

MANAGEMENT OF RED DRUM IN A TEXAS ESTUARY — A CASE STUDY

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Abstract: In September 1974 the Texas Parks and Wildlife Commission banned the use of plastic baits on trotlines because these baits were thought to be selective for small (<500 mm) red drum (*Sciaenops ocellata*). The size of red drum landed by commercial fishermen before (1972-1974) and after (1974-1978) the ban was compared with the size of fish collected during Texas Parks and Wildlife Department trammel net surveys in order to determine whether the ban had any effect on either the commercial catch or fish availability. Fish landed by commercial fishermen were significantly larger after the ban than before; therefore, it appears that plastic baits are selective for small red drum and that the ban resulted in the desired effect. The larger red drum in the commercial landings as compared with trammel net caught fish may have resulted from such factors as fishing method (hook size and bait type), fishing location and/or culling. The reason for the increase in size of trammel net caught red drum after the ban is not clear but may involve a complex series of effects such as year class success, changes in recreational fishing pressure or general decrease in commercial harvest. While this study does not prove conclusively that the ban on plastic baits altered the size composition of commercially harvested red drum, it does indicate that the desired result was achieved. Studies of the effects of management regulations of fish populations are necessary to evaluate the effectiveness of such regulations.

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Red drum management has generally involved sociological, economic and biological considerations (Matlock 1978). Management regulations generally have been imposed in response to concerns expressed by recreational fishermen. For example, the minimum (356 mm) and maximum (889 mm) size limits for red drum retainable by both recreational and commercial fishermen were established to protect immature as well as sexually mature fish. However, the effect of restrictive size limits on the red drum fishery has not been documented.

The primary commercial finfish fishery in the Laguna Madre of Texas is comprised of red drum caught on trotlines (Matlock 1978). In 1972 the Texas Parks and Wildlife Department (TPWD) received many complaints that artificial (plastic) baits on trotlines in the Laguna Madre of Texas were selective for small red drum. Also, many fish were left on hooks, thereby becoming food for scavengers because the durability of plastic baits reduced the need for baiting hooks daily.

In October 1972 the Coastal Fisheries Branch of the Texas Parks and Wildlife Department initiated a study to determine the size composition of red drum landed by commercial fishermen and of red drum available for harvest in the lower Laguna Madre. After 1 year of sampling, Breuer (1973) concluded that trotlines used by commercial fishermen and baited with plastic "took small red drum in a greater proportion than they were present in the total fish population, or more simply, trotlines are selective to small red drum." On 1 September 1974, the Texas Parks and Wildlife Commission banned plastic baits on trotlines throughout Texas bays. Breuer (1974, 1975) later concluded that the regulation resulted in a decrease in the commercial harvest of small (<500 mm) red

drum; however, no extensive data analysis was provided. Estimations of red drum availability and commercial harvest have continued through fall 1978.

The purpose of this study was to analyze existing data to determine if banning plastic baits on troutlines affected the size composition of commercially harvested red drum during 1972-1978.

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MATERIALS AND METHODS

During the fall months of October and November and the spring months of April and May from fall 1972 through fall 1978, commercial fish dealers in Port Mansfield and Port Isabel, Texas (Fig. 1) were visited at random. All red drum caught with trotlines and sold by commercial fishermen to each dealer were measured (total length to the nearest 5 mm). During the same periods red drum in lower Laguna Madre were sampled by TPWD personnel with a 366-m trammel net, consisting of 1 layer of 7.6-cm stretched mesh multifilament webbing sandwiched between 2 layers of 30.5-cm stretched mesh multifilament webbing.

All TPWD trammel nets were set during daylight in the shape of a rectangle with 183 m of shoreline as 1 side and 91 m as the width of each rectangle. After setting the nets, the water inside the rectangle was disturbed to frighten fish into the net. At least 20 of the red drum captured during each set were measured (total length to the nearest 5 mm).

During 1972-1975, sites historically containing red drum were sampled along the shoreline on 2 or 3 different days during each season. From 1976 through 1978 sampling sites were selected at random from a list of available sites (Matlock et al. 1978, Matlock and Weaver 1979).

