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Preconstruction Report: Biological Monitoring of the Hollywood-Hallandale Beach Renourishment: 1991

Richard E. Dodge
Nova Southeastern University Oceanographic Center, dodge@nova.edu

Walter Goldberg
Coral Reef Associates

Steven C. Hess
Environmental Resources Management - South, Inc.

Charles Messing
Nova Southeastern University Oceanographic Center, messingc@nova.edu

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PRECONSTRUCTION REPORT: BIOLOGICAL MONITORING OF THE HOLLYWOOD - HALLANDALE BEACH RENOURISHMENT: 1991

Prepared for:

Broward County Board of County Commissioners
Erosion Prevention District of the Office of Natural Resource Protection
609b S.W. 1st Ave.
Ft. Lauderdale, FL 33301

Prepared by:

Dr. Richard E. Dodge [1], Dr. Walter Goldberg [2], Dr. Steven Hess [3],

Dr. Charles Messing [1]

[1] Nova University Oceanographic Center
8000 N. Ocean Dr.
Dania, FL 33004

[2] Coral Reef Associates
9701 SW 62nd Ct.
Miami, FL 33156

[3] Environmental Resources Management - South, Inc.
8181 N.W. 36 Street, Suite 20
Miami, FL 33166

Submitted:

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1.0 INTRODUCTION

1.1 Project Background

In 1990, Nova University (Contractor) with Coral Reef Associates and ERM South (Subcontractors) was awarded a contract to provide biological monitoring services for the Hollywood Hallandale Beach Renourishment Project. A notice to proceed for the initial biological monitoring (Preconstruction) was issued in ?August, 1990. Preconstruction field monitoring took place in October, 1990. Laboratory work was begun at the start of 1991 following the analysis of samples from the previous John U. Lloyd beach renourishment monitoring. Renourishment dredging is tentatively scheduled to take place starting in April or May, 1991. Approximately ? cubic yards of sediment are scheduled to be removed and subsequently emplaced on ? miles of shoreline.

1.2 Project Overview

1.2.1 Contracted Scope of Services

Biological Analytical Services contracted for in the Hollywood - Hallandale Beach Renourishment Monitoring are organized in four separate evaluation periods:

(a) Once during Summer or early Fall before construction begins.

(b) Once approximately one (1) year after (a).

(c) Once approximately two (2) years after (a).

(d) Once approximately four (4) years after (a).

The scope of analytical services consisted of three tasks as described below.

Task 1. - Transects: Contractor shall at reef areas adjacent to each of fifteen coral community stations conduct transects of a method to allow an assessment of the density of scleractinian (stony) coral colonies in each area (corals/square meter).

Task 2 - Quadrats: Contractor shall conduct an *in situ* qualitative (species identification) and quantitative (species counts) inventory of all sessile flora and fauna found within fifteen 2 x 2 meter (m) pre-established, coral community monitoring stations.

Task 3 - Cores: Contractor shall sort and identify to the taxon as low as reasonably achievable, within any time constraints that may be imposed by Florida Department of Environmental Regulation, all specimens larger than 0.5 mm (millimeters) stained with Rose Bengal contained in sand core samples obtained from offshore soft bottom sites.

The offshore soft bottom sand coring infaunal study sites will be located and conducted as follows. Infauna at the fill site shall be collected from four transects from the fill area at least three hundred (300) meters apart. One station shall be established along each transect at an elevation of -5 to -7 feet MLW. Control site infauna shall be collected from four (4) transects offshore J.U. Lloyd Beach as control sites. Fifteen (15) replicates shall be taken at each elevation along each transect. Infauna at the borrow sites shall be collected from five (5) randomly

spaced stations from portions of the borrow area that are used for the project. For the preconstruction samples, the stations should be placed in areas that are expected to be excavated. The stations must be at least twenty (20) meters apart. Three (3) samples shall be taken at each station. In addition, triplicate samples shall also be taken at five (5) stations in a comparable area that is not affected by the project. There will be a total not to exceed on hundred fifty (150) samples.

