PRNC178

PRNC ~ 178

! PUERTO RICO NUCLEAR CENTER

LA CHALUPA MISSION # 12

FINAL REPORT

(March 1975)

OPERATED BY UNIVERSTTY OF PUERTO RICO UNDER CONTRACT

'NO. AT (40:1)-1899 FOR US ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

---Page Break---

LA GIALUPA Mission #12

FINAL REPORT

by

R. Castro, P. H. Davis, J. J. Kimmel

T.W, Purcell, and J. A. Rivera

Report Coordinator: P. H. Davis

Technical Editors: M. L. Kimmel and Ferne Galantai

---Page Break---

Rico Water Resources Authority completed a research mission utilizing *

undervater habitat, La Chalupa.

of Puerto Rico in the Barrio Islote area, The habitat was locate! 20s. 2

offshore in 22 meters of water.

Seven scientists and technicians from the Puerto Rico Nuclear Center

Mayaguez laboratory composed La Chalupa Mission #12 research and support <=

La Chalupa Mission #12 Tean

Paul H. Davis, Research Associate 11 Benthic Studies

?Joseph J, Kimel, Research Associ Tehthyology

?Thomas W. Purcell, Research Associate I! Phytoplanktology

?Roberto Castro, Scientific Associate 11 Benthic Ecology

José A, Rivera, Scientific Associate II Benthic Ecology

Eric Klos, Research Associate 1 Benthic and Plankton Support

No61 Rivera, Research Assistant 111 Ichthyology Support

*aquanauts

---Page Break---

?TABLE OF CONTENTS

---Page Break---

[INTRODUCTION

The Islote area on the north coast of Puerto Rico, approximately 7.5 vriles east of Arecibo, is under consideration as a miciear power plant site (Figure 1). The Puerto Rico Nuclear Center (PRNC) has been? contracted since 1973 to collect both physical and biological baseline data on the marine gaviroment at this site, Prograns have been initiated to investigate she {ebthyofauna, benthic invertebrates and algae, phytoplankton, zooplankton, and fhe physical ?environment (refer to Environmental Report, North Conse Necleas

The undervater habitat, La Chalupa, was and June 1974. This facility allowed PRNC the ecology of ?the area from a different

A. fem of two invertebrate zoologists, one ichthyologist, and one phyto- prnktologist entered La Chalupa which was ?positioned approximately, 300 gteys offshore in 22 meters of water (Figure 2). The tean hat access to 4 x 10% e

of botton for the duration of the mission, Within this area, differest habitats were determined, observations were made, and samples were collected, ?The sates other tean menbérs provided support for? the aquanauts,

Peuthic Commities, The invertebrate zoologists were primarily interested in

TUT Gustribution of the doninant benthic flora and fauna, ?The eeolog-
ASgl Zelstionships of several comercially valuable organisms such as conch,
lobster, and crabs were investigated. The bottom wes first mapped and cubsfeas
ie designated for sample collection. Several physical parameters? (selinen
tation, \sedinent transport, and currents) were considered in Telatiog te
aninal ?distribution.

FESR Smmbling The PRC-PRWRA ichthyology progran began in June 1973, Fish
Traps, surfaee ant botwon silt sort? spear guns, and rotenone fish poison had
been used for sampling fron the R/V'Sultana, Kith the aid of La Chelupa met
fishes could be observed, including those not previously captured, ant there
apundance and inportance'in the area estinated. At the sane tine, the efficiency
of fish traps as a continuous sampling device was evaluated first hand.

jankton Sampling. The phytoplanktologist gathered data during the mission
top ?Supplenental infomation to the phytoplankton survey of the area in
fhe fom of: ?sdentification of populations and major species near the betsay
determination of changes which might occur in the populations as a recur ce
ENGL indluences er tine of day; and detemination of a crude idea of prowc-
Saity in the study area by use of cell counts, chlorophyll measurenents, snl
dark-Light bottle studies,

wrahinas, the first research team to use La Chalupa for continuous survey

Eee within an existing progran. Therefore, evaluation of the facility as a

survey tool is presented in the final section.

---Page Break---

---Page Break---

---Page Break---

I, BENTHIC COMMUNITIES

Methods and Materials

Four 100 meter transect Lines of 1/8" nylon rope, marked at 10 meter

intervals, were laid out from La Chalupa in north, south, east, and west directions. Iron rods were driven into the bottan to hold the lines dow.
Notes were taken on commumity changes, geographic features, and the abundance and habits of comercially valuable species. Additional observations were nade on feeding habits, population relationships, habitat preferences, and diurnal/nocturnal activity. A Konica AT in an Ikelite housing made photo-graphic records both of geyeral areas along the transect lines and specific Conminities within the I'm? quadrats,

Sediment samples were collected slong the north-south transect lines to determine particle size and composition (Figure 3 and Table 1). These data were used to help determine sedinent transport in relation to currents. Samples of the upper 3.5 to S cn of the sediment were collected in 125 ml screw cap vials. ?Sediment traps (3.7 x 37 om upright plastic tubes) were attached to the bottom at three stations along the north-south transect Lines. At each station, three traps were set in a triangle, 1 meter on each side,

A feu hard substrate samples were collected to determine its composition

and possible origin (e.g., coralline algae layers, coral skeletons) «

Four replicate bionass samples were taken frgn the area (Figure 3). Goliections? From each Tine vere nade with a 1/4 me quajrats A fifth seation was established southeast of La Chaltpa, and one'1/4 n° sasple was collected

there (Figure 3). Corals and gorgonians were aiso collected in different

areas, especially on the west ard north transect lines, for species. identification.

?The comass orientation of gorgonians was measured and compared to the Prevailing currents (Table 2). Orientation was determined only for gorgonians EME nopalty branch in one piane, and the height of these gorgonians was ?measured to obtain an average colony size (Table 3).