Total length-frequency histograms were constructed for red drum caught in trammel nets and for those landed by commercial fishermen during each season in each year. The log likelihood ratio test was used to determine if significant ($P < 0.05$) differences existed between the size composition of fish caught in each season in trammel nets and landed by commercial fishermen by comparing the number of red drum in each of 5 length classes-- ≤ 400 , 401-500, 501-600, 601-700 and > 700 mm (Sokal and Rohlf 1969). Fish < 355 mm were not included in the TPWD vs. commercial catch analyses since these fish could not be retained legally. Differences between the mean sizes of fish captured in trammel nets and those landed by commercial fishermen were not tested statistically because length-frequency distributions of fish were not normally distributed (Fig. 2).

RESULTS

Commercial fishermen landed red drum ranging from 320 to 860 mm (Fig. 2). More large red drum were landed in fall than in spring with 58% > 500 mm in fall and 20% > 500 mm in spring (Tables 1 and 2). The proportion of commercially harvested red drum composed of fish > 500 mm was 32% prior to the ban and 56% after. There was a greater change in size composition in the spring than in the fall; i.e., about 15% of the fish landed during springs before the ban were > 500 mm compared with 45% after, while 51% of the fish landed during falls before the ban were > 500 mm compared with 61% after the ban.

Red drum ranging from 260 to 760 mm were caught with experimental trammel nets (Fig. 2). Fish ≤ 400 mm constituted 48% of the fall catch and 36% of the spring catch. A larger proportion of the red drum caught in trammel nets exceeded 500 mm after the ban than before. About 25% of the fish were > 500 mm before the ban, 32% after. There was a greater change in size composition in the spring than in the fall. Substantial changes in the

