LIFE HISTORY STUDIES OF SOUTHERN FLOUNDER (*PARALICHTHYS LETHOSTIGMA*) AND GULF FLOUNDER (*P. ALBIGUTTA*) IN THE ARANSAS BAY AREA OF TEXAS

by

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ABSTRACT

Monthly samples were taken from January 1974 through September 1975 to determine the life histories of southern flounder (*Paralichthys lethostigma*) and Gulf flounder (*P. albigutta*) in the Aransas Bay area of Texas. Data concerning the commercial and sport gig flounder fishery were also gathered.

Sexually mature southern and Gulf flounders left the bay during October, November and December for spawning in the Gulf of Mexico. Male flounder were not present in the run after 25 November. Both the beginning and period of maximum emigration for adult southern flounder coincided with rapid water temperature drops of 4°C to 5°C. Tagged southern flounder were recovered in water depths of up to 62.8 m (204 ft) in the Gulf of Mexico. Both species spawned for the first time at two years of age. Adult southern flounder began to return to the bay as early as February and Gulf flounder returned as early as April. Maximum immigration of juveniles of both species occurred in February when the average water temperature was between 16.0°C and 16.2°C. Both species were taken at temperatures ranging from 10.0°C to 31.0°C. Female southern flounder were taken up to 620 mm (24.4 in) total length, while males did not exceed 320 mm (12.6 in). Female Gulf flounder were captured up to 420 mm (16.5 in) total length, but males did not exceed 290 mm (11.4 in). Small southern and Gulf flounders fed mainly on invertebrates, while the larger individuals were more piscivorous. Gulf flounder were only taken from areas where the average salinity was above 16°/oo, while southern flounder were taken at salinities ranging from 6°/oo to 36°/oo. Juveniles of both species were not taken from areas where the average turbidity was above 65 J.T.U. Juvenile southern and Gulf flounders were most abundant in areas where shoal grass (*Diplanthera wrightii*) existed in patches. In the shallow areas, adult southern flounder were most numerous over fine sediments with cord grass (*Spartina alterniflora*) along the shoreline, while adult Gulf flounder were more numerous over coarse sediments with no vegetation along the shoreline. From 1 January 1974 through 15 September 1975 a total of 34,007 kg (74,906 lb) of flounder was landed by commercial fishermen in Aransas Bay, while the sport gig fishery yielded 84,823 kg (186,834 lb).

INTRODUCTION

During the past 10 years commercial flounder landings in Texas have increased 300 percent over the previous 10 years. During the peak year of 1966, 380,100 pounds were landed in Texas. Commercial landings within individual bays along the Texas coast often show great variation from year to year. In addition an extensive sport gig fishery exists for flounder along the Texas coast. Unofficial estimates are that the sport fishery has increased similarly to the commercial fishery.

The southern flounder (*Paralichthys lethostigma*) and Gulf flounder (*P. albigutta*) are the two major species involved in the Texas flounder fishery. Knowledge concerning the life history of these two species is minimal. With an increasing commercial and sport demand, a thorough understanding of their life histories is essential for proper management.

The Aransas Bay system contains a variety of channels, flats and open bays and is typical of other areas in Texas where flounders concentrate. The area also supports both a sport and commercial flounder fishery.

PROCEDURES

Flounder samples were taken with a 1 mm (.394 in) mesh dredge seine with 1.09 m (43 in) wide mouth opening, 6.1 m (20 ft) minnow seine with 1.91 cm (¾ in) stretched mesh, 18.3 m (60 ft) minnow seine with 1.91 cm (¾ in) stretched mesh, otter trawl with 4.57 m (15 ft) wide mouth opening and 3.18 cm (1¼ in) stretched mesh, otter trawl with 13.72 m (45 ft) wide mouth opening and 6.99 cm (2¾ in) stretched mesh, gig and gill net with 8.88 cm (3½) stretched mesh and .91 m (3 ft) brails from lead line to float line. In this report the gill net will be referred to as flounder net. All seines were towed by hand for 30.5 m (100 ft). The 15 ft trawl was towed by boat for 15 minutes and the 45 ft trawl for 30 minutes. Gig stations were sampled for at least 4 hours each month and were only sampled at night. Lanterns were mounted on the front of a flat bottomed skiff to provide illumination while gigging. With the exception of flounder net stations, all stations were sampled at least once a month. Flounder net stations were only sampled during October, November and December. Forty-three sampling stations were established (Fig. 1).

A Kemmerer water sampler was used to take bottom water samples coincident with flounder samples. Water samples were tested for salinity, temperature, pH and turbidity. Water temperature was determined upon collection by centigrade thermometer. Salinity, pH and turbidity were determined immediately upon return to the laboratory with a Goldburg T/C refractometer, Photovolt meter and colorimeter, respectively.

Vegetation and sediment samples were taken with an Eckman dredge. Each sediment sample was sifted through a series of Tyler screens. Screens used included numbers 5, 10, 20, 45, 70 and 325.

All flounder captured were measured in total length. Aging was accomplished by length data analysis and by otolith analysis. Otoliths were stored dry and soaked in 50 percent glycerin for 2 hours prior to reading. Only complete and distinct rings were counted.

Flounder were tagged with Floy reinforced tags. Fish that were not tagged were analyzed in the laboratory. These individuals were weighed, stomach contents were analyzed and the stage of sexual maturity was determined as outlined in Field Methods of Fishery Biology by the Food and Agricultural Organization of the United Nations.

Data concerning the commercial flounder catch in Aransas Bay were obtained from the Texas Parks and Wildlife statistical agent. The term Aransas Bay is meant to include Lydia Ann Channel, the channel to Aransas Pass, Corpus Christi Ship Channel from Port Aransas to Marker 13, the area of Redfish Bay which lies north of the channel to Aransas Pass and Aransas Bay proper.

Surveys were conducted at least twice a month to determine the flounder harvest of the sport gig fishery. During each survey the number of sportsmen within the study area was determined. As many interviews as possible were undertaken to determine the number of hours that individuals had gigged and the number of flounder taken. During the interview flounder in possession were measured. Weights for these fish were determined from length-weight data obtained during preliminary work in 1973. Wind velocities for each night of the month were monitored. Based on preliminary work, flounderable nights were considered to be those nights for which the average wind velocity was below 15 mph. The total weight of flounder landed was estimated by the formulae:

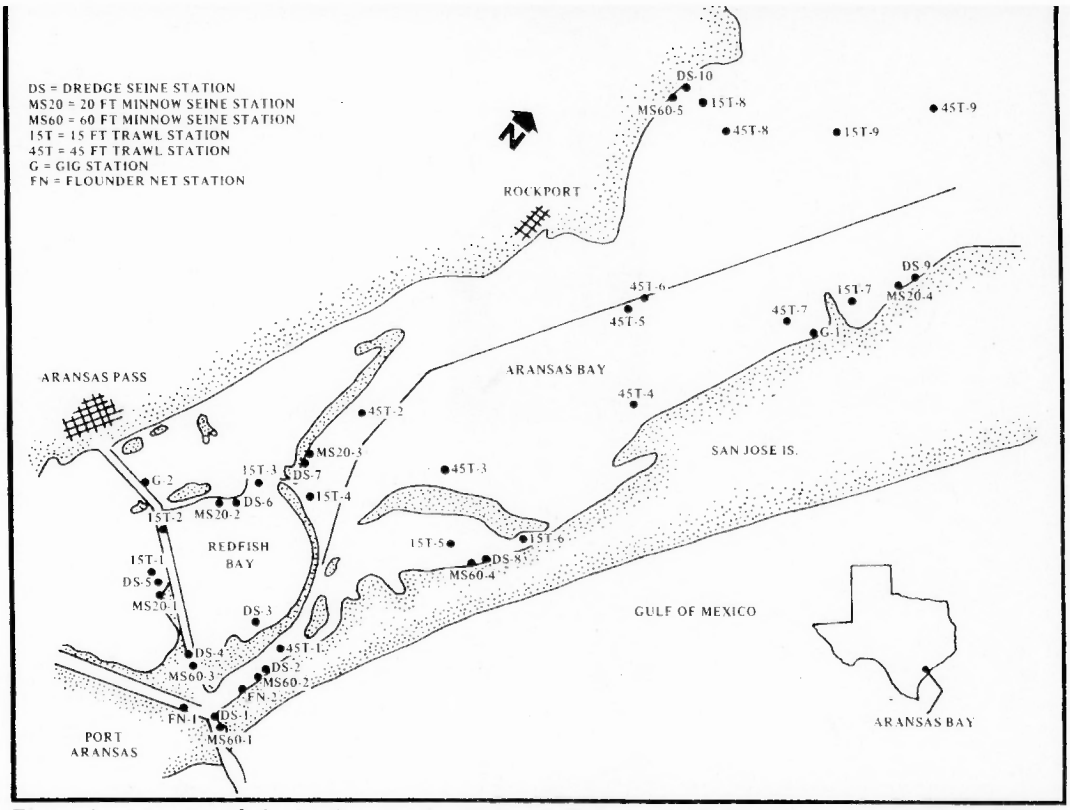

Figure 1 A map of the study area showing sampling locations. Not shown are stations DS-11 and DS-12 located in Copano Bay and St. Charles Bay, respectively.

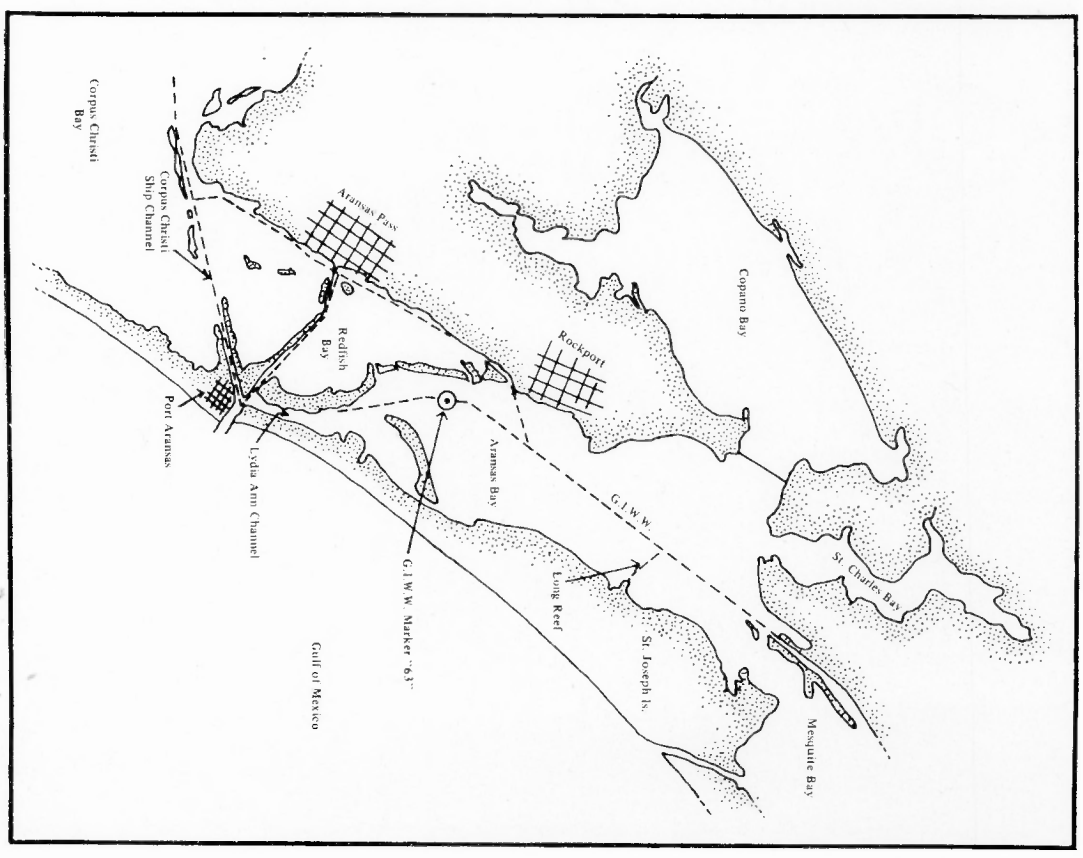

Figure 1-A Location of bays, channels and other features in study area.

