Assessment of Bottom Longline Fishing Off the Central Texas Coast

by Terry J. Cody and R. M. Avent

Management Data Series Number 16
1980

Texas Parks and Wildlife Department
Coastal Fisheries Branch

ASSESSMENT OF BOTTOM LONGLINE FISHING OFF THE CENTRAL TEXAS COAST

by

Terry J. Cody and R. M. Avent

MANAGEMENT DATA SERIES
NO. 16

1980

Texas Parks and Wildlife Department
Coastal Fisheries Branch
4200 Smith School Road
Austin, Texas 78744

ASSESSMENT OF BOTTOM LONGLINE FISHING OFF THE CENTRAL TEXAS COAST

EXECUTIVE SUMMARY

From October 1977 through September 1979 the Texas Parks and Wildlife Department conducted a study to assess and evaluate the commercial potential of bottom longline gear as a harvest method for finfish stocks off the central Texas coast. Sampling was conducted quarterly in 10-fm increments out to 50 fm using 1200-ft sections of halibut-type longline gear and tuna circle hooks.

A total of 469 fish representing 32 species was caught at 79 stations. The Atlantic sharpnose shark (Rhizoprionodon terraenovae) was the most abundant species in number (310) and weight (2958 lb) representing 66.1% of the total fish caught and 54.8% of the total biomass. Average catch rates were highest during spring and fall at depths ranging from 11 to 40 fm. The mean weight of Atlantic sharpnose sharks was 9.55 lb.

No species having commercial value was collected in great enough abundance to justify commercial exploitation. Life history data on red drum, Sciaenops ocellata (Table A), and red snapper, Lutjanus campechanus (Table B) are presented.

The catch data demonstrated that bottom longlining at depths less than 50 fm is not likely to offer a practical commercial alternative for shrimping fleets unless underutilized species (mainly sharks) could be marketed.

Table A. Red drum (Sciaenops ocellata) caught on bottom longlines set at 10 fm depth off the central Texas coast (1977-1979).

Month-year day	Bottom temp. (F)	Bottom sal. (°/oo)	Total length (in)	Weight (lb)	Sex	Maturity stage[a]
December 1977						
14	66.0	31.6	-	-	-	-
January 1978						
27	53.6	32.2	40.2	22.0	M	II
March 1978						
30	63.1	33.9	39.0	24.0	M	VIII
30	63.1	33.9	40.6	27.0	M	VIII
April 1978						
13	66.2	31.6	38.2	22.0	-[b]	-
13	66.2	31.6	44.5	35.0	-[b]	-
13	66.2	31.6	35.0	17.0	-[b]	-
14	66.6	31.6	37.4	20.0	-[b]	-
14	66.6	31.6	38.2	22.0	-[b]	-
14	66.6	31.6	39.8	25.0	-[b]	-
14	66.6	31.6	37.4	20.0	-[b]	-
January 1979						
16	54.3	32.2	41.3	28.0	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 B. Red snapper (Lutjanus campechanus) caught on bottom longlines off the central Texas coast (1978-1979)

Month-year day	Depth (fm)	Bottom temp. (F)	Bottom sal. (°/oo)	Total length (in)	Weight (lb)	Sex	Maturity stage[a]
March 1978							
9	26	61.7	35.5	32.0	17.5	M	III
9	26	61.7	35.5	31.3	15.5	M	VIII
15	28	62.2	37.8	30.9	17.2	M	II
15	28	62.2	37.8	31.9	19.5	M	II
15	30	61.7	36.6	27.9	15.5	M	II
November 1978							
9	50	69.6	37.2	30.5	15.0	M	VIII
29	20	71.6	34.4	32.7	21.0	-	-
February 1979							
8	22	58.6	36.6	32.9	20.0	M	III
8	22	58.6	36.6	32.5	21.5	F	III
8	26	58.3	36.6	36.0	23.5	M	III
8	26	58.3	36.6	35.0	22.0	F	III
13	31	61.7	36.1	32.3	22.0	-	-
13	47	61.9	36.6	32.7	19.0	M	III
13	47	61.9	36.6	32.9	18.0	M	III
13	47	61.9	36.6	33.1	20.0	M	III
March 1979							
6	55	62.6	36.6	34.2	23.5	F	III
7	25	62.8	36.1	37.0	27.0	F	III
7	25	62.8	36.1	36.6	25.0	M	VII

[a]Key for maturity stages:
I-virgin; II-maturing virgin/recovering spent; III-developing; IV-developed; V-gravid; VI-spawning; VII-spent; VIII-resting

ASSESSMENT OF BOTTOM LONGLINE FISHING OFF THE CENTRAL TEXAS COAST

ABSTRACT

From December 1977 through September 1979 the Texas Parks and Wildlife Department conducted a study to assess and evaluate the commercial potential of bottom longline gear as a harvest method for finfish stocks off the central Texas coast. Sampling was conducted quarterly in 18-m increments out to 91 m using 366-m sections of halibut-type longline gear and tuna circle hooks.

A total of 469 fish representing 32 species was caught at 79 stations. The Atlantic sharpnose shark (Rhizoprionodon terraenovae) was the most abundant species in number (310) and weight (1341.6 kg) representing 66.1% of the total fish caught and 54.8% of the total biomass. Average catch rates were highest during spring and fall at depths ranging from 20 to 73 m. The mean weight of Atlantic sharpnose sharks was 4.33 kg.

No species currently having commercial value was collected in great enough abundance to justify commercial exploitation. Life history data on red drum (Sciaenops ocellata) and red snapper (Lutjanus campechanus) are presented.

The catch data demonstrated that bottom longlining at depths < 91 m is not likely to offer a practical commercial alternative for shrimping fleets unless underutilized species (mainly sharks) could be marketed.

INTRODUCTION

Texas Gulf of Mexico offshore fisheries historically have been shrimp oriented. Because of closed seasons and cyclic variations in the size of shrimp harvests the shrimping industry is not active throughout the year. To maximize benefits in relation to cost the shrimping community has often wondered whether other marine resources of commercial value might be utilized during periods of reduced shrimping activity (especially winter) to supplement its income. With an increasing consumer demand for fishery products, underutilized resourses could possibly play an increasingly prominent role in the coastal fisheries economy.

A fishing method with commercial potential is longlining, a hook and line technique basically equivalent to trotlines 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.

In 1977 with federal aid pursuant to the Commercial Fisheries Research and Development Act, the Texas Parks and Wildlife Department (TPWD) initiated a study of experimental bottom longline fishing to assess and evaluate the commercial potential of finfish stocks off the central Texas coast. Little information is available on the potential use of longline equipment.

