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CABO ROJO PLATFORM ENVIRONMENTAL STUDIES

Prepared for the Puerto Rico Water Resources Authority

By the Staff of Puerto Rico Nuclear Center of the

University of Puerto Rico

May 16, 1975

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CABO ROJO PLATFORM FNVIRONMENTAL STUDIES

by

E.D. Wood, M.J. Youngbluth, and P. Yoshioka

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PREFACE

This report stems from investigations carried on by

the Puerto Rico Nuclear Center. The studies were designed to provide data upon which to judge the suitability of a site for the construction of power generating facilities and to allow the determination of the impact of such construction and operation upon the environment.

?The report represents the combined effort of the scientists, technicians and support staff of the Site Selection Survey Project.

?The authors who contributed to the Cabo Rojo Platform

Site Selection Survey are:

E.D. Wood, Project Leader Physical, Chemical and

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1.1 INTRODUCTION

The Puerto Rico Nuclear Center of the University of Puerto Rico has been under contract to the Puerto Rico Water Resources Authority since 1972 to conduct site se- Jection surveys and environmental research studies of seven coastal sites. Experience gained from these investigations will add to the knowledge about these areas, and provide useful data which will aid in the assessment of the desira- bility and practicability of locating power generating plants on one or more of these sites:

Puerto Rico Nuclear Center scientists have studied the physical, chemical and geological parameters of the sites, and the ecological parameters of zooplankton, benthic invertebrate and fish communities. Plant associations, except for the Cabo Rojo Platform site, have been included.

The sites chosen for study were: Tortuguero Bay, Punta Manati, Punta Higuero, Cabo Rojo Platform, Punta Verraco, and?Cabo Mala Pascua (see Figure 1.1-Fi). The seventh site, Barrio Islote, was studied and reported under a separate contract.

The first of these reports is entitled, "Tortuguero Bay Environmental Studies" and is dated April 1,"1975. second report, dated April 15, 1975, is entitled, ?Punta Manati En- Vironméntal Studies." "The third report, entitled "Punta Higuero Environmental Studies" is dated?May 1, 1975. Previous Studies of Punta Higuero, also referred to as'"Rincon? oF ?the BONUS site," have been reported in "Punta Higuero Power Plant Environmental Studies 1973-1974" (Wood et al., 1974).

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2a PHYSICAL AND CHEMICAL PARAMETERS

?AT CABO ROJO PLATFORM

by

B.D. Wood

2.1.1 INTRODUCTION

Most of the physical, chemical and geological measurements at the Cabo Rojo Platform site were made at

or near the stations shown in Figure 2.1-Fl. The transects were spaced at one nautical mile with the "A" stations located as near to shore as it was safe to sample with the RMW-R.F, Palunbo. The "B" stations were located on a north-south line which passed through the center of the two basins on the Platform. One "C" station was located in a channel on the seaward side of the south basin. The sample depths for the stations were: "A" - 0, Sm; "BY - 0, 10m; "C" = 0, (5), 10, (15) and 20m,

2.1.2. TIDES

Tides that affect the Cabo Rojo Platform originate in the North Atlantic Ocean. The tides for Puerto Real, located on the east-central border of the Platform, (Figure 2.1-F1) are predicted by the National Ocean Survey? (1972). ?The tides are semi-diurnal with an average diurnal excursion of 30 cm and a mean tide level of 12 cm. The tides for the period of current measurements on the Cabo Rojo Platform are plotted in Figure 2.1-F2. An example of the tides plotted over a lunar cycle is shown in Punta Higuero Environmental Studies (Wood et al., 1975)

2.1.3. CURRENTS

The Cabo Rojo Platform site is part of a broad shallow shelf off the southern half of the west end of Puerto Rico. The shelf edge extends sone 25 kilometers seaward due west of the north basin of the site. The shelf edge is about 10 kilometers from the southern basin at its closest point.

The shelf edge extends along a northwest-southwest line off the southwest corner of the island.

?The open sea currents of the Caribbean flow generally to the west along the south coast then turn to the northwest around Cabo Rojo following the shelf contour lines. This flow is affected by wind and tide.

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1-71 Gabo Xojo Platform site with depth contour Lines and one to three liyérographie

vampLing stations on each of ine transects.

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PLATFORM.

