MARK-RECAPTURE STUDIES OF PENAEID SHRIMP IN TEXAS, 1978-80

by Terry J. Cody and Billy E. Fuls

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ABSTRACT

The Texas Parks and Wildlife Department and National Marine Fisheries Service conducted 14 mark-recapture studies to determine movement and growth of penaeid shrimp along the Texas coast. All shrimp were tagged with colored polyethylene streamer tags and released in inshore areas near Port Mansfield, Port Aransas and Port Isabel or in offshore waters near Port Aransas.

From May 1978 through July 1980, 101,699 shrimp were tagged; 96,842 were released. By November 1980, 2,906 shrimp had been returned for an overall recapture rate of 3.00%. Recapture rates during inshore studies ranged from 0.00 to 16.32% while those for offshore releases ranged from 3.67 to 16.05%. Pink shrimp were returned at higher rates than brown shrimp when released during the same study.

Over 89% of the shrimp from inshore releases and 74% of the shrimp from offshore releases were returned within 4 weeks. Over 94% of all shrimp returned from inshore releases moved < 18 km. For offshore releases the overall percentage of returns moving < 37 km was 64% for brown shrimp, 56% for pink shrimp and 65% for white shrimp.

Returns indicated short-term movement in all directions with movement predominantly south and southwest from inshore releases at Port Isabel and alongshore to the northeast and south from offshore releases near Port Aransas. Long-term recaptures for brown shrimp (Penaeus aztecus) came from the south while pink shrimp (P. duorarum) and white shrimp (P. setiferus) were captured from both north and south.

Growth rates for individual shrimp were highly variable. For shrimp released inshore and free > 20 days growth rates for brown shrimp and pink shrimp were 0.268 and 0.287 mm/d (tail length) respectively. For brown shrimp released offshore and free > 20 days growth rates were 0.282 mm/d for June, July and August releases and 0.142 mm/d for October releases.

INTRODUCTION

As shrimping became an important fishery along the Atlantic and Gulf coasts of the United States after World War I, biologists soon realized the need for more information on the abundance, life history and population dynamics of the commercial penaeids. From 1935 to the late 1950's shrimp were tagged with small celluloid-disks affixed to the first abdominal segment with nickel pins (Lindner and Anderson 1956). These tags were similar to those used successfully for tagging fish since their invention by C. G. J. Petersen in 1894 (Rounsefell and Kask 1945).

In the late 1950's Dawson (1957) and Costello (1959) showed the penaeid shrimp could be marked with biological strains. Strain-injection was widely used in the 1960's by Klima (1964), Kutkuhn (1966), Costello and Allen (1966) and Clark et al. (1974). Techniques were further modified by Klima (1965) to identify classes with the use of fluorescent pigments and by Neal (1969) to identify individuals with small internal PVC tags. Marullo et al. (1976) developed a vinyl streamer tag for shrimp that has been slightly modified through the years into the small flexible polyethylene tag that is currently being used in the MEXUS-GULF Shrimp Tagging Program by National Marine Fisheries Service (NMFS), Texas Parks and Wildlife Department (TPWD), Louisiana Wildlife and Fisheries Commission (LWFC) and the Instituto Nacional de Pesca of Mexico (INP).

Regional managment plans for the shrimp fishery of the Gulf of Mexico developed by the Gulf States Marine Fisheries Commission (Christmas and Etzold 1977) and the Gulf of Mexico Fishery Management Council (Van Lopik et al. 1979) acknowledge that for resource managers to recommend effective measures to utilize the annual yield of penaeid shrimp, it is essential that estimates of growth rates, mortality rates, migration patterns and maximum yield curves be developed. Tagging studies can provide some of the data necessary for these estimates.

The Texas Parks and Wildlife Department and National Marine Fisheries Service initiated mark-recapture studies in 1978 to determine movements and growth of penaeid shrimp stocks along the Texas coast.

MATERIALS AND METHODS

The mark-recapture studies in Texas are cooperative efforts by the Texas Parks and Wildlife Department, National Marine Fisheries Service and Texas A&M University Sea Grant Program. Species tagged were those most available within the predetermined release area.

All shrimp during 1978-1980 were tagged with colored polyethylene streamer tags similar to those described by Marullo et al. (1976). Tags were provided by NMFS and were 95 mm long, 3 mm wide and 4 or 6 mils thick depending on the size of shrimp to be tagged. Tags were notched to 2 mm near the center for a distance of 22 mm for better retention

in the shrimp. Tags were colored coded (orange, green, blue or black) and identified on each end by the letters "NMFS" and a 5 or 6 digit number (Figure 1).

A sewing needle with a slotted eye was attached through one end of each tag. For convenience and speed, consecutively numbered tags were aligned on a thin cardboard sheet and placed in front of each group of three or four "taggers" (Figure 2). Needles were dipped in a 10% concentration of Aureomycin in white petroleum jelly to retard infection in the tagged shrimp. The needle was inserted between the first and second abdominal segments and the tag was pulled through and centered in the shrimp. The tag was then removed from the needle. On large shrimp, needle-nose pliers were used to insert the needle and pull the tag through the exoskeleton.

Shrimp species, sex, tag number and tail length were recorded before the shrimp was returned to a holding tank. Tail length measured from the anterior edge of the exoskeleton of the first abdominal segment to the tip of the telson was the standard measurement used in this program since tagged shrimp are sometimes headed by fishermen before the tag is noticed.

To enhance the return of recaptured shrimp, a fishing contest was implemented in which awards ranging from $50.00 to $500.00 were paid for recovered shrimp. Contest drawings were held periodically with eight winners being selected by computer. One award winner of $500.00, one of $100.00 and six of $50.00 were selected during each drawing.

Through a contract with NMFS the Texas A&M University Sea Grant Program was responsible for the awards system. Each individual returning a tagged shrimp with the required information received a letter acknowledging his participation in the program and explaining the cash award contest pool (Appendix A). "Certificates of Recognition" are presented to fishermen who return 10 or more tagged shrimp (Appendix B) and distribution by NMFS of "The Gulf Streamer", a NMFS shrimp tagging newsletter, is distributed to interested parties (Appendix C).

Tagged shrimp were returned to port agents and biologists located in major ports. In addition to collecting catch and effort statistics, these agents collect recovered tagged shrimp and obtain and verify pertinent information on area and date of recapture. Contest posters (Figure 3) showing the location of the tag in the shrimp were placed at major ports to acquaint fishermen with the tagging program and type of tag being used. Posters also gave instructions on the handling of shrimp and reporting of the required recapture information for eligibility in the contest. Posters were distributed in English, Spanish and Vietnamese (Figure 4).

All release and recovery data for recaptured shrimp were processed by NMFS personnel at the Galveston Laboratory or by agents at the major shrimping ports. NMFS compiled the tag return data as part of their MEXUS-GULF Program and supplied the information to the cooperating agencies.

The TPWD research vessel Western Gulf was used during the offshore studies as a tagging facility and to obtain, transport and/or release tagged shrimp. Holding tanks, aerators and other tagging gear were provided by TPWD and NMFS. Manpower for the capture, tagging and release was provided by TPWD and NMFS with assistance during 1978 from the Instituto Nacional de Pesca.

During offshore studies 10-20 min tows were made with a standard 12.2-14.3 m shrimp trawl to capture live shrimp. As the contents of the net were dumped on the deck, live shrimp were quickly transferred to 1893-l tanks with circulating water. Holding tanks and tagging equipment were similar to those described by Emiliani (1971).

Every effort was made to insure that shrimp to be tagged were maintained in healthy condition. When large numbers of organisms were caught a preliminary culling of live shrimp into galvanized wash tubs was used to reduce stress on the shrimp. Aboard the Western Gulf compressed air was bubbled through air-stones to provide additional aeration to the flow-through water system. Shrimp were usually held at least 6 h to allow them to recover prior to tagging. Periodic culling of dead and unhealthy shrimp reduced water fouling and stress on remaining shrimp.

After tagging, the shrimp were held for 3-6 h to determine tagging mortality. To protect tagged shrimp during offshore releases they were placed in expendable canisters (Emiliani 1971) and released at approximately 0.8-km intervals while the vessel was underway. The canisters sank to the bottom, opened after 10-12 min and released the shrimp.

The tagging procedure for inshore and offshore studies was basically the same, but there were some differences in capture and release methods. Except for the Rockport-Port Aransas studies during 1978 all shrimp for inshore releases were purchased from local bait dealers in the study area. Inshore and shallow-water releases during 1978 were made with sections of flexible dryer hose (102 mm dia). All tagged shrimp during 1979 and 1980 inshore studies were transported by skiff from the tagging site to the release area and released by hand in water < 1.25 m deep.

