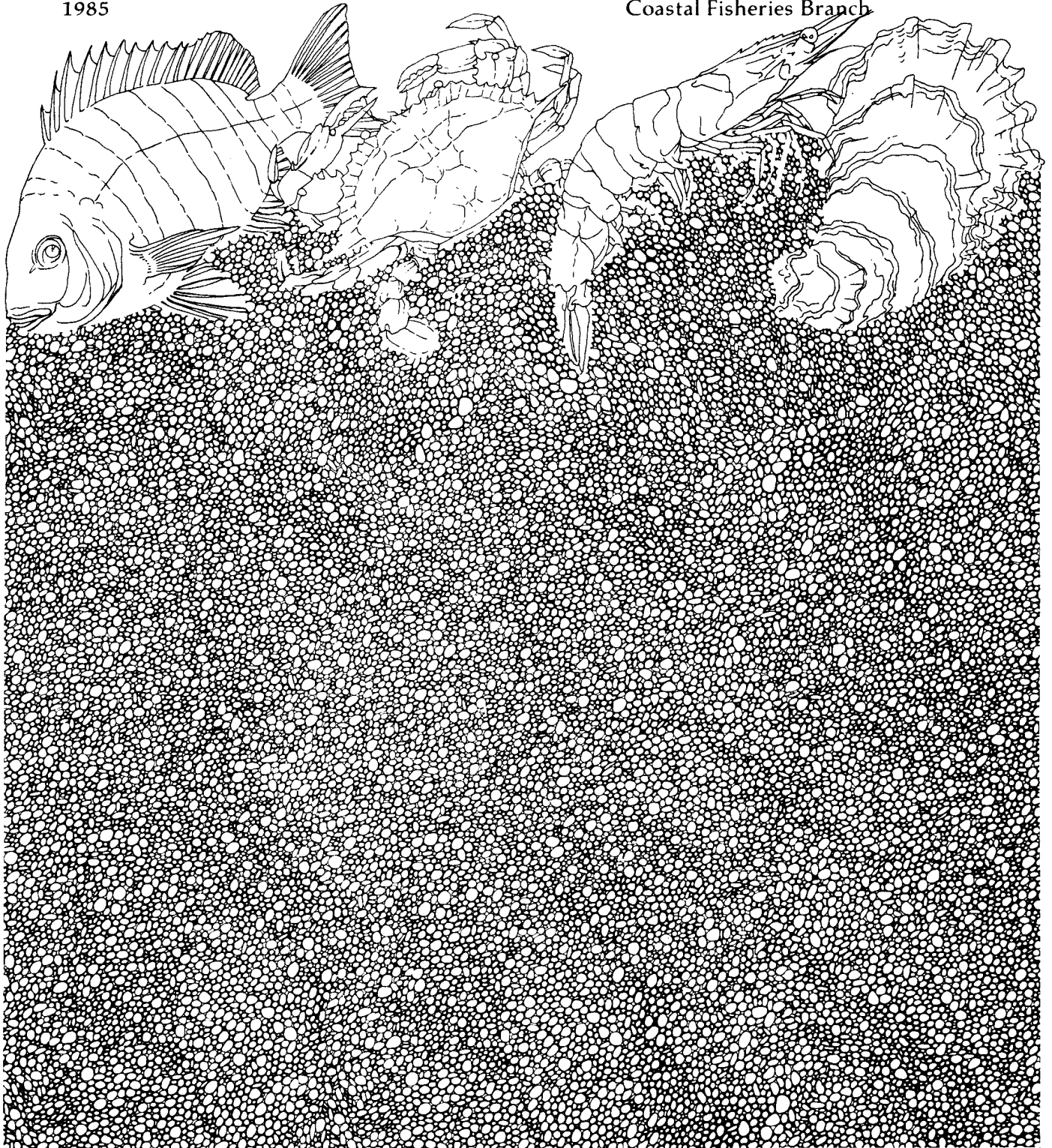


# Distribution and Gonadal Development of Black Drum in Texas Gulf Waters

by T.J. Cody, K.W. Rice, and C.E. Bryan

Management Data Series Number 72  
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## ACKNOWLEDGMENTS

