BENTHIC MACROFAUNA OF ROMER SHOAL (RARITAN BAY) IN RELATION TO SAND MINING

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1. Introduction

Recreational fishing in the New York metropolitan area has increased dramatically in the past fifty years. Favorite fishing grounds in this area are among the most heavily fished in the world. As seasonal migrations of fish stocks enter the Hudson-Raritan River estuarine system, they tend to concentrate in areas characterized by sharp relief (scarps) along the ocean floor. Isolated rises or "banks" and depressions or "holes" off these scarps serve as gathering spots for large numbers of fishes (Freeman and Walford 1974). Many factors may play a role in determining these congregations, including temperature and, of course, food abundance.

Romer Shoal, located in eastern Raritan Bay south of Ambrose Channel and north of Swash Channel, has been traditionally a major summer/fall recreational fishing area (D. Christensen, NMFS, Sandy Hook, NJ, pers. comm.). Between July and November, these grounds are utilized heavily by anglers fishing for fluke, bluefish, weakfish and striped bass. The shoal's attractiveness to these species is probably due in large part to its physical characteristics and/or to forage organisms present on and near the shoal. Mining of portions of the shoal could alter the composition of the benthic macrofauna, which represent a portion of the food supply. This report therefore presents NMFS's existing data on the area's macrofauna, beginning with a brief overview of the fauna of Raritan Bay as a whole, followed by descriptions of the fauna of Romer Shoal-Ambrose Channel and of a deep dredge hole just west of Romer. An assessment of possible changes due to mining is then given.

2. Benthic Macrofauna of Raritan Bay

In 1972, McGrath (1973) sampled sediments and benthic macrofauna at 88 stations located throughout Raritan Bay (Figure 1). Samples were collected with a 0.1 m Smith-McIntyre bottom grab, and a 1.0 mm sieve aperture was used to retain the macrofauna (these methods apply to all samples discussed in this report). McGrath described two faunal assemblages, one in muds and one in sands, with the former much lower in numbers of individuals and species. McGrath observed that the fauna of the bay as a whole was very sparse compared to values reported in the literature for other areas. His bay-wide census terminated just west of Romer Shoal, but did include Flynns Knoll, a smaller shoal area immediately to the southwest (Figure 1). Table 1 shows numbers of species and individuals found on Flynns Knoll and at other stations near Romer, compared to mean values for the entire bay census. Clearly, the sandy sediments in the eastern bay support a denser, more species-rich assemblage than does the overall bay (whole-bay averages are reduced by inclusion of data from mud-bottom stations; other sandy areas in the bay also contain higher than average numbers of species and individuals). One of the two Flynns Knoll stations had exceptionally high (for Raritan Bay) densities -- a mussel bed, with its characteristically rich associated fauna, was present at this station.

Species listed by McGrath (1973) as abundant in sandy sediments near Romer Shoal and elsewhere include a number of taxa considered important as forage, e.g. haustoriid amphipods, (*Parahaustorius longimeris*, *Protohaustorius wigleyi*, *Acanthohaustorius millsi*), mussels, and juvenile surf clams (*Spisula solidissima*) and tellin clams (*Tellina agilis*). Bloodworms, *Glycera* spp., were also collected in the sandy sediments, and sandworms, *Nereis* spp., are probably present there as well -- these two genera, which are choice forage items, may be undersampled

by the Smith-McIntyre grab. Three other highly important forage species which are undoubtedly more abundant than their occasional presence in grab samples would indicate, are the mysid, Neomysis americana, sand shrimp, Crangon septemspinosa, and sand eel, Ammodytes americanus.

