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by Paul C. Hammerschmidt

Management Data Series Number 106
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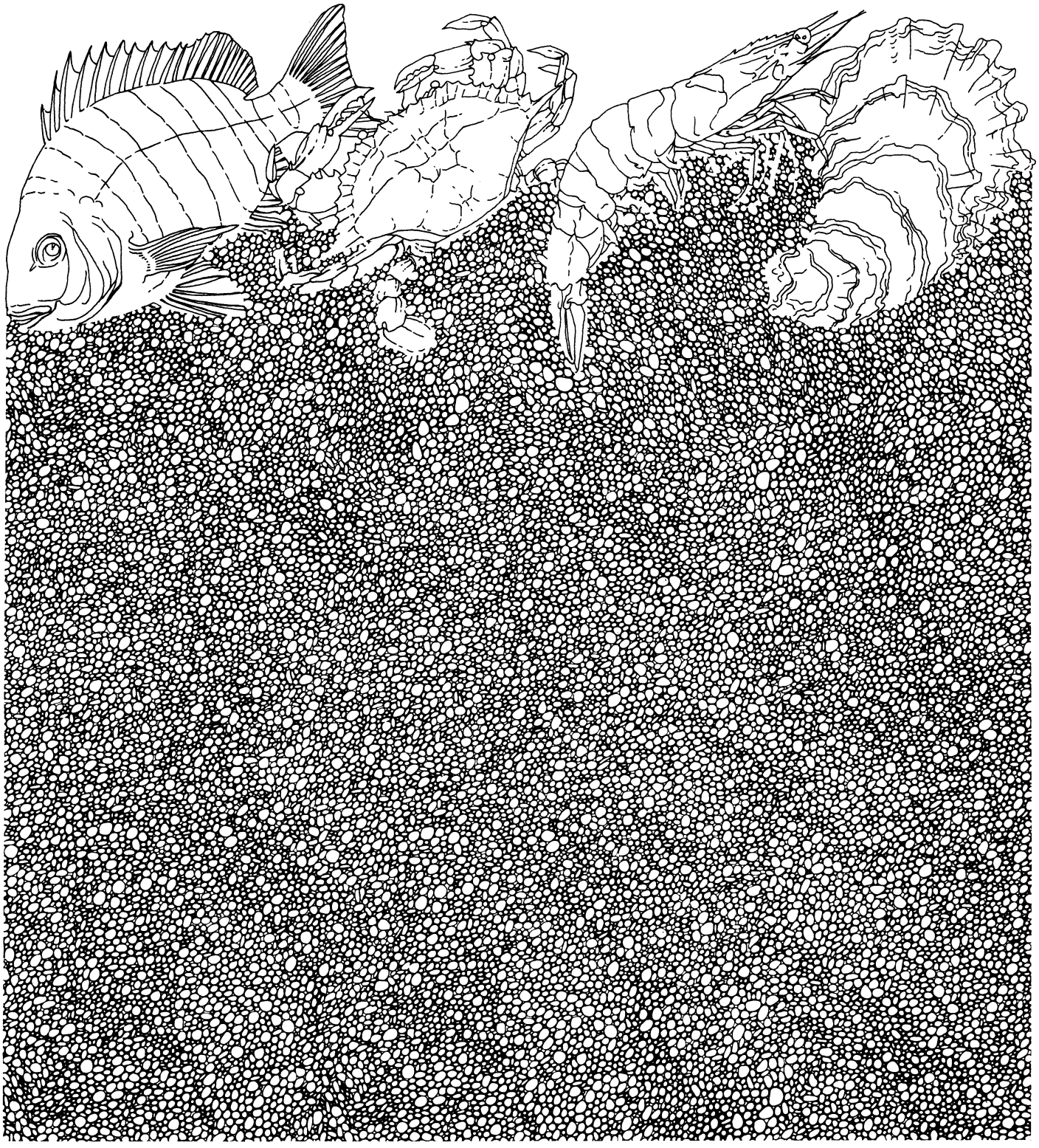