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## ABSTRACT

From October 1975 through September, 1977, a high-opening fish trawl was used monthly in the Gulf of Mexico to determine the species composition and relative abundance of fishes. A total of 251 fish trawl samples were made in 5-9, 11-18, 20-27, 29-37 and 38-46 m zones off the central Texas coast. Black drum (Pogonias cromis) were collected during October 1975, January-April 1976 and November 1976-April 1977. The trawls captured 210 adult black drum between depths of 5 and 37 m; 176 of the fish were caught between 20 and 27 m. During November 1976, one 30-minute sample contained 101 black drum weighing a total of 354 kg. Black drum with maturing gonads were found during all months in which they were captured except October. Black drum apparently spawn in the Gulf between 7 and 31 m during the fall through spring period with peak activity during January-April.

## INTRODUCTION

In Texas the black drum (Pogonias cromis) is an important recreational and commercial fish which spends part of its life in the bays and part in the Gulf of Mexico. Texas commercial landings from 1977-1982 averaged 593,200 kg of black drum with an average value of \$550,900 per year (Hamilton 1983); recreational fishermen landed an average of 237,000 black drum per year from 1975-1983 (McEachron and Green 1984).

Information on spawning and oceanic distribution of black drum is sparse. Hildebrand and Schroeder (1928) reported a fully ripe male was caught off Virginia in 14.6 m, and Ross et al. (1983) caught 21 black drum off Freeport, Texas. Simmons and Breuer (1962) reported that black drum spawn "in or near passes, in the Gulf, and in all bay systems" in Texas. Pearson (1929) stated that black drum spawn from February to May with a secondary spawning in late July to November.

This lack of life history information is largely due to inadequate gear. Most research on Texas Gulf finfishes has concerned fish captured in shrimp trawls (Hildebrand 1954, 1955; Chittenden and McEachran 1976). Since large, fast-swimming fish can often evade these trawls, the Texas Parks and Wildlife Department (TPWD) used a large-mesh fish trawl during 1975-77 to investigate the spatial and seasonal distribution of fish off the central Texas coast. This paper presents the results of this sampling as it relates to distribution and spawning of black drum.

## MATERIALS AND METHODS

Field work was conducted aboard the TPWD research vessel Western Gulf, a 21.9-m steel hull, double-rigged shrimp trawler. From October 1975 to September 1977 an 18.3-m wide, high-opening (4.6 m) fish trawl with 11.4-cm stretched mesh in the wings and body, tapering to 7.6-cm stretched mesh in the belly and cod end was used (Figure 1). The net was spread with wooden trawl doors (0.9 x 2.1 m). The leglines (cable between doors and net) were 4.6 m long until November 1976 when they were lengthened to 27.4 m. The headrope was buoyed by 17 to 23 plastic floats (20.3 cm long) and the bottom line was weighted (looped) its entire length with 10-mm galvanized chain.

Bottom trawling took place each month in the northwestern Gulf of Mexico in an area bounded by latitude 27°10'N, longitude 95°30'W and the Texas coastline, with concentrated sampling along the central Texas coast from Corpus Christi Pass to Pass Cavallo (Figure 2). Sampling stations were established in 5-9, 11-18, 20-27, 29-37 and 38-46 m zones off Port Aransas, Cedar Bayou and Pass Cavallo. Trawls were pulled at each station once a month for 30 minutes except when bottom conditions or the presence of large numbers of organisms limited tows to 15 minutes. The towing speed was 4-5 km/h.

Individual black drum were weighed to the nearest 10 g and total length (TL) measured to the nearest mm. Maturity stages of gonads were identified according to a modified numerical scale formulated by the FAO (1960) (Table 1). Average catch rates were calculated by dividing the total number (or weight) by the number of hours trawled.

## RESULTS

### Seasonal and Depth Distribution

Black drum were caught in fall (October-November), winter (December-February) and spring (March-April). The mean catch rates were highest during November 1976 (Table 2) because of one 30-minute trawl in 20 m that captured 101 black drum weighing 354 kg.