?The area surveyed can be divided generally into three major comunities: algal flat, sand flat, and rock outcroppings (Figure 5). Of these com mmity types has a typical invertebrate, fish, and algal population associated with it. However, the fish and some of? the invertebrates actively move between ?communities,

Cormunity Types

?Algal Flat. The algal flat is a long band, parallel to shore approxinately Sib aotes' wide at fhe gortn-south teatanee Pines ey tat PEE a

substrate is composed of calcareous red algae and shell fragments cenented

together, There are a few large crevices and holes. The other 301 of the substrate is covered by sand pockets,

---Page Break---

?The dominant species in this area are the red algae Bryothamion triquetin, the bro algae Dictyota spp. and Dictyopteris Spee the comon Easter spinge Yestospongia AIEE and an octocoPal Peewiopeerosorgia, sconoea Te ree is ?coversd RostTy BY fod. and brow sigae, WIEN sone greon gue? present (Chanaedoris peniculum, Hlalineda discoidea, and Valonia ventricosa). ?Tee sponges an gorgntans ware coneprousus But rather scar aE eis

served on the algal flat were Montastrea cavernosa, Dichocoenia stokesii, apa some ead Yanicina colonies Two common opifaunat Tivertebrates wore the arrow crab-Stenorynctus seticomis and Coniylactis gigantea, an ancnone. ding places (GFT invertebrates are seaeee oA ah ae account for the lack of epifaunal invertebrates.

?The algat flat seens to be relatively hanogeneous, although a subtle zonation occurs. Reds predominate on the deep side of the flat, and brows predoninate on the shallow side, A few large Sargassum sp. plats were served at 18 neters depth at the end of the SOU transect Line,

?There are a few rock outcroppings and snall ridges scattered around the algal flat, with the ridge in the southwest quadrant (Figure 3) being the most conspicuous. This ridge begins as an outcropping near the west transect line and gradually becomes a single ridge about § neters high.

Tt diminishes gradually until it is about 30 on high and then changes to @ south-southwest and finally easterly direction, rising again to about 6 meters at the end. The area encircled by the ridge depresses toward the botton, the outside being 20 meters deep and the depression itself 22 to 23 meters. There were mmerous fishes along the ridges and a few lobsters (Panulirus argus) were observed in the deeper crevices.

To the south, the algal flat ended sbruptly with a few high areas drop-Bi steenly te the sand.? The north end of the area exhibits a more gradual change in which the algae is slowly displaced by sand. There were a few gorgonians in this rock-sand interphase covered mostly by sand, A hard sub-Strate was found 15 to 20-on under the sand.

Biomass samples were collected at the ends of the east, west, and south transect Lines and in the north interphase, This information is presented in Table 3-A,

Sand Flat. Two sandy areas were found, one north of the algal flat and the Other south (Figure 3). The north sand flat began at the 17 meter mark of the north transect line and extended it with a small rock outcrop at ?the end of the transect line. The south sand flat was 75 meters beyond the end of the south line, Sedinent samples were taken and visual observations were nade,

urogl POS, cnepicueus species inthe north sand flat is a seagrass Ialophita bailionis which forms large scattered patches along the fransect

Tine Aisablisd wor was observed" during oth fey and nights Sault ssa dollar (Melita sexiesperforata) skeletons were noted and snail live specinens collected: A Fortunid crab (ornunus floridanus), two unidentified nudibranch, one Aphroditridae worn, and shelTs (ail Olivells petiolita) were collected,

During four night dives to the north area, the starfish Astropecten sp. was observed, and two individuals were noted cating a small fl sepfesperforata,

---Page Break---

Fioure 3, 7

General community map showing placement of sediment traps and areas of benthic. sampling.

Legend

uterepping

&

F

k

8

sand Flat

Halophite

algal tae

sedinent traps

biomass sanples

cae PRO

sediment samples

---Page Break---

During these night dives Pennatulaceans, tentatively classified as Stylatula Sp., wore observed and collected, They were observed only at night -ShFings were observed also.

Rock Outcrops. The outcroppings elevate above the botton and have a species ?amposition completely different from that of any other comunity in the stuly area. They are rather sparsely scattered over the area except at tne fend of the east transect line about 130 meters from La chalupa. There a series of larger outcroppings (15 to 20 meters long) occur. The outer

are on the algal flat, except for one found in the middie of the sand flat at the end of the north transect line. The outcropping substrate is similar to the algal flat, but crowded with boring sponges, holes, and crevices, Most of the outcrops are 5 to 10 meters in diameter and 2'neters high.

?The most common invertebrates found on these outcrops were the sclerac-Binian corals (Table 4). Most of the lobsters were observed in this habitat. There were some algae, mostly epiphytes, occurring in the spaces not covered by sponges or corals.? Many brittle stars, mollusks, worms, and crustaceans were collected at rotenone fish stations.? There were more? invertebrates in these areas probably because of the shelter and the greater availability of food provided at the rock outcroppings.

?The outcroppings at the end of the east trahsect line are wider and higher and Largely covered by Sargassum sp., Crinoids, Psewlopterogorgia Spp-y, and Eundeea laxispica,? Thevtao Tatvor species vere now aeseset sa the ?other outcrops.

The north outcrop is surrounded by sand about 100 neters fron the algal fat, approximately 8 meters high, meters wide, ant 10 meters long Hake svaii algae" than corals ere observed, but mst of the species of coral foud gn the other outcrops were present, ihe gorgonian Telesto riisel, the corals Stylaster roseus and TubastYea sursa were also comin TADAEERER aurea and TOGTTSET EE Sosomad only on Whee: outcrop.? Other ogee STE ere Sere-the coral crab Carpilius coralimus. the lobster Panulsrus eres

Serpulid worns anong the corals, Sibelitd worms, a feather-Tike fyttstoan also present on the algal flat, ani a total of 16 species of corals,

Except for the east and north outcrops, where T. riisei was observed, no gorgonians were found growing on the outcrops, bit there were many scleractinian corals. Most of the gorgonians were growing on the algal flat where only a few species of corals were seen.

Sediment Samples and Traps

?The data obtained from the seiiment samples are tabulated in Table 1. The cumulative percentages for the different sizes are plotted in Figure 4 ?The sand from the north sandy area had a median Phi disneter (Mi 8) of 2.85 compared to 1.95 from the south sandy area, Evidently, the median grain size increases gradually from north to south (Figure 5}. If there is signi-ficant sediment transport, it seems to be moving from south to north, This probably is due to the effect of increased surge in the shallower waters of the south sandy area.

