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Gear and Economic Efficiency Results of a Sea Grant Twin-Trawl Demonstration in South Carolina¹

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ABSTRACT

Twin trawls have been utilized by a few commercial shrimpers and refined through sea trials by Sea Grant programs in North Carolina and Georgia. However, South Carolina shrimpers have not invested in the new equipment. Two-seam nets were used on a vessel of a class (40-59 ft.) which was thought could benefit most from twin trawls. The 2-month demonstration was designed to indicate the economic feasibility of utilizing the twin trawl for brown shrimp harvesting in shallow water (less than 30 ft.). The analysis of results through partial budgeting indicates that this gear increases yield sufficiently to justify the additional investment on vessels of similar horsepower and length.

INTRODUCTION

Most gear research on the shrimp otter trawl has concentrated on improving the catch efficiency of the net itself (e.g., Marinovich and Whiteleather, 1969; Seidel, 1969). In contrast, the recent twin trawl experimentation does not represent an effort to improve the efficiency of the trawl net design itself. Instead, it

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is basically a return to the principles which motivated trawler owners in the South Atlantic states and Gulf of Mexico to switch from pulling one net to two nets during the late 1950s. The benefits of double-rig trawling to fishermen also seem to apply to the twin trawl. For example: (1) By allocating the catch among more nets, the crew's ability to handle the gear increases because the nets and doors are smaller for the same effective trawl sweep. (2) It is also believed that the double-rig trawling design increases the bottom line's linear contact with the substrate compared to the single-rig design. The second factor is also apparently important in the twin trawl design (Dave Harrington, personal communication).

Although there was some twin trawl experimentation by trawler owners in the South Atlantic states and in the northern Gulf of Mexico in the 1960s, not until recently did it gain the interest of the industry in the Southeast (Bullis and Floyd, 1972; Harrington, Bartlett, and Higgins, 1972). The increase in fuel costs, especially during 1973, has probably contributed to this recent interest. Prior to the drastic increase in fuel costs, shrimpers frequently repowered their vessels with larger engines or replaced the vessel with a larger, more powerful vessel in order to pull larger nets. The scarcity and high cost of capital in 1974-75 to finance such new purchases also encouraged shrimpers to evaluate the suitability of twin trawls as an alternative means of increasing linear contact of the net with the bottom. In the Carolinas and Georgia, the choice of increasing vessel size (length) and consequently horsepower has an additional disadvantage since many vessel owners like to maintain the alternative of fishing in the shallow estuarine and near-shore waters. In South Carolina, this particular phenomenon is reflected in the length and horsepower of resident vessels (Tables 1 and 2). Many vessels (Table 1) are less than 69 feet in length, with about 59% between 40-59 feet. The twin trawl may represent an additional alternative for trawler owners for increasing the vessel's fishing power without concurrently increasing capital needs.

During 1973 and early 1974 South Carolina trawler captains made such frequent requests of the Sea Grant Extension Advisory Program for twin trawl information that a demonstration was arranged. In May, 1974, the trawler *Captain Gene*, owned by the University of Georgia, conducted a demonstration of twin trawls for shrimpers at four South Carolina ports. Subsequently, meetings were held with captains to explain net designs and show a film which included scenes of the gear operating underwater. The demonstrations and meetings were held to provide enough information about various aspects of the gear that each captain could decide on its usefulness in his particular operation. In 1974, only one captain invested capital and time in twin trawls following the meetings. Apparently, three factors were at work: (1) captains had received sufficient information and rejected its use in the near future, or (2) the meetings and demonstrations were imperfect substitutes for a full scale commercial test, and (3) undoubtedly the financial losses during the 1974 shrimp season increased the reluctance of owners to risk new gear experimentation then. That year produced losses ranging from \$6,658 to \$13,610 per trawler (Roberts, 1975).

