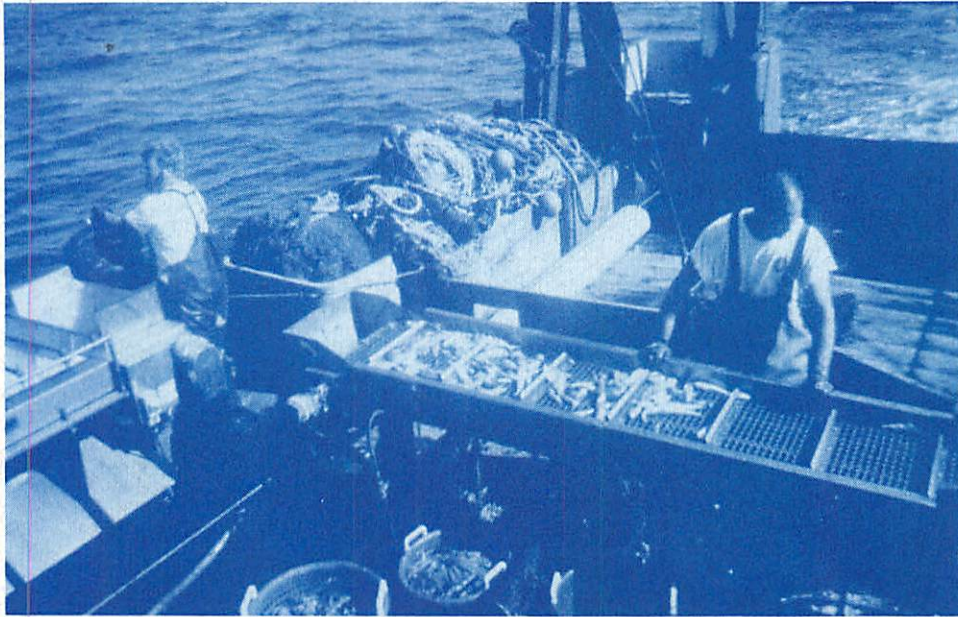


*Royal Red Shrimp:
An Emerging Deep-Sea Fishery
in the Northeast*



*A report on the results of a federal
Fishing Industry Grant project
awarded to Clinton Fisheries, Inc.*

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*by Nancy Balcom,¹ John Leamon,²
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Introduction

There are several key considerations for Northeast fishermen moving into deep water to target royal red shrimp (*Pleoticus robustus*) or any deep-sea species. The first is the amount of additional capital investment required to outfit a vessel to tow and haul back from great depths safely and efficiently. What depths will be fished? What kind of gear will be used? Are existing winches and hydraulics adequate, or is there a need to invest in new ones designed for deepwater operations? Are new electronics needed? Trawl doors? Processing equipment? How much capitalization is required to target this new species?

The second consideration is finding one or more new species that are both acceptable to seafood consumers *and* profitable to the fishing operation. Compare the cost to enter the fishery with estimated profits, factoring in expenses associated with any capital outlay, labor, processing, and operations (longer distances to fishing grounds, price of fuel and repairs, etc.) as well as the capacity to process, ice or freeze at sea. What kind of return can be expected for the product form (fresh, frozen, processed, unprocessed)? How much will market prices and demand fluctuate?

A third is an ecological consideration for the resources. The stressed status of many nearshore and coastal stocks has been the impetus for the shift to explore and harvest deep-sea resources. Deep-sea species tend to do things slowly--they grow slowly, mature slowly, and reproduce slowly. Deepwater resources of the Northwest Atlantic have not been the target of fishing pressure until recently and little is known about these resources. It is important for fishermen and fishery managers to determine early on whether or not a species can sustain long-term harvest pressure, or whether its growth and reproductive characteristics make it susceptible to overharvesting unless fishing pressure is regulated. It may be necessary to set up deep sea fisheries as experimental, with limited entry, until more is learned about the resources.

This report provides a summary of one of four federal Fishing Industry Grant (FIG) projects awarded in support of deep-sea resources exploration in 1995. While it does not by any means provide all the answers, the results of this project provide insight into the potential of a new fishery targeting royal red shrimp, and give some indication of the capitalization required to outfit a commercial vessel to harvest this species, as well as the market and profitability outlook for this species. The project results also point to information gaps that should be looked at in the near future, as fishing effort on this species is expanding rapidly.

Objectives

The purpose of this FIG project was to assess the commercial viability of the deep-sea scarlet shrimp, *Plesiopenaeus edwardsianus*, during a six-week period, along the upper continental slope off southern New England and the mid-Atlantic. Published reports noted the commercial potential of the scarlet shrimp, and anecdotal information indicated that this large shrimp had been caught in quantities incidentally by fishermen. In reality, fewer than 100 specimens of scarlet shrimp were caught in 74 tows at the depths and locations towed during this project. It is possible that scarlet shrimp can be found in quantities in deeper, more northern waters, but documentation of that was beyond the scope and capabilities of this project. However, a different species of shrimp, the royal red shrimp, was caught in harvestable quantities and thus became the *de facto* focus of the project.

The project was carried out on the *F/V Patty Jo*, a 95' western-rigged sea scalloper owned and operated by the William I. Bomster family of Stonington, Connecticut during a six-week period in

September and October of 1995. The objectives of the project were to:

- ✓ *Assess commercial quantities of royal red shrimp while conducting a stock assessment, within the limitations of 30 days at sea during the first quarter of 1995.*
- ✓ *Examine the feasibility of targeting this deep water species using existing winches, net reel and doors presently on board the F/V Patty Jo, purchasing only new nets and towing wire. (It was later determined that new doors would have to be purchased as well.)*
- ✓ *Develop processing and freezing methods for shrimp, building on successful methods currently used for sea scallops.*
- ✓ *Assess extent of bycatch problem, test performance of Nordmore grate in the deep water shrimp nets to reduce or eliminate bycatch problem.*
- ✓ *Test the market acceptance of the shrimp as frozen (head on, head off) or fresh product.*
- ✓ *Collect data and samples of the shrimp and bycatch species for scientific analysis.*

The F/V Patty Jo was newly outfitted with the following:

1,000 fathoms of 5/8" tow wire (per drum)
Two - 150' sweep shrimp nets with two-inch mesh and mud rollers
Four-meter PolyIce® trawl doors
30" Kerian® shrimp sizer
Shrimp Pro 2000® (to de-vein & butterfly shrimp)
Nordmore grate with two-inch spacing between slats

Total capital outlay to re-fit the F/V Patty Jo for shrimping was about \$50,000. This vessel was already equipped with a conveyor to which a spray wash system was rigged, a Dole® plate freezer, and a vacuum pack machine.