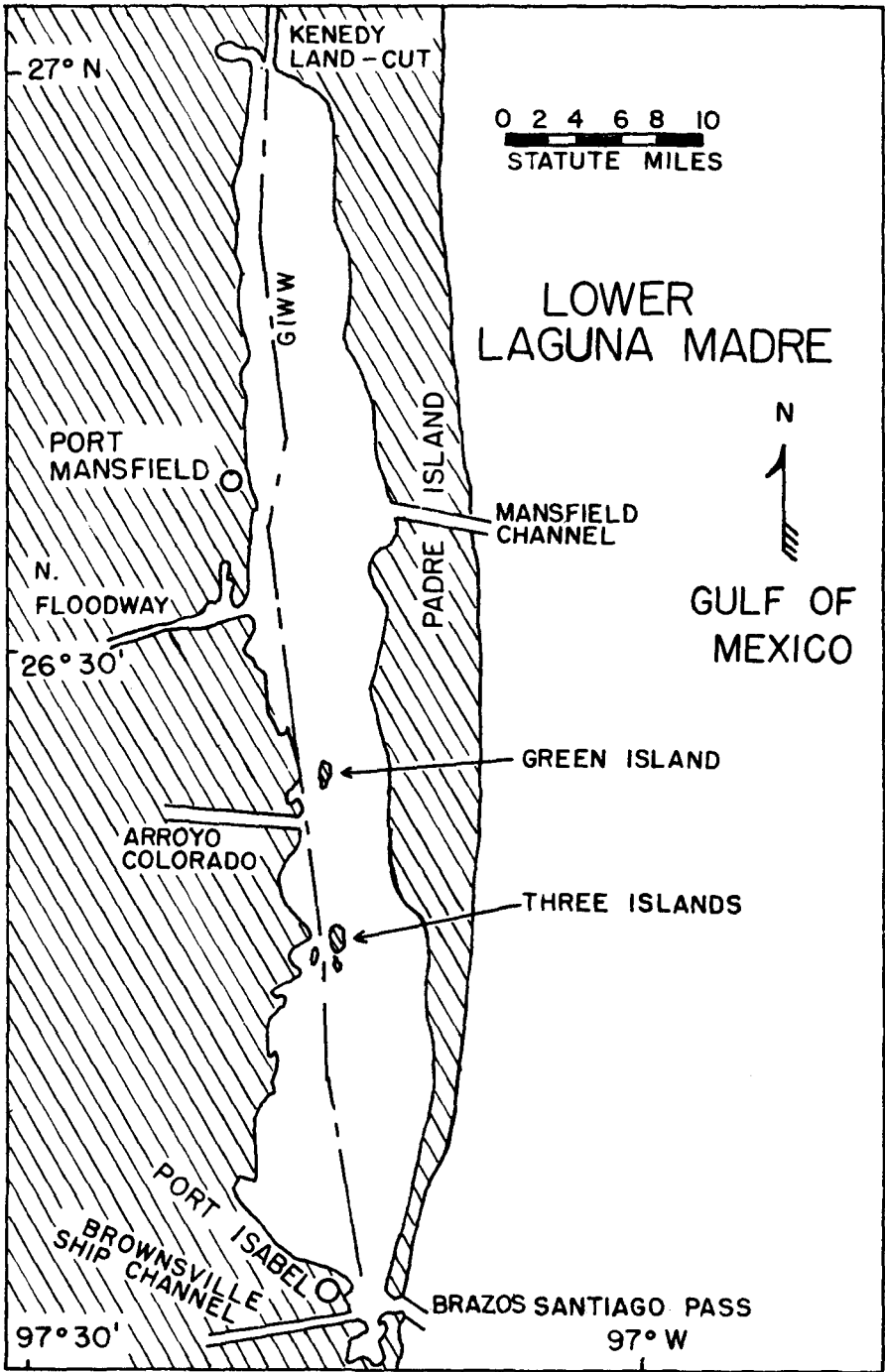


Fig. 1. Map of the lower Laguna Madre, Texas.

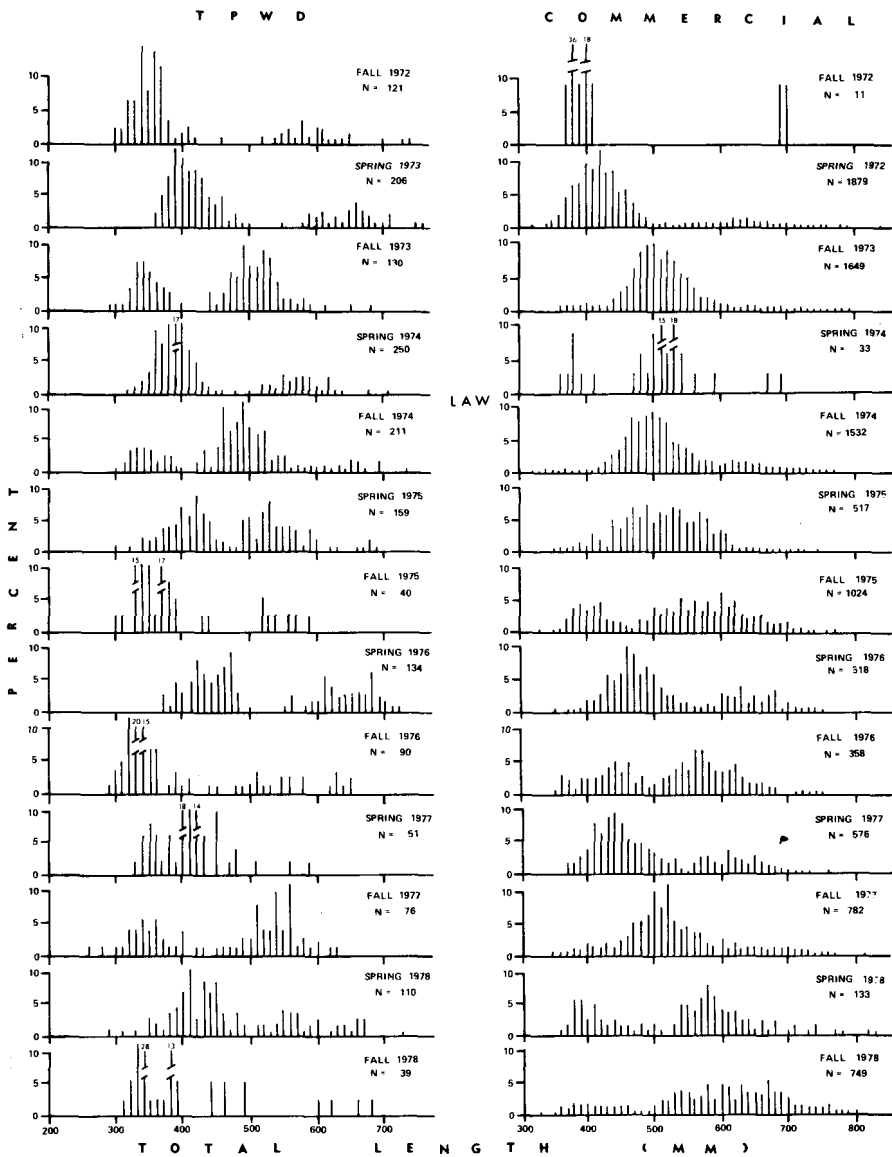


Fig. 2. Percentage of red drum in each 10 mm size class caught in Texas Parks and Wildlife Department (TPWD) trammel nets and landed by commercial trotlines during each fall and spring 1972-1978 (N = number of fish measured; numbers above lines represent percentages).