Black drum were caught in all depth zones except the 38-46 m zone. During the first year all catches occurred in the 11-18 and 20-27 m zones; during the second year black drum were also captured from 5-9 and 29-37 m (Figure 3). Of the 210 black drum caught, 198 were taken between 11 and 27 m. Of these, 176 were captured in the 20-27 m zone.

### Spawning Time and Location

Spawning occurred during November through April each year with a peak in January through April. All 28 female black drum in gravid, spawning or recently spent condition were captured during November through April (Table 3). Twenty-five of the 28 were caught in February, March and April. The seven black drum captured during October 1975 were in the virgin or early maturation states of gonadal development (Table 4). No black drum were caught during November or December 1975, but the four collected during January 1976 were in developed or gravid conditions. Development continued and spawning was indicated during February when 19 of 32 fish were in the spawning or spent stages. Three fish in February, two in March and two in April 1976 were spent. During November 1976, 104 fish were examined; 25 were maturing virgin or recovering spent, 53 were developing, 16 were developed, 9 were gravid and one was in spawning condition (Table 4). From January through April 1977, 40 out of 43 black drum were in the developed to spent stages. Males were caught in spawning or spent condition from January through April; females in spawning or spent condition were predominantly captured from February through April.

Most maturing male and female black drum were caught in 20-27 m. Of the 66 fish in the gravid or spawning stages, 47 were caught in 20-27 m, 10 in 11-18 m and 5 in 5-9 m. All four black drum captured in the 29-37 m depth zone were in spawning condition (Table 5).

## LITERATURE CITED

- Allshouse, William C. 1983. The distribution of immigrating larval and postlarval fishes into the Aransas-Corpus Christi bay complex. M.S. Thesis, Corpus Christi State Univ., Corpus Christi, Texas. 118 p.
- Chittenden, M. E. Jr., and J. D. McEachran. 1976. Composition, ecology and dynamics of demersal fish communities on the northwestern Gulf of Mexico continental shelf, with a similar synopsis for the entire gulf. TAMU-SG-76-208. Tex. A&M Univ. 104 p.
- Cody, T. J., B. E. Fuls, G. C. Matlock, and C. E. Bryan. 1981. Assessment of bottom longline fishing off the central Texas coast, a completion report. Tex. Pks. Wildl. Dep., Coast. Fish. Branch, Mngmnt. Data Ser. No. 22. 51 p.
- Cornelius, S. E. 1984. Contribution to the life history of black drum and analysis of the commercial fishery of Baffin Bay, Volume II. Tech. Bull. No. 6, Caesar Kleberg Wildl. Res. Inst., Tex. A&I Univ. 53 p.
- Finucane, J. H., L. A. Collins, and J. D. McEachran. 1977. In: W. B. Jackson (Editor), Environmental studies of the south Texas outer continental shelf, ichthyoplankton/mackerel eggs and larvae. NOAA Final Rep. Bur. Land. Mngmnt., Interagency Agree. No. AA550-IA7-3. 484 p.
- Food and Agricultural Organization of the United Nations. 1960. Manual of field methods in fisheries biology. Rome. 152 p.
- Gunter, G. 1945. Studies on marine fishes of Texas. Publ. Inst. Mar. Sci., Univ. Tex. 1:1-190.
- Hamilton, C. L. 1983. Texas commercial harvest statistics, 1977-1982. Tex. Pks. Wildl. Dep., Coast. Fish. Branch, Mngmnt. Data Ser. No. 54. 65 p.
- Hildebrand, H. H. 1954. A study of the fauna of the brown shrimp (Penaeus aztecus Ives) grounds in the western Gulf of Mexico. Publ. Inst. Mar. Sci., Univ. Tex. 3(2):233-366.
- \_\_\_\_\_. 1955. A study of the fauna of the pink shrimp (Penaeus duorarum Burkenroad) grounds in the Gulf of Campeche. Publ. Inst. Mar. Sci., Univ. Tex. 4:169-232.
- Hildebrand, S. F., and W. C. Schroeder. 1928. Fishes of Chesapeake Bay. Bull. Bur. Fish. 43:287-289.
- King, B. D., III. 1971. Study of migratory patterns of fish and shellfish through a natural pass. Tex. Pks. Wildl. Dep., Coast. Fish. Branch, Tech. Ser. No. 9. 54 p.