Ave. No. Sportsmen X Ave. No Hours Gigged = Total Hours Gigged in Month

Total Hours Gigged in Month X Ave. No. Fish Per Hour = Total No. Fish Taken

Total No. Fish Taken X Ave. Wt. Per Fish = Total Weight Landed

No. Flounderable Nights

RESULTS AND DISCUSSION

Southern Flounder (*Paralichthys lethostigma*)

Distribution and Abundance

Adult southern flounder left Aransas Bay to spawn in the Gulf of Mexico from 16 October 1974 through 12 December 1974 (Fig. 2). Movement through the Lydia Ann and Corpus Christi Ship Channels to the pass at Port Aransas was erratic with the average number of flounder taken per hr per 100 ft of flounder net varying from 0.8 to 10. Maximum emigration was from 11 November to 14 November. During this period an average of 10 flounder per hr was taken per 100 ft. of flounder net. Male flounder were not present in the run after 25 November. During preliminary work in 1973 males were not present after October (Stokes, 1973). Simmons (1951) found emigration of male southern flounder occurred prior to that of females.

Seine samples showed that immigration of juvenile southern flounder began during February in 1974 and in January during 1975 (Fig. 3). The smallest individuals were taken by dredge seine and this device indicated that February was the month of maximum immigration during both years when 0.5 juveniles were taken per 100 ft tow in February 1974 and 1.8 in February 1975. As the juveniles increased in size they were apparently able to avoid capture by either minnow seine or dredge seine and were not taken by these methods after May 1974 or June 1975.

Dredge seine stations were more numerous and wide spread than either the 20 ft or 60 ft minnow seine stations (Tables 1 & 2) and thus gave the best data on the distributional pattern of juvenile southern flounder. During the winter when juveniles were first entering the bay, maximum numbers were caught in the pass at Port Aransas, the channel to Aransas Pass, Lydia Ann Channel and Redfish Bay (Table 1). During the winter of 1974 juveniles were not taken by dredge from any other areas, while during the winter of 1975 average numbers per 100 ft tow from the pass at Port Aransas, the channel to Aransas Pass, Lydia Ann Channel and in Redfish Bay were from 23 to 63 percent greater than the average numbers from the remaining stations. During the spring numbers decreased in the channels and at the pass and increased at stations in Redfish Bay, on the east shore of Aransas Bay and in St. Charles and Copano Bays (Table 1). Juvenile southern flounder were most numerous in Redfish Bay during the spring where average numbers per 100 ft dredge tow were 30 to 50 percent greater than from the east shore of Aransas Bay and in St. Charles and Copano Bays. Juveniles were not taken by dredge from the west shore of Aransas Bay during the spring.

The 15 ft trawl primarily captured juvenile flounder larger than those taken by seine due to the larger mesh size. Average numbers of juvenile southern flounder in 15 ft trawl samples increased throughout the spring, reached a maximum of 1.8 and 2.3 per tow during July 1974 and June 1975, respectively, and declined throughout the remainder of the summer and fall (Fig. 4). I believe this was the result of fish being able to escape the net as they became larger.

Numbers of juvenile southern flounder taken by 15 ft trawl were always greatest from stations located in Redfish Bay (Table 3). During the summer these stations yielded numbers at least 63 percent greater than averages from the rest of the stations.

The catch from the 45 ft trawl was primarily composed of adult flounder because of the large mesh used (2¾ in stretched mesh). Immigration of adult southern flounder from the Gulf of Mexico was first detected during April in

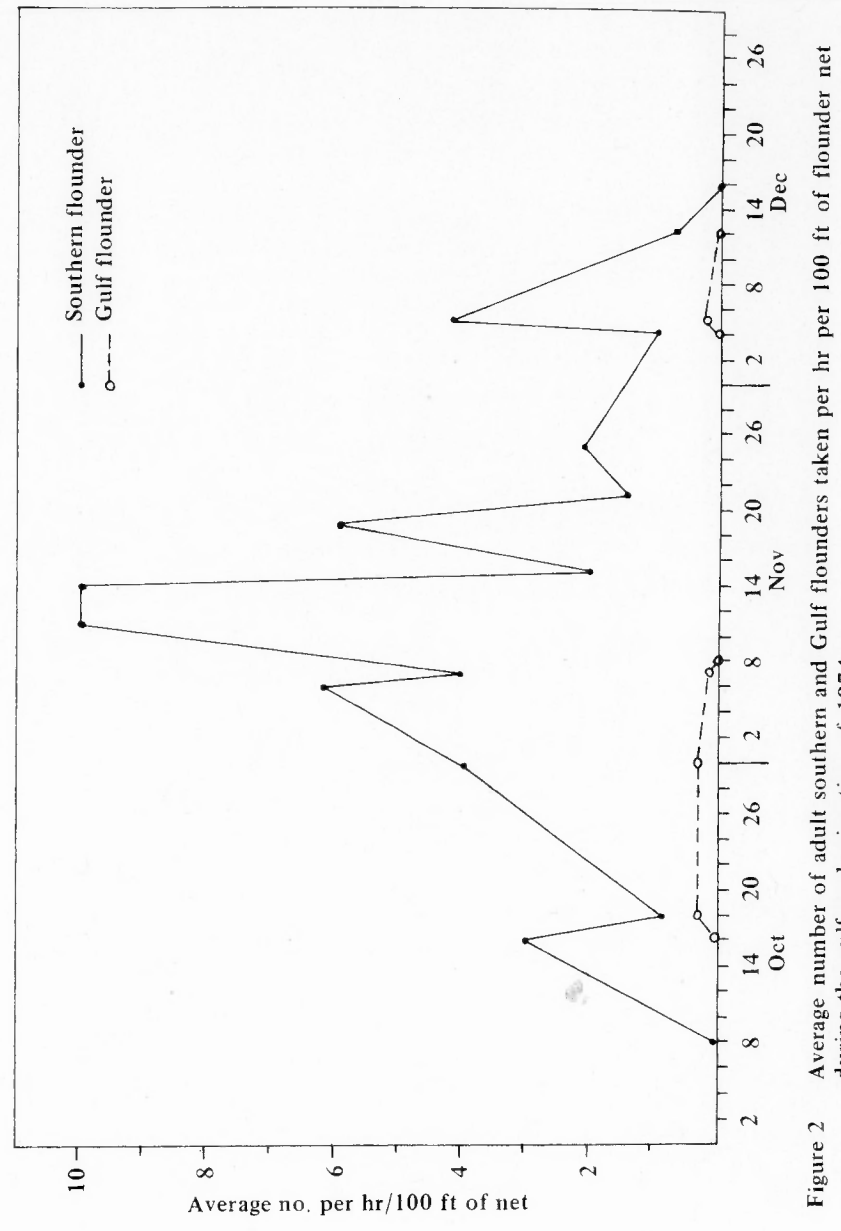

Figure 2 Average number of adult southern and Gulf flounders taken per hr per 100 ft of flounder net during the gulfward migration of 1974.

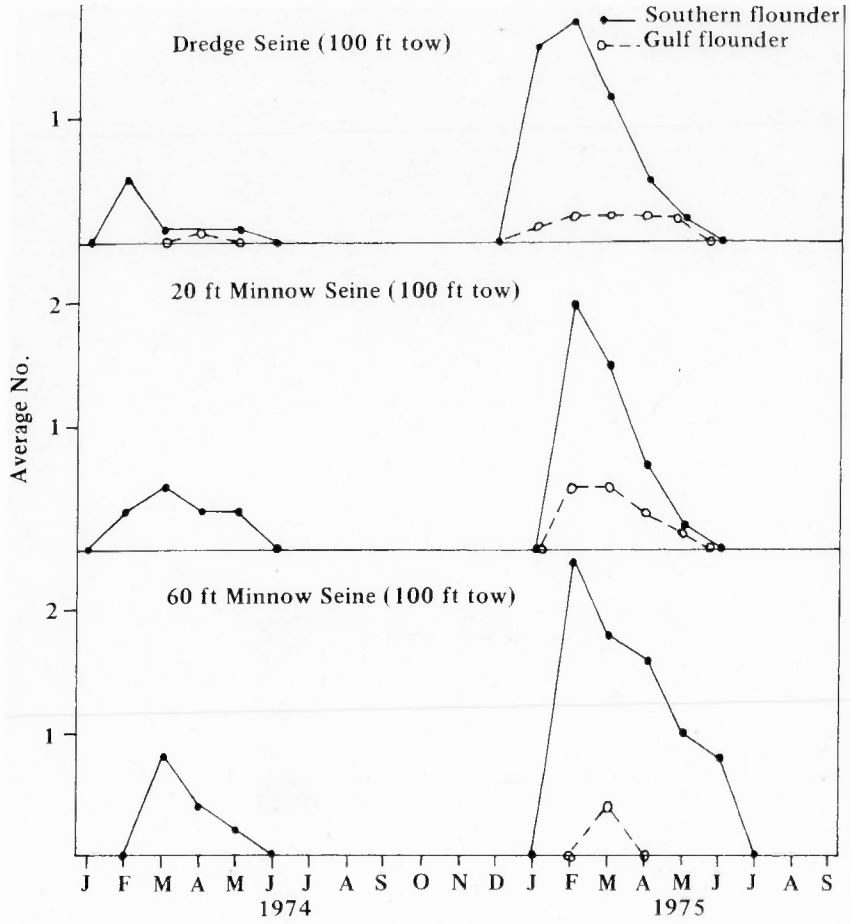

Figure 3 Average number of juvenile southern and Gulf flounders taken by seine each month.

1974 and in February in 1975 (Fig. 4). As a result of continuing immigration, numbers increased through June of both years. Catches of 7.2 and 9.0 fish per tow were recorded in June 1974 and June 1975, respectively. As a result of emigration to the Gulf, the average number per tow dropped to 5.2 in October 1974. This decline continued through January 1975 when the average catch was 1.8.

