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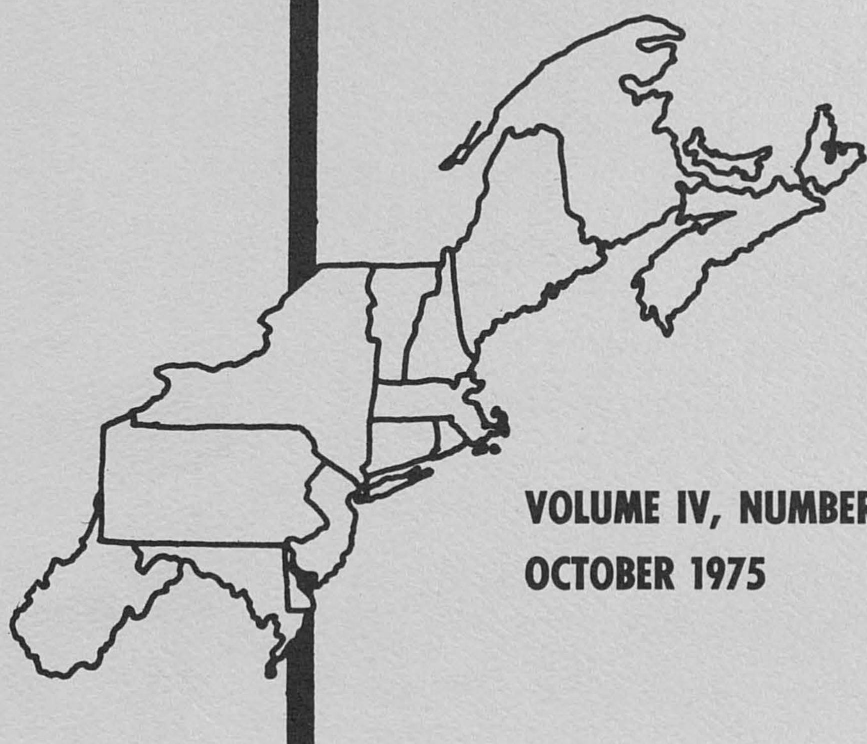

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COSTS AND RETURNS OF FISHERMEN IN THE MASSACHUSETTS INSHORE LOBSTER FISHERY

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Introduction

The inshore lobster fishery is one of the more important ones in the Commonwealth of Massachusetts, accounting for approximately 14 percent of the total landed value of all species in Massachusetts in 1971. Until recent years this fishery accounted for virtually all the pot landings in the state. Despite numerous attempts at conservation such as gear regulation, size restrictions, and prohibitions on harvesting egg-bearing females, the fishery has been subject to rapidly increasing effort and virtually constant landings. In the past decade it has become obvious to many fishery biologists and economists that conservation of fish stocks is a necessary but not sufficient criterion for fisheries management. Resource managers have become increasingly aware of the interdependence between economic factors and the intensity, location and composition of fishing effort.

In June, 1974, the Massachusetts Lobstermen's Association (MLA) and the Division of Marine Fisheries (DMF), Department of Natural Resources of the Commonwealth of Massachusetts expressed an interest in conducting an economic survey of the Massachusetts inshore lobster fishery to begin to establish an inventory of data relative to the economic performance of this fishery. An economic survey was initiated during fall 1974 with the active assistance of the DMF and MLA. Our objective in this paper is to describe the methods, results and conclusions of that survey. Following a discussion of methods and procedures,

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results are reported under the headings of technical characteristics of the fleet, costs of the fleet and economies of size and gross and net income measures.

Methods and Procedures

Due to time and budgetary constraints, a mail survey questionnaire was the method chosen for the survey. A questionnaire was designed and distributed to Massachusetts fishermen with the support of the MLA. We believe that the strong interest and participation of the MLA may have contributed to a higher response rate (22%) and reliability than could otherwise have been obtained by this method. The patterns which appear in the results are sensible and are difficult to explain unless one assumes that respondents attempted to answer conscientiously. The potential bias of this method must be recognized however. In particular, nonresponse represents a source of potential bias that persists no matter how much effort is put into the design of questions and is not diminished very effectively by increases in sample size (2,3). This is especially true when, as in our case, the nonresponse rate exceeds 10%. Despite the recognized weaknesses of the method it does provide information to policy makers quickly and at low cost.