## DISCUSSION

The fact that black drum spawn in the Gulf has not been proven conclusively since there have been no direct observations of a female spawning eggs. However, the capture of black drum with gonads in a gravid and spent condition in this study as well as the collection of larvae in the same location and during the same period of year strongly suggests that black drum spawn in the Gulf primarily in the winter-spring. This conclusion is supported by findings of Ross et al. (1983), McFarland (1963), Gunter (1945) on mature fish and Finucane et al. (1977) who reported larvae off Port Aransas in 22 m during April. Larval drum were also collected in bay-Gulf passes from fall through spring (Allshouse 1984, King 1971).

Black drum also spawn in Texas bays during this period. The gonad-somatic index (GSI) for both sexes in Alazan Bay, Texas, rose during late winter and early spring with secondary rises during fall (Cornelius 1984). The peak GSI for males was in March; for females it was February.

It is unclear where the drum that spawn in the Gulf originate, but they probably come from the estuaries. The absence of black drum in trawl collections beyond 37 m and their presence within 37 m support this conclusion. Osburn and Matlock (1984) found no mass migration of these fish in the winter or during spring, but hypothesized that a quasi-permanent movement of black drum from the bays to the Gulf takes place at Age 4 or greater.

If fish spawning in 20 to 27-m in winter-spring originated in the estuaries then one would expect higher catch rates in shallower depths prior to the spawning season. This expected pattern was not found in this study or by Cody et al. (1981), who reported black drum only during February and April in 18-22 m.

A possible explanation is that the fish originated in the estuaries and moved to the Gulf in such a fashion that they did not encounter the gear as frequently as they did after reaching their spawning site. Once they reached the area of spawning they stopped movement, remained in that area and additional recruitment concentrated their number making them more susceptible to the gear. Additional research is needed to define more clearly their distribution and movement patterns.

If a quasi-permanent movement of drum into the Gulf occurs one would also expect the fish to be present there all year. No black drum were caught in summer. This may be due to the efficiency of the gear. Perhaps drum were able to escape the trawl more effectively in warm weather when metabolic rates are higher than in cooler weather.



- McEachron, L. W., and A. W. Green. 1984. Weekend sport-boat fishermen finfish catch statistics for Texas bay systems, May 1974-May 1983. Tex. Pks. Wildl. Dep., Coast. Fish. Branch, Mngmnt. Data Ser. No. 59. 138 p.
- McFarland, W. N. 1963. Seasonal change in the number and the biomass of fishes from the surf at Mustang Island, Texas. Publ. Inst. Mar. Sci., Univ. Tex. 9:91-105.
- Osburn, H. R., and G. C. Matlock. 1984. Black drum movement in Texas bays. N. Am. J. Fish. Mngmnt. 4:523-530.
- Pearson, J. C. 1929. Natural history and conservation of redfish and other commercial sciaenids of the Texas coast. Bull. Bur. Fish. 44:129-214.
- Ross, J. L., J. S. Pavela, and M. E. Chittenden, Jr. 1983. Seasonal occurrence of black drum, Pogonias cromis, and red drum, Sciaenops ocellatus, off Texas. N. E. Gulf Sci. 6(1):67-70.
- Simmons, E. G., and J. P. Breuer. 1962. A study of redfish, Sciaenops ocellata Linnaeus and black drum, Pogonias cromis Linnaeus. Publ. Inst. Mar. Sci., Univ. Tex. 8:184-211.

