
Chlamys sp.							0.18	0.18			0.04	0.04					0.22	0.01
Ostreacea	22.19	35.89	23.39	81.47	248.89	290.89	174.59	714.37	11.67	2.31	11.89	25.87					821.71	24.96
Chama macerophylla	73.59	264.48	314.89	652.96	281.39	204.89	306.29	792.57	185.09	272.59	213.39	671.07	24.00			24.00	2,140.60	65.02
Kellia suborbicularis†											0.07	0.07					0.07	0.00
Ctenodrilus sp.†					*			*									*	*
Polydora sp.†													*			*	*	*
Dodecaceria sp.†	*			*					*			*		*		*	*	*
Anaitides mucosa†			0.31	0.31													0.31	0.01
Autolytus sp.†	*		*	*	*	*	*	*	*			*	*	*		*	*	*
Brania sp.†	*	*	*	*			*	*	*			*					*	*
Exogone dispar†	*	*		*													*	*
Eusyllis sp.†	*	*	0.02	0.02	*	*	*	*	*		*	*			*	*	0.02	0.00
Odontosyllis sp.†	*	*	0.01	0.01	*	*	*	*					*			*	0.01	0.00
Haplosyllis spongicola†	*	*	*	*	*	*	*	*	0.03	0.04	*	0.07	0.07		0.01	0.08	0.15	0.00
Syllis sp.†									*	0.02		0.02	*			*	0.02	0.00
Typosyllis sp.†	0.03	*	*	0.03	*		*	*	*	*		*	*			*	0.03	0.00
Nicanthes succinea†	0.04	0.14	0.06	0.24					0.04			0.04					0.28	0.01
Lumbrineris inflata†									1.18			1.18		0.03		0.03	1.21	0.04
Dorvillea sp.†	0.01	*	*	0.01	*			*									0.01	0.00
Megalomma lobiferum†?											1.72	1.72					1.72	0.05
Hypsicomus sp.†															*	*	*	*
Sipuncula†	0.06	0.02	0.12	0.20	0.06			0.06									0.26	0.01
Pycnogonida†			*	*													*	*
Balanus amphitrite	19.19	10.34	22.10	51.63	0.22		3.83	4.05									55.68	1.69
Balanus calidus							0.44	0.44									0.44	0.01
Balanus eburneus			0.01	0.01													0.01	0.00
Balanus improvisus	0.06			0.06			0.03	0.03									0.09	0.00
Balanus tintinnabulum			0.83	0.83	25.09		3.83	28.92									29.75	0.90
Tanais sp.†	*	*	*	*		*	*	*									*	*
Podocerus brasiliensis†	0.02	*	*	0.02	*	*	*	*	*	*		*			*	*	0.02	0.00
Jassa falcata†	*		0.01	0.01		*	*	*									0.01	0.00
Erichthonius brasiliensis†						*		*	0.08	0.05	0.06	0.19	0.03	*	0.06	0.09	0.28	0.01
Stenothoe sp.†	*	*	*	*	*	*	0.02	0.02	*	*	*	*	*	*	*	*	0.02	0.00
Caprella equilibra†	0.03	0.02	0.09	0.14	0.06	0.46	0.15	0.67	*	0.04	0.01	0.05	0.16	0.11	0.02	0.29	1.15	0.03
Periclimenes americanus?							*	*	*	*		*					*	
Synalpheus fritzmulleri			0.04	0.04	0.05	0.14	0.11	0.30	*	0.23	0.10	0.33					0.67	0.62
Pseudomedaeus agassizii	0.03	0.10	0.07	0.20	0.58	0.57	0.64	1.79	0.78	0.80	0.77	2.35	0.16	0.06	0.01	0.23	4.57	0.14
Micropanope nuttingi		0.02	0.18	0.20													0.20	0.01
Arbacia punctulata†					0.28		0.12	0.40									0.40	0.01
Ophiactis savignyi†	1.18	0.98	3.50	5.66	1.63	0.57	0.87	3.07	0.06		0.15	0.21		0.19	0.03	0.22	9.16	0.28
TOTAL	124.66	329.33	385.36	839.35	663.54	499.93	544.08	1,707.55	214.44	276.30	228.57	719.31	24.60	1.24	0.34	26.18	3,292.39	100.00
Area Sampled (m^2)	0.0625	0.0625	0.0625	0.1875	0.0625	0.0625	0.0625	0.1875	0.0625	0.0625	0.0625	0.1875	0.0625	0.0625	0.0625	0.1875	0.7500	
Dry Weight (g/m^2)	1,994.56	5,269.28	6,165.76	4,476.53	10,616.64	7,998.88	8,705.28	9,106.93	3,431.04	4,420.80	3,657.12	3,836.32	393.60	19.84	5.44	139.63	4,389.85	
Number of Taxa	30	24	33	38	25	22	31	37	23	15	16	27	12	10	10	20	54	
Species Diversity (H")	1.17	0.71	0.73	0.81	1.22	0.74	1.07	1.09	0.54	0.09	0.30	0.33	0.15	1.00	1.19	0.43	1.03	
Species Richness (D)	3.08	2.21	3.03	3.26	2.16	1.94	2.75	2.99	2.21	1.37	1.50	2.32	1.41	1.87	2.55	2.41	4.17	
Evenness (J)	0.34	0.22	0.21	0.22	0.38	0.24	0.31	0.30	0.17	0.03	0.11	0.10	0.06	0.43	0.52	0.14	0.26	

†Subsampled organisms (dry weights have been multiplied by 25 at 1 and 10 m depths and by 20 at 20 and 30 m depths).

*Taxa with dry weight less than 0.01 g are not recorded.

TABLE A23. Relative percent cover of colonial organisms in 25 × 25 cm scraping samples from P4.

Platform	P4											
Depth (m)	1			10			20			30		
Replicate	1	2	3	1	2	3	1	2	3	1	2	3
TAXA												
Algae	70.0	65.0	50.0	30.0	40.0	40.0	2.5	10.0	5.0			
Demospongiae 2			2.5				20.0		10.0			
Demospongiae 4				2.5								
Demospongiae 5				5.0								
Demospongiae 6							2.5					
Demospongiae 7								20.0	2.5	30.0	5.0	
Demospongiae 8										50.0		
Calcarea Homocoelidae	10.0	5.0	15.0	2.5		2.5						2.5
Turritopsis nutricula		2.5	2.5			2.5	2.5	2.5	2.5		2.5	
Halecium sp.						2.5			2.5	5.0	5.0	
Clytia sp.	2.5	2.5	2.5	2.5	2.5	2.5						2.5
Obelia dichotoma					2.5		2.5	2.5				
Sertularia turbinata	5.0	5.0	2.5									
Zoanthidea									30.0		2.5	85.0
Entoprocta										5.0	5.0	5.0
Aetea anguina	2.5	5.0	10.0	2.5	5.0	5.0	2.5					
Membranipora savartii				2.5								
Antropora tincta												2.5
Symotum aegyptiacum										2.5		
Bugula neritina	5.0	5.0	5.0	40.0	40.0	30.0	30.0	40.0	2.5		5.0	2.5
Bugula sp.			5.0	5.0	2.5	5.0						
cf. *Caulibugula* sp.						2.5						
Savignyella lafontii	2.5	5.0	2.5	2.5	2.5	2.5						
Cleidochasma contractum							5.0	5.0	30.0	2.5		
Schizoporella errata							5.0					
Vittaticella contei	2.5	5.0	2.5		2.5							
Salmacina sp.						2.5	10.0	5.0	5.0	2.5	2.5	
Ascidiacea 2				5.0	2.5	2.5	15.0	15.0	10.0	2.5	70.0	
Total %	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Area sampled (m^2)	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625
Number of taxa	8	9	11	11	9	12	12	8	10	8	9	6
Species Diversity (H")	1.15	1.36	1.71	1.73	1.44	1.77	2.05	1.69	1.85	1.38	1.22	0.66
Species Richness (D)	1.52	1.74	2.17	2.17	1.74	2.39	2.39	1.52	1.95	1.52	1.74	1.09
Evenness (J)	0.55	0.62	0.71	0.72	0.65	0.71	0.83	0.81	0.80	0.66	0.55	0.37

TABLE A24. Checklist of biofouling fauna collected by this effort depicting the taxonomic precision obtained and relationships of the taxa with respect to higher classification.

Porifera

Demospongiae

Demospongiae 1

Demospongiae 2

Demospongiae 3

Demospongiae 4

Demospongiae 5

Demospongiae 6

Demospongiae 7

Demospongiae 8

Demospongiae 9

Hadromerida

Clionidae

Calcarea

Homocoelidae

Heterocoelidae

Cnidaria

Hydrozoa

Anthomedusae/Athecata

Clavidae

Corydendrium parasiticum
Turritopsis nutricula

Eudendriidae

Eudendrium carneum

Leptomedusae/Thecata

Haleciidae

Campalecium sp.
Halecium bermudense
Halecium sp.

Campanulinidae

Campanulina sp.

Campanulariidae

Clytia cylindrica

Clytia gracilis
Clytia macrotheca
Obelia dichotoma

Sertulariidae

Sertularia turbinata

Anthozoa

Octocorallia (Alcyonaria)

Telestacea

Telestidae

Telesto sp.

Zoantharia (Hexacorallia)

Zoanthidea

Unidentified Zoanthidea

Actiniaria

Aiptasiidae

Aiptasia sp.

Unidentified Actiniaria

Madreporaria

Rhizangiidae

Astrangia sp.
Phyllangia americana

Oculinidae

Oculina diffusa?

Platyhelminthes

Turbellaria

Unidentified Platyhelminthes

Nemertea

Unidentified Nemertea

Entoprocta

Unidentified Entoprocta

Bryozoa (Ectoprocta)

Ctenostomata

Vesicularidae

Amathia distans

Walkeriidae

Aeverrillia setigera

Cheilostomata

Aeteidae

Aetea anguina
Aetea truncata

Membraniporidae

Membranipora savartii
Conopeum comensale
Membraniporidae (unidentified)

Hincksinidae

Antropora tincta

Epistomiidae

Synnotum aegyptiacum

Bicellariellidae

Beania mirabilis

Bugulidae

Bugula californica
Bugula neritina
Bugula stolonifera
cf. *Caulibugula* sp.

Savignyellidae

Savignyella lafonti

Hippoporinidae

Hippoporina americana
Cleidochasma contractum

Schizoporellidae

Schizoporella errata

Smittinidae

Parasmittina munita
Parasmittina spathulata

Cheiloporinidae

Hippaliosina rostrigera

Vittaticellidae

Vittaticella contei

Cyclostomata

Crisiidae

Crisia eburnea

Phoronida

Phoronis sp.

Mollusca

Gastropoda

Prosobranchia

Epitoniidae

Epitonium humphreysi

Crepidulidae

Crepidula plana

Muricidae

Murex fulvescens

Thaisidae

Thais haemastoma

Opisthobranchia

Cephalaspidea

Atyidae

Haminoea cf. *petiti*

Thecosomata

Cavolinidae

Cavolina longirostris

Nudibranchia

Dotonidae

Doto uva

Coryphellidae

Coryphella cf. *lineata*

Aegiretidae

Aegires punctilucens

Bivalvia (Pelecypoda)

Pteriomorphia

Arcoida

Arcidae

Arca zebra
Arca imbricata
Barbatia candida
Barbatia tenera
Anadara transversa
Noetia ponderosa

Mytiloida

Mytilidae

Musculus lateralis
Lithophaga bisulcata
Lithophaga aristata

Pinnidae

Pinna carnea

Pterioida

Pteriacea

Pteriidae

Pteria colymbus
Pinctada imbricata

Isognomonidae

Isognomon bicolor

Pectinacea

Pectinidae

Chlamys ornata

Spondylidae

Spondylus americanus

Anomiacea

Anomiidae

Anomia simplex

Ostreina

Ostreidae

Lopha frons (= *L. folium*)
Crassostrea virginica
Ostrea equestris

Gryphaeidae

Hyotissa thomasi

Heterodonta

Veneroida

Ungulinidae

Diplodonta cf. *soror*

Chamidae

Chama macerophylla
Chama congregata
Pseudochama radians

Kelliidae

Kellia suborbicularis

Myoida

Gastrochaenidae

Gastrochaena hians

Hiatellidae

Hiatella arctica

Annelida

Polychaeta

Ctenodrilidae

Ctenodrilus sp.

Spionidae

Polydora websteri

Chaetopteridae

Chaetopterus variopedatus

Cirratulidae

Dodecaceria sp.

Phyllodocidae

Anaitides mucosa

Hesionida

Ophiodromus obscura

Syllidae

Autolytus cf. *prolifer*
Autolytus sp.
Brania sp.
Exogone dispar
Eusyllis sp.
Odontosyllis cf. *fulgurans*
Trypanosyllis sp.
Haplosyllis spongicola
Syllis sp.
Typosyllis sp.
Syllinae (unidentified)

Nereidae

Neanthes succinea

Amphinomidae

Hermodice carunculata

Lumbrineridae

Lumbrineris inflata

Dorvilleidae

Dorvillea cf. *sociabilis*

Terebellidae

Terebella rubra

Sabellidae

Megalomma lobiferum?
Hypsicomus cf. *phaeotaenia*
Potomilla sp.

Serpulidae

Salmacina sp.
Eupomatus dianthus

Sipuncula

Unidentified Sipuncula

Arthropoda

Pycnogonida

Unidentified Pycnogonida

Mandibulata

Crustacea

Cirripedia

Balanidae

Balanus amphitrite niveus
Balanus calidus
Balanus eburneus
Balanus improvisus
Balanus tintinnabulum

Malacostraca

Tanaidacea

Tanaidae

Tanais sp.

Isopoda

Sphaeromidae

Sphaeroma sp.

Amphipoda

Gammaridea

Podoceridae

Podocerus brasiliensis

Ischyroceridae

Jassa falcata

Corophiidae

Ericthonius brasiliensis
Corophium acherusicum

Colomastigidae

Colomastix sp.

Stenothoidae

Stenothoe gallensis
Stenothoe minuta

Gammaridae

Elasmopus rapax

Caprellidea

Caprellidae

Caprella equilibra
Leuconacia incerta
Paracaprella pusilla

Decapoda

Caridea

Palaemonidae

Periclimenes americanus?

Alpheidae

Synalpheus fritzmuelleri

Brachyura

Portunidae

Cronius ruber

Xanthidae

Menippe mercenaria
Pseudomedaeus agassizii
Micropanope nuttingi
Eurypanopeus depressus

Majidae

Stenorhynchus seticornis
Mithrax sp.

Echinodermata

Echinoidea

Cidaridae

Eucidaris tribuloides

Diadematidae

Diadema antillarum

Arbaciidae

Arbacia punctulata

Stelleroidea

Ophiuroidea

Ophiothricidae

Ophiothrix angulata

Amphiuridae

Ophiactis savignyi

Chordata

Ascidiacea

Unidentified Ascidiacea

A verified voucher collection representing the above taxa was submitted to the U.S. National Museum, Smithsonian Institution, Washington, D.C. 20560.

APPENDIX B

GENERAL NOTES AND DRAWINGS OF DR. H. HARRY, TAXONOMIC CONSULTANT TO LGL FOR BLM-SPONSORED ECOLOGICAL INVESTIGATIONS IN THE CENTRAL GULF OF MEXICO

APPENDIX B. General notes and drawings of Dr. H. Harry, Taxonomic Consultant to LCL for BLM-sponsored ecological investigations in the Central Gulf of Mexico.

PREFACE

Dr. Harold W. Harry, in addition to verifying the voucher collection of molluscs, echinoderms and barnacles, provided LGL with a list of references, species descriptions, comments on taxonomic problems and illustrations of some of the fauna he identified. The usefulness of his notes and the high quality of his illustrations warrant their inclusion in this report, as an aid to others who attempt to study the biofouling communities on the petroleum platforms in the Gulf of Mexico.

GENERAL NOTES

Bivalvia, Arcidae

The numerous species of the western Atlantic have not recently been seriously reviewed. The generic status of some species can only be arbitrarily designated until such is done. *Barbatia tenera* is a case in point.

The *Anadara transversa* seem to be all juveniles, less than 1-cm long; possibly they are adventitious at the collecting sites, from a reproducing population nearby.

Bivalvia, Ostreidae and Gryphaeidae

In the material examined, oysters of two families are present:

Ostreidae
- *Crassostrea virginica*
- *Ostrea equestris*

Gryphaeidae
- *Hyotissa thomasi*

These are often difficult to separate on the basis of external shell characters. On examining the two specimens of oysters submitted initially, I was perplexed by the unusually large size of what is evidently *Ostrea equestris*, and so I asked to see additional material. Three lots of the P2 series, and six of the P1 series were examined. Some of the lots were not exhaustively examined, so those may contain more species than those listed here:

Lot	Species of Oysters
P2 Blenny voucher	*Crassostrea virginica*
P2 less than 20′	*Crassostrea virginica*
P2 greater than 20′	(no oysters present)
P1 Blenny voucher	*Crassostrea virginica*
P1 (8-9 m)	*Ostrea equestris*
P1 A 10-15′	*Crassostrea virginica*
P1 A less than 30′	*Crassostrea virginica*
P1 A greater than 30′	*Ostrea equestris*
	Hyotissa thomasi
P1 A 30-45′	*Hyotissa thomasi*
P1 A 45-60″	*Ostrea equestris*
	Hyotissa thomasi

MAJOR CHARACTERS TO SEPARATE THE THREE SPECIES OF OYSTERS

CHARACTER	*Ostrea equestris*	*Crassostrea virginica*	*Hyotissa thomasi*
size	to 40 mm high & about as long	80-150 mm high length usually much less	to 100 mm high and about as long
Muscle scar	same color as shell interior	white in shells less than 25 mm high; blue, brown or purple in larger shells	same color as shell interior
Chomata (denticles along margin)	Always present near hinge. Short and widely spaced	never present	Variably present. Long and closely spaced
Promyal chamber	absent	present	present
Heart-gut relationship	intestine passes back of (above) ventricle	intestine passes back of (above) ventricle	intestine passes posterior to ventricle
Labial palps	small, both same size	small, both same size	Large, outer palp envelopes inner one like a cap
Eggs	in gills (during late summer)	never in gills	(no data)

Bivalvia, Chamidae

At least two species are present. All specimens seem to be smaller than ones described by Bayer. Larger series from the northwestern Gulf of Mexico would be necessary to make certain identifications. No material from this area was included by Bayer in his review of the family:

Bayer, F. M. 1943. The Florida species of the family Chamidae. Nautilus 56(4): 116-123, Pls. 12-15.

Bivalvia, others

Some of the smaller bivalves have been drawn, to aid in identification of future material: *Kellia suborbicularis, Diplodonta* cf. *soror* and *Hiatella arctica*.

Nudibranchs

Specimens of the several species in the collection have been drawn, to aid in future identifications.

Barnacles

Balanus calidus Pilsbry 1916 (U. S. Nat. Mus. Bull 93) superficially resembles *Chthamalus*, but *B. calidus* has a calcareous basis. This species may be limited to the northwestern Gulf of Mexico, and so it is not to be found in the manuals for identifying invertebrates of other regions.

H. W. Harry
Dec. 1978

1. Echinoderms. Previous records of echinoderms in the northwestern Gulf of Mexico have been compiled by Harry (1979). *Ophiactis savignyi*, a small, six-armed brittle star said to be world-wide in the tropics and subtropics, is very abundant as a member of the epibiota-hydroids, bryozoa, etc., on many of the shells. The two urchins, *Eucidaris* and *Diadema*, are known from the coral banks at the margin of the continental shelf (see Bright and Pequegnat, 1974). Much more abundant than those is the brown urchin, *Arbacia punctulata*, which probably comes from the same banks.

The single specimen of *Ophiothrix angulata* Say was drawn. The following description applies to it:

Disc about 6 mm diameter, arms about 48 mm long. Five unbranched arms, arising at mouth (i.e., below disc); they do not coil vertically. Aboral surface of disc covered with skin, so that no plates except the five pairs of radial plates are evident. The radial plates are tear-shaped, faintly outlined beneath the skin. Numerous short, tri-pronged spines cover the skin, projecting outward. They extend between the members of a pair of the radial plates, and are sparse over the surface of the plates. A few larger spines, glassy, with thorny sides,and tips ending in several thorns, are scattered over this side of the disc. They are similar to the arm spines, but shorter, smaller. The tri-pronged spines increase in size as they pass over the disc margin; they form a small triangle between the arms on the oral side of the disc, most of the surface of which is covered only by thin skin, without granules or scales. There is a pair of plates on each interradius, near the base of the arms; these surround the inner end of the reproducing grooves, which extend completely along the disc part of each arm. A second large plate is at the distal end of each groove, and extends a short way along the margin of the disc.

The mouth has five large teeth, each with two or three vertical rows of rounded knobs projecting medially. No tooth scales or any marginal scales (oral papillae) are present along the ventral margin of the teeth. The oral shields and aboral shields are present, the latter tear-shaped. Sometimes a small piece is present between the radial ends of aboral shields but this may be fused to one of them or to the oral end of the oral shield.

Tentacle scales seem to be absent. The tentacles, both around the mouth and along the arms, are swollen, conical, flesh colored, covered with numerous short papillae, almost touching each other. These tentacles, really modified tube feet lacking suckers, are evidently not capable of being withdrawn into the arms.

The ventral plates of the arms are quadrate, as are the dorsal ones, but the rounded distal margin of the latter often show a slight projection toward the tip of the arm. These plates are covered with skin, and there are no ridges on dorsal or ventral plates. Arm spines project at right angles from the arms, are in rows of about seven spines on each side of an arm segment. The spines of a series are in graded length, the smallest spines at each end of a row, the two middle spines of a row being the longest. Each spine is glassy, transparent, flattened, with several thorns on the margins, and at the tip, which is somewhat blunted.

Color (preserved) is gray, with no stripes on the upper arm.

2. Gastropods. *Thais* is highly variable in body proportions and shoulder angulation, which is often knobbed. The genus in the western Atlantic has been monographed by Clench (1947). The genus *Murex* in the western Alantic has been monographed by Clench and Farfante (1945).

3. *Arca zebra* is well illustrated in Sheldon (1916), with modernization of nomenclature, also description and figures, in Weisbord (1964) and McLean (1951). The specimens are of unusually large size, and very symmetrical, often with small oysters or chamas attached to them.

4. *Pinna carnea.* The several specimens of the two lots are all small, but definitely epifuanal, having filamentous algae and bryozoa adhering to the entire outer surface of the shell, if sparsely. Most pinnas are infaunal. The group in the western Atlantic has been monographed by Turner and Rosewater (1958), who are ambivalent about the distinction between *P. carnea* and the eastern Atlantic *P. rudis*, especially in the juvenile state.

5. *Pinctada radiata* (Leach 1814). Only one species of this genus is known from the western Atlantic, and this name is properly applied to it. The specimens fit the descriptions and figures well (Weisbord, 1964; McLean, 1951). Andrews (Shells and Shores of Texas) applied the name *P. imbricata* "Bolten" Roding, noting *P. radiata* Leach is a synonym. There is no justification for this unnecessary name change, which is totally fallacious. Had the trivial name *imbricata* been applied to any member of this genus in the "Bolten" Roding catalogue, wherein the genus *Pinctada* itself is first named, surely subsequent authors would have noted it. A very extensive synonymy and numerous excellent illustrations are found in Ranson (1961).

6. *Gastrochaena hians.* The specimen agrees with the description in Lamy's (1925) monograph of the genus. Note the peculiar hinge lamellae, simulating lateral teeth, shown in the accompanying drawing.

7. *Pseudochama radians.* Although numerous papers have appeared on the Chamidae (see Pilsbry and McGinty, 1938; Bayer, 1943; and Yonge,1967), the group is still poorly understood and specimens difficult to identify, owing to much variability in sculpture and color. The numerous specimens in the present material merit an in-depth study which has not yet been done.

The material collected by LGL could be used to clarify some of the numerous problems of anatomy and systematics of oysters, in this area, as well as throughout the world. Such work is underway, but it will require time. The four species on the supports of drilling rigs off Louisiana,as presently understood, are as follows:

a) *Crassostrea virginica* Gmelin 1791.

Large (to 100 mm long or more), irregular in form, usually elongate dorso-ventrally but often circular. Attachment by direct cementation of left valve to substrate; extent of attachment varies greatly. No hyotid spines are ever formed. Shell structure never vesicular. Never with chomata (denticle pustules or ridges) present on shell margin. Muscle scar (at least when shell is greater than 25 mm maximum dimension) always dark colored, blue, purple or brown, contrasting greatly with general color of interior of the valve. Margin of shell valves may meet in a smooth plane or a crenulated,interlocking pattern. The crenulations are usually rounded, rarely or never sharply angled.

Rectum passes posterior to heart, not through the ventricle. Auricles not outpocketed. Outer labial palp not fused to form a cap over the inner. Free surface of mantle epithelium smooth, not papillate. Kidney much branched, tubular, antero-lateral to pericardium, not projecting between the pericardium and adductor muscle.

Color of tissue gray, gonad white, in life and preserved. Promyal chamber large (i.e., little fusion of right mantle lobe with visceral mass on that side).

b) *Ostrea equestris* Say 1825.

Shell small (to 25 mm maximum dimension), elongate or circular, usually very broadly, directly cemented by left valve to substrate, but the attachment varies and may be small. No hyotid spines ever formed. Chomata always present as raised pustules in the right valve, with pits to receive them in the left, but these limited to anterior and posterior

margin, present on the ventral margin rarely, and by only a few units. Muscle scar the same color as inner surface of valve, which is whitish, or chiefly the right valve, greenish bronze. Valve margins usually meet in a smooth plane, but may be slightly crenulate. Rarely or never are the crenulations sharply angled. Shell structure is not vesicular.

Rectum passes behind the heart not through the ventricle. Auricle not outpocketed. Outer labial palps are slightly fused to form a partial cap over the inner. Free surface of mantle not papillate. Kidney much branched, tubular, having form and position of that of *Crassostrea*. Color of tissue gray, gonad white, in life and in preserved material. Promyal passage absent.

c) *Lopha frons* Linne 1758.

On the basis of what is now known, there is no sound reason for separating this from what is called in the Indo-pacific area *Lopha folium* Linne 1758, Dodge's (1952) argument not withstanding. But to avoid confusion pending further studies, it is better to retain the name which has long been used to designate the Atlantic population, *L. frons*.