Table 1. Registered length of double-rigged shrimp trawlers licensed as resident South Carolina owners during fiscal year July 1, 1974, to June 30, 1975

Length Class (Feet)	Number	Percent	Accumulated Percent
19 and less:	1	.3	.3
20-29:	8	2.9	3.2
30-39:	29	10.7	13.9
40-49:	81	29.8	43.7
50-59:	78	28.7	72.4
60-69:	55	20.2	92.6
70-79:	16	5.9	98.5
80-Greater:	4	1.4	99.9

Prior to the 1975 shrimp season, the president of the South Carolina Shrimpers Association identified, via a request for a commercial test, that the second factor was responsible. The commercial demonstration would fit the industry's learning profile by permitting shrimpers to teach other shrimpers.

Table 2. Reported horsepower of double rigged shrimp trawlers licensed as resident South Carolina owners during fiscal year July 1, 1974, to June 30, 1975

Horsepower (Class)	Number	Percent	Accumulated Percent
69 and less:	7	2.6	2.6
70-119:	39	14.4	17.0
120-149:	16	5.9	22.9
150-164:	27	10.0	32.9
165-189:	77	28.4	61.3
190-279:	49	18.1	79.4
280-399:	45	16.6	96.0
400 and Greater:	11	4.1	100.1

PROCEDURE

The demonstration was conducted with nets designed by the two captains participating and purchased by the Sea Grant Extension Marine Advisory Program. The participating captains thought the twin trawl was best suited to the brown shrimp fishery from mid-June to mid-August. A demonstration to isolate the merit of the gear was designed as follows: (1) A trawler with low horsepower, comparatively slow towing speed, and restricted outrigger length was equipped with the twin trawl gear. Such boats are numerous in South Carolina and have comparatively few means of increasing productivity. (2) The catch of the boat equipped with the twin trawl was compared with that of a standard double-rig trawler. (3) The two vessels trawled the same area for equal periods. (4) One captain controlled, when both trawlers were shrimping, the fishing time and duration of the trip. (5) Weekly reports on the productivity of both trawlers were provided.

This procedure tended to equalize stock availability, captain's skills, and productive fishing time in order to focus on the gear's performance. Although Chleborowicz (1974) evaluated the twin trawl's benefits in North Carolina from an engineer's standpoint, he made no attempt to eliminate the effects of captain's skills, number of trips, and area fished.

Two captains from Shem Creek near Charleston, South Carolina, agreed to assume the risk of working the gear during the brown shrimp season and to conform to the above procedure. The *South Seas*, a 56-foot trawler with a 180-horsepower engine and 36-foot outriggers, was the test boat. During brown shrimp season it would normally pull 60-foot two-seam nets. The *South Seas* worked under the direction of Wally Shaffer, Jr., captain of the comparison vessel, *Carol El*. The *Carol El* is a 70-foot trawler with 325 horsepower which during brown shrimp season pulls 75-foot two seam nets. The authors assume that the *Carol El* has a higher fishing power compared to the *South Seas* due to its higher horsepower.

RESULTS RELATING TO GEAR EFFICIENCY

The *South Seas* and *Carol El* conducted the demonstration from June 28, 1975 to August 22, 1975 on grounds between the north jetty of Charleston harbor and Capers Island. The specifications of the two-seam twin trawls with which the demonstration began are shown in Table 3. The nets were designed and built locally to acquaint local net builders with the design and to attract their attention to the demonstration. The towing speed of the *South Seas*, while faster than that experienced with conventional 60-foot two seam nets, was not up to expectations. One of the four nets was modified to specifications shown in Table 3 and compared for productivity to a net with the original design. There being no production differential, the remaining nets were similarly modified. After these modifications the towing speed on the *South Seas* increased to that of the larger *Carol El*. Apparently the reduced webbing decreased the hydraulic drag of the net.

