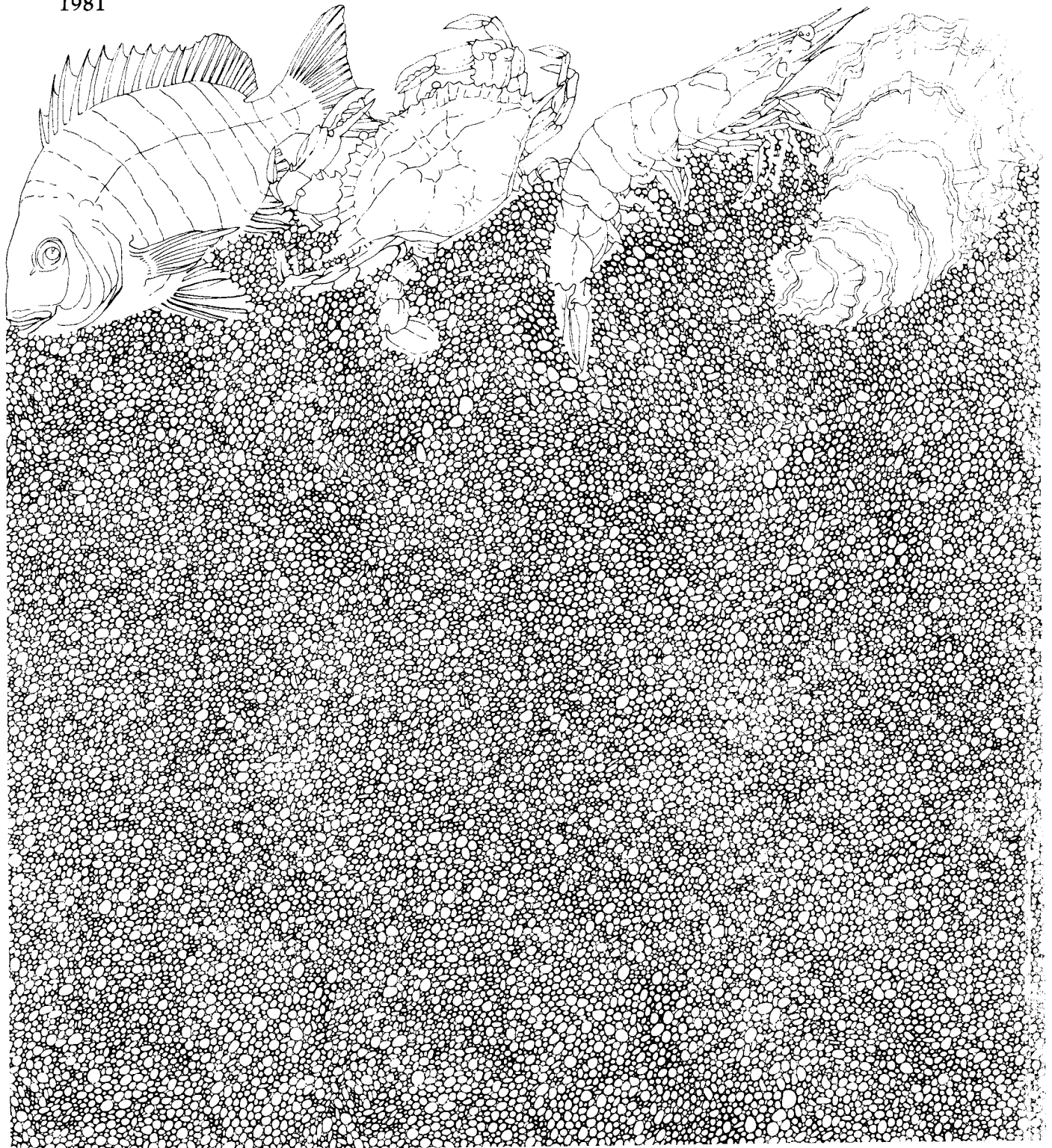


Paul Hammerschmidt

ASSESSMENT OF BOTTOM LONGLINE FISHING OFF THE CENTRAL TEXAS COAST, A COMPLETION REPORT

by Terry J. Cody, Billy E. Fuls,
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ACKNOWLEDGEMENTS

We would like to thank Gary Graham, Marine Fisheries Specialist with the Texas Agricultural Extension Service, for his help and advice during this project.

We thank T. L. Heffernan and R. B. Johnson of Texas Parks and Wildlife Department for reviewing the manuscript.

This study was funded in part by the U. S. Department of Commerce, NOAA, National Marine Fisheries Service, under PL 88-309, Project number 2-312-R-3.

ASSESSMENT OF BOTTOM LONGLINE FISHING
OFF THE CENTRAL TEXAS COAST, A COMPLETION REPORT

ABSTRACT

The commercial potential for incorporating bottom longline fishing off the central Texas coast into the penaeid shrimp fishery during December-April (non-shrimping season) was determined using data from 91 samples collected during February 1978-February 1980. Each sample involved a 366-m long bottom longline with 50-100 hooks baited with dead fish and invertebrates and set for about 1 h. The mean catch of total fish varied between seasons, depth zones and years, however, the mean weight caught was generally higher during the non-shrimping season in the 38-91 m (31-50 fm) depth zone than in the 6-37 m (3-20 fm) zone in each year. The highest mean catch of 157.2 ± 23.6 kg/100 hook-h (346.6 ± 52.0 lb/100 hook-h) occurred in 1979-80. Atlantic sharpnose shark (Rhizoprionodon terraenovae) was the most abundant species caught during the study; it represented 78.4% of the number and 69.5% of the weight caught.

The inclusion of bottom longline fishing during December-April into the Gulf shrimp fishery in 1980 would have been more economically feasible than shrimping or remaining docked during this period. The vessel owner would have lost less money, and the crew would have made more money annually from bottom longlining during the non-shrimping season than from shrimping or from docking the vessel.

Problems that might be encountered in a bottom longline fishery include the lack of markets for shark products in Texas, variability in catches, potential for overfishing stocks and potential conflicts with established fisheries.

INTRODUCTION

Historically, Texas Gulf of Mexico offshore fisheries have been based on penaeid shrimp. Because of closed seasons, cyclic variations in the abundance of shrimp and economic pressures, the shrimping fleet is not fully active throughout the year. To maximize benefits in relation to cost, the shrimping community has often expressed interest in other marine resources of commercial value which might be utilized during periods of reduced shrimping activity (especially winter). With an increasing consumer demand for fishery products, underutilized resources could possibly play an increasingly prominent role in the coastal fisheries economy.

A fishing method with possible commercial potential is longlining, a hook and line technique basically equivalent to trotlining but larger in scale. Longlines have been used for years to catch both demersal and pelagic species in the open sea (Morgan 1955), the gear varying only in minor ways to catch the target species. Lines may be set directly on the bottom or at any depth within the water column by the use of buoys. In 1979 and 1980 many Gulf shrimpers rigged their vessels with subsurface longlines to fish for swordfish as an alternative fishery in an attempt to increase vessel profits.

National Marine Fisheries Service (NMFS) research personnel aboard the R/V Oregon II have made exploratory cruises in the Gulf of Mexico, bottom longlining for tilefish (Lopholatilus chamaeleonticeps) and grouper (Epinephelus sp.). NMFS found that tilefish and possibly yellowedge grouper (Epinephelus flavolimbatus) are present in potentially commercial concentrations off Texas between 274-366 m and 128-274 m respectively (Nelson and Carpenter 1968). However, Nelson and Carpenter (1968) stated that bottom longlines may be more suitable for assessing tilefish stock abundance than for commercially harvesting the fish.

In 1977, with federal aid pursuant to the Commercial Fisheries Research and Development Act, the Texas Parks and Wildlife Department (TPWD) initiated the present study of experimental bottom longlining to assess the commercial potential of finfish stocks off the central Texas coast.

The objectives of this study were to determine:

- o species of fish susceptible to bottom longlines and their seasonal and areal abundance within the 91 m (50 fm) depth contour,
- o commercial potential for bottom longline fishing off the central Texas coast, especially during the December-April period, and
- o if tilefish and yellowedge grouper were available beyond the 91 m (50 fm) depth contour.

MATERIALS AND METHODS

The study area off the central Texas coast is shown in Figure 1. All inshore stations (within the 91-m depth contour) lay in the region between latitude 27°20'N and 28°00'N and between the Texas coastline and longitude 96°20'W. All offshore stations (depths > 91 m) lay in the region between latitude 27°00'N and 27°30'N and between longitude 96°00'W and 96°30'W.

Of the 104 samples obtained, 91 came from the inshore zone within the 91-m depth contour between February 1978 and February 1980 (Table 1). After preliminary testing of the gear during December 1977 and January 1978, at least one sample was collected during each season from each 18-m depth zone increment out to 91 m except during summer 1978 in the 75-91 m zone and spring 1979 in the 6-18 m zone. Sampling in the inshore zone ended in winter 1980. Additional samples (13) were collected between 93 m and 421 m during spring 1978 and 1979 and winter-spring 1980.

The bottom longline used was 366 m long with 50-100 hooks (Figure 2). The gear was deployed and retrieved from the stern of the R/V Western Gulf (TPWD's research vessel) using a small winch mounted centrally on the afterdeck. The groundline was wound onto a winch drum or hand-coiled into tubs.

Brummel hooks were used to attach lines together so that buoy lines, anchors, groundline sections, etc. could be attached or removed quickly. Using Brummel hooks (Inset A, Figure 2) the bottom longline with 100 hooks (spaced 3 m apart) was normally deployed in 10-30 minutes, depending on the depth of water. Tuna circle hooks (sizes 4, 6, 7 and 8) were prebaited with fresh or frozen fish and invertebrates (collected by trawl) and hung on the edge of washtubs or garbage cans to prevent tangling. Up to 25 grouper hooks (sizes 7/0 and 9/0) were used on some offshore longline sets. Quick-release snap-on connectors with swivels (Inset B, Figure 2) were used to attach gangions to the groundline.

The longlining operation was conducted with a crew of 3-4 (including the captain). In setting the longline, one person controlled the speed of the line being released from the winch while another handed the prebaited gangions to a third person who snapped them into place at regular intervals on the groundline. The retrieval operation was the reverse of the setting operation; one person controlled the groundline speed, one person unsnapped gangions from the groundline and handed them to the third person who placed hooks with fish in one area of the deck and hooks without fish back onto the garbage cans.

Set time was considered to be the minimum bottom time; i.e., the time from total release of the longline until the time retrieval began. Sample times ranged from 30 to 150 minutes with 83 of 104 sets consisting of 100 hooks fished for 60 minutes. Catch rates were expressed as number or weight of fish caught with 100 hooks fished for 1 h (no/100 hook-h or kg/100 hook-h). Mean catch rates were calculated by giving equal weight to the adjusted catch rate for each sample. Standard errors were calculated (Sokal and Rohlf 1969).

Fish were identified using the key of Gallaway et al. (1971). Common and scientific names are from Bailey et al. (1970). All fish were measured to the nearest mm total length. Platform scales were used for all weights; fish \leq 4 kg were weighed on scales accurate to \pm 10 g and those $>$ 4 kg on scales accurate to 56 g (2 oz).

Appendix A presents station data for 1977-80 in chronological order. Bottom and surface hydrological data were accurate to \pm 1 C (with greater errors from bottom water samples at offshore stations) and \pm 1 o/oo salinity.

Bottom water samples were taken with a Nansen Bottle; an A. O. refractometer was used to obtain salinities; standard lab-grade thermometers were used to measure temperatures. Station locations were estimated using water depth and LORAN-A station 3H3, station 3H2 being weak in the study area. Locations were accurate to ± 1 km latitude and ± 2 km longitude.

For analysis purposes the adjusted catch rates were grouped into two separate time periods: 1) a 5-mo "non-shrimping" season (December-April) and 2) a 7-mo "shrimping" season (May-November) based on historical cost and return data for the Texas shrimp fleet. Data were grouped into two depth zones (6-37 and 38-91 m) of equal area before analysis. The boundary between zones also corresponded to a change in the bottom gradient in offshore Texas waters.