The main objectives of this sampling program were to determine:

- Species of fish susceptible to bottom longline techniques
- Seasonal variations in the catch
- Commercial potential for bottom longline fishing off the central Texas coast
- Areas and conditions most productive for species presently of commercial importance or those having potential value
- Practicability of longlining for the Texas shrimp fleet during times of low shrimp yield.

MATERIALS AND METHODS

Project documents for the first year required that bottom longlining be conducted off the central Texas coast in February and March 1978. Additional sets were to be made in April if cruise time could be scheduled around the annual vessel haulout. Amendments during the first project year added September to the sampling schedule to provide seasonal information. During the second year (1978-1979) sampling was conducted quarterly in 18-m (10 fm) increments out to 91 m (50 fm) using 50-100 hooks per longline set.

Preliminary bottom longline sets were made in December 1977 and January 1978 to test the available gear. Project samples were taken in February, March and April 1978. Additional longline sets were made in June and September to provide preliminary data during the two quarters of the year that were not originally scheduled and to provide a base for the second year of sampling during which bottom longline samples were taken every quarter.

The study area and stations occupied are shown in Figure 1. All stations lay in the region between latitudes 26°00' N and 29°40' N and between the Texas coastline and 95°30' W longitude. Sampling was concentrated in the area directly off the Aransas Pass Ship Channel to make this job compatible with other project sampling, to keep running time between stations at a minimum and to provide maximum coverage of the area with the limited time available.

Table 1 lists the stations occupied from December 1977 to September 1979 which met or exceeded sampling requirements with one minor exception. During the spring of 1979 the 5-18 m zone (3-10 fm) was omitted because of a heavy work schedule during cruise 78-13 which prevented sufficient time for an additional station.

Appendix A presents station data for 1977-79 in chronological order. Bottom and surface hydrological data were accurate to $\pm$ 1 C and $\pm$ 1 °/oo. Station locations were estimated with LORAN-A station 3H3 and depth, station 3H2 being quite weak in the study area. Locations were accurate to $\pm$ 1 km latitude and $\pm$ 2 km longitude.

Set time refers to minimum bottom time; i.e., time from total release of the longline until the time it began to come on board. Sampling time ranged from 30 to 150 min with the standard set being 100 hooks fished for 60 min. 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 $\pm$ 56 g (2 oz).

The bottom longline used is shown diagrammatically in Figure 2. The gear was deployed and retrieved from the stern of the R/V Western Gulf using a small winch mounted centrally on the afterdeck. The groundline was wound onto the winch drum or hand coiled into tubs. Commercially-made longline pullers would make the retrieval process easier.

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 10-15 min. Tuna circle hooks (sizes 4, 6, 7 and 8) were prebaited with fresh fish and invertebrates collected by trawl and hung on the edge of washtubs or garbage cans to prevent tangling. Quick release snap-on connectors with swivels (Inset B, Figure 2) were used to attach gangions to the groundline (Figure 2).

The procedure used for setting and retrieving bottom longlines involved three main phases:

1. Pre-set preparation.

    a. Catch, select and prepare bait (fresh or frozen fishes, squid, crabs or mantis shrimp) for hooks.

    b. Inspect and untangle groundlines, gangions and buoy lines.

    c. Arrange anchors and buoys for efficient deployment.

    d. Bait hooks and hang on edges of garbage cans or washtubs.

2. Deployment.

   a. Select sample site and establish direction of set. Steam ahead at minimal speed.

   b. Release first buoy with buoy line.

   c. Attach no. 1 anchor between buoy line and groundline.

   d. Attach baited hooks with halibut line snaps as groundline is payed out. Distance between gangions = 3-4 m.

   e. Attach no. 2 anchor between terminus of groundline and buoy line.

   f. Release terminus of buoy line, flag buoy and catch buoy.

3. Retrieval operation.

   a. Hook catch buoy and pull aboard vessel.

   b. Retrieve flag buoy and hook buoy line to winch or winch head.

   c. Pull buoy line onto winch drum.

   d. Remove no. 2 anchor from between buoy line and groundline and hook latter two together.

   e. Continue retrieval of groundline. One man removes gangions and passes them to another who hangs hooks back onto garbage cans or washtubs.

   f. At end of groundline remove no. 1 anchor from between groundline and buoy line and retrieve buoy line fully.

   g. Continue pulling buoy line until No. 1 buoy is brought aboard and secured on deck.

In deploying the longline, one man controlled the speed of the line being released from the winch while another handed the prebaited gangions to a third man who snapped them into place at regular intervals on the groundline. The retrieval operation was the reverse of the setting operation--one man controlled the groundline speed, one man unsnapped gangions from the mainline and handed them to the third man who placed hooks with fish in one area of the deck and hooks without fish back onto the garbage cans. Thus a crew of 3-4 men normally occupying a Gulf shrimp boat could set and retrieve longlines commercially and have adequate time to bait hooks and process the catch.

Catch rates are presented by season--winter (December-February), spring (March-May), summer (June-August) and fall (September-November).

RESULTS AND DISCUSSION

A total of 469 fish representing 32 species was caught at 79 stations (Table 2). The Atlantic sharpnose shark (Rhizoprionodon terraenovae) was the most abundant species in number (310) and in weight (1341.61 kg) representing 66.1% of the total fish caught and 54.8% of the total biomass (2449.6 kg) (Table 3). The 10 most abundant species represented 91% of the total catch; 18 of the 32 species (56%) were represented by only one or two individuals, together constituting only 5.3% of the total fish caught.

The highest catch of fish was at station 77-11-11 where 42 fish were caught on a 100-hook longline set at a depth of 48 m on 9 March 1978 (Table 2). This sample consisted of 36 Atlantic sharpnose sharks, 2 Florida smoothhound sharks (Mustelus norrisi), one great hammerhead (Sphyrna mokarran), one warsaw grouper (Ephinephelus nigritus) and 2 red snapper (Lutjanus campechanus). Total weight for the set was 205.08 kg. The highest catch by weight was on 24 May 1979 (Sta. 78-13-10, 22 m) when 38 Atlantic sharpnose sharks weighing 226.11 kg were caught.

Of the 79 stations, only 13 yielded 10 or more fish and at 11 of these Atlantic sharpnose shark dominated the catch (Table 2). At 17 stations nothing was caught. The average catch per set was 5.94 fish (SD = $\pm$ 8.57) and 31.01 kg (SD = $\pm$ 44.41).