The 1973 commercial catch reports of the DMF were examined to determine the number of fishermen reporting from each of the eight major lobstering counties. A stratified sample of 342 commercial license holders was drawn and mail questionnaires were distributed to reflect the relative percentage of license holders within each county. For example, Plymouth County, with 24% of the commercial license holders, received 24% of the questionnaires. Of the 342 commercial license holders that received the questionnaire, 76 or 22% responded. Based on commercial registration of 1200, the sampling rate for our mailing list was about 28% while our response sample was about 6%. Examiniation of responses indicated that some were of questionable validity, perhaps due to misinterpretation of the question. Consequently, certain editing criteria were used as discussed below. By editing the data it is possible that we introduced bias. However, as already noted, one cannot claim unbiasedness with the anonymous mail questionnaire method when the nonresponse rate is substantial.

Examination of the questionnaire responses indicated that few boats made more than 220 trips per year. Since the inshore lobster fishery is considered by fisheries biologists to be within 12 miles of shore, we excluded one response which indicated primary catch location outside this boundary. We combined these facts about distance and trips per year and excluded two responses indicating a total number of one-way-trip-miles in excess of 2400 per year. This cut off of 2400 trip-miles was obtained by multiplying mean one-way distance, plus one standard deviation, by mean number of trips, plus two standard deviations. Five responses indicating maintenance costs in excess of the mean plus two standard deviations were excluded. Five responses in which there was an obvious misinterpretation of miscellaneous expenses were excluded.

As an additional check on responses, a meeting was held with fishermen selected to represent the range of boat sizes in the inshore fleet. Preliminary results were reviewed with these fishermen as a check on the accuracy of responses. Their opinion was that the data were accurate. Questions were raised about fuel costs, the estimated opportunity cost of labor and property taxes each of which was judged excessive in one or more cases which we discuss below. Both fuel expenditure and lobster gear expenditures are strongly correlated with number of traps hauled. Responses for fuel and gear expenditures more than two standard deviations above or below the mean value were excluded. The numbers excluded were two and three, respectively.

The opportunity cost of captain and crew poses some special problems. One must have an estimate of these opportunity costs to analyze economies of size, to synthesize industry cost curves or to calculate economic rent under alternative management regimes (4). The mean wage rate of crew members is presumably an adequate measure of their opportunity cost. We requested such information in our questionnaire. Unfortunately, the response rate on this question was extremely poor; only 14 respondents indicated a crew member and of these, only 9 reported their crew share or wages. For captain's labor and management the problem was that salaries are not paid by the captain to himself and must be imputed.

Two alternative measures of opportunity cost of labor were considered. The first of these was the respondent's estimate of his opportunity cost and that of his crew if he had a crew. Since there was a good response to this question which preceded the question on wages paid, it is possible that respondents felt it redundant to answer the latter.

The second measure which was considered was prevailing wage rates in Massachusetts. Unfortunately, when this measure is applied to both captain and crew, no recognition is given to differences in the entrepreneurial abilities or marketable skills of either. Moreover, it tends to force constant returns to size by implicitly assuming that these entrepreneurial or other skills are randomly distributed between vessels of differing sizes. Consequently, we concluded that it would be interesting and more appropriate to use respondents' estimates of opportunity costs. However, as a check, we include a discussion of the effects of using regional wage rates as a measure of the opportunity costs of captain and crew. We also compare these with reported wages paid on larger vessels.

In using the respondents' estimates of opportunity costs, an estimate was calculated for each vessel by multiplying mean crew size by the daily mean opportunity cost of the crew. This product was added to the daily mean opportunity cost of the captain. The resultant sums were then multiplied by the mean number of trips per year by vessel class to obtain the desired annual opportunity cost of labor in dollars per vessel per year. In using the prevailing wage rate approach we chose an average of the Boston and New Bedford wage rates for nonsupervisory production workers in manufacturing. This average was $30 per day (9).

In our discussions with fishermen they asserted that the small number of pots fished by class 1 and class 2 vessels could be tended with not more than 2 and not more than 4 hours of work per day, respectively. We therefore multiplied the daily opportunity cost for vessel classes 1 and 2 by factors of .25 and .50, respectively, to reflect the percent of a day spent fishing.

