TRENDS IN SPOTTED SEATROUT AND RED DRUM ABUNDANCE IN TEXAS COASTAL WATERS INFLUENCED BY COMMERCIAL NETTING ACTIVITIES

GARY C. MATLOCK, Coastal Fisheries Branch, 4200 Smith School Rd., Texas Parks and Wildlife Department, Austin, TX 78744

JAMES E. WEAVER, Coastal Fisheries Branch, 4200 Smith School Rd., Texas Parks and Wildlife, Department, Austin, TX 78744

ALBERT W. GREEN, Coastal Fisheries Branch, 4200 Smith School Rd., Texas Parks and Wildlife Department, Austin, TX 78744

Abstracts Spotted seatrout (*Cynoscion nebulosus*) and red drum (*Sciaenops ocellata*) populations in Texas bays were randomly sampled with 183 m long gill nets November 1975 through March 1976 and November 1976 through March 1977. Catch rates in areas closed to commercial netting for spotted seatrout were about twice as high as those from areas open to netting. There was no difference between the mean total length of spotted seatrout from closed areas and trout from open areas. Closed areas produced about twice as many red drum as open areas. No generalization could be made about the size of red drum and whether they were caught in open or closed areas. Apparently, the effect of commercial netting on these species is local. When spotted seatrout and red drum are removed from netted areas, populations in adjacent non netted areas are not appreciably affected. Both species are apparently capable of sustaining their populations when subjected to limited commercial netting unless adverse environmental conditions exist.

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Spotted seatrout and red drum support important sport and commercial fisheries in Texas. During 1975-76 sport fishermen harvested an estimated 3.0 million kg of spotted seatrout and 0.6 million kg of red drum from Texas waters (Heffernan and Green 1977). Bay commercial fishermen took 1.4 million kg of spotted seatrout (1.3 million dollars) and 1.8 million kg of red drum (1.6 million dollars) during the same period (Current Fisheries Statistics 6923, 1977; Current Fisheries Statistics, in press).

The sport harvest of these sciaenids relies heavily on inefficient rod and reel techniques whereas commercial fishermen use more efficient methods such as trotlines, trammel nets, gill nets, and drag seines. The use of trotlines is legal throughout the state, but they are essentially confined to the Laguna Madre complex. Although the legal use of nets is restricted to about 50 percent of Texas coastal waters (Fig. 1), their presence invariably results in severe conflicts between sport and commercial fishermen.

Recently, the concept of optimum sustainable yield (OSY) for effective management of fisheries resources for both sport and commercial interest has gained widespread attention (Roedel 1975, Larkin 1977). The basis for OSY is regulation and allocation of harvest to optimize benefits to all interested users. The success of management regulations imposed for achieving OSY depends on sustained monitoring of the resource by an unbiased measuring system (Radovich 1975).

In September 1974 the Coastal Fisheries Branch of the Texas Parks and Wildlife Department began an intensive survey to estimate total finfish harvest from Texas bays. In November 1975 Coastal Fisheries began a sampling program designed to measure trends in finfish population abundance in 7 bay systems utilizing analysis of variance techniques. The results presented in this paper represent a partial analysis of the data collected during the first 2 winters of this program.

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MATERIALS AND METHODS

During November 1975 through March 1976 (winter 1975) and November 1976 through March 1977 (winter 1976) gill net samples were taken monthly at selected stations in each of Galveston, Matagorda, San Antonio, Aransas, Corpus Christi, and upper and