Table 1. Classification of gonadal development.<sup>a</sup>

<u>Stage</u>	<u>Identification</u>
I -	<u>Virgin</u> : Very small sexual organs close under the vertebral column. Testis and ovary transparent, colourless to grey. Eggs invisible to naked eye.
II -	<u>Maturing virgin</u> and <u>recovering spent</u> : Testis and ovary translucent, grey-red. Length half, or slightly more than half, the length of ventral cavity. Single eggs can be seen with magnifying glass.
III -	<u>Developing</u> : Testis and ovaries opaque, reddish with blood capillaries. Occupy about half of ventral cavity. Eggs visible to the eye as whitish granular.
IV -	<u>Developed</u> : Testis reddish-white. No milt-drops appear under pressure. Ovary orange-reddish. Eggs clearly discernible: opaque. Testis and ovary occupy about two-thirds of central cavity.
V -	<u>Gravid</u> : Sexual organs filling ventral cavity. Testis white, drops of milt fall with pressure. Eggs completely round, some already translucent and ripe.
VI -	<u>Spawning</u> : Roe and milt run with slight pressure. Most eggs translucent with few opaque eggs left in ovary.
VII -	<u>Spent</u> : Not yet fully empty. No opaque eggs left in ovary.
VIII -	<u>Resting</u> : Testis and ovary empty, red. A few eggs in the state of reabsorption.

<sup>a</sup>Modified version of Classification of Gonadal Development from Manual of Field Methods in Field Biology, Food and Agriculture Organization of the United Nations (1960).

Table 2. Monthly mean catch rates, size, and number of black drum (*Pogonias cromis*) caught with fish trawls off the central Texas coast. (Blank = no black drum caught during these periods).

Month	Number of collections	Mean catch		Total length (mm)		Mean wt. (kg)	Number	
		(kg/h)	(No./h)	Range	Mean		Male	Female
Oct 75	7	5.94	1.75	515-810	717	3.39	4	3
Nov 75	12							
Dec 75	10							
Jan 76	10	4.74	0.80	715-775	740	5.92	2	2
Feb 76	15	20.84	4.27	620-820	703	4.88	15	17
Mar 76	9	14.31	3.11	585-775	661	4.60	6	8
Apr 76	8	10.55	1.00	780-965	878	10.55	2	2
May 76	11							
Jun 76	10							
Jul 76	8							
Aug 76	14							
Sep 76	15							
Oct 76	5							
Nov 76	10	81.00	21.89	505-900	636	3.70	48	56
Dec 76	12	2.70	0.33	765-877	821	8.11	0	2
Jan 77	9	18.51	1.72	760-1000	875	10.79	5	2
Feb 77	14	16.56	2.00	725-880	810	8.28	8	5
Mar 77	15	5.77	1.05	544-870	708	5.50	4	3
Apr 77	9	16.94	3.70	590-780	681	4.59	8	8
May 77	8							
Jun 77	8							
Jul 77	9							
Aug 77	8							
Sep 77	15							
Total	251						102	108

Table 3. Total Number, number "ripe"<sup>a</sup> and percent of ripe female black drum (*Pogonias cromis*) caught monthly with fish trawls in each depth zone along the central Texas coast. (Blank = no female black drum caught).

Month	Depth zones (m)												Total						
	5-9			11-18			20-27			29-37			38-46			Total			
	No.	Ripe	%	No.	Ripe	%	No.	Ripe	%	No.	Ripe	%	No.	Ripe	%	No.	Ripe		
Oct 75																			
Jan 76																			
Feb 76																			
Mar 76																			
Apr 76																			
Nov 76																			
Dec 76																			
Jan 77																			
Feb 77																			
Mar 77																			
Apr 77																			
Total	4	2	50	9	6	67	94	19	20	1	1	100	108	28	26				

<sup>a</sup> "Ripe" = gravid, spawning or recently spent condition.

Table 4. Monthly number of black drum (Pogonias cromis) in each gonadal stage taken in fish trawls off the central Texas coast.

Month		VIRGIN I	MATURING VIRGIN RECOVERING SPENT II	DEVELOPING III	DEVELOPED IV	GRAVID V	SPAWNING VI	SPENT VII	RESTING VIII
Oct 75	M	4							
	F	1	2						
(No black drum from November to December 1975)									
Jan 76	M				1	1			
	F				1	1			
Feb 76	M					2	12	1	
	F			2	3	6	4	2	
Mar 76	M			5		1			
	F		2	2	1			2	1
Apr 76	M					2			
	F							2	
(No black drum from May to October 1976)									
Nov 76	M		13	16	10	9			
	F		12	37	6		1		
Dec 76	M								
	F			1	1				
Jan 77	M				1	2	2		
	F				1	1			
Feb 77	M					2	6		
	F				1	2	2		
Mar 77	M					1	2	1	
	F				1	1		1	
Apr 77	M				1	4	2	1	
	F		2	1	2			3	
(No black drum from May to September 1977)									



Figure 1. General drawing of a fish trawl.