Changes in procedures during the first two years were detailed by Cody and Rice (1979) and Cody and Avent (1980). The only changes to proposed procedures during the third year were to conduct two inshore studies along the lower Texas coast during March-April instead of one during May. Both studies were completed earlier in the spring than previous studies, which shifted emphasis from brown shrimp (Penaeus aztecus) to pink shrimp (P. duorarum).

In analyzing shrimp return data all recoveries were included, with the exception of those in which recovery data were lacking or were obviously erroneous.

RESULTS

All tagging studies proposed during the first three years were completed as scheduled. The time frame for some of the studies was changed to take advantage of the availability of shrimp and weather conditions conducive to successful releases. Overall, 50,000 shrimp were to be tagged during 1978, 30,000 during 1979 and 25,000 during 1980; 49,186 shrimp were tagged during 1978, 32,602 during 1979 and 19,911 during 1980 (Table 1).

Releases and Returns

From 1978 through 1980, 101,699 brown shrimp, pink shrimp and white shrimp (P. setiferus) were tagged and 96,842 (95.2%) were released (Table 1). The percentage released each year was relatively constant -- 94.6% (46,510) during 1978, 96.1% (31,333) during 1979 and 95.4% (18,999) during 1980. Short-term tagging mortality for individual studies averaged 4.4% and ranged from 2.1 to 8.3%. Release areas are shown in Figure 5.

By 17 November 1980, 2,906 tagged shrimp (3.00%) had been recaptured and returned; 1,792 (2.13% return rate) were from inshore releases and 1,144 (8.11% return rate) were from offshore releases (Table 1). Seven returns were from inshore releases during 1978, 223 were from inshore releases during 1979 and 1,532 were from inshore releases during 1980. A total of 347 tagged shrimp was returned from offshore releases during 1978 and 495 were returned from offshore releases during 1979. Preliminary returns from offshore releases during 1980 totaled 302 shrimp.

Tag return rates for inshore releases ranged from 0.00 (June-July, 1979) to 16.32% (March 1980) and return rates for offshore releases ranged from 3.67 (June 1980) to 16.05% (October 1979) (Table 1).

Return rates by species show that pink shrimp were consistently returned at higher rates (4.66 to 25.00%) than brown shrimp (0.09 to 7.69%) for inshore releases during 1979 and 1980 (Table 1). The overall return rate for offshore releases was 7.34% for brown shrimp and 7.73% for pink shrimp. For individual offshore releases brown shrimp return rates were highest during October 1978 (10.26%), September 1979 (19.75%) and October 1979 (19.86%).

Time Free

Over 78% of the shrimp from inshore releases were returned during the first 2 weeks and 89% were returned during the first 4 weeks (Table 2). The only exception was May-June 1979 when 64% (7) of the shrimp were returned after 1-3 mo , which corresponds with the end of the closed season in the Gulf. When nearly equal numbers of brown shrimp and pink shrimp were released the return patterns for both species were similar. No shrimp from inshore releases were returned after 1 year.

For offshore releases 57% of the shrimp were returned during the first 2 weeks and 74% were returned during the first 4 weeks (Table 2). July 1980 releases had the lowest percentage returned after 4 weeks, probably due to reduced fishing effort caused by Hurricane Allen. The

percentage of returns during the first 4 weeks ranged from 70 to 90% for other offshore releases. The only shrimp returned after a year of freedom were from releases during August and October 1978.

No shrimp were returned during the first week after June 1980 releases (Table 2). Most of the returns from this release (60%) were made during weeks 3 and 4 which correspond with the end of the closed Gulf season.

Except when the number of returns was very low, brown shrimp, pink shrimp and white shrimp released during the same study showed similar return patterns.

Distance travelled

Over 94% of all shrimp returned from inshore releases moved < 18 km (Table 3). Only 10 shrimp (0.6%) moved > 185 km. Pink shrimp appeared to move slightly more than brown shrimp released during the same study.

Shrimp released in offshore waters moved more than those released in inshore waters. Only 47% of all shrimp returned from offshore releases moved < 18 km (Table 3). For individual releases the percentage moving < 18 km ranged from 27 to 74%. Of the total returns 20% moved 93-185 km and 3% moved > 185 km. A total of 28 brown shrimp, 2 pink shrimp and 5 white shrimp moved > 185 km.

Tagged shrimp released offshore during August, September and October appeared to move less than those released during June and July. For shrimp released during August-October the percentage moving > 92 km ranged from 9 to 16% (Table 3). For shrimp released during June-July the percentage moving > 92 km was 27 to 60%.

The overall percentage of returns moving < 37 km was similar for brown shrimp (64%), pink shrimp (56%) and white shrimp (65%) during offshore releases (Table 3). There appeared to be some differences in long-range movement between species. Over 25% of the brown shrimp, 36% of the pink shrimp and 12% of the white shrimp returned moved 92 km.

Direction travelled

Shrimp returned from inshore releases moved mainly E, SE, S, SW and W (Table 4). During 1979, 88% of the returns from releases at Port Isabel moved E, SE, S or W. During 1980 when tagged shrimp were released earlier in the year than in 1979, 85% of the returned shrimp moved S or SW. Brown shrimp and pink shrimp appeared to move in similar directions for each inshore release.

Shrimp returned from offshore releases moved mainly NE, E, SE, S and SW (Table 4). Over 65% of the returns from releases during August, September and October were from the NE, S and SW. Altogether 84% of the returns from June and July releases were from the E, SE, S and SW.

For all offshore releases combined 33% of the brown shrimp, 40% of the pink shrimp and 60% of the white shrimp moved N, NE or E; 63% of the brown shrimp, 60% of the pink shrimp and 26% of the white shrimp moved SE, S, or SW.

Growth

Brown shrimp and pink shrimp free for ≤ 20 days showed more variability in growth/day than shrimp free for > 20 days. The mean growth/day (tail length) for brown shrimp released inshore and free for 0-10 and 11-20 days ranged from -0.023 to 0.107 mm (Table 5). Mean growth/day for pink shrimp free 0-10 and 11-20 days ranged from -0.067 to 0.752 mm. After 20 days, growth rates ranged from 0.195 to 0.450 mm/d for brown shrimp and 0.209 to 0.384 mm/d for pink shrimp when > 1 shrimp was returned per period.

Combining all recoveries from April 1979 and 1980 releases the mean growth/day for brown shrimp free > 20 days was 0.268 mm (19 returns; mean size 50 mm at release). Combining April 1979, March 1980 and April 1980 releases the mean growth/day for pink shrimp free > 20 days was 0.287 mm (203 returns; mean size 53 mm at release).

For offshore releases the mean growth/day of brown shrimp free 0-10 and 11-20 days ranged from -0.013 to 0.919 mm (Table 5). After 20 days mean growth rates ranged from 0.008 to 0.420 mm. Mean growth rates for white shrimp ranged from 0.079 to 0.226 mm/d after release in September 1979.

Combining August 1978, June 1980 and July 1980 releases the mean growth/day for brown shrimp free > 20 days was 0.282 mm (173 returns; mean size 67 mm at release). Combining October 1978 and October 1979 releases the mean growth/day for brown shrimp free > 20 days was 0.142 mm (188 returns; mean size 77 mm at release).

DISCUSSION

Inshore return rates for 1978 and 1979 were < 2.5%. Procedures used during the two years, changes in the release methods and possible reasons for the poor results are discussed in Cody and Avent (1980).

Increased return rates for inshore studies during 1980 may be the result of an attempt to increase the quality of shrimp released, tagging only 1,000 shrimp per day, scheduling the releases when water temperatures were lower (20.7-21.0 C) than in 1978 and 1979 (25.8-31.3 C) and a change in the fishing pattern of the Port Isabel bait shrimpers who recaptured most of the tags. Before 1980 most trawling was done in the Brownsville Ship Channel and the Turning Basin at Port Isabel. During 1980 more boats entered the bait shrimp fishery and because of dredging in the Ship Channel nearly all effort was concentrated in the Turning Basin. Many of the tagged shrimp released in the Laguna Madre followed the ICWW through the Turning Basin on their migration route to the Brownsville Ship Channel and the Gulf of Mexico.