3. Macrofauna of Romer Shoal

Between August 1972 and July 1973, McGrath (unpublished) conducted seven samplings of 16 stations in and near Ambrose Channel (Figure 1). Six of these stations are on the northeast edge of Romer Shoal, and several more may be on the southern margin of East Bank, depending on how the bank is defined. Table 2 shows numbers of individuals collected at each station, for each cruise. Table 2 may indicate some seasonality in the data, with higher densities in the warmer months (as would be expected). However, as with many benthic data sets, spatial and temporal variability appear too great to make strong statements based on the single grab samples. Averages of the seven samplings at each station are therefore also given in Table 2. A computer listing of numbers of each species collected for each station and sampling date is provided as Appendix A.

Mean densities at all stations are seen to be higher, often by a wide margin, than the bay-wide average of 11 organisms/0.1 m. Again, this is partly because sands throughout the Raritan Bay area have higher faunal densities than do muds; the Romer Shoal-Ambrose Channel area does not necessarily support higher biomass or productivity than do other sand bottoms. Mean densities shown in Table 2 are lower than those reported for sandy sediments in Long Island Sound (Reid, Frame and Draxler 1979), and are comparable to densities found just off the southwest Long Island coast (Steimle and Stone 1973).

Collections from the Shoal-Channel areas (Appendix A) did contain relatively large numbers of the forage species listed above as occurring in Raritan Bay sands. Haustoriid amphipods were especially abundant at the "S" (Romer Shoal) and "N" (East Bank) stations. Haustoriids were present but less abundant at the Ambrose Channel stations, where other forage species (polychaetes, mysids) were more common.

No great differences in overall faunal densities were apparent between shoal and channel stations (Table 2).

SCUBA observations by the senior author in July-August 1980 revealed large mussel beds along the edges and slopes of Romer Shoal. Again, these mussels and their associated fauna may be a valuable food source for several fish species.

4. "Dredge Hole" Macrofauna

McGrath (unpublished) also studied the "Dredge Hole", a heavily mined area approximately 2 nautical miles west of Romer Shoal (Figure 1). Data on faunal densities encountered in seven samplings of the Dredge Hole are listed in Table 3. The area was found to be consistently low in macrofaunal density and diversity, with species composition typical of the mud fauna in Raritan Bay. As was reported for the bay-wide survey (McGrath 1973), several grab samples had very few or no macrofauna specimens.

There has been concern that creation of deep holes in Raritan Bay would inhibit mixing of bottom waters, potentially generating anoxic conditions which could lead to death of most metazoans, and release of hydrogen sulfide and other toxicants. McGrath (unpublished), in a late July 1972 survey, found temperature, salinity and dissolved oxygen not to change greatly with depth in the Dredge Hole. He speculated that the area's strong currents might prevent establishment of a typical thermocline, but noted that measurements should be made later in the summer, and in subsequent years, before it could be concluded that anoxia would not be a problem. A survey of dredge holes in other New Jersey estuaries (Murawski 1969) found stagnant bottom waters with reduced dissolved oxygen, and absence of benthic macrofauna, in a majority of the holes.

5. Possible Impacts of Mining on Romer Shoal

This assessment will not address any direct effects an alteration of Romer Shoal might have on the shoal's physical attractiveness to finfish. We must also note that it is merely an assumption that fish in the shoal area are feeding extensively on the small crustaceans and other benthic forage species which are relatively abundant there; no gut content analyses have been made to confirm this. Our best estimate is that the shoal's benthic macrofauna make a contribution, though probably not the most important contribution, to the area's overall attractiveness to fish.

A range of impacts of mining on the benthic macrofauna is possible. If the mining went no deeper than Ambrose Channel (depths of 39-44 feet, according to NOAA charts), then the recolonizing fauna would be expected to resemble those of the channel (see Section 3). Some changes in species abundances could take place including reduction in numbers of amphipods, and perhaps elimination of mussel beds, but other forage organisms would be among the replacing species. Given the dynamic nature of the area, and the mobility of many of its benthic species, recolonization should be fairly rapid. Romer Shoal is thought to be a relict glacial deposit, and could not be expected to be rebuilt by sands brought from Long Island by littoral drift, as occurs to some extent on East Bank (Schlee and Sanko 1975).