Two minor adjustments which were made in early July had a significant beneficial effect on the ease with which the gear was worked. The four doors were 5 feet by 30 inches with 3/4 by 6-inch runners. Initially the concern was whether or not two such doors would spread the twin 33-foot nets. Excessive spread was experienced as evidenced by the inside doors tangling frequently behind the vessel in spite of adjustments made in the towing cable's length. Paint was sprayed on the inside doors after each adjustment to identify the degree of success. After several trials, "windows" were cut in the inside doors to achieve a 25% reduction in surface area. A second adjustment proved successful in correcting a minor but aggravating problem. A highly buoyant line with a plastic float attached was used between the bags to prevent the bag straps from becoming tangled in the chaffing gear.

The second net modification indicated in Table 3 occurred in the last week of August. White shrimp began to comprise most of the catch at the end of the third week in August. The captains modified the wings in one of the nets and

Table 3. Specifications for two-seam nets used in Sea Grant twin trawl demonstration, 1975

Item	(footrope length: 33ft., 1 ¼ inch mesh, 12 thread twine)		
	Original	Modification	
		#1	#2*
Top body	275 meshes	240 meshes	240 meshes
Bottom body	257 meshes	216 meshes	180 meshes
Taper (top & bottom)	2:1	3:1	3:1
Body depth	200 meshes	150 meshes	150 meshes
Top corner	50 wide, 55 long 20 jib.	40 wide, 55 long 20 jib.	22 wide, 55 deep 20 jib.
Bottom corner	30 wide, 75 long 20 jib.	20 wide, 75 long 20 jib.	22 wide, 75 deep 20 jib.
Bag	120 meshes	95 meshes	95 meshes

*Essentially this is an 80 mesh wing at 2:1 taper from where the body sews to the end of the corner.

added more floats in an effort to improve capture of white shrimp. This proved to be unsatisfactory. Although the nets were removed from the *South Seas* on August 27, the data in the economic presentation to follow ends with the termination of the brown shrimp "season." This "season" was defined by industry simply as the emergence of white shrimp as the majority of the catch, i. e., August 22, 1975.

RESULTS RELATING TO ECONOMIC CONSIDERATIONS

The determination of production relationships and the specification of relevant variables in the production process is a passion of firm management-oriented economists. No attempt was made to make the demonstration previously described into a tightly controlled research project on production relationships. To do so would have dampened industry interest in conducting the demonstration as a means of self education. As it turned out, the shrimpers had designed the demonstration to isolate the performance of the twin trawls separate from stock availability, fishing time, and skill of the captains involved. This does not fully satisfy the econometrician whose job it is to statistically test production hypotheses based on cross section or time series data. The demonstration did not provide such data but did generate useful information. The shrimper as a decision-making businessman is concerned about the components of a particular decision and their associated dollar amounts. To this information he will naturally apply his own preference function for risk and discount rate.

Information on fuel consumption, gear costs, days fished, and weekly catch was collected on the two trawlers for both the 1974 and 1975 brown shrimp season. Table 4 indicates the results of the 1975 demonstration and the previous year's shrimp catch. In 1975, the twin trawl equipped *South Seas* surpassed its 1974 performance with two conventional 60-foot two-seams (Table 4): (1) For

Table 4. Comparison of productivity of twin trawls during May 28 – August 22, 1975, Sea Grant demonstration

	South Seas	Carol El	Total
1974			
days fished	43	43	86
catch (lbs)	11,773	22,514	34,287
1975			
days fished	43	43	86
catch (lbs)	8,438	12,300	20,738

Notes:

1. South Seas - Carol El comparison: 1974, 11,773 lbs. + 22,514 lbs. = 52%; 1975, 8,438 lbs. + 12,300 lbs. = 69%
2. 1974 versus 1975 individual comparison: South Seas, 8,438 lbs. + 11,773 lbs. = 72%; Carol El, 12,300 lbs. + 22,514 lbs. = 55%
3. South Seas production as percent of total: 1974, 11,773 lbs. + 34,287 lbs. = 34%; 1975, 8,438 lbs. + 20,738 lbs. = 41%

the same period in each year with an equal number of trips, the *South Seas* reached 52% of the *Carol El*'s production in 1974 and 69% of the *Carol El*'s production in 1975. (2) While production fell between 1974 and 1975 for identical fishing effort for both trawlers, the *South Seas* produced 72% of what it had in 1974, while the *Carol El* reached only 55% of its 1974 production. (3) If one were to view the two boats as a unit owned by one captain, a relevant comparison would be that the *South Seas* produced 34% of the trawlers' total catch in 1974 and 41% of the combined catch in 1975.