Three cruises were made during September and October 1995, between Veatch canyon and the Virginia line on sandy or muddy bottom (see Appendix for bridge logs). Seventy-four tows were taken, at an average hauling speed of 2.5 - 2.9 knots per hour. The net was towed at depths ranging from 156 fm to 410 fm (288 m to 757 m) in water temperatures ranging from 7.0°C to 10.7°C. Tows were made with the current, into the current and across the current. Tow length (from time trawl hit water to start of haulback) ranged from 45 minutes to 3.5 hours. Time of haulback varied according to depth fished. Water temperature and depth were recorded at one minute intervals for the majority of tows during Cruises 1 and 2, using a computer-interfacing minilog that was inserted into a casing attached to one of the doors. Computer failure prohibited the collection of similar data during the third cruise.

For each tow, the catch was sorted into bushel baskets. The amount of monkfish, large whiting and shrimp caught was recorded. All unusable bycatch and regulated species were returned to sea. (For the purpose of this project, bycatch refers to anything other than the targeted shrimp species.) Some of the shrimp were weighed and measured, and samples were frozen for further study. The majority of the shrimp were processed and frozen on board. During the third cruise, tows were made with and without the Nordmore grate installed in the net and the resulting effects on bycatch documented.

Findings

The results of this project provide limited data on the commercial viability of deep-sea shrimp during a contiguous six-week period. The target species for the project was the scarlet shrimp, *Plesiopenaeus edwardsianus* (Figure 1), however, this species was not found in commercial quantities south of Cape Cod at the depths fished. Fewer than 100 scarlet shrimp were caught during the three cruises. However, commercial quantities of the royal red shrimp, *Pleoticus robustus* (Figure 2), were harvested, and by default, became the target species for the project. According to *An Illustrated Guide to Shrimp of the World* (Dore and Frimody, 1987), royal red shrimp grow to 225 mm (8.9 inches). They like muddy or silt bottoms at depths of 245 to 730 meters (880 to 2,400 feet), and prefer a temperature range of 7° to 13° C (45°F to 55°F). They are a soft-fleshed shrimp, with color ranging from pink to red.

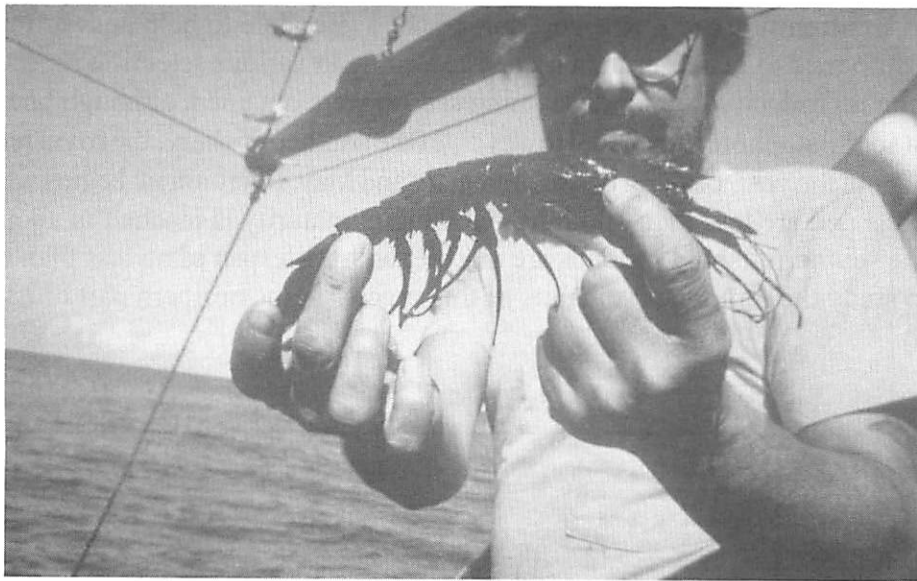


Figure 1. Scarlet shrimp, *Plesiopenaeus edwardsianus* (photo by John Leamon)

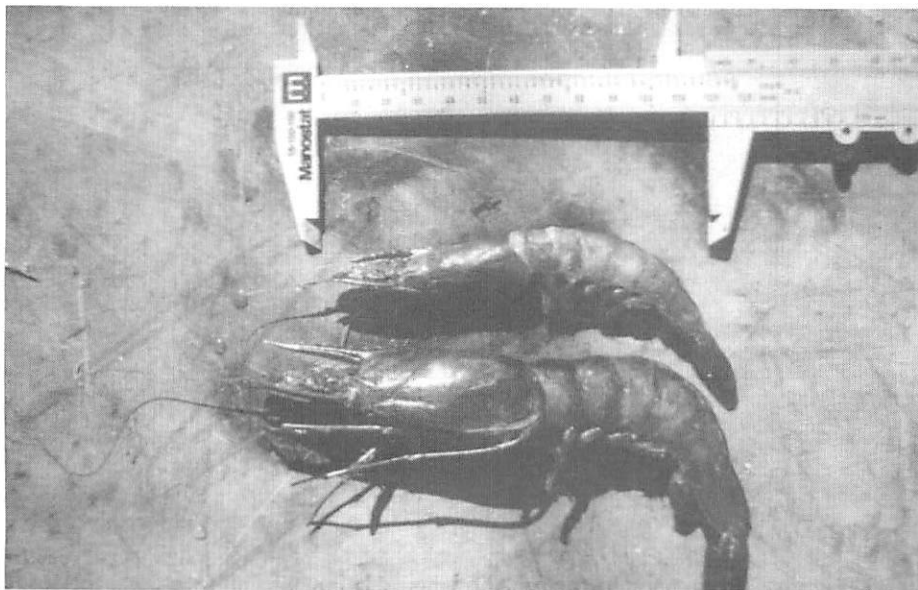


Figure 2. Royal red shrimp, *Pleoticus robustus* (photo by John Leamon)

Royal reds were caught in quantities of 0 lbs to 500 pounds per tow. The shrimp appeared to be distributed in pockets. They were not found in significant quantities during the second cruise, which explored south of Hudson Canyon to the Virginia line. (However, this deepwater peneid has been the subject of a commercial fishery from Cape Hatteras to Brazil in depths between 140-300 fathoms (256-549 meters).