INITIAL SURVIVAL OF RED DRUM FINGERLINGS STOCKED IN TEXAS BAYS DURING 1984-1985

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ABSTRACT

Overall survival of pond reared red drum fingerlings held in cages was 86.2 ± 2.2%, indicating that current harvesting, transporting and stocking procedures are adequate for stocking fish that will survive. Red drum (Sciaenops ocellatus) were stocked in the San Antonio Bay system during May and July 1984, in lower Laguna Madre during July 1984 and in the Corpus Christi Bay system during January 1985. Random samples of fish from each trailer load were placed in cages to determine initial 24-h survival after release. There were no significant differences ($P > 0.05$) in fingerling survival between bay systems. There were, however, significant differences ($P < 0.05$) in survival among stocking dates, suggesting differences in the condition of fingerlings among stockings. Mean survival ranged from 34.0 ± 3.5% on 13 July to 100.0 ± 0.0% on 15 May and 4 July.

INTRODUCTION

Stocking of red drum (Sciaenops ocellatus) in Texas bays to enhance depleted stocks began in 1975 with the development of techniques to spawn and rear red drum in captivity (Arnold et al. 1977). During 1975-1982, Texas bays were stocked with 8.5 million red drum eggs, 45.1 million fry and 2.8 million fingerlings (Matlock 1984).

A three-year program of intensive stocking in Espiritu Santo Bay (San Antonio Bay system) and Nueces Bay (Corpus Christi Bay system) was begun to assess the contribution of hatchery-reared red drum for rebuilding overharvested populations and to provide enhanced red drum harvest by fishermen within four years of first stocking (Hammerschmidt and Saul 1984). These bay systems were selected because adequate fishery-independent sampling relative to surface area was available, they were diversely different in habitats (Hegen and Matlock 1980) and they had diverse fishing pressures (McEachron and Green 1983). Furthermore, native fish have similar movement patterns and bays are sufficently separated spatially that any "overflow" of stocked fish would contribute little in recruitment to either system (Osburn et al. 1982).

Success of any stocking program depends upon the health and survivability of the organisms released. Handling and transport reduce that surivability by inducing stress in the fingerlings (Barton et al. 1980, Carmichael et al. 1983, Wheaton 1977). Hammerschmidt and Saul (1984) estimated that >89% of the red drum fingerlings stocked during 1983 survived the initial 24-h after stocking.

The objectives of this paper were to 1) determine the initial 24-h survival rate of red drum fingerlings stocked during 1984-1985, and 2) determine if survival studies should be continued during subsequent stocking efforts.

MATERIALS AND METHODS

Red drum were spawned and reared at the John H. Wilson Marine Fish Hatchery during 1984 according to procedures described by Roberts et al. (1978). Fingerlings were stocked in Espiritu Santo Bay during May and July 1984, in lower Laguna Madre during July 1984 and in Nueces Bay during January 1985 (Fig. 1-3).

All fish were transported from the hatchery to stocking sites in hauling trailers fitted with a 3-chamber wood and fiberglass tank 3.0 m long, 1.2 m wide and 0.8 m high. Each chamber had a liquid capacity of approximately 1950 l. A similar tank was secured to a barge for final transport to stocking sites.

Survival cages were 0.6 m long and 0.3 m in diameter with 18 meshes/25 mm fiberglass screening. Cages were weighted at the bottom to maintain an upright position in the water column and staked in water deep enough to insure water coverage throughout the tidal cycles. Cages were located in the immediate vicinity of fingerling release.

One hatchery pond was harvested for each day of stocking. Draining of the ponds began approximately 72 h before scheduled releases. Fish were removed from the pond by dip net and transferred directly from the pond to the hauling trailers.

All fish were treated with 10 ppm furacin in the hauling trailer tanks. Oxygen from a compressed gas cylinder was bubbled through each chamber at a rate of 4-6 l/minute to maintain a dissolved oxygen level of 4-10 ppm. Fish stocked in Espiritu Santo Bay were transferred to the barge hauling tank by gravity flow, oxygenated in the same manner as hauling trailers and towed to the release site.

Fingerlings were acclimated to ambient release-site temperatures and salinities by exchanging hauling water with release-site water at a rate of approximately 2600 l/hour until water temperatures and salinity in the hauling tank were within 2 C and 5 o/oo, respectively, of that at the release site.