Lobster boats and gear are not subject to total property tax in Massachusetts but wharfage and sheds used to store gear are. The mean for vessel length classes 5 and 6 was thought by fishermen, including those owning vessels of these length classes, to be excessive by $500-$600. The fishermen felt that the mean property tax reported for vessel length class 4 was also a reasonable estimate for vessel length classes 5 and 6 and their judgement was accepted.

Pot inventory increases and decreases were used to adjust expenditures on lobster gear. Pot inventory increases (decreases) were subtracted from (added to) expenditures for lobster gear. An average value of $10 per pot was used for this adjustment.

It was anticipated that the interest costs reported by respondents would be interest on borrowed capital only and as such would not include the opportunity cost of equity capital. Accordingly, we derived estimates by vessel length class of the opportunity cost of capital from depreciation. For these estimates we assumed a ten year straight line depreciation schedule and calculated interest at 10% of the average book value. The sample was divided into six vessel length classes and the data analyzed using the Statistical Analysis System available at the Computer Center, University of Rhode Island.

Results

Technical Characteristics of the Fleet

We believe that an appreciation of certain technological or noneconomic differences facilitates subsequent discussions of cost and income differences. Accordingly, Table 1 summarizes the means by vessel length class for these noneconomic variables.

Most vessels operating in the inshore fishery are one-man operations. However, some vessels do have helpers, or "sternmen," and the percentage of vessels having helpers does increase with vessel length class. This results in an average crew size of 0.42 for larger length classes.

Table 1

Selected Characteristics of the Massachusetts Inshore Lobster Fleet by Vessel Length Class

Item	Units	Vessel Class						Mean[1/]
		1	2	3	4	5	6	
Vessel length	feet	<17	17-21	21-26	26-31	31-36	>36	
# respondents	number	17	10	11	9	13	15	
Vessel distribution:	percent							
State registration		12	21	12	16	17	22	
Sample data		23	13	15	12	17	20	
Crew size[2/]	men/vessel	0.03	0.22	0.00	0.25	0.42	0.42	0.22
Pots/vessel	number	35	80	117	144	314	369	108.46
Days/vessel	number	52	88	149	132	140	221	129.59
Distance to grounds	miles	1.47	1.5	3.36	3.38	7.08	8.53	4.35
Pot-days/vessel	number	1817	7049	17388	19098	44096	81545	30039.56
Annual catch	pounds	503	2018	2265	4313	9587	10702	5005.53
Relative catch	percent	100	401	450	857	1096	2186	1006.69
Catch/pot-day	lbs./pot-day	.2768	.2863	.1303	.2258	.2174	.1312	0.21
Fishing power	percent	100	103	47	82	79	47	76.11

[1/] Means calculated using the vessel distribution from the sample data.

[2/] Crew size exclusive of operator.

The mean distances fished from shore show distinct discontinuities between vessel length classes. Classes 1 and 2 are essentially the same at 1.5 miles. Classes 3 and 4 are essentially the same at 3.4 miles or more than double the distance of the smaller classes. Classes 5 and 6 are quite similar with respect to distance from shore but these distances are more than double those of classes 3 and 4 and five to six times those of classes 1 and 2. The discontinuity in distance from shore between classes 2 and 3 may reflect "part-time" vs. "full-time" lobstermen. For part-timers, proximity to shore may be necessary due to their time constraints. The discontinuity between length classes 4 and 5 may be due to the greater sea worthiness of larger vessels.

The days fished per vessel per year vary greatly between vessel length classes from 52 days per year to 221 days per year for classes 1 and 6, respectively. These two extremes exemplify the "part-time" and "commercial" fishermen. However, such dichotomies are misleading since there is a more or less continuous spectrum encompassing intermediate length classes.

Pots fished per vessel vary enormously between vessel length classes. The larger vessels fish approximately ten times as many pots as do the small vessels. One factor which may influence annual catch per pot is the "set-over" frequency. Set-over fishing is a term used to describe the frequency with which pots are hauled. If pots are hauled on successive days, the average fishing time per set-over is then one day. This fishing practice is referred to as daily hauls. If pots are hauled on non-successive days, the practice is termed set-over fishing. The average time that a pot is in the water between successive hauls is the fishing time of an average or "representative" pot. This time lapse between successive pullings of a pot is also termed set-over-days. There exists some disagreement in the literature concerning the relative efficiency of set-over fishing versus daily fishing (5,6,8). Unfortunately, our data does not shed any direct light in this area.

