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Sedimentation From a Hydraulic Dredge in a Bay¹

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Abstract

Red gravel was used to mark the bay sediment surface at 5 stations in turtle grass flats near Aransas Pass, Texas prior to the dredging of an intracoastal waterway. Cores were taken and sediments were studied before, one week after dredging, and 18 months later. 22 to 27 cm of sediment (11 to 55% silt-clay) were deposited within 0.5 mile of the dredge, but effects at greater distance were negligible. Little sediment sorting was observed during dredging.

Introduction

It is routine in the digging of channels in Texas bays and lagoons for a hydraulic dredge to deposit sediment removed from channels in discrete piles called "spoil islands" or "spoil banks." The objective of the present study was to ascertain the amount of sediment distributed on a shallow fertile bay bottom as a result of sediment by-passing the spoil island during the dredging operation, and by later erosion of the spoil island. The work was part of a joint project by the Texas Game and Fish Commission of Texas and the Institute of Marine Science, designed to determine the effect of dredging on marine life. The area chosen for the study was Redfish Bay, near Aransas Pass, Texas. A "before and after" type study was possible because of a projected extension of the intracoastal canal, 125 feet wide and 12 feet deep, through Redfish Bay.

The method used to estimate the amount of sediment deposited in the bay by the dredge was as follows: square meter quadrats were marked off in five locations over the turtle grass flats in Redfish Bay by setting a bamboo pole, easily visible from a distance, at each corner of a quadrat. A layer of red aquarium gravel was then spread on top of the sediment inside the quadrats. Cores were then collected periodically before and after dredging from within each quadrat, and the thickness of sediment above the red gravel measured. Plastic tubes 1 $\frac{7}{8}$ inches in diameter were used for coring.

The five quadrats were oriented perpendicular to the proposed channel (Fig. 1). The channel was dug between quadrat 1 and the mainland. Quadrat 1 was approximately 0.03 mile from the channel, quadrat 2 was 0.5 mile, quadrat 3 was 1.0 mile, quadrat 4 was 1.5 miles, quadrat 5 was 2.0 miles distant from the channel. The spoil from the channel was deposited between quadrats 1 and 2, but closer to 1 than 2.

Results

Cores obtained immediately after the red gravel was spread on the sediment were kept in the laboratory as controls in order to determine whether or not the gravel would sink by its own weight into the sediment. The gravel remained on top of the sediment

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FIG. 1. Photograph facing south along the intracoastal channel after the dredging in May, 1960. Station 1 is indicated in the middle right. Station 2 is along the left margin. Stations 3-5, not visible, stretch out to the left (west) of the spoil island more or less perpendicular to the channel axis. Dark areas underwater behind the spoil island are grass flats. The causeway between Aransas Pass and Port Aransas is visible in the background. The narrow strip of land covered with vegetation in the foreground is man-made, once supporting a railroad. The picture was taken by Mr. W. Garner from a U. S. Army helicopter.

in the coring tubes throughout the tests. Slight agitation simulating wave action in the tubes did not cause the gravel to sink into the sediment.

In September, 1959, nine months after the gravel was distributed, the quadrats were re-cored in order to estimate thickness of sediment deposited in the bay under existing conditions prior to dredging. The amount of sediment deposited during the nine month period was negligible at all 5 quadrats, being at most 2-3 mm. The quadrats were again re-cored about one week after the dredge passed through the sample area. Twenty-seven cm of sediment were deposited over quadrat 1, and 22 cm over quadrat 2 (Table 1). Sediment deposited on quadrats 3, 4, and 5 was negligible.

Eighteen months after the dredge had passed the sample area the quadrats were again

TABLE 1
Amount of sediment deposited before and after dredging*

Station quadrat no.	Thickness of sediment deposited in 9 months prior to dredging, cm	Thickness of sediment 1 week after dredging, cm	Thickness of sediment 18 months after dredging, cm
1	negligible	27	32
2	negligible	22	33
3	negligible	1/2	negligible
4	negligible	1/2	.
5	negligible	1/2	3

* Thickness of sediment measured from reference surface marked with red gravel spread in December, 1958.

re-cored in order to estimate the amount of sediment that had been distributed on the bottom as a result of erosion of the spoil island. The gravel in quadrat 1 was found to be covered with 32 cm of sediment and in quadrat 2 with 33 cm showing that 5 cm of sediment had been added to quadrat 1 and 11 to quadrat 2 as a result of erosion of the spoil island. Sedimentation on quadrat 3 was negligible; quadrat 4 could not be located. Quadrat 5 had 3 cm of organic muck over the gravel, but this apparently was not derived from the spoil island.

In order to ascertain how the composition of the sediment was affected by dredging, the upper 10 cm of sediment in quadrats 1, 2, 4, and 5 were separated into a silt-clay and shell-sand fraction before the dredging by sieving (Table 2). The sieving was re-

TABLE 2
Composition of sediment before and after dredging

Station no.	Miles from dredge	Before dredging silt-clay per cent*	One week after dredging silt-clay per cent*
1	0.03 west	51	11
2	0.5 east	43	55
3	1.0 east	60	60
4	1.5 east	.	.
5	2.0 east	67	67

* Remaining percentage of sediment consisted of sand-shell fraction.

peated with the sediment deposited by the dredge in quadrats 1 and 2. The sediment deposited by the dredge in quadrat 1 was coarser than the original, containing only 11 per cent of silt-clay mixture compared to 45 per cent before dredging (Table 2). The sediment deposited on quadrat 2 was not appreciably different from the underlying sediment. The sediment deposited on quadrats 1 and 2 during the dredging operation was homogenous with no layers apparent. Sediment deposited during post-dredging erosion of the spoil island was finer than that deposited during the dredging (R. Schultz, personal communication, 1960).

Discussion and Conclusions

Ingle (1952) found after studying sediment deposition during dredging in a Florida bay that damage caused by deposition of mud on the bottom did not extend beyond 0.23 mile from the dredge. In Redfish Bay dredged sediment was deposited more than

0.5 mile, but less than 1 mile, from the spoil bank, somewhat further than Ingle observed in Florida.

It might have been erroneously predicted that during the dredging operation dredged sand and shell would remain on or close to the spoil area, and clay and silt spread widely on the bay bottom. The similarity in the composition of sediment before and one week after dredging on quadrat 2 and non-deposition of sediment appreciably further than 0.5 mile from the spoil area indicate that the sediment was not sorted to an appreciable extent during the dredge operation. This may be because sediment containing clay is usually ejected from the dredge flume as chunks (mud balls) rather than as discrete particles (Kornicker, Oppenheimer, Conover, 1959). Some sorting locally is indicated by the low percentage of the silt-clay fraction in sediment deposited on quadrat 1 during dredging.

The accumulation of sediment finer than the original on quadrats 1 and 2 during the 18 months following the dredging indicates that sediment forming the spoil island is sorted as it is reworked by waves. It might be predicted that sediment surrounding the spoil area will become somewhat coarser as the finer material is removed and distributed in deeper water.

The fact that more sediment was deposited during the 18 month post-dredging period on quadrat 2 (11 cm) than on quadrat 1 (5 cm) suggests that waves are the principal agent eroding the spoil bank, since station 2 faces the windward side of the spoil island, whereas station 1 faces the lee side.

The accumulation of more sediment on the windward side of the spoil island than on the lee side during the post-dredging period suggests that spoil islands formed during dredging should be situated on the windward side of channels from which the sediment was obtained in order to minimize the amount of sediment returning to the channel.

The technique of using colored gravel chips as a reference to gauge deposition of sediment proved workable and may be useful for making similar studies elsewhere.

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