The percent of fish dead in the hauling tanks was estimated by inspection at the stocking site prior to release of red drum fingerlings. A random sample of live fish was removed by dip net from each discharge pipe leading from the tank chambers. From this sample, 25 fish were placed in each of three or four survival cages. Cages were checked after approximately 24 h to count surviving fish. The 24-h time frame was selected based on the findings of Barton et al. (1980) who reported that the high plasma cortisol levels detected in fingerling rainbow trout after stocking persisted through 24 h and was reduced at 48 h.

Water temperatures (nearest 0.5 C) and salinity (nearest 0.1 o/oo) were measured in the hauling trailers before acclimation began, periodically during acclimation and just prior to releasing the fish. These hydrological data were also measured at the release site when the fish were placed in cages and again when they were examined after 24 h.

Percent survival for each cage was calculated as the ratio of the number of fish alive at the end of 24 h divided by the number of fish initially placed in the respective cages.

Significant differences ($P < 0.05$) in mean percent survival among bays stocked and dates stocked within each bay were determined using a nested analysis of variance (Sokal and Rohlf 1981). Bay systems and dates stocked within bay systems were considered random effects. Percentages were arcsine transformed prior to analysis to reduce unequal variances.

RESULTS

Overall mean survival of red drum fingerlings was 86.2 ± 2.2% (Table 1). Mean survival was not significantly different between bay systems (Table 2). Significant differences were found among stocking dates. Mean survival ranged from 34.0 ± 3.5% on 13 July to 100.0 ± 0.0% on both 15 May and 4 July 1984 (Table 1).

The overall mean estimated percent of fish dead in the hauling tanks observed at the stocking sites during all stocking dates for all bay systems combined was <1% and ranged from <1% to 5% in the San Antonio Bay system and was <1% in the Corpus Christi Bay and lower Laguna Madre systems (Table 1).

Differences in water temperature between hauling trailer and release site ranged from 0.0 to 5.0 C. They ranged from 0.0 to 3.0 C between initial and final survival check periods (Table 3).

Salinity values were generally higher (36-49 o/oo) in the hauling trailer than at the release site (26-36 o/oo). Salinities changed slightly between initial and final survival check periods with differences ranging from 0 to 5 o/oo (Table 3). Acclimation time varied among stockings from 0.2 to 2.4 h (Table 3).

DISCUSSION

This study demonstrates >85% of stocked red drum fingerlings survive the first 24 h after release. This is similiar to the findings of Hammerschmidt and Saul (1984). Significant differences in survival among stocking dates suggests that the condition of the fingerlings or induced stresses varied among the trailer loads.

Assuming each load of fish was handled identically, differences in survival could be attributed to: 1) initial condition of fish in the ponds; 2) stress induced by varying acclimation times and 3) variations in holding conditions in the bays.

As Hammerschmidt and Saul (1984) noted, relationships between observed estimates of hauling mortality and the ultimate survival of caged fish were not apparent. Low survival in cages was preceded by both high (5%) and low (<1%) estimated hauling mortality. Likewise, there were no apparent relationships between overall survival in cages and differences in water temperature and salinity from hauling trailer to stocking site and from initial survival check to final survival check. In order to determine the causes of these occassional high mortalities, it is necessary to monitor the condition of each load of red drum fingerlings throughout the harvesting, hauling and stocking procedures and relate

those conditions to the 24-h survival of those fish.

Based on the findings of this study and the previous study (Hammerschmidt and Saul 1984), it is apparent that the procedures used to harvest, transport and stock red drum fingerlings from hatchery to release site are adequate to obtain at least an 85% initial 24-h survival rate of red drum fingerlings. It is recommended that survival studies of future red drum releases be discontinued unless more precise information as to the causes of the periodic high mortalities is deemed necessary. Perhaps studies to determine the physiological relationships between blood chemistry and survival should be conducted for red drum fingerlings. Similar studies have been conducted by Barton et al. (1980) for rainbow trout and by Carmichael et al. (1983) for smallmouth bass.

LITERATURE CITED

Arnold, C. R., W. H. Bailey, T. D. Williams, A. Johnson, and J. L. Lasswell. 1977. Laboratory spawning and larval rearing of red drum and southern flounder. Proc. Ann. Conf. S.E. Assoc. Fish Wildl. Agencies 31:437-441.

Barton, B. A., R. E. Peter, and C. R. Paulencu. 1980. Plasma cortisol levels of fingerling rainbow trout (Salmo gairdneri) at rest, and subjected to handling, confinement, transport, and stocking. Can. J. Fish. Aquat. Sci. 37:305-811.

