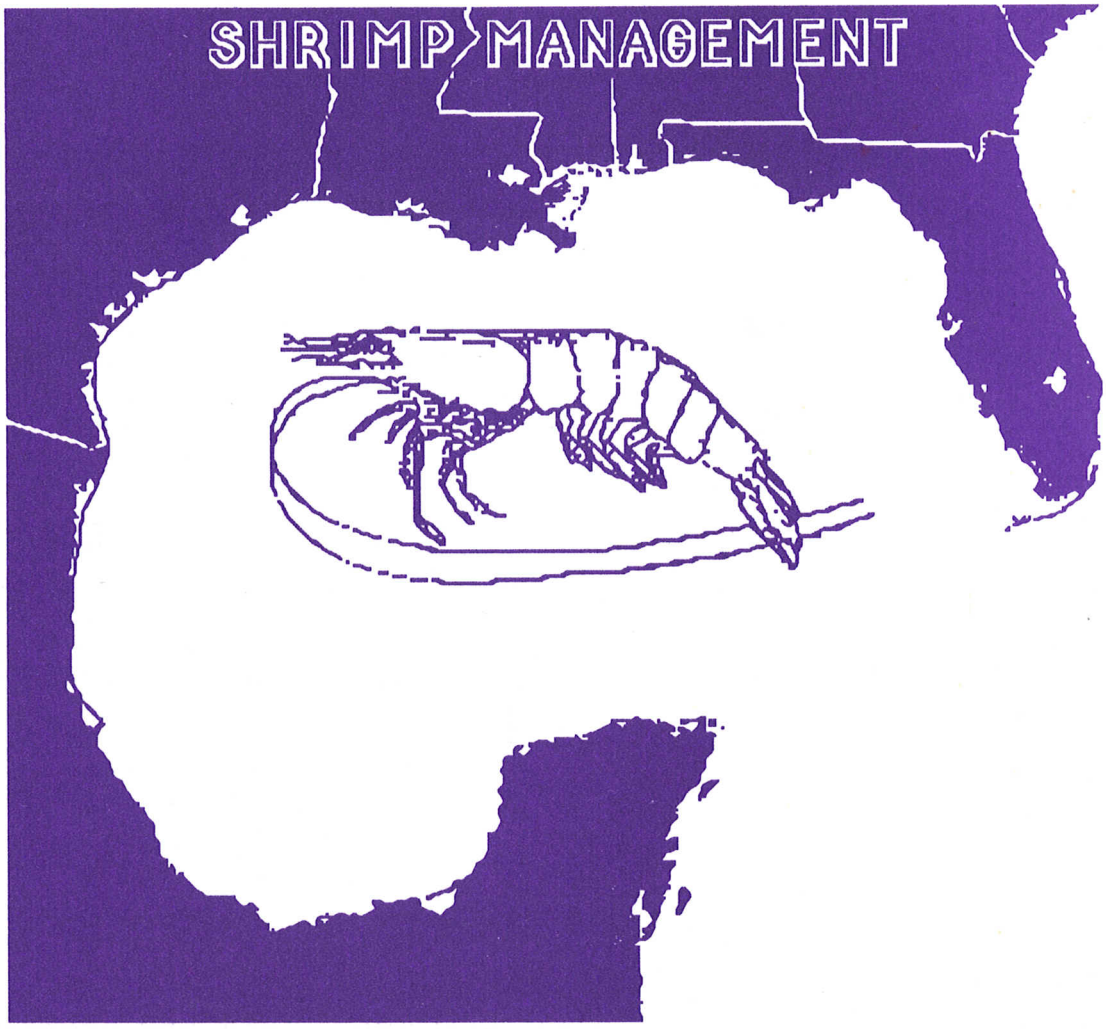
NOAA Technical Memorandum
NMFS - SEFSC - 321

Analysis of White Shrimp Closures in the Gulf of Mexico



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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
DEPARTMENT OF COMMERCE

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Analysis of White Shrimp Closures in the Gulf of Mexico

BY

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NOTICE:

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INTRODUCTION

The Gulf of Mexico is the major U.S. production area for shrimp and accounts for approximately 70% of the total weight and 80% of the total value of shrimp landed in the United States (Holliday and O'Bannon 1991). Average annual commercial shrimp catch during 1980-1990 was 108,213 mt (whole weight), with an annual value of $417 million. The greatest harvest occurred in 1986 (137,949 mt; $565 million), while the lowest catch was in 1980 (86,719 mt; $321 million). Nine shrimp species contribute to the fishery, however, Penaeus spp. comprise over 97% of the commercial harvest. On the average, brown shrimp (P. aztecus) account for 58% of the harvest, white shrimp (P. setiferus) for 31% and pink shrimp (P. duorarum) for 8%. The other six species (Hymenopenaeus robustus, Sicyonia brevirostris, S. doralis, Trachypenaeus constrictus, T. similis, and Xiphopenaeus kroyeri) account for a combined 3% of the total. The highest densities of brown shrimp occur off the Texas/Louisiana coast, the highest concentration of white shrimp occurs off the Louisiana coast, and the highest densities of pink shrimp occur off southwest Florida (Klima 1989).