A consequence of these differences in days fished per vessel and pots fished is an enormous variation in pot-days fished per vessel. Vessels of length class 6 fished 81,545 pot-days or 45 times as many pot-days as did vessels of length class 1. The annual catch per vessel shows somewhat smaller variation between length classes than does pot-days fished.

Table 1 may be used to analyze technical efficiency by vessel class. The technical efficiency of vessels can be measured in at least two very different ways. One measure is relative catch, which is simply the annual catch of each vessel class expressed as a percentage of the annual catch of a base class. Using length class 1 as the base, it is interesting that the catch of length class 6 is more than twenty times that of length class 1. Another measure would be relative fishing power which would be the catch per unit effort of each vessel class expressed as a percentage of that of a base class. Using pot-days as a measure of effort, vessels of length class 6 are only 47% as efficient as those of vessel class 1.[1/] The causes of these differences between the two measures of efficiency have already been described. As vessel length class increases there is a tendency toward fishing more days and toward fishing more pots both of which increase the annual catch of a vessel, ceteris paribus. Note, however, that despite a forty-fold increase in pot-days fished, the relative catch of vessel class 6 is only twenty-fold that of vessel class 1.

It is evident from Table 1 that vessel class 3 is an unusual class in several respects. Crew size is smaller than vessels of classes 2 and 4. More days are fished than for classes 2 and 4. The distance from shore is, as noted earlier, equivalent to that of class 4 vessels and double that of class 2. These differences, with the exception of crew size, are ones which tend to substantially increase cost. Yet the annual catch of this class is only 12% greater than that of class 2 and the catch per pot-day is only 45% that of class 2. These differences will have a direct bearing on costs which are discussed next.

Costs of the Fleet and Economies of Size

The costs of lobster fishermen include both fixed and variable or operating costs. Fixed costs include depreciation and interest, insurance, license fees and property taxes. Operating costs include fuel, bait, repairs, lobster gear and miscellaneous expenses. They also include the opportunity cost of labor. Table 2 contains mean values by vessel class for all fixed and operating costs except the opportunity cost of captain and crew. This component of operating costs will be discussed later.

Annual fixed costs increase with vessel length; specifically, class 6 fixed costs are eleven times as great as those of class 1. Annual operating costs also increase rapidly with length class; in class 6 these costs are fourteen times as great as in class 1. Fixed costs per pound of catch decline from 65¢/lb. for class 1 to 37¢/lb. for class 4. Thereafter, they are essentially constant at 31-34¢/lb. In vessel class 3, however, the fixed costs per pound of catch are 61¢/lb. or almost as much as for class 1 vessels and substantially more than the 46¢/lb. for class 2 vessels.

Annual operating costs increase with vessel length but less rapidly than catch. Excluding any opportunity charge for labor, operating costs per pound of catch range from $1.21 per pound for class 1 to 50¢ per pound for class 5. Class 3 vessels had high unit operating costs as

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1/ A more accurate measure of effort would be pot-set-over-days which, as discussed earlier, would include the frequency of set-overs as a component of fishing effort.

Table 2

Fixed and Operating Costs Exclusive of
Opportunity Costs of Captain and Crew

Item		Vessel Class 1	2	3	4	5	6	Mean[1/]
		-dollars per vessel per year-						
Fixed Costs:								
Depreciation and Interest		216	564	1083	1041	2264	2916	1378.45
Insurance		44	93	173	232	332	406	213.64
License		58	98	100	92	100	100	89.12
Property Tax		8	165	34	250	250	250	150.89
Subtotals:	$/vessel	326	920	1390	1615	2946	3672	1832.10
	$/lb.	0.65	0.46	0.61	0.37	0.31	0.34	0.37
Operating Costs:								
Fuel		90	213	317	934	850	1851	722.72
Bait		80	407	268	943	1214	2398	870.60
Repairs		65	358	649	442	784	1281	554.95
Lobster Gear		172	563	961	1284	1223	2347	1088.29
Miscellaneous		200	242	286	758	678	656	457.78
Subtotals:	$/vessel	607	1783	2481	4361	4749	8533	3780.80
	$/lb.	1.21	0.88	1.10	1.01	0.50	0.80	0.76
Fixed & Operating Costs:	$/vessel	933	2703	3871	5976	7695	12205	5612.90
	$/lb.	1.85	1.34	1.71	1.39	0.80	1.14	1.12
Price received:	$/lb.	1.71	1.47	1.81	1.88	1.53	1.49	1.64

[1/] Means calculated using vessel distribution from sample as listed in Table 1.

well at $1.10 per pound. Class 6 vessels had high unit operating costs due to bait and lobster gear costs which were, respectively, 97% and 92% higher than for class 5 vessels.