The partial budgeting technique will enable a dollar estimate of twin trawl feasibility based on the information available. A partial budget is used to generate decision information that concerns only one part of the business, e. g., the brown shrimp season. Essentially the technique involves combining cost and production information on the contemplated change in the business. The total pluses and minuses are compared to reveal a net benefit or cost. Cost information for the analysis is presented in Table 5. For comparison purposes the partial budget is arranged to simulate the choice facing a captain as to the feasibility of purchasing new twin trawls or conventional two seams. The partial budget for the decision to equip the *South Seas* and similar boats with twin trawls or conventional two seams is as follows: (1) Increased costs? (The cost of the twin trawl gear) \$ 2,947.50 (2) Decreased costs? (The cost of conventional two seams) \$ 1,926.75 (3) Increased receipts? (Twin trawl production, 8,438 lbs., at \$1.44 per lb. heads off) \$12,150.72 (4) Decreased receipts? (Conventional two seam production in 1975, if proportional to 1974 catch, 6,396 lbs., at \$1.44 per lb. heads off)² \$9,210.24 (5) Potential gross benefit is decreased cost *plus* increased receipts: \$1,926.75 + \$12,150.72 = \$14,077.47 (6) Potential gross debit is increased cost *plus* decreased receipts: \$2,947.50 + \$9,210.24 = \$12,157.74 (7) Net benefit: \$14,077.47 – \$12,157.74 = \$1,919.73.

²Assumes the *South Seas*' production compared to the *Carol El*'s production in the 1975 period of study would have been the same as in 1974 (52%) if conventional two seams were fished in 1975 (.52 X 12,300 lbs. = 6,396 lbs.).

Table 5. Twin trawl and conventional gear costs for brown shrimp fishing in Charleston, South Carolina, May 1975

Item	Twin Trawl		Conventional	
	Quantity	Cost	Quantity	Cost
Nets	5*	\$1,897.74	2	\$1,146.89
Doors	4	559.94	4	713.86
Dummy sleds	2	189.90	0	—
Cable (ft.)	500†	205.00	0	—
Chain (ft.)	152	75.92	120	66.00
Miscellaneous (splices, thimbles)	—	19.00	0	—
Total		\$2,947.50		\$1,926.75

*A spare net was built to facilitate testing of modifications. It is recommended that the five net approach be adopted commercially.

†Necessary for middle bridle on twin trawls.

The net benefit of using the twin trawls during this 7-week period of 1975 was \$1,919.73. The implication from this demonstration and partial budget is that twin trawls will pay their way. If the assumption cited in footnote 2, although plausible, fails to please the puritanical, the information can be arranged in another manner. A comparison of the costs of the two gear types reveals that twin trawls would require additional initial investment of \$1,020.75. With the average brown shrimp price for the June to August 1975 period for 41- to 55-count sizes in Charleston being \$1.44 per pound, the break even catch is approximately 710 pounds. Thus, 710 pounds more shrimp would have to be landed for the same effort if the additional investment were to be repaid in one season. Captains expect the useful life of nets to be at least two seasons on the shrimp grounds in South Carolina. Consequently, the increased catch necessary, at 1975 prices, to pay the additional cost of the twin trawl gear would be approximately 710 pounds.

SUMMARY

The demonstration reported in the paper was a blend of Sea Grant Extension expertise and native intelligence provided by industry participants. The need evolved from extension work over an 18-month period. The demonstration would not have been successful without the problem specification phase. Industry participants focused on gear efficiency improvements and economic feasibility consideration. The gear and economic findings of the demonstrations suggest increased use of twin trawls on similar boats for brown shrimp in South Carolina.

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