In 1976 the United States extended its jurisdiction over fisheries, exclusive of tuna, to 200 nautical miles. The U.S. Congress opted for regional management of these fisheries, with the U.S. Gulf of Mexico selected as one of eight jurisdictional regions. Gulf fisheries within the territorial seas continued to be managed by individual states, while fisheries within the exclusive economic zone (EEZ) were managed by National Marine Fisheries Service (NMFS), with management planning authority delegated to the Gulf of Mexico Fishery Management Council (GMFMC) (Leary 1985).

A fishery management plan for Gulf shrimp was implemented in 1981. The principal objectives of the shrimp management plan are to optimize the yield of shrimp recruited to the fishery and to reduce the discard of undersized shrimp. Presently, two state/federal cooperative shrimp closure exist to fulfill these objectives. One for the brown shrimp fishery off the state of Texas, and another for the pink shrimp fishery off the state of Florida (Klima 1989).

The GMFMC requested that NMFS investigate the feasibility of improving economic returns from the white shrimp fishery through cooperative management measures with Gulf coast states. The General Bioecomomic Fisheries Simulation Model (GBFSM) developed at Texas A&M University (Grant et al. 1981) was used to simulate various white

shrimp closures in the Gulf of Mexico. This report contains the results of this analysis.

MATERIALS AND METHODS

The GBFSM, as tuned and parameterized to evaluate TEDs (Griffin and Oliver 1991), was used to simulate the effects of various offshore white shrimp closures. Griffin and Oliver (1991) present a thorough account of how the model works, what variables are used, how variables are dimensioned, and the methodology used to tune and validate the model. Therefore only a few important parameters will be discussed in this report.

The present model used 5 depths zones, 3 vessel classes, and 3 areas (statistical zone groupings) as depicted in Table 1. Only the two major shrimp species (brown shrimp and white shrimp) found in the analysis areas were included in the model. Current estimates of monthly instantaneous rate of natural mortality (M) for brown and white shrimp range between 0.20 and 0.35. A monthly M value of 0.31 was used for white shrimp and a monthly M value of 0.29 was used for brown shrimp. These values were set during initial model development and are slightly larger than the M values used in previous NMFS model simulations (0.275 for brown and white shrimp). Lower values of M may be more appropriate for large spawning white shrimp. Nevertheless, the M values used is this analysis are extremely conservative.

In the model, the number of vessels in the fishery represents full-time vessel equivalents, not actual vessels. Vessel equivalents are defined as the total number of vessels needed to catch the reported amount of shrimp, if each vessel fished full-time and each experienced an average catch. Full-time equivalents were calculated for each area and vessel category (Table 1).

The baseline condition of the model incorporated both a TED effect (6.7% shrimp loss) and a Gulf of Mexico brown shrimp closure in the offshore waters during the May 15 - July 15 period. This baseline condition was selected since TEDs have been required in offshore vessels since 1990 and a brown shrimp closure analysis was presented to the GMFMC two years ago (Nance et al. 1990). All values in this report are summarized as departures from the baseline condition. This analysis shows the effects of having an offshore white shrimp closure in conjunction with an offshore brown shrimp.

Three offshore closure policies were examined during the analysis: closure 1) white shrimp closure in offshore waters during the May 15 - July

15 period (same time as the brown shrimp offshore closure), closure 2) white and brown shrimp offshore closure during the May 15 - July 15 period with a white shrimp only offshore closure from September 1 - September 30, and closure 3) white and brown shrimp offshore closure during the May 15 - July 15 period with a white shrimp only offshore closure from September 1 - October 31. The first closure was chosen to determine if there is an economic benefit to the shrimp fishery during the protection of the spring spawning stock of white shrimp. The other two closures were chosen to determine if there is an economic benefit to the shrimp fishery during the protection of small white shrimp as they move into offshore waters during the late summer and early fall. White shrimp usually move from inshore to offshore waters in late August and early September. Migration may be accelerated following the passage of cold fronts from the north or heavy rainfall associated with hurricanes or cold fronts.