Eleven thousand pounds (heads-on) of shrimp were harvested, with an average catch-per-unit-effort (CPUE) of 61.6 lbs/tow hour (range 0-225 lbs/tow hour; std. dev. = 61.8 lbs/tow hour; N=74). The CPUE was lower than it might normally be, due to the stock assessment objective of the project which necessitated the continual movement of the vessel in an effort to assess distribution and abundance. Shrimp accounted for 0% to 55.6% of each tow, averaging 28.5% (N=37; std. dev. =14.3).

A frequency histogram (Figure 3) of oblique carapace lengths (OCL) measurements of royal red shrimp reveals a bimodal distribution that breaks in the 41-45 mm size range. It is unknown whether this size differential reflects two cohorts or age classes or whether it is gender-related. Samples of whole shrimp, currently frozen, will be examined at a later date to help answer this question. Female royal red shrimp tend to be larger than males, according to various scientific reports.

No data on reproductive state or spawning season were obtained, although one female shrimp was found with a spermatophore attached. However, in the southern fishery, the royal red shrimp reportedly spawn throughout the year, peaking between January and May. Recruitment begins when shrimp approach one year of age and are less than 100 mm total length; maturity is reached in about three years. Most shrimp on the southern fishing grounds are mature, with a lifespan of no less than five years. It will be important to study the reproductive habits of this species in the northern part of its range.

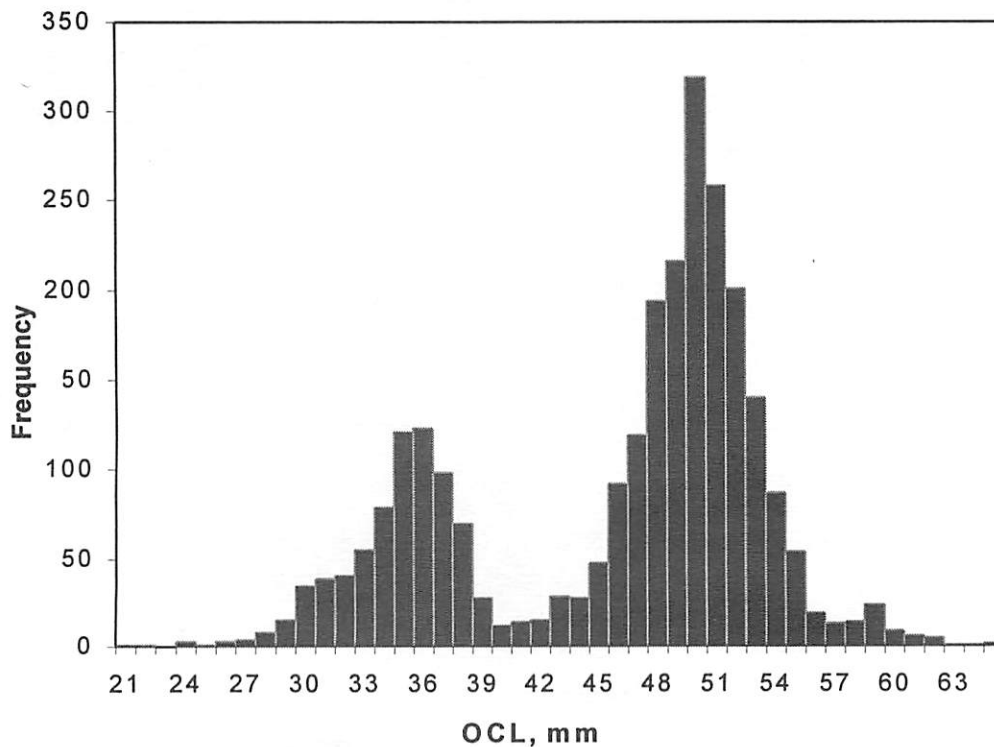


Figure 3. Frequency histogram showing breakdown of oblique carapace lengths in mm. Note break in the 41-45 mm range. (N=2,589)

Bycatch

During the third cruise, a Nordmore grate was installed in the net (Figure 4) for several tows, to determine its effect on reducing bycatch (defined in this case as anything other than shrimp). Monkfish, large whiting and shrimp were separated from the remainder of the catch, and sorted into bushel baskets. The remainder of the bycatch was also sorted into bushel baskets, with the contents of the first and last baskets set aside so that the contents could be examined and grouped loosely into categories. A plot of the number of bushel baskets of total catch, monkfish, shrimp and other bycatch (Figure 5) caught per tow during the bycatch retention/exclusion study illustrates that the grate reduced the catch of monkfish to almost zero, leaving the catch relatively clean (Figure 6). This was doubly beneficial, since the monkfish could not be kept, and their weight and enthusiastic eating habits tended to ruin the shrimp. As it happened, some of the tows made with the grate installed were in areas where the royal red shrimp were scarce, resulting in low shrimp catch rates as well.



Figure 4. Nordmore grate installed in net (photo by John Leamon).

Large monkfish accounted for 4.8% to 35.7% of each tow without the grate. The Nordmore grate reduced monkfish take to 0% to 3.7% of each tow. The first and last bushel of "other" bycatch were kept and sorted into general categories, which were then weighed. From this information, percent of total catch was calculated. This breakdown of the total catch (in bushels) into general categories, such as monkfish, large and small whiting, shrimp, crustaceans, blackbellied rosefish, flatfish and miscellaneous, is illustrated in Figures 7a (no grate installed) and 7b (grate installed).

The Nordmore grate was awkward to use, particularly because it could not roll up on the net reel. As a result, a double bite (two whips) was needed to pull the net in. Fortunately, a bull rope was also attached to the grate, which made it possible to retrieve the grate when the net hung up and tore. Two-inch slats seem adequate to reduce larger fish and overall bycatch. The effectiveness of soft excluder devices (soft panels) should be examined, since they can be handled more easily, and can wrap right onto the net reel.