2.0 METHODS AND MATERIALS

2.1 Field Assessments

2.1.1 Sites

2.1.1.1 Transects and Quadrats

Fifteen Broward County reef sites were selected for detailed biological monitoring of the stony coral community. Figure 1 shows monitoring sites off the beach fill area and sites near the borrow area. Six (6) existing sites offshore of John U. Lloyd Park were chosen as control sites (JUL5 & JUL6 - First Reef, JUL7 & JUL10 - Second Reef, and JUL8 & JUL9 - Third Reef). Three sites were established on the First reef adjacent to the Construction Beach (sites HH1, HH2, and HH#). Three sites were chosen on the Second Reef adjacent to and west of the primary and secondary borrow areas (JUL1, HH4 and HH5) (JUL1 was a prior J.U. Lloyd assessment site. Three sites were chosen on the Third Reef adjacent to and east of the primary and secondary borrow areas (JUL2, HH6, and HH7) (JUL2 was a prior J.U. Lloyd assessment site). Depths of stations at each reef were approximately as follows: First reef 10-20'; Second Reef 30-50'; Third Reef 45-75'.

2.1.1.2 Cores [CHUCK & STEVE]

Names sites and briefly describe, refer to DER permit requirements

2.1.2 Field Methods

2.1.2.1 Belt Quadrat Transects

Following an initial survey of each site, SCUBA divers drove metal stakes (rebar) into the reef to define 2 x 2 m square quadrats and a transect of 20 m length along the reef surface. One corner stake of the 2x2 m quadrat was used as the start stake of each transect. Another stake was emplaced at 10 m and a final stake at 20 m. Transects were oriented in an approximate north-south direction and were implemented by securing a tape measure (graduated in centimeters (cm)) between the 10 m interval metal stakes.

Each reef site was assessed by laying a quadrat of known area (0.75 m^2) sequentially along first one side and then the other of the 20 m transect line. The stony corals within each quadrat were identified to species and sized (either approximate diameter for hemispherical or length and width for subrectangular colonies). Corals with diameters less than 1 cm were

omitted from analysis. The species *Siderastrea siderea* and *Siderastrea radians* were grouped as *Siderastrea* spp. because of difficulties with precise field identification. The hydrozoan *Millepora alcicornis* also was included in the assessment. Corals, if bleached, were so noted.

Shannon-Weaver Diversity Indices for stony corals (including *Millepora alcicornis*) were calculated for each transect. Two indices were calculated, one based on numerical abundance, H'N, and one based on coverage abundance, H'C. The calculation procedure for H is given below under 2.2.1 for cores. The proportions, p_i, were based upon either numerical abundance for H'N or coverage abundance for H'C.

2.1.2.2 Quadrats

At each of the fifteen quadrat stations, four metal stakes, previously implanted by hand, defined the corners of a 4 m^2 quadrat. Initial examination by SCUBA divers indicated if any stakes were dislocated or lost. Following replacement of stakes where necessary, SCUBA divers tied a length of yellow polypropylene line around the stakes to define the quadrat perimeter. Macroepibenthic organisms were identified and counted *in situ*. When specific identifications could not be made, samples from outside the quadrat were collected, transferred to plastic bags, preserved in 70% ethanol or fixed in 10% borate-buffered formalin, and transported to the laboratory for subsequent identification. A series of color photographs were taken of each quadrat. Underwater photographs were taken using a Nikonos V camera with 28 mm or 20 mm lens affixed to a tripod.

Certain taxa, notably algae, encrusting alcyonarians, and zoanthideans, were difficult to enumerate because, in many cases, it was not clear whether a single colony or cluster of separate colonies was present. Similarly, it sometimes was difficult to assess if loose associates of ascidians represented colonies or isolated zooids. Some of these forms were noted as numerous, but uncounted, organisms in colonies or clusters.