Carmichael, G. J., G. A. Wedemeyer, J. P. McCraren, and J. L. Miltard. 1983. Physiological effects of handling and hauling stress on smallmouth bass. Prog. Fish-Cult. 45(2):110-113.

Hammerschmidt, P. C., and G. E. Saul. 1984. Initial survival of red drum fingerlings stocked in Texas bays during 1983-84. Tex. Chapt. Am. Fish. Soc. 7:13-28.

Hegen, H. E., and G. C. Matlock. 1980. Monitoring of coastal finfish resources for sport fish management, October 1978-September 1979. Tex. Pks. Wildl. Dep., Coast. Fish. Branch, Mngmnt. Data Ser. No. 17. 243 p.

Matlock, G. C. 1984. A summary of 7 years of stocking Texas bays with red drum. Tex. Pks. Wildl. Dep., Coast. Fish. Branch, Mngmnt. Data Ser. No. 60. 14 p.

McEachron, L. W., and A. W. Green. 1983. Weekend sportboat fishermen finfish catch statistics for Texas bay systems, May 1974-May 1982. Tex. Pks. Wildl. Dep., Coast. Fish. Branch, Mngmnt. Data Ser. No. 50. 113 p.

Osburn, H. R., G. C. Matlock, and A. W. Green. 1982. Red drum (Sciaenops ocellatus) movement in Texas bays. Cont. Mar. Sci. Univ. Tex. 25:85-97.

Roberts, D. E., Jr., B. V. Harpster, and G. E. Henderson. 1978. Conditioning and induced spawning of the red drum (Sciaenops ocellatus) under varied conditions of photoperiod and temperature. Proc. World Maricult. Soc. 9:311-332.

Sokal, R. R. and F. J. Rohlf. 1981. Biometry. W. H. Freeman and Co., San Francisco, California, USA. 859 p.

Wheaton, F. W. 1977. Aquacultural engineering. John Wiley and Sons, New York, New York, USA. 709 p.

Table 1. Summary of percent survival of red drum (Sciaenops ocellatus) fingerlings held in cages, by bay system, date and stocking site during 1984-85 (ND = no data).

Bay	Latitude	Longitude	Stocking date	Mean estimated hauling mortality (%)	Mean total time in cages (h)	Percent survival				Mean percent survival 1S.E.[a]
						Cage 1	Cage 2	Cage 3	Cage 4	
Espiritu Santo	28°15'18"	96°26'06"	05-15-84	<1	24.7	100	100	100	ND	100.0 ± 0.0
	28°23'50"	96°29'12"	05-16-84	<1	24.1	96	100	96	100	98.0 ± 1.2
	28°24'48"	96°27'25"	05-17-84	<1	24.4	96	100	92	76	91.0 ± 5.3
	28°21'45"	96°33'52"	05-18-84	<1	28.0	88	59	ND	ND	84.0 ± 15.0
	28°15'18"	96°26'06"	05-19-84	<1	23.1	80	88	88	80	84.0 ± 2.3
	28°24'13"	96°28'18"	05-20-84	<1	24.0	92	100	96	96	96.0 ± 1.6
	28°15'18"	96°26'06"	05-22-84	<1	23.7	100	100	100	92	98.0 ± 2.0
	28°24'48"	96°27'25"	05-23-84	<1	24.4	100	96	100	100	99.0 ± 1.0
	28°15'18"	96°26'06	05-24-84	<1	24.2	100	100	100	96	99.0 ± 1.0
	28°23'15"	96°30'10"	07-03-84	1	20.2	80	88	92	88	87.0 ± 2.5
	28°23'00"	96°27'09"	07-04-84	<1	24.2	100	100	100	100	100.0 ± 0.0
	28°22'40"	96°27'20"	07-05-84	<1	23.8	92	96	96	92	94.0 ± 1.2
	28°23'00"	96°27'09"	07-06-84	<1	22.2	100	96	100	92	97.0 ± 1.9
	28°25'54"	96°25'00"	07-07-84	1	24.4	100	96	92	100	97.0 ± 1.9
	28°25'54"	96°25'00"	07-08-84	1	23.9	84	96	96	96	93.0 ± 3.0
	28°25'54"	96°25'00"	07-10-84	2	25.2	76	92	88	76	83.0 ± 4.1
	28°23'00"	96°27'09"	07-12-84	2	22.9	64	60	52	68	61.0 ± 3.4
	28°25'54"	96°25'00"	07-13-84	5	23.0	36	24	36	40	34.0 ± 3.5
Lower Laguna Madre	26°33'28"	97°25'38"	07-14-84	<1	23.8	32	56	24	ND	37.0 ± 9.6
Nueces	27°51'35"	97°28'00"	01-07-85	<1	21.0	84	80	96	ND	87.0 ± 4.8
	27°51'35"	97°28'00"	01-08-85	<1	25.5	84	88	92	ND	88.0 ± 2.3
Overall mean				<1						86.2 ± 2.2

