The Effects of Engineering Projects on Galveston Bay Estuaries

Project: 2-12-R-1

Roy B. Johnson

The Effects of Engineering Projects on the Ecology of Moses Lake

INTRODUCTION

In 1962, construction was begun on the Texas City-LaMarque Hurricane Flood Protection Project, a program of the U. S. Army Corps of Engineers, which provided for a 16.2 mile-long earth levee along the western edge of Galveston Bay. This levee, with a maximum height of 23 feet above sea lev was designed to protect low areas from tidal flooding during storms.

In 1964, preliminary work was completed on a portion of the Hurricane Protection Levee which crossed the mouth of Moses Lake, a protected estuar of the Galveston Bay System. During the three year period from 1964-1967, this portion of the Hurricane levee has remained incomplete, as a closable tide control and navigation structure has been under construction. During this period, exchange of water between Galveston Bay and Moses Lake has been through a temporary ditch, 155 feet wide and 10-12 feet deep, which was reduced in width to 35 feet in October, 1966 after the ditch was closed up during a storm threat. Final procedures in construction wil be the opening of the tide structure, and shaping and sodding of the levee

The Hurricane Levee, and accompanying spoil enclosure, cover approxi- mately 250 acres of bay bottom, and constrict the natural mouth of Moses Lake which existed prior to 1964. Water exchange will be through the tida structure, which will be 56 feet wide and 13 feet deep, compared to the natural opening which was approximately 0.5 miles wide with an average dep of 3 feet.

The purpose of this study is to determine the effects of the Hurrica Levee on the fishery ecology of Moses Lake, in order that procedures migh be determined to minimize harmful effects in similar, future projects.

METHODS

Gear used were a minnow seine (60 feet wide, with a mesh size of 3/4 inch stretched), a bar seine (6 feet wide, 1/2 inch mesh) and a drag sein (750 or 1,350 feet long, 2 inch mesh). Each gear type was pulled a standard distance to collect a sample. Other samples were collected with net, trammel net, otter trawl, modified Ekman Dredge, coring tube, and b hand.

Six seine stations and one bar seine station were sampled at least monthly, and two other bar seine stations were sampled through October. dom samples were collected in other areas. Drag seine samples were colle at 2 regular stations and at random locations from June through October.

Sediment samples were collected with a bottom dredge and coring tube, and portions of dredge samples were dried and labelled for future reference and analysis. Surface water temperatures were determined using a Centigrade thermometer. Surface water samples were collected for salinity and turbidity analysis. Salinity was determined using an American Optical Goldberg Refractometer. The refractive index was converted to salinity in parts per thousand. Turbidity was determined in per cent light transmission using a Bausch and Lomb colorimeter. Estimates of current velocity were made by timing drift markers and dyes over known distances.

DESCRIPTION OF THE AREA

Moses Lake is located on the southwest edge of Galveston Bay near the outskirts of Texas City, in Galveston County (Figure 1). It is approximately 12 miles northwest of Bolivar Roads, the nearest Pass to the Gulf of Mexico.

The bay is 2.5 miles long, 0.5 to 3 miles wide, and has an area of approximately 1,600 acres. The major source of fresh water is Moses Bayou, which enters the western corner of the bay.

Average depth is 3-4 feet, with the exception of a short oil well channel in the central bay (4-6 feet), and two borrow pits near the Hurricane Levee which range from 15 to 40 feet deep.

Except for stretches of bluffs (5 feet elevation) along the northwest and Texas City shore and a sand flat along the Hurricane Levee, Moses Lake is fringed by marsh.

FINDINGS

Hydrographic Conditions

In the absence of strong winds, currents in back bays and marshes were negligible. Strong currents were observed only at the tidal opening. Corps of Engineers personnel[1] measured current velocity from 1.7 - 2.4 knots in the opening during a normal diurnal tide. In November, current velocities of approximately 4 knots were estimated during a strong ebbing tide, associated with a drastic drop in Galveston Bay tides during a cold front. Considerable impounding of water in Moses Lake was noted.

Salinities were lowest during the spring and summer, 1966 (2.0-10.0 ppt), associated with heavy rainfall, with a gradual increase to a high of 26.6 ppt in March, 1967, during high spring tides. Salinities were low in Moses Bayou during most of the year (less than 3 ppt), but increased to 17.0 ppt in March near State Highway 146, with a gradient to lower salinities inland.

There was no evidence that salinities were altered by reduced flow through the Hurricane Levee. Although salinities were lower in Moses Lake, variations in salinity patterns were similar to those of Jones Bay[2] (Figure 2).