Difference between mean catch rates by number and weight for all fish combined and Atlantic sharpnose shark separately during the non-shrimping season of three consecutive years (1978, 1978-79 and 1979-80) in each of the two depth zones were determined using a two-way analysis of variance (Overall and Spiegel 1969). Differences between mean catch rates by number and weight for all fish combined and Atlantic sharpnose shark separately in the shrimping and non-shrimping seasons of 1977-78 and 1978-79 in each of the two depth zones were determined using a three-way analysis of variance (Overall and Spiegel 1969). All data were transformed to common logarithms before analysis. The 0.05 level of confidence was used to indicate significant differences.

Economic analysis was based on a modification of Nichols et al. (1980) using monthly cost and return and data from Hixon et al. (1980). The cost of bait, freight and handling were assumed to be zero. The expected price per weight (\$0.57 per kg whole weight) was based on Hamilton (1981). The highest mean catch of total fish in any one depth zone during the non-shrimping season was used to determine the expected loss or profit to the owner, captain and crew of a typical Gulf shrimp vessel.

To determine how feasible it would be to enter into an alternate fishery like bottom longlining the fisherman must estimate the quantity or price he needs to allow his operation to cover all costs or "breakeven." This can be done by estimating the quantity needed at a price he expects to receive, or by estimating the price he must receive for the quantity he expects to land.

The formula for calculating the breakeven price is:

$$P = \frac{FC + VC}{XQ}$$

where,

- P = Breakeven price per weight of total fish
- FC = Fixed costs of the bottom longlining operation assigned to owner (or crew) plus any required net return
- VC = Variable costs of the bottom longline operation assigned to owner (or crew),
- X = Percentage of landings given to owner (or crew) and
- Q = Quantity of product landed seasonally.

By exchanging P and Q in the formula the breakeven quantity can be determined for a given price. Breakeven prices were estimated for quantities ranging from 6754 to 316,915 kg per season.

Breakeven prices for the crew were calculated in the same manner using only variable costs assigned to the crew since they pay no fixed costs. Breakeven prices were estimated with and without an opportunity cost, which in general terms is the amount of money the crew could have made at other jobs if they had not gone longlining. In this analysis the opportunity cost was estimated by determining the value of the crew's time at the minimum wage rate. This estimate of \$3377 per crew member was added to the variable costs in determining the breakeven prices.

Breakeven landings per season were estimated over a range of prices from \$2.20/kg to \$0.11/kg.

RESULTS

Inshore Gulf

A total of 709 fish representing 30 species and weighing 3558.6 kg was caught in 91 samples during 10,506 hook-h of fishing (25 cruises) from February 1978 through March 1980 (Appendix B). Atlantic sharpnose shark (Rhizoprionodon terraenovae) was the most abundant species caught (556 fish weighing 2466.6 kg) representing 78.4% of the total fish and 69.5% of the total weight (Table 2). The highest mean catch rate of Atlantic sharpnose shark in number occurred during December 1979 in the 38-55 m zone (45.0 + 1.0 fish/100 hook-h); the highest catch in weight occurred during May 1979 in the 20-37 m zone (226.1 kg/100 hook-h) (Table 3). No consistent patterns in the mean catch of Atlantic sharpnose shark with respect to month or depth zone were apparent. Besides Atlantic sharpnose shark, only red drum (Sciaenops ocellata), red snapper (Lutjanus campechanus), sea catfish (Arius felis), spinner shark (Carcharhinus maculipinnis), and scalloped hammerhead (Sphyrna lewini), were represented by 10 individuals during the study. None of these species was caught during June or August (no samples collected during July) but at least one of these five species was caught every fall and spring (Table 4).

Red drum and sea catfish were caught only in the shallowest depth zone (6-18 m). Red snapper were caught in every depth zone except the shallowest; spinner shark were caught in water < 55 m deep; scalloped hammerhead were caught in all depth zones except the 38-55 m zone.

The mean number of fish caught per 100 hook-h during the non-shrimping season was consistently higher in the 38-91 m zone than in the 6-37 m zone (Table 5). The mean catch of all fish was significantly different between years and depth zones; however, the magnitude of the differences between depth zones was not consistent among years (Table 6). The mean weight of fish caught per 100 hook-h during the non-shrimping season was also significantly different between years and depth zones with the weight caught in the 38-91 m zone about four times greater than that in the 6-37 m zone (Tables 5 and 7).

During 1977-78 and 1979-80 the mean catch rates of Atlantic sharpnose shark were higher in the 38-91 m zone than in the 6-37 m zone; during 1978-79 the mean catch rates in the two depth zones were about the same (Table 8). The mean catch rates (both no/100 hook-h and kg/100 hook-h) of Atlantic sharpnose shark during the non-shrimping season were significantly different

between years and depth zones, however the magnitude of the differences between depth zones were not consistent among years (Tables 9 and 10).

The mean catch of all fish combined ranged from 0.8 ± 0.7 fish/100 hook-h (4.9 ± 3.6 kg/100 hook-h) in the 6-37 m zone during the 1978-79 non-shrimping season to 13.3 ± 6.4 fish/100 hook-h (69.3 ± 34.8 kg/100 hook-h) in the 6-37 m zone during the 1978-79 shrimping season (Tables 11 and 12). The mean catch rate (both no/100 hook-h and kg/100 hook-h) of all fish combined was significantly different between seasons, depth zones and years; no consistency in the magnitude of the differences was found (Tables 13 and 14).

The mean catch of Atlantic sharpnose shark ranged from 0.0 ± 0.0 fish/100 hook-h (0.0 ± 0.0 kg/100 hook-h) in the 38-91 m zone during the 1978-79 non-shrimping season to 11.9 ± 6.5 fish/100 hook-h (61.3 ± 35.4 kg/100 hook-h) in the 6-37 m zone during the 1978-79 shrimping season (Tables 15 and 16). The mean catch rate (both no/100 hook-h and kg/100 hook-h) of Atlantic sharpnose shark was also significantly different between seasons, depth zones and years; no consistency in the magnitude of the differences was found (Tables 17 and 18).

The estimated income from bottom longlining between 38 and 91 m during December-April would be \$90,321 if the highest total mean catch rate (157.2 kg/100 hook-h) was caught on 84 fishing days where six 1-h sets of 200 hooks were made on each day and price/kg was \$0.57. The owner would lose \$3,195 per year if shrimping were supplemented by 5 mo of bottom longlining (Appendix C, Table 5). Compared with the options of shrimping all year or shrimping 7 mo and tying up 5 mo, bottom longlining combined with shrimping would result in a smaller loss to the owner and higher profits to the crew (Table 19). However, compared with a combination of shrimping and longlining for swordfish, the swordfish option would yield the greatest profit to the owner and about the same return to the crew as bottom longlining.

Breakeven prices for the owner when bottom longlining is considered as an alternative to shrimping during December-April ranged from \$0.02/kg (Table 20) to \$0.71/kg. If the owner assigns a share of the vessel fixed costs to the bottom longlining operation the breakeven range becomes \$0.17/kg to \$7.87/kg.

At an average catch rate of 157.2 kg/100 hook-h over the entire season the breakeven price for the owner including vessel fixed costs is estimated to be \$0.34/kg. This price is below that assumed in the operational budgets (\$0.57/kg) and indicates a potential benefit to the owner from bottom longlining.

Breakeven prices estimated over the same range as for the owner ranged from \$0.11/kg to \$5.15/kg without the opportunity cost and \$0.18/kg to \$8.66/kg with the opportunity cost (Table 20). Breakeven requirements for the crew with opportunity costs were approximately 10% higher than the requirements for the owner when vessel fixed costs were included.

Requirements for the crew were higher than for the owner, indicating that the crew assumes a large share of the costs in this type of crew share arrangement (Table 21). At the price used in the budgets (\$0.57/kg) presented here the breakeven landings for the crew were 102,595 kg with opportunity

cost included. This is approximately 35% less than the total landings estimated using the highest mean catch rate for the non-shrimping season.

Miscellaneous Notes

Prior to initiating routine sampling in February 1978, two bottom longline samples were collected with available gear to test deployment and retrieval methods. Total fish caught, date, location, effort and hydrological data are presented in Table 22. Because of the small number of hooks used these samples were not included in the data analysis.

Sex and maturity stages for 8 of 16 red drum and 15 of 17 red snapper caught at inshore stations were determined during the study (Tables 23 and 24). The red drum weighed from 7.7 to 15.9 kg (mean: 10.6 ± 0.5 kg) and ranged from 890 to 1130 mm total length (mean: 1000 ± 14 mm). Six of the 8 fish examined were males; none were ripe or showed signs of pre-spawning development. The females were not examined. Stomach contents included the remains of small fishes, stomatopods and portunid crabs. The red snapper caught at inshore stations weighed from 6.8 to 12.3 kg (mean: 9.0 ± 0.4 kg) and ranged from 708 to 940 mm total length (mean: 834 ± 14 mm). Twelve of the 15 fish examined were males; 9 of these were maturing or developing. The remaining three males were either spent or resting. All three females were developing.

Offshore Gulf

A total of 71 fish representing 14 species and weighing 209.3 kg was caught in 13 samples (1400 hook-h of fishing) during March 1978, March 1979 and February-March 1980 (Appendix A). Tilefish was the most abundant species caught, representing 40.1% of the total number and 34.8% of the weight (29 fish weighing 72.9 kg). Tilefish were caught in the 272-397 m zone; yellow-edge grouper in the 115-196 m zone (Table 25). Highest mean catch rates of all fish combined 4.0 ± 3.0 and 10.6 ± 9.7 by number and weight respectively occurred on 29 February, 1980 (Tables 26 and 27). Tilefish, Florida smoothhound (Mustelus canis) and yellowedge grouper constituted 73.4% (153.7 kg) of the total weight of fish caught (Table 25). Two red snapper were caught with one individual in a developing stage (Table 24).

DISCUSSION

Based on the analysis presented in this report, the inclusion of bottom longline fishing into the Gulf shrimp fishery during December-April 1980 would have been more economically feasible than shrimping alone or remaining docked during this period. The vessel owner would have lost less money, and the crew would have made more money annually from bottom longlining during the non-shrimping season than from shrimping or from docking the vessel.

The owner decides how the vessel is used and must consider at least three factors in his decision:

1. The profit or loss expected from each operation-longlining, shrimping or remaining docked,
2. The profit or loss to the crew and
3. The retention of a crew for the shrimping season.

The incentive for the crew to be available at the start of the shrimping season would be less if the vessel were docked than if the vessel were operating during the non-shrimping season. Retaining a crew through the non-shrimping season would require the generation of a profit for the crew. Bottom longlining during the non-shrimping season keeps the vessel operational and apparently yields a profit to the crew higher than shrimping alone. In addition, the owner would lose annually about one-tenth the amount he would lose from shrimping alone or remaining docked. Therefore, it appears as if bottom longlining is a viable alternative to shrimping during December-April, assuming the same economic conditions used in this analysis. Although this analysis indicates that bottom longlining is an economically feasible alternative for an average vessel, some vessels may have higher or lower returns than the average.

Nichols et al. (1980) reached the same conclusion with respect to longlining for swordfish. The profit for the owner from the combination swordfish longlining and shrimping operations would be about \$10,000. Although swordfish longlining appears to be more profitable than bottom longlining, the investment associated with swordfish longlining (\$31,000) would be five times greater than that associated with bottom longlining.

The above conclusion is based on the presence of a reliable market for the catch as well as a consistent catch rate. The most likely target species of a bottom longline fishery off the central Texas coast would be the Atlantic sharpnose shark. At present sharks are not utilized extensively in Texas. During September 1978-August 1979, 775 kg of shark were landed by commercial fishermen in Texas (Texas Parks and Wildlife Department, unpublished data). However, the potential for the development of a market in Texas exists. Sharks could be landed in Texas and shipped to consumers throughout the world. In 1973 world landings of shark totaled 447.8 thousand metric tons, and the utilization of sharks for human consumption will probably increase (Ronsivalli 1978). Sharks are valued as a source of protein in many parts of the world and are utilized in a variety of nonfood uses including shark leather, pharmaceuticals, novelties and other miscellaneous uses (Ronsivalli 1978).

