IMPACT OF SAND DREDGING ON THE FAUNA OF A SUBMERGED DATA SOUTH OF KEY BISCAYNE, FLORIDA

by

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Report to the Des Rocher Sand Co., Inc., H. McGovern, President

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At the request of Mr. H. McGovern a study was made on the site of the dredging operation of his company to determine the effect on the animals in the area. This report is limited to the biological aspects of the study, specific geological and hydrographic information is given in separate reports. The dredge site is located south of Cape Florida near channel marker "S" (Figure 1). The top of the platform or bar is about 7 feet below the surface of the water and is composed of calcareous and small broken shell. The sand in the immediate area of the mining operation i8 devoid of any of the larger forms of vegetation. Ripples in the and atop the platform extend east and west suggesting strong prevailing currents over the bar in this general direction. Our observations extended from April 27 through October 16, 1973, and involved 5 sampling trips to the dredging site. On the first two trips samples were collected on the barge when the commercial operation was still in progress. The three remaining trips were carried out after the commercial operation was stopped.

Commercial dredging was done using a Maddox pump driven by a GH 671-165 HP Diesel engine. No cutter head or Jet pump device was used in the operation. The pump draws the bottom material up through a 8 in. diameter hose onto the sloping flume where it passes over fine screening that allows the desirable sand to fall through the screening onto the barge where it is retained in a single large bin. The larger material such as shells, stones, coral, etc., quickly pass down the flume and directly over the side of the barge. The barge can be loaded in about 2 hours. The operation is done on ebbing tide because the water is calmer and over clear sand to avoid clogging screening with plant material.

After two visits to the dredging site we became aware of the difficulties of answering the numerous questions about the impact of the operation on the environment. So at that we strongly recommend that the commercial operation be given an extension of their permit to mine commercially in order to allow us to do an adequate study of the effects of sand dredging on the fauna of the bar. Mr. McGovern agreed to finance the proposed study for any period up to one year. Sampling from the commercial dredge permits large representative samples from actual operation and the results of the proposed study would provide guidelines for other dredging operations in other locales in south Florida. Unfortunately, an extension of the permit to mine sand was not allowed so the sampling had to be done by other means.

METHODS AND MATERIAL

After the commercial operation had stopped field collections were mate using a suction device powered by a Maya fluid transformer connected to a 5 HP gasoline engine. This pump has a 2 in. diameter nozzle and is rated at approximately 140 gal/min to the transformer. Pumping was

carried out for 5 minutes at each location within a one-quarter meter square frame set on the bottom. Animals and debris were retained in a fine woven mesh beg with a 1/8 in. opening. Station positions were determined with a bearing compass.

A general survey was made of the bottom character, extent of seagrass ant animals on the sand bar. These visual transects were completed by diver-biologists who were towed behind a slow moving skiff.

RESULTS

One of the most difficult problems facing marine biologists is to attempt to measure productivity of a particular locality. In connection with these studies there are many direct questions put to them such as:

"Is one area more productive than another?" or: "What would be lost, or gained, if certain alterations were made to an area?" These questions are especially difficult for two reasons:

1. There is no firm agreement on methods of measuring biological productivity at the various levels of production.

2. There are so many variables that enter the equation that it is almost impossible to measure even the more important ones in the usual short term studies..

One attempt to answer questions of this sort is to use the concept of species structure involving species diversity and abundance. In general, and this is greatly oversimplified, in a productive area many species exist (diversity) and because of good conditions of existence such species is represented by many individuals (abundance).

The lists of species we collected on the dredge and later at the dredge site using our own pump are attached. The number of species from all samples is small and the number of individuals is also small (Table 1). The tiny clam *Gouldia* and some of the polychaete worms are the only species that live in substantial numbers on the platform. ~ number of others present occur in very low abundance. This result agrees with statements by Odum (1963, 1971). In 1963 he wrote "The pattern of a few common species associated with many rare species seems to hold regardless whether we deal with an ecological category such as "producers" or herbivores or with a taxonomic group...". In 1971 he wrote "Species diversity tends to be low in physically controlled ecosystems (i.e., subjected to strong physiochemical limiting factors) and high in biologically controlled ecosystems". The small number of species we found on this platform reflects the severity of the environment. The only organisms that can survive here are those that inhabit the sand and then only the first few centimeters below the sand-water interface. The mobility of the sand and the high velocity of the currents (see D'Amato's report) coupled with scarce food in this environment makes existence very difficult. Odum (1963) also states a general ecological principle that "The total numbers of species is reduced where conditions of existence are severe (as in the Arctic) or the geographic isolation is pronounced (as on an island)". Again, our findings agree with this principle when we consider the nature of this sand bar environment. In other work on the productivity of grass flats (Bader and Roessler, 1971) found 354 animal species in Biscayne Bay associated with seagrass beds of *Thalassia*.

