REHABILITATION OF PUBLIC OYSTER REEFS DAMAGED BY A NATURAL DISASTER IN SAN ANTONIO BAY

by

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ABSTRACT

Flooding during winter 1986-1987 and heavy rains in the following June and July in the San Antonio and Guadalupe River watersheds damaged the public Eastern oyster (Crassostrea virginica) resource in San Antonio Bay. Lowest salinities (0‰) were detected during June-September. No live Eastern oysters were collected by the Texas Parks and Wildlife Department (TPWD) in routine oyster dredge samples from July through mid-September. The fall 1987 spat set and catches of small (26-75 mm) and market (≥76 mm) Eastern oysters remained low.

Because Eastern oyster populations were damaged or destroyed by flooding, federal aid funds were obtained to spread 6,117 m^3 of clam shell for cultch at a cost of $194,600. Shell plantings began on 8 August 1989 and were completed on 18 August. Clam shell was sprayed in a thin layer (95 m^3/ha) over 65 ha at three sites in middle and lower San Antonio Bay. Evidence of reef rehabilitation success was documented by the presence of spat and small oysters on clean clam shell during November 1989.

INTRODUCTION

Eastern oyster (Crassostrea virginica) production in Texas averaged 1,600,000 kg annually during 1977-1986 with an average annual ex-vessel value of $5.5 million. The Eastern oyster fishery average annual total economic impact was $17.1 million on the Texas economy during this period (Quast et al. 1988a). The Eastern oyster fishery was the second most valuable commercial fishery in Texas during 1986 with landings of 2,600,000 kg valued at $10.5 million (Quast et al. 1988b).

From 1979 through 1986, 90% of reported commercial landings were harvested from public reefs (9,211 ha) during the public open season of 1 November-April 30; the remainder were harvested from private leases (951 ha) throughout the year. Ninety-three percent of the public reef area is in the Galveston, Matagorda and San Antonio Bay systems. San Antonio Bay Eastern oyster production comprised 20% of the total Texas harvest and averaged 400,000 kg annually during 1977-1986. An ex-vessel value of $1.1 million resulted in a total economic impact of $3.4 million (Quast et al. 1988a, Quast et al. 1988b).

In 1987 the Eastern oyster resource in San Antonio Bay was severely damaged by flooding. Beginning in December 1986, excessive rainfall (108-204 mm) (Anonymous 1986) occurred in the San Antonio River and Guadalupe River watersheds emptying into San Antonio Bay. Flooding (24-145 m^3/sec) was exacerbated by heavy rains (47-345 mm) in June and July (Anonymous 1987a, Anonymous 1987b, Anonymous 1987c). From January through November 1987, salinities ranged from 0-5 o/oo in the upper region of San Antonio Bay, 0-16 o/oo in the central region and 0-34 o/oo in the lower region (Table 1). Lowest salinities (0 o/oo) were observed during June-September. Salinities below 3 o/oo affect Eastern oyster feeding and increase mortality (Loosanoff 1953). Prolonged salinities below 5 o/oo coupled with temperatures >25 C cause Eastern oyster mortalities (Quast et al. 1988a). All of these conditions existed in San Antonio Bay for an extended period.

TPWD personnel routinely collect 26 reef samples/month from the San Antonio Bay system (Meador et al. 1988). By March 1987, TPWD samples revealed a 50% decline in numbers of live Eastern oysters collected; in July through mid-September, few live Eastern oysters were collected (Table 2) (Meador et al. 1988). The fall 1987 spat (5-25 m) set in San Antonio Bay remained depressed with spat, small (26-75 mm) and market (≥76 mm) Eastern oysters found only along the fringes of lower San Antonio Bay. Mortality and low reproduction affected the entire San Antonio Bay system. Clean cultch material on existing oyster reefs, that normally allow small oysters to attach, had become fouled by growth of algae and encrusting organisms (TPWD unpublished data).

Due to residual effects of excessive flooding in San Antonio Bay and the decline in Eastern oysters commercially landed during 1987 (42,000 kg valued at $0.2 million), the TPWD rehabilitated the oyster reefs by planting clean cultch material on selected public oyster grounds during summer 1989. Introduction of clean cultch during this period insures that suitable substrate is available for spat setting. A federal grant-in-aid award was obtained by the TPWD to purchase and spread 6,117 m^3 of clean shell cultch material. The present report documents the procedures used in completing the

rehabilitation of public oyster reefs damaged by a natural disaster in San Antonio Bay.

MATERIALS AND METHODS

Shell planting sites were selected according to suitable bottom types, accessibility, desirable hydrological conditions and history of Eastern oyster production. The three sites selected were in middle and lower San Antonio Bay and were situated to maximize spat survival in future drought or flood conditions (Figure 1). Bottom types in the three locations ranged from natural Eastern oyster shell to Eastern oyster shell/mud to stiff mud bottom. All sites were in areas open to sport and commercial oystering. Control areas were retained at each reef site for future comparison if needed.