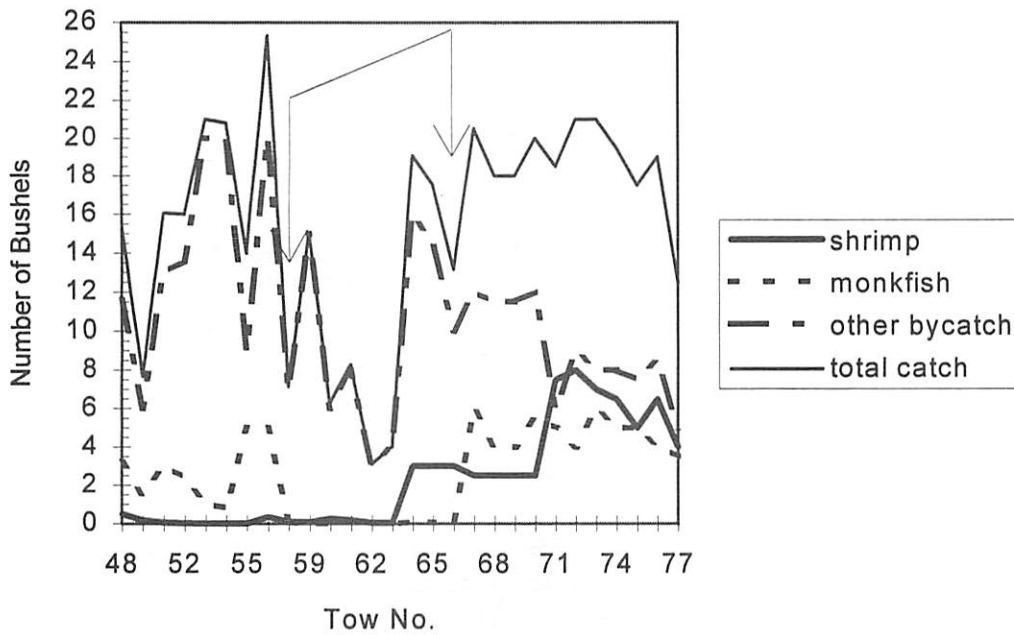


Figure 5. Number of bushels by category and tow. Arrows indicate tows with Nordmore grate.

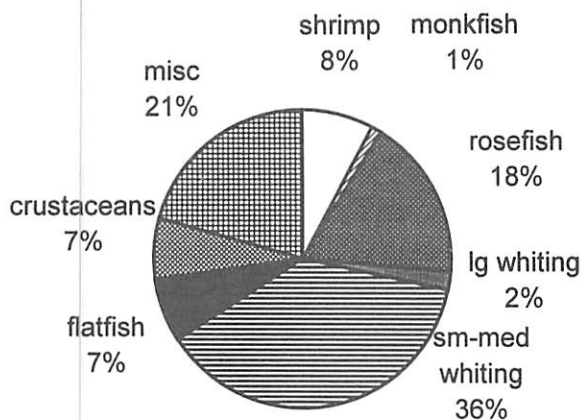
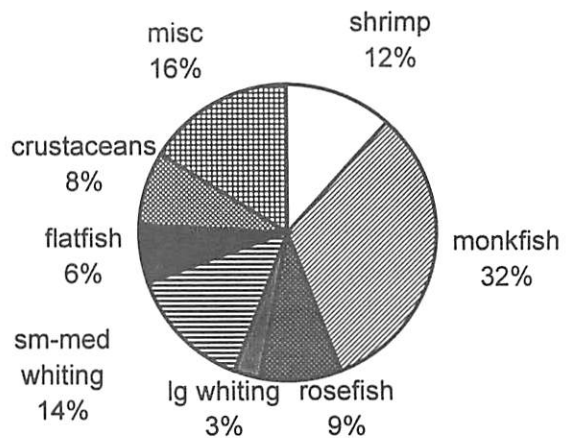


Figure 6. Relatively clean tow resulting from use of Nordmore grate. The predominant fish species is the blackbellied rosefish, *Helicolenus dactylopterus* (photo by John Leamon).

Processing and Marketing

The shrimp were washed as they were sorted from the conveyor belt into bushel baskets. The shrimp were then put through the Kerian grader for sizing, which broke the product into two

Figure 7a (right) and 7b (below) illustrate the breakdown of the total catch by category resulting no use of Nordmore grate (right) and use of the grate (below). Note the reduction of monkfish catch from 12% to 1% with grate installed.



counts based on size: 20 count (21-25 per pound) and 40 count (36-40 per pound). The shrimp were treated with EverFresh®, a melanosis inhibitor for shrimp blackspot prevention, and supercooled in an ice brine chill tank (Figure 8) until they could be headed and frozen. During the first cruise, 2,700 pounds were brought in fresh, but the remainder of the shrimp was frozen during all subsequent cruises. Shrimp were vacuum packed and frozen with heads on during the first cruise, but for subsequent cruises, the shrimp were headed by hand, individually quick frozen (IQF) on trays in the Dole plate freezer and boxed. IQF was the preferred product form of buyers, particularly attractive to chefs.

In addition to selling shrimp to wholesalers, some of the shrimp were marketed as “Stonington Reds” through the grantee's wholesale/retail company, Stonington Seafood Harvesters, Inc. It was difficult to sell the smaller count (36-40) shrimp at first. However, when the smaller shrimp were processed further (de-veined and butterflied), they became more attractive to chefs and other buyers.

Ex-vessel prices paid by wholesalers for the shrimp were \$2.00 /pound for fresh shrimp, and \$4.25 - \$5.00 per pound for the IQ frozen, headed shrimp (both counts). Anecdotal information on sales of iced royal red shrimp (heads on) by other fishermen along the East Coast indicates the price can go as low as \$1.25 to \$1.80 per pound.

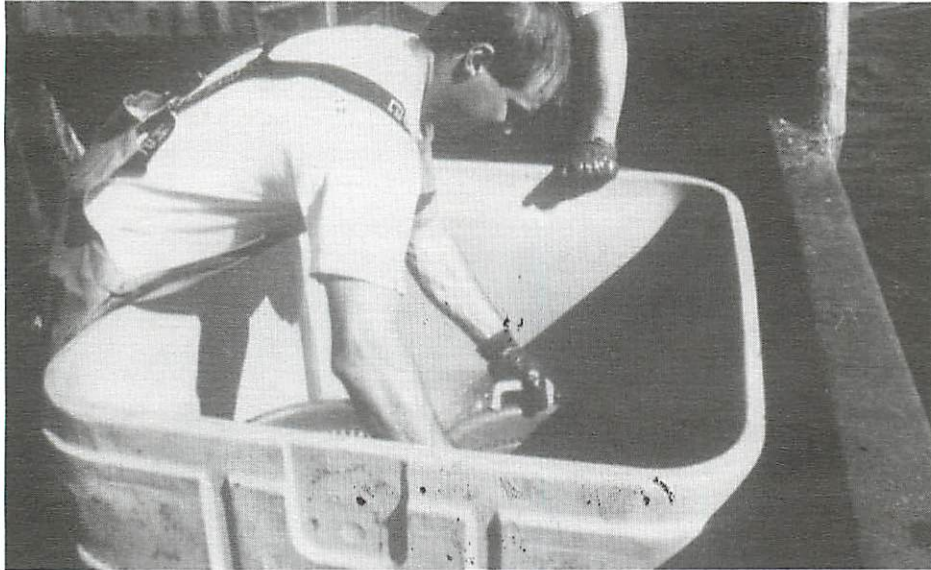


Figure 8. Bushels of shrimp are placed in an ice brine to superchill them until they can be headed and processed further (photo by John Leamon).