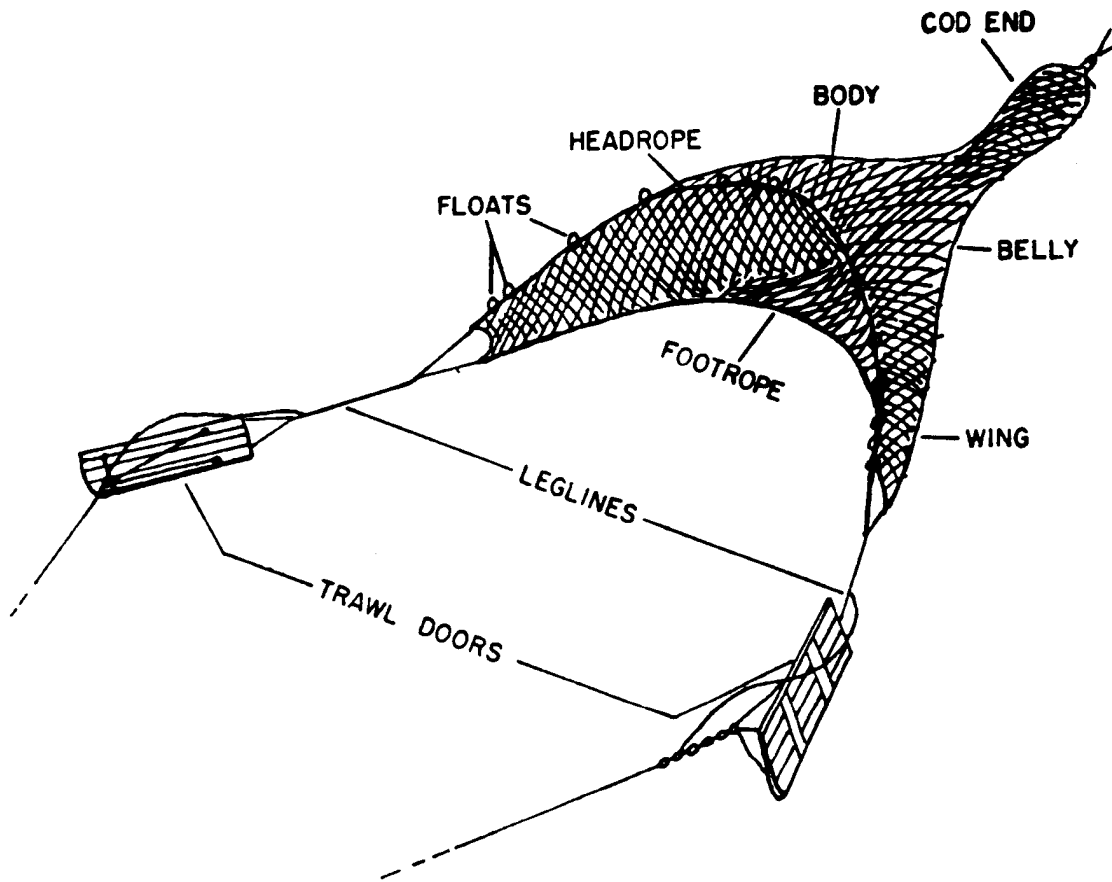




Figure 2. Sampling areas where the fish trawl was used off the central Texas coast, 1975-1977.