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[1] Source of information, Mr. D. T. Graham, Chief, Engineering Division

[2] 2-12-R Phase 2 Project Area

Figure 1: Diagram of Moses Lake showing location of the Texas City Hurricane Protection Levee. Sampling stations are also indicated.

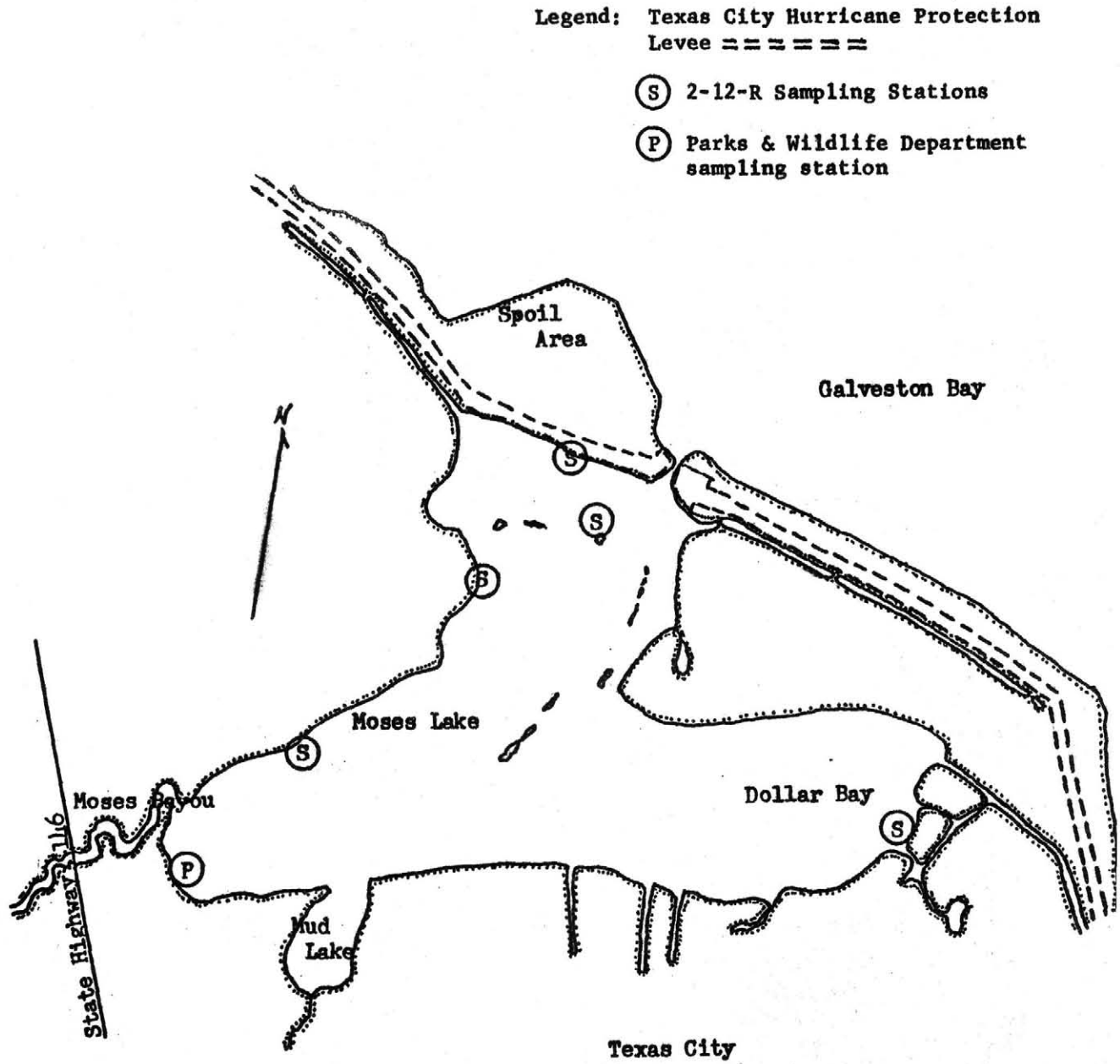


Figure 2: Average Salinities by Sampling Period, Moses Lake, April 1966 - March 1967, Compared to Salinities from Jones Bay.