No species currently having commercial value was collected in great enough abundance to justify commercial exploitation by longlining. Red snapper, gafftopsail catfish (Bagre marinus), red drum (Sciaenops ocellata) and rock sea bass (Centropristis philadelphica) were among the ten most abundant species (Table 2) but together represented only 9.0% of the total fish caught and 12.6% of the total biomass.

Spring and fall were more productive for bottom longlining than winter and summer (Table 4). Highest catches occurred in spring in every depth zone sampled. The maximum catches seasonally occurred at 5-55 m in fall, 75-91 m in winter, 5-18 m in summer and 20-73 m in spring.

Catches of most species were sporadic (Tables 5-9). Two species were considered to be of high commercial and sport value--red drum (Table 5) and red snapper (Table 6). Catches of other species of secondary commercial and sport importance are presented together in Table 7. A major group of under-utilized fishes were sharks--primarily Atlantic sharpnose, spinner (Carcharhinus maculipinnis) and Florida smoothhound (Table 3). Catch rates of Atlantic sharpnose shark are given in Table 8 because of its dominance; catch rates of the other 12 species of sharks are presented together in Table 9.

Red Drum

This sciaenid is highly prized by both sport and commercial fishermen. It is considered to be of major importance to the inshore and estuarine sport fisherman and along with spotted seatrout (Cynoscion nebulosus) supports a

substantial coastal tourist trade. The Texas Parks and Wildlife Department presently conducts several studies on red drum movement and abundance in estuarine lagoons and is restocking bays in an attempt to replace declining stocks.

Data on red drum caught with bottom longlines off the central Texas coast are presented in Table 10. The red drum ranged from 7.71 to 15.88 kg (mean, 10.80 kg) and from 890 to 1130 mm in total length (mean, 996 mm). None of the fish examined was ripe or showed signs of pre-spawning development. Stomach contents variously included the remains of small fishes, stomatopods and portunid crabs.

During the first two years red drum were captured with bottom longlines only in the winter and spring at 18 m (10 fm) (Table 10). However, additional samples in October 1979 (not included in this report) yielded 3 red drum at 13 m (7 fm). Texas law prohibits the selling of red drum larger than 889 mm and the maximum catch rate of 0.68 fish per 100 hook-h (Table 5) does not justify their consideration as a longline target species.

Red Snapper

This valuable sport and commercial fish was captured in low numbers from November through March at depths ranging from 37 to 101 m (20-55 fm) (Table 11). Total lengths ranged from 708 to 940 mm (mean, 836 mm); weights ranged from 6.80 to 12.25 kg (mean, 9.14 kg). Thirteen of 15 fish examined in February and March showed some early gonadal development.

The average catch per 100 hook-h was highest during the winter in the three depth zones between 38 and 91 m (Table 6). No relationship existed between proximity to natural or artificial reefs and increased catch rates. The large red snapper taken in this study were all caught on muddy bottom areas away from reefs or other man-made structures. Bottom longlines were not set on known snapper reefs because of possible gear loss or damage. Samples close to reefs yielded no red snapper.

Secondary Commercial Species

This group contained species commonly recognized as having food value but not supporting a major local fishing industry. It included gafftopsail catfish, rock sea bass, warsaw grouper, yellowedge grouper (Ephinephelus nigritus), wenchman (Pristipomoides aquilonaris) and black drum (Pogonias cromis). As a group these species were caught in greatest abundance in the deeper areas (> 75 m, 41 fm) but never more than 1.00 per 100 hook-h (Table 7). The same uncertain relationships between bottom type, foraging behavior and longline efficiency existed for the serranids and small lutjanids as for the red snapper.

Sharks

Sharks were the most abundant group of fishes caught on the bottom longline. A total of 378 sharks was captured representing 80.6% of the total fish (Table 3).

Sharks were caught during every season and in all depth zones. They were most abundant during spring and least abundant during winter when the existing shrimp fleet would be most available for longlining (Tables 8 & 9).

The Atlantic sharpnose shark was the most abundant shark in number (310) and in weight (1341.6 kg). Average catch rates were highest during spring and fall at depths ranging from 20 to 73 m (Table 8). The average weight for Atlantic sharpnose sharks was 4.33 kg with a mean total length of 961 mm.

Other sharks caught on bottom longlines included members of families Carcharhinidae, Triakidae, Sphyrnidae and Squalidae (Table 3). The mean catch rates for these sharks were highest in spring at depths beyond 57 m (Table 9). Florida smoothhound (20) and spinner sharks (17) ranked second and fourth, respectively, in number caught (Table 3). Florida smoothhound were most common during spring at depths of 48-137 m while spinner sharks were caught at 9-37 m during fall and at 35-48 m during spring.

At present sharks are not utilized extensively in United States fisheries; however, their potential should not be overlooked. In 1973 world landings of shark total 447,806 kg and the utilization of sharks for human consumption will probably increase in the future (Ronsivalli 1978). Texas landings of shark based on Individual Sales Transactions during 1978-79 totaled 775 kg with at least part of this entering fresh seafood markets (McEachron, personal communication).

Sharks are valued as a source of protein in many parts of the world and are utilized in a variety of nonfood uses which include shark leather, pharmaceuticals and other miscellaneous uses (Ronsivalli 1978). Small local markets have developed for edible shark meat in the United States; however, the general marketability of shark meat is still limited.

CONCLUSIONS

The catch data demonstrated that bottom longlining at depths < 91 m (50 fm) is not likely to offer a practical commercial alternative to existing shrimping fleets unless presently underutilized species (mainly sharks) could be successfully marketed at a price yielding an acceptable profit.

The potential for deep water hook and line techniques, however, has been established in several areas on the east coast and Gulf coast of the United States (Nelson and Carpenter 1968, Kelley 1978). The primary target species on soft bottom habitats off the Texas coast have been the golden tilefish (Lopholatilus chaemeleonticeps), the yellowedge grouper (Epinephelus flovolimbatus) and the warsaw grouper (Nelson and Carpenter 1968). Tilefish are considered the most desirable commercially, are typically caught at depths of 229-366 m (125-200 fm) and are most abundant at water temperatures of 12-14 C (Nelson and Carpenter 1968).

In experimental studies on the R/V Oregon II, the National Marine Fisheries Service caught golden tilefish in the western Gulf of Mexico in sufficient numbers to suggest commercial potential (Bullis and Thompson 1970). On the east coast of Florida and off New Jersey, successful local fisheries for this species exist

which supply existing specialty markets in the northeastern United States and elsewhere. Fishing is usually conducted with high speed electric reels or with bottom longlines extending 10-15 miles (Anonymous 1978).