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Tide Level

Fig. 2.4-F2 Tides on the platform predicted for Puerto Real, Janvary 15-17, 1974,

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There appears to be a laree gyre or back eddy over

the Platform which is strongly modified by wind and tides

This back eddy brings water shoreward to the vicinity of

Mayaguez, where it divides, flowing north and south. The

southern? flow forces the plume of the Cuanajibo River south

around Punta Guanajibo through bramadero Bay, past Punta

Arenas and finally seaward between Puerto Real and Soqueron

Bay. Currents over the reefs are quite strong at times, in

excess of 50 cm/sec (ca one knot). This current pattern

contributes much fine terrestrially-derived sediment to the

eastern portion of the basins, especially the northern basin.

This general description is based on the work done by the author in the Puerto Rico Nuclear Center's Marine Biology Program and numerous observations in the course Of PRWRA work,

The currents at the site wore measured during the period 0745 January 16, 1974 to 1000 January 17, 1994 at

four depths near Station CRP-4C. The weather was exceptionally galm during this period with the highest wind velocity only

8 m/sec (ca 6 knots) from the southeast in the early morning (Jan. 16) shifting to northeast for the rest of the mornings then from the northwest near noon and from the south in the afternoon. The sca surface was glassy calm the morning of January 17, 1974,

?The currents were measured using General Oceanic film recording inclination meters. The data were computerized, averaged and plotted for each depth. The plots are in three forms: 1) direction and velocity versus time (Appendix 2.1A)

2) a progressive vector (Figure 2.1-F9 and 3) a "current rose" (Figure 2.1-F4).

The top current meter in the string of four was just beneath the surface (ca lm). It indicated the highest currents of about 20 cm/sec to the northeast during the last of the falling tide, low tide and the beginning of the rising tide. This was against the prevailing wind. The surface currents were generally to the southwest during the evening with velocities of about 10 cm/sec. Currents were light and variable during the night flowing io the southwest in the morning hours of January 17, 1974 at about 15 cm/sec.

The currents at the deeper meters generally followed the surface current during the day of January 16. The 7 meter depth showed more variation in the direction after 1400 January 16, but wenerally the flow was to the southwest

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Fig. 2.1-F3 Progressive vectors for currents at Stations CRP-AC, Jan, 16-17, 1974

---Page Break---

Fig. 24-FS Offeet bottas profiles along the sampling transects on the Cabo Rofo

Platform. ?Vertical Lines indicate relative positions of hydrographic stat fons

CABO_ROJO

PLATFORM,

VERTICAL EXAGGERATION: 673

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2.1.5 TEMPERATURE, SALINITY AND DENSITY

The physical parameters of temperature and salinity were measured at the Cabo Rojo Platform on five cruises covering four seasons (Table 2.1-T1),

TABLE 2.1-T1 Schedule of hydrographic ervices to Cabo Rojo Platform.

Sa NEnREneeeeeeee

wiNrER SPRING SUMMER PALL

ee

PA-035

1973 - - 9/2/73, -

PA-036 PA-o80 PA-Ob7 ??_a-052

1974 4/16/74 8/2 8/27/18 13/15/74

SSS

The hydrographic sampling stations are shown in Figure 2.1-F1. The coordinates of the stations ?and hydro-graphic data are in the "Hydrographic Data Report Nest Coast Of Puerto Rico? (Wood and Asencio, 1975), Nine transects Were sampled on each cruise. The'deepest sample was taken from 20 meters at Station CRP-4C, The "A" stations were sampled at 0 and 5 meters and the "S" stations at 0 and 10 meters. The sampling, analytical and data processing procedures are described?in "A Manual for Hydrographic Cruises? (Wood 1975).

perature

Temperatures were measured using deep sea reversing thermometers, accurate to better than + 0.05°C.. The thermoReters were used in pairs or three at @ tine. Although usually only one temperature is shown in the data for each depth, these values are often the average of two or three thermometer readings.

Averaged temperature depth profiles are shown plotted by type of station and by season along with other hydro. graphic parameters in Figures 2.1-F6 and F7.. The temperature profiles are flanked by dashed lines in most cases

to indicate the range of temperatures found.

Temperatures were highest in the summer with the

Sgpgenber 1973 sampling registering temperatures of over

29°C. These were the highest temperatures measured at any

of the sites and they are due to the water being shallow

and protected. The lowest temperatures were measured in

a

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Pig. 204-76 Averaged hydrographic paranaters (temperature, TCs salinity» $°/003

density, #; afssolved oxygen, Opi ane reactive phosphate, Pog) va

andafd depth in peters for the-winter and spring evesone of 197%

fon the Cabo Rofo Platform

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Fig. 2.A-F7 Averaged hydrographic paraneters vs. standard depth fn meters for the

sumer (1973 and 1974) and fall (1974) svazone on the Case Rojo Pat orm.