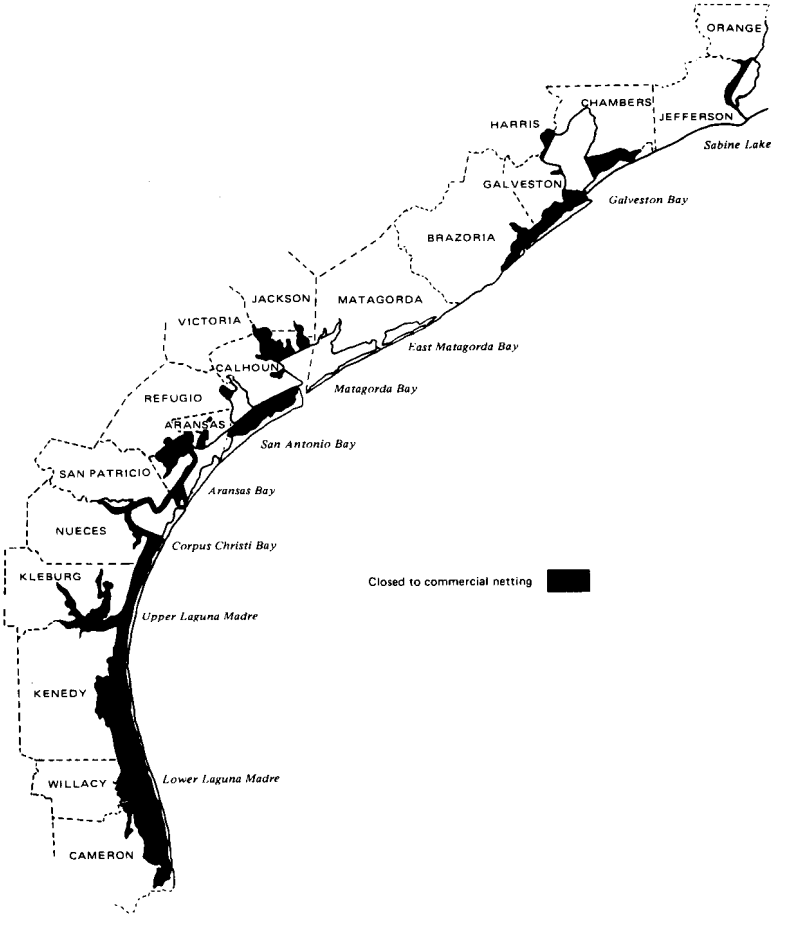

Fig. 1. Texas coast showing the 7 major bay systems and the areas within each that are open to commercial netting.

lower Laguna Madre bay systems (Fig. 1). Each gill net was 182.9 m long with separate 45.7 m sections of 7.6, 10.2, 12.7, and 15.2 cm stretched monofilament mesh tied together in ascending order. The minimum mesh size of 7.6 cm was selected because it is the minimum legal size available to commercial netters. All nets were 1.2 m deep except those fished in Corpus Christi Bay system which were 1.8 m.

For each bay system, monthly sample sites were randomly selected from a list of 20 available sites in each of 3 station types:

1. Pass station: A near-shore sample site located within 1.6 km of the junction between 2 bays or major bodies of water and at least 1.6 km from any other sample site.
2. Shoreline station: A near-shore sample site, other than a pass station, at least 1.6 km from any other sample site.
3. Open water station: A sample site other than a pass or shoreline station at which the entire length of the gill net is set in water as deep as the depth of the net.

Twelve different stations were sampled monthly in Galveston Bay system in winter '75: 5 pass stations, 4 shoreline stations, and 3 open-water stations. In all other bay systems,

8 different stations were sampled monthly in winter '75: 3 pass, 3 shoreline, and 2 open-water stations. In winter '76 we began evaluating other types of gear and the number of gill net samples taken was altered. During December 1976 through March 1977 the number of sets in each bay system was identical to the winter '75 schedule. However, during November 1976 only 4 different sets (1 pass, 2 shoreline, and 1 open-water stations) were made in each bay system except Galveston Bay where 5 different stations were sampled.

One gill net was set at each station within 1 hr before sunset on each Monday and Thursday of the first 4 full weeks of each month and raised within 1 hr after sunrise the following day. Gill nets at pass and shoreline stations were set on the bottom and perpendicular to shore with the smallest mesh near shore. Gill nets at open water stations were set on the bottom without regard to any shoreline.