Because there were only 4 shrimp returned out of 47,918 released inshore near Port Aransas and Aransas Pass during 1978 and 1979, the procedure of releasing shrimp in shallow inshore waters was replaced with a plan to capture and release shrimp in the shallow Gulf of Mexico. The theory being that most of these shrimp would be recent migrants from the bays and would already be adjusted to the Gulf environment.

Preliminary results indicated return rates for offshore releases during 1980 would not be as high as during 1978 and 1979. However, return rates were higher (3.67-5.00%) than for any previous June or July release (0-0.12%). Short-term recovery rates were lower than usual during June and July 1980 due to the closed season in the Gulf and little fishing effort in the immediate area.

Cooperative tagging studies by TPWD and NMFS in Texas during 1980 had the highest return rates of all the MEXUS-GULF releases. Return rates for releases at Port Isabel totaled 12.41% while rates for other inshore releases ranged from 0.01% (San Luis Pass-LGL) to 10.53% (Calcasieu Lake-LGL) (NMFS unpublished data). The return rate from 1980 offshore releases in Texas totaled 12.60% and compared favorably with return rates from Mexico (17.66%), Mississippi (8.76%), Alabama (6.80%) and Louisiana (6.74%) (NMFS unpublished data).

Many tagged shrimp released during 1978-1980 were returned within the first two weeks after release, a pattern which has also been reported by Klima (1964) and Compton and Bradley (1962). Klima reported more than 90% of the recoveries from releases near Galveston, Texas and Grand Isle, Louisiana were returned within 10 days. Compton and Bradley reported most of the returns from the Aransas area were within 2 weeks.

Klima (1964) reported that the distance moved did not increase with increased time at large and that most brown shrimp returns from Texas during 1962 were within 30 miles of the release site. No consistent relationship between distance moved and time free was observed during 1978-80 release.

Movement of tagged shrimp may be related to prevailing currents along the Texas coast which flow predominantly to the northeast or to the south depending on the time of the year. Previous Texas studies by McRae (1952) and Compton and Bradley (1962) reported southward movement of tagged shrimp, which is a characteristic of this study and other MEXUS-GULF studies along the south Texas coast.

Growth for individual shrimp was highly variable. When analyzing return data for growth, there appears to be several problems inherent in the measurement of shrimp on release and on return which may affect individual growth/day calculations. Shrimp free only a few days often had negative growth rates. Some of the variation may be explained by shrinkage of shrimp due to drying, freezing and/or preservation in formalin (McCoy 1972) and some may be due to improper measurement during the tagging process. Moulting of shrimp shortly after tagging and release may explain why growth was sometimes > 5 mm/d.

Factors such as size of shrimp at release, area of release, month of release and water temperature can affect the growth rate of tagged shrimp and make comparisons difficult. Knudsen et al. (1977) discussed some of these difficulties in comparing mark-recapture experiments.

Another problem in comparing our growth data to previous studies is our use of tail length instead of total length for all measurements. Using total length-tail length conversion tables prepared by Fontaine

(1971), total length growth estimates for inshore releases were 0.427 mm/d for brown shrimp and 0.478 mm/d for pink shrimp. Brown shrimp growth rates estimated by Knudsen et al. (1977) for releases in a Louisiana coastal marsh ranged from 0.52 to 0.87 mm/d. Offshore growth rates for brown shrimp were comparible to inshore growth rates during the summer (0.469 mm/d) but were considerably less during the fall (0.238 mm/d).

The validity of conclusions based on mark-recapture experiments depends on the accuracy of the recovery information. All participants in the recovery phase make every effort to obtain detailed and accurate information on recaptured shrimp. Nevertheless, caution should be exercised when drawing conclusions based on very few recoveries. For this reason the best data available are those from inshore releases at Port Isabel during 1979 and 1980 and from offshore releases during 1978, 1979 and 1980.

Preliminary results on the movement and migration of tagged shrimp recovered from MEXUS-GULF Shrimp Tagging Studies have been presented at various conferences and meetings in the United States and Mexico by NMFS and TPWD personnel.

The cooperative mark-recapture studies of penaeid shrimp in Texas are an integral part of the MEXUS-GULF Shrimp tagging program being conducted by fisheries departments from the United States and Mexico. Data obtained from the releases of tagged shrimp in the western Gulf of Mexico will provide valuable information for resource managers of this extremely valuable fishery.

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Table 1. Preliminary tag return totals as of 17 November 1980 for penaeid shrimp tagged in Texas during 1978-1980.

Release date	Release site	Species	No tagged	No released	No returned	% returned
INSHORE RELEASES						
16-21 May 1978	Port Mansfield	Brown	3982	3873	3	0.08
6-15 June 1978	Port Aransas	Brown	28659	27324	1	<0.01
11-20 July 1978	Port Aransas	Brown	11973	10983	3	0.03
23 April-1 May 1979	Port Isabel	Brown	6691	6305	82	1.30
		Pink	2856	2770	129	4.66
		Unknown	9	9	1	
		Total	9556	9084	212	2.33
30 May-5 June 1979	Port Isabel	Brown	9885	9486	9	0.09
		Pink	9	8	2	25.00
		Total	9894	9494	11	0.12
26 June-3 July 1979	Aransas Pass	Brown	9917	9611	0	0.00
19-25 March 1980	Port Isabel	Brown			5	
		Pink	6482	6236	1013	16.24
		Total	6482	6236	1018	16.32
16-22 April 1980	Port Isabel	Brown	3098	2912	224	7.69
		Pink	3361	3212	290	9.03
		Unknown	3	3		
		Total	6462	6127	514	8.39
OFFSHORE RELEASES						
8-18 August 1978	Port Aransas	Brown	2986	2832	193	6.81
10-20 October 1978	Port Aransas	Brown	1504	1423	146	10.26
		Pink	82	75	7	9.33
		White			1	
		Total	1586	1498	154	10.28
25-28 September 1979	Port Aransas	Brown	161	157	31	19.75
		Pink	33	33	1	3.03
		White	1395	1365	208	15.24
		Total	1589	1555	240	15.43
1-3 October 1979	Port Aransas	Brown	1123	1108	220	19.86
		Pink	18	17	2	11.76
		White	505	464	33	7.11
		Total	1646	1589	255	16.05
19-26 June 1980	Port Aransas	Brown	2104	2013	67	3.33
		Pink	247	235	16	6.81
		Unknown	11	11		
		Total	2362	2259	83	3.67
16-25 July 1980	Port Aransas	Brown	4589	4362	216	4.95
		Pink	16	15	3	20.00
		Total	4605	4377	219	5.00

Table 2. Time free of recaptured shrimp tagged in Texas during 1978–1980.

Release date	Release site	Species	No.	% of shrimp free for:						
				1 wk	2 wk	3–4 wk	1–3 mo	3–6 mo	6–12 mo	>1 yr
INSHORE RELEASES										
16–21 May 1978	Port Mansfield	Brown	3	66	--	--	--	--	33	--
6–15 June 1978	Port Aransas	Brown	1	--	100	--	--	--	--	--
11–20 July 1978	Port Aransas	Brown	3	33	--	33	33	--	--	--
23 April–1 May 1979	Port Isabel	Brown	82	46	24	17	8	4	--	--
		Pink	127	56	14	2	19	6	2	--
		Total	209	52	18	8	15	5	1	--
30 May–5 June 1979	Port Isabel	Brown	9	11	11	11	56	11	--	--
		Pink	2	--	--	--	100	--	--	--
		Total	11	9	9	9	64	9	--	--
26 June–3 July 1979	Aransas Pass	Total	0	--	--	--	--	--	--	--
19–25 March 1980	Port Isabel	Brown	5	--	20	20	60	--	--	--
		Pink	1011	60	17	13	8	2	<1	--
		Total	1016	59	17	13	9	2	<1	--
16–22 April 1980	Port Isabel	Brown	221	74	14	9	3	--	--	--
		Pink	288	63	24	7	4	2	--	--
		Total	509	68	20	8	3	1	--	--
OFFSHORE RELEASES										
8–18 August 1978	Port Aransas	Brown	178	64	19	7	8	<1	--	1
10–20 October 1978	Port Aransas	Brown	141	17	32	22	18	7	2	1
		Pink	7	14	29	--	43	14	--	--
		White	1	--	--	--	--	--	--	100
		Total	149	17	32	21	19	7	2	2
25–28 September 1979	Port Aransas	Brown	31	19	29	26	23	3	--	--
		Pink	1	--	100	--	--	--	--	--
		White	197	27	35	20	15	<1	3	--
		Total	229	26	34	21	16	<1	2	--
1–3 October 1979	Port Aransas	Brown	215	40	30	9	13	6	2	--
		Pink	2	50	--	--	--	--	50	--
		White	32	44	31	3	16	--	6	--
		Total	249	41	30	8	13	5	3	--
19–26 June 1980	Port Aransas	Brown	65	--	25	62	12	2	--	--
		Pink	16	--	19	56	25	--	--	--
		Total	81	--	23	60	15	1	--	--
16–25 July 1980	Port Aransas	Brown	215	28	6	14	51	<1	--	--
		Pink	3	--	--	--	100	--	--	--
		Total	218	28	6	14	52	<1	--	--

Table 3. Minimum distance travelled (Km) by recaptured shrimp tagged in Texas during 1978-1980.