The major taxonomic groups of organisms identified are as follows: Porifera, Cnidaria (Alcyonaria, Scleractinia, Zoanthidea) and algae. Minor components included Ascidiacea, Hydrozoa, and Polychaeta.

2.2 Laboratory Assessment Methods

2.2.1 Cores

Unconsolidated sediment samples were diver collected with a hand-held coring apparatus. Each sediment sample was transferred underwater to a plastic bag and fixed on shipboard in 10% borate-buffered formalin solution containing Rose Bengal.

At the laboratory, each core sample was separately washed with sea water through a 0.5 mm mesh Nalgene screen. Organisms and sediment retained on the screen were decanted into a 70% ethanol solution and stored in glass jars pending sorting.

Organisms were sorted initially to phylum or general morphological form (e.g., Mollusca,

Crustacea, "worm", "other") and subsequently to lowest recognizably distinct taxa. Only organisms apparently alive at the time of collection were counted (i.e., dead molluscan shells were not considered). Specimen identifications were undertaken by Nova University staff and various taxonomic specialists recognized as authorities for the specific taxa they were asked to identify (Appendix 4).

Shannon-Weaver Diversity Indices were calculated for each core site and each period using the following equation:

$$H' = -\sum_{i=1}^{s} p_i \ln p_i$$

where p_i is the relative abundance of species *i*. H' increases with increasing number of species *S*. For any given *S*, H' reaches a maximum value (H'_{max}) when all values of *p* are equal ($p_1 = p_2 = p_3 ...$), and H' equals ln *S*. Because H' is primarily affected by species number rather than by abundances of common or rare species or by species of moderate abundance. Evenness (J') also has been calculated for each core site at each period using the equation:

$$J' = H'/H'_{max} = H'/\ln S \qquad (2)$$

As a ratio between the Diversity Index (H') for a given station and the maximum possible diversity index (H'_{max}) for the number of species and specimens at that station, Evenness (J') gives an indication of how close the data come to maximum possible diversity.

3.0 RESULTS

3.1 Transect Results

A relatively large bottom area of 30 m^2 was assessed at each reef site. Figure 2 shows the species-area curves calculated from the Belt-Quadrat transect at each site in the pre-construction assessment. These curves plot the cumulative number of coral species encountered versus the cumulative number of square meters of reef sampled. When the curve shows pronounced leveling, a sufficient area of reef has been assessed to obtain a representative sample. The fifteen figures are grouped by the First, Second, and Third Reefs. The curves of each site show pronounced leveling by approximately 20 m^2, which confirms that the 30 m^2 area is sufficient for assessment.

Figure 3 depicts the population parameters versus depth of each individual station for the preconstruction data. Data points have a station abbreviation identifier affixed. Coral coverage appears positively correlated with station depth, although some stations at deep depth have low coverage (e.g., H6). Coral density is more variable with depth, showing no clear pattern. There is a general trend of increasing diversity (H'C, H'N) with depth. There appears to be a trend of increasing Evenness (H'C/HMAX, H'N/HMAX) with depth, although variability is high.

Figure 4 shows the mean of parameters over the five stations on each "reef". Variability within the means is very high. Mean coral cover and mean density is lowest on the First reef and roughly equal on the Second and Third Reefs. Diversity indices (H'C and H'N) are lowest on the First Reef and roughly equal on the Second and Third Reefs. A similar pattern is evident for Evenness (H'C/HMAX and H'N/HMAX).

Table 1-1 (Appendix 1) provides statistics from the belt-quadrats transects describing the coral community for the Preconstruction assessment. Included are total number of corals sampled, percent coral coverage, coral density, and diversity indices. Diversity statistics included both number of species and the Shannon-Weaver Diversity Index (calculated both on coral abundance, H'N, and coral coverage, H'C). Evenness, using the two methods, also is provided. Detailed data for each station, including a breakdown of areal coverage of each species, number of specimens and percentage of coral are included.