RESULTS AND DISCUSSION

Closure 1:

The first policy change considered was an offshore white shrimp closure in conjunction with an offshore brown shrimp closure during the period from May 15 through July 15. During the initial year of the closure, pounds of shrimp landed would be reduced by 1.002 million pounds when compared to the baseline condition (Table 2). Most of the reduction would occur in area 13-17 (0.658 million), followed by area 9-12 (0.308 million), and then by area 18-21 (0.036 million). White shrimp landing totals would be reduced by 0.457 million pounds (Table 3), with over half (0.264 million) coming from area 13-17. Area 9-12 would have a net decrease in white shrimp landings of 0.080 million pounds with less than 0.005 million pound gains only in the smaller shrimp sizes (>51 count groups) (Table 3). Area 13-17 would have a net decrease of 0.264 million pounds with gains in the <20 count size group and in the >96 count size groups. Area 18-21 would have a net loss in white shrimp production of 0.113 million pounds, with gains only in the middle size groups (31-95 count size groups) (Table 3).

The initial year of the closure would have a net increase in ex-vessel revenue of $5.151 million over baseline conditions (Table 2). Most of the increase in ex-vessel revenue would come from area 13-17 ($4.953 million). There would also be an increase in ex-vessel revenue in area 18-21 ($0.749 million), but a loss in area 9-12 ($0.551 million).

Total owner cost in the fishery would show a net decrease in each of the three areas, with the overall loss at $0.897 million. The decrease would

be from a combination of reduced effort (less costs associated with fishing) and reduced landings (less charges associated with unloading). With the net decrease in total owner cost and the net increase in ex-vessel revenue, there would be a net increase in owner rent (profit) ($6.048 million) (Table 2). Most of the increase in owner profit would occur in area 13-17 ($5.318 million). There would be a decrease in owner profits in area 9-12 ($0.096 million) with this closure type (Table 2).

In each of the three areas the owners of the bay boats would show a net loss in profits with this closure type (Table 4). The owners of the <55 ft vessels would show a loss in profits in area 9-12 ($0.035 million), but would have small increases in profits in the other two areas ($0.027 million in area 13-17 and $0.005 million in area 18-21) (Table 4). The owners of the ≥55 ft vessels would have a loss in profits in area 9-12 ($0.037 million), but would have increases in profits in the other two areas ($5.364 million in area 13-17 and $0.898 million in area 18-21) (Table 4).

Closure 2:

The second policy change considered was an offshore white shrimp closure in conjunction with an offshore brown shrimp closure during the period from May 15 through July 15, combined with a white shrimp only closure during the September 1 through September 30 period. During the initial year of the closure, pounds of shrimp landed would be increased by 0.689 million pounds when compared to the baseline condition (Table 2). All of the increase would occur in area 13-17 (1.289 million), with a decrease in landings in the other two areas (area 9-12 with 0.502 million and area 18-21 with 0.098 million). White shrimp landing totals would be increased by 0.878 million pounds (Table 3), with all the increase (1.633 million) coming from area 13-17. Area 9-12 would have a net decrease in white shrimp landings of 0.347 million pounds with gains only in the very small shrimp size (>135 count group) (Table 3). Area 13-17 would have a net increase of 1.633 million pounds with gains in the <50 count size groups. Area 18-21 would have a net loss in white shrimp production of 0.408 million pounds, with no gains in any of the size groups (Table 3).

The initial year of the closure would have a net increase in ex-vessel revenue of $14.421 million over baseline conditions (Table 2). Most of the increase in ex-vessel revenue would come from area 13-17 ($14.372 million). There would also be an increase in ex-vessel revenue in area 18-21 ($0.984 million), but a loss in area 9-12 ($0.935 million).

Total owner cost in the fishery would show a net increase of $1.673 million. A decrease would occur only in area 9-12 ($0.747 million), with increases in area 13-17 ($2.320 million) and area 18-21 ($0.100 million). The increase in total owner costs would be from an increase in effort (more costs associated with fishing). Even with the net increase in total owner cost, there would be a net increase in owner rent for the shrimp fishery ($12.748 million) (Table 2). Most of the increase in owner profit would occur in area 13-17 ($12.052 million), followed by area 18-21 ($0.884 million). There would be a decrease in owner profits in area 9-12 ($0.188 million) with this closure type (Table 2).