Release date	Release site	Species	No.	% of shrimp traveling (Km): 0-10	11-20	21-30	31-40	41-50	51-100	>100
INSHORE RELEASES										
16-21 May 1978	Port Mansfield	Brown	3	--	33	--	--	--	--	66
6-15 June 1978	Port Aransas	Brown	1	--	--	--	--	--	100	--
11-20 July 1978	Port Aransas	Brown	3	--	66	--	33	--	--	--
23 April-1 May 1979	Port Isabel	Brown	80	95	1	--	--	--	4	--
		Pink	118	85	2	1	2	2	8	--
		Total	198	88	2	<1	2	2	6	--
30 May-5 June 1979	Port Isabel	Brown	9	22	33	11	--	11	11	11
		Pink	2	--	--	--	50	50	--	--
		Total	11	18	27	9	9	18	9	9
26 June-3 July 1979	Aransas Pass	Total	0	--	--	--	--	--	--	--
19-25 March 1980	Port Isabel	Brown	5	80	--	--	--	--	20	--
		Pink	991	96	1	<1	<1	--	2	<1
		Total	996	96	1	<1	<1	<1	2	<1
16-22 April 1980	Port Isabel	Brown	222	99	<1	<1	<1	--	--	--
		Pink	286	95	<1	<1	--	--	1	1
		Total	508	97	<1	<1	<1	--	<1	<1
OFFSHORE RELEASES										
8-18 August 1978	Port Aransas	Brown	176	74	14	<1	<1	<1	9	1
10-20 October 1978	Port Aransas	Brown	135	46	26	2	6	4	13	2
		Pink	6	33	33	--	--	17	17	--
		White	141	45	26	2	6	5	13	2
		Total								
25-28 September 1978	Port Aransas	Brown	30	33	10	10	3	10	27	7
		Pink	1	--	--	--	100	--	--	--
		White	172	43	22	8	10	3	11	2
		Total	203	41	20	8	9	4	13	3
1-3 October 1979	Port Aransas	Brown	202	58	19	5	5	3	7	2
		Pink	1	100	--	--	--	--	--	--
		White	27	37	30	19	4	4	4	4
		Total	230	56	20	7	5	3	7	2
19-26 June 1980	Port Aransas	Brown	54	44	15	6	9	2	19	6
		Pink	14	29	36	--	--	--	29	7
		Total	68	41	19	4	7	1	21	6
16-25 July 1980	Port Aransas	Brown	209	28	3	5	2	2	53	7
		Pink	3	--	--	--	--	--	67	33
		Total	212	27	3	5	2	2	53	7

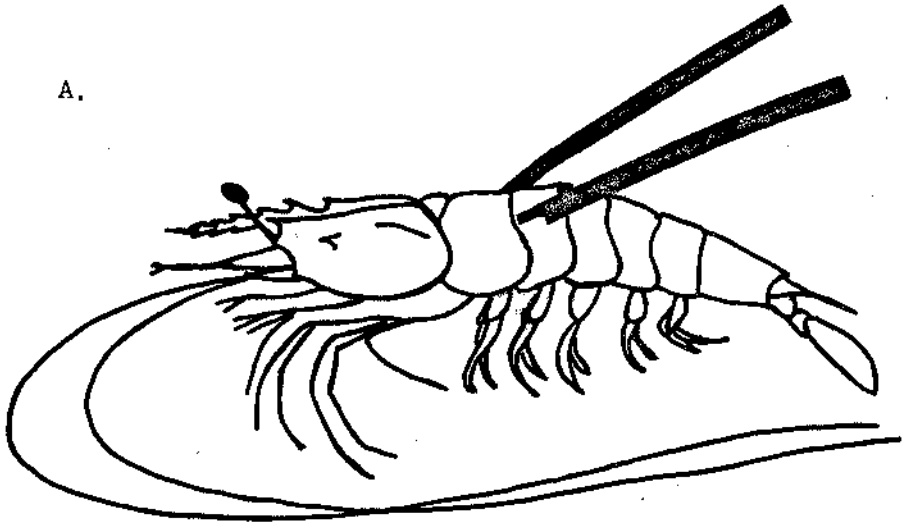
Table 4. Direction travelled by recaptured shrimp tagged in Texas during 1978-1980.

Release date	Release site	Species	No.	% of shrimp travelling							
				N	NE	E	SE	S	SW	W	NW
INSHORE RELEASES											
16-21 May 1978	Port Mansfield	Brown	3	33	--	--	--	33	--	33	--
6-15 June 1978	Port Aransas	Brown	1	--	--	100	--	--	--	--	--
11-20 July 1978	Port Aransas	Brown	3	--	--	33	--	33	--	33	--
23 April-1 May 1979	Port Isabel	Brown	80	2	2	11	20	31	--	32	--
		Pink	118	9	5	12	15	15	--	43	--
		Total	198	6	4	12	17	22	--	39	--
30 May-5 June 1979	Port Isabel	Brown	9	11	--	22	44	11	11	--	--
		Pink	2	50	50	--	--	--	--	--	--
		Total	11	18	9	18	36	9	9	--	--
26 June-3 July 1979	Aransas Pass	Total	0	--	--	--	--	--	--	--	--
19-25 March 1980	Port Isabel	Brown	5								
		Pink	992								
		Total	997								
16-22 April 1980	Port Isabel	Brown	222	--	2	--	3	3	92	<1	--
		Pink	286	<1	1	1	4	7	86	--	--
		Total	508	<1	2	<1	4	5	89	<1	--
OFFSHORE RELEASES											
8-18 August 1978	Port Aransas	Brown	167	13	26	18	6	19	13	<1	4
10-20 October 1978	Port Aransas	Brown	135	3	19	7	7	29	24	10	<1
		Pink	6		33	17	--	33	17	--	--
		White	141	3	20	7	7	29	24	9	<1
		Total									
25-28 September 1979	Port Aransas	Brown	30	7	43	10	--	37	--	3	--
		Pink	1	--	--	--	--	--	100	--	--
		White	172	15	39	7	--	8	18	10	2
		Total	203	14	39	7	--	12	16	9	2
1-3 October 1979	Port Aransas	Brown	203	1	8	14	13	49	9	3	1
		Pink	1	--	--	--	--	--	100	--	--
		White	27	19	26	7	--	4	19	19	7
		Total	231	3	10	13	11	44	11	5	2
19-26 June 1980	Port Aransas	Brown	54	9	13	6	30	17	20	6	--
		Pink	14	21	14	7	21	7	29	--	--
		Total	68	12	13	6	28	15	22	4	--
16-25 July 1980	Port Aransas	Brown	209	6	5	11	9	64	5	--	<1
		Pink	3	--	33	--	--	67	--	--	--
		Total	212	6	6	10	9	64	5	--	<1

Table 5. Apparent growth (mm/d) of tagged shrimp returned in 10-d intervals following release in Texas waters during 1978-1980.

Release date	Release site	Species	Number	Male/Female ratio	Mean size (± 1 SE)	Growth in mm/day (Tail length) 0-10 d	11-20 d	21-30 d	31-40 d	41-50 d	>50 d
INSHORE RELEASES											
23 April-1 May 1979	Port Isabel	Brown	77	.638	46 (± 0.56)	0.003	0.107	0.238	-0.050	0.195	0.450
		Pink	119	.839	52 (± 0.52)	0.026	-0.067	0.210	0.372	0.325	0.329
19-25 March 1980	Port Isabel	Pink	951	.886	53 (± 0.17)	0.752	0.255	0.249	0.384	0.264	0.272
16-22 April 1980	Port Isabel	Brown	211	.780	52 (± 0.45)	-0.023	0.052	0.277	-0.080	0.345	0.510
		Pink	271	.862	52 (± 0.36)	0.118	0.088	0.209		0.120	0.285
OFFSHORE RELEASES											
8-18 August 1978	Port Aransas	Brown	155	.203	70 (± 0.55)	0.272	0.206	0.191	0.262	0.420	0.150
10-20 October 1978	Port Aransas	Brown	125	.412	73 (± 0.82)	0.365	0.061	0.219	0.169	0.168	0.168
25-28 September 1979	Port Aransas	White	170	.657	85 (± 0.74)	0.226	0.170	0.184	0.125	0.079	0.137
1-3 October 1979	Port Aransas	Brown	199	.877	79 (± 0.75)	0.022	-0.013	0.139	0.008	0.055	0.112
19-26 June 1980	Port Aransas	Brown	58	.295	70 (± 1.26)	0.342	0.070	0.100	0.090		0.250
16-25 July 1980	Port Aransas	Brown	176	.598	64 (± 0.69)	0.919	0.328	0.365	0.366	0.284	0.239

A.