During the summer, adult southern flounder were taken in greatest numbers from the 45 ft trawl stations bordering Mud Island and San Jose Island (Table 4). Average numbers from these stations at that time were at least 27 percent greater than averages from the remaining stations. In fall samples, the averages from stations 45T-1, 45T-2 and 45T-3 (stations located nearest to the pass at Port Aransas) were at least 46 percent greater than those from the rest of the 45 ft trawl stations. During winter, catches were highest at stations located in the middle of Aransas Bay. These stations are along the edge and in the middle of the Gulf Intracoastal Waterway. Average

Table 1 Average number of juvenile southern flounder taken per 100 ft tow by dredge seine at each station during seasonal periods. (n = number of times each station sampled)

Station	Winter		Spring		Summer		Fall	
	1974 n=2	1975 n=3	1974 n=3	1975 n=3	1974 n=3	1975 n=3	1974 n=3	1975 n=1
DS-1	0.5	1.3	0.0	0.3	0.0	0.0	0.0	0.0
DS-2	0.3	1.3	0.0	0.3	0.0	0.0	0.0	0.0
DS-3	0.3	2.7	0.3	1.0	0.0	0.0	0.0	0.0
DS-4	0.5	1.7	0.3	1.0	0.0	0.0	0.0	0.0
DS-5	0.7	2.7	0.3	1.3	0.0	0.0	0.0	0.0
DS-6	0.7	1.7	0.3	1.0	0.0	0.0	0.0	0.0
DS-7	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0
DS-8	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0
DS-9	0.0	1.0	0.0	0.6	0.0	0.0	0.0	0.0
DS-10	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0
DS-11	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0
DS-12	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0

Table 2 Average number of juvenile southern flounder taken per 100 ft tow by 60 ft and 20 ft minnow seines at each station during seasonal periods. (n = number of times each station sampled)

Station	Winter		Spring		Summer		Fall	
	1974 n=2	1975 n=3	1974 n=3	1975 n=3	1974 n=3	1975 n=3	1974 n=3	1975 n=1
MS60-1	0.0	1.3	0.3	1.7	0.0	0.3	0.0	0.0
MS60-2	0.0	1.1	0.3	1.7	0.0	0.3	0.0	0.0
MS60-3	0.0	1.3	0.3	1.3	0.0	0.3	0.0	0.0
MS60-4	0.0	0.4	1.2	2.7	0.0	0.3	0.0	0.0
MS60-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MS20-1	0.5	1.0	0.7	1.7	0.0	0.0	0.0	0.0
MS20-2	0.0	1.0	0.7	1.0	0.0	0.0	0.0	0.0
MS20-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MS20-4	0.0	0.7	0.0	0.7	0.0	0.0	0.0	0.0

Table 3 Average number of southern flounder taken per 15 min tow by 15 ft trawl at each station during seasonal periods. (n = number of times each station sampled)

Station	Winter		Spring		Summer		Fall	
	1974 n=2	1975 n=3	1974 n=3	1975 n=3	1974 n=3	1975 n=3	1974 n=3	1975 n=1
15T-1	1.3	0.3	2.0	2.7	5.0	5.3	0.7	5.0
15T-2	5.0	2.3	2.0	5.7	3.3	7.3	1.3	4.0
15T-3	0.0	0.0	1.0	1.0	0.7	1.3	0.0	1.0
15T-4	0.0	0.0	0.7	0.7	0.7	0.3	0.3	0.0
15T-5	0.0	0.0	0.3	0.3	0.3	0.7	0.3	0.0
15T-6	0.0	0.0	0.3	0.0	0.3	0.7	0.0	0.0
15T-7	0.0	0.0	0.3	0.3	1.0	1.0	0.3	0.0
15T-8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15T-9	0.7	0.0	1.7	0.3	1.0	2.7	0.3	1.0

numbers from these deeper areas during the winter were at least 42 percent greater than averages from other stations.

Only adult flounder were taken by gig. As with the 45 ft trawl samples, increases in the number of southern flounder taken per hr by gig during April 1974 and February 1975 marked the beginning of immigration of adults from the Gulf. In 1974 the average number taken per hr by gig rose from 2.5 in May to 4.5 in April, while in 1975 it rose from 3.0 per hr in January to 3.5 per hr in February (Fig. 5). It continued to rise through June of both years as a result of immigration. In June 1974 the average catch by gig was 6.5 southern flounder per hr while during June 1975 the average was 6.0. From June 1974 through November 1974 and from June 1975 through September 1975, the last month of sampling, the catch fluctuated only slightly. Emigration of adults to the Gulf for spawning caused the average to drop from 6.0 in November to 3.0 in December.

Adult southern flounder were taken in greater numbers from the gig station located on the east shore of Aransas Bay than from the station located in the channel to Aransas Pass (Table 5). On the east shore of Aransas Bay, southern flounder were most numerous in summer averaging 9.0 fish per hr. In the channel to Aransas Pass southern flounder were taken in greatest numbers by gig during the fall with average catches of 4.0 per hr both years.

Age, Length and Weight

Southern flounder ranged from 10 mm (0.4 in) to 620 mm (24.4 in) in total length (Fig. 6). Males grew slower than females and did not exceed 320 mm (12.6 in). Smith (1969) and Murawshi (1970) indicate that male summer flounder (*Paralichthys dentatus*) grow slower than females. Length data indicated 3 age classes of male and 5 age classes of female southern flounder (Fig. 6). Males in their first year ranged from 10 mm (0.4 in) to 230 mm (9.1 in). Those in their second year were from 231 mm (9.1 in) to 280 mm (11.0 in) and their third year they ranged from 281 mm (11.1 in) to 320 mm (12.6 in). Length intervals for females were 10 mm (0.4 in) to 300 mm (11.8 in) for the first year fish, 301 mm (11.9 in) to 450 mm (17.7 in) for second year fish, 451 mm (17.8 in) to 530 mm (20.9 in) for females in their third year, 531 mm (20.9 in) to 570 mm (22.4 in) for the fourth year and 571 mm (22.5 in) to 620 mm (24.4 in) for females in their fifth year. The fact that males

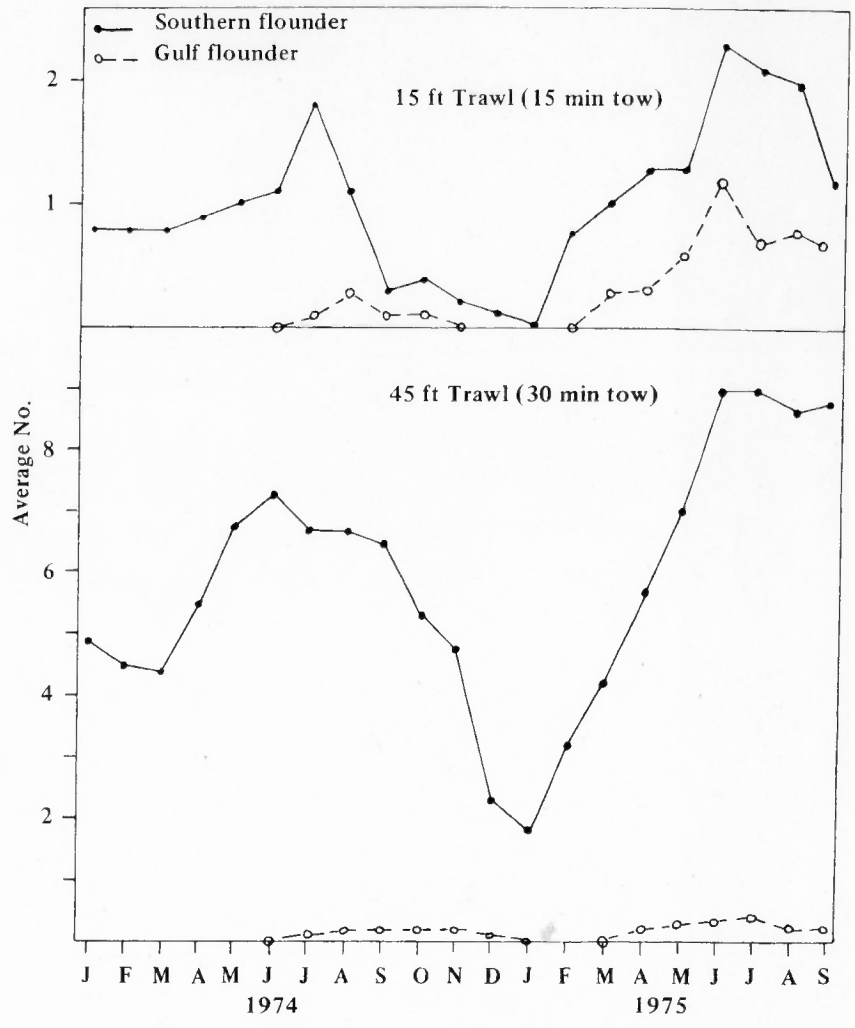

Figure 4 Average number of southern and Gulf flounders taken by trawl each month.

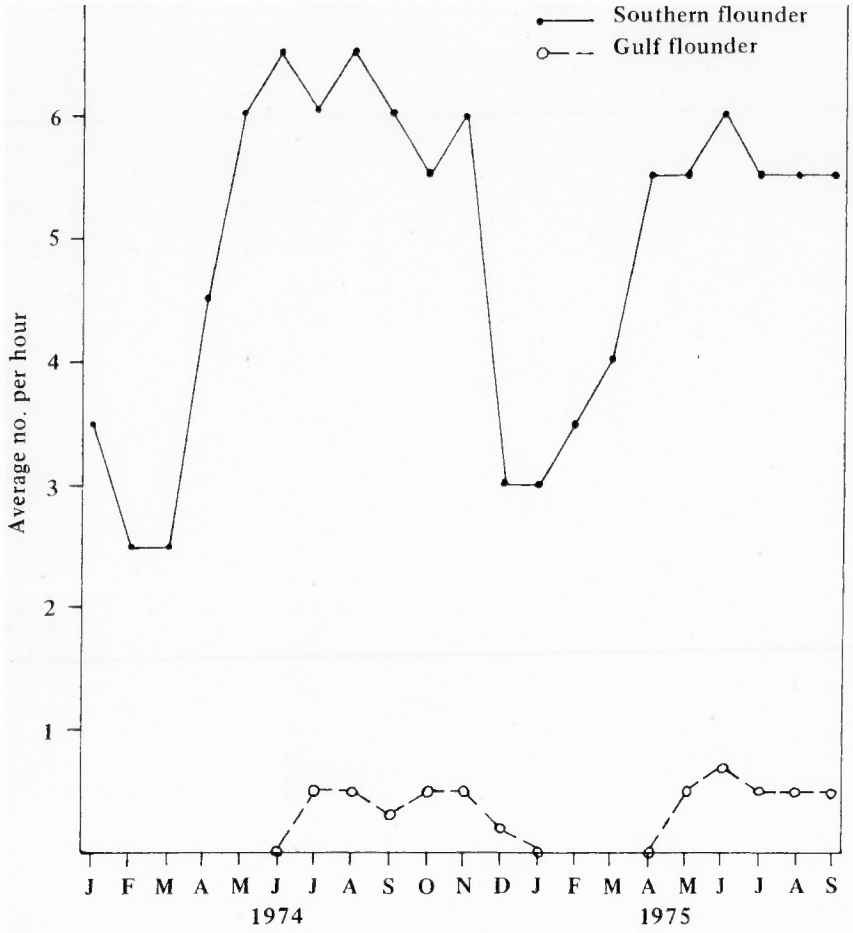

Figure 5 Average number of adult southern and Gulf flounders taken per hr by gig each month.

older than three years old were not caught indicates that either they spend the later part of their life in the Gulf, or that they die after their third year of life. One tag return indicated that the first possibility may be correct.