If the current price of \$0.57/kg (for sharks) could be obtained for the total fish catch during the non-shrimping season, the mean catch of total fish would have to be 92.5 kg/100 hook-h or about 24% higher than the 3-year mean catch rate (74.7 kg/100 hook-h) for the owner to break even during the 5 mo of longlining.

Perhaps the greatest problems facing the bottom longliner are the expected variability in the catch and the potential for overfishing the stocks. The mean total catch in the 38-91 m zone during the non-shrimping season could be expected to range from 6.7 to 204.4 kg/100 hook-h. If the catch were as low as 6.7 kg/100 hook-h the breakeven price for the owner would be almost \$8.00/kg. It seems unlikely that such a price could be obtained from the current market. Therefore, if the owner expects to continue a longlining operation, the profit made in a year during which the catch rate was high (e.g. 100 kg/100 hook-h) would have to be large enough to offset the expected loss in a year during which the catch rate were low (e.g. 10 kg/100 hook-h).

Since sharks appear to be the mainstay of a bottom longline fishery in the Gulf, the life history and population dynamics of these fish is of prime importance to the fishery. Neither the life history nor the population dynamics of any species of shark off Texas is well documented. However, two aspects that appear to be common among sharks are their slow growth rate and small number of offspring produced by each female (Ronsivalli 1978). These characteristics may increase the potential for overfishing; restrictions on harvest may therefore be necessary.

An additional problem that a bottom longline fishery may encounter includes the harvest of species which may already be the target for directed recreational or commercial fisheries. For example, red drum and red snapper were among the most abundant species caught, other than Atlantic sharpnose shark. Major recreational and commercial fisheries currently exist for both species, and the ability of these stocks to withstand additional fishing pressure is doubtful. However, red drum were not caught beyond 18 m where longlines were most successful. The potential problem associated with red drum could probably be avoided without adversely affecting the economic aspects of the longline fishery by fishing beyond 18 m. Red snapper, however, were caught in the same area where longlines would probably be fished (beyond 37 m). Although these fish may represent additional income to the fishermen there is a potential for conflict with established fisheries if a bottom longline fishery develops.

During early 1981 there were several commercial longline fisheries operating off the Texas coast. In March 1981 approximately 100 trips were made by vessels using surface and bottom longlines to catch swordfish, tuna, large sharks, tilefish, red snapper and grouper. The major bottom longline fishery off the Texas coast during early 1981 was probably the red snapper-grouper fishery. Most of the commercial effort involved from 1.6 to 3.2 km of groundline with 100-200 hooks per 1.6 km and a bottom time of 2-4 h (NMFS, unpublished data). The fact that these fisheries were operational during 1981 indicates vessel owners are looking for alternate fisheries to ease the economic situation in the shrimping industry. Whether or not these fisheries will be economically feasible and continue to be viable remains to be seen.

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Table 1. Number of bottom longline samples collected from each depth zone off the central Texas coast during each month from February 1978 through March 1980 (Blanks = 0).

Season	Month and year	Depth zone											A11 depths				
		6-18 m	20-37 m	38-55 m	57-73 m	75-91 m	93-183 m	185-274 m	276-421 m	51-100 fm	101-150 fm	151-230 fm					
Winter	2/78	1	1														2
Spring	3/78	3	3	7	2	1	1	1									18
Spring	4/78	3															3
Summer	6/78	1	1	2	1												5
Fall	9/78	3	1														4
Fall	10/78	3	1														4
Fall	11/78	4	4	1	1												4
Winter	12/78		1							2							12
Winter	1/79	3	1														1
Winter	2/79	2	2	2	2	2	2	2	2	2							4
Spring	3/79			3	1	3	1	1	1	1							10
Spring	5/79		1								1						6
Summer	8/79	2	2	1	1	1	1	1	1	1							1
Fall	10/79	1	1	1	1	1	1	1	1	1							7
Winter	12/79	2	3	2	1	1	1	1	1	1							5
Winter	1/80	3															7
Winter	2/80				1	1	1	1	1	1							3
Spring	3/80																8
All months		31	22	19	10	9	9	9	9	9	3	4	6	3	3	6	104

Table 2. Total number and weight of each species caught on inshore bottom longlines off the central Texas coast during February 1978-February 1980 with associated size, depth range and hydrological data.

Scientific name	Common name	Total number	Weight (kg)		Total length range (mm)	Depth range (m)	Bottom temperature range (C)	Bottom salinity range (o/oo)
			Range	Average				
Carcharhinidae								
<u>Aprionodon isodon</u>	Finetooth shark	6	1.5-16.9	67.6	660-1460	7-24	18.3-29.0	25.5-37.8
<u>Carcharhinus acronotus</u>	Blacknose shark	2	10.0-13.2	23.1	1200-1210	70-75	16.1-20.0	36.1-36.6
<u>C. falciformis</u>	Silky shark	4	5.4-6.8	24.4	1000-1090	51-55	20.3-25.7	35.5-36.6
<u>C. leucas</u>	Bull shark	1	61.2	61.2	1950	55	25.7	35.5
<u>C. maculipinnis</u>	Spinner shark	17	2.8-45.4	283.8	786-2000	9-48	16.9-29.0	26.6-37.2
<u>C. porosus</u>	Smalltail shark	1	2.4	2.4	745	7	27.5	25.5
<u>Rhizoprionodon terraenovae</u>	Atlantic sharpnose shark	556	0.3-10.9	2466.6	415-1170	7-77	16.1-29.9	31.2-38.3
	Unidentified sharks	2	1.6	1.6				
Triakidae								
<u>Mustelus canis</u>	Smooth dogfish	1	2.4	2.4	860	69	16.1	36.1
<u>M. norrisi</u>	Florida smoothhound	9	2.5-12.0	57.3	865-1300	48-86	16.1-17.0	35.5-36.6
Sphyrnidae								
<u>Sphyrna lewini</u>	Scalloped hammerhead	12	1.7-10.9	60.1	710-1905	18-82	16.1-28.8	31.6-37.8
<u>S. mokarran</u>	Great hammerhead	2	25.0-29.5	54.5	1680-1990	48-58	16.5-21.5	35.5-38.3
<u>S. tiburo</u>	Bonnethead	1	1.0	1.0	650	70	16.1	36.1
Dasyatidae								
<u>Dasyatis sabina</u>	Atlantic stingray	2	1.9-2.0	4.0	340-355	11-15	14.9-19.6	27.8-31.6
Muraenidae								
<u>Gymnothorax nigromarginatus</u>	Blackedge moray	3	0.2-0.2	0.8	420-450	40-55	14.8-25.7	35.5-36.6
Ophichthidae								
<u>Myrophis punctatus</u>	Speckled worm eel	1	0.4	0.4	520	18	20.5	33.3
<u>Mystriophis mordax</u>	Snapper eel	2	0.1-0.4	0.5	558-670	18-27	16.5-29.9	34.4-36.6
<u>Ophichthus gomesi</u>	Shrimp eel	3	0.1-0.2	0.4	371-610	13-73	16.5-24.8	36.6-37.8
<u>Ophichthus</u> sp.	Banded shrimp eel	8	0.8-3.3	17.3	800-1365	22-77	16.0-21.6	33.9-38.3

Table 2. (Cont'd.)

Scientific name	Common name	Total number	Weight (kg)		Total length range (mm)	Depth range (m)	Bottom temperature range(C)	Bottom salinity range (o/oo)
			Range	Average				
Ariidae								
<u>Arius felis</u>	Sea catfish	17	0.2-0.7	7.4	284-420	6-18	18.3-29.2	31.6-36.6
<u>Bagre marinus</u>	Gafftopsail catfish	8	1.2-2.3	13.8	499-590	6-18	19.0-29.2	31.6-37.8
Serranidae								
<u>Centropristis philadelphica</u>	Rock sea bass	6	0.2-0.3	1.7	255-345	70-91	16.1-22.3	35.5-39.1
<u>Ephinephelus nigritus</u>	Warsaw grouper	2	5.3-30.4	35.7	660-1150	48-51	16.5-16.8	35.5-37.8
<u>E. flavolimbatus</u>	Yellowedge grouper	1	1.7	1.7	515	91	20.9	37.2
Carangidae								
<u>Caranx hippos</u>	Crevalle jack	4	7.7-7.9	32.0	905-925	13-22	19.2-29.2	31.6-37.8
Lutjanidae								
<u>Lutjanus campechanus</u>	Red snapper	17	6.8-12.2	153.9	708-940	37-91	14.6-22.0	34.4-37.8
<u>Pristipomoides aquilonaris</u>	Wenchman	1	0.1	0.1	243	82	22.3	39.1
Sciaenidae								
<u>Cynoscion nothus</u>	Silver seatrout	2	0.3-0.3	0.6	315-316	75-82	20.0-22.3	36.6-39.1
<u>Pogonias cromis</u>	Black drum	4	6.8-12.6	33.7	750-910	18-22	11.0-19.2	31.6-32.2
<u>Sciaenops ocellata</u>	Red drum	14	7.7-15.9	148.6	890-1130	13-18	12.0-24.8	31.6-37.8
All families		709		3558.6				

Table 3. Mean catch rates (no/100 hook-h and kg/100 hook-h) + 1 SE of Atlantic sharpnose shark in each month during February 1978-1980 in each of five depth zones off the central Texas coast (Blanks = no catch; NS = no samples collected).

Month and year	Depth zone (m)									
	6-18		20-37		38-55		57-73		75-91	
	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight
2/78	0.7 + 0.4		1.9 + 1.4	9.0 + 6.6	NS	NS	NS	NS	NS	NS
3/78	2.4 + 0.4	3.3 + 1.7	NS	NS	9.6 + 2.1	41.4 + 7.7	16.5 + 5.5	57.7 + 23.0	7.3	20.0
4/78	6.2	10.0 + 1.7	NS	NS	NS	NS	NS	NS	NS	NS
6/78		28.8			0.4 + 0.4	1.5 + 1.5				
9/78					NS	NS	NS	NS	NS	NS
10/78	0.3 + 0.3	1.3 + 1.3	3.1	14.5	NS	NS	NS	NS	NS	NS
11/78	2.2 + 1.6	9.3 + 6.5	14.0 + 4.6	64.6 + 20.2	NS	NS	NS	NS	NS	NS
12/78	NS	NS	6.0	31.4	NS	NS	NS	NS	NS	NS
1/79										
2/79										
3/79	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
5/79	NS	NS	38.0	226.1	NS	NS	NS	NS	NS	NS
8/79	0.5 + 0.5	0.2 + 0.2	0.5 + 0.5	4.0 + 4.0						
10/79	8.0	30.2	35.0	164.2	6	34.7	3.3	7.9	NS	NS
12/79			19.0 + 7.5	93.9 + 37.5	45.0 + 1.0	196.4 + 1.5	NS	NS	NS	NS
1/80			NS	NS	NS	NS	NS	NS	NS	NS
2/80	NS	NS	NS	NS	NS	NS	30.0	134.3	19.0	77.3

Table 4. Mean catch rates (no/100 hook-h and kg/100 hook-h) + 1 SE of each species represented by ≥ 10 individuals during February 1978-1980 in each of five depth zones off the central Texas coast. Only those months in which at least one individual was caught are included (Blanks = no catch; NS = no samples collected).