Dastied Lines show the range of the tenperatunee.

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January 1974 (~25.5°C). Figure 2.1-F8 shows the distri-

bution of temperatures along the iine of the "B" stations.

The dashed lines indicate the average for the quartor sampled.

?The winter and spring samplings show very little spread or trend in the temperatures with distance along the "B" line. However, the plots for other seasons show generally lower Eemperatures at the southern edge of the south basin and . higher temperatures in the north basin, Low temperatures Were found opposite Boqueron Ray in the fall season of 1974 which probably reflects run-off from the lowlands of south eastern Puerto Rico through Boqueron Say. Temperature profiles (Figures 2.1-F6 and F7) show that the water is fairly well mixed with very weak gradients usually cooling with depth except that during the fall at the "C" station the water column warned with depth. Temperatures increased with distance from shore in the winter and summer but showed little or no trend during the spring and fall seasons.

Salinity

Salinities for the Cabo Rojo Platform "B" stations are shown plotted by season in Figure 2.1-F9. The averages are indicated by dashed lines. Averages are also plotted with other hydrographic parameters by season in Figures 3, loFe and F7. The highest salinities (~35.85"/oo) were found in the spring and the lowest in the fall season (+33. 75" /00) .

Salinities for the spring and summer seasons show little variation fron their respective averages. Sone trends are seen with distance. Salinities generally decreased from south to north in the spring of 1974 with the opposite trend seen in the late summer of 1973. Low salinity anomalies such as those found at Station 38, fail of 1974, and Station 5B, summer of 1974, were accompanied by low temperature anomalies for the corresponding measurements (Figure 2.1-F8). A sharp difference in salinity was seen between the south and north basins in the winter of 1974, Lower salinities were noticed in September 1973 than in August 1974 probably reflecting the effects of the sunner-fall rainy season. Salinity profiles in Figures 2.1-F6 and F7 showed little or no gradient for the spring and summer seasons. The highest gradient occurred during the fall season in all types of stations and at the "C? station in the winter season. Salinity gradients with distance from shore reflected the seasons, that is, they were positive during the fall (rainy) and?negative during the Sumner (end of dry season).

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Fig. 24-78

Cabo Rojo Platform "B" Stations

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Surface tenperatures plotted by "B" stations for each of the five

sampling trips. Dashed Lines indicate the averige temperatune.

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Cabo Rojo Platform

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ty values vs.

cate average salinities.

Y" Stations

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'BY stations for the five cruises.

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Density,

The stability of the water column is a function of the density gradient. Density,/ is a function of temperature and salinity (pressure i8(significant only at great depths) and always increases with depth in a stable water column. Density is usually converted for convenience to an expression, signa-t, 4

fa(ft- 1) x 10. any

Small changes in sigma-t with depth indicate a well mixed or unstable zone, whereas a high gradient is indicative of a very stable region of the water column

The average density is plotted by station for the four seasons in Figures 2.1-F6 and F7 with other hydrographic parameters, The density increased from fall through winter to spring as the salinity increased, then decreased through summer to fall as the salinity decreased and temperature increased (through summer). The density, as indicated by signa-t, was nearly uniform with depth having only a slight positive gradient, except for the fall season nearshore

("A" stations). Yost density anomalies coincided with major changes in salinity as the temperature changed little with depth.

There were two seasons where density gradients with respect to distance from shore existed. A negative gradient was detected in the summer with more saline water nearshore and a positive gradient in the winter from the low salinity run-off from the land.

2.2 CHEMISTRY

2.2.1 DISSOLVED OXYGEN

The amount of dissolved oxygen in the waters of the Cabo Rojo Platform was determined by the Winkler titration method described by Strickland and Parsons (1968). The samples were titrated within a few hours after being sampled. The values are usually good to better than + 1% although an occasional value seems to deviate somewhat from the norm. The data are reported by Wood and Asencio (1975). The averaged data are plotted in Figures 2.1-F6 and F7,

AlL of the oxygen values are near saturation for all Seasons with little or no gradient with depth or distance from shore. The discharges from the Guanajibo River to the north and Boqueron Bay to the south are the only significant

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sources of biological oxygen demand. They do not appear to be sufficiently large enough to make an impression upon the oxygen levels of the Cabo Rojo Platform because of the constant mixing and flushing.

2.2.2 NUTRIENTS

Nutrients are important from two aspects. First, nutrients are generally low in the tropical Atlantic Ocean

and Caribbean Sea, limiting primary productivity. Second, the discharge of wastes from agricultural, municipal or industrial sources may contain such high nutrient levels

that they cause eutrophication and local ecological degradation.