Southern flounder otoliths are oval and slightly concave. They have an opaque central core and concentric hyaline bands which are separated by narrow opaque rings. The hyaline zones are broad and probably represent growth during the warmer months, while the opaque rings are narrow and apparently represent winter growth. Southern flounder appeared to lay down one ring on their otoliths at the completion of each year of growth (Table 6). Fish that were classified as being in their first, second, third, fourth and fifth years of life had 0, 1, 2, 3, and 4 rings, respectively. Otolith readings also indicated that the length intervals suggested by length data for each age class are only approximate. Some apparently fast or slow growing individuals do not necessarily fit into these intervals.

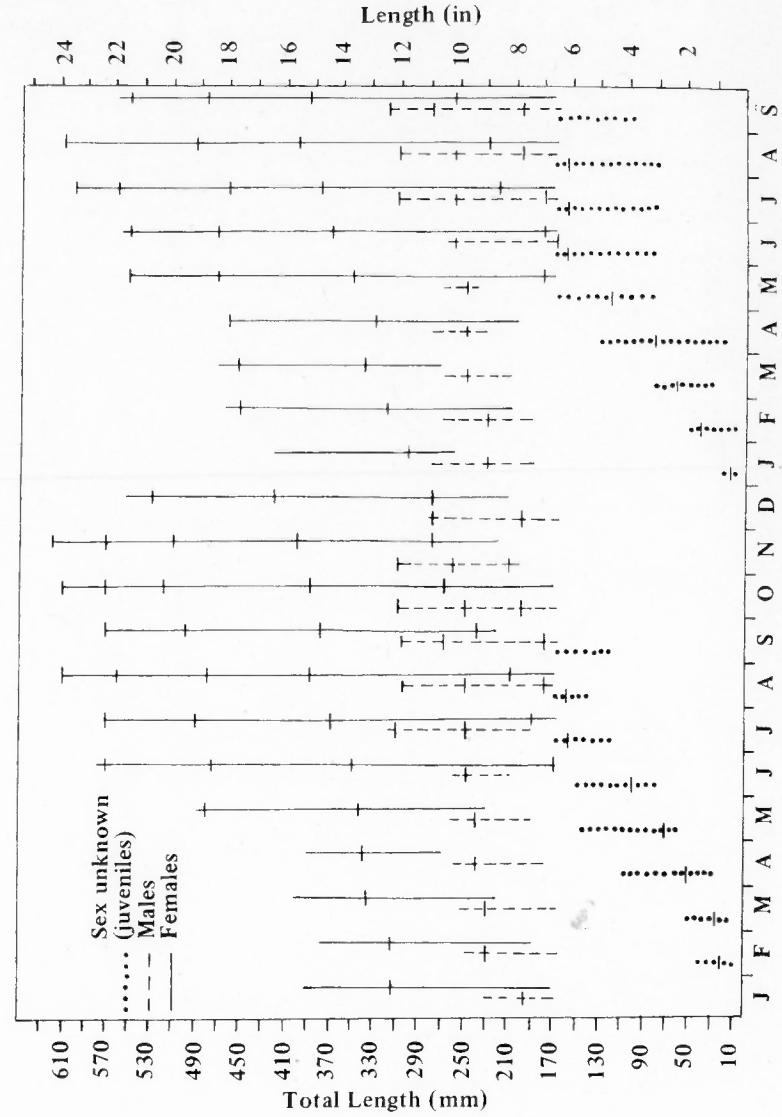

Figure 6 Length ranges and modes for southern flounder during each sampling period.

Table 4 Average number of southern flounder taken per 30 min tow by 45 ft trawl at each station during seasonal periods. (n = number of times each station sampled)

Station	Winter		Spring		Summer		Fall	
	1974 n=2	1975 n=3	1974 n=3	1975 n=3	1974 n=3	1975 n=3	1974 n=3	1975 n=1
45T-1	4.5	0.7	5.0	3.3	5.0	2.0	12.0	1.0
45T-2	0.5	1.3	4.7	7.3	5.7	2.3	9.3	2.0
45T-3	2.0	2.3	6.3	5.7	9.3	17.3	9.3	9.0
45T-4	2.0	2.7	5.0	8.0	8.7	18.0	4.7	16.0
45T-5	12.5	5.7	5.7	5.7	5.7	2.3	5.0	4.0
45T-6	16.5	6.0	5.0	4.3	6.3	3.7	3.7	5.0
45T-7	0.5	0.7	6.0	6.3	9.4	20.7	3.0	20.0
45T-8	2.5	2.3	6.0	4.7	6.3	4.7	2.0	6.0
45T-9	1.5	3.3	4.7	5.3	6.3	9.0	1.3	9.0

Table 5 Average number of southern flounder taken per hr by gig at each station during seasonal periods. (n = number of times each station sampled)

Station	Winter		Spring		Summer		Fall	
	1974 n=2	1975 n=3	1974 n=3	1975 n=3	1974 n=3	1975 n=3	1974 n=3	1975 n=1
G-1	2.0	4.3	5.7	7.3	9.0	9.0	7.7	9.0
G-2	3.5	2.0	3.0	2.7	3.7	2.3	4.0	4.0

Weights of captured southern flounder varied from less than .001 kg to 3.9 kg (8.6 lb) (Fig. 7). Males and females of equal size had similar weights. Upper weights for females in their first, second, third, fourth and fifth years of life were 0.3 kg (.66 lb), 1.15 kg (2.53 lb), 2.0 kg (4.4 lb), 2.6 kg (5.7 lb) and 3.9 kg (8.6 lb), respectively. Upper weights for males in their first, second and third years of life were .15 kg (.33 lb), .22 kg (.48 lb) and .36 kg (.79 lb), respectively.

Tag returns were too few and the measurements, submitted by sport and commercial fishermen, were considered to be too inaccurate to use as indicators of growth.

Sexual Development

Sexual differentiation became possible when the fish were approximately 170 mm (6.7 in) long. Southern flounder smaller than 170 mm were classified as stage 0 (no gonads apparent). They progressed from stage 0 through stage I (immature) and into stage II (maturing) during their first year of life. Stage II was also used to designate recovering spent fish. From January through

Table 6 Frequency of rings on otoliths of southern flounder.

Length Interval (mm)	No. Rings Female					Male		
	0	1	2	3	4	0	1	2
161-180	12					8	2	
181-200	2					10	3	
201-220	4					5	3	
221-240	7	1				3	5	
241-260	3	1				3	23	
261-280	2	3				1	21	1
281-300	6	3					3	2
301-320	2	6						9
321-340		4						
341-360		12	1					
361-380		13						
381-400		6	2					
401-420		7	2					
421-440		6	2					
441-460		3	4					
461-480		1	6	1				
481-500			7					
501-520			7	1				
521-540			2	3				
541-560			1	9				
561-580				5				
581-600					1			
601-620					4			

mid-September all adult southern flounder showed stage II development. Adults showing stage III development (developing) began to enter the catch during mid-September. Southern flounder which were captured as they moved through the channels to the Gulf from October through December showed stage IV (developed) and V (gravid) development. They became gravid for the first time at 2 years of age. Those adults which did not migrate to the Gulf during fall and winter showed no development and remained in a stage II condition. This indicates that virtually all spawning occurs in the Gulf.

Movements

A total of 1,298 southern flounder were tagged and 28 (2.2 percent) were recaptured.

Tagging in Lydia Ann Channel and the Corpus Christi Ship Channel during the gulfward spawning migration of 1974 showed that movement through the pass at Port Aransas was erratic (Table 7). Six southern flounder were taken in the pass from .5 to 1 day later and were presumed to be moving to the Gulf. However, 3 others were recaptured in the channels leading to the pass, near the release site, from 1 to 13 days later indicating slow movement for these individuals. One southern flounder was recaptured in the Gulf on 17 November in 1 fathom (6 ft) straight off Port Aransas and had probably just moved through the pass. Two others were recovered straight off Port Aransas

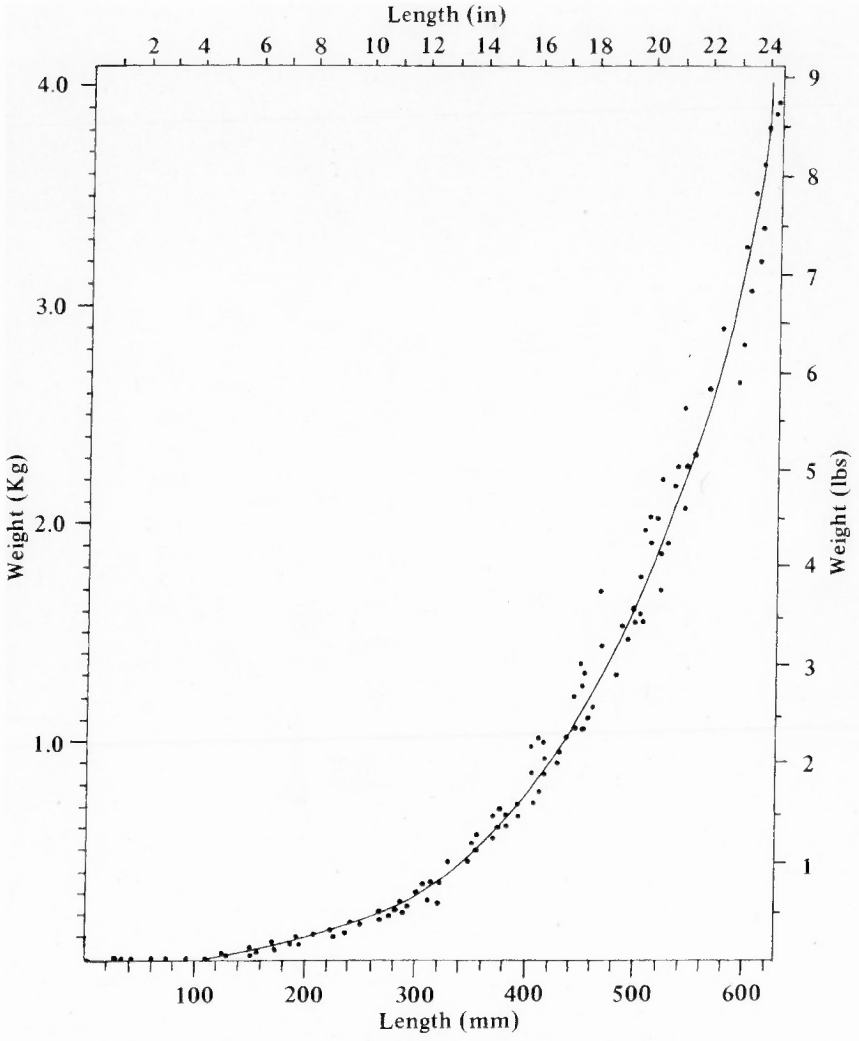

Figure 7 The length-weight relationship of southern flounder.

in 18 fathoms (108 ft) and 34 fathoms (204 ft). Another, taken in the Gulf just outside the Mustang Island Pass, 13 miles south of Port Aransas, on 15 February 1975 may have been on its way back into the bays. One more was recaptured in the Gulf. This individual was a 3 year old male and was caught in 10 fathoms (60 ft) in July 1975 48 miles northeast of Port Aransas. As previously mentioned, it is probable that the older males spend the later part of their life in the Gulf and do not return to the bays. This tag return indicates that this might be the case since bay sampling had indicated that adults had moved back into the bays during the preceeding spring.

In November 1974 a tagged southern flounder was recovered at 36 fathoms (216 ft) 280 miles east of Port Aransas and 80 miles south southwest of Morgan City, Louisiana. I had tagged this fish in the Lydia Ann Channel

Table 7 Recoveries of southern flounder tagged in the Lydia Ann Channel and Corpus Christi Ship Channel during the gulfward migration of 1974.