A negative factor for the Texas coast is the distance a vessel must travel to attain depth, temperature and bottom types suitable for tilefish exploitation. However, the very high market price of tilefish might offset this cost if the fish are caught in sufficient numbers. Other species such as deep-living serranids (yellowedge, warsaw and snowy grouper) might also provide additional incentives to the potential deepwater fisherman.

ACKNOWLEDGEMENTS

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

Special thanks go to Pat Johansen, C. E. Bryan, Tom Heffernan, Roy Johnson and Billy Fuls who reviewed the manuscript and to Elaine LeBlanc and Dolores Kleypas for preparation of the tables.

This study was conducted with partial funding from the U. S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, under P.L. 88-309 (Project No. 2-312-R).

LITERATURE CITED

Anonymous. 1978. Tilefish, seafood marketing's mystery fish. Fish Boat, October 1978. p. 33.

Bullis, H. R. and J. R. Thompson. 1970. Explorations by Oregon II in the Gulf and Caribbean. p. 13-18. In: Bureau of Commercial Fisheries Exploratory Fishing and Gear Research Base, Pascagoula, Mississippi, July 1, 1967 to June 30, 1969. U. S. Fish Wildl. Circ. No. 351. 29 p.

Kelley, T. 1978. The tilefish capital of the world. Nat. Fisherman, April 30, 1978. p. 142-146.

Morgan, R. 1955. World sea fisheries. Pitman, N. Y. 307 p.

Nelson, W. R. and J. S. Carpenter. 1968. Bottom longline explorations in the Gulf of Mexico. Comm. Fish. Rev. 30 (10):57-62.

Ronsivalli, L. J. 1978. Sharks and their utilization. Mar. Fish. Rev. 40 (2):1-14.

Table 1. Number of stations occupied in each depth range and each month (season) of the study.

Study year (Oct-Sep)	Mo/yr	Season	Depth Range (m) 5-18	20-37	38-55	57-73	75-91	93-137	139-183	> 183	All
I	12/77	Winter	1								1
	1/78		1								1
	2/78		1	1							2
	3/78	Spring	6	3	7	2	1	1		1	21
	4/78		3								3
	5/78										0
	6/78	Summer	1	1	2	1					5
	7/78										0
	8/78										0
	9/78	Fall		1							1
II	10/78		3	1							4
	11/78		4	4	1	1	2				12
	12/78	Winter		1							1
	1/79		3	1							4
	2/79		2	2	2	2	2				10
	3/79	Spring			3	1	1	1			6
	4/79										0
	5/79			1							1
	6/79	Summer									0
	7/79										0
	8/79		2	2	1	1	1				7
	9/79	Fall									
	All		27	18	16	8	7	2	0	1	79

Seasons:

Winter	Dec-Feb
Spring	Mar-May
Summer	June-Aug
Fall	Sep-Nov

Table 2. Number of fish by species caught at each bottom longline station off the central Texas coast (1977-1979).

Date	Station	Depth (m)	Finetooth shark	Blacknose shark	Silky shark	Bull shark	Spinner shark	Smalltail shark	Atl. sharpnose shark	Unidentified sharks	Smooth dogfish	Florida smoothhound	Scalloped hammerhead	Great hammerhead	Bonnethead	Cuban dogfish	Atlantic stingray	Blackedge moray	Speckled worm eel	Snapper eel	Shrimp eel	Banded shrimp eel	Sea catfish	Gafftopsail catfish	Gulf hake	Spotted hake	Rock sea bass	Warsaw grouper	Yellowedge grouper	Crevalle jack	Red snapper	Wenchman	Black drum	Red drum	Total fish caught	Total weight (kg)
12-14-77	77-06-05	18							3																								1	4	0
1-27-78	77-07-02	18																															1	1	9.98
2-14-78	77-08-05	22																														1		1	12.59
2-27-78	77-10-01	18																																1	1	12.59
3-09-78	77-11-11	48							36			2		1																				0	0
3-09-78	77-11-13	69		1					22		1	1	3		1												1			2				42	205.08
3-09-78	77-11-14	77							11				1													1								30	95.65
3-10-78	77-11-15	138										6				1						2				1								15	40.43
3-10-78	77-11-16	196														2															1			8	34.44
3-15-78	77-12-01	13																							1	1			1			1		6	2.01
3-15-78	77-12-02	51							6																									0	0
3-15-78	77-12-04	55							6												1	1					1			2				9	74.50
3-28-78	77-13-01	22							1													1								1				9	31.72
3-28-78	77-13-02	35					1		7													1												2	6.80
3-28-78	77-13-04	51							20													1												9	39.12
3-28-78	77-13-06	64							22				1																					20	81.99
3-29-78	77-13-07	48							6																									23	88.00
3-29-78	77-13-08	48					1		16																									6	31.52
3-29-78	77-13-10	40							7																									17	118.62
3-29-78	77-13-11	27																		1														7	35.38
3-29-78	77-13-12	7	1						1														1												1	0.11
3-30-78	77-13-13	18							3																									3	22.23
4-13-78	77-14-01	18							7															4									2	5	36.17
4-14-78	77-14-02	18							9														4	1					1			2	3	16	85.16
4-14-78	77-14-03	18							5				1										2										2	2	17	68.27
6-28-78	77-27-04	20																														1	2	11	56.70
6-28-78	77-27-05	18							5																									0	0
6-29-78	77-27-09	38							1																									5	23.02
6-29-78	77-27-10	51			2																													1	3.62
																																		2	12.81

Table 2. (Cont'd).