All spotted seatrout and red drum were enumerated and total lengths were determined to the nearest 5 mm. For each gill net set, catch per effort (number/hr) and mean total length were calculated for each species. Catch per effort and mean length data were grouped by time of collection (winter 1975 or 1976) bay system, and areas legally open or closed to commercial netting (Fig. 1). These data were then analyzed for significant differences between mean catch rates and mean sizes (as mean total length) using analysis of variance (Overall and Speigal 1969). This technique was necessitated by unequal sample sizes in the factorial design.

RESULTS

There were 318 gill net sets made during winter 1975 and 246 during winter 1976. A total of 4,677 spotted seatrout and 4,812 red drum were caught during the 2 winters. Of the 595 sets, 439 were made in Galveston, Matagorda, San Antonio, Aransas, and Corpus Christi Bay systems where there are areas legally open to commercial netting. The remaining 156 samples were collected in the Laguna Madre complex where all waters are closed to commercial netting. Mean catch rates (number/hr) were estimated for spotted seatrout and red drum for each bay system. Data from Galveston, Matagorda, San Antonio, Aransas, and Corpus Christi bay systems were used in testing for differences between open and closed areas.

Catch rates from areas closed to commercial netting were higher than those from areas open to commercial netting for both spotted seatrout ($P < 0.005$) and red drum ($P < 0.01$).

The overall mean catch rate for spotted seatrout from areas closed to commercial netting (0.4 ± 0.0 s.e.) was approximately twice as high as that from open areas (0.2 ± 0.1). Galveston and Corpus Christi bays had the lowest mean catch per hr (0.3) and San Antonio Bay had the highest (0.6) for closed areas. The mean catch rate for open areas ranged from 0.0 in San Antonio Bay to 0.4 in Galveston and Matagorda Bay systems. There was no interaction between bays and area types (open or closed) ($P > 0.05$). The mean catch rates from the upper and lower Laguna Madre also exceeded the mean catch rates for waters open to netting (Fig. 2).

There was no difference between the mean size of spotted seatrout from closed areas and trout from open areas ($P > 0.05$). The mean length of trout from open areas ranged from 404 mm to 487 mm while those from closed areas ranged from 403 mm to 508 mm (Table 1).

Red drum also showed a higher mean catch rate in closed areas than in open areas. In closed areas the catch rate was 0.7 ± 0.1 and in open areas it was 0.4 ± 0.1. The catch rates from the upper Laguna Madre (0.4 for the first winter and 0.3 for the second winter) resembled catch rates associated with closed areas (0.7 and 0.8; Fig. 3).

DISCUSSION

A depressed mean catch rate obtained from areas open to commercial netting indicates that commercial netting atcivities now practiced in Texas estuaries could be a factor in reducing spotted seatrout and red drum populations. Furthermore, the difference between the catch rates in adjacent open and closed areas within each bay system indicates the effect is localized. Apparently movement of spotted seatrout and red drum from closed areas to nearby open areas is not compensating for the harvesting of these fish. Tagging data suggest the existence of nearly independent subpopulations of spotted seatrout and red drum in coastal bays (Iversen and Tabb 1962, Tabb 1966, Beaumariage 1969, Moe 1972).