Tagged		Recovered		Movement Airline	
Date	Location	Date	Location	Miles	Days
10-17-74	Corpus Christi Ship Channel	10-22-74	Corpus Christi Ship Channel	.25	5
11-6-74	Corpus Christi Ship Channel	11-7-74	Corpus Christi Ship Channel	0	1
11-6-74	Corpus Christi Ship Channel	11-29-74	Gulf of Mexico, in 18 fathoms SSE of Port Aransas	15.2	23
11-6-74	Corpus Christi Ship Channel	2-15-74	Gulf of Mexico, in 1 fathom just outside fish pass 13 miles south of Port Aransas	13	70
11-6-74	Corpus Christi Ship Channel	11-7-74	Pass at Port Aransas	.5	1
11-7-74	Corpus Christi Ship Channel	11-17-74	Gulf of Mexico in 1 fathom straight off Port Aransas	1.3	10
11-14-74	Corpus Christi Ship Channel	11-19-74	Pass at Port Aransas	.5	5
11-15-74	Corpus Christi Ship Channel	11-22-74	Pass at Port Aransas	.5	7
11-19-74	Lydia Ann Channel	12-2-74	Lydia Ann Channel	.25	13
11-21-74	Lydia Ann Channel	11-21-74	Pass at Port Aransas	.25	.5
11-21-74	Lydia Ann Channel	12-15-74	Gulf of Mexico, in 35 fathoms SSE of Port Aransas	30	24
11-25-74	Lydia Ann Channel	11-25-74	Pass at Port Aransas	.25	.5
12-5-74	Lydia Ann Channel	7-3-75	Gulf of Mexico, in 10 fathoms NE of Port Aransas (off Port O'Connor)	48	210
12-5-74	Corpus Christi Ship Channel	12-5-74	Pass at Port Aransas	.5	.5

Table 8 Recoveries of southern flounder tagged in the Aransas Bay system (not including those tagged in the Lydia Ann and Corpus Christi Ship Channels).

Tagged		Recovered		Movement		
Date	Location	Date	Location	Airline Miles	Days	Direction
2-6-74	Aransas Bay, Rockport Marine Laboratory	2-19-74	Aransas Bay, Marker 41	2.25	13	E
2-6-74	Aransas Bay, Rockport Marine Laboratory	6-14-74	West shore, Aransas Bay, 1 mile South of Marine	.90	128	S
4-30-74	Redfish Bay	5-22-74	Corpus Christi Bay, 1 mile South of Marker 27	7.25	22	SW
5-21-74	North shore of Aransas Bay at Blackjack Point	6-3-74	Aransas Bay, Marker 19	2.5	13	S
5-21-74	Aransas Bay at Long Reef	7-7-74	Aransas Bay, 0.5 miles North of Allyn's Bight	4.0	47	SSW
7-15-74	Aransas Bay, Marker 43	7-18-74	Aransas Bay, off Live Oak Point	5.75	3	N
9-16-74	Aransas Bay, Allyn's Bight	4-6-75	Copano Bay Causeway	8.75	212	NNW
10-7-74	Aransas Bay, Fulton Beach	11-3-74	Aransas Bay, Fulton Beach	0	27	
10-10-74	North shore of Aransas Bay at Blackjack Point	3-13-75	San Antonio Bay	11.3	154	NE
4-11-75	Aransas Bay, Fulton Beach	6-8-75	Aransas Bay, Marker 37	2.75	58	ESE
4-22-75	Aransas Bay, Rockport Marine Laboratory	5-1-75	Aransas Bay, Marker 46	2.0	9	ESE
6-12-75	Aransas Bay, Allyn's Bight	7-15-75	Aransas Bay, East side of Mud Island	3.25	33	SSW
6-12-75	Aransas Bay, Allyn's Bight	9-7-75	North shore of Aransas Bay at Dunham Point	8.0	87	N
7-15-75	Aransas Shrimp Channel Marker 12	8-14-75	Aransas Shrimp Channel, Marker 2	5.0	30	ESE

during preliminary work in November 1973 (Stokes, 1973). This recovery and the individual recaptured 48 miles northeast of Port Aransas indicates considerable movement to the east and northeast for some of the southern flounder leaving Aransas Bay.

Movement of southern flounder between and within bays was indicated by tag returns (Table 8). There was no consistent pattern to this activity. Returns showed travel of from 0 to 11.3 miles with time free varying from 3 to 212 days. Only one fish showed no movement. The fastest movement within Aransas Bay was 5.75 miles in 3 days. Two southern flounder tagged within the Aransas Bay system were recaptured in other bays. One fish tagged in Redfish Bay was recovered in Corpus Christi Bay, while another tagged in Aransas Bay was recovered in San Antonio Bay.

Food

Ninety five percent of the food items found in the stomachs of small southern flounder (fish 10 mm to 150 mm long) were invertebrates (Table 9). Mysids were the most frequently found item in the stomachs of these smaller fish and accounted for 32 percent of the invertebrates. Diener, Inglis and Adams (1974) found that southern flounder less than 160 mm long fed mainly on invertebrates.

Larger southern flounder (fish in excess of 150 mm long) fed mainly on fish (Table 9) with 70 percent of the food items being fish. The most frequently occurring fish items were *Anchoa* sp., clupeids (*Brevoortia* sp. and unidentified), sciaenids (*Micropogon undulatus* and unidentified), *Mugil* sp. and unidentified fish remains, and these comprised 73 percent of the fish items found in the stomachs of the larger southern flounder. For southern flounder in excess of 150 mm long penaeid shrimp were the most frequently found invertebrate.

Gulf Flounder (*Paralichthys albigutta*)

Distribution and Abundance

Fewer Gulf flounder were captured than southern flounder and they never accounted for over 5 percent of the total flounder catch during any one month.

Flounder net samples indicated that this species moved to the Gulf of Mexico for spawning from 18 October 1974 through 7 November 1974 and again on 5 December 1974 (Fig. 2). Average catches of 0.1 to 0.3 fish per hr per 100 ft of net were recorded during these periods.

Juveniles were scarce in 1974 and were only taken by seine during April at an average of 0.1 per 100 ft dredge seine tow (Fig. 3). In 1975 immigration of juveniles began in January and reached a maximum in February when averages of 0.2 fish per 100 ft dredge seine tow and 0.5 per 100 ft tow by 20 ft minnow seine were recorded. Juvenile Gulf flounder were only taken from seine stations located south of Marker 63 (Tables 10 & 11).

With continued growth, juvenile Gulf flounder began to appear in 15 ft trawl samples and were present July through October 1974 and March through September (end of sampling) 1975 (Fig. 4). In 1974 the maximum number per 15 ft trawl drag occurred in August when 0.3 per 15 min tow were taken. June was the month of greatest abundance at 15 ft trawl stations in 1975 when an average of 1.2 juveniles per 15 min tow were captured.

Gulf flounder were only taken by 15 ft trawl from the channel to Aransas Pass, Redfish Bay and from the station just outside Redfish Bay at the mouth of Corpus Christi Bayou (Table 12). During the summer the average number from these areas ranged from 0.3 to 3.7 per 15 min tow.

Table 9 Stomach contents of 626 southern flounder[1].

Prey	Frequency of Occurrence 10 mm to 150 mm flounder	151 mm plus flounder
Invertebrates		
Acetes sp.	33	1
Sergestidae	21	3
Mysidacea	71	
Cumacea	13	
Ostracoda	6	
Copepoda	5	
Amphipoda	18	
Euphausiacea	7	
Isopoda		1
Polychaete larvae	3	
Penaeus sp.	22	50
Crangon sp.		1
Crab zoea	11	
Crab megalops	15	
Callinectes sapidus	2	14
Xiphopeneus kroyeri		1
Squilla empusa		1
Loligo sp.		3
Total Invertebrates	227	75
Fish		
Larval Fish	3	
Anchoa sp.		22
Brevoortia sp.		14
Opisthonema oglinum		1
Clupeidae (unidentified)		12
Micropogon undulatus		11
Cynoscion nebulosus		2
Sciaenops ocellata		1
Leiostomus xanthurus		2
Sciaenidae (unidentified)		23
Triglidae (unidentified)	1	
Mugil sp.	3	21
Orthopristis chrysoptera		3
Lagodon rhomboides		9
Atherinidae (unidentified)		4
Synodontidae (unidentified)		1
Gobiidae (unidentified)		1
Gerreidae (unidentified)		1
Cyprinodon variegatus	1	2
Unidentified fish remains	5	48
Total Fish	13	178

[1] 242 stomachs contained identifiable items, 283 were empty and 101 contained only digested matter that was totally unidentifiable.

Table 10 Average number of juvenile Gulf flounder taken per 100 ft tow by dredge seine at each station during seasonal periods. (n = number of times each station sampled)

Station	Winter		Spring		Summer		Fall	
	1974 n=2	1975 n=3	1974 n=3	1975 n=3	1974 n=3	1975 n=3	1974 n=3	1975 n=1
DS-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DS-2	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0
DS-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DS-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DS-5	0.0	0.7	0.0	0.3	0.0	0.0	0.0	0.0
DS-6	0.0	0.0	0.3	1.4	0.0	0.0	0.0	0.0
DS-7	0.0	0.0	0.4	0.7	0.0	0.0	0.0	0.0
DS-8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DS-9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DS-10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DS-11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DS-12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 11 Average number of juvenile Gulf flounder taken per 100 ft tow by 60 ft and 20 ft minnow seines at each station during seasonal periods. (n = number of times each station sampled)

Station	Winter		Spring		Summer		Fall	
	1974 n=2	1975 n=3	1974 n=3	1975 n=3	1974 n=3	1975 n=3	1974 n=3	1975 n=1
MS60-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MS60-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MS60-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MS60-4	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
MS60-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MS20-1	0.0	0.7	0.0	0.3	0.0	0.0	0.0	0.0
MS20-2	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0
MS20-3	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
MS20-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 12 Average number of Gulf flounder taken per 15 min tow by 15 ft trawl at each station during seasonal periods. (n = number of times each station sampled)

Station	Winter		Spring		Summer		Fall	
	1974 n=2	1975 n=3	1974 n=3	1975 n=3	1974 n=3	1975 n=3	1974 n=3	1975 n=1
15T-1	0.0	0.0	0.0	0.7	0.3	1.0	0.0	0.0
15T-2	0.0	0.0	0.0	0.0	0.3	0.3	0.0	0.0
15T-3	0.0	0.0	0.0	1.3	0.3	3.3	0.0	3.0
15T-4	0.0	0.0	0.0	1.7	0.7	3.7	0.3	3.0
15T-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15T-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15T-7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15T-8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15T-9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Immigration of adult Gulf flounder was indicated when the average number per 30 min tow by 45 ft trawl rose from 0 to 0.1 in July 1974 and from 0 to 0.2 in April 1975 (Fig. 4). Emigration was indicated when the average number per 30 min tow dropped from 0.2 in November 1974 to 0.1 in December and finally to 0 in January 1975.

At the 45 ft trawl stations adult Gulf flounder were only taken from stations 45T-1, 45T-2 and 45T-3 (Table 13). All of these stations lie south of Marker 63 and are the closest stations to the pass at Port Aransas.