Species	Month and year	Depth zone (m)									
		6-18		20-37		38-55		57-73		75-91	
		Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight
Red drum	3/78	0.3 + 0.3	3.1 + 3.1								
	4/78	0.8 ± 0.1	8.4 ± 1.6	NS	NS	NS	NS	NS	NS	NS	NS
	1/79	0.3 ± 0.3	4.2 ± 4.2								
	10/79	3.0	28.2								
	12/79	0.5 ± 0.5	5.8 ± 5.8								
Red snapper	3/78					0.5 ± 0.3	4.2 ± 2.4				
	11/78			0.2 ± 0.2	2.4 ± 2.4						
	2/79			NS	NS						
	3/79	NS	NS			2.0 ± 0.0	19.7 ± 0.9	0.5 ± 0.5	5.0 ± 5.0	0.5 ± 0.5	3.4 ± 3.4
Sea catfish	3/78	0.3 ± 0.3	0.2 ± 0.2			0.7 ± 0.7	7.9 ± 7.9				
	4/78	0.7 ± 0.4	0.4 ± 0.2	NS	NS						
	9/78	2.0 ± 0.5	0.7 ± 0.3								
Spinner shark	3/78										
	9/78	0.4 ± 0.2	6.8 ± 3.2	0.2 ± 0.2	0.6 ± 1.2	0.1 ± 0.1	3.24 ± 3.24				
	10/78	1.8 ± 1.3	25.7 ± 23.9			NS	NS				
	11/78	1.0 ± 0.7	12.2 ± 7.1	0.8 ± 0.25	15.8 ± 9.6						
Scalloped hammerhead	3/78										
	4/78	0.1 ± 0.1	0.8 ± 0.8	NS	NS			1.2 ± 0.2	6.2 ± 1.1	0.7	3.4
	9/78			1.1	11.6	NS	NS			NS	NS
	11/78			0.2 ± 0.2	0.4 ± 0.4	NS	NS			NS	NS
	3/79	NS	NS								
2/80	NS	NS							1.0	6.8	
										3.0	10.9

Table 5. Mean catch rate of all fish \pm 1 SE in the 6-37 and 38-91 m depth zones during the non-shrimping season (December-April) in each of 3 years (numbers in parenthesis represent sample sizes).

Type of catch rate	1977-78		1978-79		1979-1980	
	6-37	38-91	6-37	38-91	6-37	38-91
No/100 hook-h	2.7 + 0.7 (11)	12.4 + 1.9 (10)	0.8 + 0.7 (9)	2.1 + 0.5 (11)	7.4 + 4.2 (8)	36.0 + 5.4 (4)
Kg/100 hook-h	13.6 + 3.4 (11)	53.9 + 7.8 (10)	4.9 + 3.6 (9)	12.9 + 3.1 (11)	36.9 + 20.8 (8)	157.2 + 23.6 (4)

Table 6. Results of two-way analysis of variance of the mean catch of all fish (no/100 hook-h) in two depth zones (6-37 and 38-91 m) during the non-shrimping seasons of 1977-1980.

Source of variation	Degrees of freedom	Sum of squares	Mean square	F-statistic
Total	52	13.757		
Depth zones	1	4.378	4.378	39.772**
Years	2	4.367	2.183	19.835**
Depth zones X years	2	0.918	0.459	4.170*
Error	47	5.173	0.110	

* $P < 0.05$

** $P < 0.01$

NS = not significant at $P=0.05$

Table 7. Results of two-way analysis of variance of the mean catch of all fish (kg/100 hook-h) in two depth zones (6-37 and 38-91 m) during the non-shrimping seasons of 1977-1980.

Source of variation	Degrees of freedom	Sum of squares	Mean square	F-statistic
Total	52	29.683		
Depth zones	1	8.580	8.580	26.162**
Years	2	6.726	3.363	10.253**
Depth zones X Years	2	0.777	0.389	1.184 NS
Error	47	15.415	0.328	

** $P < 0.01$

NS = not significant at $P=0.05$

Table 8. Mean catch rate of Atlantic sharpnose shark \pm 1 SE in the 6-37 and 38-91 m depth zones during the non-shrimping season (December-April) in each of 3 years (numbers in parenthesis represent sample sizes).

Type of catch rate	1977-78		1978-79		1979-1980	
	6-37	38-91	6-37	38-91	6-37	38-91
No/100 hook-h	1.4 + 0.5 (11)	10.8 + 1.9 (10)	0.7 + 0.7 (9)	0.0 + 0.0 (11)	7.1 + 4.3 (8)	34.8 + 6.3 (4)
Kg/100 hook-h	6.6 + 2.1 (11)	42.4 + 7.1 (10)	3.5 + 3.5 (9)	0.0 + 0.0 (11)	35.2 + 21.1 (8)	151.1 + 28.6 (4)

Table 9. Results of two-way analysis of variance of the mean catch of Atlantic sharpnose shark (no/100 hook-h) in two depth zones (6-37 and 38-91 m) during the non-shrimping seasons of 1977-1980.

Source of variation	Degrees of freedom	Sum of squares	Mean square	F-statistic
Total	52	16.446		
Depth zones	1	3.001	3.001	29.018**
Years	2	6.788	3.394	32.824**
Depth zones X years	2	2.908	1.454	14.062**
Error	47	4.860	0.103	

** P < 0.01

Table 10. Results of two-way analysis of variance of the mean catch of Atlantic sharpnose shark (kg/100 hook-h) in two depth zones (6-37 and 38-91 m) during the non-shrimping seasons of 1977-1980.

Source of variation	Degrees of freedom	Sum of squares	Mean square	F-statistic
Total	52	36.550		
Depth zones	1	5.016	5.016	19.274**
Years	2	15.803	7.901	30.3611**
Depth zones X years	2	5.519	2.760	10.603**
Error	47	12.232	0.260	

** P < 0.01

Table 11. Mean catch of all fish (no/100 hook-h) \pm 1 SE in the 6-37 and 38-91 m depth zones during the non-shrimping (December-April) and shrimping (May-November) seasons of 1977-1978 and 1978-1979 (numbers in parenthesis represent sample sizes).

Season	1977-78		1978-79	
	6-37	38-91	6-37	38-91
Non-shrimping	2.7 + 0.7 (11)	12.4 + 1.9 (10)	0.8 + 0.7 (9)	2.1 + 0.5 (11)
Shrimping	6.1 + 1.7 (18)	1.6 + 0.6 (7)	13.3 + 6.4 (7)	2.2 + 1.0 (6)

Table 12. Mean catch of all fish (kg/100 hook-h) \pm 1 SE in the 6-37 and 38-91 m depth zones during the non-shrimping (December-April) and shrimping (May-November) seasons of 1977-1978 and 1978-1979 (numbers in parenthesis represent sample sizes).

Season	1977-78		1978-79	
	6-37	38-91	6-37	38-91
Non-shrimping	13.6 + 3.4 (11)	53.9 + 7.8 (10)	4.9 + 3.6 (9)	12.9 + 3.1 (11)
Shrimping	34.8 + 9.9 (18)	14.5 + 10.0 (7)	69.3 + 34.8 (7)	11.4 + 6.1 (6)

Table 13. Results of three-way analysis of variance of the mean catch of all fish (no/100 hook-h) in two depth zones (6-37 and 38-91 m) during the non-shrimping and shrimping seasons of 1977-1979.

Source of variation	Degrees of freedom	Sum of squares	Mean square	F-statistic
Total	78	14.854		
Years	1	1.359	1.359	10.695**
Seasons	1	0.021	0.021	0.164 NS
Depth zones	1	0.234	0.234	1.845 NS
Seasons X Years	1	1.422	1.422	11.185**
Years X Depth zones	1	0.122	0.122	0.962 NS
Seasons X Depth zones	1	2.955	2.955	23.253**
Years X Seasons X Depth zones	1	0.091	0.091	0.718 NS
Error	71	9.024	0.127	

** P < 0.01

NS = not significant at P 0.05

Table 14. Results of three-way analysis of variance of the mean catch of all fish (kg/100 hook-h) in two depth zones (6-37 and 38-91 m) during the non-shrimping and shrimping seasons of 1977-1979.

Source of variation	Degrees of freedom	Sum of squares	Mean square	F-statistic
Total	78	40.183		
Years	1	3.558	3.558	8.942**
Seasons	1	0.008	0.008	0.021 NS
Depth zones	1	0.615	0.615	1.547 NS
Seasons X Years	1	1.771	1.771	4.451*
Years X Depth zones	1	0.000	0.000	0.001 NS
Seasons X Depth zones	1	6.624	6.624	16.649**
Years X Seasons X Depth zones	1	0.068	0.068	0.172 NS
Error	71	28.248	0.398	

* P < 0.05

** P < 0.01

NS = not significant at P 0.05

Table 15. Mean catch of Atlantic sharpnose shark (no/100 hook-h) \pm 1 SE in the 6-37 and 38-91 m depth zones during the non-shrimping (December-April) and shrimping (May-November) seasons of 1977-1978 and 1978-1979 (numbers in parenthesis represent sample sizes).

Season	1977-78		1978-79	
	6-37	38-91	6-37	38-91
Non-shrimping	1.4 + 0.5 (11)	10.8 + 1.9 (10)	0.7 + 0.7 (9)	0.0 + 0.0 (11)
Shrimping	4.2 + 1.6 (18)	0.1 + 0.1 (7)	11.9 + 6.5 (7)	1.6 + 1.0 (6)

Table 16. Mean catch of Atlantic sharpnose shark (kg/100 hook-h) \pm 1 SE in the 6-37 and 38-91 m depth zones during the non-shrimping (December-April) and shrimping (May-November) seasons of 1977-1978 and 1978-1979 (numbers in parenthesis represent sample sizes).

Season	1977-78		1978-79	
	6-37	38-91	6-37	38-91
Non-shrimping	6.6 + 2.1 (11)	42.4 + 7.1 (10)	3.5 + 3.5 (9)	0.0 + 0.0 (11)
Shrimping	19.0 + 7.4 (18)	0.4 + 0.4 (7)	61.3 + 35.4 (7)	7.1 + 5.7 (6)

Table 17. Results of three-way analysis of variance of the mean catch of Atlantic sharpnose shark (no/100 hook-h) in two depth zones (6-37 and 38-91 m) during the non-shrimping and shrimping seasons of 1977-1979.

Source of variation	Degrees of freedom	Sum of squares	Mean square	F-statistic
Total	78	17.741		
Years	1	1.230	1.230	9.048**
Seasons	1	0.006	0.006	0.047 NS
Depth zones	1	0.009	0.009	0.068 NS
Seasons X Years	1	3.204	3.204	23.571**
Years X Depth zones	1	0.823	0.823	6.055*
Seasons X Depth zones	1	2.291	2.291	16.856**
Years X Seasons X Depth zones	1	0.664	0.664	4.885*
Error	71	9.651	0.136	

* $P < 0.05$

** $P < 0.01$

NS = not significant at $P 0.05$

Table 18. Results of three-way analysis of variance of the mean catch of Atlantic sharpnose shark (kg/100 hook-h) in two depth zones (6-37 and 38-91 m) during the non-shrimping and shrimping seasons of 1977-1979.

Source of variation	Degrees of freedom	Sum of squares	Mean square	F-statistic
Total	78	43.716		
Years	1	3.891	3.891	11.166**
Seasons	1	0.071	0.071	0.203 NS
Depth zones	1	0.006	0.006	0.018 NS
Seasons X Years	1	8.139	8.139	23.355**
Years X Depth zones	1	1.331	1.331	3.819 NS
Seasons X Depth zones	1	4.467	4.467	12.819**
Years X Seasons X Depth zones	1	1.435	1.435	4.118*
Error	71	24.742	0.348	

* $P < 0.05$

** $P < 0.01$

NS = not significant at $P 0.05$

Table 19. Estimated net returns (dollars) during 1980 to each individual involved in the operation of a shrimp vessel engaged in each of four different options.

Individual	Shrimp all Year ^a	Shrimp 7 mos. & dock 5 mos. ^a	Shrimp 6 mos. & swordfish 6 mos. ^a	Shrimp 7 mos. & bottom longline 5 mos.
Owner	-32,503	-35,686	10,477	-3,195 ^b
Crew	41,231	29,155	58,742	60,813 ^c

^a Based on Nichols et al. (1980)

^b Includes -\$35,686 returns from 7 mo of shrimping and \$32,491 returns from 5 mo of bottom longlining.

^c Includes \$29,155 returns from 7 m of shrimping and \$31,658 from 5 mo of bottom longlining.