Shrimp purchasers were asked to fill out a questionnaire, which polled their opinions on the product, to help determine market acceptance and demand for the shrimp. Forty-eight completed questionnaires, representing thirty-seven “personal use” buyers, nine “chefs or buyers for restaurants” and two “wholesaler/retailers,” provided the basis for the information summarized in the following tables.

Table 1. Preferred form of shrimp by buyers, $N=43$.

Product Form	No.
Heads off, frozen	23
Heads off, fresh	12
Heads on, fresh or frozen	2
Heads off, fresh or frozen	2
Heads on, fresh	1
Heads on, frozen	1
Frozen, heads on or off	1
Heads on fresh; heads off, frozen	1

Respondents were asked to indicate the price range they were willing to pay for three count ranges (10-count, 20-count and 30-count). Unfortunately, this question was written with the larger scarlet shrimp in mind, and no modification was made to seek 40-count prices. For royal red shrimp, it can be assumed that the 20-count prices and the 30-count prices more closely fit potential market return. Frozen product prices probably reflect an expectation for IQF shrimp, since most customers received the product in this form.

Customers were also asked to rate the quality and organoleptic properties of the shrimp. The responses indicated that most felt the quality was excellent or good, the taste delicious, sweet, succulent and mild; the texture firm; and the scent mild. Only one response rated the product as poor, and one chef indicated that the shrimp was too mild and had no flavor. Some found the product texture soft. This shrimp does

Table 2. Survey results indicating average and range of prices market is willing to pay for royal red shrimp by product form. (Frozen product prices probably reflect expectation for IQF form.)

Product Form	10-count	20-count	30-count
Heads on, fresh	\$8.00/lb \$2.00 - \$12.99/lb N=8	\$7.50/lb \$5.99 - \$12.00/lb N=7	\$5.92/lb \$2.50 - \$8.00/lb N=6
Heads on, frozen	\$6.33/lb \$1.50 - \$11.99/lb N=6	\$6.50/lb \$4.99 - \$7.99/lb N=6	\$5.50/lb \$5.00 - 6.00/lb N=4
Heads off, fresh	\$8.22/lb \$2.50 - \$14.00/lb N=10	\$7.31/lb \$3.50 - \$10.00/lb N=8	\$5.31/lb \$2.00 - \$8.00/lb N=8
Heads off, frozen	\$7.51/lb \$2.25 - \$12.99/lb N=10	\$7.35/lb \$3.00 - \$10.99/lb N=15	\$6.06/lb \$2.00 - \$9.00/lb N=11

need to be handled quickly and carefully, and to be kept superchilled--a consideration for fishermen targeting the shrimp during the summer months.

Survey participants were asked if the shrimp product was available, would they consider buying it on a regular basis? Forty-seven said "yes", and only one said "no". On average, chefs surveyed were liable to use 275 pounds per week, with a range of 0 to 2,000 pounds per week (N=9). The seafood retailers and wholesalers surveyed (N=2) averaged about 100 pounds per week, and the personal use buyers averaged slightly more than 2 pounds per week, with a range of .25 pounds to 10 pounds per week (N=23). Other personal use buyers indicated that they would purchase shrimp 2-3 times per year, particularly for special occasions and holidays.

Table 3. Summary of responses to questions on quality and organoleptic properties of royal red shrimp.

Quality	Taste	Texture	Scent
Excellent - 31	Delicious - 30	Firm - 40	Pleasant - 29
Good - 14	Sweet - 23	Mushy - 4	Mild - 27
Average - 1	Mild - 15	Soft - 3	Strong - 0
Poor - 1	Succulent - 11	Unpleasant - 0	
	Rubbery - 5		
	Strong - 3	Mealy - 1	
	Other (gritty) - 1		

Processing the shrimp (sorting, grading, chilling, heading, de-veining, butterflying, freezing and boxing) is labor intensive, but it can all be done on board a fishing vessel between tows as part of crew costs. In comparing crew costs versus profit margin, it appears that if fishing effort is focused on productive

areas, the profit is sufficient to make targeting the shrimp worthwhile even on a part-time, fill-in basis. (This, of course, depends on start-up costs and any increase in operational costs.) It is unclear at this time whether it will be profitable for vessels to target these shrimp if they cannot freeze or process on board. The royal red shrimp is soft-fleshed and requires quick and careful handling to maintain its quality.

Conclusions

It can be concluded from this project that scarlet shrimp, *Plesiopenaeus edwardsianus*, are not found in commercial quantities on the upper continental slope off southern New England in the depths fished during this project. However, royal red shrimp, *Pleoticus robustus*, can be commercially harvested from upper continental slope waters (200 - 400 fathoms) of southern New England and the mid-Atlantic. The shrimp seem to be concentrated in pockets, over mud and sandy bottom, near features such as the offshore canyons.

The costs to outfit a vessel to harvest shrimp resources will vary, depending on how a vessel is currently equipped. In this case, new nets, doors, wire, mud rollers, Nordmore grate, shrimp grader, shrimp de-veiner, and miscellaneous supplies totalled approximately \$50,000. Existing winches, net reel and hydraulics were used, as well as the plate freezer and conveyor previously installed on the vessel. Winches and hydraulics are the primary limiting factors in determining how deep a vessel will be able to fish for the shrimp. Capitalization costs and increased operational costs should be balanced against potential profits to assess feasibility.