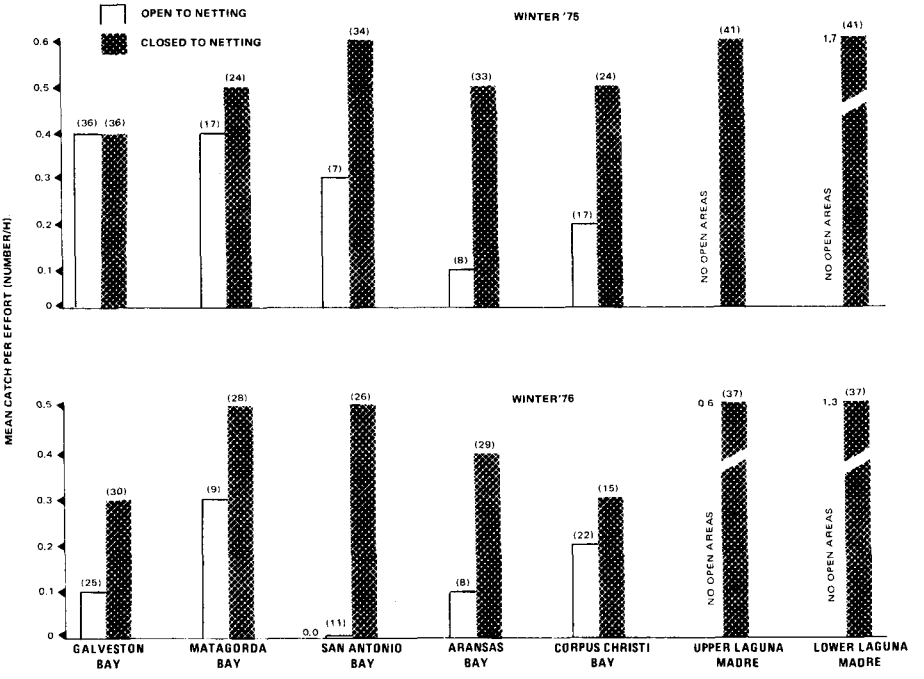

Fig. 2. Mean catch per effort for spotted seatrout caught in gill nets in each Texas bay system during two winter sampling periods (number in parentheses above each bar represents number of samples).

Table 1. Mean total length (mm) of seatrout caught in gill nets in each Texas bay system during two winter sampling periods (numbers in parentheses represent number of net sets).

Sampling year	*Bay system*	*Commercial netting*	
		Legal	*Illegal*
75-76	Galveston	471 (26)	508 (25)
	Matagorda	411 (15)	434 (22)
	San Antonio	420 (7)	421 (28)
	Aransas	404 (4)	470 (24)
	Corpus Christi	482 (12)	500 (24)
	Upper Laguna Madre	—	465 (33)
	Lower Laguna Madre	—	475 (41)
76-77	Galveston	487 (8)	486 (19)
	Matagorda	434 (8)	416 (28)
	San Antonio	441 (5)	403 (21)
	Aransas	424 (4)	460 (21)
	Corpus Christi	475 (12)	471 (10)
	Upper Laguna Madre	—	470 (34)
	Lower Laguna Madre	—	485 (32)

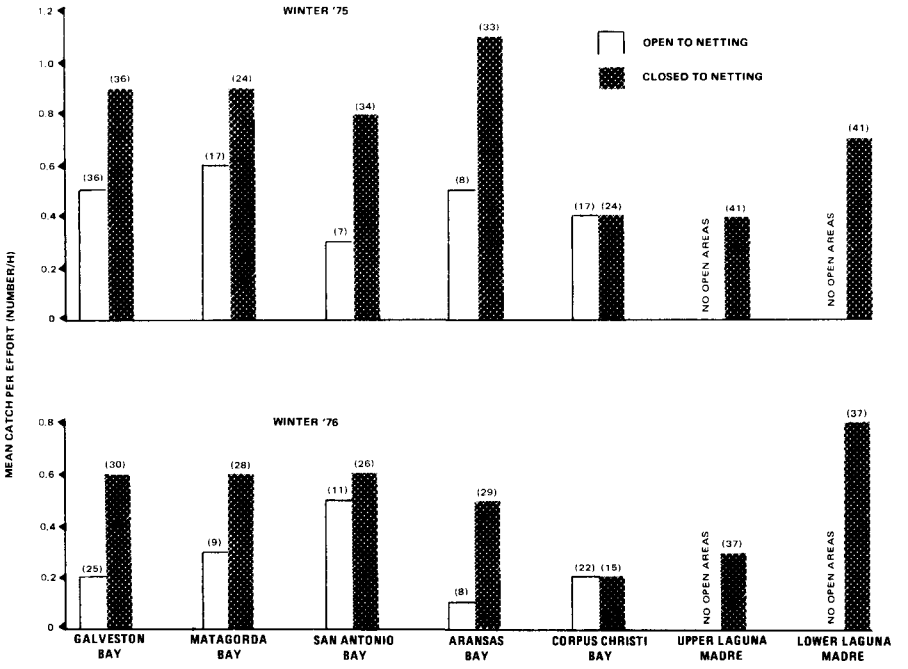

Fig. 3. Mean catch per effort for red drum caught in gill nets in each Texas bay system during two winter sampling periods (number in parentheses above each bar represents number of samples).