[a] Calculated for all cages for each stocking day.

Table 2. Nested analysis of variance of arcsine transformed mean percent survival among bay systems and dates stocked within bay systems of red drum (Sciaenops ocellatus) held in cages for 24 h during May 1984-January 1985.

Source of variation	Degrees of freedom	Mean square	F
Total	77	0.13917	
Bays	2	1.00953	2.4937
Dates	18	0.40484	16.3638*
Error	57	0.02474	

*$P < 0.05$

Table 3. Summary of red drum (Sciaenops ocellatus) acclimation time and hydrology of hauling water and stocking site during 1984-85. (ND = no data).

Bay	Latitude	Longitude	Stocking date	Water temperature (C)			Salinity (o/oo)			Acclimating time (h)[d]
				Trailer[a]	Initial[b]	Final[c]	Trailer[a]	Initial[b]	Final[c]	
Espiritu Santo	28°15'18"	96°26'06"	05-15-84	26.5	26.5	26.0	39.0	30.0	30.0	1.4
	28°23'50"	96°29'12"	05-16-84	25.0	25.0	25.0	36.0	26.0	28.0	1.9
	28°24'48"	96°27'25"	05-17-84	25.0	24.0	24.0	38.0	28.0	28.0	1.6
	28°21'45"	96°33'52"	05-18-84	24.0	24.0	24.0	35.0	23.0	28.0	1.9
	28°15'18"	96°26'06"	05-19-84	25.5	25.0	25.0	36.0	26.0	26.0	1.6
	28°24'13"	96°28'18"	05-20-84	25.5	25.0	25.0	36.0	26.0	28.0	2.3
	28°15'18"	96°26'06"	05-22-84	27.0	27.0	27.0	38.0	26.0	28.0	1.5
	28°24'48"	96°27'25"	05-23-84	27.0	27.0	28.0	38.0	29.0	30.0	1.4
	28°15'18"	96°26'06"	05-24-84	28.0	28.0	31.0	36.0	28.0	29.0	1.3
	28°23'15"	96°30'10"	07-03-84	29.5	29.5	31.0	43.0	28.0	32.0	2.4
	28°23'00"	96°27'09"	07-04-84	27.5	29.0	32.0	45.0	31.0	34.0	2.3
	28°22'40"	96°27'20"	07-05-84	26.5	30.0	30.05	43.0	31.0	32.0	2.2
	28°23'00"	96°27'09"	07-06-84	27.0	30.0	31.0	46.0	32.0	34.0	2.2
	28°25'54"	96°25'00"	07-07-84	27.0	30.0	31.0	45.0	34.0	31.0	1.1
	28°25'54"	96°25'00"	07-08-84	26.0	31.0	32.0	44.0	34.0	34.0	1.0
	28°25'54"	96°25'00"	07-10-84	26.0	30.0	33.0	45.0	32.0	34.0	1.3
	28°23'00"	96°27'09"	07-12-84	27.0	30.0	32.0	45.0	34.0	34.0	2.0
	28°25'54"	96°25'00"	07-13-84	27.0	31.0	31.0	49.0	32.0	35.0	1.0
Lower Laguna Madre	26°33'28"	97°25'38"	07-14-84	26.0	29.5	ND	46.0	36.0	ND	0.9
Nueces	27°51'35"	97°28'00"	01-07-85	18.0	15.0	15.5	36.0	32.0	33.0	0.8
	27°51'35"	97°28'00"	01-08-85	22.0	15.5	17.0	36.0	33.0	29.0	0.5

[a]Average water temperature and salinity in hauling trailers at time of delivery to stocking site.
[b]Average water temperature and salinity of stocking site on day fish were placed in cages.
[c]Average water temperature and salinity of stocking site on day of survival check.
[d]Average acclimation time of all trailer loads of red drum each day; calculated from time of first water exchange in barge or trainer to time last fish was released.