Royal red shrimp, particularly when they are sized, headed, and individually-quick-frozen, have strong market acceptance, and can be sold profitably. Larger count shrimp are easier to market. Ex-vessel prices can range from \$1.50 to \$5.00 per pound, depending on product form, count size, and quality. The shrimp received favorable reviews in terms of their quality and organoleptic properties. Most retail purchasers expressed interest in continuing to purchase the shrimp as available, and indicated a willingness to pay between \$1.50 and \$14.00 per pound, depending on product form, count, and quality.

A Nordmore grate used in conjunction with the shrimp net significantly reduces bycatch, especially eliminating the retention of large whiting and monkfish which can damage the shrimp in the net. Given the awkwardness of using the grate in the net, consideration should be given to testing the effectiveness of soft panels or TEDS in excluding bycatch from these shrimp nets.

More data are needed on the royal red shrimp, *Pleoticus robustus*, in the northern part of its range. Information is needed on age class structure, age of maturation, fecundity, spawning season, lifespan, feeding habits, etc. This data, combined with additional information on range and distribution, will help fishery managers and fishermen determine the ability of this species to support a directed commercial fishery off the upper continental slope of New England.



Appendix - Bridge Logs

F/V Patty Jo Cruise No. 1 Dates: 9/15 - 9/20/ 95

Date	Tow No.	Minilog Tow No.	Position - Trawl in Water		Position - Gear Haulback		Haul Depth (fm)	Avg. Haul Depth Temp °F	CPUE (catch per tow hour)	Total Catch (lbs)
			Lat/Long	Time	Lat/Long	Time				
9/16/95	1		39-57-56 70-46-20	6:15	39-57-37 70-53-18	8:15	220		—	0
	2		25-5-84 43-3-15	9:25	25-5-98 43-3-19	10:00	156-164		—	100 lbs; no shrimp
	3	001	14-5-30 43-2-91	11:05	14-5-01 43-2-89	12:05	217-222	44-46	20	20 lbs shrimp; 50% whiting, 20% red crab, 8 monkfish, 500 lbs total
	4	002	14-5-06 43-2-80	1:20	14-5-30 43-2-83	2:50	248	42	0	no shrimp; 500 lbs total; 75% whiting, 15% red crab, 19 monkfish
	5	003	14-5-09 43-2-95	4:10	14-4-98 43-2-96	6:05	200	44	156	20 monkfish; 15 grenadiers 300 lbs Royal Red shrimp; 700 lbs total
	6	no data	25-5-21 43-2-91	6:45	25-5-59 43-2-96	8:30	195-203		85.7	150 lbs Royal Red shrimp; 300 lbs total; 30% whiting, 40% monkfish
9/17	7	no data	14-4-70 43-2-95	3:25	25-5-69 43-3-01	6:00	182-190		153.8	25 monkfish; 7 bu Royal Red shrimp (400 lbs)
	8	004	25-5-60 43-2-97	6:30	25-5-10 43-2-90	9:40	190	46	109.4	350 lbs R.R. shrimp; 40% whiting, 20% monkfish, 15% red crab, 1000 lbs
	9	005	39-58-37 70-52-84	4:25	39-58-21 70-44-84	7:25	190	44-45	166.7	500 lbs R.R. shrimp; 900 lbs total-squid, whiting, red crab, galatheid, batfish

F/V Patty Jo Cruise No. 1

Dates: 9/15 - 9/20/ 95

Date	Tow No.	Minilog Tow No.	Position - Trawl in Water		Position - Gear Haulback		Haul Depth (fm)	Avg. Haul Depth Temp °F	CPUE (catch per tow hour)	Total Catch (lbs)
			Lat/Long	Time	Lat/Long	Time				
9/17	10	006	39-57-79 70-44-98	8:30	39-58-43 70-53-27	11:05	200-210	44-46	76.9	200 lbs R.R. shrimp; 1000 lbs total; 25% ling, 30% whiting, 25% grenadiers
9/18	11	007	39-58-20 70-52-15	12:00	39-58-21 70-44-62	2:30	190-197	46	180	450 lbs R.R. shrimp; 1000 lbs total
	12	008	39-58-12 70-44-30	3:30	39-58-36 70-52-37	6:10	190-200	45	129.6	350 lbs R.R. shrimp; 800 lbs total
	13	009	39-58-31 70-52-41	6:50	39-58-26 70-44-65	9:30	190-195	44	129.6	350 lbs R.R. shrimp; 700 lbs total; 40% ling, 30% monkfish, 15% whiting
9/19	14	010	39-58-22 70-44-66	10:15	39-58-43 70-53-36	12:15	190	46	150	300 lbs R.R. shrimp
	15	010	39-68-55 70-55-21	1:30	39-58-23 70-44-31	4:00	190-195	44	140	350 lbs R.R. shrimp; 700 lbs total
	16	010	39-58-60 70-44-01	5:00	39-58-35 70-52-89	7:45	195-200	44	90.0	250 lbs R.R. shrimp; 700 lbs total
	17	011	39-58-40 70-52-27	8:40	39-58-15 70-45-10	11:30	190-195	45-46	89.3	250 lbs R.R. shrimp; tore up net

F/V Patty Jo Cruise No. 2Dates: 9/23 - 10/01/95

Date	Tow No.	Minitog Tow No.	Position - Trawl in Water		Position - Gear Haulback		Haul Depth (fm)	Avg. Haul Depth Temp °F	CPUE (catch per tow hour)	Total Catch (lbs)
			Lat/Long	Time	Lat/Long	Time				
9/24	18	012	39-53-79 71-27-31	6:45	39-51-99 71-33-55	8:45	200-210	44	0	75 monkfish; no shrimp; red crabs, blkbellied rosefish, squid, gren
	19	013	59-50-32 71-35-36	10:05	39-48-82 71-39-30	11:20	240-310	42-44	0	17 monkfish; 6 scarlet shrimp; viperfish, 17 snipe eels, whiting
	20	014	39-43-98 71-43-98	1:00	39-40-02 71-47-80	1:45	280-320	42	0	17 monkfish; 24 scarlet shrimp
	21	014	39-38-10 71-57-09	4:35	39-36-84 71-58-63	5:15	160	46	7.5	5 lbs R.R. and scarlet shrimp (3); 18 monkfish, BB rosefish, lobsters
9/25	22	015	39-20-64 72-12-13	4:30	39-16-71 72-16-47	6:20	190-200	44	7.7	65 monkfish; 14 lbs R.R. shrimp; whiting, squid, ling, octopi, bb rosefish
	23	no data	39-12-31 72-24-70	7:45	39-11-64 72-28-02	8:45	200-260	42	0	15 royal & 6 scarlet shrimp; 8 monkfish, grenadiers, viperfish
	24	017	39-07-40 72-35-44	10:15	39-05-38 72-38-06	11:10	410-460	40	0	Hung net; 2 scarlet shrimp, 12 unidentified shrimp, red crabs, grenadiers, blowfish
	25	018	38-52-76 72-52-99	3:10	38-50-17 72-55-86	4:20	190-205	44-45	0	4 monkfish; 6 R.R. shrimp
9/26	26	no data	38-03-04 73-49-82	1:10	38-00-48 73-52-53	2:10	178-200		0	2 monkfish; 12 R.R. shrimp