I have examined only one complete specimen with animal,and another empty shell with both valves. This species may have been mistakenly considered *O. equestris* by me, in briefly examining the "discrete samples" from near-shore rigs in December, 1978. Gunter (1951, 1951*a*) found only this one of the stenohaline oysters on oil rig supports off Louisiana and Texas. He was aware that *H. thomasi* occurred on the banks near the margin of the continental shelf, however.

Shell small (to 35 mm maximum dimension), circular or elongate anterior-posteriorly (not dorso-ventrally, as are *Crassostrea virginica* and *Ostrea equestris*). Attached by very small area of direct cementation of left valve, augmented by hyotid spine supports, the tips of which are cemented to the substrate. Muscle scar same color as the rest of the shell interior, which is subnacreous, whitish, varying to golden bronze. Chomata prominent around entire margin of right valve only, as rounded or slightly elongate pustules. No sockets or pustules on margin of left valve, except along post dorsal margin, where sockets occur.

Exterior of shell red, with about 10 prominent regular radial ribs with subacute crests. Shell margins crenulate, crenulations sharply angled, those of left valve occasionally reflexed and extended to form the hyotid spines. The structure of the shell is not vesicular.

The rectum passes behind the pericardium, does not penetrate the ventricle. Auricles of heart are not outpocketed. Outer labial palps extensively fused in midline to form a cap over inner ones.Free surface of mantle is pustulate (unlike *Crassostrea* and *Ostrea*). Kidney is much branched, tubular, having the same form and position as that of *Crassostrea* and *Ostrea*. There is no promyal chamber. Color of tissue in alcohol is faint pink.

d) *Hyotissa thomasi* McLean 1941.

Shell large (to 100 mm maximum dimension or more), usually circular or subcircular, may be slightly elongate dorso-ventrally. Attachment by extensive, direct cementation of the left valve to the substrate, but occasionally the area of cementation may be very small. No hyotid spines seem to be formed in material from the northwestern Gulf of Mexico. Shell structure extensively vesiculate, which allows extensive erosion of right valve outer surface, usually thus destroying the natural sculpture; the left valve easily splits from the substrate in a plane parallel to the latter. Muscle scar is the same color of the valve interior, which may be white to light bronze, and subnacreous. Margin of the shell often purple. Shell margin usually crenulate, the interlocking crenulations obtuse to acutely angled. Chomata present in both valves along the post dorsal margin, and sometimes along the anterio-dorsal margin also. These are vermiculate; low, closely spaced, branching and rejoining ridges, elongate perpendicular to the shell margin.

The rectum does not penetrate the heart, but passes posterior to it. Auricles of heart are extensively outpocketed with large lobes (unlike the other three oysters treated here). Kidney a large sac, mostly inserted between the pericardium and adductor muscle. Outer labial palps extensively fused in midline to form a cap over the inner ones. Free surface of the mantle epithelium extensively papillate. Promyal passage very large.

Color of tissue preserved in formalin is dark purple, lavender or reddish-brown, and the dorsal part of adductor muscle and ovary may be bright orange. The orange color fades within a few hours in isopropyl alcohol.

These oysters are very difficult to open, even after several months preservation, owing to the firm attachment to the shell of the adductor muscle, which retains its elasticity and keeps the valves closed even after the ligament of the hinge is broken.

This species is very abundant on oil rig supports at least on the rigs farther offshore along the Louisiana coast.

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The following references include most of those used to verify identifications of the February, 1979 list, and a few which are important in identifying the material examined in December, 1978 (Pruvot-Fol, Schmekel, on nudibranchs and other opistobranchs; Turner and Boss on *Lithophaga*; Pilsbry on barnacles). A few general references, useful partly to confirm identities but chiefly to determine distribution records, are also included: Bright and Pequegnat; Bullis and Thompson; Springer and Bullis. Most of the references are lead papers, wherein other papers are cited which need to be consulted to make identifications as accurate as possible.

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H. W. Harry
February, 1979

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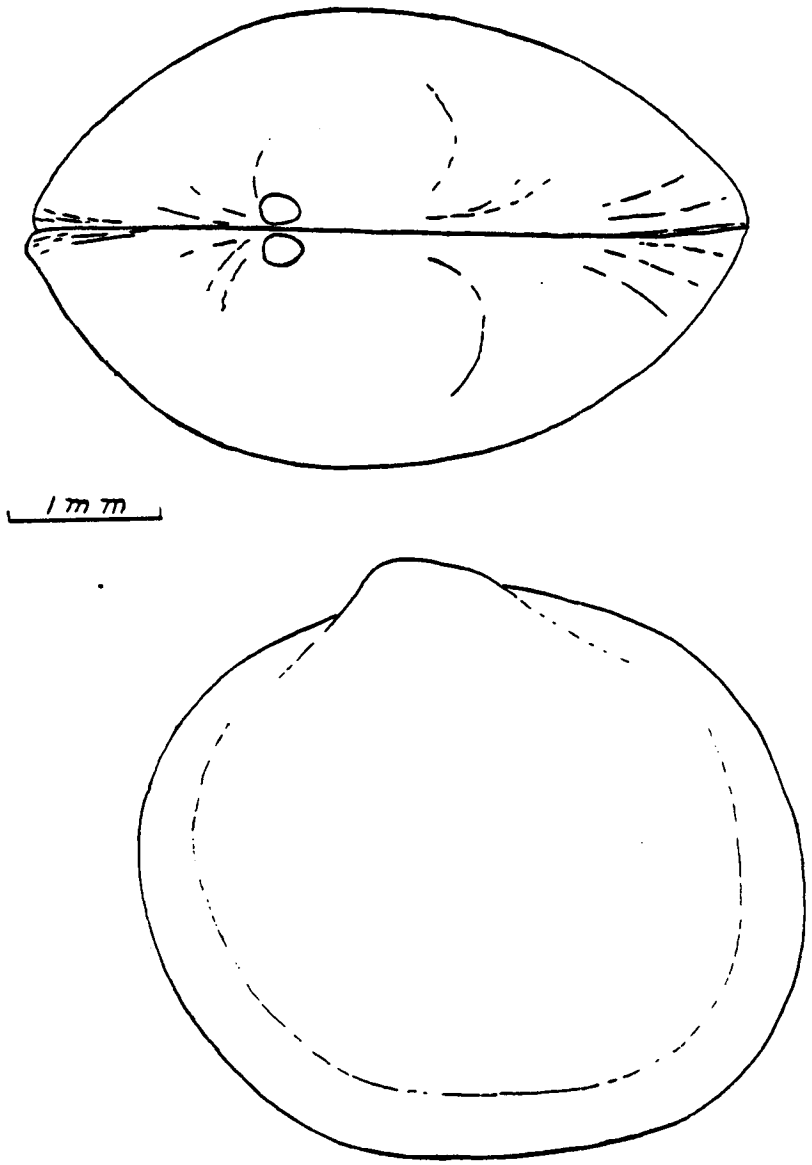


Plate 1. *Kellia suborbicularis*, exterior of shell.

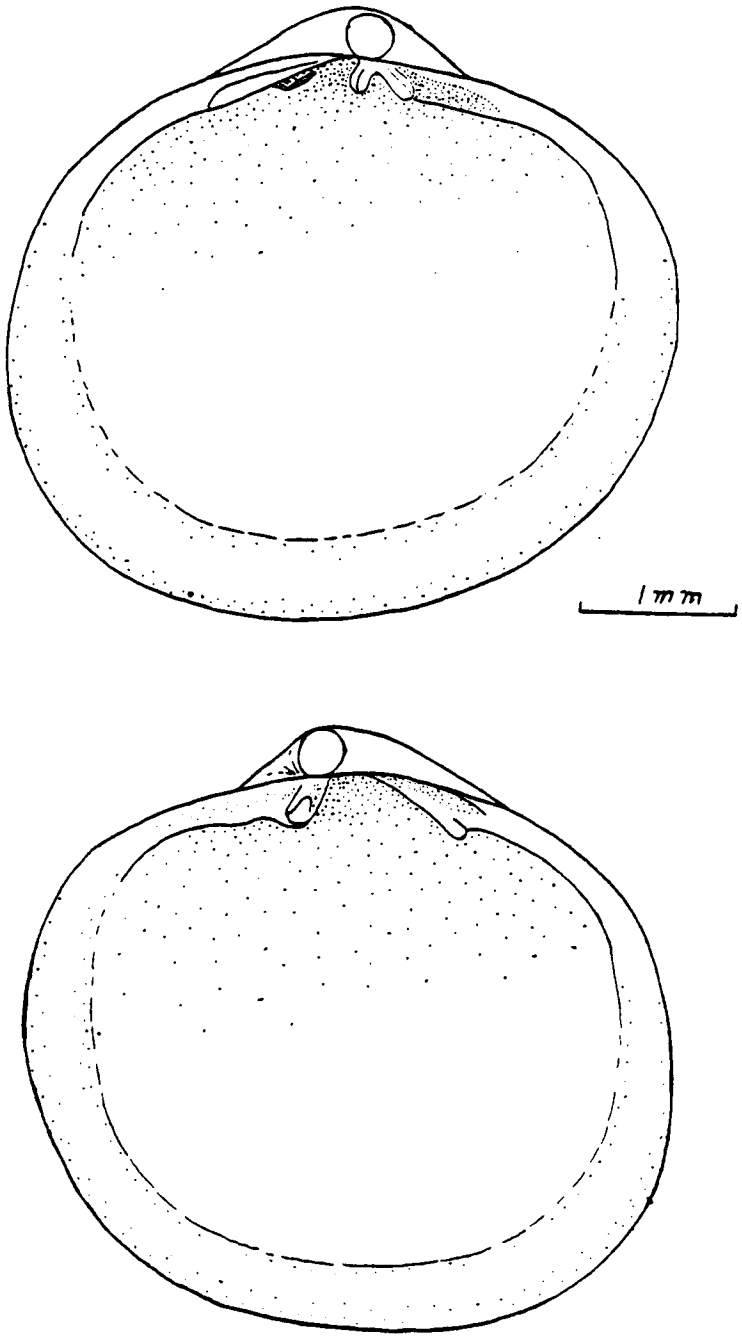


Plate 2. *Kellia suborbicularis*, interior of shell.

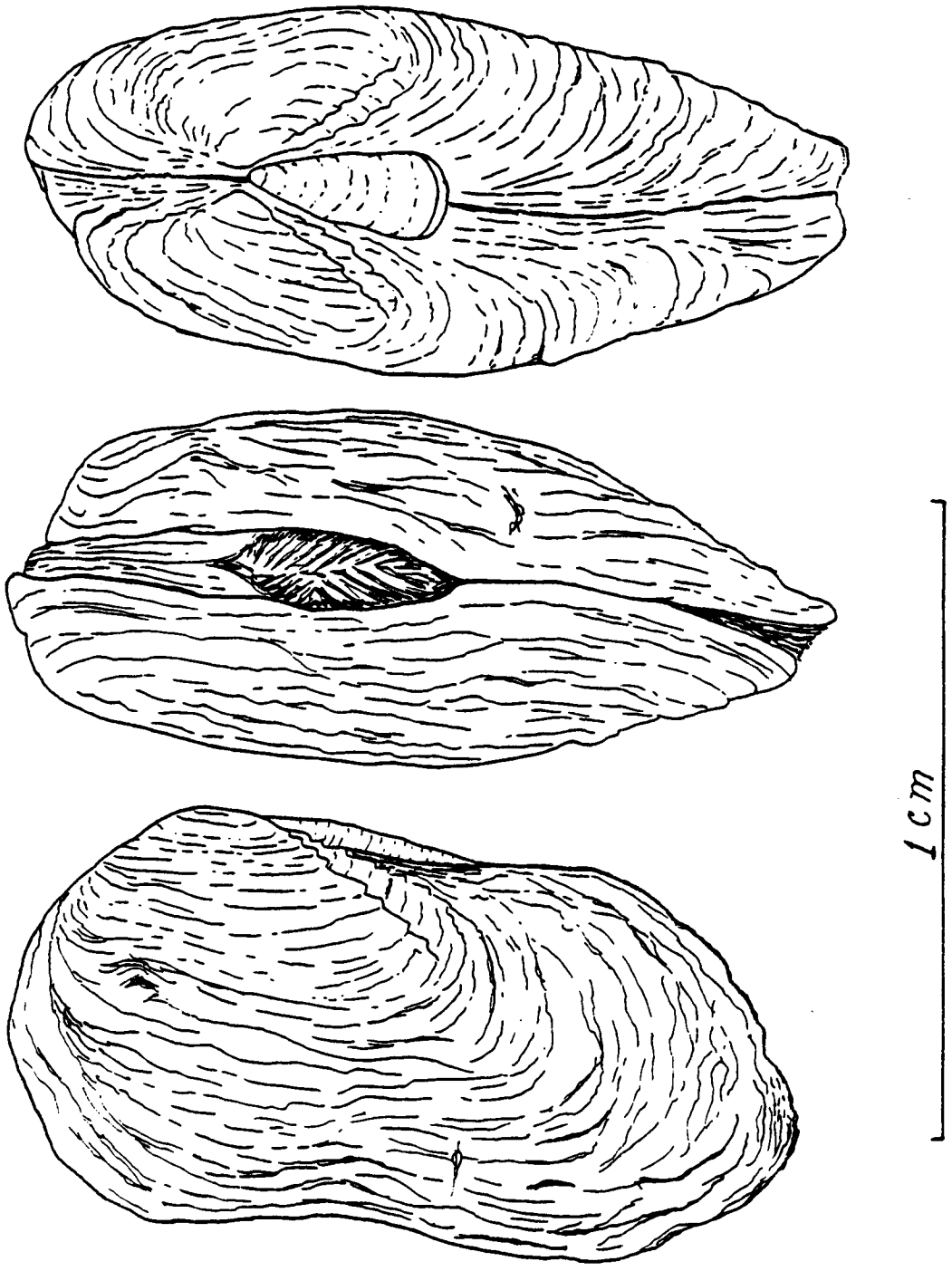


Plate 3. *Hiatella arctica,* exterior of shell.

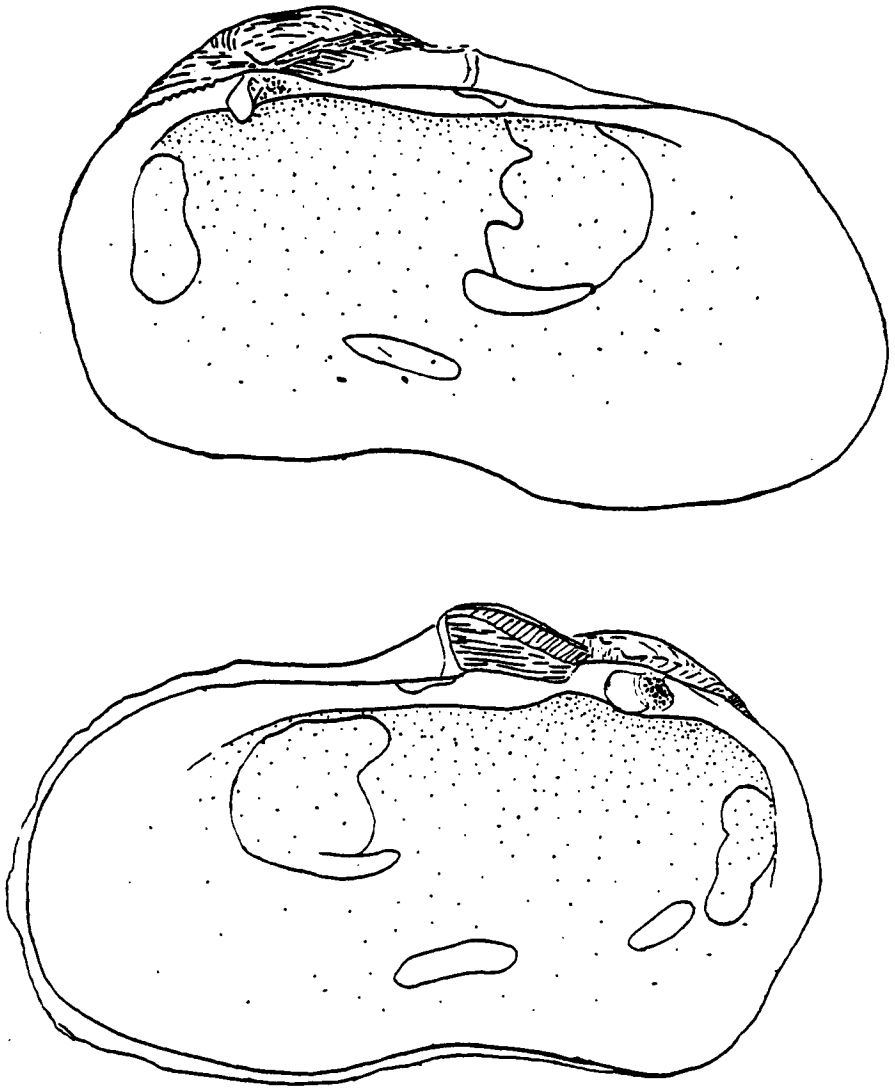


Plate 4. *Hiatella arctica,* interior of shell.

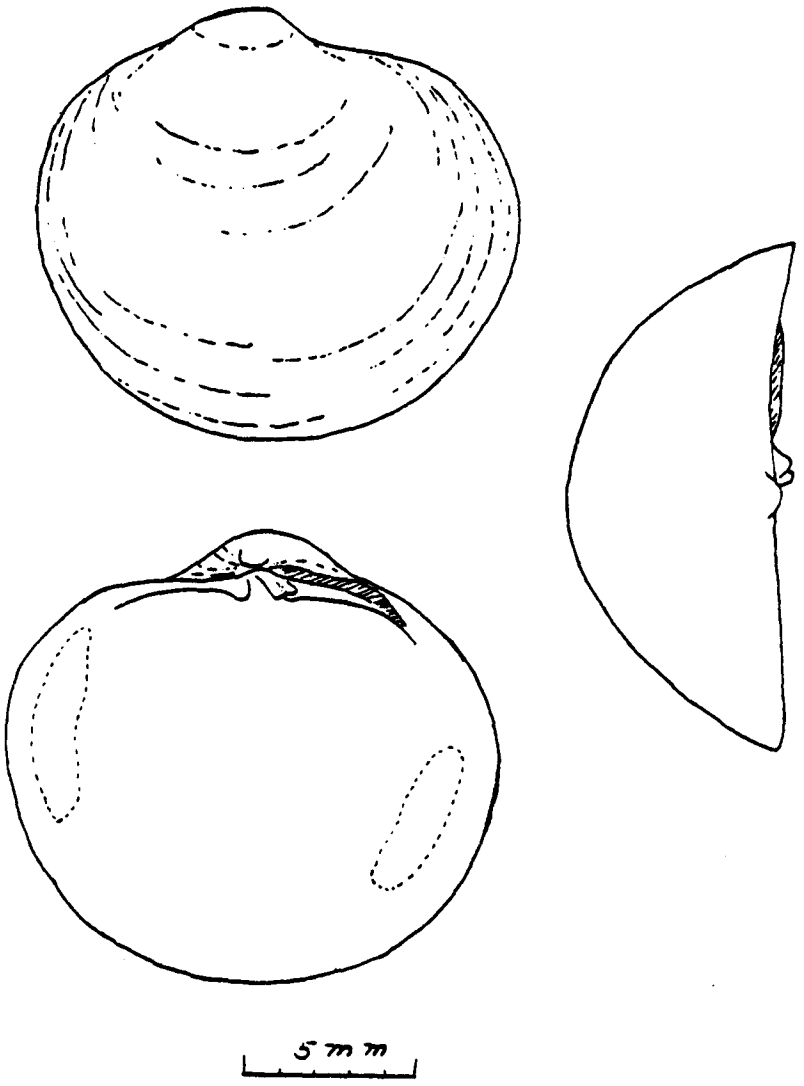


Plate 5. *Diplodonta* cf. *soror*, exterior of shell (top left) interior of shell (bottom left, side view of shell (right).

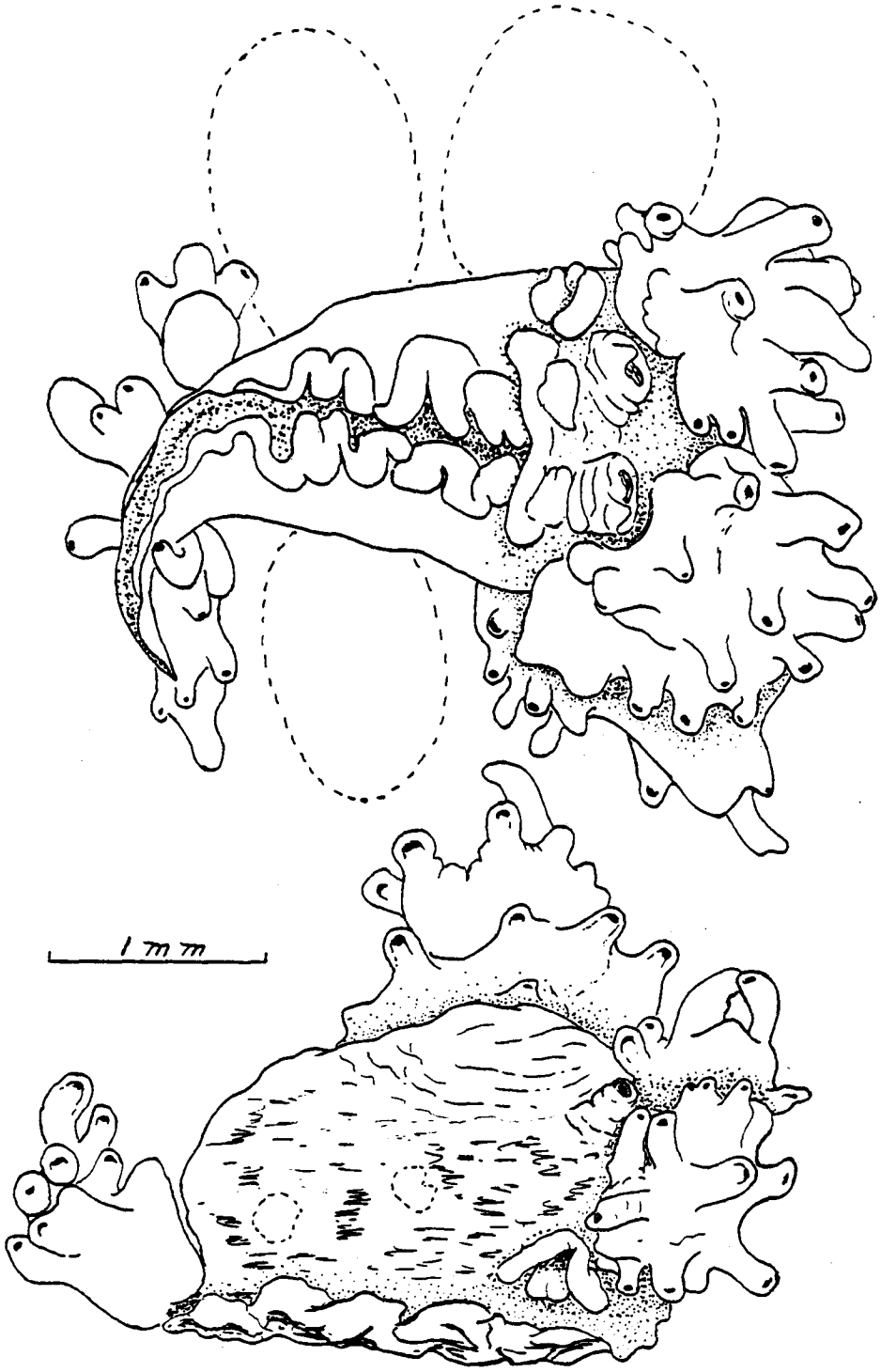


Plate 6. *Doto uva*, ventral view (top), side view (bottom).

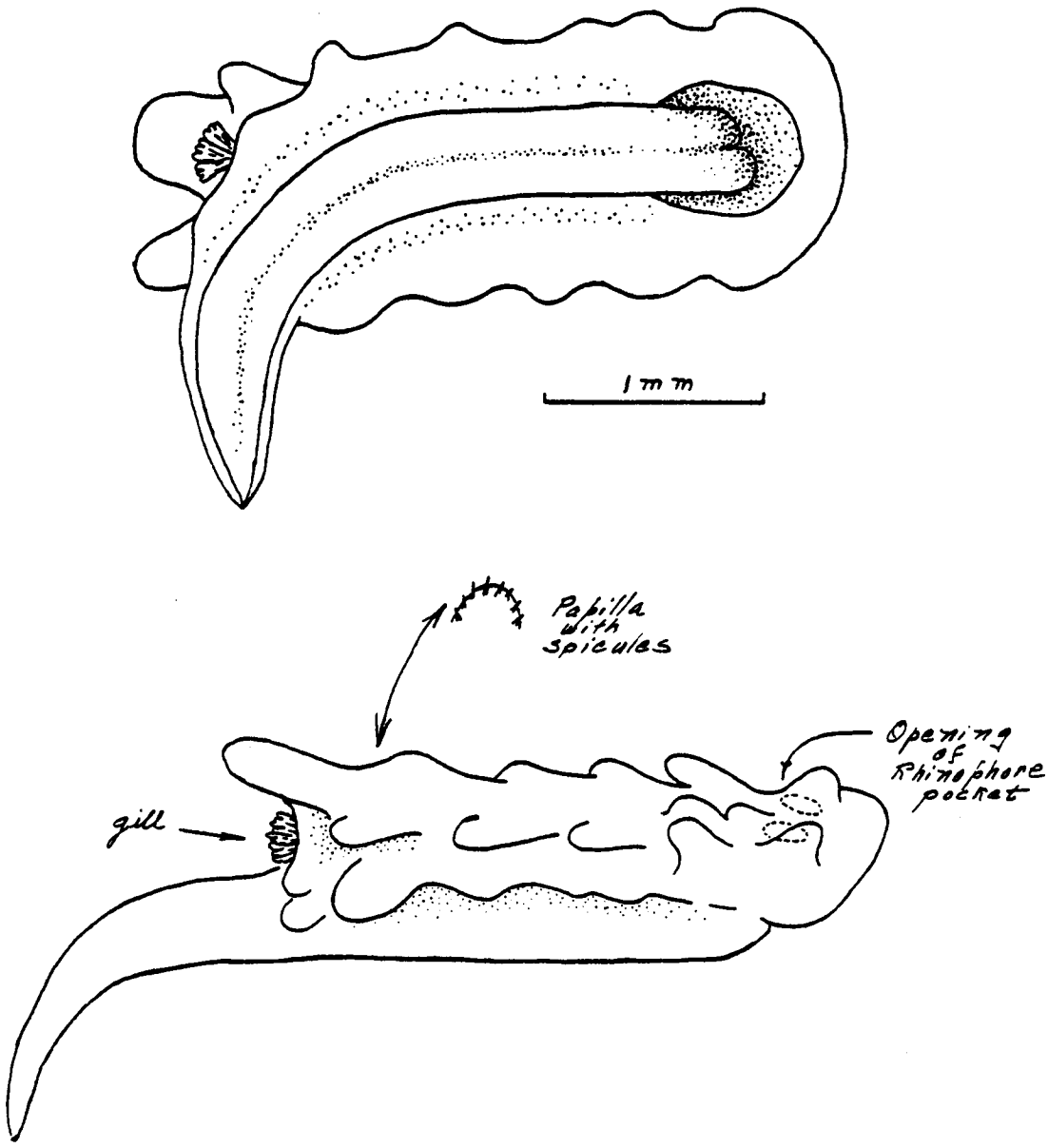


Plate 7. *Aegires puntilucens*, ventral view (top), side view (bottom).