Figure 1. Red drum fingerling release sites (indicated by ✖) in the San Antonio Bay system during May and July 1984.

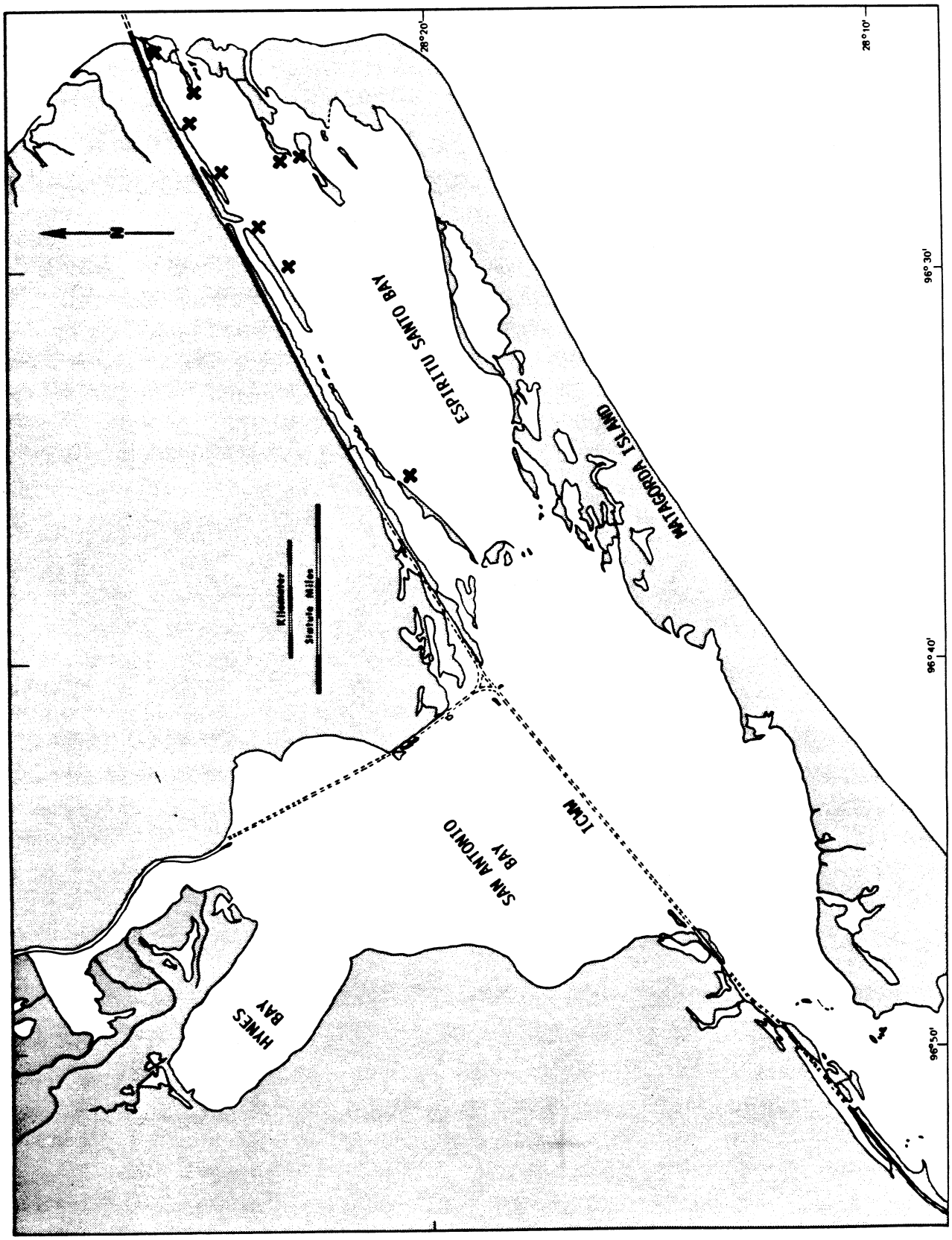

28°20'
28°10'
96°30'
96°40'
96°50'
N
ESPIRITU SANTO BAY
MATAGORDA ISLAND
Kilometer
Statute Miles
ICWW
SAN ANTONIO BAY
HYNES BAY

Figure 2. Red drum fingerling release sites (indicated by ✖) in the lower Laguna Madre system during July 1984.