Reactive phosphate can be determined quickly and accurately with the Murphy and Riley molybdate complex method (Strickland and Parsons, 1968) and is a good indicator of pollution. Only linited nitrate analysis has been performed on the waters of the Cabo Rojo Platform because there exists a good relationship between phosphate, POg, and nitrate, NOs, in the open ocean (1:14) (except that ?nitrate is somewhat deficient in the tropical and sub-tropical Atlantic Ocean surface waters). Reactive silica is usually not regarded as a problem from a pollutant aspect.

Reactive Phosphate

Samples for reactive phosphate were frozen soon after sampling and returned to the laboratory for analyses. The phosphate values are given in the Hydrographic Data Report

West Coast of Puerto Rico (Wood and Asencio, 1975) and the

averages plotted in Figures 2.1-F6 and F7.

Phosphate levels are low over most of the Platform for all seasons (~0.05 ug-at, P/1) with the highest values being at "A" stations in the fall (rainy) season. The only distance gradient noticed vas during the fat! when an inverse relationship of phosphate and salinity occurred with distance from shore. That is, it appeared that the phosphate coincided with terrestrial run-off.

Nitrate

A limited number of nitrate samples were analyzed for the Cabo Rojo Platform during the fall 1974 season only.

The data are too spotty to establish trends. The values were all less than 2 ug-at. N/1 with the higher values nearshore.

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5.1 GEOLOGICAL PARAMETERS ON THE CABO ROJO PLATFORM

by

E.D. Wood

The Cabo Rojo Platform is composed mainly of calcium carbonate in the form of sand shelf and coral fragments or coral formations. The nearshore sediments are principally non-carbonate, terrestrially derived.

A series of grab samples were taken at the "? stations and at Station 4C (Figure 2.1-F1) and analyzed by sieving for size. ?The histograms and cumulative weight per-gent plots are shown in Figures 3.1-F1 through Fé, The larger sediment sizes (phivequal ?1 to +1) were mainly. shell fragments. The fine material (90-951) is finer than phi equal one (<0.5 mm) with the mean phi equal to about 3\¢ (0.125 mn). ?The histogram plots for the Stations at the north and south basin boundries were poorly sorted (4s2.0 4) with significant Sediment fractions larger than 1-0 mm.

The largest mean in the center of the north basin was jn3.3 + 0.9 at Station 8A. The south basin had its finest Sediments just seaward of Boqueron Bay (Mé=3.7 + 0.7). Fine, well-sorted sediment was also sampled at CRP-4C(Mé=3.7 + 0.6). The currents measured there January 16-17, 1974 were very Weak near the bottom which allows for the deposition of fine sediments, Twenty to fifty percent of the basin sediments

Were finer than 0.063 mn (>4d). This shows that weak currents occur often enough to allow appreciable amounts of fine material to settle out. This does not preclude, the occurrence of Strong currents as fine, plate-shaped sediments require much higher currents to resuspend them than to keep them in suspension, The sieving statistics are given in Table 3.1-T1.

?TABLE 3.1-T1. Sieving statistics for cabo Rojo Platform grab samples.

Wean Median ?Standard Dev.

STATION Ms ?6

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2.2 2.8 2.0

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29 3.2 0:9

3:2 308 1.0

3:3 3a or

27 3a ua

33 anu 3

12 0.9 2

3.7 4.0 0.6

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Sedinent size analyses plots for CRP=t, 2 and 3."2

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Pig. 9,1-F2 Sediment size analyses plots for CRP-4, 5 and 6" cumulative weight percent and histograms.

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Fig. 3.1-f3 Sediment size analyses plots for CRP-7, 8 and 9 "B" stay

cumulative weight percent and histograms.

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Fig. 944-P Sediment size analyeis plot for CRP-NC showing cumlative weight

percent and histogran.

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Most of the terrestrial sediments are carried onto

the Cabo Rojo Platform by the Guanajibo River plume. This

plume flows south around Punta Guanajibo, south along the

shore and then seaward over the Platform, The river flow

is greatest in the late summer and fall (rainy season) and

least in the spring (dry season),

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4a ?OOPLANKTON. STUDIES 1974

by

Marsh J. Younyhtuth

4.1.1 INTRODUCTION

The following report provides estimates of the abun-
slance and diversity of zooplankton in the surface waters ear
the Southwestern coast of Puerto Kico. ?These data represent
one part of vironmental survey conducted by the Muerte
Rico Nuclear Center in an area proposed for offshore siting
of power stations. Samples were pathered on 4 days during
1974 Yo January, 2 April, 29 August, and 15 November.