---Page Break---

Ficune §,

Cumulative percentages of edtan grain sizes (Hd 8) of sediments from seven stations.

oor

005:

ot

40

30

70.

90

35,

9998

---Page Break---

me

Frome 5,

Median grain size (Md 6) of sedinents

from seven stations.

Isr

sta

ste ?

sta ote st?

sre

La cHaLuPa,

sano ALGaL_FLAT- ROCK SAN

= 700 Ey 200 250 300

NoRTH o???? METERS ??» soutH

---Page Break---

By the end of the mission there was no sediment in the traps, Furthermore,

the traps remained empty for over three months after the mission vas completed

Gorgonian Orientation

?The gorgonians branching in one plane seen to have a consistent orientation

in their growth patterns (Table 2). The genus Pseudopterogorgia (of two species

found, the more comon was acerosa) was oriented in a 300" = 176" direction,

The genus Peerogorgia,(Citeine Being the nove come of owe species found) was

griented ina SOX "124" direction. The genus Eunicea (E. lerispica and

E, toumeforti, neither comon) was oriented in a 302 123° direction. The

Surge may have ?more influence on gorgonians than the predoninant currents.

Te is not unusual to have a strong surge at 22 meters? depth on the north coast,

Comercially Valued Species

Ten conch shells (Stronbus gigas) were found during the survey, Most

appeared to be old, but two Young specinens were found.? Hovenont of the Conchs

around the algal flat was about one neter/hour. any small Sy gigas, S- gallus,

and S, costatus shells were occupied by hermit crabs. ?No live Speciness SS

Si gallus oS; costatus were found.

The spiny lobster Panulirus angus was found around the algal flat, especially

under ledges between the algal Tlatand the sand and inside the larger? outcroppings.

4n estimated population of six lobsters was consistently seen over the algal

flat. The east side outcroppings harbored populations of 20 to 25 individuals

Surface diving in the Islote area prior to the mission uncovered two outcrops

at 22 meters depth. A standing crop of 30 lobsters was found there,

DISCUSSION

?The distribution of invertebrates in diverse habitets is partly cont*:11-
by biological factors such as food sources, protection, and competition? it

Teiote this is especially noticeable in the living ables at Hien Lanriers,

and corals and gotgonians, Populations of fish congregated around the soscrcy
pings for shelter and food, Lobsters were found only tn protective ales on

the outcroppings or snall ridges along the algal flat. They were usualy

found in the sane place, except two lobsters (possibly in search of food)

were caught in fish trafs set at night on the sigal flat amy fron the autcrops
and ridges. Scleractinian corals were consistently found growing on hard substrate

Of the 45 species of scleractinian corals reported for Puerto Rico by
Ainy-Carrién (1963), 17" (391) wore collected at Tslote, OF the 17 specie. of
corals found in the'general area, only two species (lontastrea cavernosa an?
Dichocoenia stokesii) vere observed on the algal flat. ?The Histfibitice of

s over the algal flat suggests Significant sedinent transport in the ares,

Although the algal flat furnishes the rough, solid botton required by the coral Planulae for attachment, they are apparently soon covered over ty the moving ?sediment. On the outcrops, the planulae are Probably less affected by the sedinent ?and have more opportunity to settle and grow.

---Page Break---

2

Cary (1914) indicated that the planulae of most gorgonians are sinilar to those of corals in that they require a rough solid bottom for attachment. However, most of the gorgonians were found on the algal flat with a few on

the east outcroppings. One factor influencing this distribution could be the nature of the substrate. Both the algal flat and the outcroppings are composed of hard calcareous material, but the outcroppings are crowded with boring sponges which loosen the substrate. This allows the gorgonians to be under-mined and prevents then fron establishing permanent settlenents. Of 54 species of gorgonians reported by Ress (193), only 10, or 18%, were found at Islote. Bayer (1961) reported 75 shallow-water species for the?Atlantic, but only 9 were found at Islote,

---Page Break---

3

IL, FISH SAMPLING

Methods and Materials

y - Four chevron fish traps, 36" x 18", two baited and two umbaited, ere dropped fron the R/V Susans ind places fot"s Sait day intervals at four different habitats, The traps were periodically inspected, and the contents were recorded. After the traps were hauled to the surface, the contents mere bagged and preserved on ice until they could be frozen at the Islote field station. The traps were then noved to a new location and rebaites (Figure 6) -

Gensusing, Censusing involved swimming along a transect line and noting all The Fishes within 2 meters of the Tine? ?Eorensiteect observations were nade from three transect lines laid over typical rock cutcrops and algal flat areas, Other census work was done along each of the four 100 meter transece lines ?that extended north, south, east, and west from La Chalupas, On? two Occasions isolated rock outcrops were Visited, and all the fishes observed were recorded,

Poisoning. Other fish samples fram the rock outcrops, algal flats, and sandy areas were obtained with Pro-Nox fish poison. These samples were froven in La Chalupa and subsequently taken to the PRNC fish laboratory in Mayeguct,

Laboratory Analysis. All specimens captured were identified and the standard Tenge, weTght, and? sex recorieas

RESULTS AND DISCUSSION

Table S is a species list of trapped fish which also indicates mmbers ?Gaught in baited as opposed to unbaited traps. ?Table 6 lists all species obtained or observed throughout the Mission?

?The, sea floor is a combination of algal flats, sand flats, and rock outcrops (Figure 6). The habitats fomned from these different bottan types offer protect ton and food to at least 112 species of fish. The algal flat which is phe Rost common bottom type, is underlaid by a honeyconbed calearesus base which Provides a substrate for the algal and sponge communities which in tam offer food and protection for the snaller fishes especially the wrasses'(Lahricas), Gamsel fishes (Ponacentridae), and small groupers (Serranidae), espec!ally Cephalopholis fulva (Table 7)?

Erratically scattered ou harbor the greatest diversity and number of fishes per unit area. Most of the larger fishes at Islote such as several species of snappers (Lutjanidae), grunts (Ponadaysidae), groupers (Serranidac) and squirrelfishes (Holocentridaé) are associated with these formations.