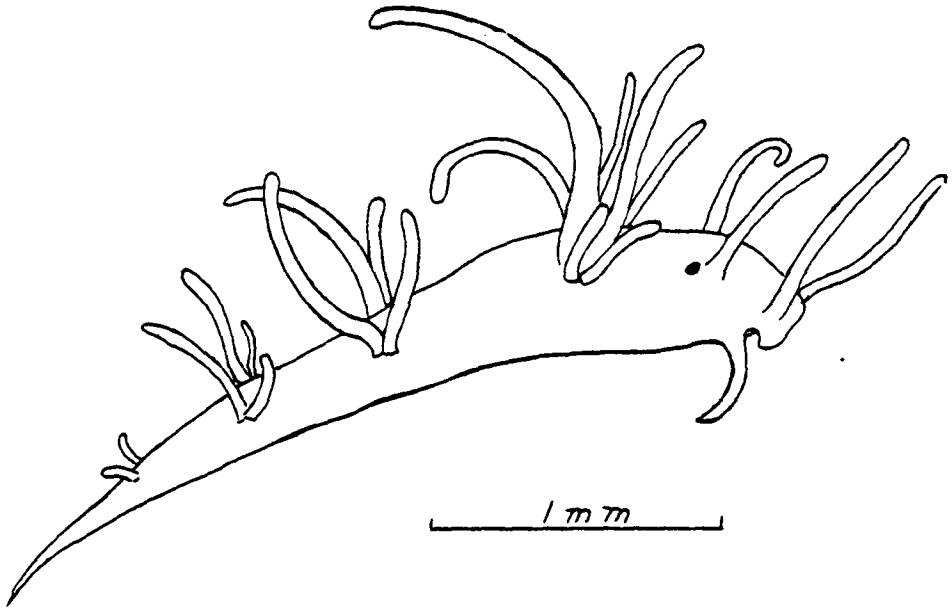


Plate 8. *Coryphella* cf. *lineolata*.

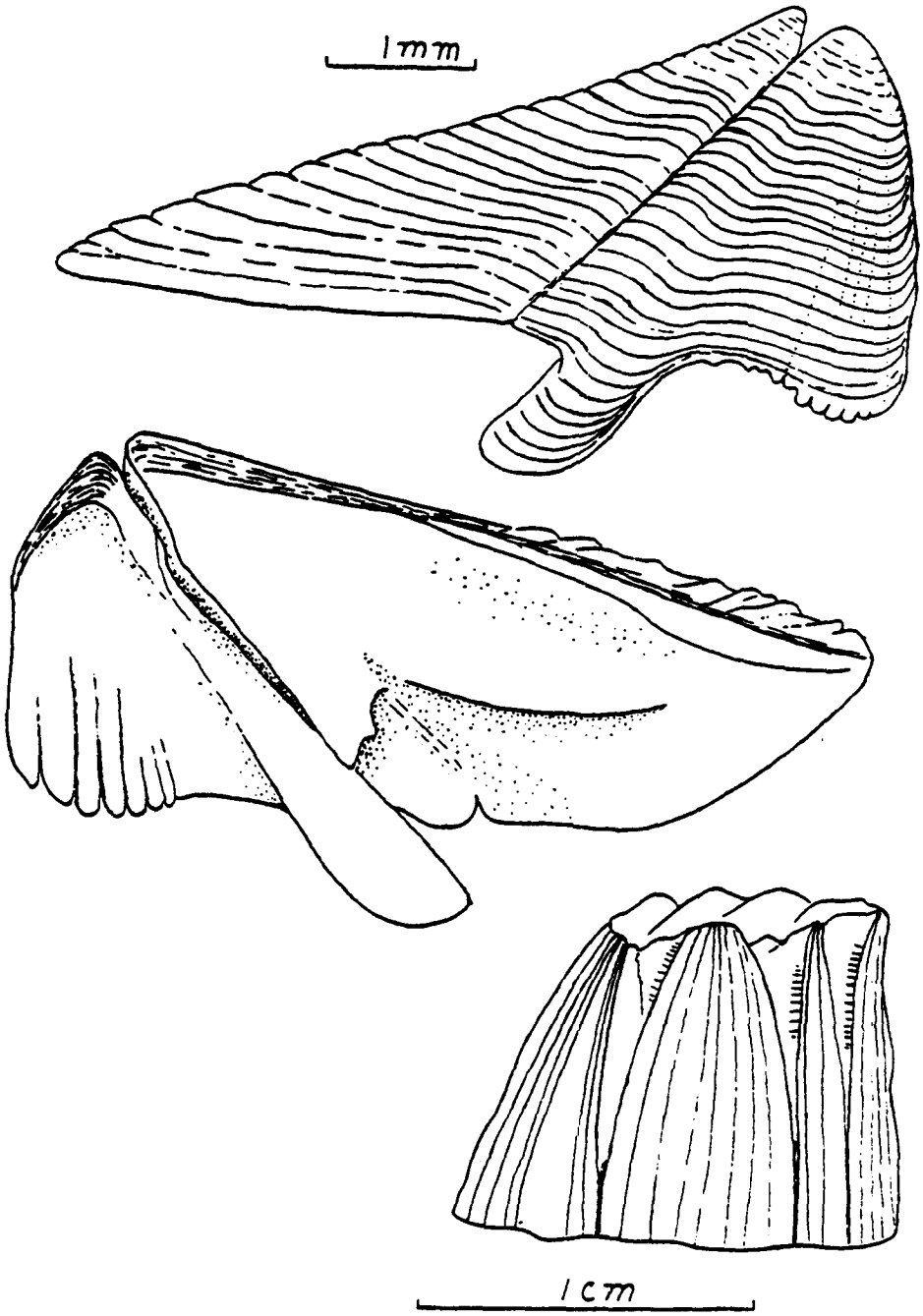


Plate 9. *Balanus amphitrite niveus*, exterior surface tergum and scutum (top), interior surface tergum and scutum (middle), side view of whole animal (bottom).

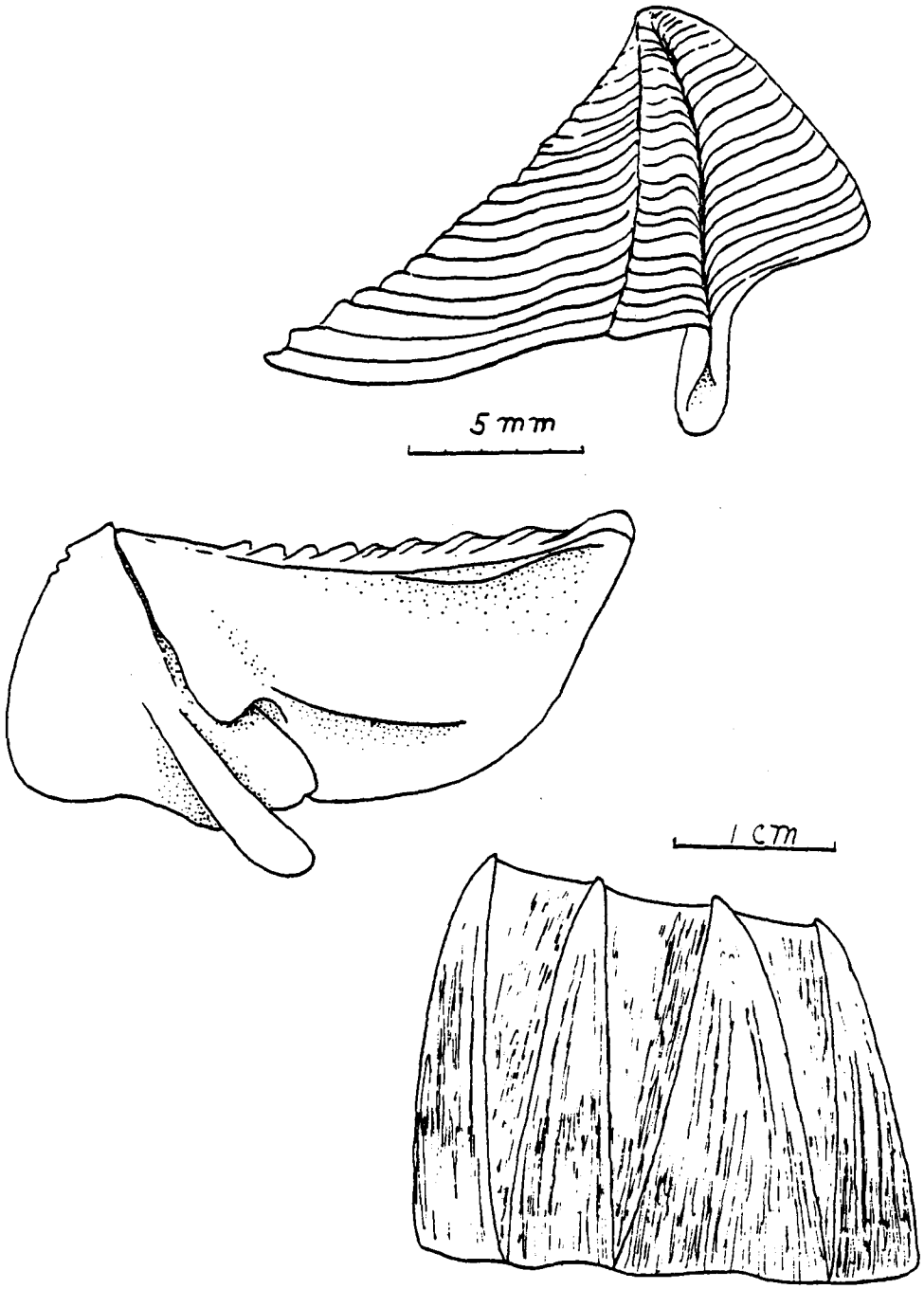
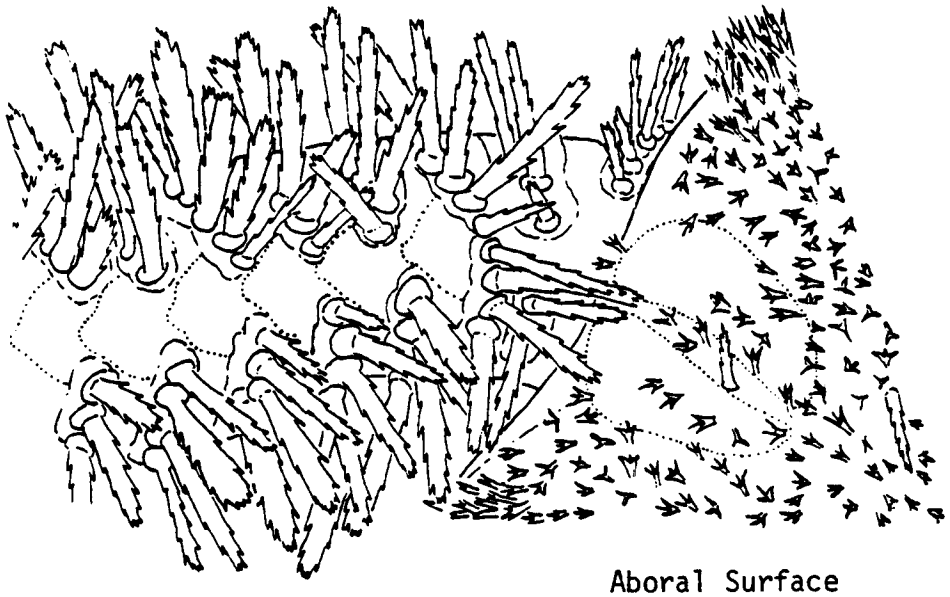
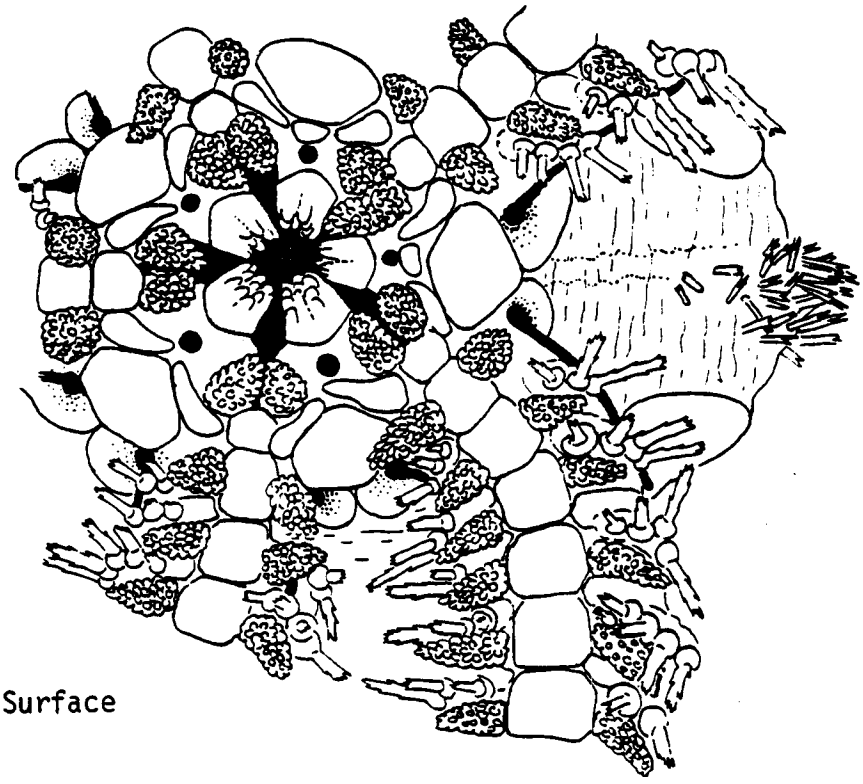


Plate 10. *Balanus tintinnabulum antillensis*, exterior of surface tergum and scutum (top), interior surface tergum and scutum (middle), side view of whole animal (bottom).

Disc 6 mm diameter

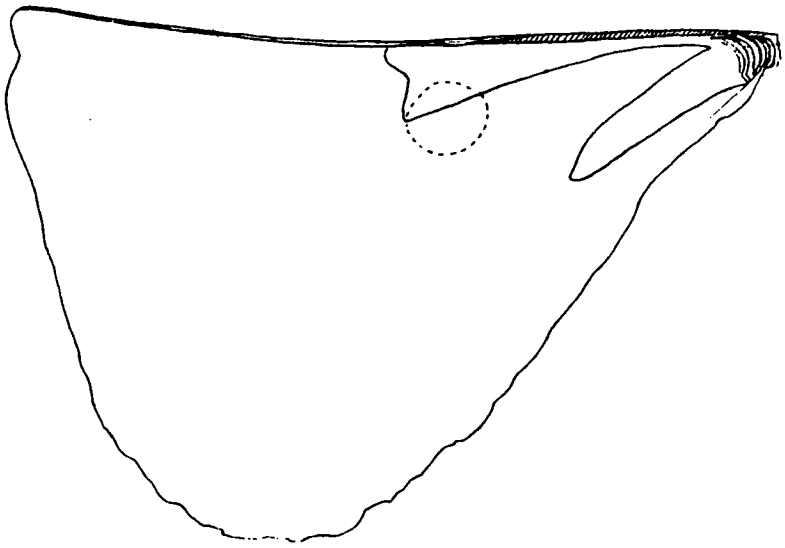


Aboral Surface



Oral Surface

Plate 11. *Ophiothrix angulata.*



33 mm long

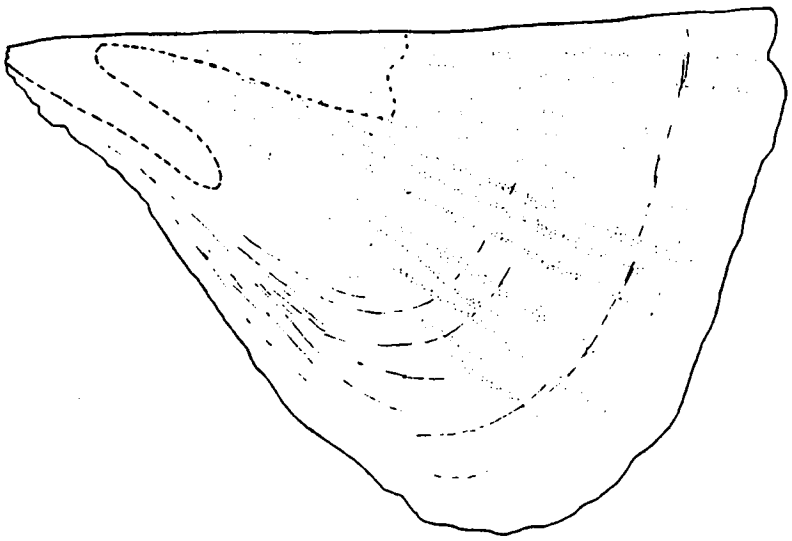
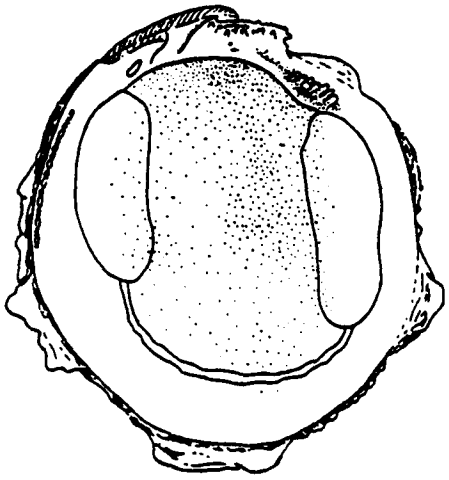
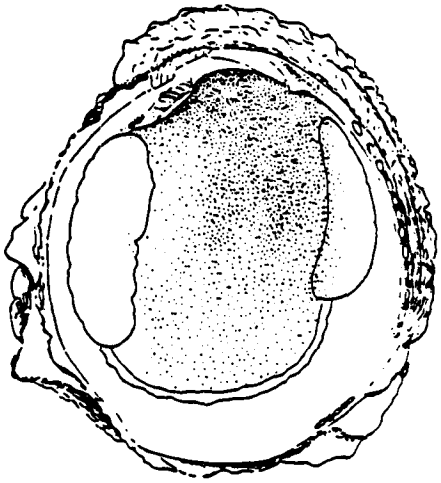


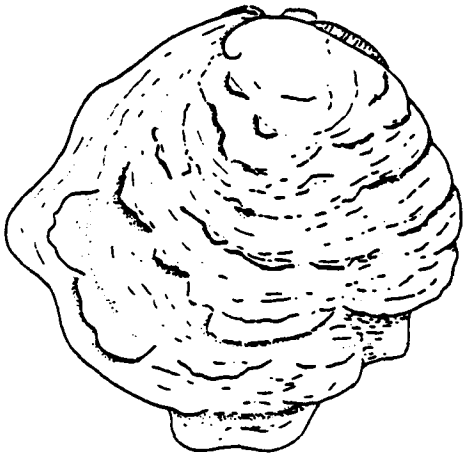
Plate 12. *Pinna carnea.*



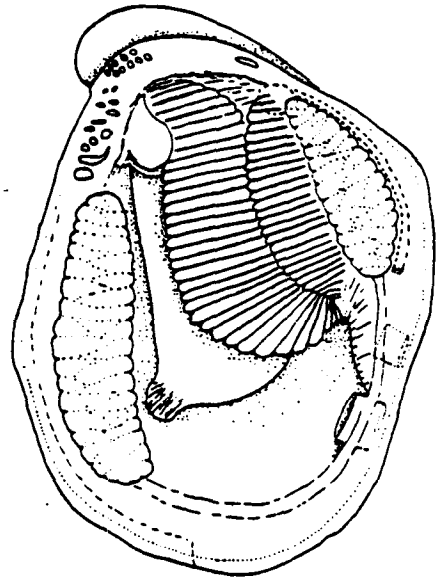
Right valve interior



Left valve interior



Right valve exterior



Animal, left side, mantle removed inside parallel line

Plate 13. *Pseudochama radians*.

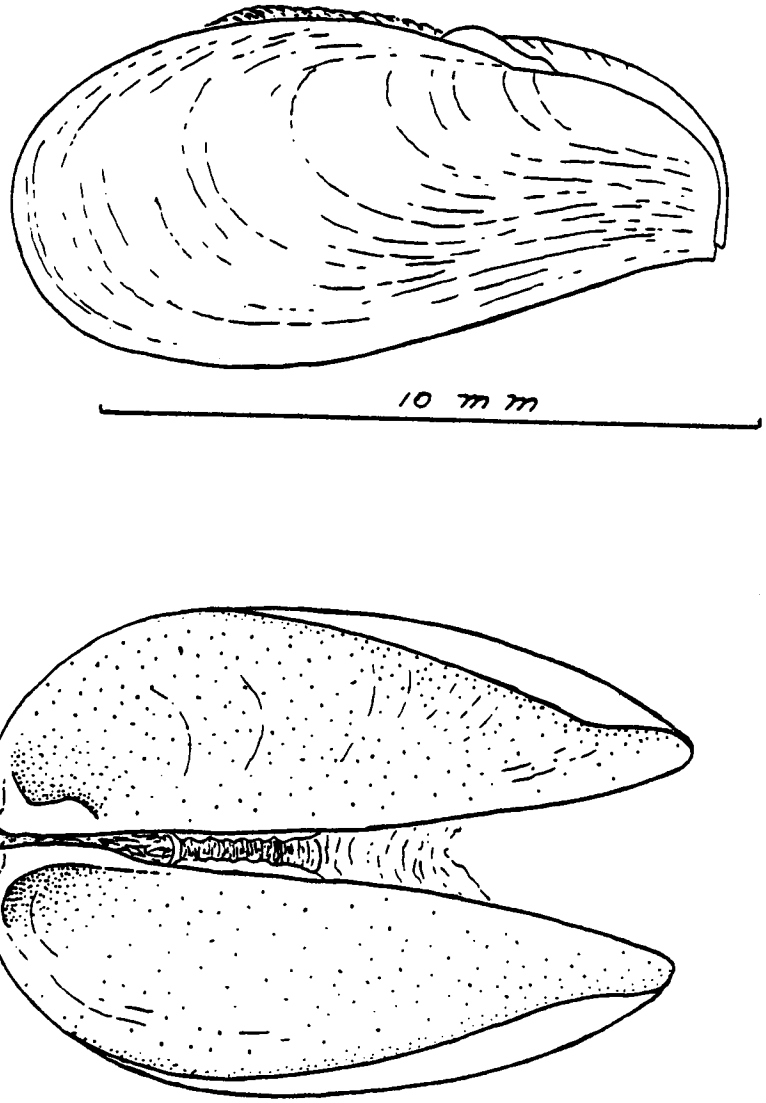
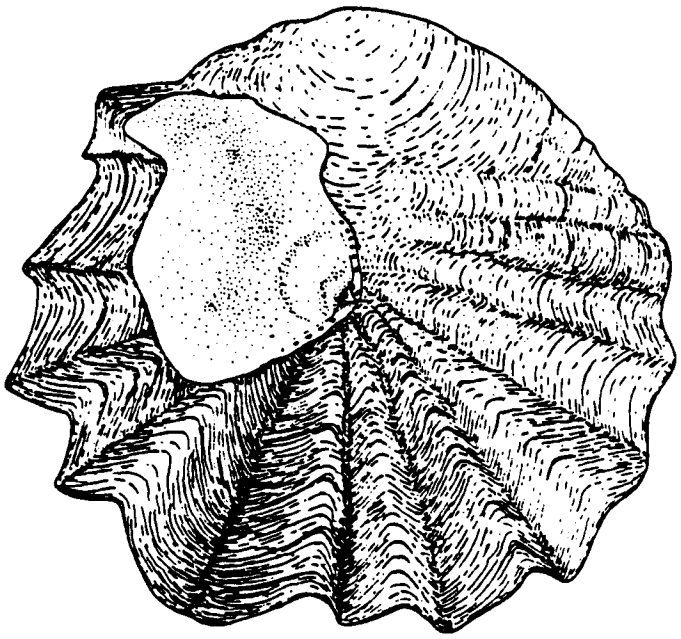
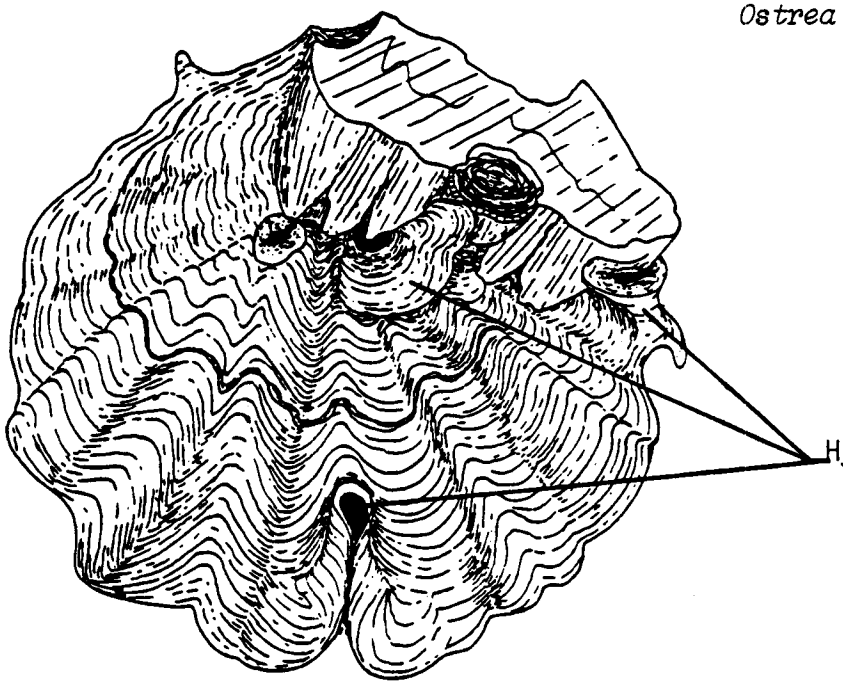


Plate 14. *Gastrochaena hians.*

35 mm high



Exterior of right valve
(attached oyster is
Ostrea equestris)



Hyotid spines

Plate 15. *Lopha frons*, exterior of shell.