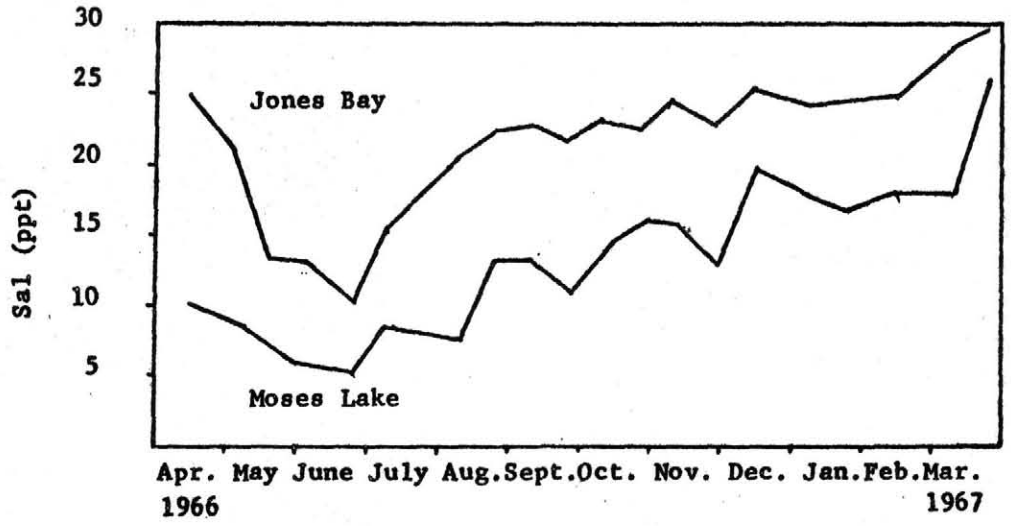
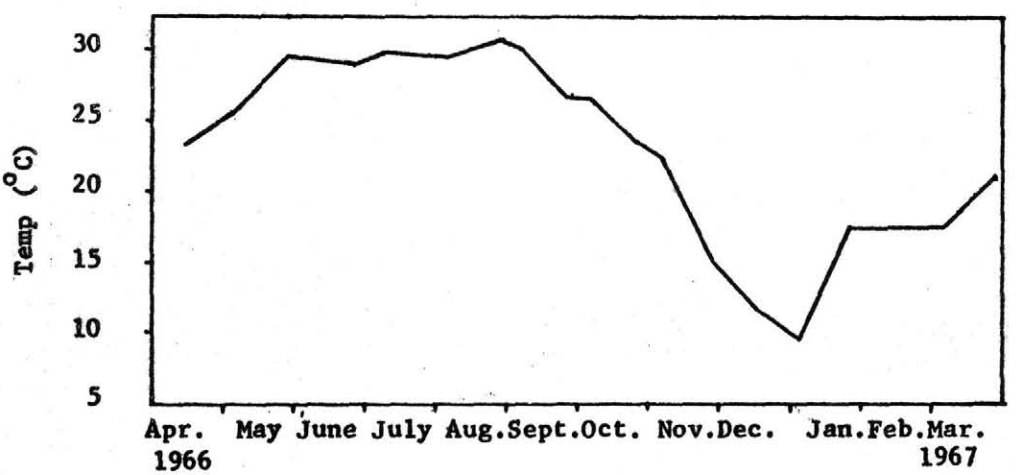


Figure 3: Average Surface Temperatures by Sampling Period, Moses Lake, April 1966 - March 1967.



Temperatures, as expected in shallow estuaries underwent seasonal extremes, ranging from less than 8° Centigrade in January to a high of 34° C. in July. Average temperatures are presented in Figure 3.

Vegetation

Benthic macroscopic plants were not abundant. Species of the algae Enteromorpha and Cladophora (Division Chlorophyta) found attached to shel and other submerged objects, exhibited maximum growth in fall and winter. Polysiphonia sp. (Division Rhodophyta) an epiphyte on marsh plants, and Lyngbya sp. (Division Cyanophyta), a mat forming alga, were present in marshes. Widgeon grass, Ruppia maritima, and aquatic phanerogam, populat a small pond near Moses Bayou, but only fragments of this species was detected in the Bayou, and none in the bay. The scarcity of benthic plan is possibly due to excessive turbidity.

Perennial grasses and rushes which populate marshes are of primary influence on the ecology of the bay in the production of food and in the provision of "cover" for marine organisms. Cord grass, Spartina alternif and salt grass, Distichlis spicata, were found near the bay, while dense stands of S. patens populated inland marshes. Accumulation of plant detr from the erosion of shorelines was evident.

Invertebrates

The relative abundance of major groups of organisms taken by minnow seine is presented in Table 1. Seasonal abundance of major species is sh in Figure 4.