F/V Patty Jo Cruise No. 2

Dates: 9/23 - 10/01/95

Date	Tow No.	Minilog Tow No.	Position - Trawl in Water		Position - Gear Haulback		Haul Depth (fm)	Avg. Haul Depth Temp °F	CPUE (catch per tow hour)	Total Catch (lbs)
			Lat/Long	Time	Lat/Long	Time				
9/27	27	019	39-59-29 70-59-14	3:00	39-58-10 71-08-47	6:00	180-220	44-46	50	150 lbs R.R. shrimp; 700 lbs total
	28	020	39-58-26 71-07-46	6:30	39-58-96 70-58-74	9:30	180-210	45-46	50	150 lbs R.R. shrimp; 50 monkfish, 700 lbs total
	29	021	39-58-41 70-57-21	10:05	39-58-55 70-46-32	12:05	190-200	45	125	3 monkfish; 250 lbs R.R. shrimp
	30	021	39-58-47 70-45-79	2:15	39-58-47 70-51-36	5:50	180-195	44-46	83	4 monkfish; 300 lbs R.R. shrimp; 700 lbs total; red crab, rosefish, slime eels
	31	022	39-58-04 70-57-52	6:30	39-58-32 70-47-10	9:30	200	44-46	66.7	200 lbs R.R. shrimp; 600 lbs total
9/28	32	023	39-58-00 70-47-58	10:15	39-58-43 70-57-65	1:15	190-220	44-46	58.3	175 lbs R.R. shrimp
	33	023	39-58-18 70-58-11	2:40	39-58-42 70-46-76	6:10	180-200	46	35.7	125 lbs R.R. shrimp; 500 lbs total; anemones, lobsters, crabs
	34	024	39-57-79 70-44-49	7:25	39-58-49 70-55-80	10:50	190-210	45-46	44.1	150 lbs R.R. shrimp; red crabs
	35	025	39-57-59 70-55-78	11:35	39-58-18 70-46-34	2:35	200-215	45	25	75 lbs R.R. shrimp

F/V Patty Jo Cruise No. 2Dates: 9/23 - 10/01/95

Date	Tow No.	Minilog Tow No.	Position - Trawl in Water		Position - Gear Haulback		Haul Depth (fm)	Avg. Haul Depth Temp °F	CPUE (catch per tow hour)	Total Catch (lbs)
			Lat/Long	Time	Lat/Long	Time				
9/28	36	025	39-58-10 70-46-26	3:15	39-58-99 70-56-49	6:15	180-195	45-46	50	150 lbs R.R. shrimp
	37	026	39-59-08 70-55-68	7:15	39-50-43 70-47-01	10:15	180-195	45-46	33.3	100 lbs R.R. shrimp
9/29	38	027	39-59-15 70-58-96	12:15	39-58-31 71-08-57	3:15	190-240	45	41.7	125 lbs R.R. shrimp
	39	027	39-58-12 71-08-62	3:50	39-59-73 70-59-58	6:40	190-200	45	71.4	200 lbs R.R. shrimp; 20 monkfish; 700 lbs total
	40	028	39-59-34 70-59-41	7:15	39-58-36 71-07-73	9:50	190-230	45	57.7	150 lbs R.R. shrimp; 700 lbs total; lots of small grey sole
	41	029	39-51-91 71-08-25	10:30	39-59-91 70-58-61	1:30	185-205	45	83.3	250 lbs R.R. shrimp
	42	029	40-06-09 70-58-62	2:25	39-58-24 71-09-04	5:45	180-200	46	75.8	250 lbs R.R. shrimp; 700 lbs total, lots of small lobsters
	43	030	39-58-20 71-08-73	6:20	39-59-72 70-59-35	9:30	190-200	45	46.9	150 lbs R.R. shrimp; lots of small lobsters
9/30	44	031	39-59-71 70-58-58	10:10	39-58-47 71-08-63	1:10	180-220	44-45	33.3	100 lbs R.R. shrimp

F/V Patty Jo Cruise No. 2

Dates: 9/23 - 10/01/95

Date	Tow No.	Minilog Tow No.	Position - Trawl in Water		Position - Gear Haulback		Haul Depth (fm)	Avg. Haul Depth Temp °F	CPUE (catch per tow hour)	Total Catch (lbs)
			Lat/Long	Time	Lat/Long	Time				
9/30	45	031	39-58-45 71-08-50	2:00	39-59-75 70-56-44	6:00	160-200	45-46	31.3	125 lbs R.R. shrimp; 20 monkfish; small lobsters; 700 lbs total
	46	032	39-50-65 70-58-16	6:50	39-58-05 71-08-15	9:50	190-230	45-47	41.7	125 lbs R.R. shrimp; 500 lbs total
	47	033	39-57-65 71-09-46	10:30	39-59-31 70-59-82	1:30	190-220	45-47	16.7	50 lbs R.R. shrimp

F/V Patty Jo Cruise No. 3 Dates: 10/07 - 10/15/95

* Computer failure prevented collection of temperature and depth data via minilog