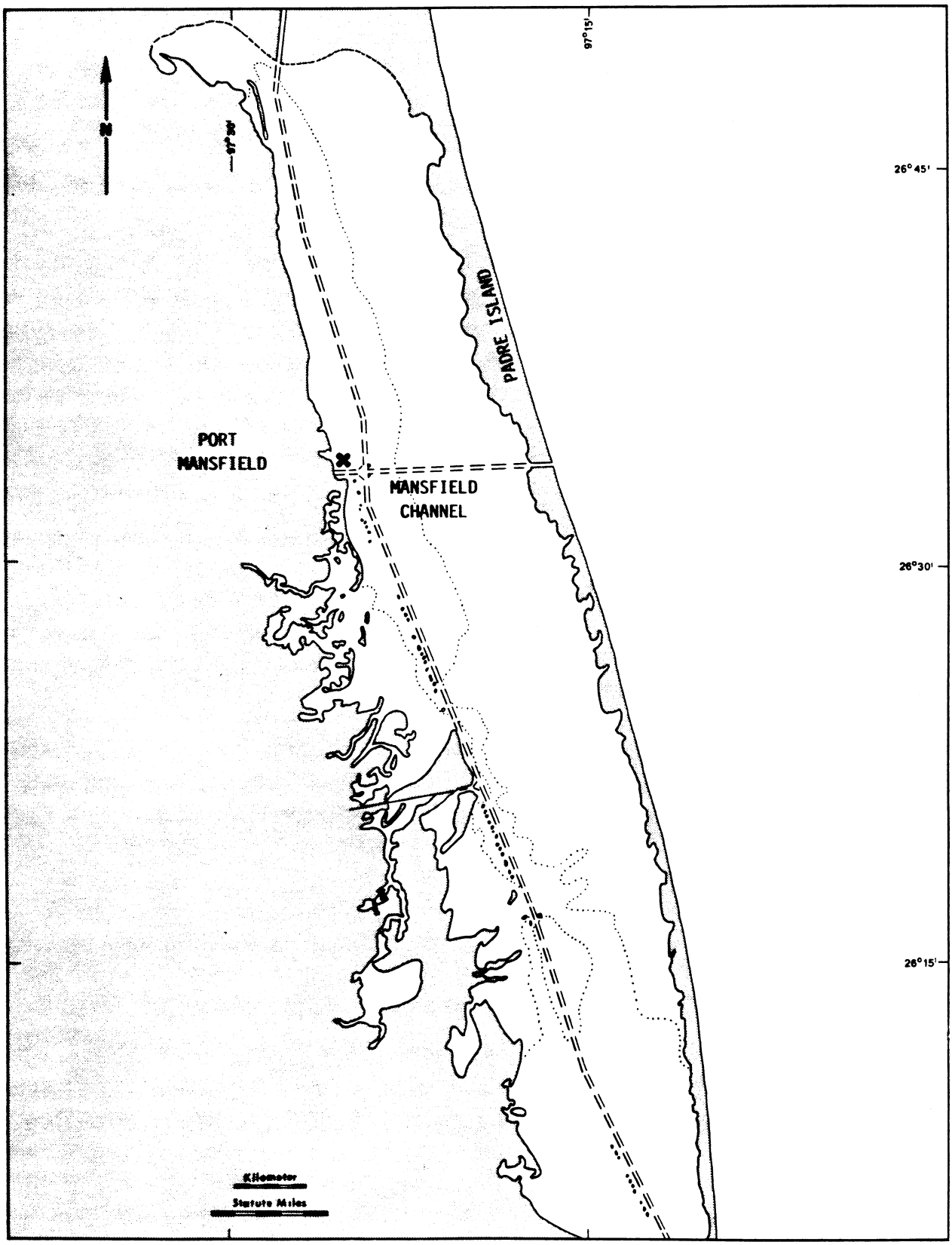
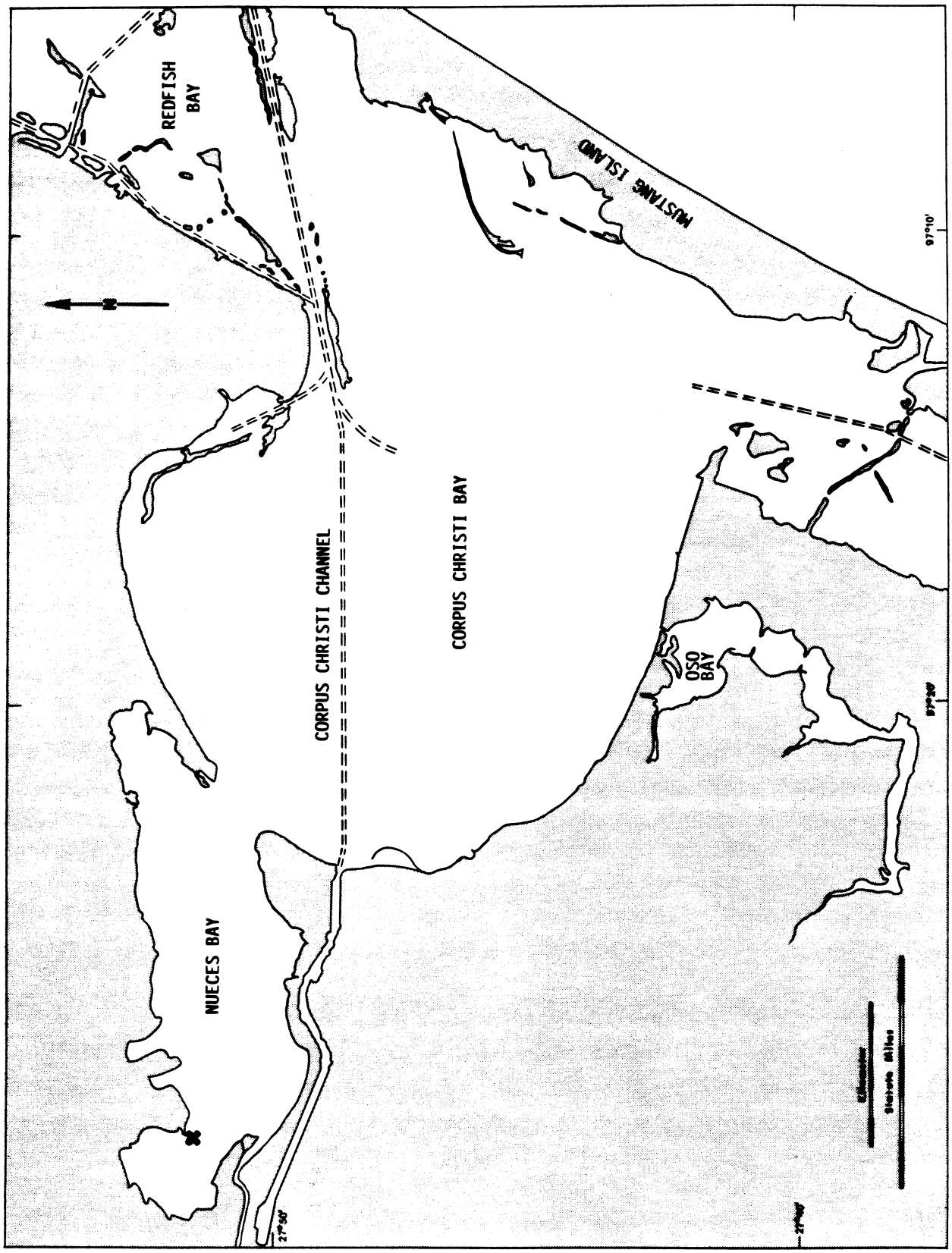

N
97°15'
97°30'
26°45'
26°30'
26°15'
PADRE ISLAND
PORT
MANSFIELD
MANSFIELD
CHANNEL
Kilometer
Statute Miles

Figure 3. Red drum fingerling release sites (indicated by ✖) in the Corpus Christi Bay system during January 1985.


REDFISH BAY
MUSTANG ISLAND
CORPUS CHRISTI CHANNEL
CORPUS CHRISTI BAY
OSO BAY
NUECES BAY
97°10'
27°50'