Table 20. Estimated breakeven prices during December-April for total fish caught on bottom longline at selected levels of landings for owner and crew of a 22.9-m Gulf vessel using a 60/40 share arrangement (format from Nichols et al. 1980).

Landings		Breakeven price (\$/kg)			
		Requirements for vessel owner		Requirements for crew	
Kg/100 hook-h	Seasonal ^a	Returns to shrimping alternative	Including vessel fixed costs	Without opportunity costs	With opportunity costs
6.7	6,754	0.71	7.87	5.15	8.66
12.9	13,003	0.37	4.09	2.67	4.50
43.9	54,331	0.09	0.98	0.64	1.08
157.2	158,458	0.03	0.34	0.22	0.37
204.4	206,035	0.02	0.26	0.17	0.28
314.4	316,915	0.02	0.17	0.11	0.18

^a December-April based on 1200 hook-h per day; 84 days.

Table 21. Estimated breakeven landings during December-April for total fish caught on bottom longline at selected prices for owner and crew of a 22.9-m Gulf vessel (format from Nichols et al. 1980).

Price (\$/kg)	Breakeven landings (kg/season) ^a			
	Requirements for vessel owner		Requirements for crew	
	Returns to shrimping alternative	Including vessel fixed costs	Without opportunity costs	With opportunity costs
0.11	43,804	482,919	316,188	543,627
0.22	21,902	241,459	158,094	265,813
0.44	10,951	120,730	79,047	132,907
0.57	8,453	93,195	61,019	102,595
0.66	7,301	80,486	52,698	88,604
0.88	5,475	60,365	39,524	66,453
1.10	4,380	48,292	31,619	53,163
1.32	3,650	40,243	26,349	44,302
1.76	2,738	30,182	19,762	33,227
2.20	2,190	24,146	15,809	26,581

^a December-April.

Table 22. Total fish caught, date, location, effort and hydrological data associated with preliminary bottom longline samples taken off the central Texas coast.

Date mo/da/yr	Sample	Latitude (N)	Longitude (W)	LORAN-A (3H3)	Depth		Hooks (no)	Effort (h)	Hook-h	Temperature (C)		Salinity (o/oo)		Total fish caught
					(m)	(fm)				Bottom	Surface	Bottom	Surface	
12/14/77	77-06-05	28°13.8'	96°24.7'	2600	18	10	15	1.0	15	18.9	17.9	31.6	29.4	4 ^a
01/27/78	77-07-02	27°37.3'	97°04.6'	2030	18	10	27	1.0	27	12.0	12.3	32.2	32.2	1 ^b

a 3 Atlantic sharpnose shark; 1 red drum.

b 1 red drum.

Table 23. Red drum (*Sciaenops ocellata*) caught on bottom longlines off the central Texas coast (1977-1979).

Date mo/da/yr	Depth (m)	Bottom		Total length (mm)	Weight (kg)	Sex	Maturity stage ^a
		Temperature (C)	Salinity (o/oo)				
12/14/77	18	18.9	31.6				
01/27/78	18	12.0	32.2	1020	10.0	M	II
03/30/78	18	17.3	33.9	990	10.9	M	VIII
03/30/78	18	17.3	33.9	1030	12.2	M	VIII
04/13/78	18	19.0	31.6	970	10.0	_b	
04/13/78	18	19.0	31.6	1130	15.9	_b	
04/13/78	18	19.0	31.6	890	7.7	_b	
04/14/78	18	19.2	31.6	950	9.1	_b	
04/14/78	18	19.2	31.6	970	10.0	_b	
04/14/78	18	19.2	31.6	1010	11.3	_b	
04/14/78	18	19.2	31.6	950	9.1	_b	
01/16/79	18	12.4	32.2	1050	12.7	M	VIII
10/24/79	13	24.8	37.8	1030	9.8	M	
10/24/79	13	24.8	37.8	990	9.3	F	
10/24/79	13	24.8	37.8	1000	9.1	F	
12/19/79	18	14.9	27.8	1020	11.6	M	VIII

^a Key for maturity stages:

I-Virgin; II-Maturing virgin/recovering spent; III-Developing; IV-Developed;
V-Gravid; VI-Spawning; VII-Spent; VIII-Resting.

^b Transported alive for spawning studies.

Table 24. Red snapper (Lutjanus campechanus) caught on bottom longlines off the central Texas coast (1977-1979).

Date mo/da/yr	Depth (m)	Bottom		Total length (mm)	Weight (kg)	Sex	Maturity stage ^a
		Temperature (C)	Salinity (o/oo)				
Shallow-water samples							
03/09/78	48	16.5	35.5	815	7.9	M	III
03/09/78	48	16.5	35.5	795	7.0	M	VIII
03/15/78	51	16.8	37.8	786	7.8	M	II
03/15/78	51	16.8	37.8	810	8.8	M	II
03/15/78	55	16.5	36.6	708	7.0	M	II
11/09/78	91	20.9	37.2	775	6.8	M	VIII
11/29/78	37	22.0	34.4	830	9.5		
02/08/79	40	14.8	36.6	835	9.1	M	III
02/08/79	40	14.8	36.6	825	9.8	F	III
02/08/79	48	14.6	36.6	915	10.7	M	III
02/08/79	48	14.6	36.6	890	10.0	F	III
02/13/79	57	16.5	36.1	820	10.0		
02/13/79	86	16.6	36.6	830	8.6	M	III
02/13/79	86	16.6	36.6	835	8.2	M	III
02/13/79	86	16.6	36.6	840	9.1	M	III
03/07/79	46	17.1	36.1	940	12.3	F	III
03/07/79	46	17.1	36.1	930	11.3	M	VII
Deepwater samples							
03/06/79	101	17.0	36.6	870	10.7	F	III
02/27/80	115	18.6	37.2	815	7.6		

^a Key for maturity stages:

I-Virgin; II-Maturing virgin/recovering spent; III-Developing; IV-Developed;
V-Gravid; VI-Spawning; VII-Spent; VIII-Resting.

Table 25. Total number and weight of each species caught on deepwater bottom longlines off the central Texas coast during March 1978, March 1979 and February-March 1980 with associated size, depth range and hydrological data.

Scientific name	Common name	Total number	Weight (kg)		Total length range (mm)	Depth range (m)	Bottom temperature range (C)	Bottom salinity range (o/oo)
			Range	Average				
Carcharhinidae								
<i>Carcharhinus falciformis</i>	Silky shark	1	1.9	1.9	766	333	15.7	36.6
<i>Rhizoprionodon terraenovae</i>	Atlantic sharpnose shark	1	1.0	1.0	620	115	18.6	37.2
Trikiadae								
<i>Mustelus canis</i>	Smooth dogfish	3	1.9-5.4	4.1	805-1180	115-187	16.6-18.6	36.6-37.2
<i>M. norrisi</i>	Florida smoothhound	11	1.9-11.3	4.7	810-1320	101-138	16.4-17.0	36.1-36.6
Sphyrnidae								
<i>Sphyrna lewini</i>	Scalloped hammerhead	1	9.1	9.1	1265	101	17.0	36.6
Squalidae								
<i>Squalus cubensis</i>	Cuban dogfish	7	0.4-0.7	0.5	448-488	137-336	13.7-16.6	36.1-36.6
Ophichthidae								
<i>Ophichthus</i> sp.	Banded shrimp eel	1	4.3	4.3	1400	101	17.0	36.6
Gadidae								
<i>Urophycis cirratus</i>	Gulf hake	5	0.1-1.4	0.7	208-538	196-397	14.6-16.4	36.1-36.6
<i>U. regius</i>	Spotted hake	1	0.2	0.2	289	196	16.4	36.1
<i>U. floridanus</i>	Southern hake	2	0.5	0.5	318-350	187	16.6	36.6
Serranidae								
<i>Ephinephelus flavolimbatus</i>	Yellowedge grouper	4	0.6-12.6	7.3	354-985	115-196	16.4-18.6	36.1-37.2
Branchiostegidae								
<i>Lopholatilus chamaeleonticeps</i>	Tilefish	29	0.8-9.4	2.5	436-952	272-397	13.7-16.2	36.6
Lutjanidae								
<i>Lutjanus campechanus</i>	Red snapper	2	7.6-10.7	9.1	815-870	101-115	17.0-18.6	36.6-37.2
<i>Pristipomoides aquilonaris</i>	Wenchman	3	0.2-0.3	0.2	245-275	115-196	16.4-18.6	36.1-37.2
All families		71		209.3				

Table 26. Mean catch rates (no/100 hook-h) \pm 1 SE of each species caught on bottom longlines in offshore waters (101-417 m) off the central Texas coast on each sample date during March 1978, March 1979 and February-March 1980 (number in parenthesis represent number of samples; Blanks = 0.0 fish/100 hook-h).

Species	Sample date					All samples (13)
	3-10-78 ^a (2)	3-6-79 ^b (1)	2-27-80 ^c (1)	2-28-80 ^d (5)	3-11-80 ^e (4)	
Florida smoothhound	1.5 \pm 1.5	5.0				0.6 \pm 0.4
Cuban dogfish	1.2 \pm 0.8			0.6 \pm 0.2	0.2 \pm 0.2	0.5 \pm 0.2
Wenchman	0.8 \pm 0.2		1.0			0.2 \pm 0.1
Gulf hake	0.5 \pm 0.5			0.2 \pm 0.2	0.8 \pm 0.5	0.4 \pm 0.2
Spotted hake	0.5 \pm 0.5					0.1 \pm 0.1
Yellowedge grouper	0.5 \pm 0.5		3.0			0.3 \pm 0.2
Scalloped hammerhead		1.0				0.1 \pm 0.1
Banded shrimp eel		1.0				0.1 \pm 0.1
Red snapper		1.0	1.0			0.2 \pm 0.1
Atlantic sharpnose shark			1.0			0.1 \pm 0.1
Smooth dogfish			2.0			0.2 \pm 0.2
Southern hake				0.2 \pm 0.2		0.2 \pm 0.2
Tilefish				0.4 \pm 0.4		0.2 \pm 0.2
Silky shark				2.6 \pm 1.2	4.0 \pm 3.0	2.2 \pm 1.1
					0.2 \pm 0.2	0.1 \pm 0.1
Total fish	5.0 \pm 1.0	8.0	8.0	4.0 \pm 1.0	5.2 \pm 3.6	5.3 \pm 1.1

^a Samples collected at 138 and 196 m.

^b Sample collected at 101 m.

^c Sample collected at 115 m.

^d Samples collected at 187, 227, 276, 336 and 397 m.

^e Samples collected at 272, 333, 371 and 417 m.

Table 27. Mean catch rates (kg/100 hook-h) + 1 SE of each species caught on bottom longlines in offshore waters (101-417 m) off the central Texas coast on each sample date during March 1978, March 1979 and February-March 1980 (number in parenthesis represents number of samples; Blanks = 0.0 kg/100 hook-h).

Species	Sample date					All samples (13)
	3-10-78 ^a (2)	3-6-79 ^b (1)	2-27-80 ^c (1)	2-28-80 ^d (5)	3-11-80 ^e (4)	
Florida smoothhound	8.4 + 8.4	17.7				2.7 + 1.8
Cuban dogfish	5.9 + 3.7			0.3 + 0.2		1.1 + 0.7
Wenchman	1.5 + 0.4		0.3			0.3 + 0.2
Gulf hake	0.4 + 0.4			0.1 + 0.1	0.7 + 0.5	0.3 + 0.2
Spotted hake	1.0 + 1.0					0.2 + 0.2
Yellowedge grouper	3.0 + 3.0		28.7			2.7 + 2.2
Scalloped hammerhead		9.1				0.7 + 0.7
Banded shrimp eel		4.3				0.3 + 0.3
Red snapper		10.7	7.6			1.4 + 1.0
Atlantic sharpnose shark			1.0			0.1 + 0.1
Smooth dogfish			7.0	1.1 + 1.1		1.0 + 0.7
Southern hake				0.5 + 0.1		0.0 + 0.0
Tilefish				6.2 + 3.4	10.6 + 9.7	5.6 + 3.2
Silky shark					0.5 + 0.5	0.2 + 0.2
Total fish	9.6 + 7.6	41.7	44.6	8.2 + 3.0	11.8 + 10.6	16.6 + 5.0

^a Samples collected at 138 and 196 m.