If sands were mined to the depth of the Dredge Hole (~80 ft), deposition of fine sediments (and associated contaminants) would likely occur, and the fauna would eventually resemble the impoverished Raritan Bay mud assemblage. Forage value of the benthos would undoubtedly be lessened, and anoxia might or might not be created in bottom waters (Section 4). We do not know at what depth, between the depth of the channel and that of the Dredge Hole, deposition of fine sediment would become significant, and the mud faunal assemblage would begin to predominate.

Finally, one possibility which is gaining in interest is the mining of sand banks in Lower Bay, followed by backfilling with contaminated dredge spoils and capping with sands. If these sand caps were indeed stable, they should soon be colonized by fauna from the surrounding sands, with little or no change in forage value to finfish. Remobilization of contaminants would be a threat during and after dredging, and the fauna and interstitial water of several sand caps should be monitored closely for increases in contaminant loads. If no problems are uncovered, mining with capping could represent at least a partial solution to the multiple demands placed on areas such as Romer Shoal.

Literature Cited

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Table 1. Numbers of individuals and species per single 0.1 m^2 grab (McGrath 1972) at stations near Romer Shoals, compared to averages for his entire Raritan Bay survey. See Figure 1 for station locations.

Station	Number of Species	Number of Individuals
7	8	24
9	26	68
10	11	52
11	9	30
12	24	1062
19	6	12
20	10	28
Bay-Wide Average	4	11

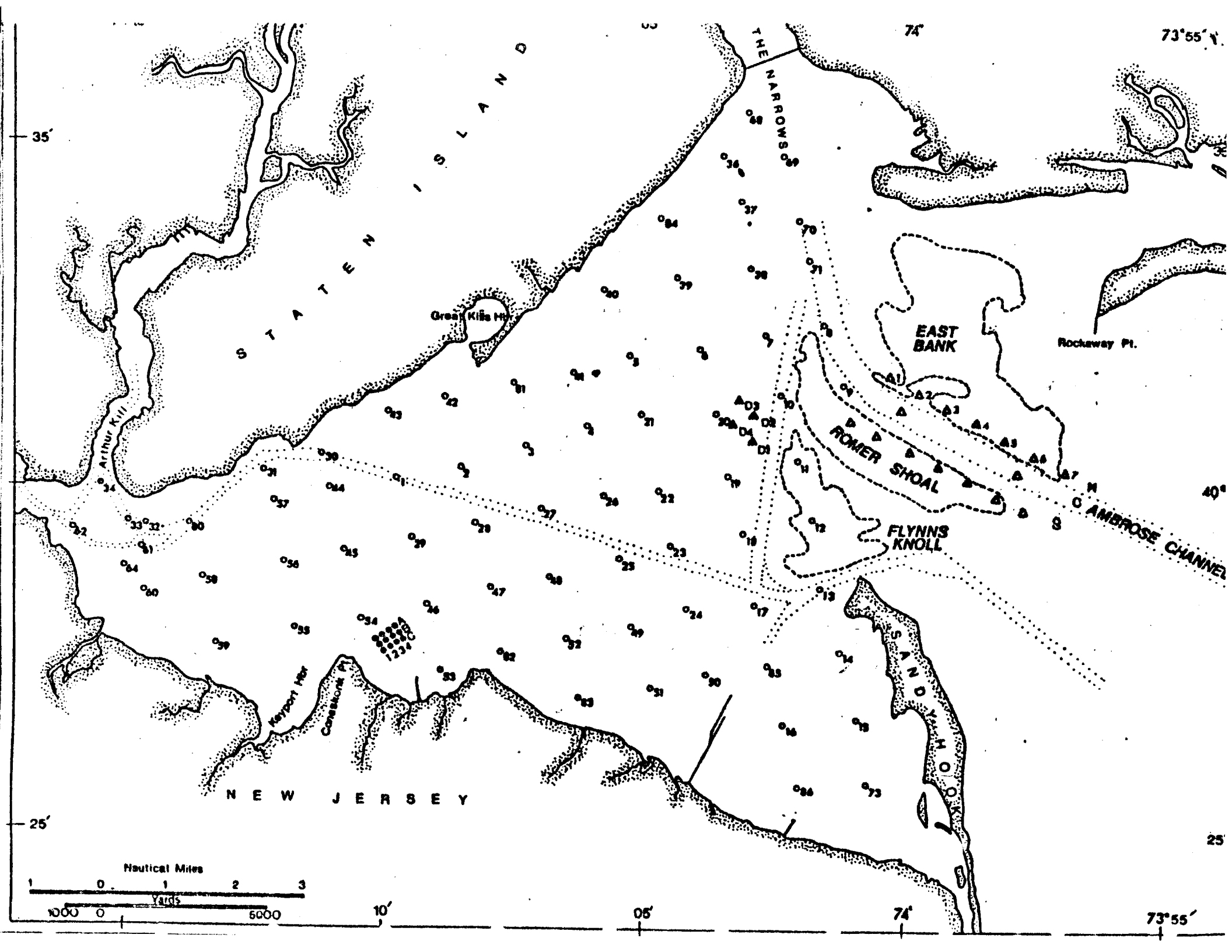
Table 2. Numbers of individuals per single 0.1 m^2 grab sample at stations in ("C"), north of ("N"), and south of ("S") Ambrose Channel on seven sampling dates (McGrath, unpublished). Stations S1-S6 are on edge of Romer Shoal, and some "N" stations are on or near East Bank -- See Figure 1.