Clam shell was used as cultch material for the project. Specifications called for clean shell with not more than 15% by volume of shells <10 mm at the widest point and with at least 50% of shells >25 mm at the widest point. Pontchartrain Materials Corporation of New Orleans, Louisiana received the contract for the shell planting operation. Work was authorized by the U.S. Army Corps of Engineers under permit number 18,385 dated 30 August 1988.

Clam shell was delivered to staging areas near planting sites using three small barges holding 1,064, 1,084 and 1,062 m^3 each and two large barges holding 1,055 and 1,852 m^3 each. A crane off-loaded 250-575 m^3 of the shell to the smaller, flush deck barges. Light loading was necessary to reach planting sites in water 1.2-1.8 m deep. Small barges were maneuvered over the planting sites by a shallow draft tug boat. A smaller barge contained pumps and high pressure water hoses (Figure 2).

Planting sites were marked with flagged poles. Inside corners of each site were located by latitude and longitude using a Loran navigation system (Furuno Electric Co., Ltd., Nishinomiya, Japan). As the shell barge was maneuvered within the flagged areas, shell was sprayed overboard at an average rate of 95 m^3/ha using high pressure hoses. TPWD personnel were present to supervise plantings. Clam shell sprayed overboard up to 15 m from the barge fell to the bottom in a thin layer. Coverage at each site was estimated from total ha covered by the planting equipment and m^3 of material planted.

Success of the rehabilitation effort will be evaluated through the TPWD routine Eastern oyster monitoring program. If clam shell is recovered, spat and small Eastern oysters attached will be counted; types of fouling organisms and their densities will be recorded following procedures described in the 1989-1990 TPWD Marine Resource Monitoring Operations Manual.

RESULTS

Shell plantings began on 8 August 1989 and were completed on 18 August. The contractor planted 6,117 m^3 of clam shell at a cost of $194,600. Rehabilitated reefs (Figure 1) were Mosquito Point Reef (25 ha), Panther Point Reef (26 ha) and Live Oak Point Reef (14 ha).

Spat set was verified by sampling of Mosquito Point Reef on 6 November 1989. Spat set had taken place on at least 16% of clam shell collected in the samples. Average number of spat or small oysters on these shells ranged from 1-3/shell. Spat ranged from 11-24 mm in width and small oysters ranged from 27-40 mm in width.

DISCUSSION

The spreading of clam shell to rehabilitate the reefs is a success as evidenced by the documented presence of spat and small oysters on the clam shell. Evidently, setting of oysters took place immediately after spreading based on the size of Eastern oysters collected in November (TPWD unpublished data). Long term success of the rehabilitation project will be determined from routine TPWD oyster dredge samples, TPWD commercial fishermen surveys and by reported commercial Eastern oyster harvest when the 1989 spat reach marketable size (≥76 mm) during the 1991-1992 harvest season. Use of clam shell to rehabilitate natural oyster shell reefs will allow the TPWD to determine the long term success of the rehabilitation project because natural clam shell is uncommon in the immediate area.

Prior to this project, only one other Eastern oyster reef rehabilitation project was previously completed in Texas (Hofstetter 1981). Severe oyster mortality occurred in Galveston Bay in 1979 due to flooding on the Trinity River and additional heavy rainfall associated with tropical storms. As a result, 37,491 m^3 of oyster shell (costing $620,000) was planted at nine sites (313 ha) in Galveston Bay in June 1980. By September 1980 spat were found at all planting sites and it was estimated the plantings increased spat setting by 3.7 million spat/ha in addition to the set on natural reef shells (Hofstetter 1981).

Both clam shell and oyster shell have been used as cultch material. Clam shell is the preferred cultch material in Louisiana for reef rehabilitation because it produces a well-shaped oyster (Chatry et al. 1986), and lends itself to the method of planting used in this project.

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Table 1. Salinity ranges (o/oo)[a] for the upper, middle and lower regions of San Antonio Bay during December 1986-March 1988. ND = no data.

Month	Upper	Middle	Lower
Dec 1986	13-14	13-20	12-30
Jan 1987	5	3-12	10-29
Feb	0-1	2-7	6-22
Mar	3	1-5	2-25
Apr	1-2	0-10	5-12
May	0-2	3-6	6-30
Jun	0	0	0-28
Jul	0	0-11	0-27
Aug	1	1-3	0-11
Sep	0	0	3-5
Oct	3	5-14	8-34
Nov	0	5-16	16-34
Dec	3-8	6-10	10-30
Jan 1988	12	0-15	8-32
Feb	ND	12-22	22-33
Mar	10-14	15-25	23-34

[a]Data obtained from TPWD routine sampling conducted under federal aid projects 2-427-R and F-34-M.