^b Sample collected at 101 m.

^c Sample collected at 115 m.

^d Samples collected at 187, 227, 276, 336 and 397 m.

^e Samples collected at 272, 333, 371 and 417 m.

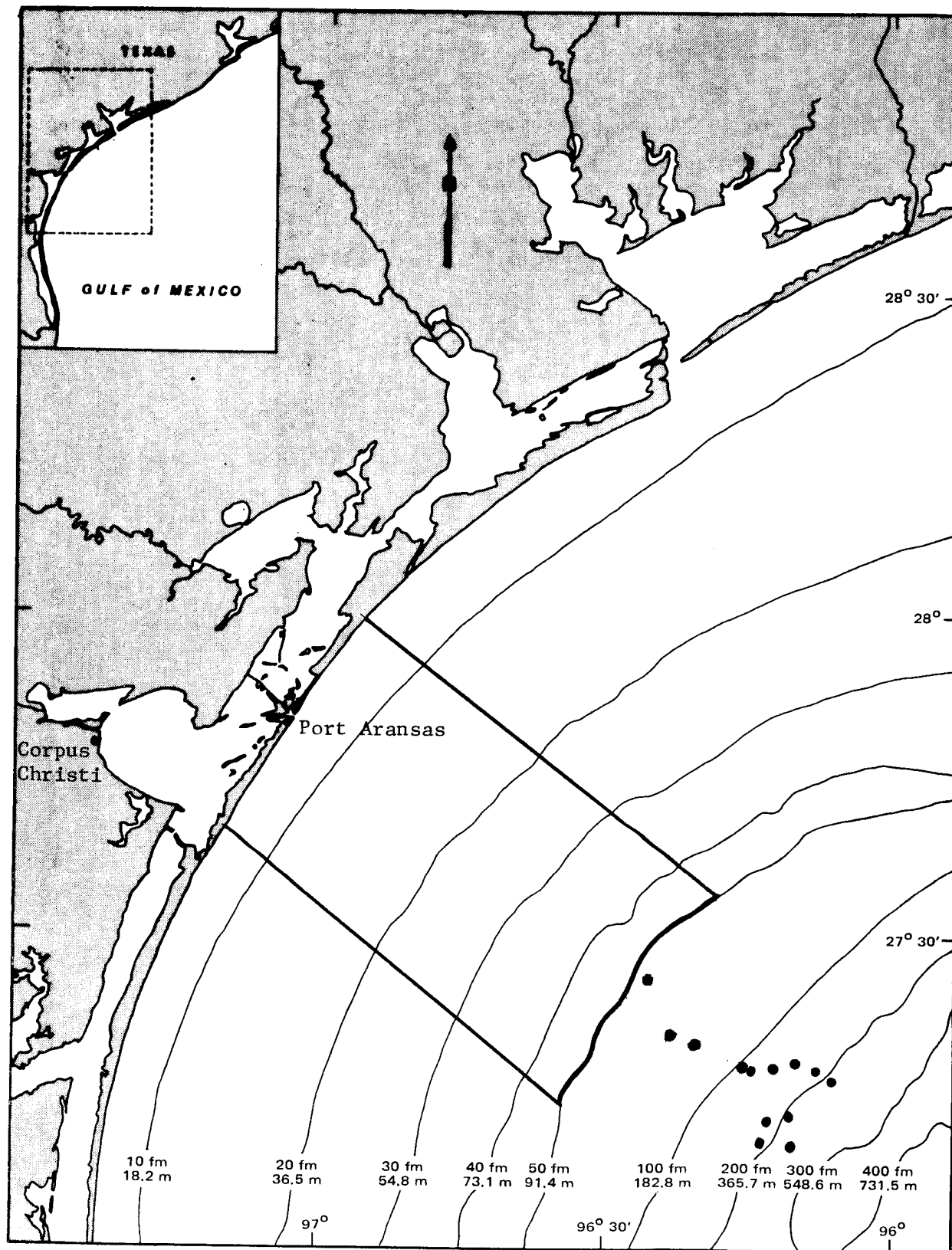
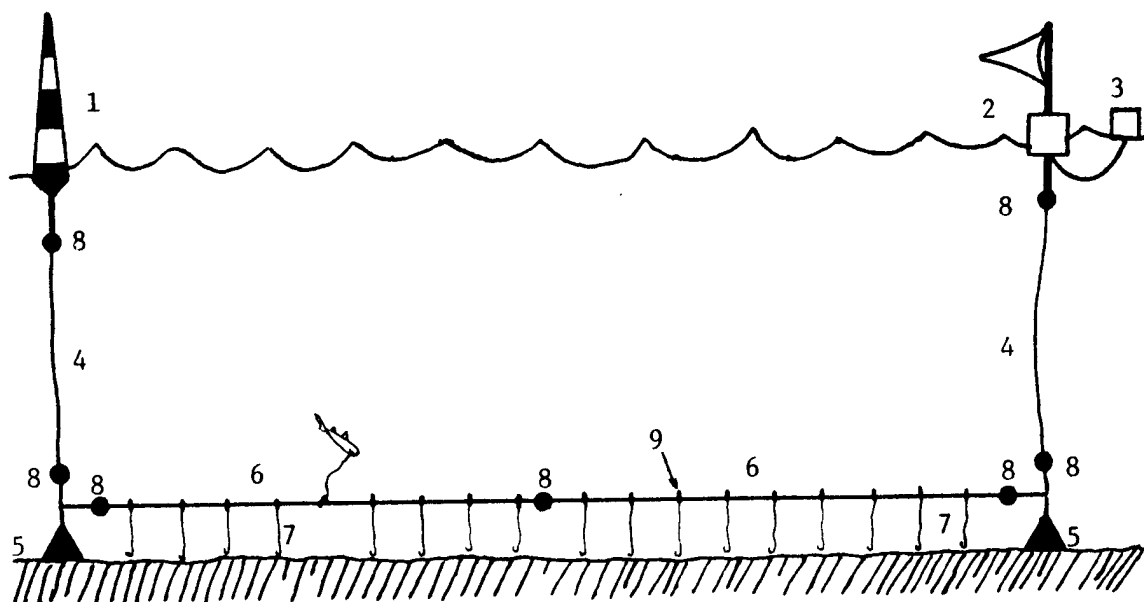
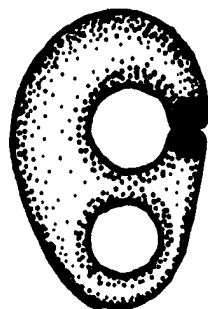


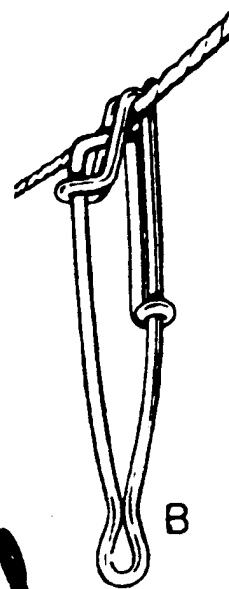
Figure 1. Bottom longline sampling area off the central Texas coast, 1977-1980. Boxed area represents area in which inshore bottom longline samples (< 91 m) were taken and circles represent individual offshore bottom longline samples (> 91 m).



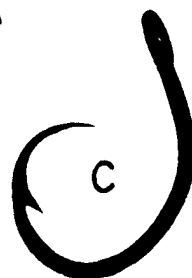
1. Marker buoy
2. Flag buoy
3. Catch buoy
4. Buoy lines
5. Anchors, Navy type,
20-30 pounds
6. Groundline - Mittet
#32 (1/4" nylon)
7. Gangions
200# monofilament
#9 halibut snap with
6/0 swivel
Tuna circle hooks (Inset C)
8. Brummel hooks (Inset A)
9. Halibut line snaps
(Inset B)



A



B



C

Figure 2. Diagram of the bottom longline.

Appendix A. Bottom longline stations sampled with associated effort and hydrological data.

Table 1. Inshore bottom longline stations sampled with associated effort and hydrological data.

Station	Date mo/da/yr	Location		LORAN-A (3H3)	Depth		Gear Effort		Bottom		Hydrology		
		Latitude (N)	Longitude (W)		(m)	(fm)	Hooks (no)	Set time (min)	Hook-h	Temperature (C)	Salinity (o/oo)	Temperature (C)	Salinity (o/oo)
77-08-05	02/14/78	27°39.7'	96°59.5'	2077	22	12	93	120	186	11.0	32.2	10.5	31.1
77-10-01 ^a	02/27/78	27°46.2'	96°58.2'	2148	18	10	100	60	100	13.5	32.8	13.0	31.6
77-11-11	03/09/78	27°38.6'	96°37.1'	2176	48	26	100	150	250	16.5	35.5	16.9	35.5
77-11-13 ^a	03/09/78	27°34.5'	96°27.6'	2176	70	38	100	120	200	16.1	36.1	18.0	35.5
77-11-14 ^a	03/09/78	27°26.5'	96°32.2'	2079	77	42	100	90	150	16.1	35.5	18.7	34.4
77-12-01 ^a	03/15/78	27°38.2'	97°07.5'	2024	13	7	100	60	100	14.2	34.4	14.7	34.4
77-12-02	03/15/78	27°26.8'	96°44.4'	2016	51	28	100	60	100	16.8	37.8	17.0	37.8
77-12-04	03/15/78	27°25.6'	96°35.5'	2006	55	30	100	60	100	16.5	36.6	17.2	36.6
77-13-01	03/28/78	27°48.1'	96°51.6'	2198	22	12	95	60	95	16.3	36.6	17.5	35.5
77-13-02	03/28/78	27°39.3'	96°44.9'	2147	35	19	100	60	100	18.3	32.8	18.2	32.8
77-13-04	03/28/78	27°41.0'	96°32.6'	2229	51	28	100	60	100	16.9	36.6	17.9	35.0
77-13-06	03/28/78	27°37.3'	96°27.5'	2215	64	35	100	60	100	17.6	37.8	18.5	36.6
77-13-07	03/29/78	27°37.3'	96°36.2'	2197	48	26	100	60	100	16.9	37.2	17.5	36.6
77-13-08	03/29/78	27°38.6'	96°37.1'	2176	48	26	100	120	200	16.9	37.2	17.6	35.0
77-13-10	03/29/78	27°35.9'	96°44.2'	2113	40	22	100	60	100	17.4	37.8	17.2	35.5
77-13-11	03/29/78	27°42.9'	96°50.5'	2151	27	15	100	60	100	16.5	36.6	17.2	33.3
77-13-12	03/29/78	27°48.4'	97°03.0'	2147	7	4	100	60	100	18.3	32.8	18.2	32.8
77-13-13	03/30/78	27°46.2'	97°58.2'	2148	18	10	125	120	250	17.3	33.9	19.0	33.3
77-14-01 ^a	04/13/78	27°46.2'	96°58.2'	2148	18	10	145	120	290	19.0	31.6	19.4	31.6
77-14-02 ^a	04/14/78	27°46.2'	96°58.2'	2148	18	10	145	120	290	19.2	31.6	19.5	31.6
77-14-03 ^a	04/14/78	27°46.2'	96°58.2'	2148	18	10	145	120	290	19.2	31.6	19.5	31.6
77-14-04 ^a	04/14/78	27°49.2'	96°54.0'	2198	20	11	80	90	120	26.8	36.6	29.0	34.4
77-27-05 ^a	06/28/78	27°46.4'	96°58.0'	2151	18	10	80	60	80	25.6	35.5	28.4	35.5
77-27-09	06/29/78	27°44.5'	96°37.5'	2237	38	21	80	90	120	21.1	38.3	29.0	33.9
77-27-10	06/29/78	27°38.7'	96°35.4'	2189	51	28	78	60	78	20.3	36.6	29.4	34.4
77-27-11	06/29/78	27°34.5'	96°28.2'	2185	57	31	80	60	80	19.8	37.8	29.3	34.4
77-39-01 ^a	09/16/78	27°43.0'	97°05.8'	2078	11	6	100	120	200	29.0	36.6	29.7	36.6
77-39-02 ^a	09/16/78	27°46.5'	96°58.2'	2150	18	10	100	105	175	28.9	36.6	29.7	36.6
77-39-03	09/16/78	27°51.5'	97°01.2'	2186	5	3	98	60	98	29.2	34.4	29.2	34.4
77-40-04	09/21/78	27°42.8'	96°48.1'	2164	29	16	75	75	94	28.8	36.6	29.4	35.5
78-01-01	10/02/78	27°47.4'	97°02.4'	2151	7	4	52	60	52	27.5	25.5	27.6	25.5

Table 1. (Cont'd.)