Seasonal abundance of brown shrimp, Penaeus aztecus, and white shri P. setiferus, followed patterns reported for Galveston Bay by Moffett (19 Small brown shrimp (20-30 mm) were present in samples from late April to mid-May, while larger juveniles, 40-90 mm, were taken in moderate numbers through July. During these periods, marshes were affected by runoff fro heavy rainfall. Brown shrimp were scarce in drainages where salinities w less than 2 ppt.

White shrimp were abundant from September to November. In October, large numbers of shrimp were landlocked when the Hurricane Levee was clo for five days during a storm threat. Except for a larger size group of shrimp in seine samples than otherwide might be expected (numerous specir from 90-130 mm), no abnormal conditions were noted. Salinities were 13.: 15.5 ppt just before the levee was reopened.

The grass shrimp, Palaemonetes pugio, was abundant during spring an summer in marshes.

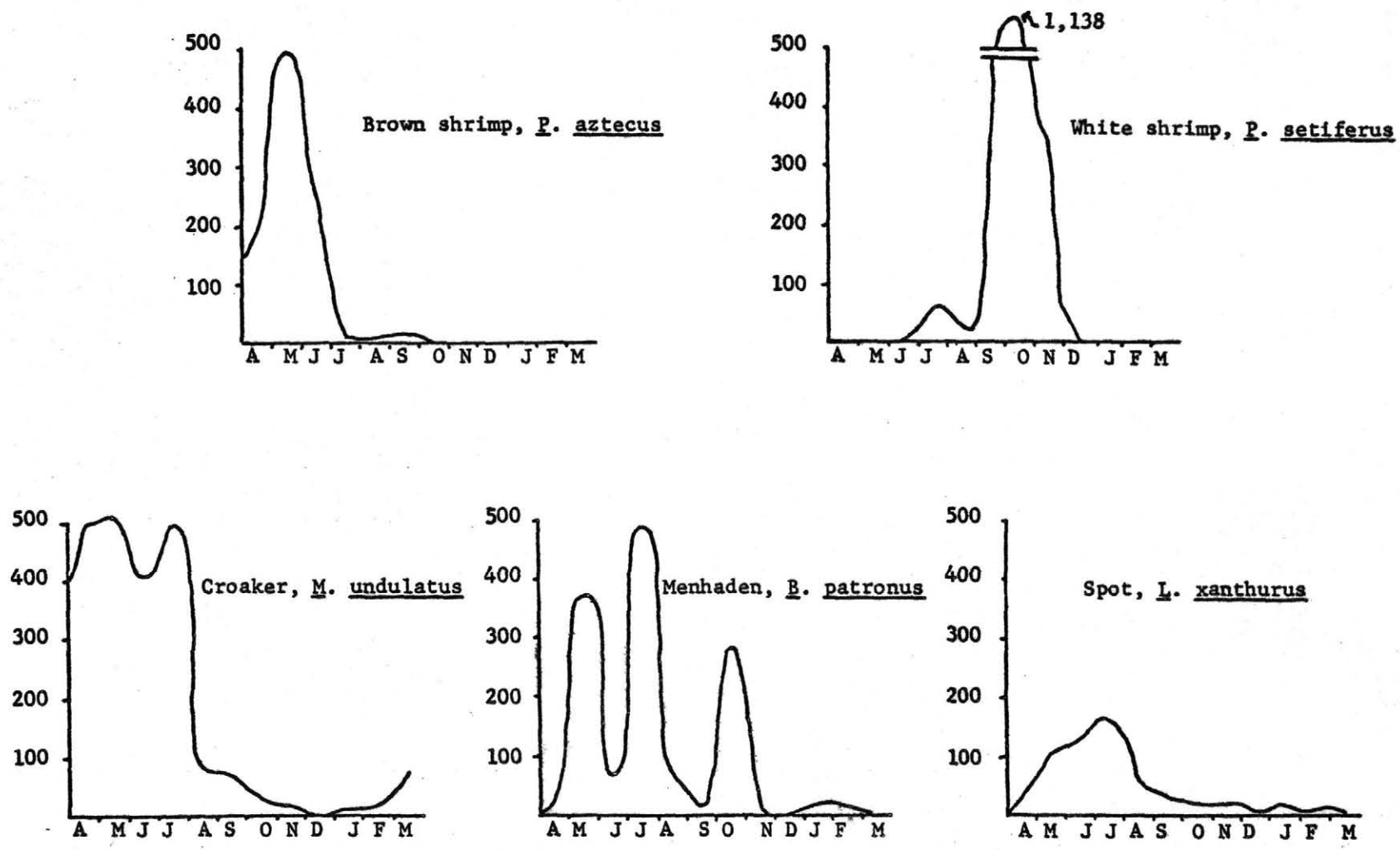
Although blue crabs, Callinectes sapidus, were not abundant in samp they were taken throughout the year in all salinities. Juveniles less t 20 mm carapace width were taken in greatest numbers in spring and summer Adult crabs were present all year and supported a limited fishery in the During two years of study in Moses Lake by Parks and Wildlife Department personnel, consistent large catches of juvenile blue crabs had been made