B.

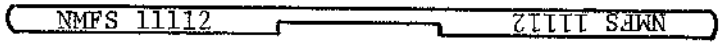
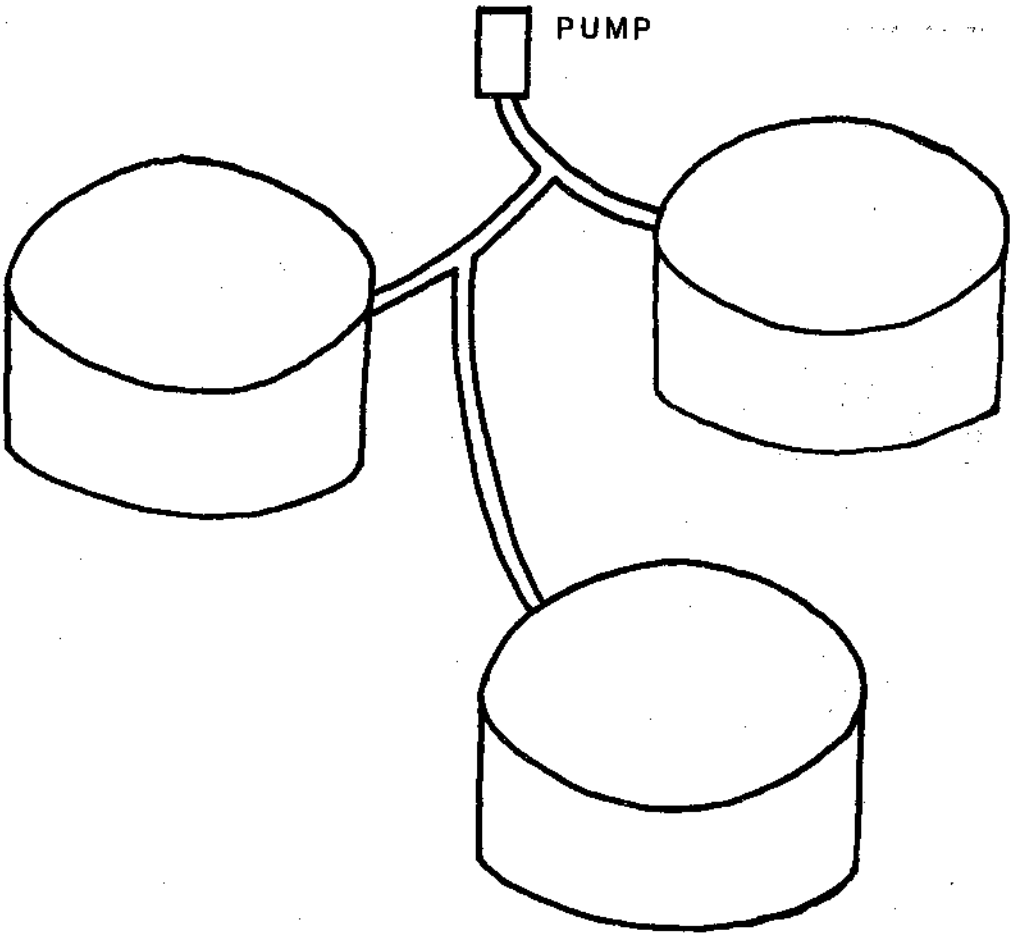


Figure 1. A. Tagged shrimp showing placement of polyethylene streamer between abdominal segments. B. Drawing of tag showing actual size.



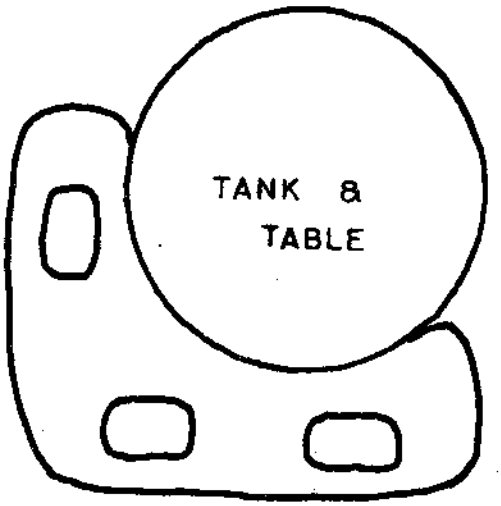
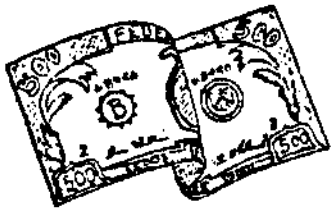


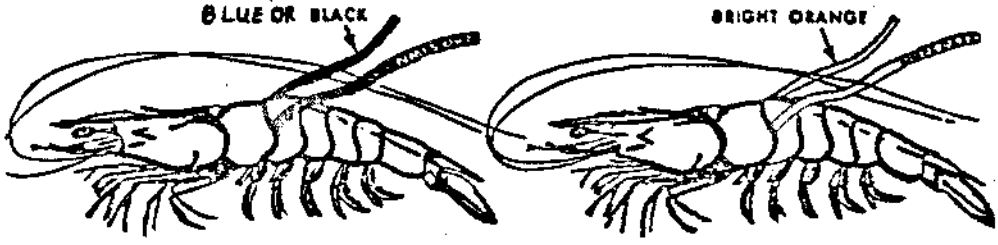
Figure 2. Diagram of 3-tank system and tagging table used for holding and tagging penaeid shrimp.

JOIN A FISHING CONTEST

CASH!  AWARDS!

AWARDS FROM $50.00 TO $500.00!
OUR SHRIMP FISHERY NEEDS YOUR HELP!

SHRIMP HAVE BEEN TAGGED WITH PLASTIC RIBBONS LIKE THIS:



Awards will be randomly selected from tagged shrimp that are returned. To qualify as an entry, the tag must be in the shrimp and the date and location the shrimp was caught must be given. Sets of awards will continue into 1979. Any tag number that hasn't been chosen remains eligible in the later drawings.

AWARDS OF $500 -- $200 -- $100 -- AND $50 WILL BE AVAILABLE IN EACH SELECTION.

Dates for making awards will be announced.

THIS STUDY IS BEING CARRIED OUT JOINTLY BY THE TEXAS PARKS AND WILDLIFE DEPARTMENT, TEXAS A&M UNIVERSITY, THE NATIONAL MARINE FISHERIES SERVICE AND THE INSTITUTO NACIONAL DE PESCA OF MEXICO.