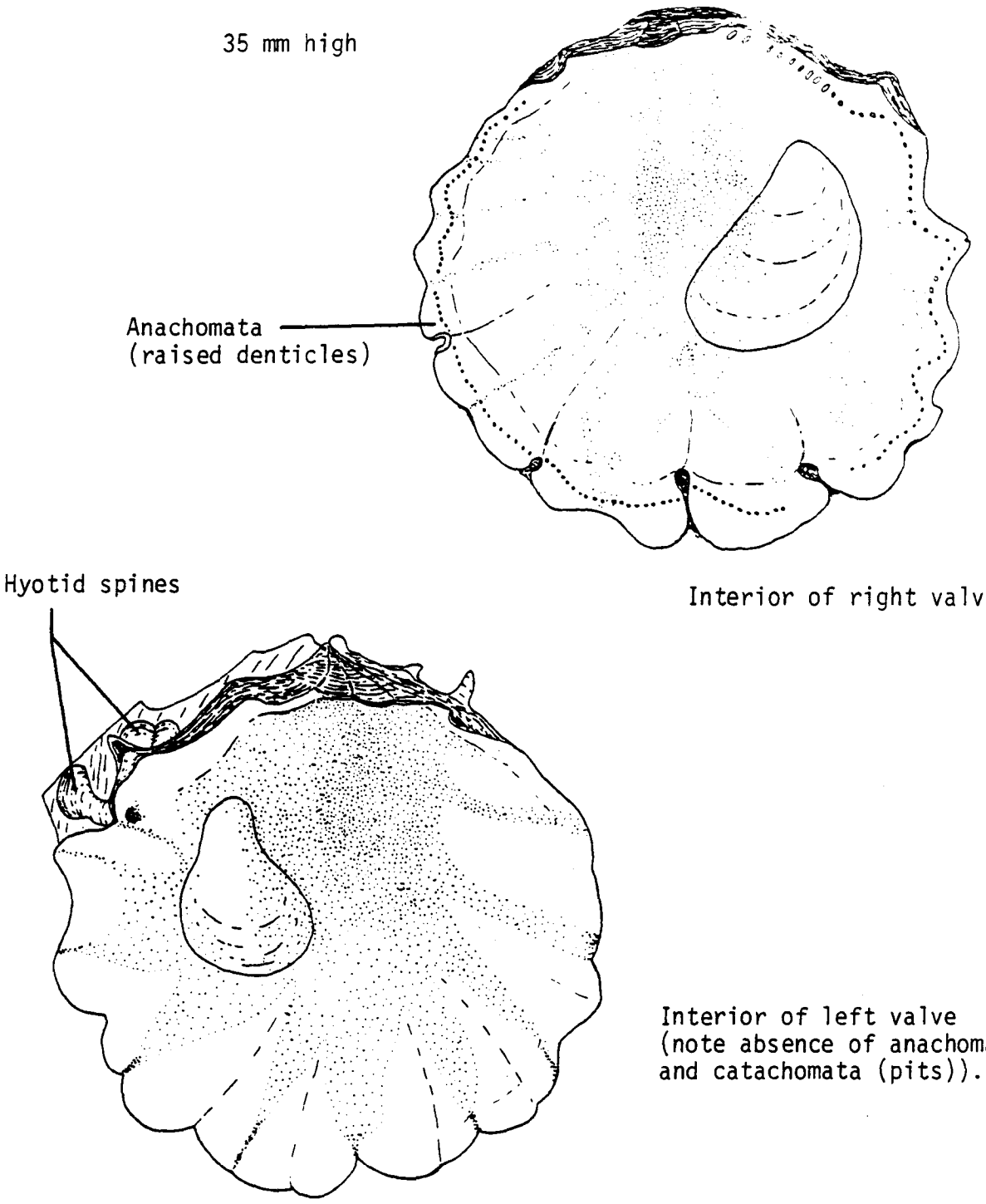
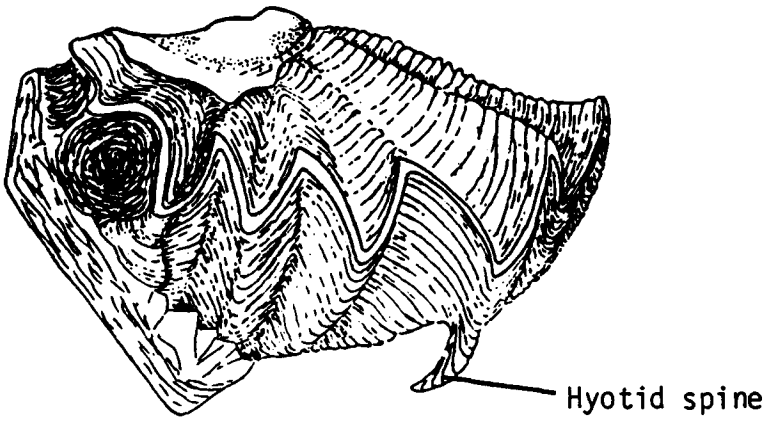
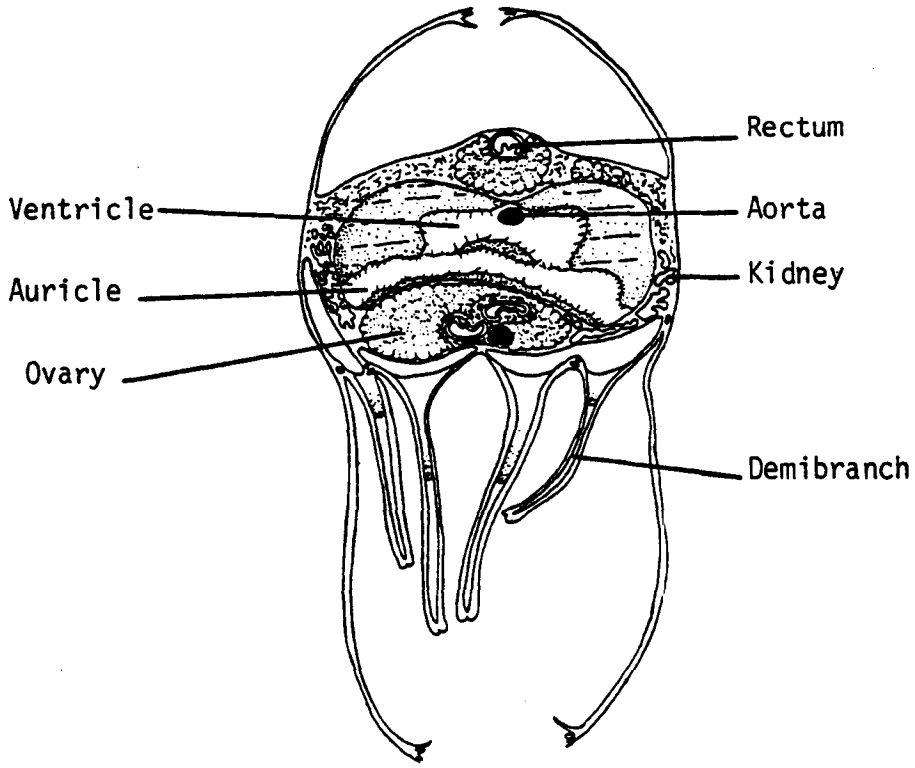


Plate 16. *Lopha frons*, interior of shell.

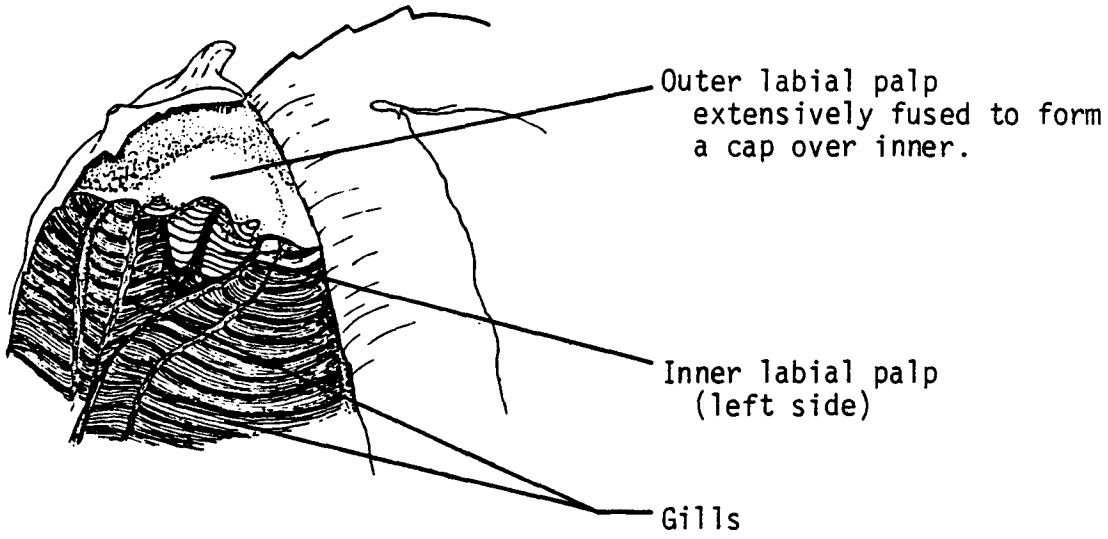


Posterior view
valves slightly opened

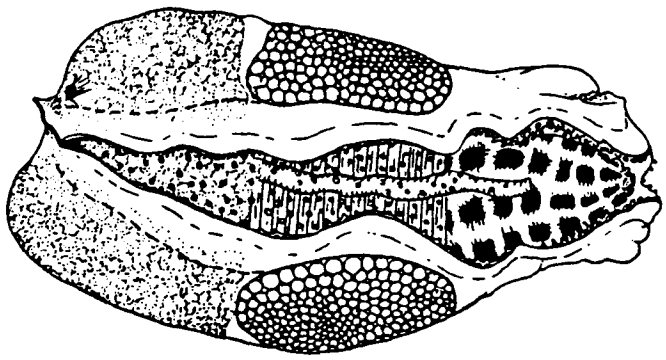


Transverse section through
dorsal part of pericardium

Plate 17. *Lopha frons*, side views and cross section.



Left mantle lobe cut and folded aside

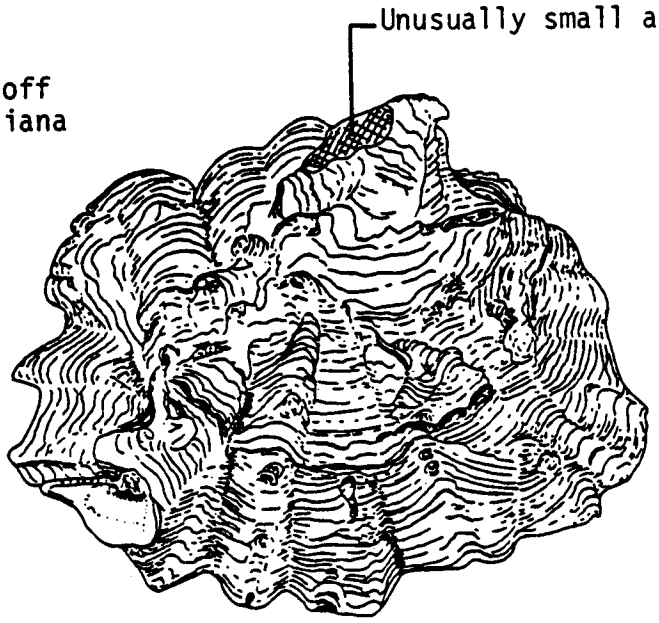


Posterior view of animal
removed from shell

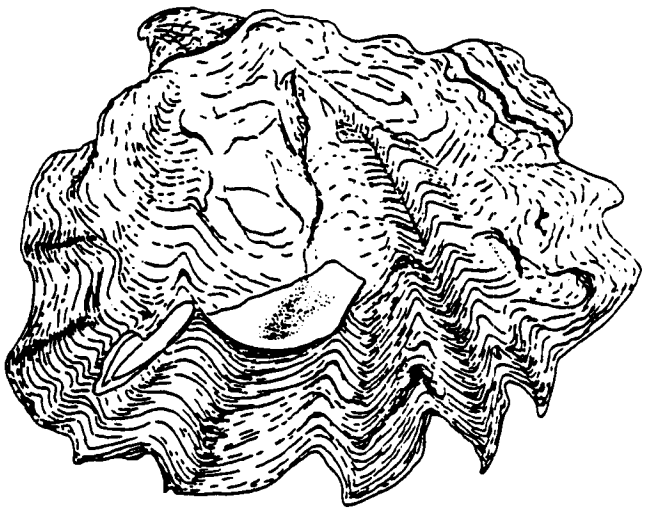
Plate 18. *Lopha frons*, palps and dorsum.

65 mm long

Oil rig support off
Timbalier, Louisiana



Exterior of left valve



Exterior of right valve

Plate 19. *Hyotissa thomasi*, exterior of shell.

APPENDIX C
DISTRIBUTIONAL PATTERNS OF BARNACLES AND PELECYPODS

APPENDIX C. DISTRIBUTIONAL PATTERNS OF BARNACLES AND PELECYPODS

PREFACE

In the following figures, results of Duncan's Multiple Range Test performed on $\log_e$ transformed collection data were used as a basis for constructing graphs. The purpose of the graphs is to depict relative distribution of organisms among the platforms and depths sampled. On these graphs, each continuous, interconnected band of stations joined by a zone of equal tones constitutes a grouping or stratum of stations whose respective mean values for $\log_e$ transformed data were not significantly different ($\alpha = 0.05$). The geometric mean of all station values within each stratum is depicted in the legend for each tone.

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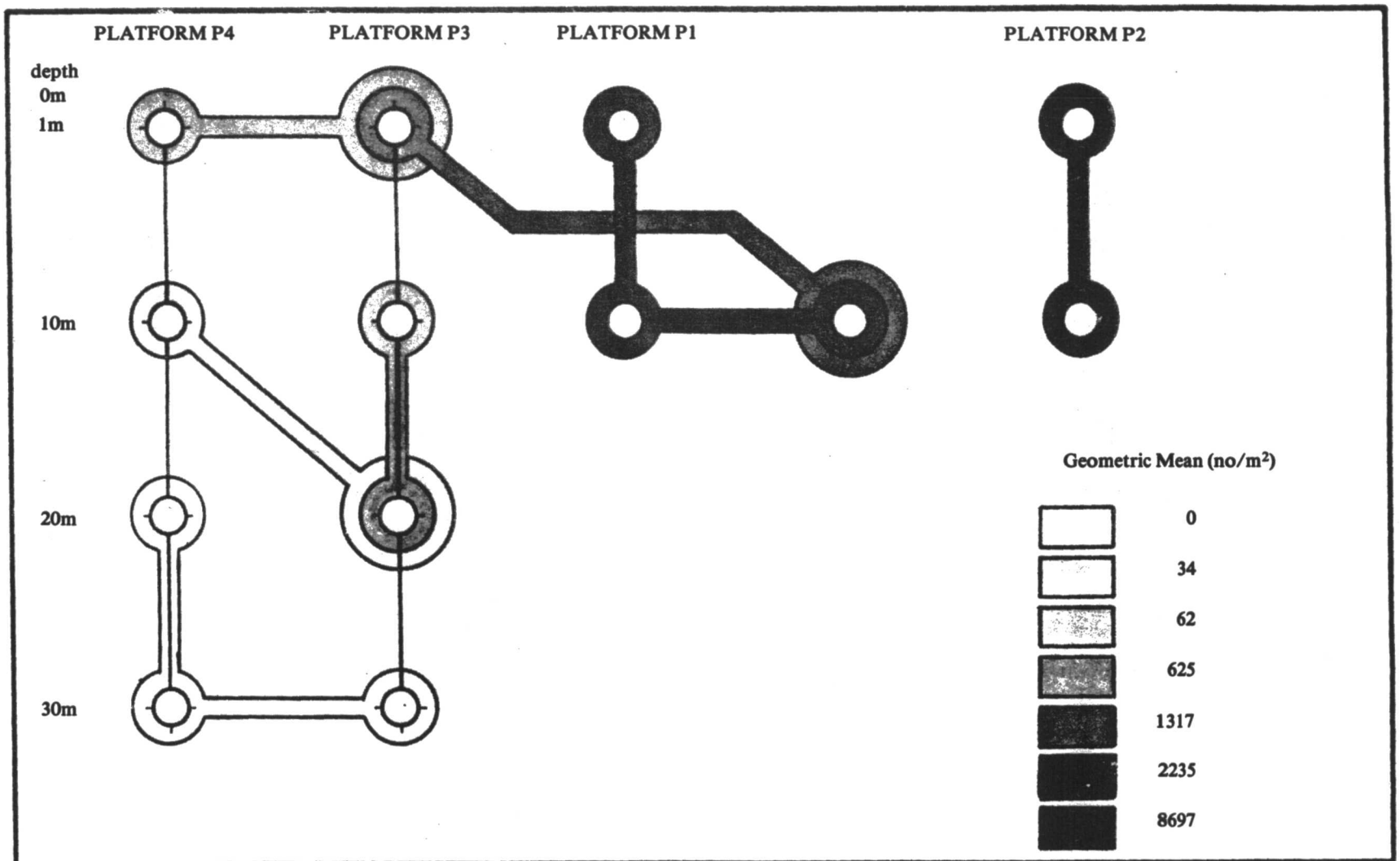

FIG C1. Distribution of *Balanus amphitrite* by depth and platform as shown by results of Duncan's Multiple Range Test performed on $\log_e (n + 1)$ values.

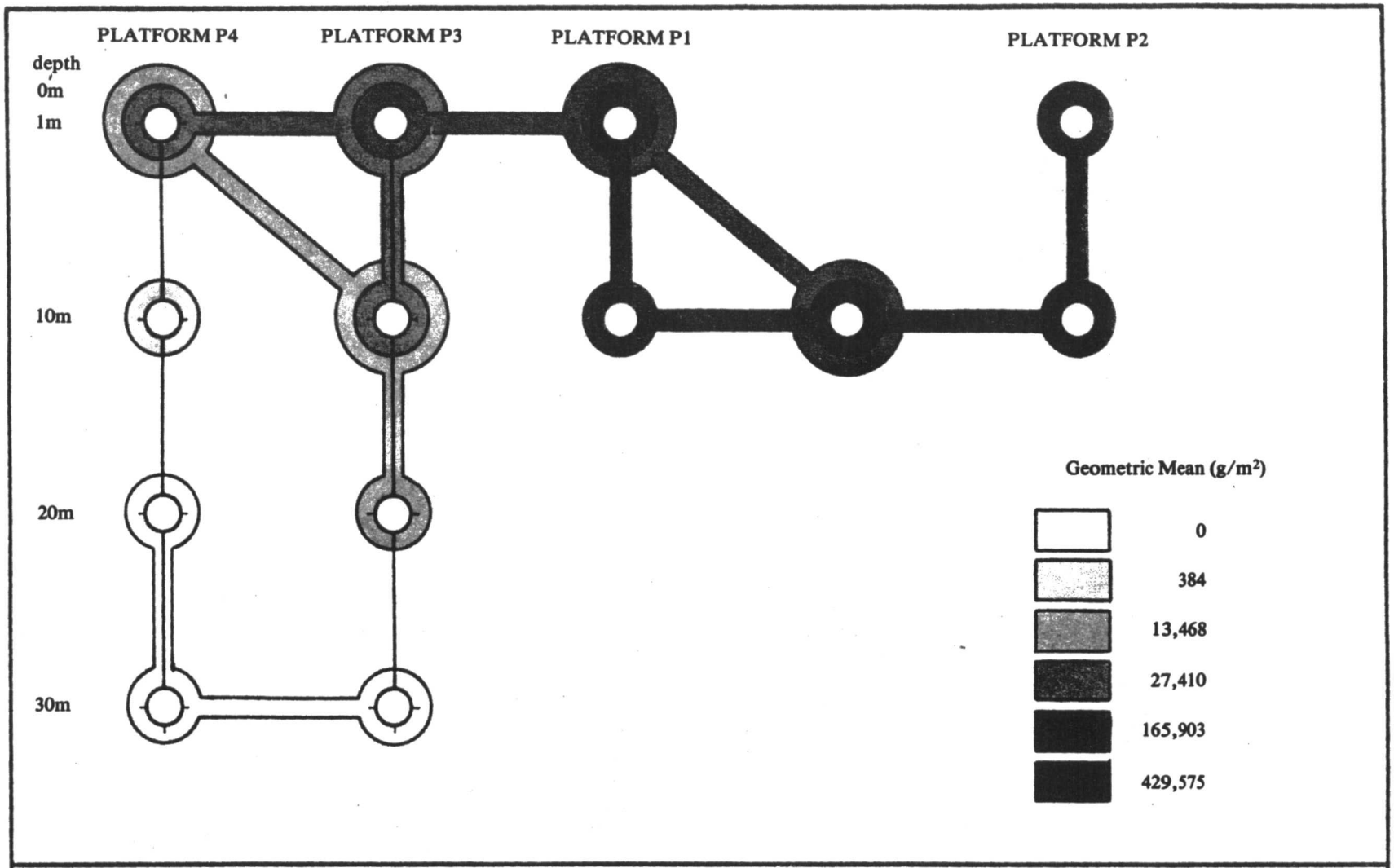

FIG C2. Distribution of *Balanus amphitrite* by depth and platform as shown by results of Duncan's Multiple Range Test performed on $\log_e$ (wet weight(g) + 1) values.

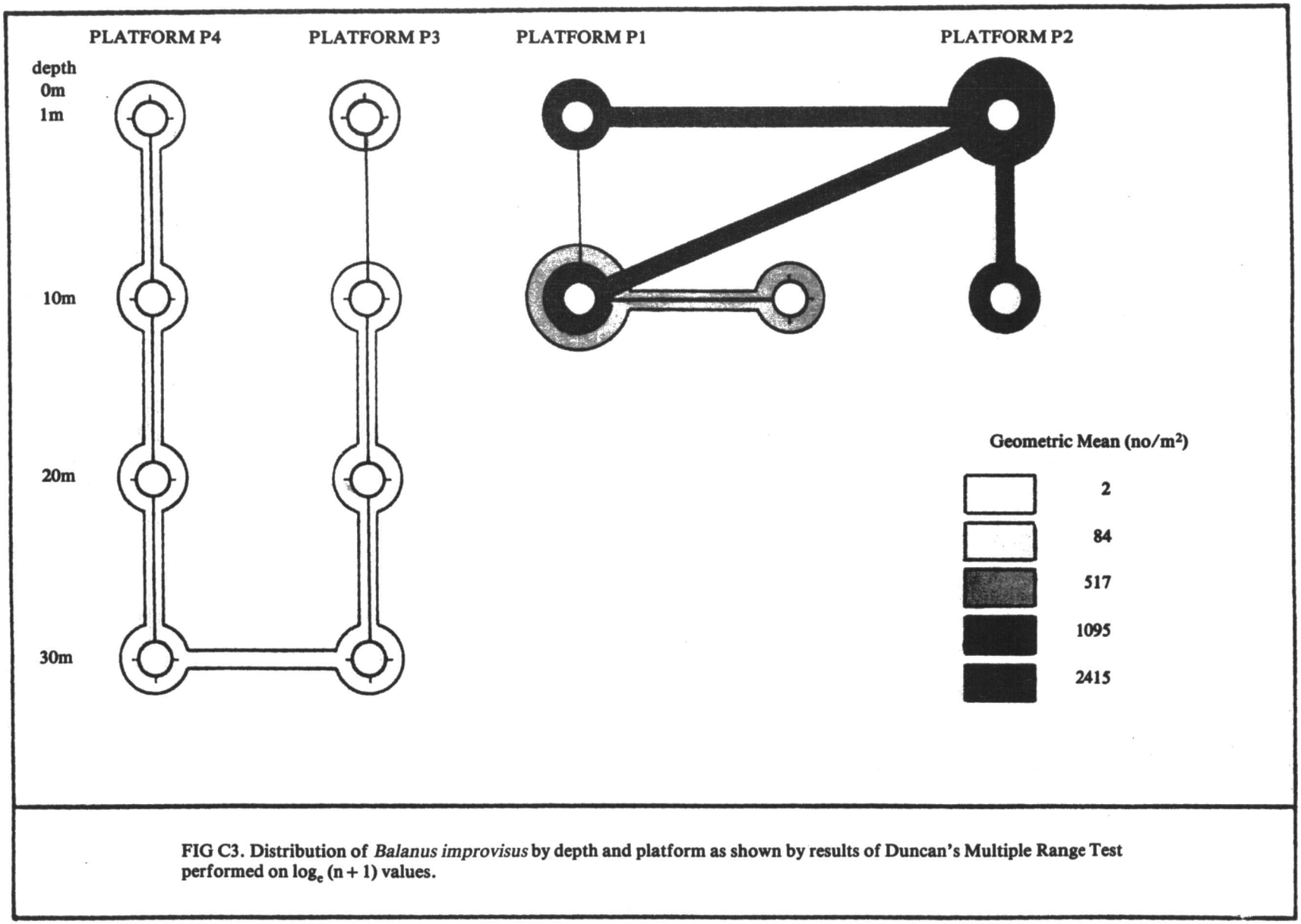

FIG C3. Distribution of *Balanus improvisus* by depth and platform as shown by results of Duncan's Multiple Range Test performed on $\log_e (n + 1)$ values.