Table 1: Summary of major groups of organisms collected by seine from Moses Lake, April, 1966 - March 1967.

	Total Number	No./ Sampling Period
(A) Commercial Crustaceans		
Penaeus setiferus (White shrimp)	3,662	203.4
P. aztecus (Brown shrimp)	1,284	71.3
Callinectes sapidus (Blue crab)	205	11.4
Total	5,151	
(B) Year Class 0 Food and Game Fish		
Sciaenops ocellata (Redfish)	33	1.8
Pogonias cromis (Black drum)	23	1.3
Cynoscion nebulosus (Spotted seatrout)	11	.6
Paralichthys lethostigma (Southern flounder)	10	.6
Total	77	
(C) Major Forage and Other Fish Species		
Micropogon undulatus (Atlantic croaker)	2,631	146.1
Brevoortia patronus (Largescale menhaden)	1,981*	110.1
Leiostomus xanthurus (Spot)	721	40.1
Mugil spp. (Mullet)	560	31.1
Galeichthys felis (Sea catfish)	343	19.1
Fundulus grandis (Gulf killifish)	98	5.4
Lagodon rhomboides (Penfish)	92	5.1
Citharichthys spilopterus (Spotfin whiff)	76	4.2
Total	6,502	

*Excludes catches of approximately 10,500 menhaden on 30 May and 1,195 on 9 October, 1966.

Figure 4: Seasonal abundance of major species taken in seines, Moses Lake, April 1966-March 1967.



However, a general decline in numbers were noted in all areas sampled in Galveston Bay in 1966 (More, personal communication).

Gulf crabs, C. danae, were taken in small numbers in spring and fall.

The mussel, Brachidontes recurvus, was associated with reefs of oysters, along with numerous mud crabs and marine annelids. Other pelecypods frequently taken in benthic samples were Macoma mitchelli, Mulinia lateralis, Tagelus plebeius and Rangia flexuosa.

Fishes

Juvenile redfish, Sciaenops ocellata, were taken in greatest numbers during spring and early summer (Figure 5). Principal sizes taken were 120-300 mm total length. Adult redfish (450-700 mm) were abundant in drag seine collections in June and July. Juvenile speckled seatrout, Cynoscion nebulosus, were taken in samples during the fall, while "school trout" 250-350 mm were common in early summer, and older seatrout (500-675 mm) were taken in October. The largest concentration of these species was found along the western shoreline of the bay.

Black drum, Pogonias cromis, were detected throughout the year. Juveniles (50-135 mm) were common during summer and fall. Other important food and game fish collected were southern flounder, Paralichthys lethostigma the young of which were taken during winter and early spring (Figure 5), and sheepshead, Archosargus probatocephalus.

Excluding conspicuous catches of largescale menhaden, Brevoortia patronus, (see footnote, Table 1), Atlantic croaker, Micropogon undulatus, were the most abundant species of fish taken in minnow seine collections, comprising 37.7 per cent of the fish taken. Together with menhaden, striped mullet, Mugil cephalus, and spot, Leiostomus xanthurus, they were collected in all areas sampled and in all salinities.