MATERIALS AND METHODS

dures

Zooplankton were collected with a 1/2 meter diameter cylinder-cone shaped nylon net. This net was designed to reduce clogging error (Smith ct al., 1968). Mesh size was

233 microns. The net was towed from a 17 it. skiff in a circular path through the upper 2 mcters, The speed of the

Vessel ranged from 2 and 8 knots (determined with @ Sims

yacht speedometer). The duration of a tow was 10 minutes. After each tow, before the cod end was removed, the net was washed with sea water with the aid of a battery driven pump

(12 volt, Jabsco water-puppy). The catch was preserved in

43 sea water formalin buffered to pil 7.6. All samples were gathered during the daylight hours. The volume of water filtered through a net was estimated with a flowmeter (TSK oF General Oceanics Model 2030) suspended off-center in the

mouth of the met. The volunes usually ranged {rom 100 to 150 m: The meters were calibrated every 2 months. Calibration factors fell within &% of the mean,

At cach site three tows were made in the area adjacent

te the region where power station may be located. Single

tows were ?taken at the other stations. The regions sampled

were chosen in such a way as to collect within and around the

area where thermal alteration is likely to occur (Figure 4-1-F1).

Laboratory Procedures

Within 24 hours af

Y samples were collected the pli

was checked and adjusted, if necessary, to 7.6. Tf a sample

sngtadned (a nor iveable conglomerate of? phytoplinktun or detritus,

the zooplankton were separated from such material by pentic

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filtration through 202 micron mesh netting. Refore esti-

mates of biomass or numbers were made all organisms Larger

than 1 em, usually hydrozoan medusae, were removed.

Biomass was calculated as wet volume (Ahistrom and

Thraikill, 1962). This estimate is subject to considerable

error and?should be viewed only as a rough measure of stand-

ing stock. The measurements were reproducible but are u

doubtedly biased toward higher than actual values by va

Proportions of interstitial water and detritus.

?The total nunber of organisms was estimated by volumetric subsampling with replacement (Rrinton, 1962). Three aliquots from each sample were counted, The abundance of §ajor taxonomic groups of holoplankton and meroplankton were determined from dilutions of 300 to 500 organisms, Copepods, usually the most numerous of the zooplankters, were identified to species.

All biomass and enumeration data were standardized to a per cubic meter basis or multiple thereof, Data were initially reduced with hand calculators (Hewlett Packard Model 45) and more recently with a computer (PDP-10). See Appendix 1A for a listing of the program.

4.1.3. RESULTS

A total of 49 samples were collected from 9 stations (Figure 4.1-F1). The concentrations of several taxonomic groups of zooplankton at each station have been calculated (Table 4.1-T6 through 17). These data are arranged to facilitate ?comparisons between sets of consecutive tows, nearshore tows, and offshore tows.

Densities usually differed more between samples gathered from different areas than between consecutive tows from one

area. This observation is summarized in Table 4.1-T1.

TABLE 4.1-T1 Summary of ratios between the highest and

lowest density values of total zooplankton

during each sampling period.

SS SRRIEIEEITEe Teme

DATE. January April August November.

Consecutive Tows 1.4 5.6 1.2 4.7

Nearshore Tows 29 so a9

Offshore tows 1.3 1.0 16 a.

ALL Tows Re 2.8 we m8

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co

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The degree of variation between samples is expecssed

as a ratio formed by dividing the largest total surber of

ooplankton by the smallest within each set. The rates 3

similar to those observed in other coastal tegions around

Puerto Rico (Youngbluth 1973, 1974), Another way of judgin

differences between samples is also present (Table 4.1-T2).

By calculating the variance between consecutive sanpies, the

number of tows needed to detect various levels of difference was determined.

TAMLE 4.-T2, Total zooplankton Gory, transformed from 4 ucts of

replicate tows. Tha nunber of replicate

To detect +5 ~ 505 disterence in density

2.98278 2. Sess

2.99551 2.92694

2.80862 3.2306

a8 1081 18 49

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Sgn? x a? Where (®) tm phe ance level

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These data indicate that a large number of replicate tows would be necessary to detect density differences at the S$ level. However, in most cases, with only three tows, differences of 308?could be noted? and significant diffetences of S0% or more can be detected with a single tow. These data agree with estimates of field sampling error found in other studies of zooplankton (Wiebe and Holland 1968, Carpenter et al., 1974), Differences larger than SO$ were found be~ tween Samples from different stations but these higher densi- ties were rarely more than an order of magnitude greater.