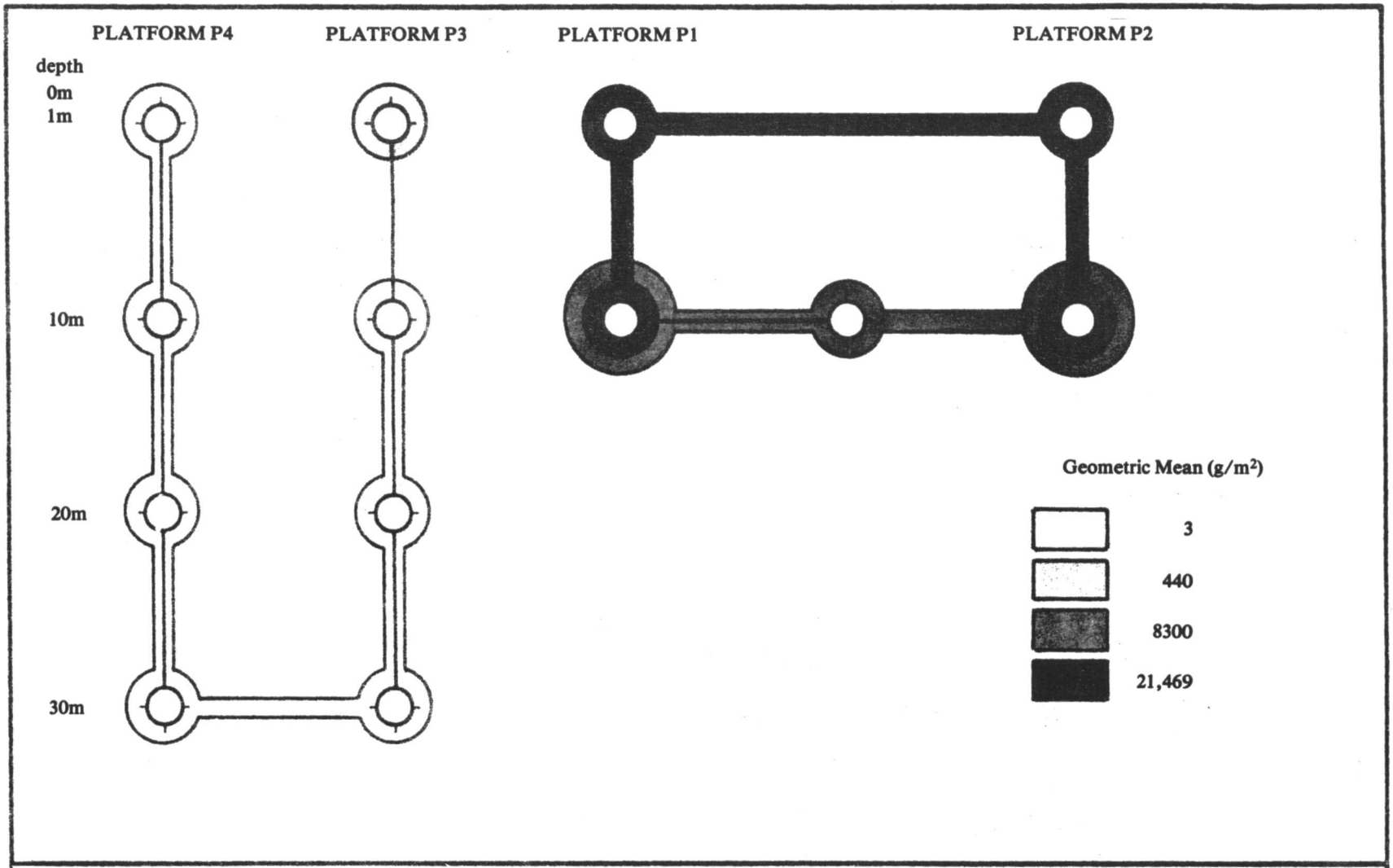

FIG C4. Distribution of *Balanus improvisus* by depth and platform as shown by results of Duncan's Multiple Range Test performed on $\log_e$(wet weight(g) + 1) values.

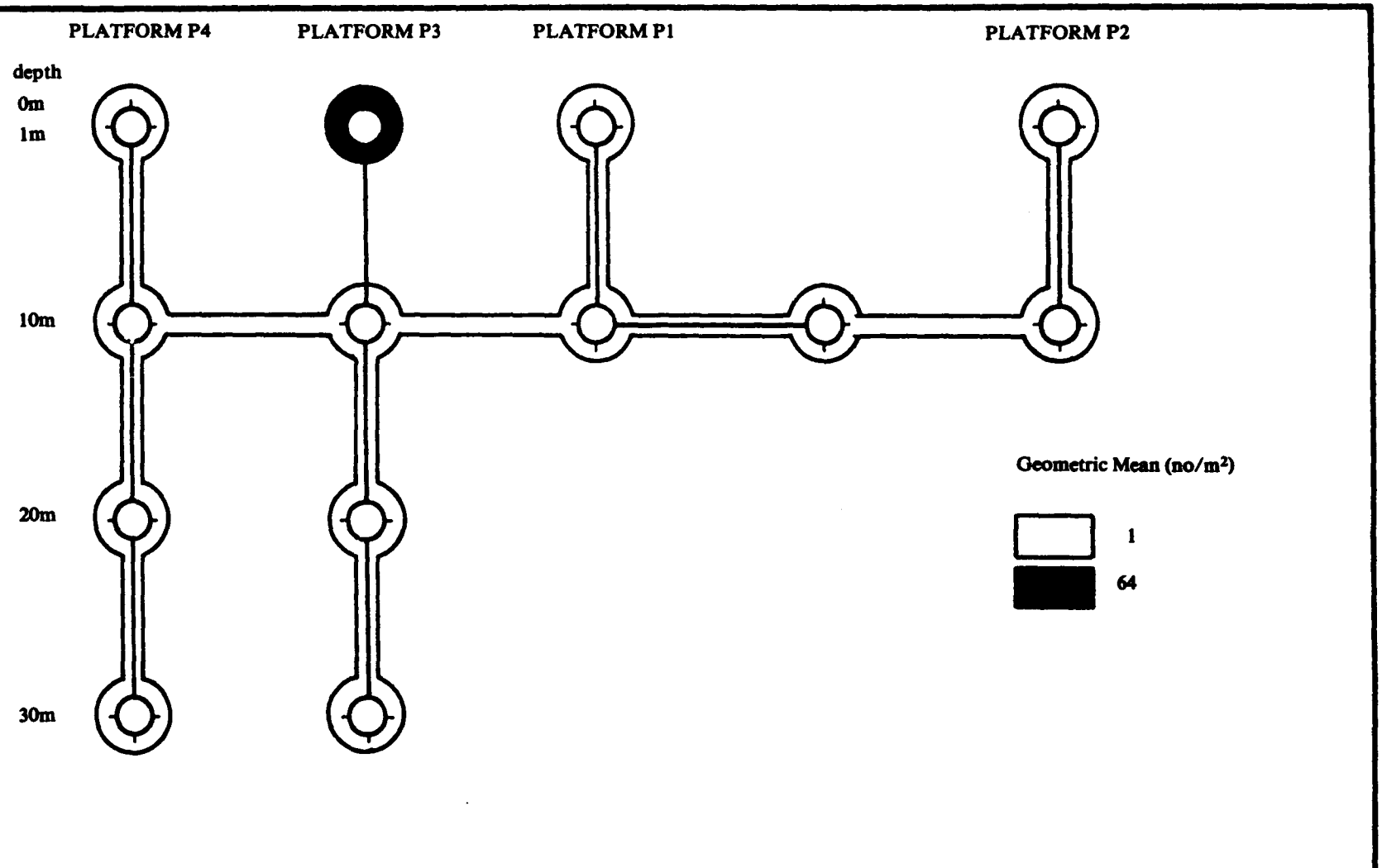

FIG C5. Distribution of *Balanus tintinnabulum* by depth and platform as shown by results of Duncan's Multiple Range Test performed on $\log_e (n + 1)$ values.

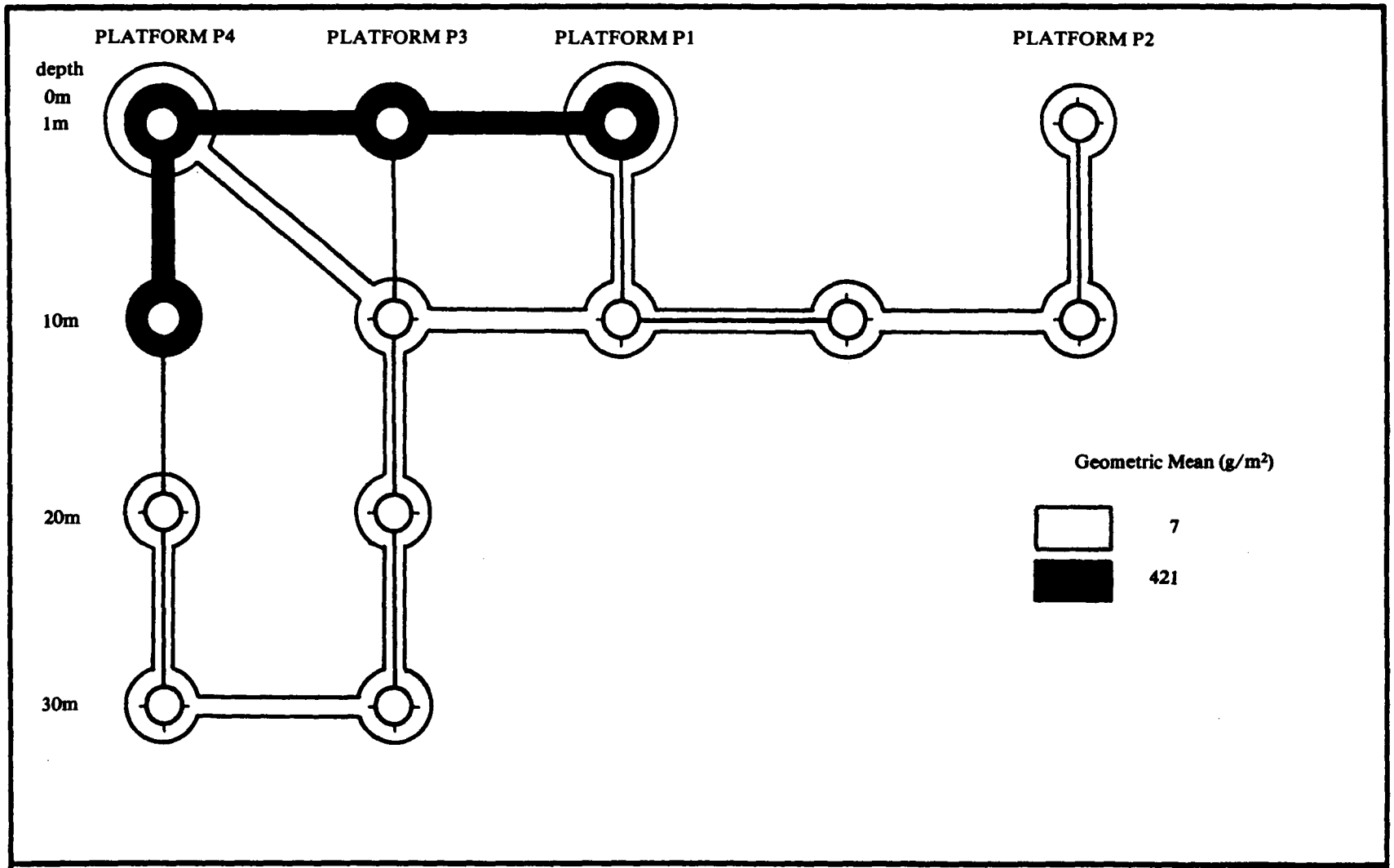

FIG C6. Distribution of *Balanus tintinnabulum* by depth and platform as shown by results of Duncan's Multiple Range Test performed on $\log_e$ (wet weight(g) + 1) values.

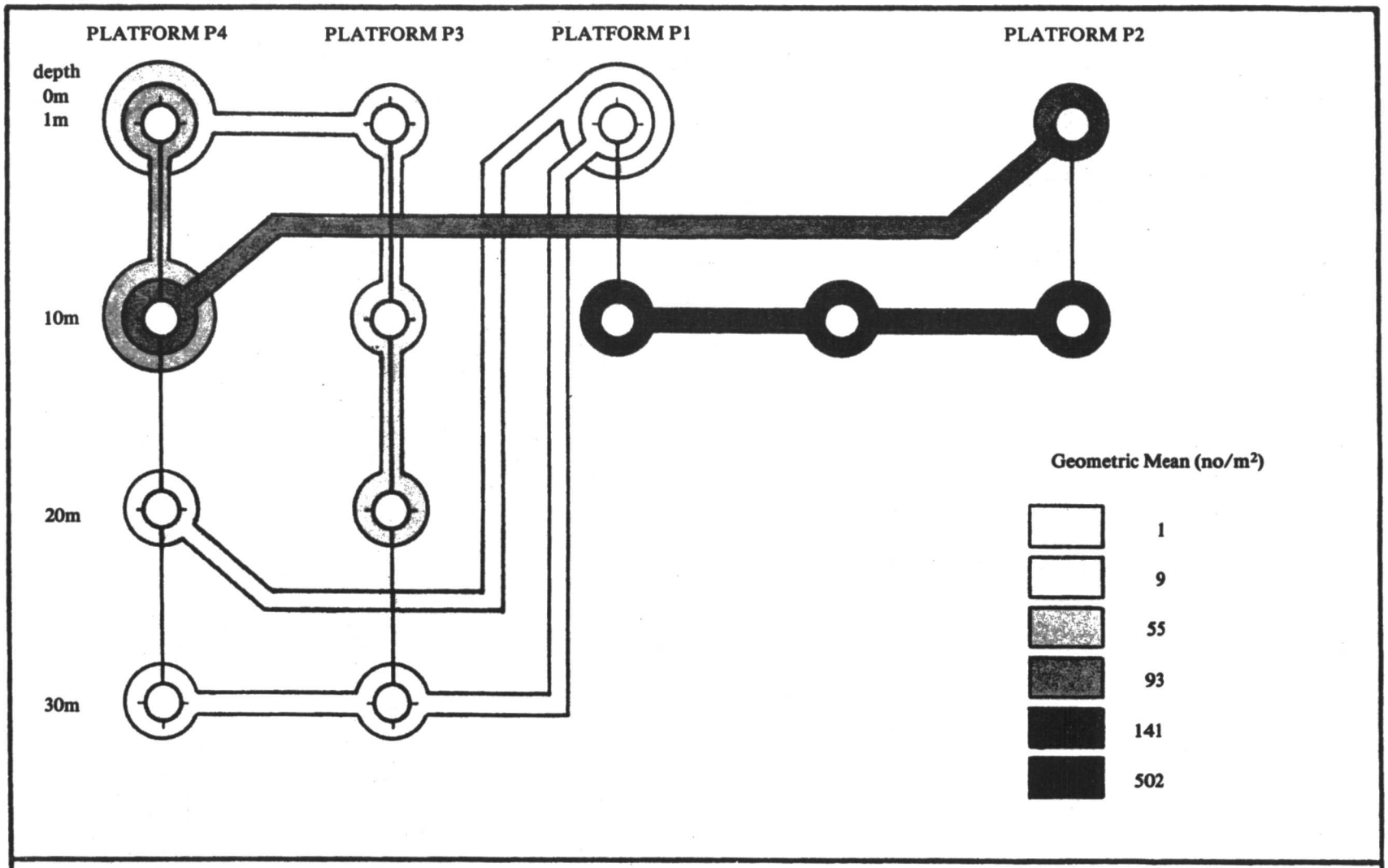

FIG C7. Distribution of Ostreacea by depth and platform as shown by results of Duncan's Multiple Range Test performed on $\log_e (n + 1)$ values.

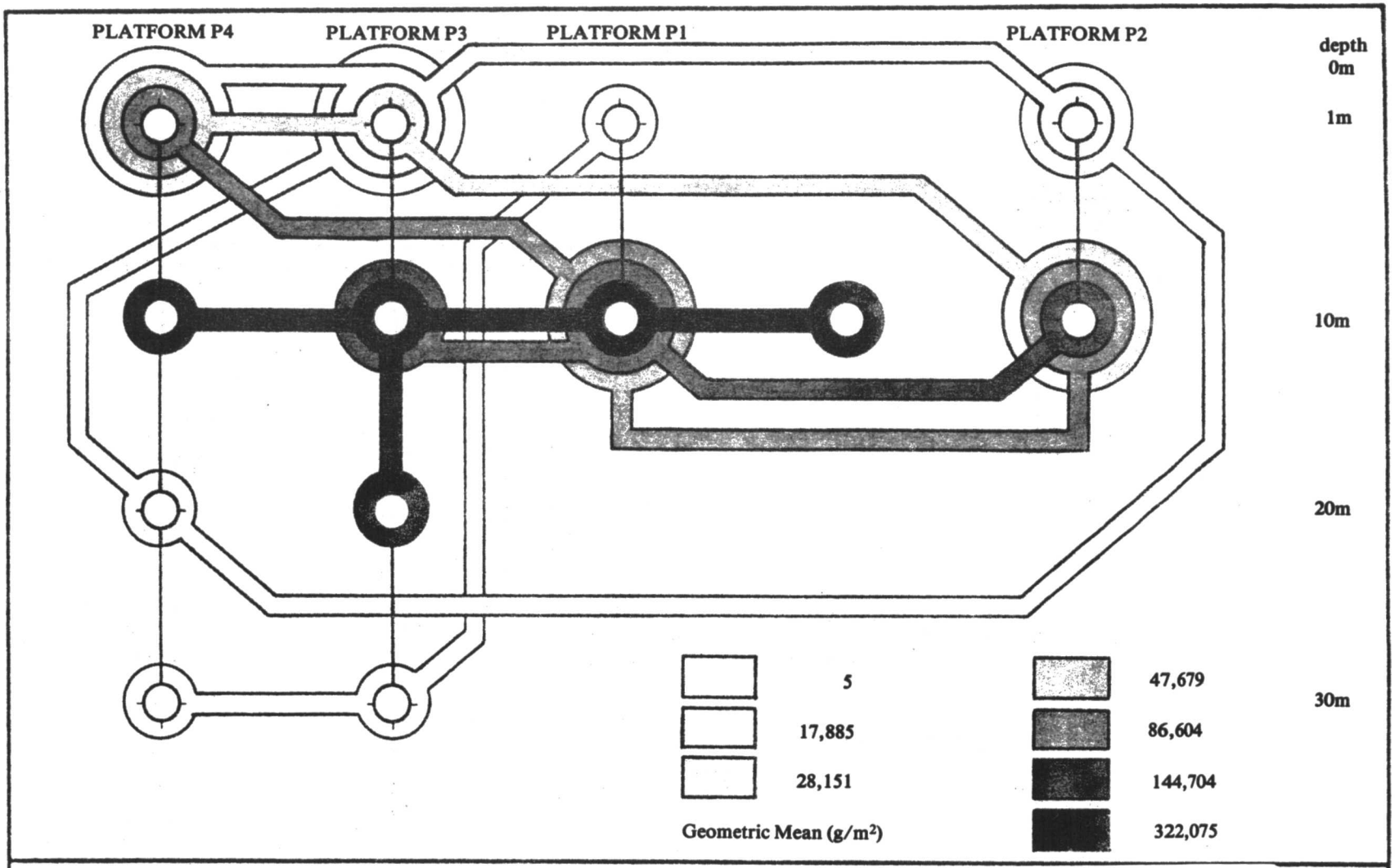

FIG C8. Distribution of Ostreacea by depth and platform as shown by results of Duncan's Multiple Range Test performed on $\log_e$(wet weight(g) + 1) values.

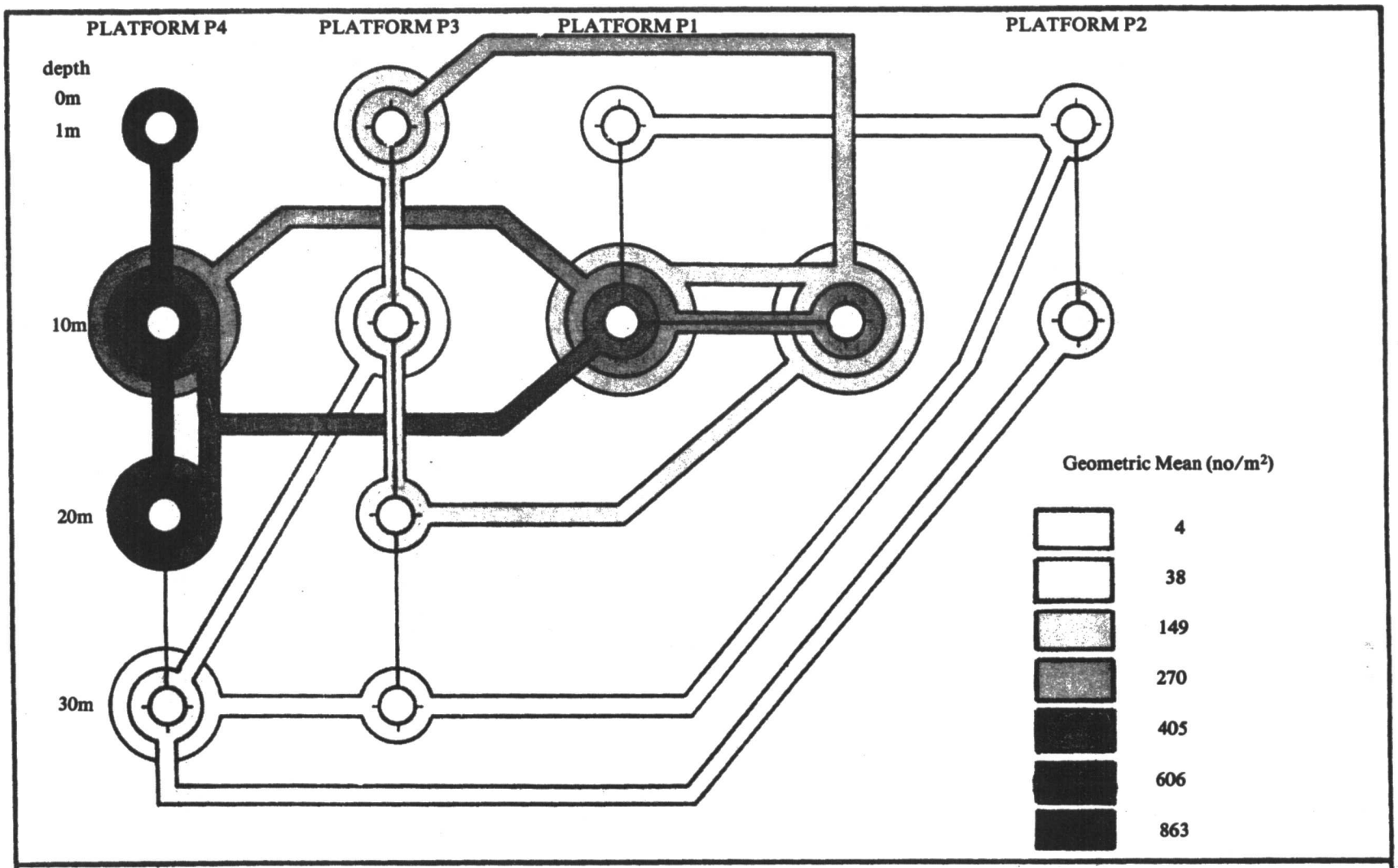

FIG C9. Distribution of *Chama macerophylla* by depth and platform as shown by results of Duncan's Multiple Range Test performed on $\log_e (n + 1)$ values.

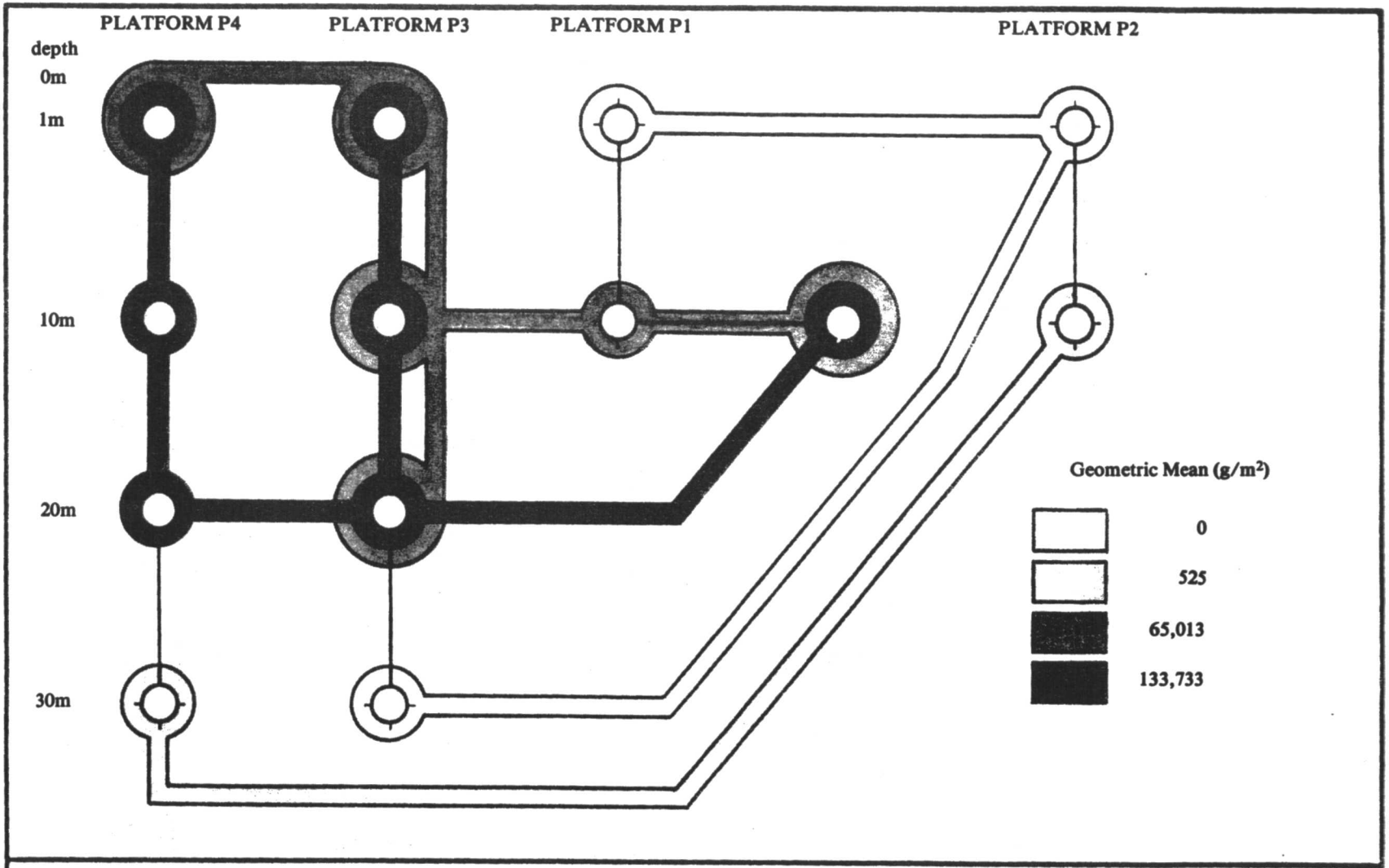

FIG C10. Distribution of *Chama macerophylla* by depth and platform as shown by results of Duncan's Multiple Range Test performed on $\log_e$ (wet weight(g) + 1) values.