Date	Station	Depth (m)	Finetooth shark	Blacknose shark	Silky shark	Bull shark	Spinner shark	Smalltail shark	Atl. sharpnose shark	Unidentified sharks	Smooth dogfish	Florida smoothhound	Scalloped hammerhead	Great hammerhead	Bonnethead	Cuban dogfish	Atlantic stingray	Blackedge moray	Speckled worm eel	Snapper eel	Shrimp eel	Banded shrimp eel	Sea catfish	Gafftopsail catfish	Gulf hake	Spotted hake	Rock sea bass	Warsaw grouper	Yellowedge grouper	Crevalle jack	Red snapper	Wenchman	Black drum	Red drum	Total fish caught	Total weight (kg)
6-29-78	77-27-11	57																																0	0
9-16-78	77-39-01	11	1				1																4											6	28.85
9-16-78	77-39-02	18	1				1			2													5											9	39.11
9-16-78	77-39-03	5																					1	2										3	3.01
9-21-78	77-40-04	29											1																					1	10.89
10-02-78	78-01-01	7	1					1																										2	3.90
10-02-78	78-01-02	18					5		1																									6	89.36
10-03-78	78-01-03	24							4																									4	18.48
10-03-78	78-01-04	9					1																											1	3.18
11-08-78	78-04-01	9																																0	0
11-08-78	78-04-04	18					3		7																									10	53.86
11-09-78	78-04-08	55			2	1												1																4	73.03
11-09-78	78-04-10	73																			1													1	0.23
11-09-78	78-04-11	91																									1		1		1			3	8.73
11-09-78	78-04-12	77																																0	0
11-29-78	78-05-01	27					1		4																									5	31.30
11-29-78	78-05-03	37					1		24				1																		1			27	165.79
11-30-78	78-05-04	10	1														1																	2	18.37
11-30-78	78-05-05	22					1		19													1												21	94.92
11-30-78	78-05-07	20							9																									9	46.07
11-30-78	78-05-08	18					1		2										1															4	32.66
12-12-78	78-06-03	26							6																									6	31.41
1-16-79	78-07-01	13																																0	0
1-16-79	78-07-02	18																															1	1	12.70
1-22-79	78-08-01	20																																0	0
1-22-79	78-08-02	9																																0	0
2-08-79	78-09-01	22																																0	0
2-08-79	78-09-02	23																																0	0
2-08-79	78-09-03	40																1													2			3	18.82
2-08-79	78-09-04	48																													2			2	20.64

Table 2. (Cont'd).

Date	Station	Depth (m)	Finetooth shark	Blacknose shark	Silky shark	Bull shark	Spinner shark	Smalltail shark	Atl. sharpnose shark	Unidentified sharks	Smooth dogfish	Florida smoothhound	Scalloped hammerhead	Great hammerhead	Bonnethead	Cuban dogfish	Atlantic stingray	Blackedge moray	Speckled worm eel	Snapper eel	Shrimp eel	Banded shrimp eel	Sea catfish	Gafftopsail catfish	Gulf hake	Spotted hake	Rock sea bass	Warsaw grouper	Yellowedge grouper	Crevalle jack	Red snapper	Wenchman	Black drum	Red drum	Total fish caught	Total weight (kg)
2-12-79	78-10-01	13																																0	0
2-12-79	78-10-02	18																																0	0
2-13-79	78-10-04	57																												1				1	9.98
2-13-79	78-10-05	66																				1												1	1.47
2-13-79	78-10-06	77																				1												1	0.79
2-13-79	78-10-07	86										1															1			3				5	31.98
3-06-79	78-11-03	55										1																						1	8.39
3-06-79	78-11-04	58										2																						2	14.06
3-06-79	78-11-05	82										2	1														1							4	13.61
3-06-79	78-11-06	101										5	1									1								1				8	41.73
3-07-79	78-11-07	40																																0	0
3-07-79	78-11-08	46																1												2				3	23.81
5-24-79	78-13-10	22							38																									38	226.11
8-09-79	78-17-02	11																																0	0
8-10-79	78-17-06	22							1																					1				2	15.76
8-10-79	78-17-07	40																																0	0
8-10-79	78-17-08	59												1																				1	40.00
8-10-79	78-17-09	75																																0	0
8-21-79	78-18-02	18							1												1													2	0.69
8-21-79	78-18-03	31																																0	0
Total all stations			5	1	4	1	17	1	310	2	1	20	10	2	1	3	1	3	1	2	2	9	17	7	1	1	5	2	2	2	18	2	4	12	469	2449.61

Table 3. Taxonomic list of species caught, with total number and relative ranking, 1977-79.

Family	Scientific name	Common name	Total no.	% of total	Rank	No. of times caught
Carcharhinidae (Requiem sharks)	Aprionidon isodon	Finetooth shark	5	1.1	10,11	5
	Carcharhinus acronotus	Blacknose shark	1	0.2	>14	1
	C. falciformis	Silky shark	4	0.9	12,13	2
	C. leucas	Bull shark	1	0.2	>14	1
	C. maculipinnis	Spinner shark	17	3.6	4,5	9
	C. porosus	Smalltail shark	1	0.4	>14	2
	Rhizoprionodon terraenovae	Atlantic sharpnose shark	310	66.1	1	33
	Unidentified sharks		2	0.4	>14	1
Triakidae (Dogfish)	Mustelus canis	Smooth dogfish	1	0.2	>14	1
	M. norrisi	Florida smoothhound	20	4.3	2	8
Sphyrnidae (Hammerhead sharks)	Sphyrna lewini	Scalloped hammerhead	10	2.1	7	8
	S. mokarran	Great hammerhead	2	0.4	>14	1
	S. tiburo	Bonnethead	1	0.2	>14	1
Squalidae (Dogfish)	Squalus cubensis	Cuban dogfish	3	0.6	14	3
Dasyatidae (Stingrays)	Dasyatis sabina	Atlantic stingray	1	0.2	>14	1
Muraenidae (Moray eels)	Gymnothorax nigromarginatus	Blackedge moray	3	0.6	>14	2
Ophichthidae (Snake eels)	Myrophis punctatus	Speckled worm eel	1	0.2	>14	1
	Mystriophis mordax	Snapper eel	2	0.4	>14	2
	Ophichthus gomesi	Shrimp eel	2	0.4	>14	2
	O. sp.	Banded shrimp eel	9	1.9	8	8
Ariidae (Sea catfish)	Arius felis	Sea catfish	17	3.6	4,5	6
	Bagre marinus	Gafftopsail catfish	7	1.5	9	3
Gadidae (Codfishes)	Urophycis cirratus	Gulf hake	1	0.2	>14	1
	U. regius	Spotted hake	1	0.2	>14	1
Serranidae (Sea basses)	Centropristis philadelphica	Rock sea bass	5	1.3	10,11	6
	Ephinephelus nigritus	Warsaw grouper	2	0.4	>14	2
	E. flavolimbatus	Yellowedge grouper	2	0.4	>14	2
Carangidae (Jacks)	Caranx hippos	Crevalle jack	2	0.4	>14	2
Lutjanidae (Snappers)	Lutjanus campechanus	Red snapper	18	3.8	3	11
	Pristipomoides aquilonaris	Wenchman	2	0.4	>14	2
Sciaenidae (Drums)	Pogonias cromis	Black drum	4	0.8	12,13	3
	Sciaenops ocellata	Red drum	12	2.8	6	7
		Total number caught	469			

Table 4. Spacial and temporal catches (all species combined) as indicated by longline fishing at depths < 200 m off the central Texas coast, 1977-79.