≤400 and 401-500 mm size classes occurred in the fall catches; whereas substantial changes occurred in all 5 size classes in the spring (Table 3).

Commercial fishermen landed more large red drum (>500mm) than were caught with TPWD trammel nets in both fall (Tables 5 and 6) and spring (Tables 7 and 8) as well as

TABLE 1. Percentage of fish in each of 5 size classes landed by commercial fishermen in each season before (1972-1974) and after (1974-1978) the ban on plastic baits.

Season	Relationship to ban	Number of fish measured	Total length (mm)				
			≤400	401-500	501-600	601-700	>700
Fall	Before	1660	4.5	44.9	44.2	5.2	1.3
Fall	After	4445	7.3	31.8	38.4	19.3	3.2
Fall	Combined	6105	6.5	35.3	40.0	15.5	2.7
Spring	Before	1912	30.0	54.9	5.8	8.3	1.0
Spring	After	1744	6.0	49.1	28.2	14.8	1.8
Spring	Combined	3656	18.5	52.2	16.5	11.4	1.4
Fall & Spring	Before	3572	18.1	50.2	23.6	6.8	1.2
Fall & Spring	After	6189	6.9	36.7	35.6	18.0	2.8

TABLE 2. Results of log likelihood ratio test comparing length frequencies of red drum landed by commercial fishermen by season, before and after the ban on plastic baits, and their interactions.

Hypothesis tested (all years combined)	Degrees of freedom	G-statistic	
Season (fall vs. spring)	Millimeter groups	4	929.875*
Before or after ban	Millimeter groups	4	712.500*
Interaction (season x before or after ban)		4	235.750*

*P<0.05

both before and after the law was enacted. However, the percentage of fish in each size class differed depending on season and the method and time.

In the falls before the law was enacted the greatest differences between the commercially landed and trammel net caught fish were in the ≤400 and 601-700 mm size classes. In the springs before the law was enacted the greatest differences between the commercially landed and trammel net caught fish were in the 401-500 and 501-600 mm size classes (Table 7). After the law was enacted the greatest difference was in the ≤400 mm size class.

TABLE 3. Percentage of fish in each of 5 size classes caught in TPWD trammel nets in each season before (1972-1974) and after (1974-1978) the ban on plastic baits.

Season	Relationship to ban	Number of fish measured	Total length (mm)				
			≤400	401-500	501-600	601-700	>700
Fall	Before	251	53.0	17.9	23.5	4.8	0.8
Fall	After	456	44.5	26.3	22.2	6.8	0.2
Fall	Combined	707	47.5	23.3	22.6	6.1	0.4
Spring	Before	456	50.2	27.0	11.4	9.6	1.8
Spring	After	454	22.2	43.2	18.9	14.8	0.9
Spring	Combined	910	36.3	35.0	15.2	12.2	1.3
Fall & Spring	Before	707	51.2	23.8	15.7	7.9	1.4
Fall & Spring	After	1617	33.4	34.7	20.6	10.8	0.6

TABLE 4. Results of log likelihood ratio test comparing length frequencies of red drum caught in trammel nets by season, before and after the ban on plastic baits, and their interactions.

Hypothesis tested (all years combined)		Degrees of freedom	G-statistic
Season (fall vs. spring)	Millimeter groups	4	62.852*
Before or after ban	Millimeter groups	4	58.391*
Interaction (season x before or after ban)		4	34.008*

*P < 0.05

TABLE 5. Percentage of fish in each of 5 size classes landed by commercial fishermen and caught in TPWD trammel nets during falls before (1972-1974) and after (1974-1978) the ban on plastic baits.

Capture Method	Relationship to ban	Number of fish measured	Total length (mm)				
			≤ 400	401-500	501-600	601-700	> 700
Commercial trotlines	Before	1660	4.5	44.9	44.2	5.2	1.3
Trammel nets	Before	160	26.2	28.1	36.9	7.5	1.2
Commercial Trotlines	After	4445	7.3	31.8	38.4	19.3	3.2
Trammel nets	After	312	18.9	38.5	32.4	9.9	0.3

TABLE 6. Results of log likelihood ratio test comparing length frequencies of red drum landed by commercial fishermen and caught in TPWD trammel nets during falls.