The sandy areas, often with patches of the vascular plant Halophila baillonis, support prinarily razorfishes (Labridae), sand tilefiahee ?ranchiostegidae), and flounders (Bothidse).

---Page Break---

FieuRe 6.

1" General comunity map shoving placement of Fish traps,

transect Times, and phytodTankton stations.

Legend

?outeropping

© sons

$BF votonite

?OA algal flat

© Fish trap (unbaltea)

fe fish crap (baited)

1s transect lines

?6. Phytoplankton stations

176 10m

---Page Break---

1s

The pelagic fishes consist primarily of three or four species of the

fami Catenglian bot also Ince the Sl eee PRES Sosa,

The carangids do not seen to require the protection of the fotten, ter way

apparently depend on the bottom for food ts they were often aeee cratien

close to it in search of feeding opportinicien?

The general distribution of fishes over the Islote area is patchy, with

?Ga sodividuals ore around the outcrops. According to census data

te 6), the wrasse * especially res posyi, fi garrotl

sp atatem Wesclatay, e dnanf isos (aconrtaey, telat

res ; coney (Serranidae), fulva |

PTS ae RS ee coe? Garren eS

sandy areas vere comparatively barren, as indicated by the census feta. The

ost abundant species in this habitat were the rasorfish fesinterotaes 5°

(abridae), the sand titefish thus plumieri. (Branchtostoplise). and

the flouders Syacium mierurus Fame othlaoe):

Doratonot alepis (Labridae); a (Qoringuic 3

BEES OREN) and eo sai (Seorpuenidss),

The grunts (Ponadasyidae), squirrelfishes (@Holocentridae), snappers (Lutjanidae), and (Serranidse) were the most fi tly trapped fish Gable 8). At sis probably a good indication of the Yelative ania dance of these fishes, it does not mean that they were more enunteat Vea other species at Islote. The traps were apparently selective See eerenn size fish whose behavior patterns drar them to ?the Kind of cover provided ta the traps, The frequent? extrone weather conditions at slow proeticeare Protective shelter necessary for many species, and this need nighy favs ductor in the fish traps! being mote efficient than fill nets for repaler Selene Ling. {The number of fish captured by trap averaged 28 but vanced feet 98)

Mater clarity seens to aid the fish in detecting gill nets: sich that? the Danber of fish captured by this method does not adamustely refisct wearin, Seta oF species? compost ign,

Samples collected with baited and unbaited fish traps indicated that bait

is not necessary to attract fishes to the traps. In most cases, more fishes

were caught in unbaited traps than in umbaited ones (Fi 7,'8, and 9). The fishes seem to be attracted more to the cover than to the food? offered. On a ?indy bottom a baited trap might attract more fish than an inbaited one, because food resources there are not as great as those on the algal flat or rock outcrops.

Unfortunately, the optimm soak tine for chevron traps was not reached

uring the Chalupa ?mission. Mmro et al, (1971) state that Cumilative catch in traps tend toward an asymptote, In the Port Royal reefs off Janaica a value close to the maximm is within 7 to 10 days. Preliminary observations made at Islote indicate that optimm soak tine is less than 10 days,

---Page Break---

---Page Break---

sae

ois

oF

aos

a

wise

---Page Break---

---Page Break---

TIT, PHYTOPLANKTON SAMPLING

Methods and Naterials

One sampling site was established in each of three different habitets:
algal flat, sand flat, and rock outcropping (Figure 6). Phytoplankton and
chlorophyll samples were taken once a day at these sites 1 meter above the
bottom. ?In addition, during two 24 hour studies (28 May and 2 dune), chloro-
phyll samples were obtained from each of the three stations, and a phytoplankton
Sample was taken at Station 2, These samples were taken once every four hours,
Dark-Light bottle measurements were taken at each of the three stations on

27 May and 30 May.

Samples taken for phytoplankton enumeration were collected in 500 mi plastic bottles and preserved in 34 buffered formalin, Samples were exanined with a Nikon Inverted Microscope (Table 9). Counts were made of an aliquot

of the concentrate at 250K, and major species noted. Counts are in cells/liter of diatoms, dinoflagellates, coccolithophores, and blue-green algae (Table 10).

The chlorophyll samples were taken in 1 liter bottles and were filtered through a .47 micron AA Millipore filter. The filters were frozen immediately and stored. ?These samples were to be extracted and chlorophyll determined by the fluorinetry method described by Strickland and Parsons (1972), but. the samples proved insufficient for analysis.

Three standard BOD bottles were filled with water at each station for dark-Light sampling. Errors in measurenent which might have resulted from

ix bubbling out as ?the bottle was filled were avoided by filling each bettle with nitrogen before the sampling was taken. One of the three bettles was fixed upon return to La Chalupa, and the other two (one dark. one clear) se secured in situ 1 meter above the bottom from 1200 to Te00 hours, ?Ths bot were collected, fixed upon return to the habitat, and sent. to the surface | following day.? There the 0 determinations wero? obvuined by vsire he A! titration method a5 outlined by Strickland and Parsons (19%2). Results. are given in Table 11.

DISCUSSION

Data from the dark-Light studies (Table 11) indicate mininal activity at the depths (18 to 24 meters) where observations were made, This may have been the result of low light conditions at the bottom due to generally increasing turbidity of the water in the afternoons. The generally low productivity levels noted by Steenan Nielsen and Jensen (1957) off the north coast of Puerto Rico were thus further reduced by low light to levels umeasurable by dark~ Light bottle methods.

---Page Break---

CONCLUSIONS AND RECOMMENDATIONS

Major problens ?herent in sublittoral ecology are related to the Linita- £m: of exposure. .. using La Chalupa and saturation diving techniques, the

PRNC biologists were able to overcone these obstacles for fifteen days. The advantage of unlimited bottom tine at 22 meters provided a closer look at even the most inconspicuous menbers of the bottom comunity. Unusual behaviors, feeding habits, and nocturnal activities were observed and selective sampling was accomplished.