In each of the three areas the owners of the bay boats would show a net loss in profits with this closure type (Table 4). The owners of the <55 ft vessels would show a loss in profits in both area 9-12 ($0.094 million) and area 18-21 ($0.018 million), but would have increases in profits in area 13-17 ($0.251 million) (Table 4). The owners of the ≥55 ft vessels would have a loss in profits in area 9-12 ($0.020 million), but would have increases in profits in the other two areas ($11.896 million in area 13-17 and $1.063 million in area 18-21) (Table 4).

Closure 3:

The third policy change considered was an offshore white shrimp closure in conjunction with an offshore brown shrimp closure during the period from May 15 through July 15, combined with a white shrimp only closure during the September 1 through October 31 period. During the initial year of the closure, pounds of shrimp landed would be reduced by 4.984 million pounds when compared to the baseline condition (Table 2). Most of the reduction would occur in area 13-17 (2.890 million), followed by area 9-12 (1.274 million), and then by area 18-21 (0.820 million). White shrimp landing totals would be reduced by 4.640 million pounds (Table 3), with over half (2.392 million) coming from area 13-17. Area 9-12 would have a net decrease in white shrimp landings of 0.983 million pounds with no gains in any of the shrimp size groups (Table 3). Area 13-17 would have a net decrease of 2.392 million pounds with gains in the <30 count size groups. Area 18-21 would have a net loss in white shrimp production of 1.265 million pounds, with no gains in any of the shrimp size groups (Table 3).

The initial year of the closure would have a net increase in ex-vessel revenue of $3.030 million over baseline conditions (Table 2). All of the increase in ex-vessel revenue would come from area 13-17 ($7.302 million).

There would be losses in ex-vessel revenue in both area 18-21 ($1.176 million), and area 9-12 ($3.096 million).

Total owner cost in the fishery would show a net decrease in each of the three areas, with the overall loss at $7.310 million. The decrease would be from a combination of reduced effort (less costs associated with fishing) and reduced landings (less charges associated with unloading). With the overall net decrease in total owner cost and the net increase in ex-vessel revenue, there would be an overall net increase in owner rent (profit) ($10.340 million) (Table 2). All of the increase in owner profit would occur in area 13-17 ($11.957 million). There would be a decrease in owner profits in both area 9-12 ($1.313 million) and area 18-21 ($0.304 million) with this closure type (Table 2).

In each of the three areas the owners of the bay boats would show a net loss in profits with this closure type (Table 4). The owners of the <55 ft vessels would show a loss in profits in both area 9-12 ($0.218 million) and area 18-21 ($0.072 million). There would be an increase in owner profits in area ($0.297) (Table 4). The owners of the ≥55 ft vessels would have a loss in profits in area 9-12 ($0.786 million), but would have increases in profits in the other two areas ($12.040 million in area 13-17 and $0.156 million in area 18-21) (Table 4).

CONCLUSIONS

Each of the white shrimp closure options have a positive benefit to the shrimp fishery (profits to the vessel owners) in the Gulf of Mexico. The first closure, an offshore white shrimp closure in conjunction with an offshore brown shrimp closure during the period from May 15 through July 15, has a total Gulf of Mexico benefit to the vessel owners of $6.048 million. Area 13-17 had the majority of the increase in profits with $5.318 million, while area 18-21 had an increase of $0.826 million. Owners of ≥55 ft vessels had the most increase in profits in these two areas. There was a slight decrease ($0.096 million) in owner profits in area 9-12.

The second closure, an offshore white shrimp closure in conjunction with an offshore brown shrimp closure during the period from May 15 through July 15, combined with a white shrimp only closure during the September 1 through September 30 period, has a total Gulf of Mexico benefit to the vessel owners of $12.748 million. Area 13-17 had the majority of the increase in profits with $12.052 million, while area 18-21 had an increase of $0.884 million (only slightly better than the first closure type). Owners of ≥55 ft vessels had the most increase in profits in these two

areas. There was a slight decrease ($0.188 million) in owner profits in area 9-12.

The third closure, an offshore white shrimp closure in conjunction with an offshore brown shrimp closure during the period from May 15 through July 15, combined with a white shrimp only closure during the September 1 through October 31 period, has a total Gulf of Mexico benefit to the vessel owners of $10.340 million. Area 13-17 had the majority of the increase in profits with $11.957 million, while area 18-21 had an decrease of $0.304 million. Owners of ≥55 ft vessels had the most increase in profits in these two areas. There was a decrease ($1.313 million) in owner profits in area 9-12.