A comparison of dredged areas vs. undredged areas or where dredging had ceased years ago is of obvious value to help determine if continuous dredging in an area would depress the abundance of populations. We located our control area on the south end of the same bank (Figure 1) in an effort to get an environment as similar as possible in depth, current, velocity and direction, sand composition, etc., to that of the dredged site. This control area had been dredged years ago but

had been left untouched for at least 5 years. We also sampled at one station north of the dredging site (area 2) but found the bottom to be composed of large shell fragments and to be generally dissimilar to the dredged area and thus rejected its use as a control site.

Briefly, results of our study showed: - that the entire bar (areas 1 and 3) had little grass cover. The seagrasses observed by towing two divers behind the boat were mainly on the southern end of the bar (near area 3) and covered only a small percentage of the bottom. - the total number of animals in this dredged area (area 1) was small and was dominated mainly by very small gastropods (snails) and bivalves (clams) (see Wanless, 1974). About 267 cubic inches of sand (.6% of a cubic yard) of sand was removed at each sampling location and contained on the average of about 44 animals within 4 species. Most of the bivalves collected were near the sand-water interface with some of the annelid worm tubes extending slightly deeper. Below that the sand was devoid of animals. A comparisons of numbers of animals on control area 3 and dredged areas (area 1) showed just slightly more species present on the control areas.

The general conclusion that we can draw from these limited field collections and observations suggest that the number of animals taken up by the dredging operation is small and of relatively few species. Furthermore, the total biomass is small.

It is doubtful that the smaller molluscs are harmed when they return to the water, after passing through the dredge. Some perhaps most, of the small clams recover after passing through the pump because specimens dug into the sand in an aquarium we placed on deck. However, some Crustacea, polychaetes and tiny fishes were undoubtedly injured. It must be emphasized hat the latter species make up a very small portion of the total bottom animal population present in this area. The fact that we found as many animals as we did in the dredged site and that there exists the variety f species albeit few in number after so many years of dredging suggests hat the impact on the fauna has not been harsh.

CONCLUSIONS

1. The submerged sand platform where dredging was carried out is a harsh environment subjected to rather high current velocities and mobile sand.

2. Both the number of species and abundance of individuals present were small in the study area which is typical of this type of environment.

3. Comparison of species diversity and abundance between dredged and control areas shows no important differences.

The majority of animals found in the sand are found near the sand-water interface.

Molluscs, at least, apparently can pass through the dredging equipment with little harm.

Considering the low biological productivity of the area and the nature of the mining operation which allows many of the animals to survive, the amount of damage to the fauna is minimal.

LITERATURE CITED

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Figures and tables

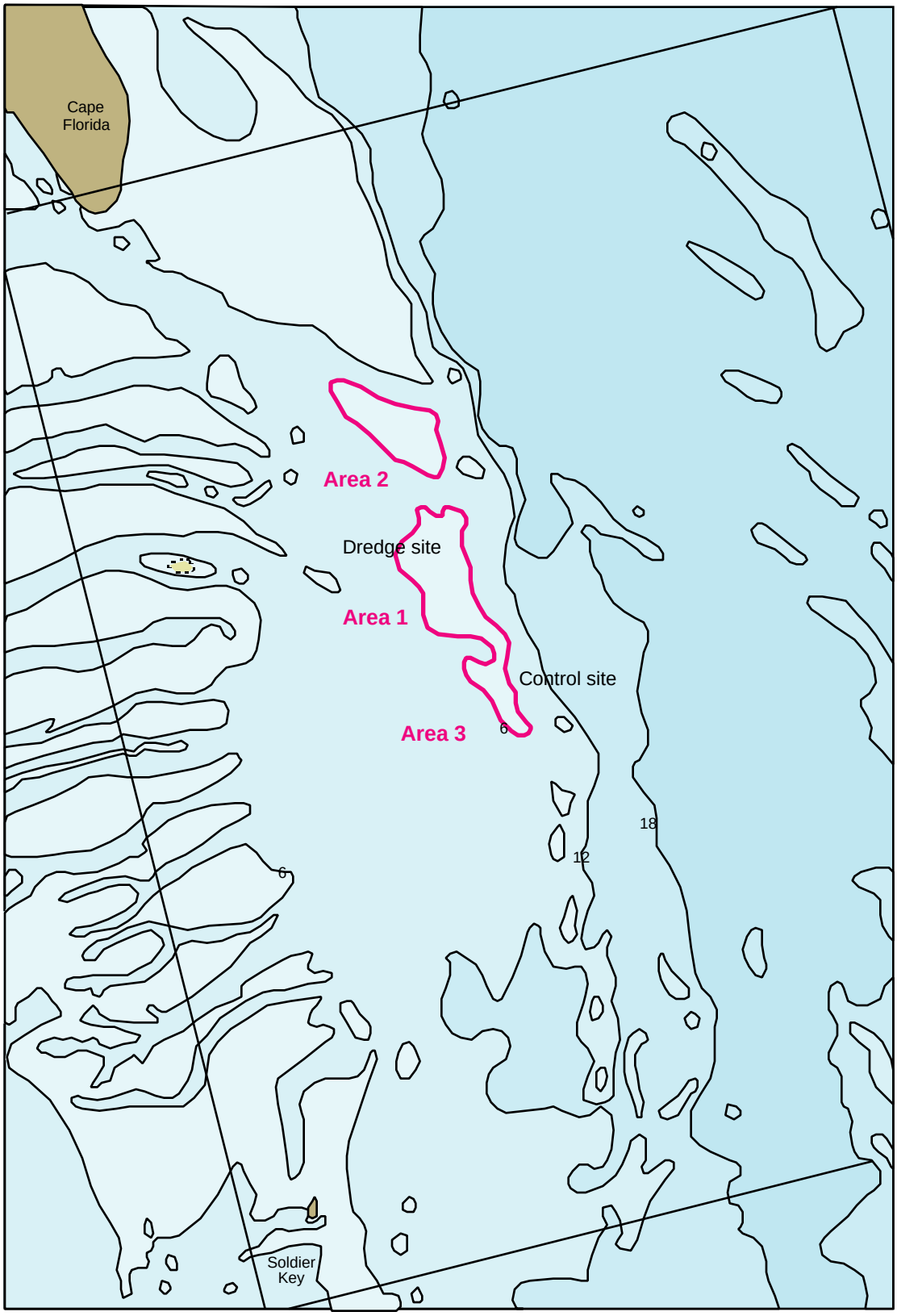
Cape
Florida
Area 2
Dredge site
Area 1
Control site
Area 3
6
18
12
6
Soldier
Key