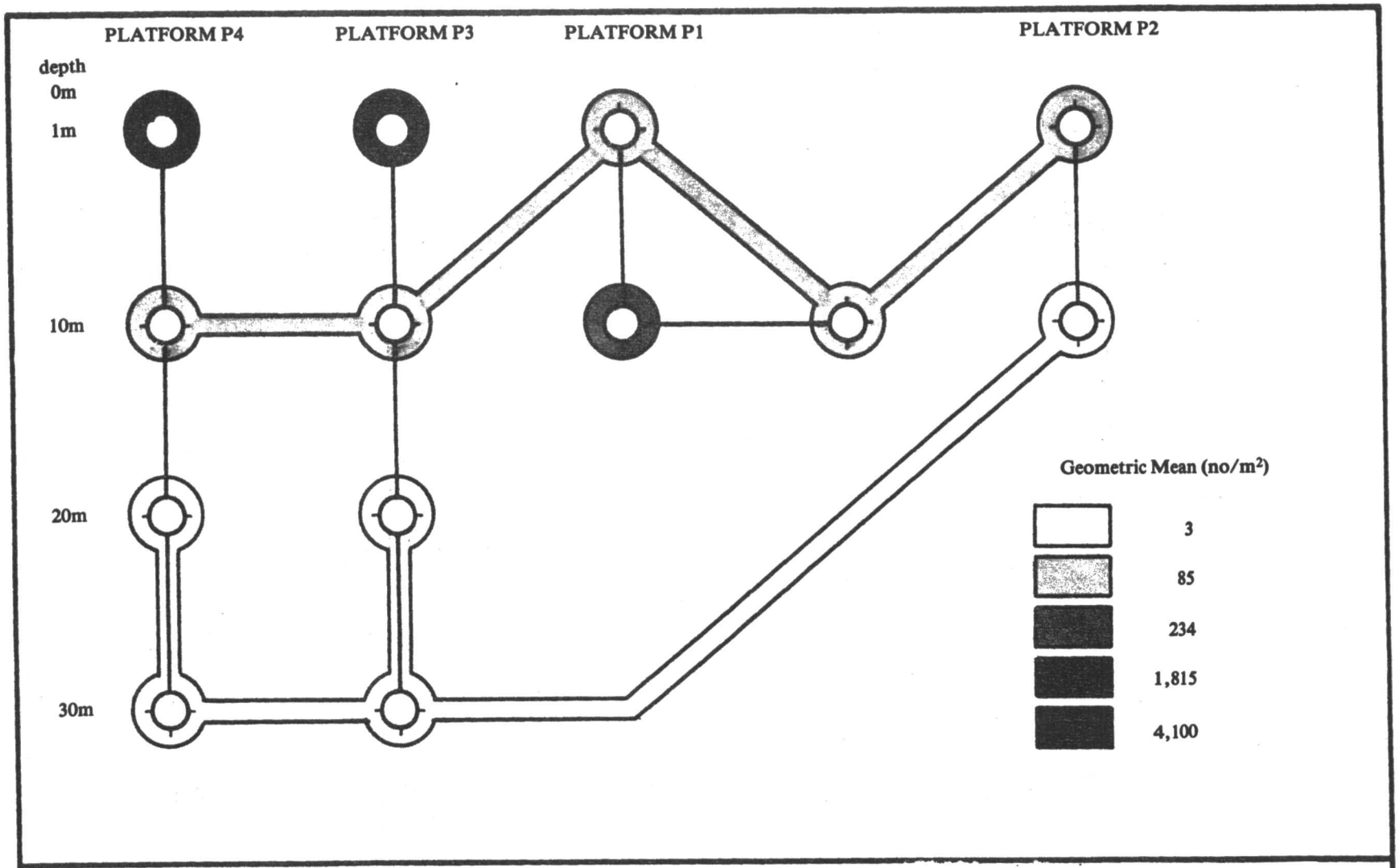

FIG C11. Distribution of *Isognomon bicolor* by depth and platform as shown by results of Duncan's Multiple Range Test performed on $\log_e (n + 1)$ values.

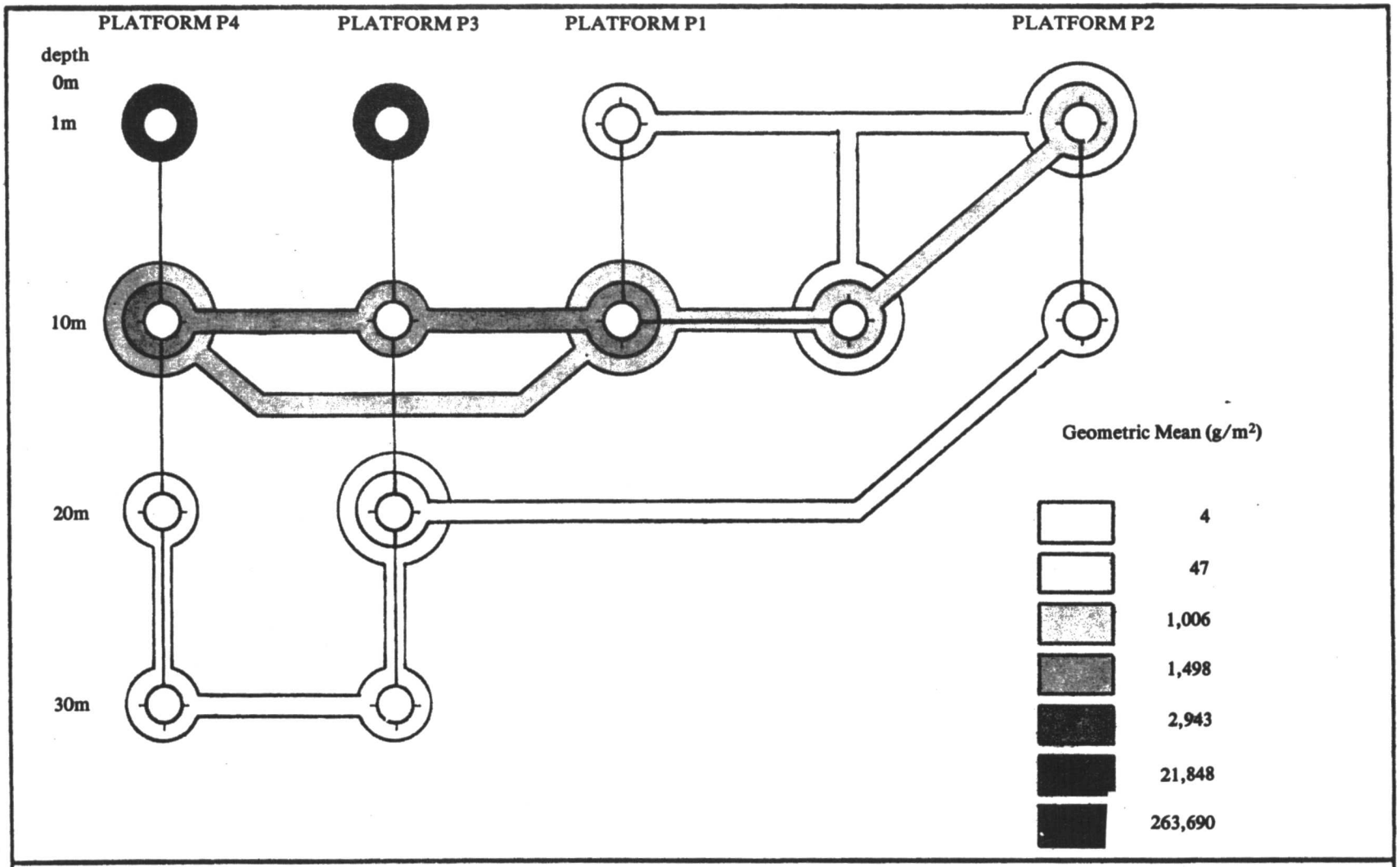

FIG C12. Distribution of *Isognomon bicolor* by depth and platform as shown by results of Duncan's Multiple Range Test performed on $\log_e$ (wet weight(g) + 1) values.

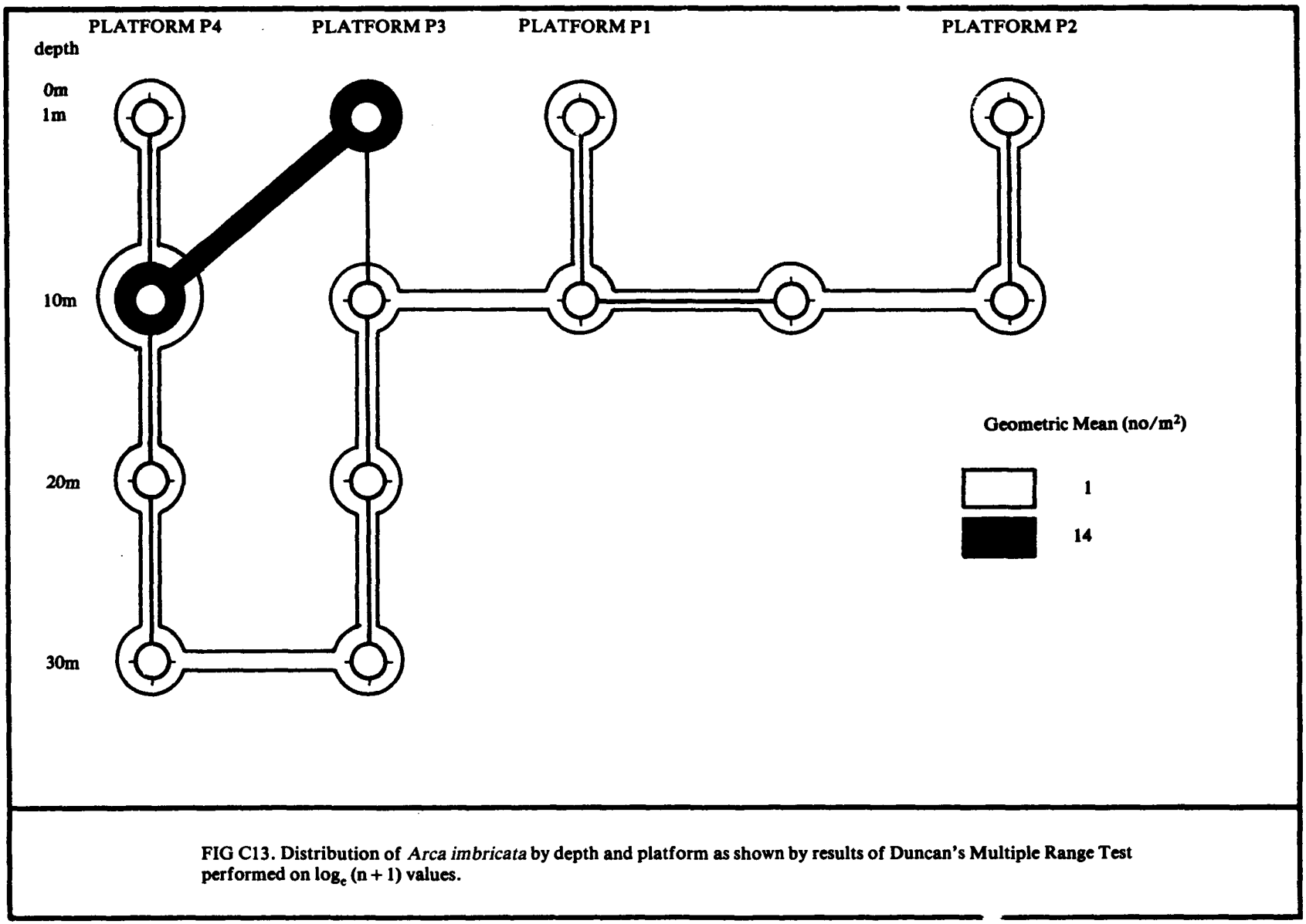

FIG C13. Distribution of *Arca imbricata* by depth and platform as shown by results of Duncan's Multiple Range Test performed on $\log_e (n + 1)$ values.

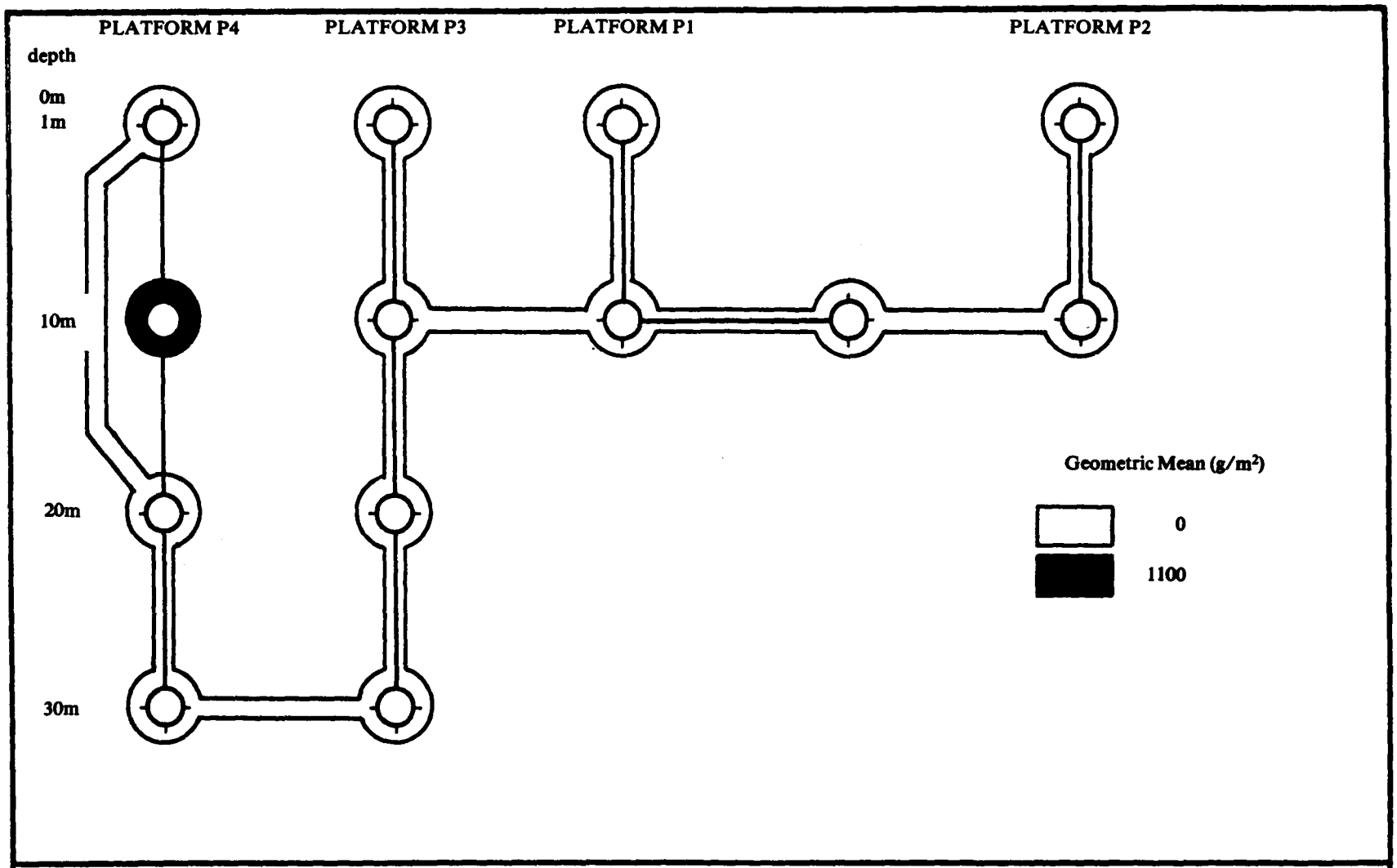

FIG C14. Distribution of *Arca imbricata* by depth and platform as shown by results of Duncan's Multiple Range Test performed on $\log_e$ (wet weight(g) + 1) values.

APPENDIX D
DISTRIBUTIONAL PATTERNS OF NUMERICALLY DOMINANT DISCRETE ORGANISMS

APPENDIX D. DISTRIBUTIONAL PATTERNS OF NUMERICALLY DOMINANT DISCRETE ORGANISMS.

PREFACE

In the following figures, results of Duncan's Multiple Range Test performed on loge (n + 1) transformed collection data were used as a basis for constructing graphs. The purpose of the graphs is to depict relative distribution of organisms among the platforms and depths sampled. On these graphs, each continuous, interconnected band of stations joined by a zone of equal tones constitutes a grouping or stratum of stations whose respective mean values for loge (n + 1) transformed data were not significantly different ($\alpha = 0.05$). The geometric mean of all station values within each stratum is depicted in the legend for each tone.

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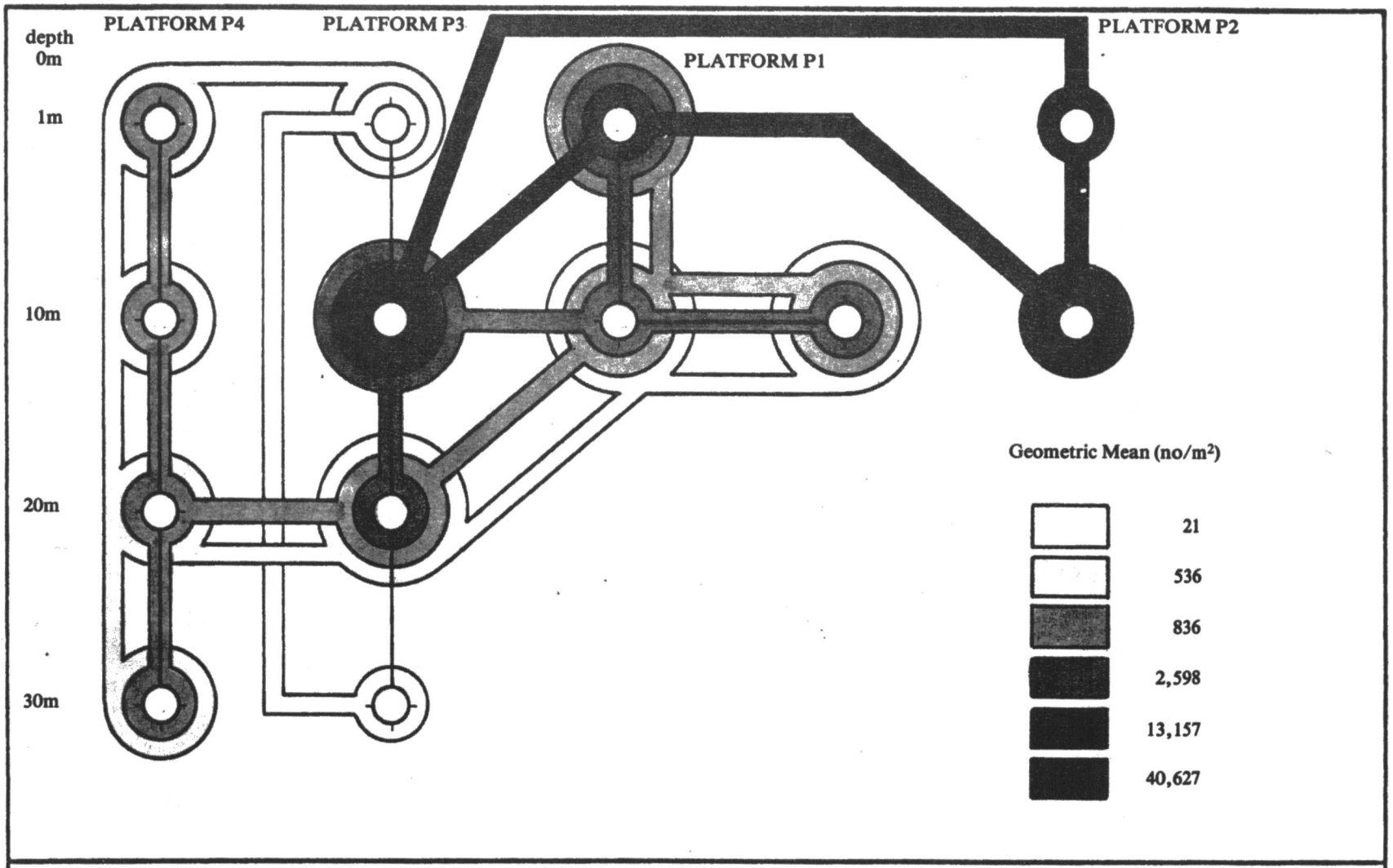

FIG D1. Distribution of actiniarians (solitary anemones) by depth and platform as shown by results of Duncan's Multiple Range Test performed on $\log_e (n + 1)$ values.

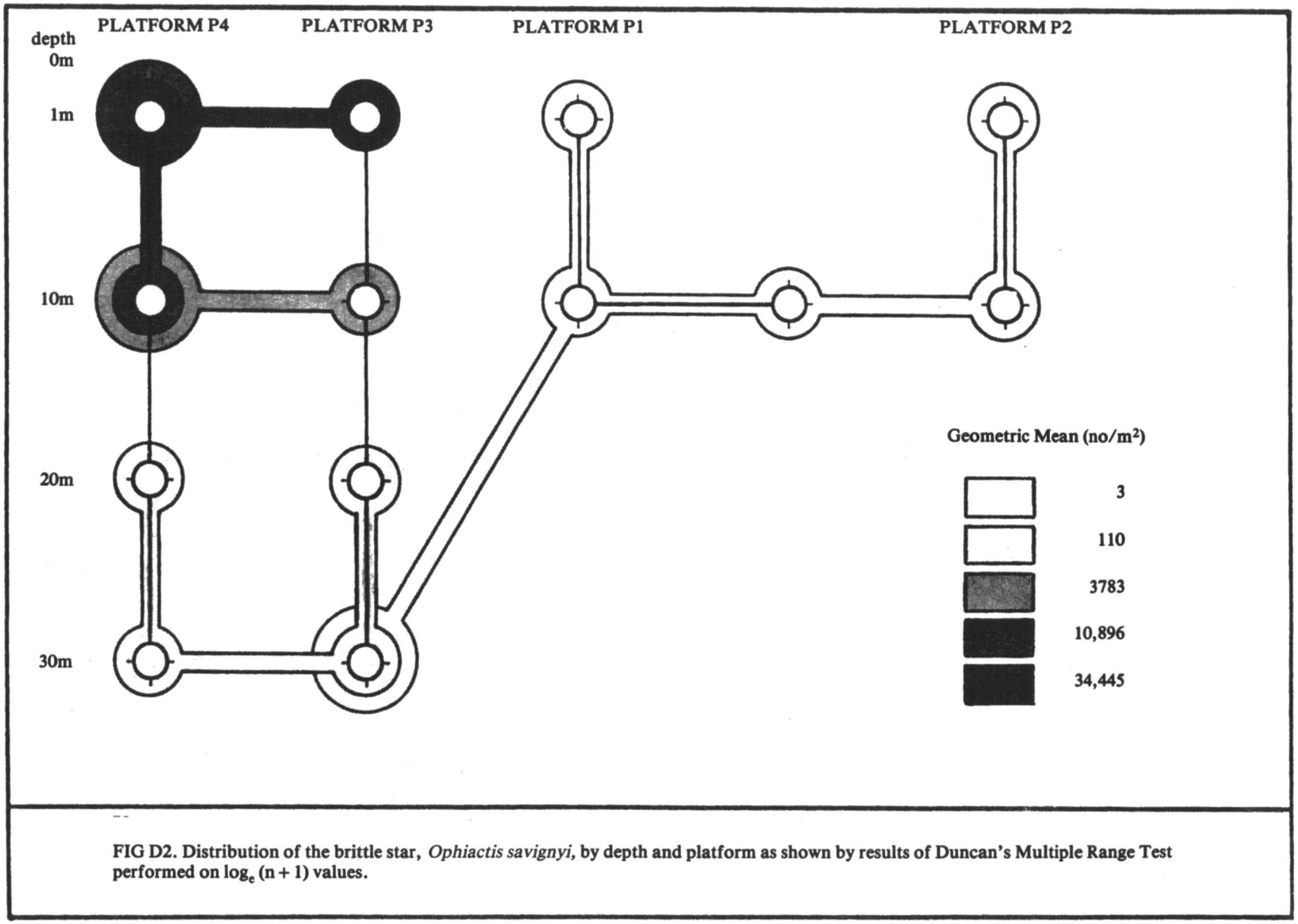

FIG D2. Distribution of the brittle star, *Ophiactis savignyi*, by depth and platform as shown by results of Duncan's Multiple Range Test performed on $\log_e (n + 1)$ values.