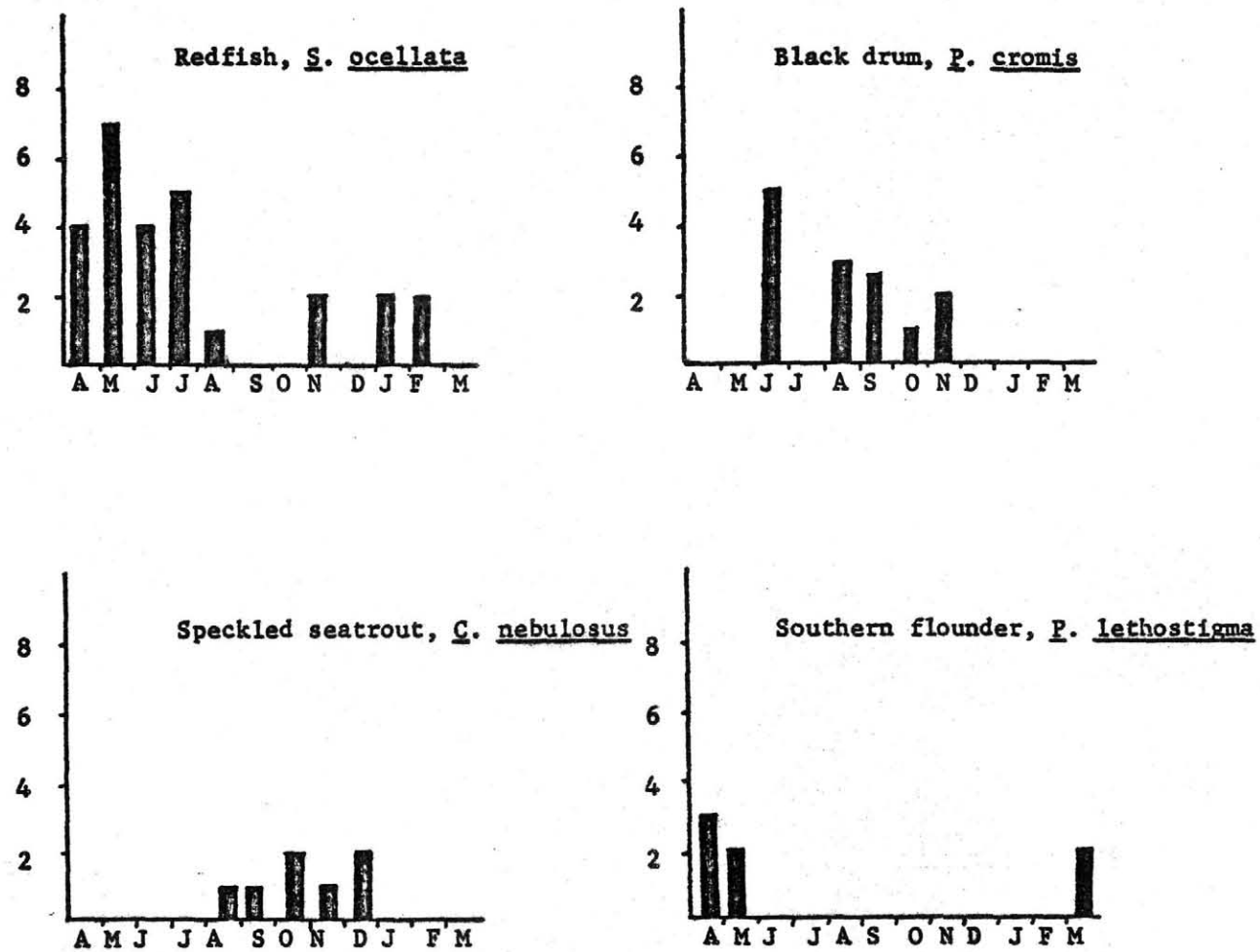
DISCUSSION

It appeared that the constricted opening in the Hurricane Levee, which existed after October, 1966, reduced the exchange of water between Moses Lake and Galveston Bay. Increased circulation may result when the permanent tide exchange opening is completed.

The deposition of dredge material on marine habitat was minimal in Moses Lake, because a relatively small portion of the bay and no major marshes were crossed, but may be an important factor in future projects in other bays.

The importance of Moses Lake as habitat and nursery of commercially important species has been established in this and previous studies (Moffett, 1965, and Moffett and More, 1965). It is felt that factors which might jeopardize the value of this estuary should be investigated. It is therefore recommended that study be continued in order that future environmental changes might be determined.

Figure 5: Seasonal occurence of juvenile food and game fish (ave. no./period), Moses Lake, April, 1966 - March, 1967.



Moffett, A. W. 1965. A Study of the Juvenile Shrimp Populations of the Galveston Bay System. Coastal Fisheries Project Reports for 1964. Texas Parks and Wildlife Dept. (Mimeographed report).

_____ 1967. A Study of the Texas Shrimp Populations. Coastal Fisheries Project Reports for 1966. Parks and Wildlife Dept. (Mimeographed report).

_____and W. R. More. 1965. Population Studies of the Blue Crabs of the Galveston Bay System. Coastal Fisheries Project Reports for 1964. Texas Parks and Wildlife Dept. (Mimeographed report).