Increases in the average number of Gulf flounder taken per hr by gig in July 1974 and March 1975 coincided with immigration of adults from the Gulf (Fig. 5). The average number per hr increased from 0 to 0.5 in both months. A decrease in the average number per hr from 0.5 in November 1974 to 0 in January 1975 was the result of emigration of adults to the Gulf for spawning.

Adult Gulf flounder were taken by gig from the channel to Aransas Pass during all periods except winter and spring of 1974 (Table 14). Excluding this period, the average number per gig hour from the channel to Aransas Pass ranged from 0.2 to 1.0. The species was not taken from the gig station located on the east shore of Aransas Bay near Long Reef except during the summer of 1975.

Age, Length and Weight

Gulf flounder ranged from 10 mm (0.4 in) to 420 mm (16.5 in) in total length (Fig. 8). Males grew slower than females and the largest males taken did not exceed 290 mm (11.4 in) in length. Length data showed that there were two age classes of male and three age classes of female Gulf flounder (Fig. 8). The species was found primarily in those areas located close to the pass at Port Aransas, and it is probable that fish in excess of 2 or 3 years of age reside exclusively in the Gulf of Mexico. Males in their first year ranged from 10 mm (0.4 in) to 220 mm (8.7 in) in length, while those in their second year were from 221 mm (8.7 in) to 290 mm (11.4 in). Length intervals for females were 10 mm (0.4 in) to 290 mm (11.4 in) for first year fish, 291 mm (11.5 in) to 360 mm (14.2 in) for second year fish, and 361 mm (14.2 in) to 420 mm (16.5 in) for females in their third year.

Otoliths from Gulf flounder were very similar in appearance to those

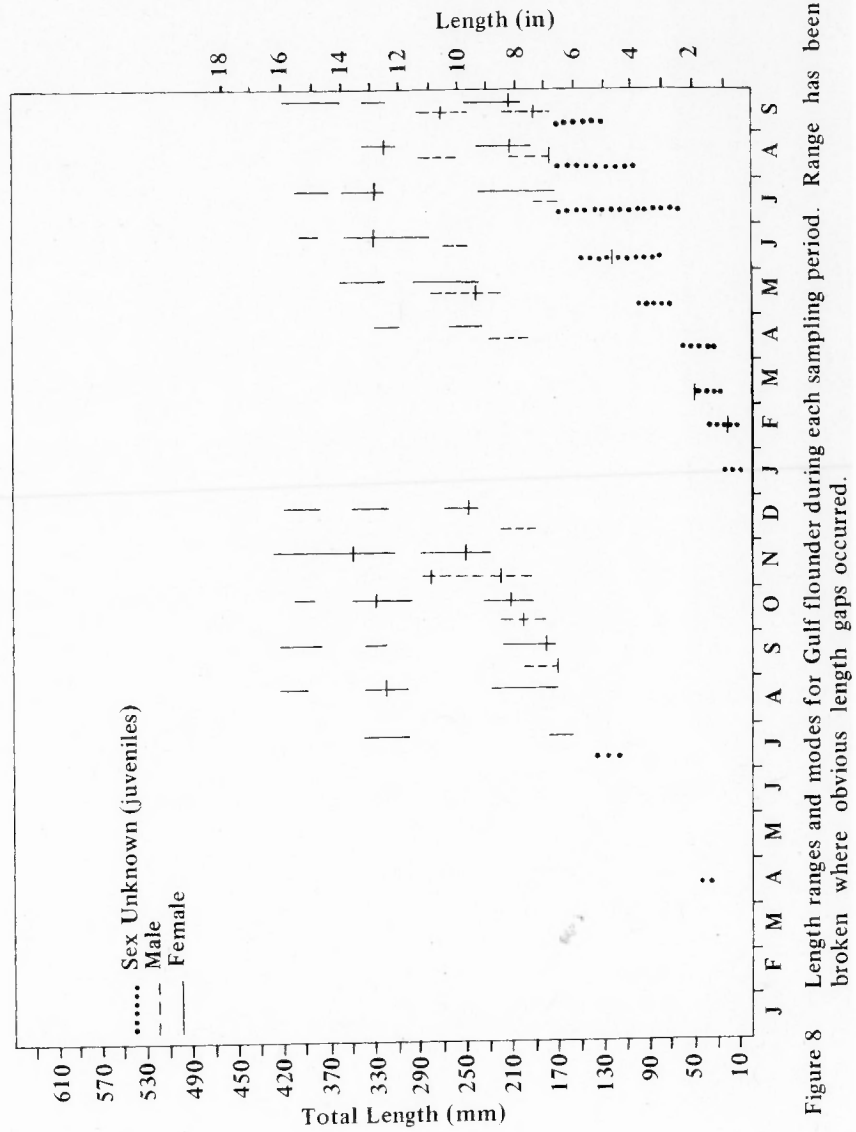

Figure 8 Length ranges and modes for Gulf flounder during each sampling period. Range has been broken where obvious length gaps occurred.

Table 13 Average number of Gulf flounder taken per 30 min tow by 45 ft trawl at each station during seasonal periods. (n = number of times each station sampled)

Station	Winter		Spring		Summer		Fall	
	1974 n=2	1975 n=3	1974 n=3	1975 n=3	1974 n=3	1975 n=3	1974 n=3	1975 n=1
45T-1	0.0	0.3	0.0	0.0	0.0	0.0	1.0	0.0
45T-2	0.0	0.0	0.0	1.7	0.7	2.3	1.0	1.0
45T-3	0.0	0.0	0.0	0.0	0.3	0.7	0.3	1.0
45T-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45T-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45T-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45T-7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45T-8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45T-9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 14 Average number of Gulf flounder taken per hr by gig at each station during seasonal periods. (n = number of times each station sampled)

Station	Winter		Spring		Summer		Fall	
	1974 n=2	1975 n=3	1974 n=3	1975 n=3	1974 n=3	1975 n=3	1974 n=3	1975 n=1
G-1	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0
G-2	0.0	0.2	0.0	0.3	0.7	1.0	0.8	1.0

Table 15 Frequency of rings on otoliths of Gulf flounder.

Length Interval (mm)	No. Rings				
	Female			Male	
	0	1	2	0	1
161-180	4			6	
181-200	2			5	
201-220	2			9	3
221-240	4			3	7
241-260	6			2	10
261-280	2	1			6
281-300	2	2			3
301-320		8			
321-340		10			
341-360		10	1		
361-380		1	1		
381-400		1	7		
401-420			5		

from southern flounder. Otolith readings indicated that Gulf flounder laid down one ring on their otoliths at the completion of each year of growth (Table 15). Fish that were classified as being in their first, second and third years of life had 0, 1 and 2 rings, respectively. As with southern flounder, the otoliths from Gulf flounder showed that the length intervals, derived from length data, for each age class are merely approximations, and that some apparently fast or slow growing fish do not fit into these intervals.

Weights of Gulf flounder were from less than .001 kg to 1.01 kg (2.2 lb) (Fig. 9). Males and females of equal size had similar weights. Upper weights for females in their first, second and third years of life were .27 kg (.6 lb), .57 kg (1.26 lb) and 1.01 kg (2.2 lb), respectively. Upper weights for males in their first and second years were .15 kg (.33 lb) and .27 kg (.6 lb).

Sexual Development

The pattern of sexual development for Gulf flounder was identical to that for southern flounder. They progressed from stage 0 (no gonads apparent) through stage I (immature) and into stage II (maturing) during their first year of life. From January to mid-September all adults showed stage II. By mid-September adults showing stage III development (developing) began to enter the catch. Adults moving through the channels to the Gulf from October through December showed stage IV (developed) and V (gravid) development. Topp and Hoff (1972) indicate that Gulf flounder spawn off southwestern Florida from November through February. Gulf flounder became ripe for the first time when 2 years old.

Movements

Only 53 Gulf flounder were tagged because of the low numbers captured during the study. None were returned. Thus it was not possible to trace their movements either within the bay or after they had left the bay for spawning in the Gulf of Mexico.

Food

Invertebrates accounted for 84 percent of the food items identified from small Gulf flounder (10 to 150 mm long) (Table 16). Mysids comprised 57 percent of the invertebrates and were the most frequently found food item.

Seventy two percent of the food items found in the stomachs of Gulf flounder in excess of 150 mm were fish (Table 16). *Anchoa* sp., clupeids (*Brevoortia* sp. and unidentified), sciaenids (*Micropogon undulatus* and unidentified), *Mugil* sp. and unidentified fish remains accounted for 85 percent of the fish items taken from the stomachs of these larger fish. Springer and Woodburn (1960) found that small Gulf flounder fed mainly on crustaceans and became more piscivorous with increasing growth.

Environmental Factors

Temperature

The average monthly water temperature during the study period ranged from 13.8°C to 29.9°C (Fig. 10). Individual water temperatures as low as 10.0°C and as high as 31.0°C were recorded, and both southern and Gulf flounders were taken throughout this range.

The period during which adult southern and Gulf flounders left the bay for spawning in the Gulf of Mexico was characterized by a drop in the average water temperature from 23.0°C in October to 14.1°C in December (Fig. 10). Five cold fronts occurred during periods of sampling in October, November and December (Fig. 11). During frontal passage the water temperature at the flounder net stations dropped 4°C to 5°C from the previous sampling period. The beginning of emigration of southern flounder on 16 October (Fig. 2) and

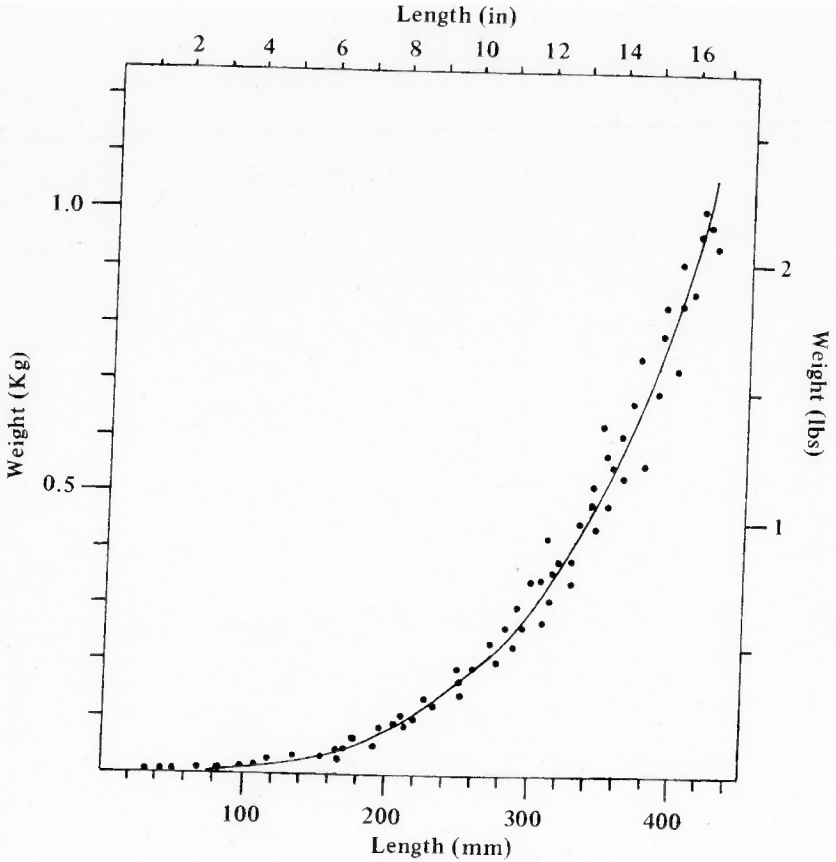

Figure 9 The length-weight relationship of Gulf flounder.

the period of maximum emigration, 11 November to 14 November, coincided with cold frontal passage. Increases in emigration on 6 November and 25 November were also associated with frontal passages. However, increases in emigration of southern flounder on 30 October, 19 November and 5 December were not associated with frontal passage.