When comparing the size of red drum from closed areas versus open areas, we found conflicting results. There was a significant interaction term in the analysis ($P < 0.005$) between bays and areas. This meant no generalization could be made about the size of red drum and whether they were caught in open or closed areas. An examination of the mean sizes (TL in mm) showed that the larger red drum came from open waters in the Matagorda and Corpus Christi Bay systems whereas larger red drum came from closed waters in the Galveston, San Antonio, and Aransas Bay systems (Table 2).

The failure to demonstrate a difference in the mean size of adult trout probably indicates that current netting activities are not dangerously reducing the potential for future productivity. However, if netting were seriously reducing stocks, it is doubtful that the expected reduction in mean size would be readily detectable. The 7.6 cm stretched mesh gill nets do not catch 1 or 2 year old spotted seatrout and catch very few 3 year old fish, consequently the mean lengths that we have computed are for seatrout 4 years old and older. Spotted seatrout have relatively slow growth rates compared to red drum (Pearson 1929, Tabb 1966) and size differences become less discernible in older fish. Therefore, there would have to be a large difference between the proportion of 4 year old fish to older fish from one area type as compared to another before a significant difference could be detected.

The fast growth of red drum (Theiling and Loyacano 1976) along with the sampling of younger age classes in the gill nets should facilitate detection of differences in mean sizes. We found that in 3 of the bay systems sampled, small sizes were associated with commercially netted areas; however, in the other 2 areas, it was just the opposite. The conflicting results obtained in mean size of red drum suggests that local environmental factors may be more important in determining the size distributions of populations rather than the harvest. It is believed that larval red drum come into the bays from the Gulf of Mexico. They remain in the bays until they are adults (3-4 yr old) and then

Table 2. Mean total length (mm) of red drum caught in gill nets in each Texas bay system during two winter sampling periods (numbers in parentheses represent number of net sets).

Sampling year	*Bay system*	*Commercial netting*	
		Legal	*Illegal*
75-76	Galveston	424 (23)	440 (27)
	Matagorda	403 (13)	370 (17)
	San Antonio	335 (5)	387 (25)
	Aransas	349 (3)	395 (22)
	Corpus Christi	371 (10)	376 (19)
	Upper Laguna Madre	—	380 (35)
	Lower Laguna Madre	—	465 (35)
76-77	Galveston	475 (7)	519 (22)
	Matagorda	516 (5)	414 (26)
	San Antonio	364 (6)	381 (14)
	Aransas	394 (4)	416 (20)
	Corpus Christi	430 (11)	407 (10)
	Upper Laguna Madre	—	470 (27)
	Lower Laguna Madre	—	430 (29)

migrate to the gulf and reproduce (Simmons and Breuer 1962). There are only 12 major passes through which the small red drum can enter the bays, a storm or toxicant in the area of one of these passes at the wrong time could have a dramatic effect on a particular year class.

The concept of OSY as a basis for fisheries management considers the impact of both commercial and recreational fishermen on the resource. The level of OSY for both user groups must consider sociological, economic, and political factors, and must be set within the limits of maximum sustainable yield or some maximum "allowable biological catch" for each species. This paper has presented evidence indicating that commercial netting generally reduces spotted seatrout and red drum populations along the Texas coast. The effect is apparently local; netting removes spotted seatrout and red drum from restricted areas but does not appreciably affect adjacent non-netted areas. In addition, these species are apparently capable of sustaining their populations when subjected to commercial netting. Allowing limited commercial netting in areas that have historically received little recreational fishing pressure is a management technique potentially useful for achieving OSY. Contact between recreational and commercial fishermen would be reduced, and economic integrity of the 2 groups would be preserved.

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