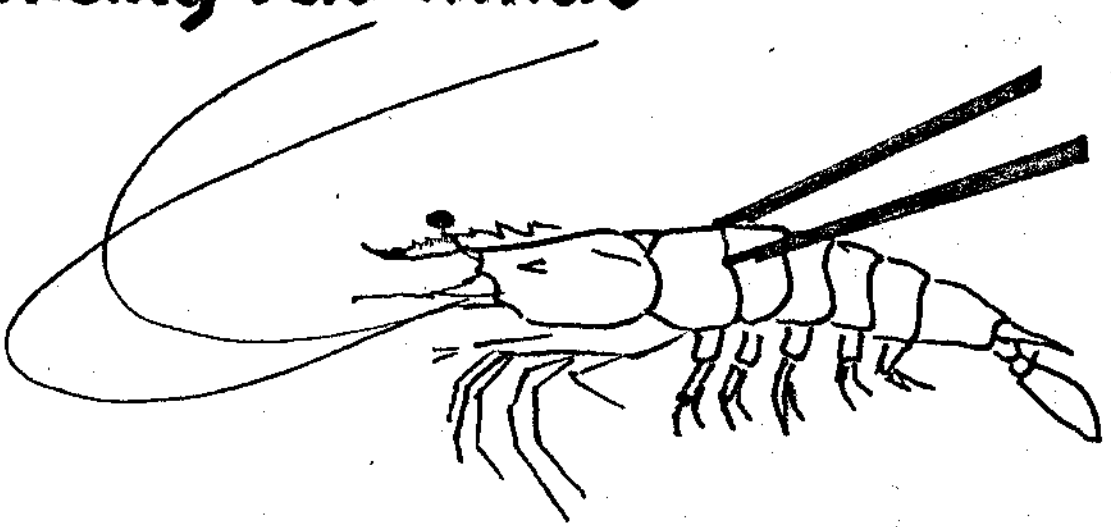
If you have caught a tagged shrimp or know someone who has please contact:

AGENCY	ADDRESS	PHONE NUMBER
NMFS Galveston Lab.	FT. Crockett Galveston Tex. 77550	713-766-1211 ext. 105
Texas Parks & Wildlife Dept.	1018 Todville (P.O. Box 8) Seabrook Tex. 77586	713-474-2811
Texas A&M University	5115 Hwy 3 Dickinson Tex. 77539	713-534-3413 713-948-2581 ext. 496

Figure 3. Poster distributed in Texas to promote the shrimp tagging program.

TÔM THÍ NGHIỆM

Mua lại $50.00 - 500.00 cho 1 con
Tôm có dánh dấu bằng 1 dãi plastic
mang vào mình



$$

XIN GHI
ĐỊA ĐIỂM
& NƠI BẮT

LIÊN* LẠC
ĐEM LẠI

National Marine Fisheries Service
4700 Ave U Galveston TX. 77550
PHONE:
Call collect: (713)763.1211 EXT. 511

Figure 4. Translation of shrimp tagging poster for Vietnamese fishermen.

SHRIMP TAGGING RELEASE AREAS

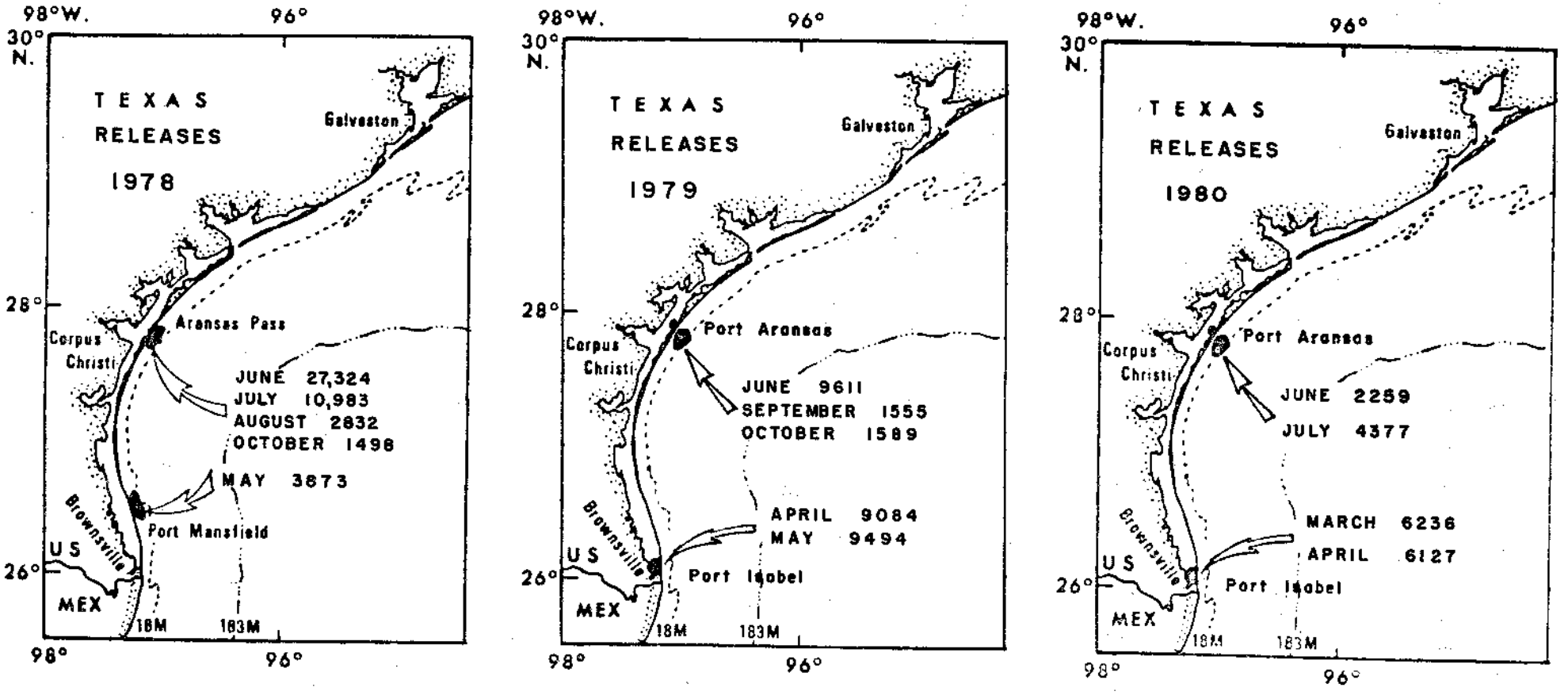
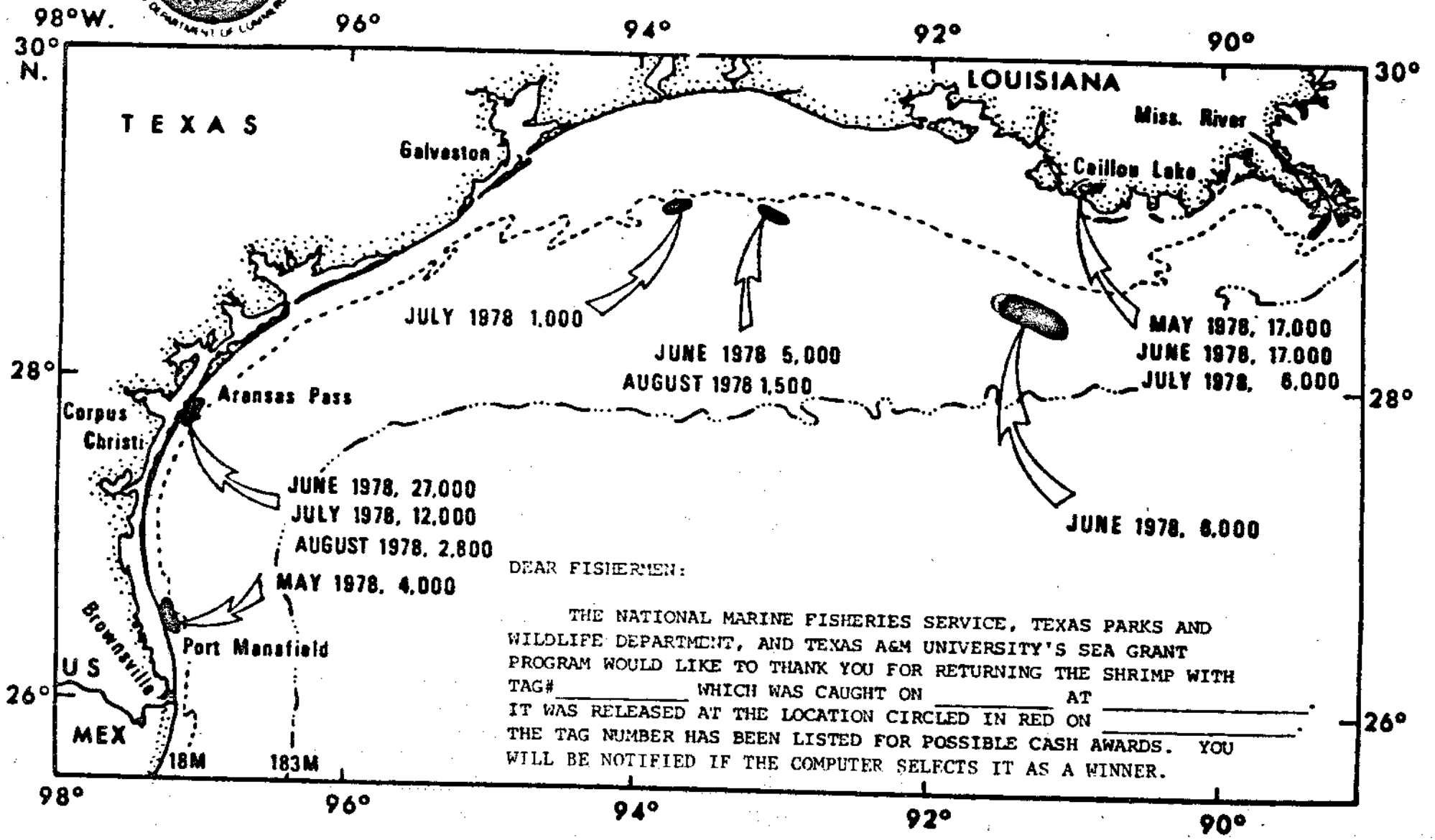


Figure 5. Release areas for Texas mark-recapture studies on penaeid shrimp during 1978, 1979 and 1980.