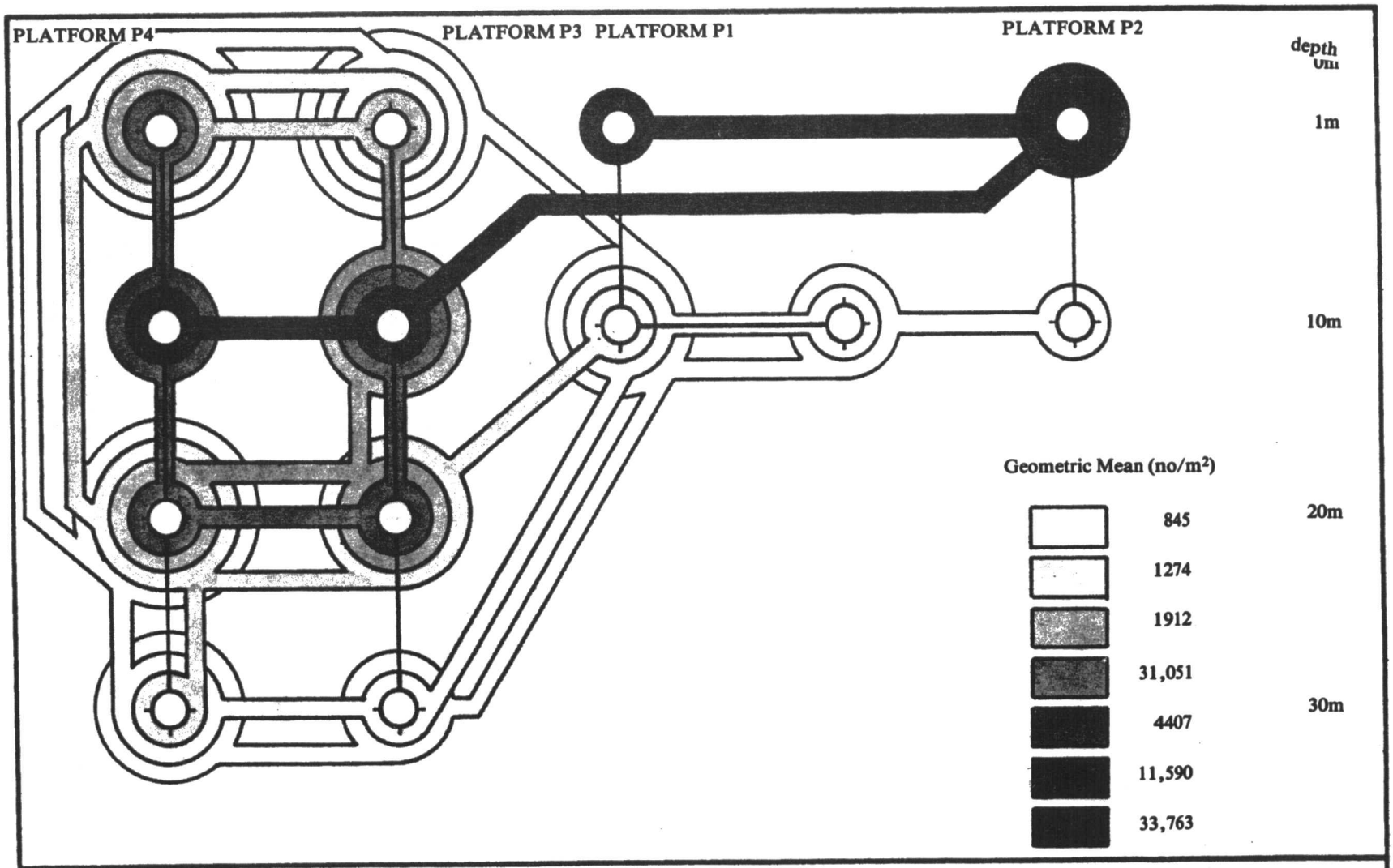

FIG D3. Distribution of the amphipod, *Stenothoe* sp., by depth and platform as shown by results of Duncan's Multiple Range Test performed on $\log_e (n + 1)$ values.

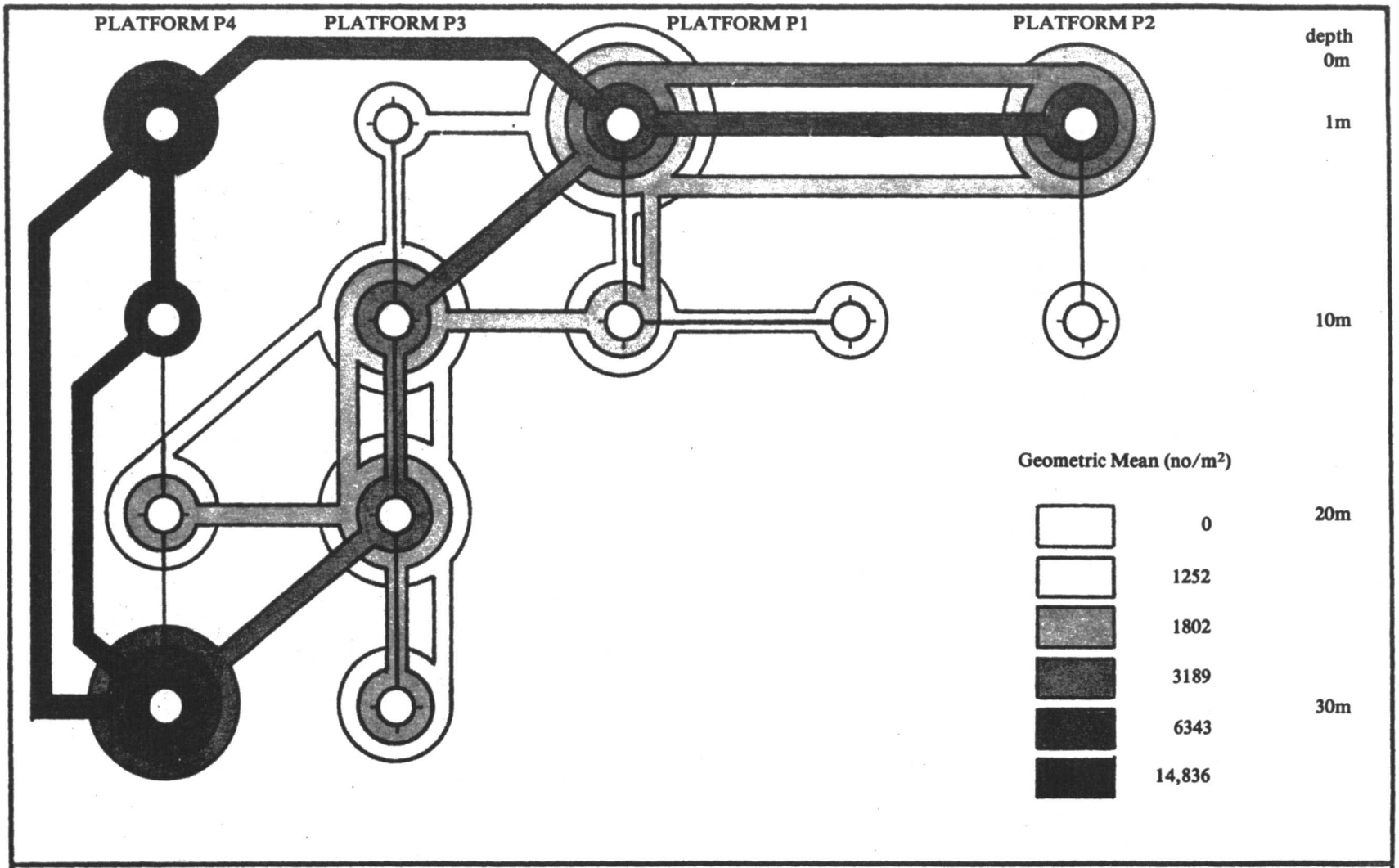

FIG D4. Distribution of the amphipod, *Caprella equilibra*, by depth and platform as shown by results of Duncan's Multiple Range Test performed on $\log_e (n + 1)$ values.

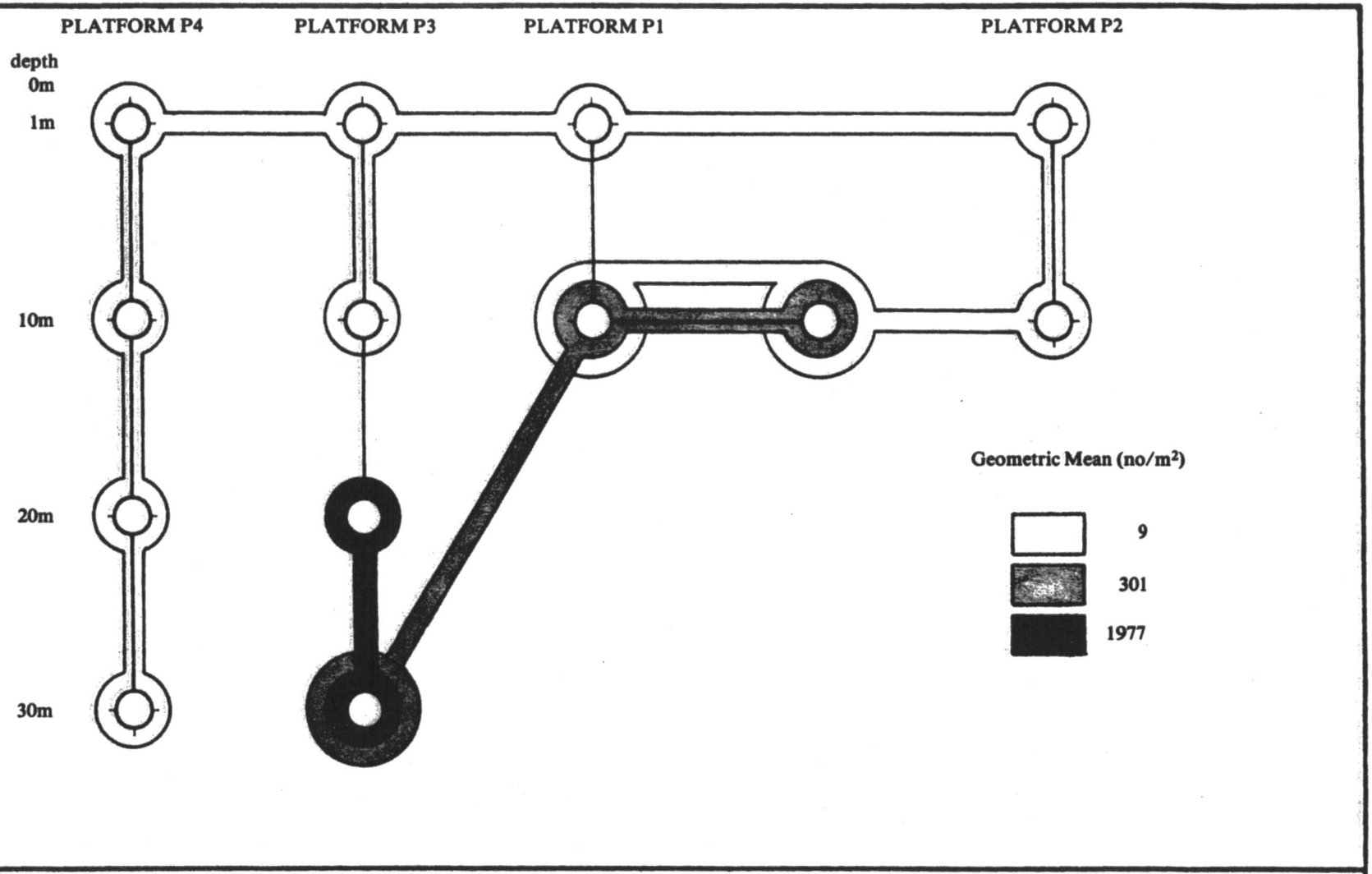

FIG D5. Distribution of the amphipod, *Paracaprella pusilla,* by depth and platform as shown by results of Duncan's Multiple Range Test performed on $\log_e (n + 1)$ values.

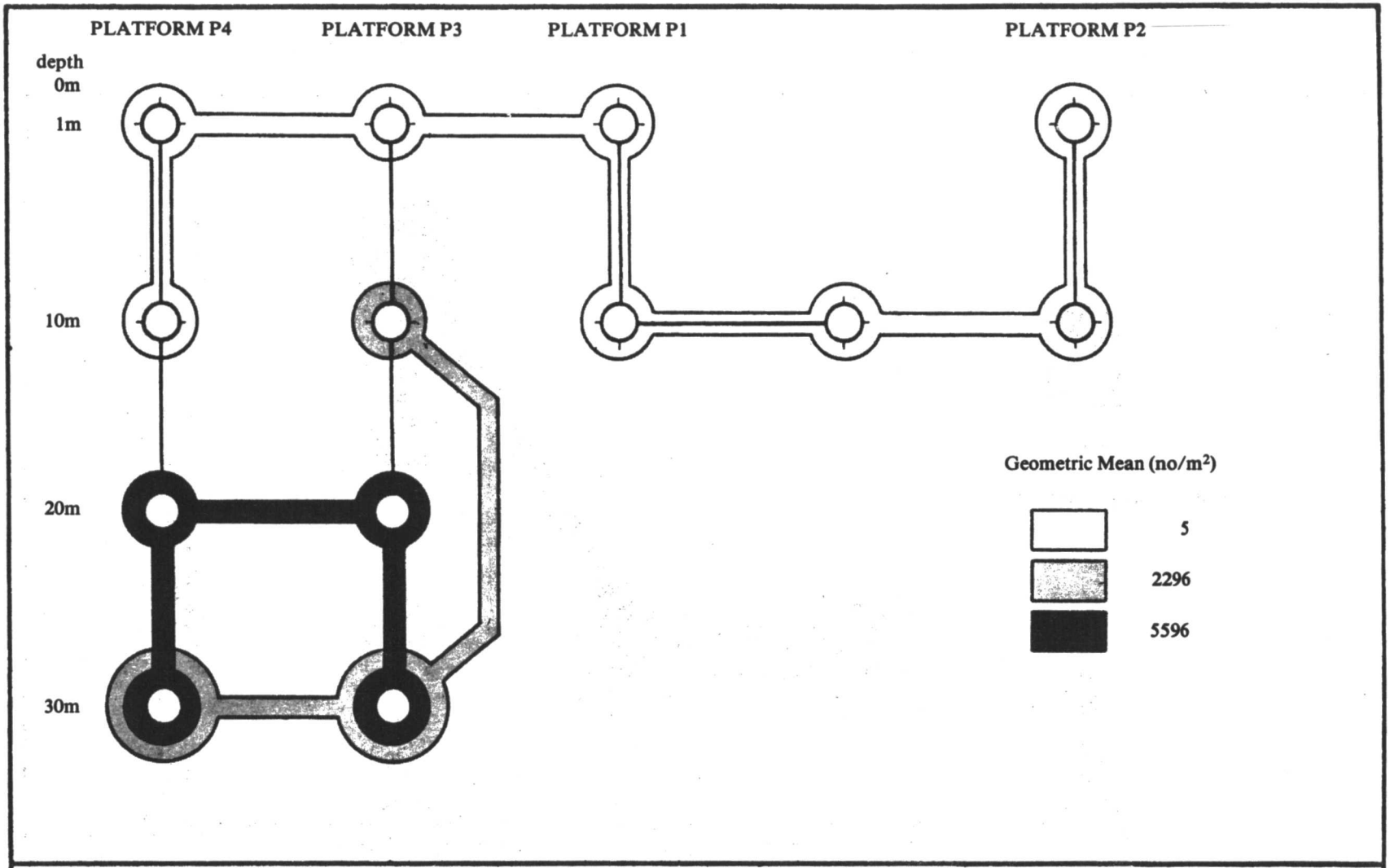

FIG D6. Distribution of the amphipod, *Ericthonius brasiliensis*, by depth and platform as shown by results of Duncan's Multiple Range Test performed on $\log_e (n + 1)$ values.

APPENDIX E
DISTRIBUTIONAL PATTERNS OF DOMINANT COLONIAL ORGANISMS

APPENDIX E. DISTRIBUTIONAL PATTERNS OF DOMINANT COLONIAL ORGANISMS.

PREFACE

In the following figures, results of Duncan's Multiple Range Test performed on square-root transformed collection data were used as a basis for constructing graphs. The purpose of the graphs is to depict relative distribution of organisms among the platforms and depths sampled. On these graphs each continuous, interconnected band of stations joined by a zone of equal tones constitutes a grouping or stratum of stations whose respective mean values for square-root transformed data were not significantly different ($\alpha = 0.05$). The squared mean of transformed values within each stratum is depicted in the legend for each tone.

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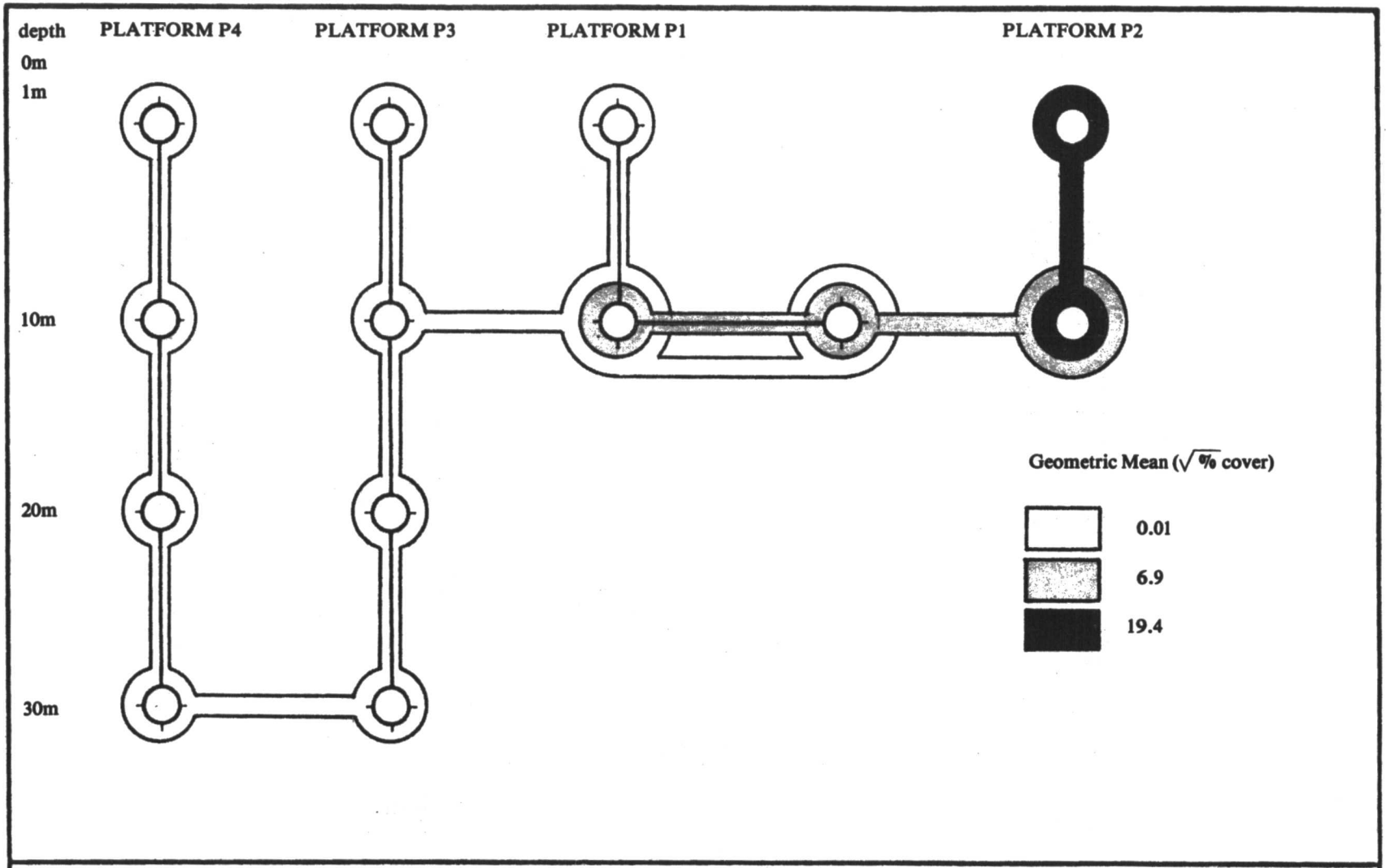

FIG E1. Distribution of the sponge, Clionidae, by depth and platform as shown by results of Duncan's Multiple Range Test d on the square root transformed percent cover data.

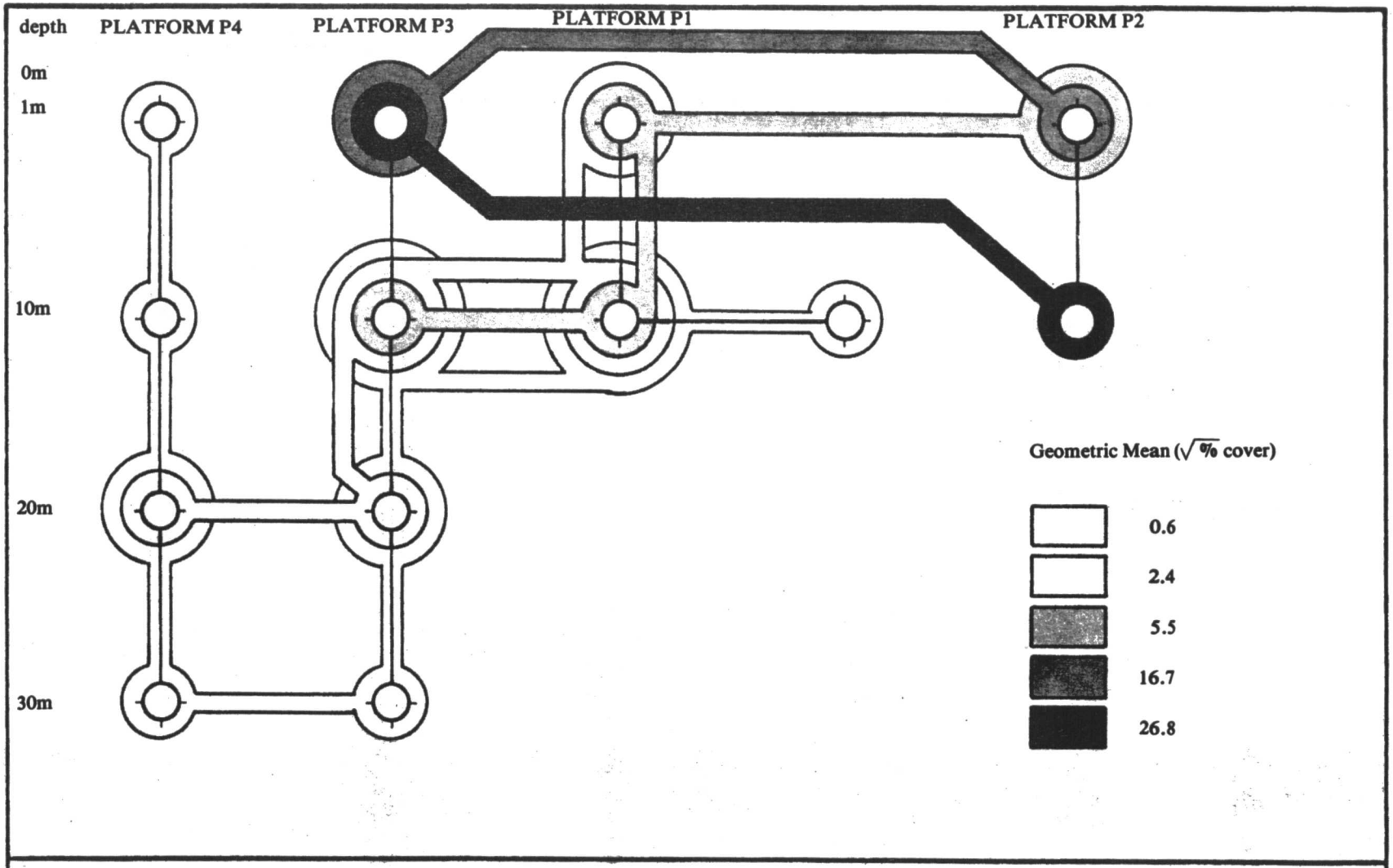

FIG E2. Distribution of the hydroid, *Obelia dichotoma*, by depth and platform as shown by results of Duncan's Multiple Range Test performed on the square root transformed percent cover data.

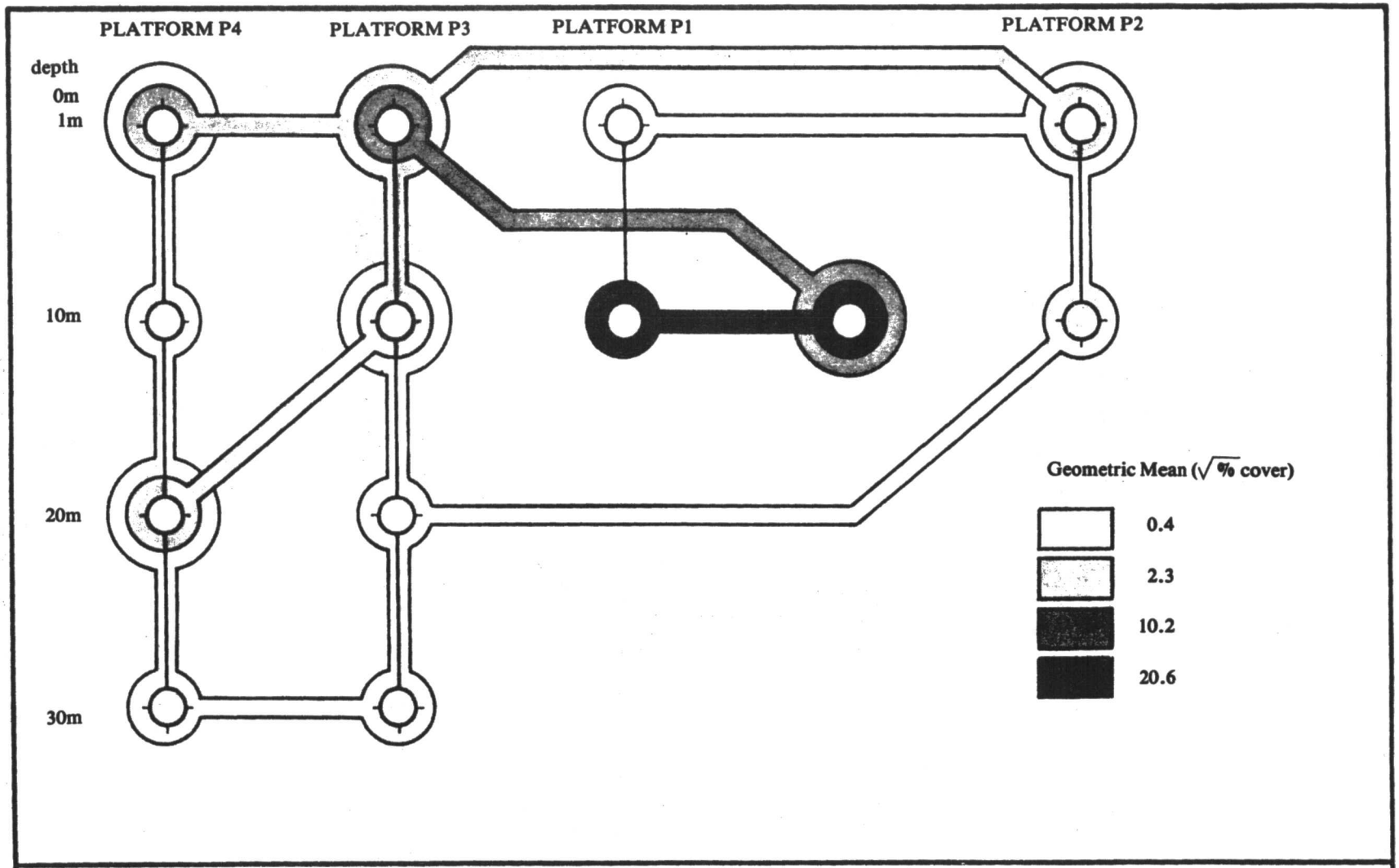

FIG E3. Distribution of the hydroid, *Turritopsis nutricula*, by depth and platform as shown by results of Duncan's Multiple Range Test performed on the square root transformed percent cover data.