If the GMFMC considers any of these types of management closures, it is recommend that they develop an active planning group to design the implementation of such management measures. Without effective planning, it would be virtually impossible to insure that any closure could be implemented without major unrest. Consideration must be given to the social and economic shifts and impacts on packing, processing, distribution and markets as well. Further, once the fishing community understands the profit that will be gained from these types of management measures, there will be rapid boat building and a major increase in fishing effort. The result will be a dissipation of profit after several years. Therefore, it is important that the GMFMC consider some form of limited entry or quota system so that profit from such management measures will not be dissipated.

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Table 1. Characteristics of Categories for Modelling Purposes

Category	Depth (fm)	Areas	Vessel Classes
1	Inshore	09-12	Unregistered, inshore
2	0-5	13-17	Registered, <55 ft
3	6-10	18-21	Registered, ≥55 ft
4	11-20		
5	>20		

Table 2. Data Summary for Each Area and Closure

Closure: Brown and White May 15 - July 15.
Difference from Brown Only Closure. Units in Thousands.

AREA	LANDINGS	REVENUE	TOTAL COST	RENT
9-12	-308	-551	-455	-96
13-17	-658	4,953	-365	5,318
18-21	-36	749	-77	826
TOTAL	-1,002	5,151	-897	6,048

Closure: Brown and White May 15 - July 15; White only September 1 - September 30.
Difference from Brown Only Closure. Units in Thousands.

AREA	LANDINGS	REVENUE	TOTAL COST	RENT
9-12	-502	-935	-747	-188
13-17	1,289	14,372	2,320	12,052
18-21	-98	984	100	884
TOTAL	689	14,421	1,673	12,748

Closure: Brown and White May 15 - July 15; White only September 1 - October 31.
Difference from Brown Only Closure. Units in Thousands.

AREA	LANDINGS	REVENUE	TOTAL COST	RENT
9-12	-1,274	-3,096	-1,783	-1,313
13-17	-2,890	7,302	-4,655	11,957
18-21	-820	-1,176	-872	-304
TOTAL	-4,984	3,030	-7,310	10,340

Table 3. White Shrimp Landings by Count Size Groups

Closure: Brown and White May 15 - July 15.
Difference from Brown Only Closure. Units in Thousands.

AREA	<20	21-30	31-50	51-67	68-95	96-135	>135	Total
9-12	-25	-54	-2	0	0	0	0	-80
13-17	428	-387	-177	-107	-43	1	22	-264
18-21	-16	-88	3	4	2	-7	-11	-113
TOTAL	387	-529	-176	-102	-41	-6	11	-457

Closure: Brown and White May 15 - July 15; White only September 1 - September 30.
Difference from Brown Only Closure. Units in Thousands.

AREA	<20	21-30	31-50	51-67	68-95	96-135	>135	Total
9-12	-42	-122	-113	-40	-27	-3	1	-347
13-17	777	882	675	-241	-261	-179	-20	1,633
18-21	-25	-210	-140	-8	-4	-13	-8	-408
TOTAL	710	550	423	-289	-292	-195	-28	878

Closure: Brown and White May 15 - July 15; White only September 1 - October 31.
Difference from Brown Only Closure. Units in Thousands.

AREA	<20	21-30	31-50	51-67	68-95	96-135	>135	Total
9-12	-87	-301	-296	-112	-112	-71	-4	-983
13-17	798	303	-124	-514	-1,427	-894	-534	-2,392
18-21	-191	-652	-293	-71	-31	-23	-5	-1,265
TOTAL	521	-650	-713	-697	-1,570	-989	-542	-4,640

Table 4. White Shrimp Closure - Owner Profit

All Values are Differences from Brown Only Closure.
Units are in Thousands of Dollars.

Areas and Vessel Types	Brown and White May 15 - Jul 15	Brown and White May 15 - Jul 15 with White Only Sep 1 - Sep 30	Brown and White May 15 - Jul 15 with White Only Sep 1 - Oct 31
Area 9 - 12			
Bay Boat	-25	-75	-309
<55 Vessel	-35	-94	-218
≥55 Vessel	-37	-20	-786
Total	-96	-188	-1,313
Area 13 - 17			
Bay Boat	-73	-95	-380
<55 Vessel	27	251	297
≥55 Vessel	5,364	11,896	12,040
Total	5,318	12,052	11,957
Area 18 - 21			
Bay Boat	-77	-161	-388
<55 Vessel	5	-18	-72
≥55 Vessel	898	1,063	156
Total	826	884	-304