Seasonal differences in the average abundance of total zooplankton were small, i.e., less than 8X (Table 4.1-T3),

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TABLE 4.1-79, Average density of all 2ooplankgon collected

Total Zooplankton/a®

Janvary Apri August Novenber

?

Range s2a-ase2 wi-1128 261-1267 362-1776

Median 800 sit an a10

Mean ou 59 590 967

958 CL, 600-1288 227-872 290-802 509-1945

ee

The highest concentrations appeared in January and November, These larger densities, however, probably represent the range of variation among? tropical zooplankton com-Bunities in the coastal waters around Puerto Rico rather than recurrent seasonal pulses since the 951 confidence intervals from each period overlap.

?The foregoing remarks refer primarily to holoplanktonic forms as they composed 65 to 97% of the total zooplankton. Meroplankton tended to be slightly more numerous in Januaty and August. However, the wide range of abundances recorded during any? sampling period obscure any noticeable seasonal fluctuations in their densities,

Fish eggs were not abundant in this area (Table 4.1-T4). The largest density observed, Sd/n j occurred at Seation 9 during January. The mean number of? eggs during this period was 10/m' and twice the densities found at other tines of

the year. ?Fish eggs were usally round and0,s to 2 mm in Atancter, but oblong eggs were common, It 1s not known which groups of fish are represented by most of the cous.

Copepods dominated the samples, forming 57-921 of

the zooplankton community. "A total of $6 species was observed. Time did not altow a detailed study of species abundances at all stations.? Consequently, one station out of nine was Fandomly selected fron each period for quantitative analysis. In addition to these counts, all samples collected in January were scanned to form as complete a species List as possible.

On the basis of these data the species most numerous, those

conmonly observed, and others occasionally found, aré listed

In'Table 4.1°13-

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TAWLE 41-6, Somary of deneitien of Fish eggs

sampled at Cabo Rojo.

4.1.4 DISCUSSION

The diversity of zooplankton and the levels of their abundances at Cabo Rojo within each sampling period were similar. Somewhat higher average abundances were noted in January'and November. The range of density encountered among the stations was not associated with nearness to shore, depth, or current flow. This lack of pattern suggests that the density fluctuations probably present the patchy dispersion commonly observed among planktonic organisms.

Limitations of the Data

The sampling program was designed to provide quantitative estimates of: 1) the standing stock of zooplankton, 2) the variety of major taxonomic groups, and 3) the diversity and abundance of the more numerous copepod species. The manner of field sampling determined the variety and bionass of organisms encountered. The data in this report are based on collections made in the surface waters during the daylight hours. The sampling gear and methods were Kept uniform, i.c., net type, net mosh, ?towing speed, and depth, range sampled, "A'snall number of replicate tows were gathered at each site to obtain some measure of the variability between samples. To obt:

a better understanding of the zooplankton community more fanpling With replication should be done at Crequent intervals, at a greater number of stations, at different depths, during the day and might, and during digferent seasons for several years. Information gathered in these ways Will be necessary to interpret fluctuations in standing stock and diversity in

relation to environmental changes and biotic interactions,

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TABLE 441-15, Copepod populations at Cabo Rojo Platform.

a

Species usually most numerous (> 5 individuais /e3)

Clausocatanus furcatus

Faracalanus spp. (P. aculeatus, P. crasstrostris, P. parvus)

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Species comonly present (observed anong 6 or 9 stations and 3 or more

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Species occasionally present

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4.2 BENTHIC INVERTEBRATES AND FISH STUDIFS

by

Paul Yoshioka

4.2.1. INTRODUCTION

This report covers benthic studies at the Cabo Rojo Platform site from January to Decenber 1974. The bulk of the effort was spent on descriptive surveys at the major benthic communities. Areas visited ranged from the mangroves to the offshore reef communities. Quantitative samples, when taken, were replicated to assess the magnitude of Sampling variability. No permanent stations were established nor was any singlo area visited in all seasons, consequently no data on seasonal or other temporal changes in the benthic communities are available.

4.2.2. MATERIALS AND METHODS

Field Procedures

Field stations at the Cabo Rojo Platform site are shown in Figure 4.2-F1. Field procedures are divided into three categories: shore surveys, transect dives, and station dives.

Shore surveys. Shore surveys were descriptive in nature. The Yargery more faniliat organisms were identified in the field. Specimens of smaller or unfamiliar organisms were collected and identified in the lab. The shore biota investigated at the Cabo Rojo site were the mangrove root communities and shoreline fishes.