Immigration of juvenile southern and Gulf flounders began when the average water temperature was as low as 13.8°C (Figs. 3 & 10). Maximum immigration for juveniles of both species occurred when the average water temperature was between 16.0°C and 16.2°C.

Salinity

Salinity values were highest in the southern portion of the study area. Average salinities there for individual stations were as high as 35°/oo. Salinities became progressively lower towards the northern part of the Aransas Bay system where averages as low as 8°/oo were recorded (Table 17). Isolated values as low as 6°/oo and as high as 36°/oo were encountered.

Gulf flounder were only taken from stations where the average salinity was above 16°/oo (Tables 10, 11, 12, 13, 14 & 17). Gunter (1945) indicates that Gulf flounder are not usually found at salinities below 20°/oo.

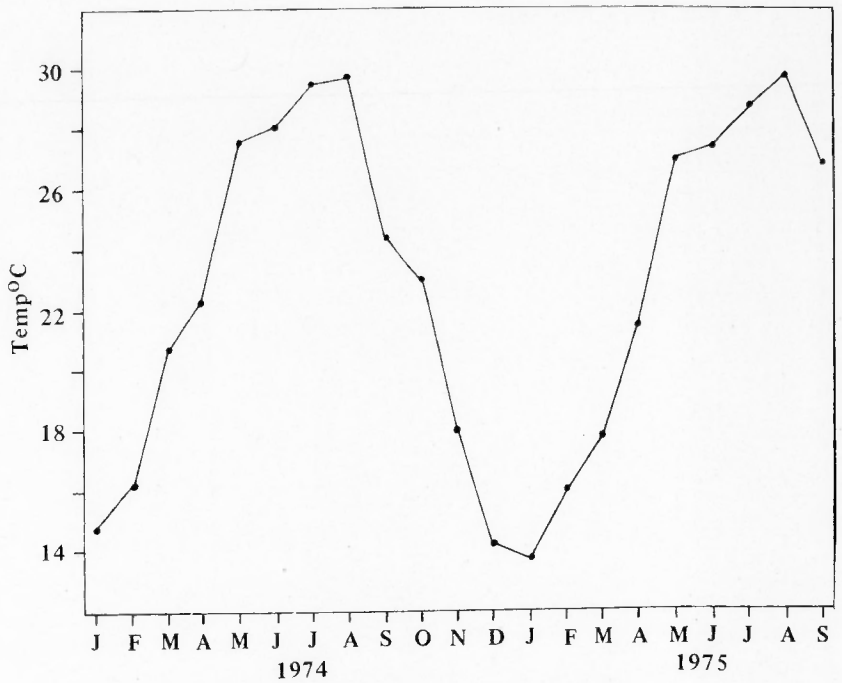

Figure 10 Average water temperature during each month.

Southern flounder were taken at salinities ranging from 6°/oo to 36°/oo. Recently spawned juvenile (post-larval) southern flounder were not taken from St. Charles and Copano Bay stations until March. These stations are the most distant from the pass at Port Aransas and this may account for the delayed appearance. However, salinities at these stations were the lowest of any sampled areas (10 to 12°/oo during spring) and this may be a contributing factor. Stickney and White (1973) found that southern flounder may not be physiologically adapted to lower salinities until advanced post-larval size. Deubler (1960) demonstrated that when food supply, temperature and light were controlled, early post-larval southern flounder grew to a larger size at higher salinities.

pH

pH values ranged from 7.65 to 8.60. There were no relationships between pH values and flounder distribution and abundance.

Turbidity

The only consistent variations in turbidity between stations occurred at seine stations during the spring. At the Live Oak Point seine stations on the west shore of Aransas Bay, turbidity values ranged from 65 J.T.U. to 130 J.T.U. during the spring while values did not exceed 50 J.T.U. at other seine stations. No juvenile southern and Gulf flounders were taken from the Live Oak Point stations during the spring. Feeding problems at higher turbidities might be one factor involved in the avoidance of this area by juveniles.

Sediment

A relationship between sediment type and flounder distribution was found to exist at gig stations (Tables 5, 14 & 18). The gig station located on

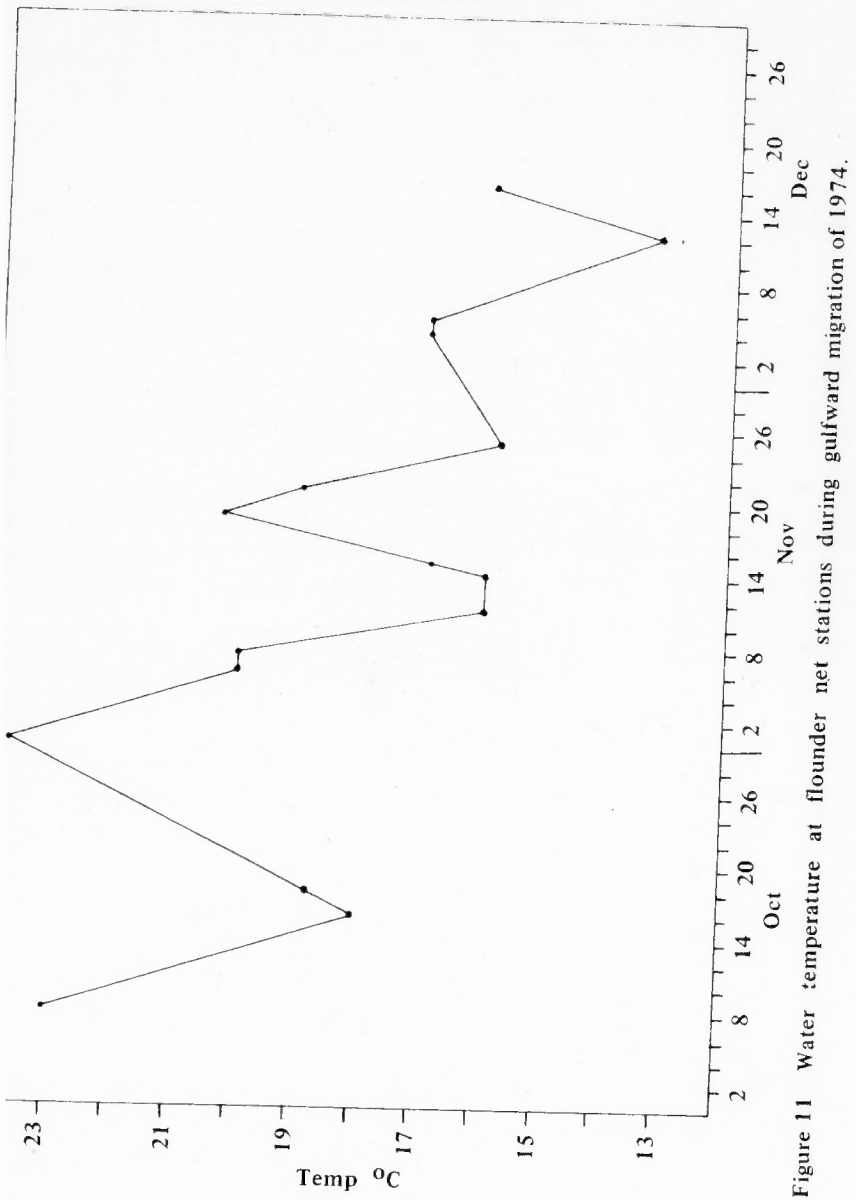

Figure 11 Water temperature at flounder net stations during gulfward migration of 1974.

Table 16 Stomach contents of 172 Gulf flounder.[1]

Prey	Frequency of Occurrence 10 mm to 150 mm flounder	151 mm plus flounder
Invertebrates		
Acetes sp.	2	
Sergestidae	1	
Mysidacea	27	
Cumacea	3	
Copepoda	3	
Amphipoda	1	
Euphausiacea	2	
Isopoda	1	
Penaeus sp.	1	14
Crangon sp.		1
Crab zoea	2	
Crab megalops	3	1
Callinectes sapidus		7
Loligo sp.	1	1
Total Invertebrates	47	24
Fish		
Larval Fish	1	
Anchoa sp.		8
Brevoortia sp.		3
Clupeidae (unidentified)	1	5
Micropogon undulatus		5
Sciaenidae (unidentified)		10
Mugil sp.	2	7
Lagodon rhomboides		3
Atherinidae (unidentified)		3
Synodontidae (unidentified)		1
Gerreidae (unidentified)		1
Unidentified fish remains	5	17
Total Fish	9	63

[1] 67 stomachs contained identifiable items, 82 were empty and 23 contained only digested matter that was totally unidentifiable.

the east shore of Aransas Bay at Long Reef had finer sediments than the station located in the channel to Aransas Pass. At the Long Reef station, 74 percent of the sediment by weight was trapped by the no. 325 screen (the finest mesh used) and only 1 percent was trapped by the no. 5 screen (the largest mesh used). At the channel station 53 percent was caught by the no. 325 screen while 26 percent of the sample weight was retained by the no. 5 screen. Southern flounder were taken in greatest numbers by gig from the station at Long Reef, while Gulf flounder were captured in greater numbers

Table 17 Average salinity (o/oo) at each station during seasonal periods.

Station	Winter 1974	Winter 1975	Spring 1974	Spring 1975	Summer 1974	Summer 1974	Fall 1974	Fall 1975
DS-1	24	27	28	24	34	29	30	28
DS-2	24	27	24	24	34	29	28	28
DS-3	23	25	25	24	34	28	30	28
DS-4	25	23	26	19	35	27	27	26
DS-5	23	24	23	20	34	38	27	27
DS-6	28	23	24	18	34	26	25	23
DS-7	25	18	21	18	34	25	24	20
DS-8	24	16	24	17	33	23	22	18
DS-9	17	13	20	15	25	17	17	15
DS-10	13	12	13	13	24	15	15	12
DS-11	8	10	10	10	13	13	13	12
DS-12	10	9	12	11	14	11	13	13
MS60-1	24	27	28	24	34	29	30	30
MS60-2	24	27	24	24	34	29	28	31
MS60-3	25	23	27	19	35	27	27	28
MS60-4	24	16	24	17	33	24	22	22
MS60-5	13	12	13	13	24	15	15	14
MS20-1	23	24	24	20	34	28	27	29
MS20-2	28	23	24	18	34	26	25	29
MS20-3	25	18	25	18	34	25	24	23
MS20-4	16	13	20	15	25	17	17	15
15T-1	24	25	27	19	34	28	25	27
15T-2	24	25	25	19	34	27	25	27
15T-3	28	23	24	18	34	26	24	28
15T-4	25	18	21	18	34	25	23	23
15T-5	24	16	24	17	33	24	22	21
15T-6	24	16	24	17	33	24	22	23
15T-7	14	13	20	15	25	17	17	15
15T-8	13	12	13	12	24	17	15	15
15T-9	13	10	13	11	22	15	15	12
45T-1	24	17	24	21	34	30	25	28
45T-2	15	16	19	17	30	26	17	29
45T-3	20	16	19	17	30	23	19	21
45T-4	18	16	18	17	29	20	18	22
45T-5	16	14	20	16	26	20	17	19
45T-6	16	14	20	16	26	20	17	20
45T-7	16	11	20	15	25	16	17	15
45T-8	13	12	14	12	24	15	15	14
45T-9	13	10	13	11	22	13	15	15
G-1	17	14	19	15	30	20	21	21
G-2	24	21	23	19	35	27	24	24

Table 18 Percentage of sample weight trapped by each Tyler screen from sediment samples taken at gig stations.