Date	Tow No.	Position - Trawl in Water		Position - Gear Haulback		Haul Depth (fm)	CPUE (catch per tow hour)	Total Catch (lbs)
		Lat/Long	Time	Lat/Long	Time			
10/8	48	39-19-26 72-14-82	6:15	39-16-16 72-18-58	7:45	170-178	20	320 lbs monkfish; 30 lbs shrimp; 60 lbs large whiting; 11 bu bycatch
	49	39-15-43 72-19-22	8:30	39-18-34 72-14-83	10:00	183-187	13.3	250 lbs monkfish; 20 lbs shrimp
	50	39-18-64 72-14-26	11:00	39-15-18 72-19-05	12:30	194-195	6.7	150 lbs monkfish; 10 lbs shrimp; 6 bu bycatch
	51	39-14-44 72-19-70	1:45	39-17-71 72-14-18	3:15	213-230	2	300 lbs monkfish; 3 lbs shrimp; 13 bu bycatch, mostly red crabs
	52	39-17-87 72-13-54	4:35	39-14-78 72-17-70	6:05	223-225	0	240 lbs monkfish; 60 lbs whiting; 13 bu bycatch; 12 scarlet and 12 royal red
10/9	53	39-15-47 72-15-65	6:15	39-12-96 72-19-77	7:45	279-282	0	1 bu monkfish; 1 bu large whiting; 19 bu bycatch; 7 scarlet shrimp
	54	39-11-11 72-20-00	8:45	39-12-23 72-16-79	10:30	391-410	0	80 lbs monkfish; 50 lbs skate; 8 scarlet shrimp; 19 bu bycatch
	55	39-18-84 72-15-39	12:45	39-15-81 72-19-44	2:30	165-167	0	5 bu monkfish; 9 bu bycatch; no shrimp
	56	39-18-40 72-15-34	4:10	39-15-29 72-19-96	6:00	175-176	11.1	5 bu monkfish; 1 bu large whiting; 19 bu bycatch; 20 lbs shrimp

F/V Patty Jo Cruise No. 3 Dates: 10/07 - 10/15/95

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Date	Tow No.	Position - Trawl in Water		Position - Gear Haulback		Haul Depth (fm)	CPUE (catch per tow hour)	Total Catch (lbs)
		Lat/Long	Time	Lat/Long	Time			
10/10 Nordmore grate in	57						—	Tore net
10/10 New net w/grate in	58	39-18-59 72-14-34	1:45	39-15-27 72-18-72	3:15	191-200	3.3	6.75 lbs monkfish; 1 bu whiting; 5 lbs shrimp; 6 bu bycatch
	59	39-14-88 72-19-26	4:15	39-17-71 72-14-11	6:15	204-214	1.8	no monkfish; 15 bu bycatch; 3.5 lbs shrimp
10/11	60	39-18-37 72-14-56	6:00	39-15-59 72-18-51	7:30	192-195	10	no monkfish; 15 lbs shrimp; 6 bu bycatch
	61	39-14-93 72-18-94	8:15	39-17-32 72-15-60	9:45	200-213	6.7	10 lbs monkfish; 8 bu bycatch; 10 lbs shrimp; 2 red crabs
	62	39-14-89 72-18-62	10:45	39-17-60 72-13-87	12:15	220224	1.3	7 lbs monkfish; 2 lbs shrimp; 3 bu bycatch
	63	39-18-12 72-13-78	1:15	39-15-21 72-18-57	2:45	207-213	1.0	no monkfish; 4 bu bycatch; 1.5 lbs shrimp
10/12	64	39-58-96 72-57-12	7:05	39-58-20 70-45-86	10:05	182-202	60	7 lbs monkfish; 16 bu bycatch; 3 bu shrimp (180 lbs)
	65	39-58-20 70-45-92	10:45	39-58-97 70-56-17	1:45	180-199	60	3 bu shrimp (180 lbs); 5 lbs monkfish; 14.5 bu bycatch

F/V Patty Jo Cruise No. 3Dates: 10/07 - 10/15/95

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Date	Tow No.	Position - Trawl in Water		Position - Gear Haulback		Haul Depth (fm)	CPUE (catch per tow hour)	Total Catch (lbs)
		Lat/Long	Time	Lat/Long	Time			
10/12	66	39-59-05 70-36-35	3:00	39-58-69 70-14-09	6:00	180-185	60	3 bu shrimp (180 lbs); 17 lbs monkfish; 10 bu bycatch
10/13 Grate removed	67	39-58-75 70-56-47	6:05	39-58-29 70-47-20	9:05	185-199	50	6 bu monkfish; 2.5 bu shrimp (150 lbs); 12 bu bycatch
	68	39-58-48 70-46-42	9:40	39-58-99 70-56-55	12:40	180-192	50	4 bu monkfish; 2.5 bu shrimp (150 lbs); 11.5 bu bycatch
	69	39-59-18 70-57-24	1:15	39-57-95 70-48-05	3:15	180-210	75	2.5 bu shrimp (150 lbs); 4 bu monkfish; 11.5 bu bycatch
	70	39-57-83 70-47-05	4:40	39-58-89 70-56-37	7:30	183-212	53.6	2.5 bu shrimp (150 lbs); 5.5 bu monkfish; 12 bu bycatch
	71	39-58-86 70-54-54	8:15	39-59-42 70-47-83	10:15	169-182	225	5 bu monkfish; 6 bu bycatch; 7.5 bu shrimp (450 lbs)
10/14	72	39-59-29 70-46-67	12:15	39-58-91 70-53-20	2:30	172-182	213	8 bu shrimp (480 lbs); 4 bu monkfish; 9 bu bycatch
	73	39-59-19 70-46-20	4:15	39-58-92 70-53-21	6:20	173-181	200	6 bu monkfish; 8 bu bycatch; 7 bu shrimp (420 lbs)
	74	39-59-36 70-53-91	7:00	39-59-37 70-45-96	9:20	170-180	169.6	8 bu bycatch; 5 bu monkfish; 6.5 bu shrimp (390 lbs)

F/V Patty Jo Cruise No. 3

Dates: 10/07 - 10/15/95

* Computer failure prevented collection of temperature and depth data via minilog

Date	Tow No.	Position - Trawl in Water		Position - Haulback		Gear	Haul Depth (fm)	CPUE (catch per tow hour)	Total Catch (lbs)
		Lat/Long	Time	Lat/Long	Time				
10/14	75	39-59-50 70-46-25	10:00	39-58-86 70-53-58	12:00		167-181	150	5 bu monkfish; 7.5 bu bycatch; 5 bu shrimp (300 lbs)
	76	39-58-94 70-53-80	12:30	39-59-21 70-46-19	2:30		173-183	195	4 bu monkfish; 8.5 bu bycatch; 6.5 bu shrimp (390 lbs)
	77	39-59-28 70-46-05	3:50	39-58-81 70-52-83	6:10		171-183	104.3	3.5 bu monkfish; 5 bu bycatch; 4 bu shrimp