Depth		Season			
		Winter	Spring	Summer	Fall
m	fm	No./100 hk-h	No./100 hk-h	No./100 hk-h	No./100 hk-h
5-18	3-10	0.93	3.94	2.95	3.61
20-37	11-20	1.19	12.66	0.63	10.77
38-55	21-30	2.50	9.64	1.21	4.00
57-73	31-40	1.00	13.75	0.56	1.00
75-91	41-50	3.00	7.60	0	1.50
93-137	51-75	-	5.33	-	-
196	107	-	6.00	-	-

Table 5. Red drum spacial and temporal catches as indicated by longline fishing at depths <137 m off the central Texas coast, 1977-79.

Depth		Season			
		Winter	Spring	Summer	Fall
m	fm	No./100 hk-h	No./100 hk-h	No./100 hk-h	No./100 hk-h
5-18	3-10	0.47	0.68	0	0
20-37	11-20	0	0	0	0
38-55	21-30	0	0	0	0
57-73	31-40	0	0	0	0
75-91	41-50	0	0	0	0
93-137	51-75	-	0	-	-

Table 6. Red snapper spacial and temporal catches as indicated by longline fishing at depths < 137 m off the central Texas coast, 1977-79.

Depth		Season			
		Winter	Spring	Summer	Fall
m	fm	No./100 hk-h	No./100 hk-h	No./100 hk-h	No./100 hk-h
5-18	3-10	0	0	0	0
20-37	11-20	0	0	0	0.16
38-55	21-30	1.50	0.59	0	0
57-73	31-40	0.50	0	0	0
75-91	41-50	1.50	0	0	0.05
93-137	51-75	-	0.33	-	-

Table 7. Secondary commercial species[a] spacial and temporal catches as indicated by longline fishing at depths < 200 m off the central Texas coast, 1977-1979.

Depth		Season			
		Winter	Spring	Summer	Fall
m	fm	No./100 hk-h	No./100 hk-h	No./100 hk-h	No./100 hk-h
5-18	3-10	0	0.61	0	0.17
20-37	11-20	0.17	0	0	0
38-55	21-30	0	0.17	0	0
57-73	31-40	0	0.25	0	0
75-91	41-50	0.50	0.80	0	1.00
93-137	51-75	-	0.67	-	-
196	107		1.00		

[a] includes groupers, sea basses, snappers, drums and gafftopsail catfish

Table 8. Atlantic sharpnose shark spacial and temporal catches as indicated by longline fishing at depths < 137 m off the central Texas coast, 1977-79.

Depth		Season			
		Winter	Spring	Summer	Fall
m	fm	No/100 hk-h	No/100 hk-h	No/100 hk-h	No/100 hk-h
5-18	3-10	0.47	1.89	1.97	0.84
20-37	11-20	1.02	11.64	0.32	9.65
38-55	21-30	0	8.19	0.40	0
57-73	31-40	0	11.00	0	0
75-91	41-50	0	4.40	0	0
93-137	51-75	-	0	-	-

Table 9. Miscellaneous sharks spacial and temporal catches as indicated by longline fishing at depths < 200 m off the central Texas coast, 1977-79.

Depth		Season			
		Winter	Spring	Summer	Fall
m	fm	No/100 hk-h	No/100 hk-h	No/100 hk-h	No/100 hk-h
5-18	3-10	0	0.15	0	1.60
20-37	11-20	0	0.25	0	0.80
38-55	21-30	0	0.42	0.81	3.00
57-73	31-40	0	2.50	0.56	0
75-91	41-50	0.50	1.60	0	0
93-137	51-75	-	4.33	-	-
196	107		2.00		

Table 10. Red drum (Sciaenops ocellata) caught on bottom longlines set at 18 m depth off the central Texas coast (1977-1979).

Month-Year Day	Bottom Temp. (C)	Bottom Sal. (o/oo)	Total length (mm)	Weight (kg)	Sex	Maturity stage[a]
December 1977						
14	18.9	31.6	-	-	-	--
January 1978						
27	12.0	32.2	1020	9.98	M	II
March 1978						
30	17.3	33.9	990	10.89	M	VIII
30	17.3	33.9	1030	12.25	M	VIII
April 1978						
13	19.0	31.6	970	9.98	-[b]	--
13	19.0	31.6	1130	15.88	-[b]	--
13	19.0	31.6	890	7.71	-[b]	--
14	19.2	31.6	950	9.07	-[b]	--
14	19.2	31.6	970	9.98	-[b]	--
14	19.2	31.6	1010	11.34	-[b]	--
14	19.2	31.6	950	9.07	-[b]	--
January 1979						
16	12.4	32.2	1050	12.70	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 11. Red snapper (Lutjanus campechanus) caught on bottom longlines off the central Texas coast (1978-1979).

Month-Year Day	Depth (m)	Bottom Temp. (C)	Bottom Sal. (°/oo)	Total length (mm)	Weight (kg)	Sex	Maturity stage[a]
March 1978							
9	48	16.5	35.5	815	7.94	M	III
9	48	16.5	35.5	795	7.03	M	VIII
15	51	16.8	37.8	786	7.82	M	II
15	51	16.8	37.8	810	8.84	M	II
15	55	16.5	36.6	708	7.03	M	II
November 1978							
9	91	20.9	37.2	775	6.80	M	VIII
29	37	22.0	34.4	830	9.53	-	-
February 1979							
8	40	14.8	36.6	835	9.07	M	III
8	40	14.8	36.6	825	9.75	F	III
8	48	14.6	36.6	915	10.66	M	III
8	48	14.6	36.6	890	9.98	F	III
13	57	16.5	36.1	820	9.98	-	-
13	86	16.6	36.6	830	8.62	M	III
13	86	16.6	36.6	835	8.16	M	III
13	86	16.6	36.6	840	9.07	M	III
March 1979							
6	101	17.0	36.6	870	10.66	F	III
7	46	17.1	36.1	940	12.25	F	III
7	46	17.1	36.1	930	11.34	M	VII

[a] Key for maturity stages:

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

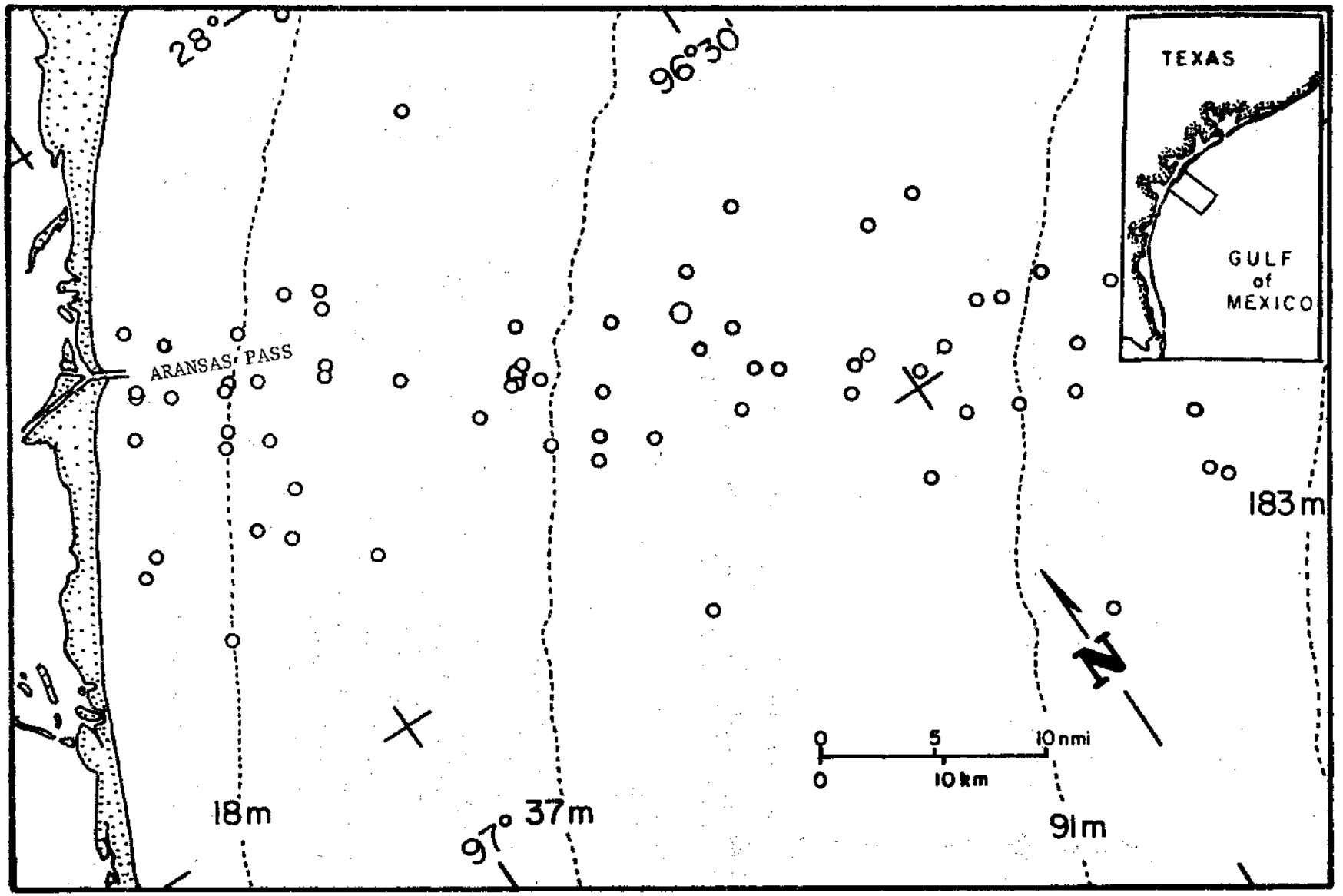
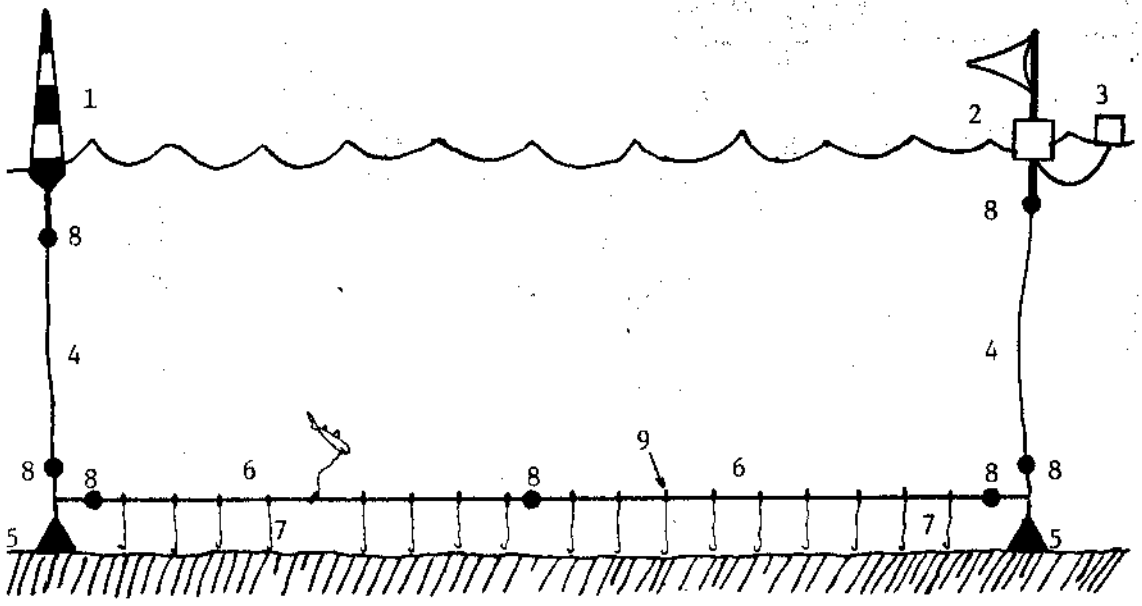


Figure 1. Station locations in the study area. Larger circles represent two or more stations, small circles represent single stations.



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)

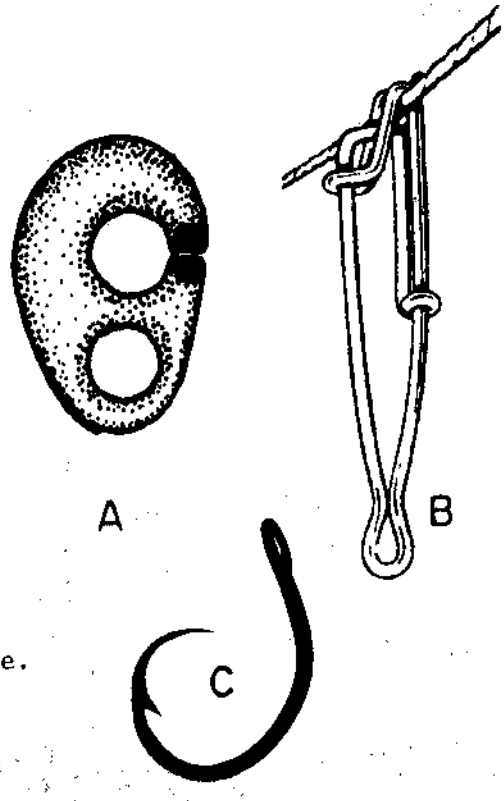


Figure 2. Diagram of the bottom longline.