?The benthic phase of the progran was aided greatly by the tine factor. Bionass samples were collected in a fraction of the normal tine, Saturation diving enabled us to know the area in nore intimate detail than had been Possible on previous sampling trips.

?The advantage of witnessing the efficiency of standard fishing methods was invaluable to the ichthyology program, Daily observations of the fish not previously trapped or netted provided a more complete picture of the true fish comunity, knowledge that could not have been obtained without La Chalupa.

However, because we vere unfamiliar with the capacity of the habitat, La chatipa, i did pot take full advantage of Sts capabilities. ?A mre sophisticated sampling progran should have been employed, and fore long-term Stidies with postemiasion follow up should have been iniciated.

Constructive criticism can increase productivity of future survey missions. Two salient criticisms deal with the tining of the mission itself and the Limitations of each excursion fron the habitat, ALI PRNC members of the ?mission agreed that more could have been learned if the habitat had been used shortly after the preliminary survey work at Islote was completed. This

sould provide, the advantage of being able to gather good quantitative baseline data rather than trying to fit the liabitat into existing prograns

A series of minor problens contributed to the limitations of each excursion fron the habitat. The hooka gear for the mission proved to be tine consuming, upreliable, and bulky; therefore, it was avoided. The only alternative to this system was the double SCUBA tark (standard size) assembly, which Limited both the range and duration of each dive, A proven "?closed-cifcuit" system, with emergency air supply and good civer-to-habitat communication, would have allowed the divers to remain in the water for several hours at a tine. This system is strongly recomended.

Moving the entire habitat to a different location half-way through the mission is feasible and would provide for the gathering of comparative data.

Future missions should be planned so that they are as self-sufficient as possible. Problens with habitat-to-surface conmmication and rough sea conditions ?caused delays in surface support operations and, consequently, in the sampling Prograns. Other problens with training, equipaent, food, and? communications uring: decompression should be overcone ?to insure the success of future missions,

---Page Break---

a

REFERENCES

Almy, CC. and C. Carrién Torres. 1963. Shallow-water stony corals of Puerto Rico. Caribbean Journal of Science, 3 (2-3): 135162,

Bayer, F.M. 1961, The Shallow-water Octocorallia of the West Indian Region: A Manual for Marine Biologists. Martinus Nijhoff, ?the Hague. 373 p.

Fohike, JE. and C.C.G, Chaplin. 1968. Fishes of the Bahanas and Adjacent Tropical Naters, ?Livingston Publishing Co., Wmnewoody Pa 71 p.

Chase, F.A. Jr. 1972. The shrimps of the Snithsonian-Bredin Caribhean ?expeditions with a sumary of the West Indian shallow-water species Decapoda: Natantia). Smithsonian Contributions to? 2001

ey, 98. Smithsonian Institution Press, Washington, D.C. 179 p.

Goldberg, WM. 1973. The ecology of the coral-octocoral communities Off! the southeast Florida coast: geomorphology, species composition

and tonation, Bulletin of Marine Science, 2303) .

Kinzie, R.A, 1973. The zonation of West Indian gorgonians, Bulletin of Marine Science, 23(1): 95-155.

Martin, F.D. Artificial key to the families of teleost fishes of Puerto Rico, Unpubl.

Munro, JeLe Pulls Reeson, and V.C. Caut. 1971, Dynanic factors affecting the performance of the Antiliean fish trap. Proc. Culf Carib. Fish Inst. 232" 184 = 194,

Opresko, D.M, 1973, Abundance and distribution of shallow-water gorgonians in the area of Mimi, Florida, Bulletin of Marine Science, 3303).

Randall, J.E, 1968. Caribbean Reef Fishes, TRI Publications, Inc. Ltd. Hong "Kong. 318 p.

Rathbun, MJ. 1933. Brachyuran crabs of Porto Rico and the Virgin Islands. Scientific Survey of Porto Rico and the Virain Islands, Vol. XV-Part 1. New York Acadeny of Sciences. 121 p.

Rathbun, M.J. 1930, The cancroid crabs of Anerica of the families

Furyalidae, Portunidae, Atelecyclidae, Cancridae and Yanthidee,

fmithsonian Institution United States National Museun Bulletin, 152,

Washington, 0.C, 609 p.

Shephard, F.D, 1973, Submarine Geology. Harper and Row, New York.

Sigh, T-C-W- 1972, Atlantic Reef Corals. thhiversity of Miani Press,

Coral abies. 164 p.

---Page Break---

Steenan Nielsen, E, and E,A. Jensen. 1987, Prinary oceanic production.

?The autotrophic production of organic matter on the oceans. Galathea

Rep., 1549-136,

Strickland, J.D.ll. and T.R. Parsons. 1972, A Practical Handbook of

Seawater Analysis, Bulletin 167, Fisheries Research Board of Canada,

Ottawa,

?Taylor, W.!l, 1973, Marine algae of the eastern tropical and subtropical coasts of the Anericas, University of Michigan Science Service,

Van Name, W.G, 1948, The North and South Anerican Ascidians. Pulletin of the American Museum of Natural Ilistory, 84.

Warnke, Gol. and R.T. Abbott. 1962, Caribbean Seashells, Livingston Publishing Co., Wymnewood, Pa. 348 p.

---Page Break---

10.

u.