Tyler Screen No.	Percent of Sample Weight Station G-1	Station G-2
5	1	26
10	1	7
20	2	10
45	1	3
70	21	1
325	74	53

Table 19 Commercial flounder landings for Aransas Bay from 1 January 1974 through 15 September 1975.[1]

Month	Total Pounds	Total Kilograms
1974 - January	1,676	760.9
February	964	437.7
March	885	401.8
April	500	227.0
May	2,945	1,337.0
June	1,633	741.4
July	2,111	958.4
August	2,598	1,179.5
September	2,500	1,135.0
October	8,139	3,695.1
November	15,222	6,910.8
December	4,073	1,849.1
1975 - January	2,450	1,112.3
February	2,316	1,051.5
March	1,564	710.1
April	1,206	547.5
May	2,991	1,357.9
June	6,692	3,038.2
July	7,135	3,239.3
August	4,636	2,104.7
September	2,670	1,212.2
Total	74,906	34,007.4

[1]Data obtained from Texas Parks and Wildlife Department statistical agent located in Flour Bluff, Texas.

Table 20 Sport gig catch of flounder for Aransas Bay from 1 January 1974 through 15 September 1975.

Month	No. Interviews	Ave. No. Sportsmen	X	Ave. No. Hours Gigged	X	No. Flounderable Nights[1]	=	Total Hrs. Gigged in Month	X	Ave. No. Fish Per Hour	=	Total No. Fish Taken	X	Ave. Wt. Per Fish lb	Ave. Wt. Per Fish kg	=	Total Weight lb	Total Landed kg
1974-Jan.	12	9		2.0		24		432		3.0		1,296		1.0	.454		1,296	588.4
Feb.	4	3		1.0		14		42		2.5		105		1.0	.454		105	47.7
Mar.	3	3		0.5		10		15		2.5		38		1.0	.454		38	17.3
Apr.	8	6		2.0		8		96		4.5		432		1.0	.454		432	196.1
May	15	21		3.0		16		1,008		6.0		6,048		1.2	.545		7,258	3,296.2
June	13	23		3.0		16		1,104		6.5		7,176		1.2	.545		8,611	3,910.9
July	20	23		3.0		15		1,035		5.5		5,692		1.4	.636		7,969	3,620.1
Aug.	17	25		3.5		15		1,312		5.0		6,560		1.4	.636		9,184	4,172.2
Sep.	14	23		3.5		23		1,851		5.0		9,255		1.4	.636		12,957	5,886.2
Oct.	24	42		4.0		23		3,864		6.0		23,184		1.6	.726		37,094	16,831.6
Nov.	21	47		4.0		18		3,384		6.0		20,304		1.9	.863		38,578	17,522.4
Dec.	15	26		2.0		23		1,196		2.7		3,229		1.9	.863		6,135	2,786.6
1975-Jan.	6	7		2.0		15		210		2.5		525		1.0	.454		525	238.4
Feb.	5	3		1.0		13		39		3.5		136		1.2	.545		164	74.1
Mar.	8	6		2.0		9		108		4.0		432		1.4	.636		605	274.8
Apr.	13	9		2.0		8		144		5.5		792		1.4	.636		1,108	503.7
May	12	18		2.5		11		495		6.0		2,970		1.6	.726		4,752	2,156.2
June	19	24		3.0		16		1,152		6.7		7,718		1.8	.817		13,893	6,305.6
July	17	23		3.5		12		966		6.0		5,796		1.8	.817		10,432	4,735.3
Aug.	15	22		4.0		16		1,408		6.5		9,152		1.8	.817		16,474	7,477.2
Sep.	11	24		4.0		10		960		6.0		5,760		1.6	.726		9,216	4,181.8
												116,600					186,834	84,822.8

in the channel to Aransas Pass. Ginsburg (1952) refers to southern flounder as "mud flounder" and to the Gulf flounder as "sand flounder."

Vegetation

Relationships between flounder distribution and vegetation existed at gig and seine stations. During nocturnal sampling by gig, southern flounder were taken in greatest numbers at the station located on the east shore of Aransas Bay at Long Reef. This station had cord grass (*Spartina alterniflora*) along the edge and extending into the water. At the gig station located in the channel to Aransas Pass, where Gulf flounder were taken in greatest numbers, there was no vegetation along the shoreline.

At seine stations where juvenile southern flounder were most abundant during the spring, shoal grass (*Diplanthera wrightii*) existed in dense patches (at least 161 culms per 25 square in) which covered 30 to 60 percent of the total area. Juvenile Gulf flounder were taken from areas with dense patches of shoal grass which covered 30 to 60 percent of the area and from areas where light stands of shoal grass (less than 61 culms per 25 square in) existed in patches which covered less than 30 percent of the area.

Commercial and Sport Fishery

From 1 January 1974 through 15 September 1975 a total of 34,007 kg (74,906 lb) of flounder was landed by commercial fishermen in Aransas Bay, while during this same period the sport gig fishery yielded 84,823 kg (186,834 lb) of flounder (Tables 19 & 20). October and November were the months of maximum production for both the commercial and sport gig fishery when commercial fishermen landed 10,606 kg (23,361 lb) and sportsmen captured 34,355 kg (75,672 lb) of flounder. During these months the fishery is centered in the channel and pass areas as the fish concentrate in this restricted area while moving to the Gulf for spawning. Should a decline in the fishery be indicated, management practices might profitably be directed towards the channel and pass areas during the fall.

Although both southern flounder and Gulf flounder are taken by sport and commercial fishermen, southern flounder consistently accounted for over 95 percent of the total catch. By law commerical flounder must be over 12 inches long, and most sportsmen are selective for fish larger than this. Thus, male flounder of both species, which seldom reach lengths over 12 inches, are rarely present in the catch. Seventy four percent of the catch consisted of female southern flounder in their second and third years of life (fish 12 in to 18 in long). Heavy dependence on females of two year classes may explain the variations seen in commercial landings from year to year. Poole (1961) found that the sport fishery for summer flounder (*P. dentatus*) in Great South Bay was primarily dependent upon 1 and 2 year old fish and concluded that this dependence was responsible for decided fluctuations in the catch.

SUMMARY

Southern flounder and Gulf flounder were sampled in the Aransas Bay system from 1 January 1974 through 15 September 1975. Seines, trawls, flounder nets and gigs were used to take monthly samples. Water samples were taken with each flounder sample. Data concerning the commercial and sport gig fishery were also gathered.

Sexually mature southern and Gulf flounders left Aransas Bay for spawning in the Gulf of Mexico during October, November and December. Up to 10 southern flounder per hr and 0.3 Gulf flounder per hr were captured by 100 ft flounder net as they moved through the channels to the Gulf. Males were not present in the run after 25 November. Five southern flounder tagged in the channels were recaptured in the Gulf at depths ranging from 1 fathom (6 ft) to 34 fathoms (204 ft).

Juveniles of both species began to enter the bay from the Gulf of Mexico during January and February. February was the month of maximum immigration when the average number of juvenile southern flounder per 100 ft dredge seine tow was as high as 1.8 and the average for Gulf flounder was as high as 0.2. Juvenile Gulf flounder were only taken from the southern third of the Aransas Bay system. Juvenile southern flounder were caught in all areas but were most numerous in Redfish Bay where numbers taken by dredge seine during the spring were at least 30 percent greater than those from the other areas.

Adult southern flounder, which had migrated to the Gulf to spawn, began to reenter the bay as early as February in 1975 but not until April in 1974. Adult Gulf flounder began to reenter the bay during July in 1974 and in April 1975. During summer, adult southern flounder were taken in greatest numbers from the eastern portion of Aransas Bay where, in both 1974 and 1975, gig samples yielded an average of 9.0 flounder per hr and 45 ft trawl samples had average catches as high as 20.7 flounder. Adult Gulf flounder were concentrated in the southern third of the Aransas Bay system and were taken only once north of Marker 63. Summer samples in the southern one third of Aransas Bay yielded an average of 0.7 Gulf flounder per hr by gig and averages as high as 2.3 flounder per 30 min tow with the 45 ft trawl.

Southern flounder ranged from 10 mm (0.4 in) to 620 mm (24.4 in) in total length and weighed up to 3.9 kg (8.6 lb). Males did not exceed 320 mm (12.6 in). Length data and otolith readings indicated 5 age classes of female and 3 age classes of male southern flounder.

Gulf flounder ranged from 10 mm (0.4 in) to 420 mm (16.5 in) in total length with weights up to 1.01 kg (2.2 lb). Males did not exceed 290 mm (11.4 in). Three age classes of female and 2 age classes of male Gulf flounder were present.

Both southern and Gulf flounders spawned for the first time when they were 2 years old. Those fish which were going to spawn showed stage III development (developing) by mid-September and from October through December they showed stages IV (developed) and V (gravid).

Tag returns indicated that southern flounder moved up to 5.75 miles in 3 days within Aransas Bay. Southern flounder tagged within the Aransas Bay system were recovered in Corpus Christi Bay and in San Antonio Bay.

Small southern and Gulf flounders (fish 10 mm to 150 mm long) fed primarily on invertebrates. Mysids were the most frequently found invertebrate in the stomachs of these smaller fish. Larger southern and Gulf flounders fed mainly on fish. For both species *Anchoa* sp., cluepids, sciaenids and *Mugil* sp. were the most frequently occurring fish items in the stomachs of these larger fish.

Both species were taken at temperatures ranging from 10.0°C to 31.0°C. The beginning emigration and the period of maximum emigration for adult southern flounder coincided with cold frontal passages during which time the water temperature dropped by 4.0°C to 5.0°C. Maximum immigration for juvenile southern and Gulf flounders occurred when the average water temperature was between 16.0°C and 16.2°C.

Gulf flounder were only taken from stations where the average salinity was above 16°/oo. Southern flounder were taken at salinities ranging from 6°/oo to 36°/oo. However, after first entering the bay, juvenile southern flounder were absent from low salinity areas.

In nocturnal sampling by gig, adult southern flounder were captured in greatest numbers over fine sediments (1 percent of sediment weight retained by no. 5 screen) with cord grass along the edge and extending into the water column, while Gulf flounder were taken in greatest numbers over coarse sediments (26 percent of sediment weight retained by no. 5 screen) with no vegetation along the shoreline. Juveniles of both species were taken in greatest numbers from areas where shoal grass existed in patches.

From 1 January 1974 through 15 September 1975 a total of 34,007 kg (74,906 lb) of flounder were landed by commercial fishermen in Aransas Bay, while during this same period, the sport gig fishery yielded 84,823 kg (186,834 lb). Although both species were taken in the fishery, southern flounder consistently accounted for over 95 percent of the total catch. Seventy four percent of the catch consisted of female southern flounder in their second and third years of life.

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