Transect dives. Transects were traversed on a p: determined compass direction by two divers cither swimming or propelled by a diver propulsion vehicle (DPV), Notes ere taken on depth, botton type, topography, and dominant or unusual organisms.

Station dives. Dives were made at various stations to collect qualitative and quantitative samples. Quantitative Samples were replicated whenever possible. Corgonians yere collected at Stations 3 and 9 in $m? (1x $m) or 10 m

(2.x 5m) subsamples. Gorgonians were collected from a total area of 10 or 20.m at each station. A qualitative sample only was taken at Station 8.

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Fig. 4.2-P1 Benthic studies field stations at the Cabo Rojo Platform site.

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ALL large macroinvertebrates were collected in 10 n?

(2 x 5m) quadrats at Stations 4 and §. All macroinvertebgates

Were surveyed in a Thalassia bed (Station 1) in three 50

(2x 25 m) quadrats.

Photographs were taken to aid in gaining a general

description of the area. The presence and absence of the

larger invertebrates and fish were also noted whenever possible.

Laboratory Procedures

Gorgonian samples were dried for several weeks, then

Weighed, measured, and identified. The more familiar? species

Were identified on the basis of external characteristics.

Questionable individuals were identified with the aid of

Spicule preparations.

Other samples were sorted into phylogenetic groups, and preserved in 70% ethyl alcohol or 10% formalin for later identification. Samples were often frozen prior to sorting.

Taxonomic references used to identify organisms are listed in the bibliography.

4.2.3 RESULTS AND DISCUSSION

?The Cabo Rojo Platform site encompasses a large

variety of benthic habitats, mangroves, sia beds, Soft bottomed basins, and coral reef communities.

Organisms observed on mangrove roots in a small bay bordering Punta Ostiones (Station 1) are listed in

Table 4.2-Tl. Organisms observed are commonly found on mangrove root communities in embayments (PRNC, 1972).

Except for filamentous algae, few organisms were found on mangrove roots at Punta Ostiones, a few hundred meters away. This large difference in mangrove root conmunities agrees with observations by McNae and Kalk, (1962) who found that no unique community is associated with mangrove roots, but rather that the composition of mangrove root communities is dependent upon other environmental parameters. Similarly, mangrove root communities differ greatly in species composition in Jobos Bay depending upon location. Shoreline fishes collected with rotenone at Punta Guanaguilla are listed in Appendix 4.24.

Gorgonians sampled at Station B, an inshore reef, are Listed in Appendix 4. B. Over 804 of the colonies were represented by two species Pseudopterogorgia acerosa and

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Pseudopteroyorgia americana. Gorgonians collected at a

Geoper offshore ree?s Station Dy are also disted in Appendix 4.26.

The More abundant ofgonians az'Station 9 were. Pseudopterogorgia acerosa, Eunicea tourneforti, Funicea laxispica, and Puntces =~ salyculata, lowever, the relative abundances of gorgontan Species Were not significantly correlated at the 0.08 level between replicate samples.

A sand-mvd nixture dominates the substrate in the two basins of the Cabo Rojo site (Stations 4 and 5).

TPOLE . RTL Vangrove recs orranfans observed at the Cabo Boje Platform site Station 1.

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Batanus 29.

Rratus plaond:

Packyrnapens

Phylus Chordata

Botry!tus planus

an

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APPENDIX 2.14

Current plots - velocity and direction

vs. time.

ii. Averaged data for (:).

iii. Progressive Vector data for Figure 2.1-F3.

iv. Current Rose data for Figure 2.1-F4.

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ABO ROyO PLATEORY CRR=4C. DEATH = -2u 0 Es HDA

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APPENDIX 4,24

Shoreline fishes of the Cabo Rojo Platform site,

OPRIDRIDAE.

Qgibia sp.

EXOCOBTIDAT

Honishanphus biastiiensis

[ATHERIIDAE

Atherinonorus stipes

HOLOCENTRIDAE

Adtorye vextiiarive

Rolocentris ascersTonis

Holocentrus rufus

APOGONTDAE

?Apogon conkLine

ASogon maculatue

POMADASYIDAE.