LST oF TAME

Splitting fraction data

Gorgonian branching with plane orientation

Gorgonian colony height in cm

Mean yet weights (gn) of algae collected in

1/4 me samples,

Species list of benthic organisms from La

Ghalupa Mission #12, May - June 1974

Species list of fish captured by trap at

Tslote, May - June 1974

Species list of fish captured or observed

uring La Chalupa Mission May - June 1974

Relative abundance of fishes on the algal

nat (Based on three 100 meter transects

during La Chalupa Mission)

Sumary of trapped fishes indicating location,

habitat, und percent composition of catch

Species list for phytoplankton 24 hour station,

0900 28 May - 0900 29 May 1974

Important phytoplankton species (those appearing

at least once in numbers greater than 50 cells)

liter) and numbers (cells/liter) for Chalupy 24

hour Station 28-29 Nay 1974

Average 0» values (ppm), dark-light botties

23

2

28

2»

7

38

as

44

---Page Break---

---Page Break---

23

TABLE 1, Splitting fraction data

Sample 1 (North sandy area)

re ata one

ss eo

ma

gousmingie ts

Error 1.6 g (0.91)

scunemngie ate

---Page Break---

TABLE 1, (Continued)

Sample #5 (20 m from north sandy area)

Sereen m s Weight Weight Gm. Wt. Gum, We,

Nesh f s i

5 3.9622

9 ager 2a 12 24 12

6 a) 47 27 6.8 3.9

3 0.4951 naz 6.6 18.0 10.5

60 0.26 2 ans 24.5 60.5 35.0

115 orm 8 79.0 45.6 139.5

250 ee) 31.6 18.5 ma 98.9

Pan ? 19 nT 173.0 100.0

Initial sample weight 175.0 8

Gm. sample weight YS08

Sample #4 (50 m from north sandy are

5 3.9622

9 vost 4s 2s 4s 25

16 a) 11.0 6A 18.5 8.6

3 ons 1 2.4 13.6 3.9 22.2

60 0.26 2 48.2 26.9 8.1 ao

us ons 07.0 3.8 155.1 86.4

250 0.0614 2.1 12.9 178.2 99.3

Pan 4 13 0.7 179.5 100.0

Initial sample weight 180.4 g

Gun, sample weight 179.5 g

Error Or

---Page Break---

TABLE 1, (Continued)

Sample #5 (100 m from north sandy area)

Screen ? ? Weight Weight

Mesh ni i k

5 3.962 2

9 1.981 1 3.0 18 3.0 18

16 0.991 o 9.0 47 no 6s

3 0,495, 1 18.1 10.7 20.1 172

60 0,246 2 82.2 30.9 81.3 48.1

Ns o.124 3 65.0 38.6 146.3 86.7

250 0,061 40, 28 12.3 167.1 99.0

Pan 4 1S 0.9 168.6 99.0

Initial sample weight 169.5 9

Gun, sample weight 168.6 &

Error 2:9 g (0.58)

5 3.962 -2

9 1,981 on on on on

16 0.991 ° 23 13 24 14

2 0.495, 1 144 19 16.8 9.3

60 0,246, 2 83.5 45,7 100.3 55.0

us 0.124 3 76.2 a7 176.5 96.7

250 0.061 4 5.6 3a 182.1 99.8

Pan 4 0.3 0.2 182.4 100.0,

Initial sample weight 183.6 g

Gm, sample weight 182.4 g

Error 1.2 g (0.79)

---Page Break---

6

TABLE 1. (Continued)

Sample #7 (South sandy area)

3 0,495 1 Ws 6.2 12.8

0 0,286 2 95.6 50.5 108.4 57.3

ns 0.128 3 73.9 39.0 182.3 96.3

250 0,061 4 68 3.6 199.1 99.9

Pan 4 on ot 189.2 100.0

Initial sample weight 190.3 g

Gum. sample weight 189.2 g

Error 11 g (0.68)

---Page Break---

TABLE 2. Gorgonian branching with plane orientation

Pseudopterogorgia spp.* Peerogorgia spp.* Bunicea sp.

280° 300" 280° 320° 300° 290°

280 280 280 320 300310

310310 300330 300300

320 300 300310 290 510

330320 30300 320510

300320 310320 200330

290330 300510 310

310320 so sto 310

20 310 300310 300

300300 290 270

320 Mo 300 280

300320 310 310

300310 300 290

310 sto 290 320

300300 290 300

300310 300 300

K = 306° i = 308° % = 302%

Average colony orientation - 304°- 124°

* Only two species found

---Page Break---

?TABLE 3, Gorgonian colony height in cn

Pseulopterogorgia spp.* terogorgia citrina _Eumices lacispica

35.0780 SSO 325

as 0 80 ITS 15.0

25 40.0 2.0 SO 30.0

15005017, 20.0 3.5

30.0 35,.0 50S BRS as

5S SS 45.0

2.05.00 SSD 20.0

ms RS 95 0 0 20.0

woo 35.050. 30.0 38.0

soo 20,035,078 2s

3.05.0 50S

300 25.0 15.0

& = 27.0 221.0 k= M45

* only two species found

---Page Break---

2

TABLE 3A, Mean wet weights (gn) of algae collected in 1/4 n2 samples

?

SPECIES STATIONS*

Rhodophyta

fransia multi fida

ator eriguetum

op

Coraline tigue

tonenta renutate

Dietyuras eceldeneatts

EnantocTauts deere

dies sceioer

racilaria Sop

reacia sr

tusiloba

scot Tanooas Tee algae

Phacophyta

2.50

0.75

Pistemterte plagograms

Bieqapteris Sop -

Distt mle amaicensis 5.00

Fospehe i variegaca

Sargassum 5p

Wiseettancots brow algae

Guiorophyta

5.75

218.50

3.80

10.05

025 115

see fsconden = a

Miscellaneous Algae 14,25

dnadyonene stettata

KuratnvTfea sigricans

?Refer to Figure 3 for station locations

---Page Break---

TABLE 4, ies list of benthic organisns from La

jupa Mission #12, May - June 1974

Spematophyta

Hydrocharitaceae

Halophila baillonis

Chlorophyta

Phacophyta

iassia testudinum

stellata

Canferpa cipiessoiges

a

mi

PenicttTus capitatus

rea Sp.

Valonfa ventricosa

Dictyopteris justeii

1B, delicatuta

os a fineensts

Pocockielia variegata

Soe

aaa

feansin multifide

uaa att

Sapte ates

Coelartrim albertisii

Corallina subulata

gubensis

Choptonents crenstace

Daya =p.

---Page Break---

TARLE 4, (Continued)

Rhadophyra (Cont)

oigeta sieuex

a

Taurencia poitei

Esp.

unidentified encrus

ag (Zam, Coratli

Porifera

Adocia sp,

SAthorighotia varians

Ghathgra aver nose

Sianarta greta

ends papyraceae

iatictons ope

Treinis faseicutata

Ficufosinetta rosacea

TrachygeTlus cinaclyra

Kestospongia muta

Coslenterata

Hydrozoa

Millepara alcicomis

lumlarta sp.