Table 2. No./h of spat, small, and market Eastern oysters collected in San Antonio Bay oyster dredge samples during December 1986-March 1988[a].

Month	No./h			
	Spat	Small	Market	Total
Dec 1986	621	468	579	1,668
Jan 1987	38	4,689	724	808
Feb	177	803	769	1,749
Mar	134	396	344	874
Apr	45	279	385	709
May	61	401	229	691
Jun	38	304	437	779
Jul	0	10	5	15
Aug	0	5	5	10
Sep	0	19	38	57
Oct[b]	213	70	50	333
Nov[b]	0	46	112	158
Dec[b]	82	72	0	154
Jan 1988[b]	28	14	0	42
Feb[b]	5	14	24	43
Mar[b]	0	5	0	5

[a]Spat <25 mm, small 26 to 75 mm, market ≥76 mm.
[b]From October 1987-March 1988 spat, small and market oysters were found only along the fringes of lower San Antonio Bay.

Figure 1. Major oyster reefs with planting sites (rectangles) that were rehabilitated in the middle and lower regions of the San Antonio Bay System.

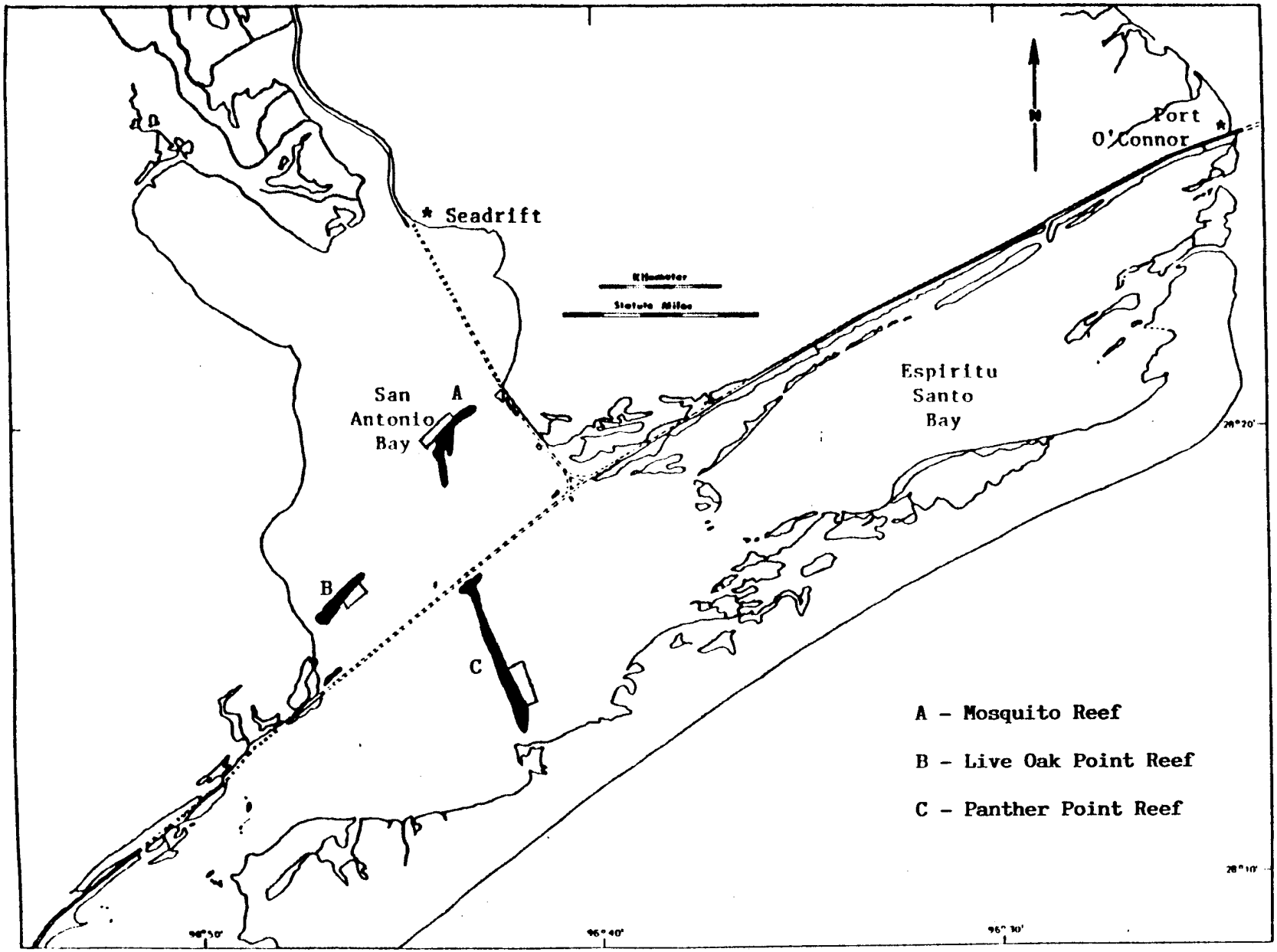
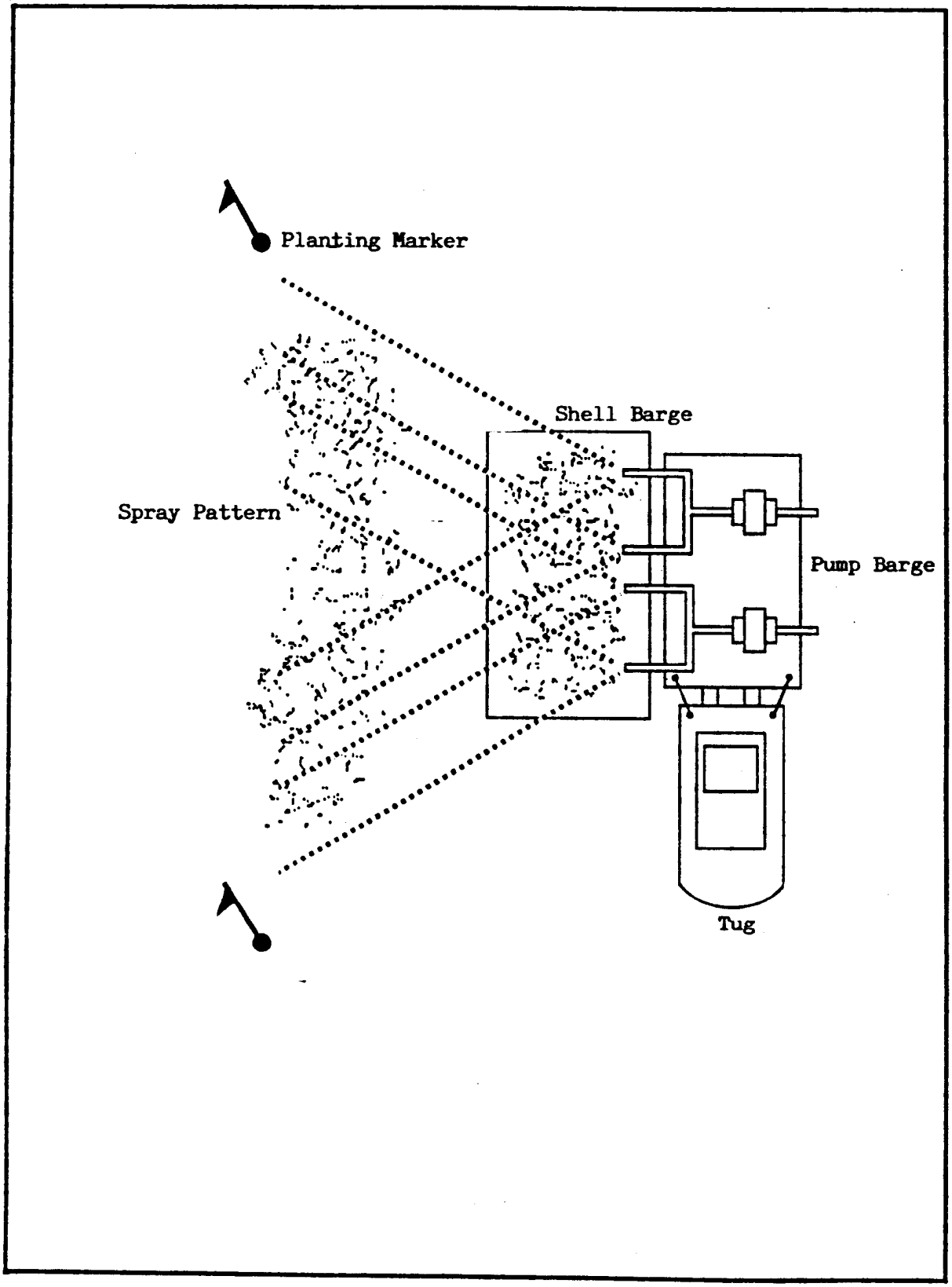

Port
O'Connor
Seadrift
San
Antonio
Bay
A
B
C
Espiritu
Santo
Bay
A - Mosquito Reef
B - Live Oak Point Reef
C - Panther Point Reef

Figure 2. Diagram of shell planting method using high pressure water hoses to spray oyster shells in a thin layer off barges.


Planting Marker
Shell Barge
Spray Pattern
Pump Barge
Tug

PWD-RP-3400-327-6/90
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