Haemulon chryeargy

?CHAETODONTTOAE

Chactodon striatus

POMACENTRIDAE

Abudefduf saxatiiic

Fonacentrus fuscua

Ponacentrus leucostictue

LABRIDAE

Thalassona bifs

SCARIDAE,

Sparisona chrysopterun

?Sparisona rubripinne

CCLINIDAE

Labrisonus bucel ferus

Malacoctenus mac

7 Apel 76

---Page Break---

APPENDIX 8,28

Gorgonians collected at

Cabo Rojo Platform site-Station 9

Station 8 Station $

iS 2m

colonies /quadrat colonies/quadrat

left/right

AMTLY, PLEXAURIDAE

Piexaura hononal la on 4

?Flesaura flexuosa 6.2 re

Fecudoptexaura flageldoes 1.0 00

Haines age 22 0,0

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2,0 ont

Eunfoca ut 13

Maricsopsts flavide on 0,0

fexaurelia dTchotoma na 00

a0 oe

z 0,0 0,2

Murfoes atlantica 10 00

TANTLY, GORGONEDAE

Pscudopterogorgia citrina 3.0

Fpeulopterogorgia sceross ea7

Besloperogeais fa americana 58

fa nigida 0,0

eudoptersgorgia sp= 0,0

---Page Break---

[APPENDIX 4,20

Macroinvertebrate

collected in 10 n? (5 x 2m)

quadrats or observed in the Cabo Rofo basins (Stationa 4 and 5).

ANIMAL, KINGDOM

Phylum Porifera

Axinelia polyeapella

Chondrfita nucute

Desnapsanma anchorata

Falfctona rubens

Walictona vindia

Hatictona molitba

Unid. Haliclonidae

sniacidon sp.

ifeate gatos

Microciona sp.

?Trachygellius ep.

Verongts sp

Onder Foseiiosalerina

Unid. sponge

Sponge fragnents

Phylum Cnidaria

Diodogorgia nodulifera

Phylum Echinodermata

Oreaster reticulatus

= eribulotdes

Pylum Chordata

Microcosmus helleri

?PLANT KINGDOM

Halophila baillonis

23

STATION 4

30 May 1974

2g. wet weight

su

36

2.0

832

1.0

10.0

370

867

51.5

2

138

STATION 5

40 May 1974

&. wet weight

25.0

26.0

31.6

---Page Break---

[APPENDIX 4.20,

Sraller invertebrates collected at the Cabo Rojo Basin.

ANTMAL, KINGDOM

Phylum Porifera

Signadocea caerulea

Phylum Cnidars

Diodogongia noduli fera

Eaeisres fp

Phylum S{punculoidea

Sipunculid sp. 7

siponeulfd sp:

Phylum Eehfuretdea

nid. Eebiuroid

Phylum Annelida

Eunice ep.

Finereis sp.

Unid. wereld

Poratostogus otellatu

tats sapere

Unid, Serpalid

Unid, sy2iia

Unid, Ferebert

Prylun Mol2usea

Clase Gastropoda

Mabina cerithidiotdes

Galtlostons Jujubious

Suiypeten cements

Grepitate aculestay

Sine a becbed

spinels Tiracle

fgiis bieeatea

fants ora

Taner brevFice

apes Pecurvivesteis rubfdue

teria 3p

Siveraa perpiexa

Wiavcing cancetiata

Torebra protexta

?Turlcetia varvegaca

Veraicutenta Keeest

ie boats

STATION 6

STATION 5

---Page Break---

APPEIDIX 4. D (continued)

Phylum Mollusca (continued)

ou

s Pelecypoda

Acquipecten musosus

Anacara notable

Anslara: tranaversa

Knodontta alba

inbricata

Barbatia domi

Sarbatia tenera

Fas. Cordidae

Chata aacerophylla

Fae sles

Chione lacilinata

?Ghianye sp.

Sodeida gacttnenta

Cris ibaea

Set Pyne

BrassTaet La guadaiupensis

Caen Sesion

gettin sens

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ries a rere

5 Tyropecten ~ Warum

Tysonta Beara

Mucalana acuta

Getren queria

Papyridea soleniformis

rape prmnidce

PLicutula gibbosa

Feeudochona radians

jenele purpura

Feilina alternata

Telitna sartiavcenots:

Telling sera

felling ope

Trangennelia stinpsont

Telgontocardia ant ftiarum

STATION 6

STATION 5

---Page Break---

APPENDIX 4.20 (continued)

STATION 6

Phytum Mollusca (continued)

Clase Seaphepoda

Pontaliun gouldi portoricense. x

Phylum Arthropoda

cass Crustacea

tatreutes parvulus x

Syoalpheua? aploceros x

Sangha sino

Phylum Echinodermata

Amphiura sp. ?

?Spetoehrix sngutaca

?pitochate Breclyactte

Phylum Chordata

Und. Asctdian

Merceosmus

STATION 5

---Page Break---

NOTICE

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