?Stylaster roseus

SHOEI tn aigae

identified - on Sargassum

Anthozoa

Octocorallia

Eunicea laxispica

Tournefortii

ricea sp,

Plexaura flexuosa

lapterogorgia acerosa

---Page Break---

TABLE 4, (Continued)

Anthozoa - Gctocora} Lia (Cont.)

Prorogorgia cizrina

Papste

Teresto ritset

anidentiFied Pennatulacean (fa,

Jooantharia

Spntastres anelar

rises sp.

?Sige angulosa

Torites astrearides

Silerastrea siderea

Stalchaetts sp.

?Tubastren aurea,

Sipuncudida

unidentified sipurcan ias

Annelida

Polychaeta

Saheliastarte magni fica

Spirobranchus gigantens

unidentt Fed AphodT eae

Serpulid sp.

llermenia verrucilosa

nti fied Nereidae

Unidentified Syitid

Vermitionsis sp.

Iysifice sp.

ftarphysa sp

Enlce sp.

siti ied Terebel Lid

unidentified Spionidae

---Page Break---

3B

TABLE 4. (Continued)

Arthropoda

Crustacea

Pygnogonidae

imidenti fied pygnogonids

?Stomatopoda

umidentified juvenile stonatopods

Cirripedia

\midentified barnacle

Anphipoda

imidenti fied gamarid amphipods

?unidentified caprellid amphipods

Tanaidacea

unidentified tanaidacean A

unidentified tanaidacean B

Tsopoda

Paracereis caudata

re

Nehatiacea

unidentified Nebaliacean (Barnes)

Decapoda

Stenopodidae

Stenopus. sp.

Macrura

Panulirus angus

alphegs se

unidentified Alpheidae

Prachyura

gettus coratinus

---Page Break---

M4

TABLE 4, (Continued)

Arthropoda - Crustacea (Cont.)

Mollusca

Gastropoda

Brachyura

jaltus dilatatus

a, forceps

3S portoricensis,

ihrer sp

Fortimus floridanus

Stenarynchus seticomis

inidentifled nayi

imidentified na}id B

tnidenti fied majid C

Anomra

unidentified pagurid

?aba incerta

ieee wabionta

?Sphatie tenets

Columbella nercatoria (dead)

Conus: daucus

Conus, mis

Trassispins Jeueooma

a

pee cates (dead)

raecassis testiculus (dead)

iter

Tagenfophue unicinctus

fettacus bisufcaras

alin temilabra

ginevie dontiaTote

ieee Sarbanes

tSurels Tages

aa >.

oie Suse weet

Fee tore

Rissoina sp.

Stronbus gigas

---Page Break---

35

TABLE 4. (Continued)

Mollusca - Gastropoda (Cont.)

Tricolia adansi

faelis Sie

SRR ST aS hranch

Pelecata

fog ice

Sees

cephatopoua

unidentified octopus

Scephopna

?un =p.

brazen

chidentified smooweeiag, ozo,

Eehinodernata

unidentified erinoide

sstropecten sp,

mse

Fehinoidea

fetter se ?Sexiesperforata

cpcurosden

wocena sp.

Wlonereis reticulata

---Page Break---

TABLE 4, (Continued)

Echinodemata - Ophiuroidea (Cont.)

eee

pophiuridae

hiodia sp.

fephipstis

Hiatothuroides

unidentified Halothuroids

chordata

Ascidiacea

idem sp.

stoma sp

Endistona carolinense

?Solgula sp.

Toljearpa sp.

ira Spe

Didemnidae

unidentified didennids

---Page Break---

TABLE 5, Species list of

at istote, Nay

Species Belted

Acanthuras bahianus 2

Aeanthunis coeruleus i

Anisostrems vivginicus 1

Ganeherhines puttus é

Gephatophotis! fala 5

Chaetodon striatus

Boteiels putats

Pinephelus Striatus

Ghmnothorax fimebris

Haomien aurolinestam

Haemuton carbonatiun

tenon chrysangyrean

tacmiton Flevel nests

Haemilon sels

Hotoceners ascensionis

Volocentrus rufus

Lactophrys:triqueter

[ejamus nahopent

Lut}anse synapris

Matlotdichthys nartinicus

Mpripristes Jacobus

ines macilatus

Ronboplives aurordens

Total

ad

188

fish captured by trap

June 1974

4

2

i

1

1

28

0

---Page Break---

38

TABLE 6. Species list of fish captured or observed

uring La Chalupa Mission May - June 1974

SPECIES

DASYATIDAE.

Dasyatis americanus

CLUPEIDAE

Jenkinsia Lamprotaenia

?SYNODONTIDAE

Synodus. foetens

NORINGIIDAE

Moringa edvardsii

MORAENIMAE,

Gymothorax funebris

Gymothorax moringa

Gymnothorax vicinus

opatarmnAE

Morophus punctatus

Nyrichthys oculatus

HOLOCENTRIMAE,

Holocentrus ascensionis

Holocentrus rufus

Myripristes jacobus

Holocentris Vexillarius

omarDrIMAE

Ogilbia sp.

Paraphidion schnisti

AULOSTOMIDAE

?Aulostomis maculatus

FISTULARIIDAE

Fistularia tabacaria

SmiquTHIDE

Micrognathus crinitus

?SPHTYRABNIDAE

Sphyraena barracula

BOTHIDAE

Bothus lunatus

Syacium micrurm

SPECIES

SSERRANIDAE

Alphestes afer

Cephalopholis fulva

Epinephelus adscensionis

Epinephelus guttatus

Epinephelus striatus

Serramus baldwini

Serranus flaviventris

Serranus tigrinus

GRAMIISTIDAE

Rypticus bistrispinus

Rypticus subbifrenatus

GRMNIDAE

Grama loreto

PRIACANTITDAE,

Priacanthus arenatus

Priacanthus cruentatus

PENPHERIDAE

Penpheris schonburgji

?BRANCHIOSTEGIDAE

Malacanthus plusieri

?CARANGIDAE

Caranx bartholonaei

Caranx fusus

Caranx ruber

Decapterus sp.