Appendix A. List of bottom longline stations occupied with associated effort data and hydrology.

Appendix A. List of bottom longline stations occupied with associated effort data and hydrology.

Station	Date	Location			Depth		Gear Effort			Hydrology			
										Bottom		Surface	
	mo/da/yr	Latitude (N)	Longitude (W)	LORAN-A (3H3)	(m)	(fm)	No. Hooks	Set Time (min)	Hk-h	Temp. (C)	Sal. (°/oo)	Temp. (C)	Sal. (°/oo)
77-06-05	12/14/77	28°13.8'	96°24.7'	2600	18	10	15	60	15	18.9	31.6	17.9	29.4
77-07-02	01/27/78	27°37.3'	97°04.6'	2030	18	10	27	60	27	12.0	32.2	12.3	32.2
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°37.9'	96°32.3'	2176	48	26	100	150	250	16.5	35.5	16.9	35.5
77-11-13[a]	03/09/78	27°31.8'	96°25.2'	2176	70	38	100	120	200	16.1	36.1	18.0	35.5
77-11-14	03/09/78	27°26.9'	96°31.7'	2079	77	42	100	90	150	16.1	35.5	18.7	34.4
77-11-15	03/10/78	27°20.0'	96°20.7'	2084	137	75	100	120	200	16.4	36.1	19.0	35.5
77-11-16[a]	03/10/78	27°17.4'	96°14.2'	2088	196	107	100	60	100	16.4	36.1	19.0	35.5
77-12-01[a]	03/15/78	27°42.4'	97°05.4'	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°17.3'	96°28.1'	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°17.3'	96°27.5'	2215	64	35	100	60	100	17.6	37.8	18.5	36.6
77-13-07	03/29/78	27°39.7'	96°36.2'	2197	48	26	100	60	100	16.9	37.2	17.5	36.6
77-13-08	03/29/78	27°37.9'	96°32.3'	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°01.8'	2147	7	4	100	60	100	18.3	32.8	18.2	32.8
77-13-13	03/30/78	27°42.8'	97°50.5'	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
77-27-04[a]	06/28/78	27°48.2'	96°50.7'	2198	20	11	80	90	120	26.8	36.6	29.0	34.4
77-27-05	06/28/78	27°48.3'	96°50.9'	2151	18	10	80	60	80	25.6	35.5	28.4	35.5
77-27-09	06/29/78	27°37.1'	96°25.0'	2237	38	21	80	90	120	21.1	38.3	29.0	33.9
77-27-10	06/29/78	27°31.3'	96°21.6'	2189	51	28	78	60	78	20.3	36.6	29.4	34.4
77-27-11	06/29/78	27°29.1'	96°19.4'	2185	57	31	80	60	80	19.8	37.8	29.3	34.4
77-39-01[a]	09/16/78	27°40.4'	97°00.7'	2078	11	6	100	120	200	29.0	36.6	29.7	36.6
77-39-02[a]	09/16/78	27°40.2'	96°45.8'	2150	18	10	100	105	175	28.9	36.6	29.7	36.6
77-39-03	09/16/78	27°51.2'	97°00.7'	2186	5	3	98	60	98	29.2	34.4	29.2	34.4
77-40-04	09/21/78	27°36.5'	96°35.8'	2164	29	16	75	75	94	28.8	36.6	29.4	35.5
78-01-01	10/02/78	27°47.3'	97°00.6'	2151	7	4	52	60	52	27.5	25.5	27.6	25.5
78-01-02[a]	10/02/78	27°40.2'	96°45.8'	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	27°59.1'	96°45.3'	2340	9	5	90	60	150	27.4	26.6	27.6	26.6
78-04-01[a]	11/08/78	27°46.5'	96°58.7'	2150	9	5	100	60	100	21.4	31.6	21.5	32.2
78-04-04	11/08/78	27°39.7'	96°46.0'	2145	18	10	100	60	100	22.3	31.6	22.4	32.2
78-04-08	11/09/78	27°27.7'	96°22.3'	2100	55	30	100	60	100	25.7	35.5	24.8	35.5
78-04-10	11/09/78	27°22.6'	96°19.4'	2109	73	40	100	60	100	21.8	37.2	25.2	36.1

Appendix A . . (Cont'd)

Station	Date	Location			Depth		Gear Effort			Hydrology			
										Bottom		Surface	
	mo/da/yr	Latitude	Longitude	LORAN-A (3H3)	(m)	(fm)	No. Hooks	Set Time (min)	Hk-h	Temp. (C)	Sal. (°/oo)	Temp. (C)	Sal. (°/oo)
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	11/09/78	27°19.4'	96°19.9'	2079	77	42	100	60	100	21.2	37.2	25.2	36.6
78-05-01	11/29/78	27°36.7'	96°37.6'	2155	27	15	80	75	100	21.7	33.9	21.6	33.9
78-05-03	11/29/78	27°32.3'	96°31.0'	2149	37	20	100	60	100	22.0	34.4	22.0	34.4
78-05-04[a]	11/30/78	27°43.5'	96°58.4'	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°36.7'	96°46.3'	2110	20	11	100	60	100	21.5	33.3	20.7	33.3
78-05-08[a]	11/30/78	27°40.4'	96°35.3'	2152	18	10	100	60	100	20.5	33.3	19.7	31.6
78-06-03	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	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°34.8'	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°40.4'	97°00.6'	2175	48	26	100	60	100	14.6	36.6	13.0	34.4
78-10-01	02/12/79	27°41.6'	97°06.5'	2070	13	7	100	60	100	11.8	31.1	11.6	30.0
78-10-02	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	02/13/79	27°31.0'	96°27.8'	2163	77	42	100	60	100	16.0	36.6	17.8	36.6
78-10-07	02/13/79	27°31.2'	96°21.9'	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
78-11-04	03/06/79	27°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
78-11-06	03/06/79	27°27.8'	96°22.2'	2123	101	55	100	60	100	17.0	36.6	19.8	36.1
78-11-07	03/07/79	27°35.1'	96°34.4'	2100	40	22	100	60	100	17.0	36.1	16.8	36.1
78-11-08	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	05/24/79	27°47.2'	96°52.0'	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	75	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°39.5'	96°48.5'	2128	31	17	100	60	100	27.7	37.2	30.0	34.4

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

PWD Book 3000-102
January 1981