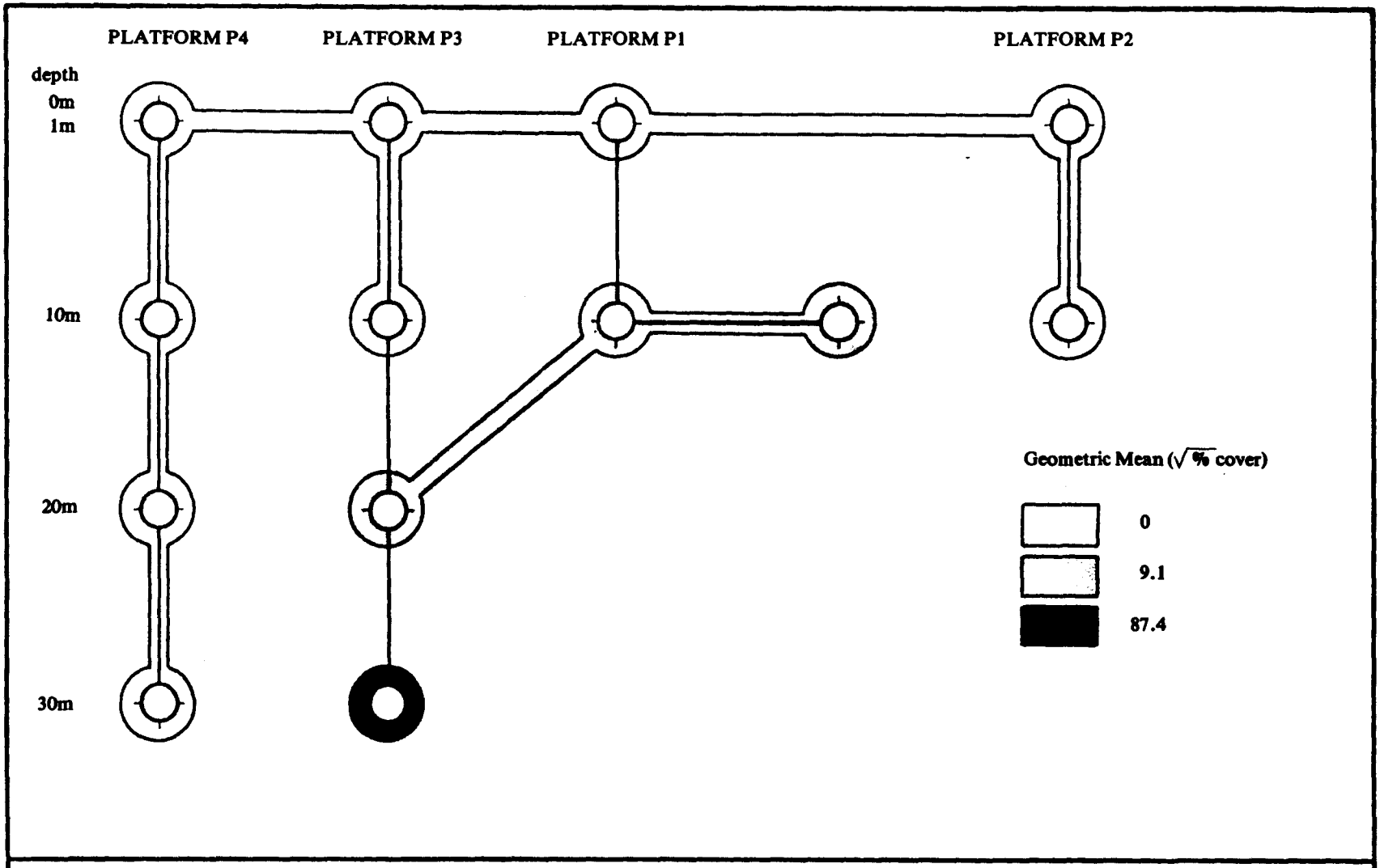

FIG E4. Distribution of the hydroid, *Eudendrium carneum*, by depth and platform as shown by results of Duncan's Multiple Range Test performed on the square root transformed percent cover data.

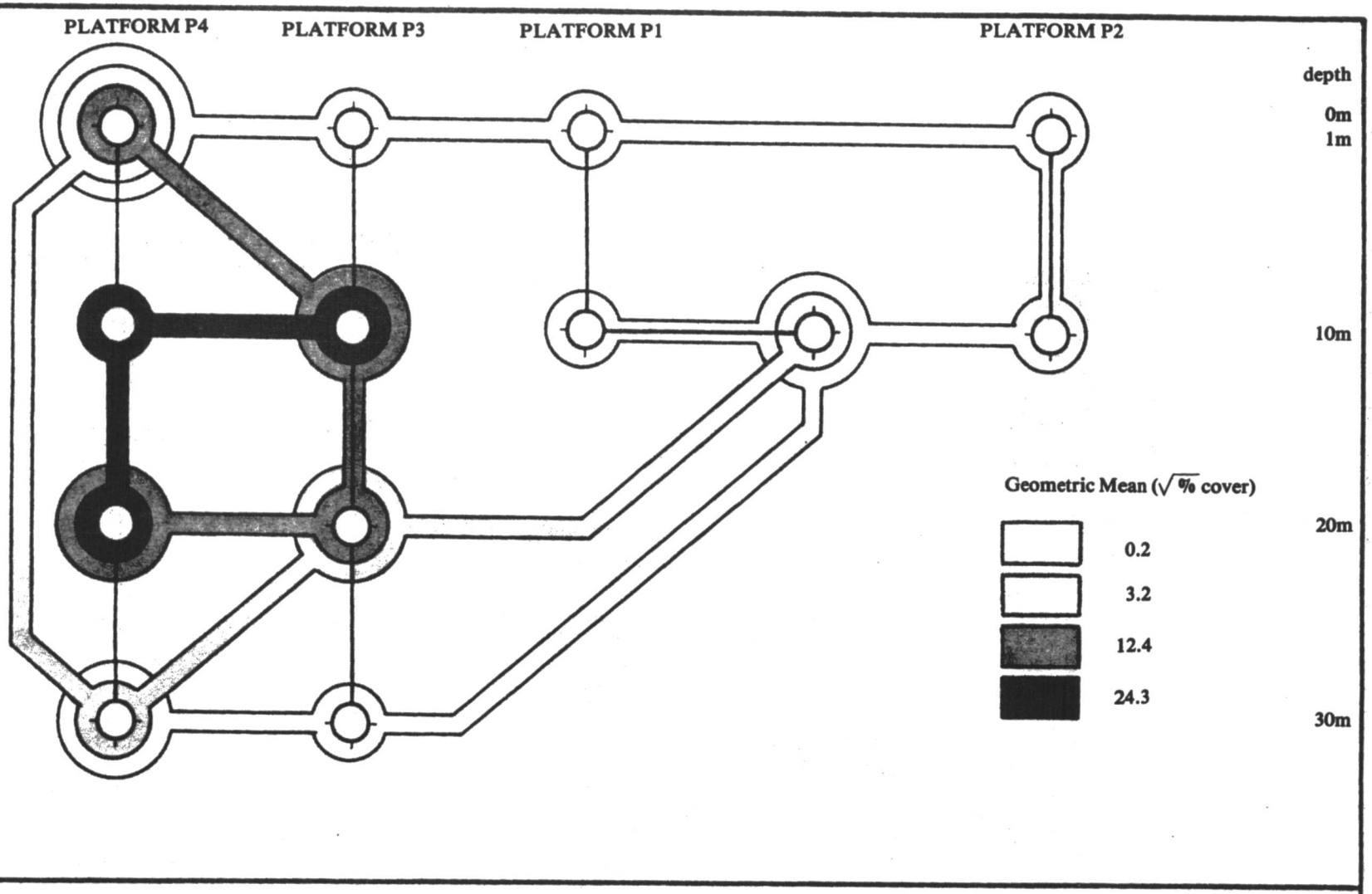

FIG E5. Distribution of the bryozoan, *Bugula neritina*, by depth and platform as shown by results of Duncan's Multiple Range Test performed on the square root transformed percent cover data.

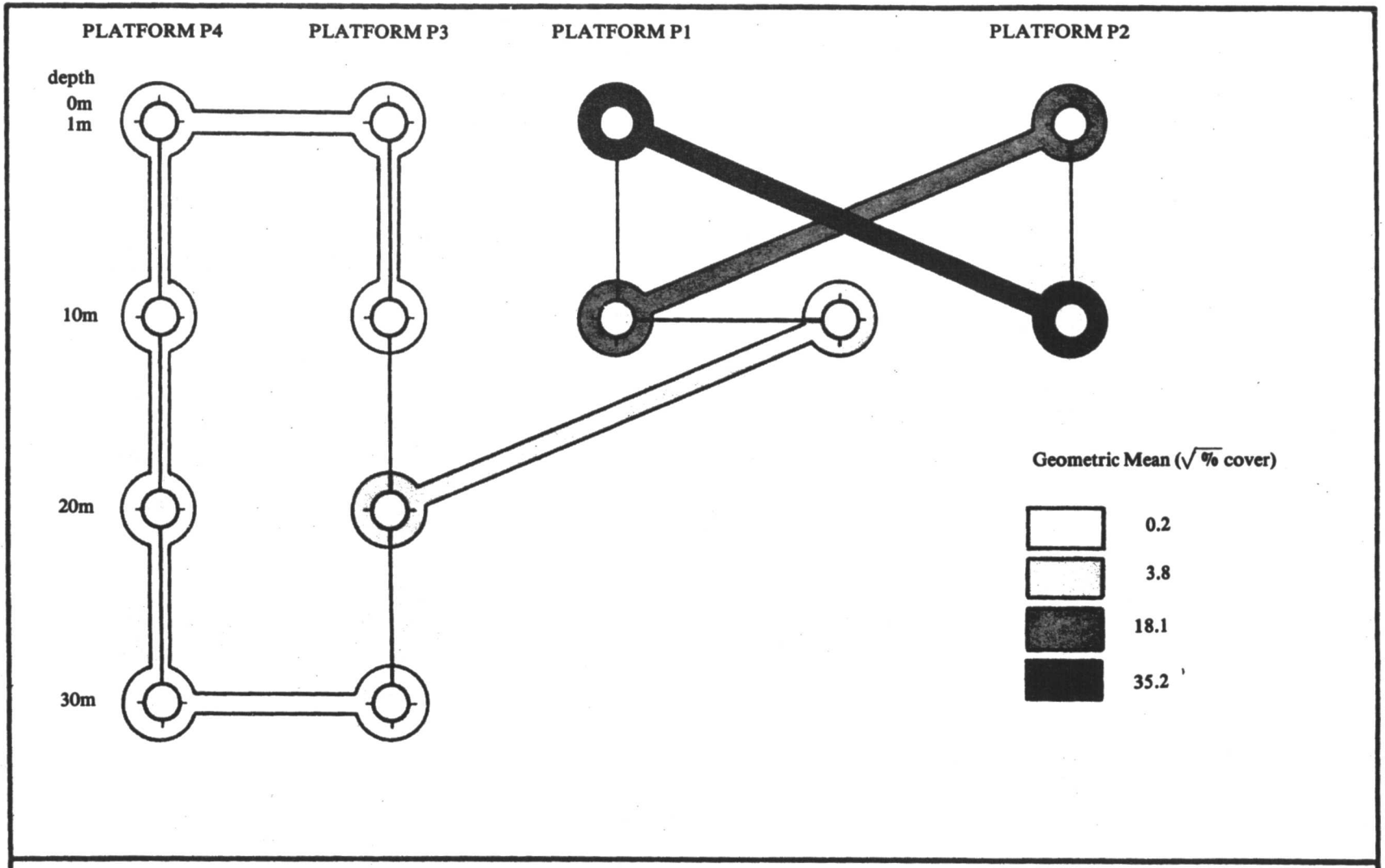

FIG E6. Distribution of the bryozoan, *Aeverrillia setigera*, by depth and platform as shown by results of Duncan's Multiple Range Test performed on the square root transformed percent cover data.

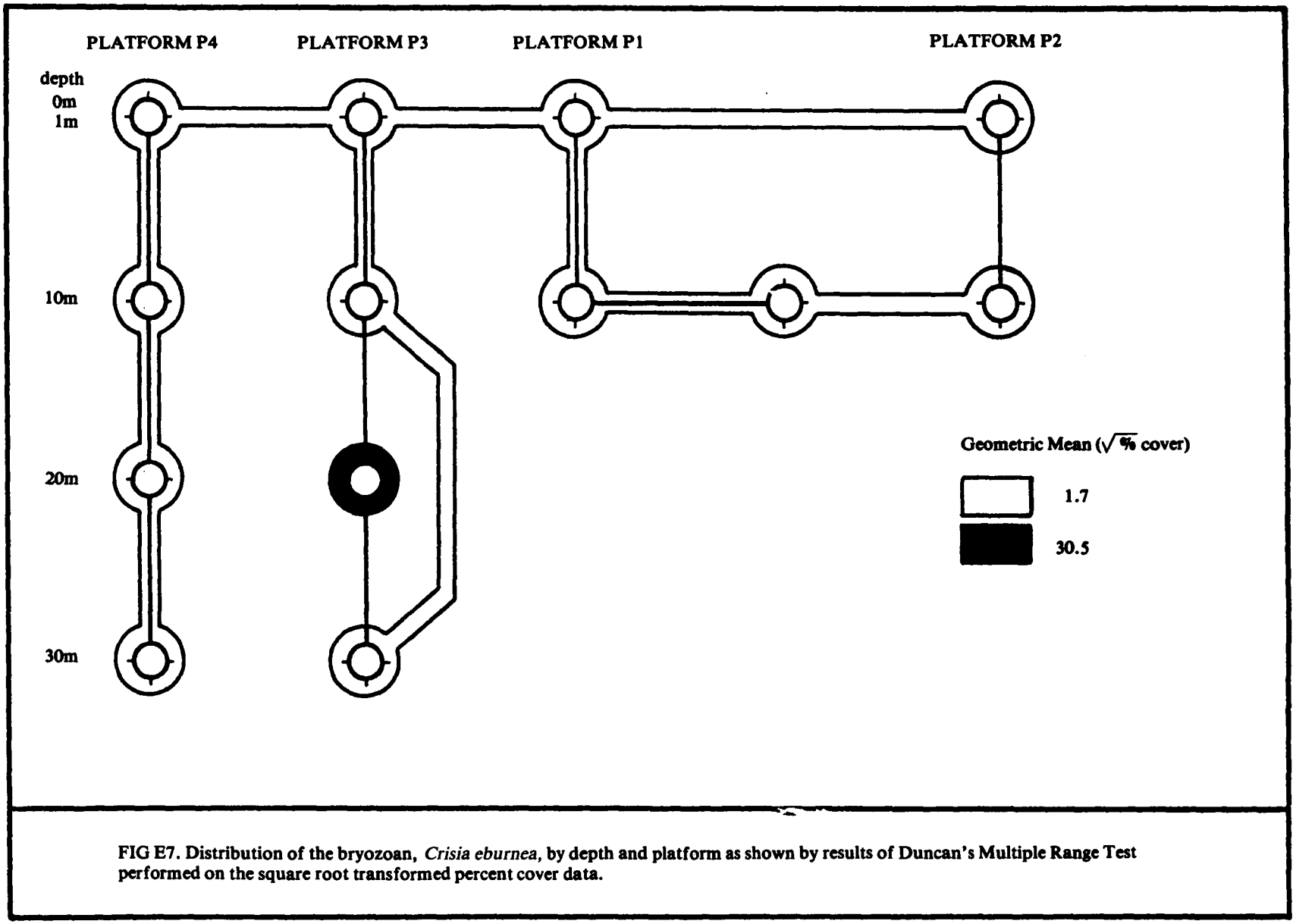

FIG E7. Distribution of the bryozoan, *Crisia eburnea*, by depth and platform as shown by results of Duncan's Multiple Range Test performed on the square root transformed percent cover data.

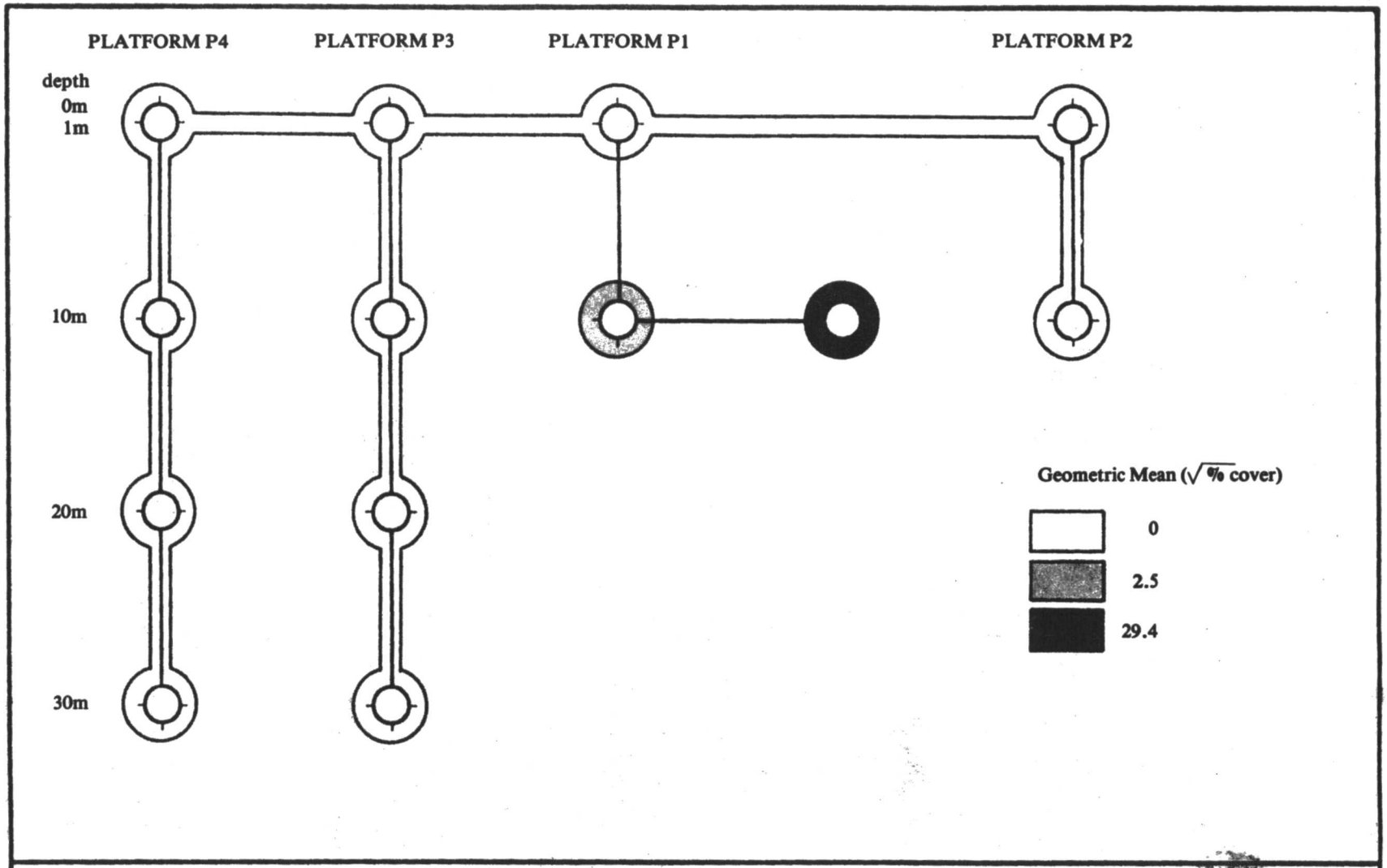

FIG E8. Distribution of the bryozoan, *Parasmittina spathulata*, by depth and platform as shown by results of Duncan's Multiple Range Test performed on the square root transformed percent cover data.

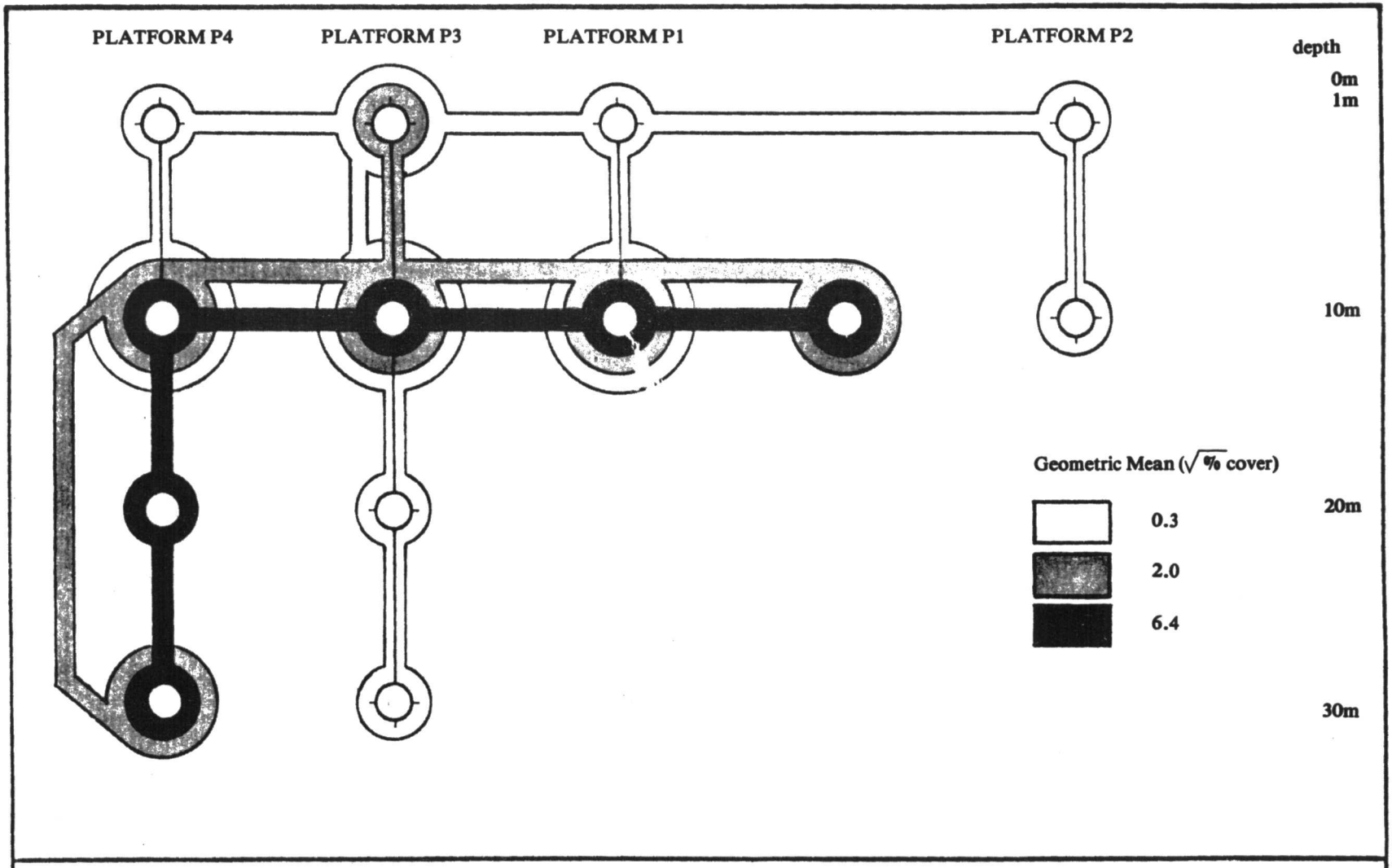

FIG E9. Distribution of the tunicate Ascidiacea 2, by depth and platform as shown by results of Duncan's Multiple Range Test performed on the square root transformed percent cover data.

The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

The Minerals Management Service Mission

As a bureau of the Department of the Interior, the Minerals Management Service's (MMS) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS), collect revenue from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues.

Moreover, in working to meet its responsibilities, the **Offshore Minerals Management Program** administers the OCS competitive leasing program and oversees the safe and environmentally sound exploration and production of our Nation's offshore natural gas, oil and other mineral resources. The MMS **Minerals Revenue Management** meets its responsibilities by ensuring the efficient, timely and accurate collection and disbursement of revenue from mineral leasing and production due to Indian tribes and allottees, States and the U.S. Treasury.

The MMS strives to fulfill its responsibilities through the general guiding principles of: (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending MMS assistance and expertise to economic development and environmental protection.