Elagatis bipinnulatus

Seriola dumerili

Trachinotus sp.

LUTJANIDAE,

Lutjanus analis

Lutjanus apodus

Lat janus cyanopterus

Latjanus jocu

Lutjanus mahogoni

Latjanus symagris

Ocyurus chrysurus

RhombopLites aurorubens

---Page Break---

TABLE 6. (Continued)

SPECIES

POMADASYIDAE

Anisostremis surinanensis

Anisostremis virginicus

Haemalon aurol ineatum

Haemilon carbonarium

aematon chrysargyreun

Haemsion flavolineatum

Haemilon melanin

Haemilon seiurus

?SPARIDAE,

Calamus bajonado

SCIAENIDAE

Equetus acuminatus

Odontoscion dentex

SULLIDAE

Pseudupineus maculatus

Mulloidichthys martinicus

QAETODONTIDAE

Chaetocon sedentarius

Chaetodon striatus

Holocanthus ciliaris

Holocanthus tricolor

Ponacanthus arcuatus

Ponacanthus paru

POMACENTRIDAE

Abudefduf saxatilis

Chronis mltilineatus

Euponacentrus fuscus

Euponacentrus partitus

Eupnacentrus planifrons

Microspathodon chrysurus

CURRUITIDAE

?Arblycirrhitus pinos

LABRIMAE

Bodianus rufus

Clepticus parrai

Doratonotus negalepis

Halichoeres bivittatus

Halichoeres garnoti

Halichoeres maculipinna

Halichoeres pictus

Halichoeres radiatus

Halichoeres poeyi

Henipteronotus martinicensis

LABRIDAE (Cont..)

Thalassoma bifasciatum

?SCARIDAE

Scarus coeruleus

Scarus croicensis

Sparisona aurofrenatun

Sparisoma chrysopterum

OPISTOGNATHIMAE

Opistognathus auri frons

CLINTDAE,

Malacoctenus triangulatus

Paraclinus fasciatus

Paraclinus grandicomis

SOOMRIDAE

Sconberonorus regalis

cosine

Gobioscma evelynae

CALLIONDADAE,

Callionymus bairdi

SSCORPAENIDAE

Scorpaena grandicornis

Scorpaena bergi

ACANTHURIDAE

Acanthurus bahianus

?Acanthurus chirurgus

Acanthurus coeruleus

BALISTIONE

Alutera schoepfi

Balistes vetula

Canthorhines pullus

Nelichthys niger

(OSTRACTIDAE

Lactophrys polygonia

Lactophrys triqueter

?TETRAODONTIDAE

Canthigaster rostrata

?Sphoeroides spengleri

DIODONTIDAE

Diodon holocanthus

---Page Break---

a

TABLE 9. Species List for phytoplankton 24 hour

station, 0900 28 May - 0900 29 May 1974

Bacillariophyceae (Diatoms)

Actinoptrcius sp.

fauigiots

eroneDia fotata

Hesfotemeta sepia

fasteriactnim STomgatan

Se

Thaetoceros atlanticus

CT. peruvianus

ce

Tocconeis sp.

fecha sp.

Biplonels fobs >)

Fras ilaria sp.

Cremmatiafors marina

one

FRanfauts Rauch

ie eee

stocylindricus danicus

lak sma

Ey,

fp am

Ricgechia elosterim

fencgasiae

N. Tongissina

& paratastcs

Hrablonens aru

Rhicosotenie sata

KR calcar aris

& gigas

RC fabstatasetispina

Striatella internpta

~ unipunetata

Stes cowteroties ira closteroides

fassionena nitzschoides

Teleration iceratiun sp.

Pennate diaton

Dinophyceae (Ninoflagellates)

fophidinium acutissinn

* Schroeder. (7)

x on

?solenia quadrispina

Cee

teres

Spe

Buvisetta sp.

ata minice

Se scrippsae

& Sp,

nium pmctatun

Sosa Saam azacile

Poridinium conicun

Pe divergens

globatus (2)

F grant

Hires

P: seein

P. frochoidem

B

Prorocentrm micans

is robusta (2)

inident ified dinofageniates

Coccolithophridae

eaters longa

Folepess aivtations

aspera

Riublospiaera styliter

or

other

Nerisnopediun sp,

THOpsezaity chethoutt

fhetbaurt

a Tbula

eee ae

Unidentiried phytoflagettate

Eutreptia marina

---Page Break---

TABLE 10, Important phytoplankton species (those appearing at Le:

umbers greater than 50 cells/liter) and timbers (

Chalupa 24 hour station 28-29 May 1974

000

Diatons

Asterionella notata 210

stoceros laevis 0

?occonets sp. 90)

Fragilaria sp. °

Hetarore 0, 510

Savfenla Sp (1g) 20

Mavicula sp, (sm) 80

Navioula c.f. warwicki 9

MitzschTa closterium 40

> delicatissina 250

R. paradoxica 0

Piebrosigta tp. 80

Wilzosolents Trapitissina ??

Striatela wipes sb

Thalassionenn nitsscholes 2)

ee istaas 0

Dinoflagellates

Exuviaetta sp, 50

Foniaulax minuta 10

ymnodiniun sp. (n 90

Gesotine Hiatus sp. (=m 150

?idiniun trochoidenum 60

Fp. 50.

SP.

Unidentified dinoflageltate 1910

Coccolithophores

Discosphaera tubifer 40

fia Barkowit 0

itosphaera sp. 4

ndentified coccolithophore 30

Other

Trichodesnium thoibauti 30

Solenicols setiaere 0

Thidentified piptoflageliate 250

Unidentified cet 30

Totals (cells/liter) S040

1300

°

20

0

420

50

120

10

180

590

60

°

20

50

430

10

50

200

2

160

10

40

0

0

500

140

3490

2100.

180

20

on

on

40

10

20

10

20

160

60

3190

Colis/Liter

28 May

215/liter)

29 May

0300

3600

---Page Break---

---Page Break---

---Page Break---