Table 1. Fauna associated with sand-water interface. Des Rocher Sand Co., Inc.

DREDGE SITE								CONTROL	
July 13, 1973									
Sample No.	1	2	3	4	5	6	7	1	
No. “Spp.”*	4	2	4	10	9	9	8	8	
No. Ind.	23	34	50	55	18	27	36	44	
July 18, 1973									
Sample No.	1	2	3					1	
No. “Spp.”	6	3	6					11	
No. Ind.	65	48	11					21	
October 16, 1973									
Sample No.	1	2	3					1	2
No. “Spp.”	6	6	7					8	10
No. Inc.	64	59	72					45	34

* Not all specimens were identified to species.

Field notes – Dr. E. S. Iversen

April 27, 1973

Live animals collected:

Crustacea:

Lepidopa sp. (1) (sand hopper)

Molluscs:-

Terebra dislocata (4) (Auger)
Tellina radiata (2) (Tellin - yellow form)

May 10, 1973

Live animals collected or observed from either dredge or diving:

Molluscs:-

Olivella mutica (7) (olive)
Divaricella quadriscula (2) (clam)

Crustacea:

Lepidopa sp. (3) (sand hopper)

Fish:

Dactyloscopus crossotus (1) (star gazer)

Worms:

Fam. *Nereidae* (1)

Dead shells (likely live in same area)

Terebra hastata (Auger)
Terebra dislocata (Auger)
Murex recurvirostris (Murex)
Phacoides sp. (clam)
Pecten ziczac (scallop)

KEY BISCAYNE DREDGE SAMPLES – July 13, 1973

Dredge site – Area 1
Sample #1

2 *Dactyloscopus crossotus* (Bigeye stargazer)
1 Unidentified Polychaete (worm)
1 Unidentified Isopod (crustacean)

19 Unidentified *Gouldia* sp. (clam)

Sample #2

1 Unidentified Polychaete (worm)
33 Little clams (clams)

Sample #3

1 *Dactyloscopus crossotus* (fish)
1 *Bittlum* sp. clam (small)
4 *Olivella mutica* (Say)
44 Unidentified bivalve (*Gouldia* sp. (clam))

Sample #4

1 *Callinectes ornatus* (crab)
2 *Dentalum floridense* (tusk shell)

Numerous dead *Tricolia affinis* and *Olivella mutica* and some very small *Astraea phoebia*.