Station	Date mo/da/yr	Location		LORAN-A (3H3)	Depth		Gear Effort		Hydrology				
		Latitude (N)	Longitude (W)		(m)	(fm)	Hooks (no)	Set time (min)	Temperature (C)	Salinity (o/oo)	Temperature (C)	Salinity (o/oo)	
78-01-02 ^a	10/02/78	27°46.5'	96°58.2'	2150	18	10	77	90	116	27.9	33.3	27.7	30.0
78-01-03	10/03/78	27°52.8'	96°43.5'	2290	23	13	85	90	128	27.7	34.4	27.0	27.8
78-01-04	10/03/78	28°02.2'	96°51.4'	2340	9	5	90	60	150	27.4	26.6	27.6	26.6
78-04-01	11/08/78	27°48.2'	97°01.8'	2150	9	5	100	60	100	21.4	31.6	21.5	32.2
78-04-04 ^a	11/08/78	27°45.6'	96°58.4'	2145	18	10	100	60	100	22.3	31.6	22.4	32.2
78-04-08	11/09/78	27°32.2'	96°39.2'	2100	55	30	100	60	100	25.7	35.5	24.8	35.5
78-04-10	11/09/78	27°28.9'	96°31.4'	2109	73	40	100	60	100	21.8	37.2	25.2	36.1
78-04-11	11/09/78	27°26.8'	96°26.2'	2120	91	50	100	60	100	20.9	37.2	25.2	36.6
78-04-12 ^a	11/09/78	27°26.9'	96°31.7'	2079	77	42	100	60	100	21.2	37.2	25.2	36.6
78-05-01 ^a	11/29/78	37°43.2'	96°50.5'	2155	27	15	80	75	100	21.7	33.9	21.6	33.9
78-05-03	11/29/78	27°39.2'	96°44.1'	2149	37	20	100	60	100	22.0	34.4	22.0	34.4
78-05-04 ^a	11/30/78	27°42.4'	97°06.1'	2074	11	6	100	60	100	19.6	31.6	19.8	31.6
78-05-05 ^a	11-30-78	27°41.4'	96°58.2'	2100	22	12	100	60	100	21.6	33.9	21.7	33.3
78-05-07 ^a	11/30/78	27°43.0'	96°59.0'	2110	20	11	100	60	100	21.5	33.3	20.7	33.3
78-05-08 ^a	11/30/78	27°46.5'	96°47.8'	2152	18	10	100	60	100	20.5	33.3	19.7	31.6
78-06-03 ^a	12/12/78	27°36.8'	96°56.3'	2066	26	14	100	60	100	19.6	33.3	18.6	32.8
78-07-01	01/16/79	27°49.5'	96°59.5'	2184	13	7	100	60	100	10.8	28.9	10.4	27.8
78-07-02	01/16/79	27°48.0'	96°55.9'	2184	18	10	100	60	100	12.4	32.2	11.2	28.9
78-08-01 ^a	01/22/79	27°46.2'	96°56.7'	2157	20	11	100	60	100	15.7	34.4	13.0	32.2
78-08-02	01/22/79	27°48.3'	97°02.1'	2156	9	5	100	60	100	14.8	31.1	13.2	28.9
78-09-01	02/08/79	27°44.8'	96°53.4'	2156	22	12	100	60	100	11.2	32.2	11.0	32.2
78-09-02	02/08/79	27°41.8'	96°44.5'	2173	33	18	100	60	100	13.4	35.0	12.0	33.3
78-09-03	02/08/79	27°39.6'	96°40.6'	2173	40	22	100	60	100	14.8	36.6	13.5	34.4
78-09-04	02/08/79	27°38.3'	96°38.5'	2175	48	26	100	60	100	14.6	36.6	13.0	34.4
78-10-01 ^a	02/12/79	27°42.3'	97°06.5'	2070	13	7	100	60	100	11.8	31.1	11.6	30.0
78-10-02 ^a	02/12/79	27°44.5'	96°59.7'	2123	18	10	100	60	100	11.8	32.2	13.0	29.4
78-10-04	02/13/79	27°34.5'	96°35.9'	2145	57	31	100	60	100	16.5	36.1	17.8	36.1
78-10-05	02/13/79	27°32.3'	96°31.7'	2145	66	36	100	60	100	16.0	36.6	17.8	36.6
78-10-06 ^a	02/13/79	27°31.5'	96°27.3'	2163	77	42	100	60	100	16.0	36.6	17.8	36.6
78-10-07	02/13/79	27°31.1'	96°23.3'	2187	86	47	100	60	100	16.6	36.6	19.1	36.6
78-11-03	03/06/79	27°33.5'	96°37.5'	2124	55	30	100	80	133	16.9	36.1	17.8	36.1

Table 1. (Cont'd.)

Station	Date mo/da/yr	Location		LORAN-A (3H3)	Depth		Gear Effort		Bottom		Hydrology		Surface Temperature (C)	Salinity (o/oo)
		Latitude (N)	Longitude (W)		(m)	(fm)	Hooks (no)	Set time (min)	Hook-h	Temperature (C)	Salinity (o/oo)	Temperature (C)		
78-11-04	03/06/79	21°31.3'	96°32.8'	2128	68	37	100	60	100	16.2	36.6	19.2	36.6	
78-11-05	03/06/79	27°28.8'	96°28.6'	2121	82	45	100	60	100	17.0	36.6	19.6	36.6	
78-11-07	03/07/79	27°35.1'	96°44.5'	2100	40	22	100	60	100	17.0	36.1	16.8	36.1	
78-11-08 ^a	03/07/79	27°34.3'	96°41.7'	2110	46	25	100	60	100	17.1	36.1	17.1	36.1	
78-13-10 ^a	05/24/79	27°40.7'	96°59.4'	2091	22	12	100	60	100	-	-	-	-	
78-17-02 ^a	08/09/79	27°46.7'	96°03.2'	2131	11	6	100	75	125	30.1	31.1	30.1	31.1	
78-17-06	08/10/79	27°45.0'	96°53.0'	2158	22	12	97	60	97	29.2	35.5	29.3	34.4	
78-17-07	08/10/79	27°37.4'	96°42.6'	2136	40	22	100	30	50	22.6	38.3	29.3	36.1	
78-17-08	08/10/79	27°34.0'	96°35.0'	2145	59	32	100	60	100	21.5	38.3	29.6	36.1	
78-17-09	08/10/79	27°30.6'	96°29.4'	2141	74	41	100	60	100	20.5	37.8	29.1	36.6	
78-18-02 ^a	08/21/79	27°44.8'	96°59.0'	2130	18	10	100	60	100	29.9	34.4	29.9	33.3	
78-18-03	08/21/79	27°39.0'	96°48.5'	2128	31	17	100	60	100	27.7	37.2	30.0	34.4	
79-02-03	10/24/79	27°47.2'	97°02.1'	2140	13	7	98	60	60	24.8	37.8	25.0	34.6	
79-02-04	10/24/79	27°42.1'	96°54.0'	2125	24	13	98	60	98	25.0	34.6	25.0	34.6	
79-02-05	10/25/79	27°28.6'	96°28.4'	2126	82	45	91	60	60	22.3	39.1	26.0	35.6	
79-02-06	10/25/79	27°30.6'	96°35.4'	2073	64	35	90	81	122	24.7	37.8	26.2	36.2	
79-02-07	10/25/79	27°32.2'	96°44.2'	2073	46	25	86	70	100	26.1	35.6	25.8	34.6	
79-03-03	12/19/79	27°45.2'	96°02.2'	2118	15	8	100	60	100	14.9	27.8	13.8	26.8	
79-03-04	12/19/79	27°46.2'	96°58.2'	2150	18	10	100	60	100	14.9	27.8	13.9	27.8	
79-03-05	12/19/79	27°42.1'	96°54.0'	2125	24	13	100	60	100	17.2	31.2	17.0	31.2	
79-03-07	12/20/79	27°40.8'	96°51.8'	2126	27	15	100	60	100	18.4	32.8	17.8	32.4	
79-03-08	12/20/79	27°38.4'	96°48.0'	2120	33	18	100	60	100	19.0	34.6	17.9	32.8	
79-03-10	12/20/79	27°37.0'	96°43.5'	2127	40	22	100	60	100	20.2	34.6	18.7	33.4	
79-03-11	12/20/79	27°35.2'	96°39.2'	2130	49	27	100	60	100	20.8	34.6	21.2	34.6	
80-01-02	01/15/80	27°45.7'	96°58.6'	2142	18	10	100	60	100	15.4	30.6	15.5	29.6	
80-01-03	01/15/80	27°41.7'	97°04.8'	2072	15	8	100	60	100	14.7	29.1	15.3	29.1	
80-01-05	01/15/80	27°47.2'	97°02.1'	2140	13	7	100	60	100	14.7	29.1	15.0	29.1	
80-02-01	02/04/80	27°35.2'	95°29.2'	2188	64	35	100	60	100	18.4	35.0	18.7	35.0	
80-02-02	02/04/80	27°34.7'	96°27.0'	2190	75	41	100	60	100	20.0	36.6	20.0	36.6	

^a Stations near hard bottom habitats (natural or artificial reefs, wrecks, oil rigs, etc.).

Table 2. Offshore bottom longline stations sampled with associated effort and hydrological data.

Station	Date		Location		Depth		Gear Effort		Bottom		Hydrology	
	mo/da/yr		Latitude (N)	Longitude (W)	(m)	(fm)	Hooks (no)	Set time (min)	Temperature ^b (C)	Salinity (o/oo)	Temperature (C)	Salinity (o/oo)
77-11-15	03/10/78		27°20.0'	96°20.7'	137	75	100	120	16.4	36.1	19.0	35.5
77-11-16 ^a	03/10/78		27°17.4'	96°14.2'	196	107	100	60	16.4	36.1	19.0	35.5
78-11-06	03/06/79		27°27.8'	96°22.2'	101	55	100	60	17.0	36.6	19.8	36.1
80-04-01	02/27/80		27°22.0'	96°22.8'	115	63	100	60	18.6	37.2	19.8	36.6
80-04-02	02/28/80		27°18.2'	96°15.0'	187	102	100	60	16.6	36.6	19.8	36.6
80-04-03	02/28/80		27°18.3'	96°12.5'	227	124	100	60	16.5	36.6	19.9	36.6
80-04-04	02/28/80		27°18.4'	96°10.2'	276	151	100	60	16.2	36.6	19.9	36.6
80-04-05	02/28/80		27°17.5'	96°10.2'	336	184	100	60	13.7	36.6	20.0	36.6
80-04-06	02/28/80		27°16.5'	96°05.5'	397	217	100	60	15.3	36.6	19.9	36.6
80-05-01	03/11/80		27°07.7'	96°18.2'	272	149	100	60	15.7	36.6	20.7	36.6
80-05-02	03/11/80		27°05.5'	96°17.5'	333	182	100	60	15.7	36.6	21.0	36.6
80-05-03	03/11/80		27°08.2'	96°16.2'	371	203	100	60	14.6	36.6	21.0	36.6
80-05-04	03/11/80		27°05.2'	96°13.7'	417	228	100	60	13.8	36.6	21.0	36.6

^a Stations near hard bottom habitats (natural or artificial reefs, wrecks, oil rigs, etc.).