Table 1-2 (Appendix 1) provides a summary of individual station and average station transect results. For averaging, stations have been grouped by general location (First, Second, and Third Reefs).

3.2 Quadrat Results **[WALT TO WRITE] e.g.,**

Tables 2-1 through 2-15 (Appendix 2) provide a listing of macrofauna and macroflora observed at each quadrat organized by major groups. Abundance and richness data also are enumerated. Descriptions of each quadrat by survey period follow.

e.g.,

Site HHJUL 1: Southwest of Borrow Area, 2nd reef, Depth 45 feet. Low relief, chiefly barren substrate with numerous large alcyonarians (e.g., Eunicea spp., Pseudopterogorgia) and scattered sponges (e.g., Ircinia campana, Callyspongia vaginalis). Corals few and mostly small.

Site ...: etc.

3.2.1 Major Taxonomic Groups

3.3 Cores Results [CHUCK & STEVE TO WRITE]

3.3.1 Introduction

e.g.,

Table 3-1 (Appendix 3) lists all organisms identified and enumerated at all core sites. Organisms have been identified to the most specific taxonomic category practicable with a few exceptions: 1) nematodes and harpacticoid copepods, normally treated as meiofauna, 2) calanoid and cyclopoid copepods, typically planktonic, 3) attached and encrusting forms not normally considered as faunal components of benthic communities on unconsolidated substrates (i.e., hydroids, scyphistoma polyps, most bryozoans), and 4) specimens (probably chiefly fragments)

unassignable to phylum ("Unknown"). These taxa have been omitted from diversity index calculations (Table 3-9) (Appendix 3). In addition, the third group has been omitted from calculations of relative abundances (Tables 3-2 to 3-8, Appendix 3).

A total of _____ specimens were collected, representing ___ taxa. The number of taxa is an approximation and represents species richness only imperfectly. As mentioned above, two major faunal components, nematodes and harpacticoid copepods, have not been identified to species and are included here as single taxa. This, of course, decreases any estimate of richness. In contrast, specimens recognizable only as juveniles or unidentifiable members of a taxon that includes other identified species [e.g., *Glycera* sp. (juv); Unidentified paleonemertean], may actually belong to one of the identified species (e.g., *Glycera americana*; Paleonemertean sp. 4), and contribute to an overestimation of richness.

Table 3-2 (Appendix 3) summarizes the abundances of major taxonomic groups of macrofauna by station and sampling period (omitting attached and encrusting forms). Tables 3-3 to 3-6 (Appendix 3) list dominant species by station and sampling period. Relative abundances (percentages) given in these tables and in the following text are derived from station totals that omit the small number of attached organisms.

Table 3-9 (Appendix 3) indicates Shannon-Weaver Diversity Indices calculated for each core site using the following equation:

$$H' = -\sum_{i=1}^{s} p_i \ln p_i$$

where p_i is the relative abundance of species i. H' increases with increasing number of species (S). For any given S, H' reaches a maximum value (H'_{max}) when all values of p are equal ($p_1 = p_2 = p_3 ...$), and H' equals ln S. Because H' is primarily affected by species number rather than by abundances of common or rare species or by species of moderate abundance, Evenness (J') also has been calculated for each core site and sampling period (Table 3-7, Appendix 3) using the equation:

$$J' = H' / H'_{max} = H' / \ln S$$

As a ratio between the diversity index for a given station (H') and the maximum possible diversity index (H'_{max}) for the number of species and specimens at that station, Evenness (J') gives an indication of how close the data come to maximum possible diversity (1.0).

3.3.2 Core Summaries [CHUCK & STEVE TO WRITE]

e.g.,

<u>DANIA BEACH (DB) Inshore control site, 500 ft off Dania Beach; depth 10 ft.</u>

<u>Survey I</u> (Mar 89): Low macrofaunal abundance (242 individuals) and richness (16 taxa),