Hypothesis tested (all years combined)		Degrees of freedom	G-statistic
Method of capture (trotline vs. trammel net)	Millimeter groups	4	116.906*
Before or after ban	Millimeter groups	4	267.500*
Interaction (method x before or after ban)		4	34.797*

*P < 0.05

TABLE 7. Percentage of fish in each of 5 size classes landed by commercial fishermen and caught with TPWD trammel nets during springs before (1972-1974) and after (1974-1978) the ban on plastic baits.

Capture Method	Relationship to ban	Number of fish measured	Total length (mm)				
			≤400	401-500	501-600	601-700	>700
Commercial trotlines	Before	1912	30.0	54.9	5.8	8.3	1.0
Trammel nets	Before	430	47.2	28.6	12.1	10.2	1.9
Commercial trotlines	After	1744	6.0	49.1	28.2	14.8	1.8
Trammel nets	After	429	17.7	45.7	20.0	15.6	0.9

TABLE 8. Results of log likelihood ratio test comparing length frequencies of red drum landed by commercial fishermen and caught in TPWD trammel nets during springs.

Hypothesis tested (all years combined)		Degrees of freedom	G-statistic
Method of capture (trotlines vs. trammel net)	Millimeter groups	4	92.594*
Before or after ban	Millimeter groups	4	675.023*
Interaction (method x before or after ban)		4	70.664*

*P<0.05

DISCUSSION

In Texas red drum are harvested by both recreational and commercial fishermen but the commercial catch constitutes the majority, especially in the lower Laguna Madre. For example, in 1975-1976 commercial fishermen landed 94.4% (by weight) of the red drum (Breuer et al. 1977). All fishermen have been prohibited from retaining fish <356 mm since at least 1957 (Stone 1957). In September 1972 the Texas Parks and Wildlife Commission implemented Rule 127.70.01.272 (b) (9) (A) to reduce the harvest of small (<500 mm) red drum by prohibiting the use of plastic baits on trotlines. Since the fish landed commercially and those caught with TPWD trammel nets (i.e. available fish) were larger after the regulation went into effect than before, it appears that plastic baits are selective for small red drum and that the ban did affect the size of red drum caught.

Breuer (1973) reached the same conclusion based on red drum commercial (trotline) landings and red drum availability to a 7.6-cm mesh trammel net. However, he failed to consider the number of fish <356 mm caught but not retained, and therefore not sold. Culling must be considered in an analysis of the size selectivity of plastic baits for red drum.

Fishing method, hook size, bait type, fishing location and culling also influence the size of commercially landed red drum. Culling, for example, occurs since very small (<356 mm) fish require more effort in cleaning and very large (>789 mm) red drum are poor in flavor and texture (Pearson 1929).

The increase in the size of commercially landed red drum after the ban is logical; however, there was no subsequent increase in the proportion of small fish available to the trammel nets. Instead, fish caught in trammel nets increased in size after the ban. The reason for this apparent inconsistency is not clear but probably involves a complex series of effects of unknown type and magnitude. In order for the number of fish in a given size class to increase, the number recruited into the size class must exceed the rates of mortality and emigration. For example, a very successful year class will result in more small fish available to reach a large size. Any increase in the number of recreational fishermen, who characteristically harvest small fish (Breuer et al. 1977), may leave a greater proportion of large fish in the population. A decrease in the number of trotlines that each fishermen could tend resulting from the ban probably would decrease the commercial harvest and increase the number of available fish of all sizes.

The smaller size of red drum caught with trammel nets in the fall as compared with spring reflected the annual recruitment of fish spawned the previous fall (Pearson 1929, Simmons and Breuer 1962). This pattern was the same both before and after the plastic ban. The larger size of commercially landed red drum in the fall as compared with the spring resulted from the minimum legal size and the growth of the fish. In fall, recently recruited fish (<356 mm) were available, but could not be retained legally by commercial fishermen. Therefore, the landings were composed of age class II and older fish. Fish not retainable in the fall had grown sufficiently to be included in the commercial landings in the spring. Therefore, the spring landings included age class I fish. This pattern also was the same both before and after the ban.

While this study does not prove conclusively that the ban on plastic baits altered the size composition of commercially harvested red drum, it does indicate that the desired results were achieved. A more definitive study would have included a comparison of size selectivity of trotlines baited with plastic and natural baits. Nevertheless, this study represents one of the few attempts to document the effects of a particular management regulation. This approach to management is necessary in order to evaluate the effects of regulations on existing fish populations.

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