^b Because of depth and distance traveled by water sample bottle through the water column, water temperatures may not be accurate.

Appendix B. Number of fish caught at each bottom longline station sampled.

Table 1. (Cont'd.)

Date	Station	Depth (m)	Finetooth shark	Blacknose shark	Stiky shark	Bull shark	Spinner shark	Smalltail shark	Atlantic sharpnose shark	Unidentified sharks	Smooth dogfish	Florida smoothhound	Scalloped hammerhead	Great hammerhead	Bonnethead	Atlantic stingray	Blackedge moray	Speckled worm eel	Snapper eel	Shrimp eel	Banded shrimp eel	Sea catfish	Gafftopsail catfish	Rock sea bass	Warsaw grouper	Yellowedge grouper	Crevalle jack	Red snapper	Wenchman	Black drum	Silver seatrout	Red drum	Total fish caught	Total weight (kg)		
06-29-78	77-27-10	51			2																															12.8
06-29-78	77-27-11	57																																		0.0
09-16-78	77-39-01	11	1			1	1															4														28.8
09-16-78	77-39-02	18	1			1	1															5														39.1
09-16-78	77-39-03	5	1						2													1														3.0
09-21-78	77-40-08	29	1										1																							10.9
10-02-78	78-01-01	7	1																																	3.9
10-02-78	78-01-02	18				5	1	1	1																											89.4
10-03-78	78-01-03	24				1	1	4	4																											18.5
10-03-78	78-01-04	9				1	1																													3.2
11-08-78	78-04-02	9				3	3	7	7																											0.0
11-08-78	78-04-08	18			2	1																														53.9
11-09-78	78-04-08	55															1																			73.0
11-09-78	78-04-10	73																																		0.2
11-09-78	78-04-11	91																		1																8.7
11-09-78	78-04-12	77																																		0.0
11-29-78	78-05-01	27				1	1		4																											31.3
11-29-78	78-05-03	37				1	1		24																											165.8
11-30-78	78-05-04	10	1										1																							18.4
11-30-78	78-05-05	22				1	1		19												1															94.9
11-30-78	78-05-07	20				1	1		9																											46.1
11-30-78	78-05-08	18				1	1		2																											32.7
12-12-78	78-06-03	26							6																											31.4
01-16-79	78-07-01	13																																		0.0
01-16-79	78-07-02	18																															1			12.7

Table 1. (Cont'd.)

Date	Station	Depth (m)	Finetooth shark	Blacknose shark	Silky shark	Bull shark	Spinner shark	Smalltail shark	Atlantic sharpnose shark	Unidentified sharks	Smooth dogfish	Florida smoothhound	Scalloped hammerhead	Great hammerhead	Bonnethead	Atlantic stingray	Blackedge moray	Speckled worm eel	Snapper eel	Shrimp eel	Banded shrimp eel	Sea catfish	Gafftopsail catfish	Rock sea bass	Warsaw grouper	Yellowedge grouper	Crevalle jack	Red snapper	Wenchman	Black drum	Silver seatrout	Red drum	Total fish caught	Total weight (kg)				
08-10-79	78-17-09	75																	1															0	0.0			
08-21-79	78-18-02	18						1																										2	0.7			
08-21-79	78-18-03	31																																0	0.0			
10-24-79	79-02-03	13	1					8												1						2					3		16	78.6				
10-24-79	79-02-04	24						35																									35	164.2				
10-24-79	79-02-05	82						4																1									3	0.7				
10-25-79	79-02-06	64						4																									4	9.6				
10-25-79	79-02-07	46						6																									6	34.7				
12-19-79	79-03-03	15														1																	1	2.0				
12-19-79	79-03-04	18																															1	11.6				
12-19-79	79-03-05	24						4																									4	19.4				
12-20-79	79-03-07	27																															4	19.4				
12-20-79	79-03-08	33						28																									28	138.6				
12-20-79	79-03-10	40						25																									25	123.6				
12-20-79	79-03-11	49						44																									44	195.0				
01-15-80	80-01-02	18						46																									46	197.9				
01-15-80	80-01-03	15																															0	0.0				
01-15-80	80-01-03	13																															0	0.0				
02-04-80	80-02-01	64						30																									30	134.3				
02-04-80	80-02-02	75		1				19					3																			1	24	101.7				
Total all stations			6	2	4	1	17	1	559	2	1	9	12	2	1	2	3	1	2	3	1	2	3	8	17	8	6	6	2	1	4	17	1	4	2	16	709	3558.7

Table 2. Number of fish by species caught at each bottom longline station in the offshore area (101-417 m) off the central Texas coast during March 1978-1979 and February-March 1980.

Date	Station	Depth (m)	Florida smoothhound	Cuban dogfish	Wenchman	Gulf hake	Spotted hake	Yellowedge grouper	Scalloped hammerhead	Banded shrimp eel	Red snapper	Atlantic sharpnose shark	Smooth dogfish	Southern hake	Tiltefish	Silky shark	Total fish caught	Total Weight (kg)
03-10-78	77-11-15	138	6	1	1												8	34.4
03-10-78	77-11-16	196		2	1	1	1	1									6	2.0
03-06-79	78-11-06	101	5						1	1	1						8	41.7
02-27-80	80-04-01	115			1			3					2				8	44.7
02-28-80	80-04-02	187		1								1	1	2			4	6.6
02-28-80	80-04-03	227		1													1	0.6
02-28-80	80-04-04	276															6	18.8
02-28-80	80-04-05	336		1											6		6	5.5
02-28-80	80-04-06	397													5		6	7.5
03-11-80	80-05-01	272				1									2		3	2.3
03-11-80	80-05-02	333		1											2		3	43.7
03-11-80	80-05-03	371				2									13	1	16	1.5
03-11-80	80-05-04	417				1									1		2	0.0
Total fish			11	7	3	5	1	4	1	1	2	1	3	2	29	1	71	209.3

Appendix C. Annual budgets for owner and crew of a shrimp vessel.

Table 1. Initial investment expenditure for equipping a 22.9-m shrimp vessel with two complete sets of bottom longline gear-400 hooks (format from Nichols et al. 1980).

Item	Cost/unit (\$)	Units	Value (\$)
1. Fishing Gear			
Line (2 complete sets)	0.16/m	2250	360
Brummel hooks	3.20/ea	20	64
Monofilament	0.06/m	833	50
Hooks	0.15/ea	800	120
Snaps w/swivels	0.97/ea	800	776
Leader sleeves	.0425/ea	1600	68
Floats			
30 inch	7.00/ea	4	28
50 inch	25.00/ea	4	100
Hiflier poles	24.00/ea	4	96
Radar reflectors	12.00/ea	4	48
Flags	3.00/ea	4	12
Strobe lights	18.00/ea	4	72
Batteries for strobe	1.00/ea	8	8
Knives	8.00/ea	4	32
Rubber bands			2
Lead ballast	1.00/kg	10	10
Anchors	15.00/ea	4	60
Total for Fishing Gear			1,906
2. Deck or Dry Equipment			
Hydraulic longline reel			1,050
Parts and labor			950
Snatch blocks	40.00/ea	2	80
Gaffs	30.00/ea	2	60
Baiting table	75.00/ea	1	75
Buoy racks	150.00/ea	1	150
Hook rack	80.00/ea	2	160
Total Deck Equipment			2,525
3. Structural Modifications			
Cutting Bulwarks			50
Installing steering station (Optional)			2,000
Total for Structural Modifications			2,050
Total Investment Expenditure without Steering Station			4,481
Total Investment Expenditure with Steering Station			6,481

Table 2. 1980 estimated average costs and returns for the owner of a 22.9-m Gulf vessel engaged in bottom longlining for a 5-mo period (December-April) (format from Nichols et al. 1980).

Revenue & Cost-Item	Cost/unit (\$)	Units (kg)	Value (\$)
1. Gross receipts from operation			
Total fish	0.57/kg	158,458	90,321
2. Share accruing to owner (38%)			
Total fish	0.57/kg	60,214	34,322
3. Variable costs			
Winch and electrical maintenance			200
Equipment expense			525
Total Variable Costs			725
4. Returns above variable costs			33,597
5. Fixed costs			
Depreciation			500
Interest			600
License			6
Total Fixed Costs			1,106
6. Total Costs			1,831
7. Returns to boat's fixed costs, owner's equity and management			32,491

Table 3. 1980 estimated average costs and returns for the crew of a 22.9-m Gulf vessel engaged in bottom longlining for a 5-mo period (December-April) (format from Nichols et al. 1980).

Revenue & Cost-Item	Cost/unit (\$)	Units	Value (\$)
1. Gross receipts from operation			
Total fish	0.57/kg	158,458	90,321
2. Share accruing to crew (57%)		90,321	51,483
3. Variable Costs			
Ice	4.00/bar	840	3,360
Fuel	3.41/l	10,500	9,450
Groceries	480/trip	7	3,360
Subtotal Variable Costs			16,170
Replacements			
Line	0.16/m	2,250	360
Monofilament	0.06/m	3,333	200
Hooks	0.15/ea	4,000	600
Snaps	0.97/ea	2,000	1,940
Leader sleeves	0.0425/ea	6,000	255
Floats			
30 inch	7.00/ea	2	14
50 inch	25.00/ea	1	25
Brummel hooks	3.20/ea	20	64
Hiflier poles	24.00/ea	1	24
Radar reflectors	12.00/ea	2	24
Flags	3.00/ea	2	6
Strobe lights	18.00/ea	1	18
Batteries	1.00/ea	28	28
Knives	8.00/ea	4	32
Lead	1.00/kg	5	5
Anchors	15.00/ea	4	60
			<u>3,655</u>
Total Variable Costs			19,825
4. Return to crew (4 members) including captain			31,658
5. Return to individual members of crew			7,914

Table 4. Estimated average cost and returns for the captain of a 22.9-m Gulf vessel engaged in bottom longlining for a 5-mo period (December-April) (format from Nichols et al. 1980).

Revenue & Cost-Item	Cost/unit (\$)	Units	Value (\$)
1. Gross receipts from operation Total fish	0.57/kg	158,458	90,321
2. Share accruing to captain (5%) Total fish	0.57/kg	7,923	4,516
4. Return to captain as crew member			7,914
5. Net returns to captain			12,430

Table 5. 1980 estimated average annual costs and returns for owner of a 22.9-m Gulf vessel engaged in 7 mo of shrimping and 5 mo of bottom longlining (format from Nichols et al. 1980).

Revenue & Cost-Item	Cost/unit (\$)	Units	Value (\$)
1. Gross receipts			
Shrimp (owner's share)	6.60/kg	9,600	63,360
Total fish	0.57/kg	60,214	34,322
Total Returns to Owner			97,682
2. Variable costs			
Ice	4.00/bar	470	1,880
Fuel	3.41/l	8,164	27,838
Nets & supplies			11,890
Repair & maintenance			11,474
Packing, freight & handling	0.22/kg	9,600	2,112
Equipment expense			525
Total Variable Costs			55,719
3. Returns to owner above variable costs			41,963
4. Fixed costs			
Fishing license			6
Depreciation			11,333
Insurance			7,073
Interest			20,850
Overhead			5,896
Total Fixed Costs			45,158
5. Total Costs			100,877
6. Returns to fixed costs, owner's equity & management			-3,195

Table 6. 1980 estimated average annual costs and returns for the crew of a 22.9-m Gulf vessel engaged in 7 mo of shrimping and 5 mo of bottom longlining (format from Nichols et al. 1980).

Revenue & Cost-Item	Cost/unit (\$)	Units	Value (\$)
1. Gross receipts			
Shrimp (crew's share)	6.60/kg	6,400	42,240
Total fish (crew's share)	0.57/kg	90,321	51,483
Total Returns to Crew			93,723
2. Variable costs			
Fuel	3.41/l	4,812	16,410
Ice	4.00/bar	1,153	4,612
Groceries			6,825
Replacement			3,655
Packing, freight & handling shrimp	0.22/kg	6,400	1,408
Total Variable Costs			32,910
3. Returns to crew, including captain			60,813

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