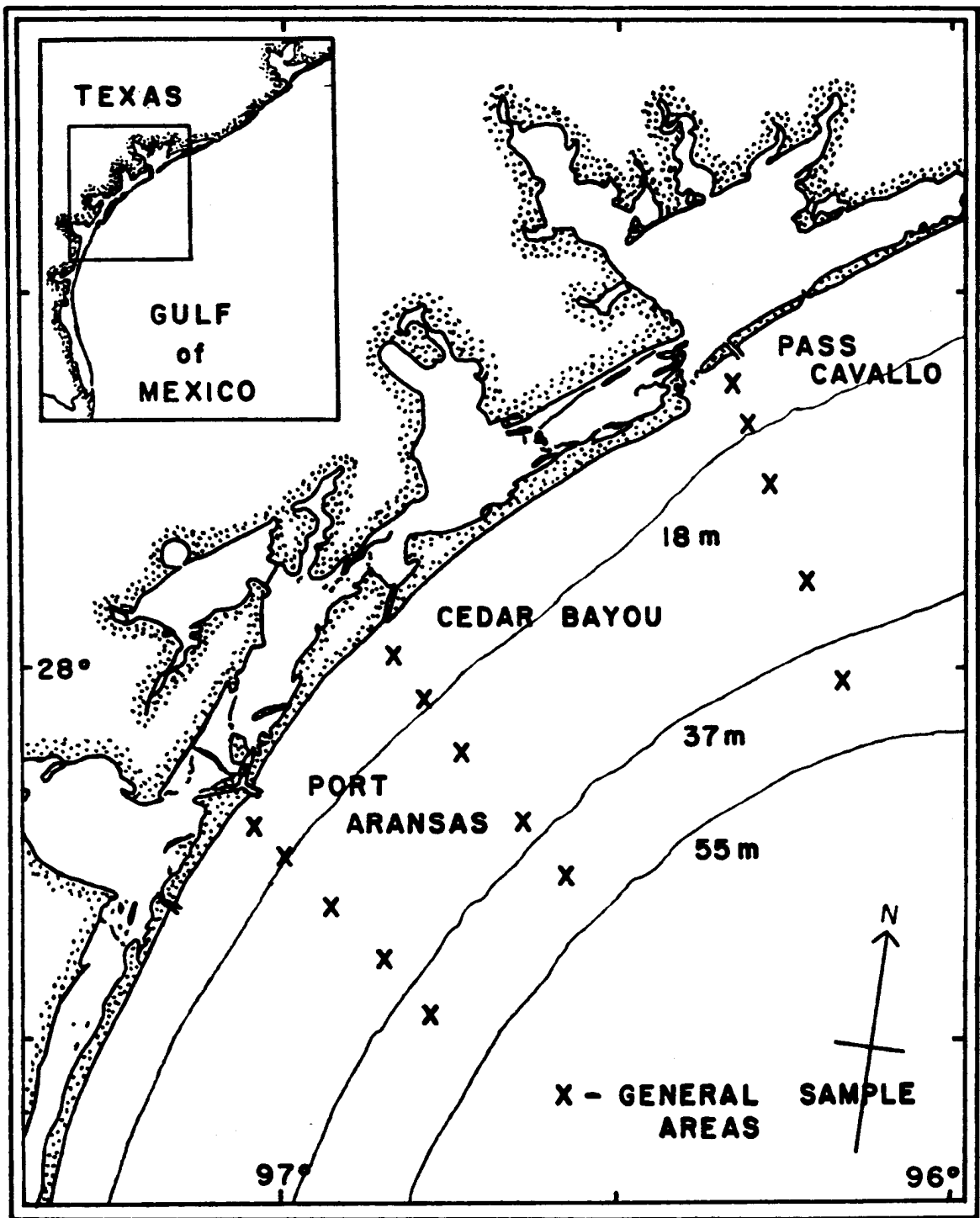
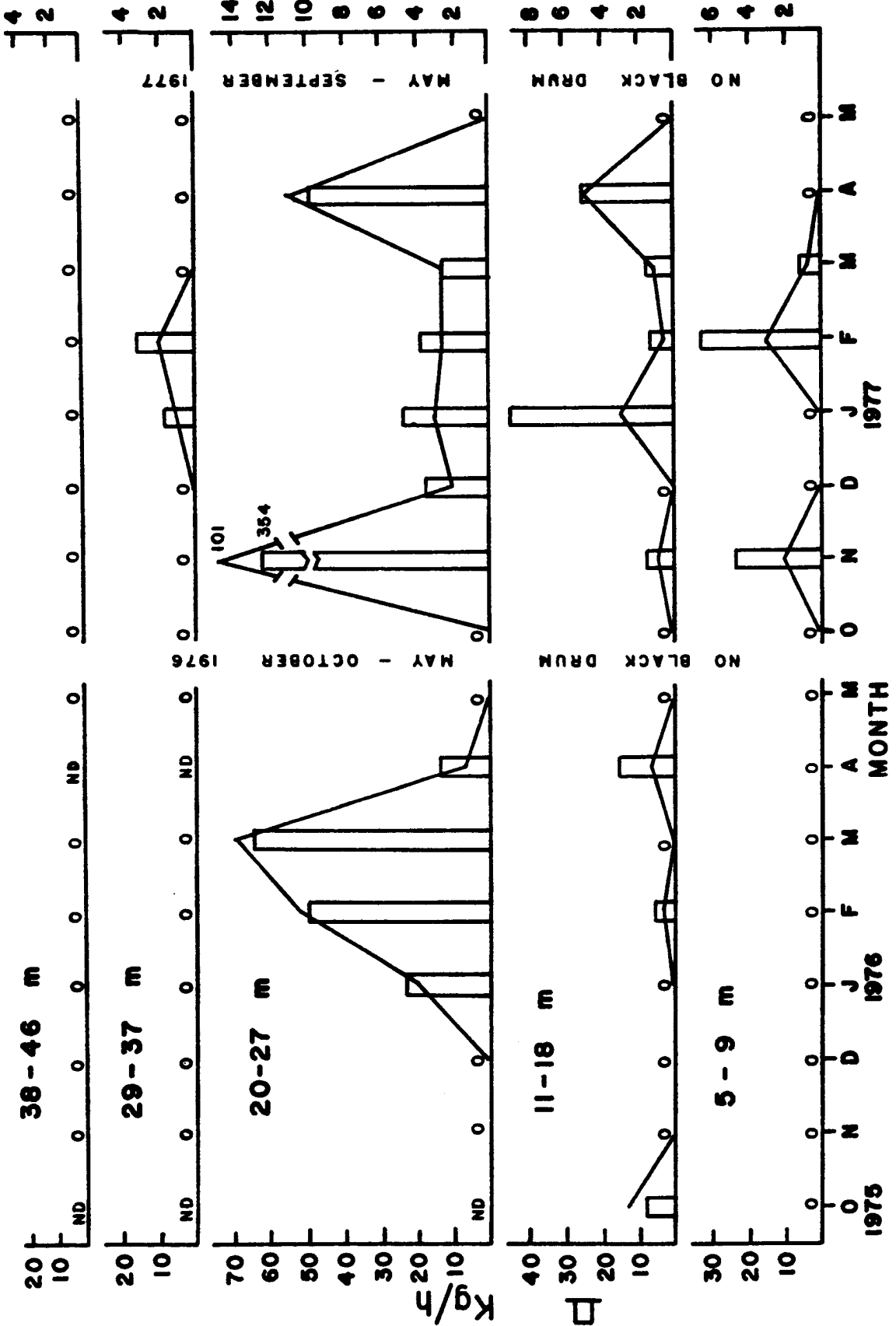


Figure 3. Monthly catch rates by depth zone of black drum (Pogonias cromis) caught with fish trawls off the central Texas coast.

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Gonadal Development and Sex Inversion in Saddleback Anemonefish *Amphiprion polymnus* Linnaeus (1758) Sukjai Rattanayuvakorn 1, Pisut Mungkornkarn 2, Amara Thongpan 3 and Kannika Chatchavalvanich 4\* ABSTRACT Gonadal development and sex inversion of saddleback anemonefish, *Amphiprion polymnus* were described. Key words: gonadal development, sex inversion, saddleback anemonefish 1 Institute of Marine Science, Burapha University, Bangsaen, Chonburi 20131, Thailand. 2 Institute of Science, Rangsit University, Patumthani 12121, Thailand. 3 Department of General Science, Faculty of Science, Kasetsart University, Bangkok 10900, Thailand. 4 Department of Zoology, Faculty of Science, Kasetsart University, Bangkok 10900, Thailand.