APPENDIX A. Letter to fishermen who have returned a tagged shrimp from Texas releases during 1978.



Appendix A. Letter to fishermen who have returned a tagged shrimp from Texas releases during 1978.

APPENDIX B. Certificate of Recognition awarded to fishermen who returned ten or more tagged shrimp during Texas mark-recapture studies.

CERTIFICATE OF RECOGNITION

Awarded to

_____

on the _____ day of _____, _____

for cooperation and assistance in recovery of tagged shrimp in Project Mexus-Gulf, a coordinated study of the Gulf of Mexico shrimp fishery

by the:

NATIONAL MARINE FISHERIES SERVICE
LOUISIANA DEPARTMENT OF WILDLIFE AND FISHERIES
TEXAS PARKS AND WILDLIFE DEPARTMENT
LOUISIANA STATE UNIVERSITY, CWR, SEA GRANT
TEXAS A&M UNIVERSITY, SEA GRANT
INSTITUTO NACIONAL DE PESCA OF MEXICO

Edward F. Klima

Dr Edward F. Klima
Dir., Galv. Lab., NMFS

APPENDIX C. Shrimp tagging newsletter --"The Gulf Streamer"-- distributed to participants, fishermen and other interested parties to keep them informed of progress of the shrimp tagging program.

THE GULF STREAMER

NOAA
NATIONAL MARINE FISHERIES SERVICE
SOUTHEAST FISHERIES CENTER

SHRIMP AND GROUNDFISH RESEARCH NEWS

Mexus-Gulf Project

The 1980 objectives for the MEXUS-Gulf Project were to determine migration, rates of growth, and mortality of pink, white, and brown shrimp as well as to define fishing characteristics and fishing effort by U.S. and Mexican fleets. Data obtained during 1978-1979 co-operative shrimp studies have been analyzed and results were presented at the MEXUS-GULF meeting in Tampico, Mexico, in October.

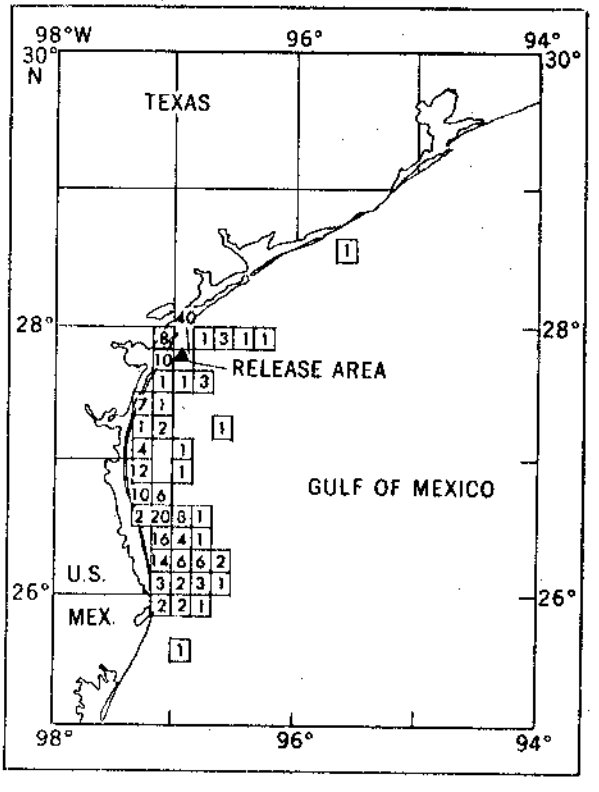
Shrimp research in the Gulf of Mexico had its first major emphasis in the late 1950's. In 1976 the Fisheries Conservation and Management Act extended U.S. jurisdiction to 200 miles from the coastline. At present, the NMFS shrimp research program is aimed at documenting geographical boundaries of the stock and developing models which can predict potential yield under varying fishing efforts.

A plastic streamer was developed for use as a tag in shrimp marking experiments at the NMFS Galveston Laboratory. With modification and more testing, the Mini-Ribbon tag proved successful in allowing individual identification of shrimp from small (200 to the pound) animals to large, sexually mature adults. Previously, smaller shrimp had not been successfully tagged and released. Simultaneously, U.S. and Mexico began developing a cooperative plan that eventually turned into Project MEXUS-GULF, an international program encompassing the fisheries of the Gulf of Mexico.

Cooperative shrimp mark and recapture studies using the Mini-Ribbon tag have now resulted in combined studies off the east coast of Mexico for three years with another combined study planned in March of 1981.

Other countries have now begun to use the Mini-Ribbon Tag. Kuwait initiated a shrimp tagging program in 1979 and the NMFS Laboratory at Galveston has recently assisted in developing a plan, to be initiated in 1981, for the South American countries of Brazil, French Guiana, and Surinam to conduct cooperative studies on their shrimp fisheries, using the Mini-Ribbon Tag and techniques developed at the galveston Laboratory. Tagging experiments provide much of the information needed for stock assessment such as growth, mortality, and migration of shrimp.

Results of a shrimp tagging cruise off Port Aransas, Texas in July 1980 are shown in the Figure below. Numbers of recoveries plotted in ten minute grids are shown by recapture location.



LOUISIANA

David Patronas Bayou LaBatre, AL	$500.00 ALITA S
Ben Pratka Patterson, LA	$500.00 PROGRESS
Warren Sweeney Valparaiso, FL	$100.00 FRANKIE LYNN
Julius Neil Chauvin, LA	$100.00 MR. NEIL
Danny Niolet Long Beach, MS	$50.00 MISS THERESA
W. A. Hedger Port Bolivar, TX	$50.00 MISS BERNICE
Roger Oyson Cameron, LA	$50.00 PATTI L
Timothy Thompson Pascagoula, MS	$50.00 STORMY SEAS IV
Stanley Benigno Waveland, MS	$50.00 MARY JANE
Godfrey Naquin Montegut, LA	$50.00 OUR JOY
Charles Racca Cameron, LA	$50.00 --
Mrs. P. L. Byler Hackberry, LA	$50.00 JILL
Wade Carroll Cameron, LA	$50.00 --
James Rogeau Eunice, LA	$50.00 --
Darren Carpentier Lockport, LA	$50.00 MASTER DARREN
Farrell Ryan Irvington, AL	$50.00 MISS VIVIAN

MEXICO

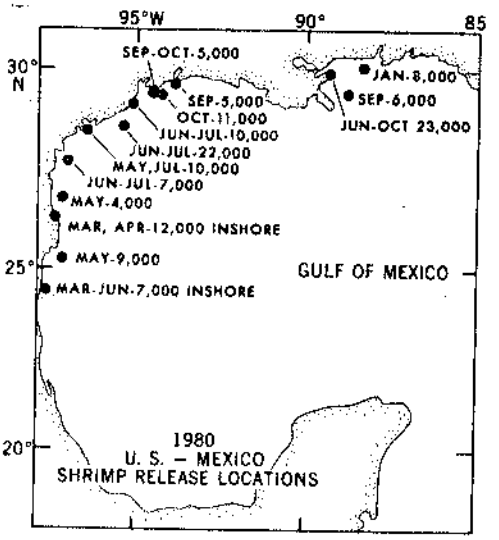
Jaime Tiburcio Prieto Alvarado, Veracruz	$500.00 FIPESCO 44
Guillermo Enriquez Torres Tampico, Tamps.	$100.00 JOSE Y FRANCISCO
Gustavo Garcia Sosa Tampico, Tamps.	$50.00 ANZORA
Enrique Reyes S. Tampico, Tamps.	$50.00 DON JOSE
Cesar Ortiz Tampico, Tamps.	$50.00 GIJON IX
Canuto Miranda Tampico, Tamps.	$50.00 MORALILLO
Napoleon Rivera Ahumada Tampico, Tamps.	$50.00 --
Joaquin Galihardo Castro Tamp. Mexico	$50.00 --

The next contest drawing will be held in January. The contest is conducted to enhance the interest of shrimp fishermen in returning tagged shrimp. The primary factor in the success of the project is the continued cooperation of the shrimp fishery.