46 little clams *Gouldia* sp. (clam)
3 *Phocoides trisulcatus* (clam)
1 Juvenile flatfish (fish)
1 *Ophellidae* (polychaete) (worm)
1 *Sigalionidae* (polychaete) (worm)

Control site – Area 2 (Sample #5)

3 *Phacoides trisulcatus* (clam)
1 *Tellina americana* (clam)
12 Unidentified bivalves *Gouldia* sp. (clam)
3 *Olivella mutica* (small)
1 *Anachis petill* (snail)?
5 *Glycesetis undata* (clam)
1 *Dentalum floridense* (tusk shell)
1 *Dactyloscopus crossotus* (fish)
14 *Glyceridae* (polychaete) (worm)
1 *Sigalionidae* (polychaete) (worm)

Sample #6

Sample Vol.	Total Vol.
500 mL	2100 mL

1 *Glycymers undata* (only 1 in total sample) (clam)
1 *Dentalium* sp. (tusk shell)
1 Unidentified isopod (crustacean)
1 tiny cockle
1 Unidentified bivalve *Gouldia* sp. (clam)
8 *Olivella mutica* (snail)
1 *Ophellidae* (worm)

Sample #7

Note: This sample consisted of a total of 1200 mL of material. A subsample of only 200 mL was sorted and the animals listed below.

3 *Melita quinquiesperforata* (sand dollar)
1 *Dactyloscopus tridigitatus* sand stargazer (fish)
2 *Procissa* sp. (crustacean)
16 *Glycellidae* (worm)
1 *Olivella mutica* (Say)
1 tiny cockle
1 Unidentified bivalve *Gouldia* sp. (clam)
1 mysid shrimp

Sample #8

8 *Glycymeris undulata* (Atlantic bittersweet)
19 *Glaeceidae* (worm)
1 *Sigalionidae* (worm)
4 *Dentalium floridense* (tusk shell)
4 *Gouldia* sp. (clam)
2 small cockles (clam)
1 small venus clam (clam)

KEY BISCAYNE – July 18, 1973

Dredge Site – Area 1
Sample #1

1 *Dactyloscopus* sp. (fish)
2 Isopods (Crustacean)
1 *Sigalionidae* (worm)
3 *Phaecoides trisulcatus* (clam)
1 *Dentalium* sp. (tusk shell)
57 *Gouldia* sp. (clam)

CI July 18, 1973 – samples

Control area 3
Sample #3

1 *Melita quinquiesperforata* (sand dollar)
1 *Tellina americana* (clam)
1 *Dentalium* sp. (tusk shell)
3 *Phaecoides trisulcatus* (clam)
7 *Gouldia* sp. (clam)
2 *Portunus depressifrons* (crab)
2 cockels (clam)
1 isopod (crustacean)
1 *Maldanidae* (worm)
1 *Sigalionidae* (worm)
1 *Ophellidae* (worm)

Sample #2

44 *Gouldia* sp. (clam)
1 *Dactyloscopus crossotus* (fish)
1 Unidentified polychaete (worm)

Sample #4

1 *Portunus depressifrons* (crab)
1 *Dactyloscopus crossotus* (fish)
6 *Gouldia* sp. (clam)
1 *Olivella mutica* (snail)
1 *Sigallon idae* (worm)
1 *Sipunculid* (peanut worm)

KEY BISCAYNE DREDGE SITE – October 16, 1973

Control - 10-16-5

1 *Melita sexiesperforata* (sand dollar)
2 *Dactyloscopus* sp. (star gazer)
18 *Gouldia* sp. (clam)
6 *Phacoides trisulcatus* (clam)
3 *Tellina Americana* (clam)
1 *Venericardia tridentata* (clam)
2 *Olivella mutica* (snail)
~12 *Leptosynapta parvipatina* (sea cucumber)

10-16/3 - Dredged area

54 *Gouldia* sp. (clam)
2 *Phacoides trisulcatus* (clam)
2 *Olivella mutica* (snail)
1 Family *Processidae* (shrimp)
1 *Leptosynapta parvipatina*
~4 *Polynoidae* (?) (worm)

10-16/1 - Dredged area

44 *Gouldia* sp. (clam)
1 *Phacoides trisulcatus* (clam)
1 *Dentalium* sp. (tusk shell)
11 *Leptosynapta parvipatina* (sea cucumber)
1 *Nereidae* (worm)
1 *Orbiniidae* (worm)

10-16/2 - Dredged area

62 *Gouldia* sp. (clam)
3 *Phacoides trisulcatus* (clam)
2 *Leptosynapta parvipatina* (sea cucumber)
2 *Olivella mutica* (snail)
1 *Polynoidae* (worm)

1 *Terebra hastata* (snail)
1 *Portunus gibbesii* (swimming crab)

10-16/4- Control area

20 *Gouldia* sp. (clam)
1 *Melita sexiesperforata* (sand dollar)
3 Isopoda
1 *Polynoidae* (worm)
4 *Phacoides trisulcatus* (clam)
1 *Sipunculid* (peanut worm)
1 *Olivella mutica* (snail)
1 *Leptosynapta parvipatina* (sea cucumber)
1 *Dentalium* sp. (tusk shell)
1 *Corbula nasuta* (clam)