Sampling Dates	C2	C6	N1	N2	N3	N4	N5	N6	N7	S1	S2	S3	S4	S5	S6	S7
Aug. 72	No Data	869	52	143	41	56	30	201	17	36	52	128	51	35	38	22
Sept. 72	No Data	25	198	537	85	28	61	167	44	71	73	96	18	83	111	41
Oct. 72	23	No Data	3	287	140	109	25	91	156	80	89	46	28	105	64	4
Nov. 72	8	6	No Data	131	27	61	14	15	5	22	11	4	11	22	12	1
Feb. 73	4	2	7	32	50	37	7	5	2	10	7	16	30	12	4	1
Mar. 73	60	130	96	19	64	67	9	19	15	36	4	27	10	35	34	6
Jul. 73	146	5	93	127	155	107	50	53	57	38	38	86	43	No Data	48	591
Total	241	1037	449	1276	562	465	196	561	296	293	274	403	191	292	311	666
2 Yr. Average	48	174	76	182	80	66	28	80	42	42	39	58	27	49	44	95

Table 3. Faunal densities per single 0.1 m^2 grab at four stations in the "Dredge Hole", Raritan Bay on seven sampling dates (McGrath, unpublished).

	D1	D2	D3	D4
Mar. 72	15	16	7	5
Jul. 72	13	1	8	41
Aug. 72	90	10	38	63
Oct. 72	18	16	2	27
Feb. 73	12	10	0	16
Mar. 73	6	2	1	6
Jul. 73	77	No Data	1	No Data
Average	33	8	7	20

Figure 1. Station locations (o) for McGrath (1973) benthic census of Raritan Bay. Stations sampled during special surveys of the Ambrose Channel environs (△) and of a dredge hole in east-central Raritan Bay (▲) are also indicated.


74°
73°55′
35′
25′
THE NARROWS
STATEN ISLAND
Great Kills Hbr.
Arthur Kill
EAST BANK
Rockaway Pt.
ROMER SHOAL
FLYNNS KNOLL
AMBROSE CHANNEL
SANDY HOOK
Keyport Hbr.
Conaskonk Pt.
NEW JERSEY
Nautical Miles
1 0 1 2 3
Yards
1000 0 5000
10′
05′
74′
73°55′