1980 Shrimp Tagging to Date

In 1980, tagging experiments were accomplished off Mexico and the Gulf States of Texas, Louisiana, Mississippi, and Alabama, as shown in the figure below.

Of the studies along the four states in 1980, the Texas study was the largest in numbers of shrimp released, with a total release of 66,768 tagged shrimp in five areas. In Mexico, there were two release areas with a total of 16,397 shrimp released. Shrimp were released in six areas along Louisiana, Mississippi, and Alabama with a total of 22,030 tagged shrimp released.



NMFS has tagged all three commercial species in 1980: brown, pink and white shrimp. Pink shrimp, however, yielded the highest recapture percentages. Combining Mexico and the state of Texas, the number of pink shrimp tagged and released was 19,589 and the number recaptured totaled 2,559, with a recapture percentage of 13 percent. The number of brown shrimp released was much higher than that of pink shrimp, yet the number of brown shrimp recaptured was slightly less than that of pink shrimp, yielding a much lower recapture percentage for brown shrimp. The number of brown shrimp tagged and released was 63,385 and the number recaptured to date is 2,459, representing a recapture percentage of four percent.

White shrimp represented the lowest number of tagged animals released. The largest number of white shrimp was released off the Mississippi-Alabama coast. White shrimp were also released off Louisiana and Mexico. The total number of white shrimp released is 11,734 and thenumber recaptured to date is 551. Recapture percentage of white shrimp to date is five percent.

The NMFS urges everyone, commercial and sport-fishermen alike, to remain active in the tagged shrimp return program. The study will not be effective unless all tagged shrimp caught are returned with: name of fisherman, location of capture, (loran reading and depth) and date. We greatly appreciate your help in returning tagged shrimp.

The table on shrimp tagging studies contains the number of each species released, recaptured, and the percentages recaptured. The table is arranged by states of release.

1980 Shrimp Fishing Contest Winners

The last shrimp contest drawings for 1980 were held in September and November. Cash awards were presented to the following fishermen with our congratulations.

SEPTEMBER

TEXAS

Robert Grant Freeport, TX	$500.00 SINGLETON FLEET #45
Ernest Lowe Freeport, TX	$500.00 VILLA B
Jesus Acosta Brownsville, TX	$100.00 NOT QUITE
Jimmy Melina Pt. Isabel, TX	$100.00 MISS TRACEY
Jesus Alvarez Brownsville, TX	$50.00 RECOVERY
J. E. Gibson Brownsville, TX	$50.00 PANCHO
Julio Sanchez Brownsville, TX	$50.00 BIG BEND
Manuel Saldivar Pt. Isabel, TX	$50.00 RICHARD BARRERA
Billy Holland Pt. Isabel, TX	$50.00 MISS VALERIE
Santana Galvan Pt. Isabel, TX	$50.00 APACHE GUIDE
Michael Boudreaux Brownsville, TX	$50.00 ENOLA B.
Robert Flores Port Lavaca, TX	$50.00 MISS INDIANOLA
Rudy Garza Port Lavaca, TX	$50.00 RUTH EILEEN
Ramon Arteaga DeAntes Tampico, Tamps.	$50.00 ALDE BARAN
Rogelio Franco Port Lavaca, TX	$50.00 HIGH STAKES
Francisco Camacho Pt. Isabel, TX	$50.00 DEBBE ANNE

LOUISIANA

Alan McCommon Pascagoula, MS	$500.00 SANDRA B.
Emily Seney Biloxi, MS	$100.00 JOHN MAVAR SR.
Russel Bosarge Pascagoula, MS	$50.00 PRIDE OF ST. TAMMANY
Billy Callaway Bon Secour, AL	$50.00 ALABAMA RAIDER
James Ryan Gautier, MS	$50.00 BLUE MARLIN
Richard Bosarge Coden, AL	$50.00 MISS AGNES
Glen Graham Bayou La Batre, AL	$50.00 --
Roland Shanahan, Jr. Warrington, FL	$50.00 --

MEXICO

Miguel Pena Mendoza Tampico, Tamps.	$500.00 ANA LORENA
Blas Rios Garza Calzada Blanca	$100.00 JOSE ALBERTO
Juan Rivero Camara Tampico, Tamps.	$50.00 ARQUETA
Gilberto Azcona Reyes Tampico, Tamps.	$50.00 CAMARONERA DEL GULFO IV
Tomas Dominguez Tampico, Tamps.	$50.00 PROGRESSO VI
Leticia Guerra Sanchez Tampico, Tamps.	$50.00 --
Sabino Mart. Ollervides Tampico, Tamps.	$50.00 --
Juan Jose Castellanos H. Cd. Del Carmen, Campeche	$50.00 TERMINOS #2

NOVEMBER

TEXAS

Steve Moore Crystal Beach, TX	$500.00 GINGER LEA
I. W. McKewon Pasadena, TX	$500.00 JESSICA
Aquileo Vasquez Tampico, Tamps.	$100.00 CAM TAMPICO V
Richard Chaples Brownsville, TX	$100.00 LESLIE V.
Raul Lima Port Isabel, TX	$50.00 GLORIA EVELYN
William Reynolds Brownsville, TX	$50.00 BILLIE ANN
Julian Hernandez Port Isabel, TX	$50.00 REMONA CRUZ
Charles Smith Aransas Pass, TX	$50.00 BILL & JACKIE
Ray Boesla Port Aransas, TX	$50.00 GULF KING 76
Alfredo Tamayo Tampico, Tamps.	$50.00 CINSA I
Juan Garza Port Isabel, TX	$50.00 GEORGE C. TOWER
Julio Sanchez Brownsville, TX	$50.00 BIG BEND
Joe Leal Brownsville, TX	$50.00 PLAYBOY
Fernando Perez Brownsville, TX	$50.00 LEON
Floyd Gaston Texas City, TX	$50.00 BARBARA DON
Jose Antonio Perez Port Isabel, TX	$50.00 RESACA

Area	Brown Shrimp Released	Recapture	%	Pink Shrimp Released	Recapture	%	White Shrimp Released	Recapture	%
Texas									
Inshore	34,481	236	1.0	9440	1307	13.8			
Offshore	29,318	1349	4.6	3521	866	24.3			
Louisiana									
Inshore	9817	7	*tr				4221	3	*tr
Offshore	33	0	0.0				174	7	4.0
Mississippi-Alabama									
Offshore	647	12	1.8				7148	541	7.6
Mexico									
Inshore	4401	22	0.5	2721	13	0.5	191	1	0.5
Offshore	4983	853	17.1	3095	305	10.1			
TOTAL	73672	2478		19569	2551		11734	551	

Although this was the fourth year of shrimp tagging in Louisiana waters, it is the first year we have tagged shrimp east of the Mississippi River Delta to include Mississippi and Alabama. Major objectives of this cruise were to determine whether shrimp cross the delta, to delineate the fishing grounds, and identify the range of stocks.

In Texas and Mexico releases, objectives were to determine numbers of transborder travelers as well as to delineate the shrimp stocks in those areas.

Bottomfish Research Program - 1980

The trawl fisheries of the Southeast region harvest two major faunal groups: shrimp and bottom fish. The directed bottomfish trawl fishery, centered in the central Gulf, exploits approximately 250 species of fish. However, Sciaenidae (croakers, spot, and sea trout) account for approximately 75% of the total fish production. The directed bottomfish trawl fishery also catches a small percentage of shrimp as by-catch. On the other hand, the shrimp fishery catches and discards up to 900,000 tons of bottomfish annually.

In the early 70's a major research effort was instituted by the Pascagoula Laboratory to evaluate and assess the bottomfish stocks of the Gulf of Mexico. In the Northern Gulf, there have been a series of assessment cruises which have provided information on bottomfish distribution, species composition, and measures of abundance.

Of all the bottomfish, the most important species is croaker, the preferred species of the industry. (Recently we have been working on methods of tagging Atlantic croaker. Different types of tags are being tested to see which is most efficient and best suited for the fish).

Highest densities of ground fish occur in the area of the Northern Gulf of Mexico between Point Au Fer, Louisiana and Perdido Bay, Florida. The fisheries operate almost entirely within this area in depths out to 90 m (50 fm).

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