Class 3 vessels incur much of the costs of larger vessels but, as discussed earlier, have little to show for it in terms of catch per vessel. Class 3 vessels had very high costs because of high fixed costs and a large number of days fished (149) which implies high fuel and bait costs.

Excluding any allowances for the opportunity costs of labor, these results suggest that there are economies of size in the Massachusetts inshore lobster fleet. The economies exist in both fixed and operating cost components but most notably in the former. Exceptions seem to be boats of length classes 3 which have exceptionally high unit costs ($1.74) and vessel class 5 which have exceptionally low ($0.80) unit costs. We suspect that these anomalies may disappear with a larger sample but a conclusion on the matter must await future research.

The next question to be examined is total and unit costs inclusive of the opportunity cost of the captain and crew and the effect which these costs have on economies of size. Tables 3 and 4 have been constructed with this in mind. Table 3 contains estimates of opportunity costs for captain and crew in dollars per man-day. These were used to calculate Table 4. Both sets of opportunity cost estimates are shown in Table 4 on an annual cost per vessel basis. Comparing these two estimates it is evident that the prevailing wage rate estimate artificially forces uniform opportunity costs while the respondents' estimates do not. Furthermore, due to the fact that respondents' estimates increase with length class the mean for all vessel classes is substantially higher ($7,156 versus $4,743) when respondents' estimates are used.

As indicated earlier, the response rate on crew wages was poor which in part necessitated alternative estimates of opportunity cost. Of the nine who did respond however, eight were in length classes 5 and 6. We compared respondents' estimates of the opportunity cost of crews against crew wages for these eight vessels. The average crew wage paid was $2,871 per vessel. Using respondents' estimates the opportunity cost of crew was $2,973 and using a prevailing wage rate it was $2,274. Thus, for the larger vessels, the respondents' estimate of opportunity cost of crew is in close agreement with actual crew wages paid. The agreement between these estimates is particularly significant in view of the percent of crew members on these larger vessels. Although length class 5 and 6 comprise only 37%-39% of vessels, approximately 70% of crew members are associated with these vessels.

As anticipated, the prevailing wage rate method tends to force constant returns to size; unit opportunity costs vary about a mean of $0.95 with a low of $0.62 for length class 5 and a high of $1.97 for length class 3. There exist no evident economies of size, however, in these costs even if the two anomalous classes 3 and 5 are excluded. If anything, there may be slight diseconomies of size.

Table 3

Estimates of the Opportunity Cost of Captain and Crew

Item	Units	Vessel Class						
		1	2	3	4	5	6	Means
Respondent's Estimates:								
Captain	$man/day	34	39	41	41	57	62	46.05
Crew	$man/day	NA	25	NA	28	38	40	30.57 1/
Average/vessel-day 2/	$vessel/day	36	44	41	38	51	55	42.65
Average/man-day 3/	$man-day	33	36	41	38	51	44	42.65
Prevailing Wage Rates 4/	$man-day	30	30	30	30	30	30	30

1/ Mean calculated using $25 per man/day for classes 1 and 3 and sample vessel distribution.

2/ Weighted average using weights of 1.0 for captain's opportunity cost and the mean crew size as a weight for the opportunity cost of crew. $25/man/day was assumed for classes 1 and 3.

3/ Average per vessel-day divided by 1.0 (for captain) plus mean crew size by length class.

4/ Average daily wage rate of non-supervisory production workers in manufacturing in Boston and New Bedford. See text for source.

Table 4

Opportunity Costs of Captain and Crew and Total Costs

Item		Vessel Class 1	2	3	4	5	6	Means
Opportunity Costs of Captain & Crew:								
Respondent's estimates:	$/vessel	438	1963	6072	6308	10255	17451	7156.50
	$/lb.	0.87	0.97	2.68	1.46	1.07	1.63	1.45
Prevailing wage rates:	$/vessel	402	1610	4470	4950	5964	9415	4743.00
	$/lb.	0.80	0.80	1.97	1.15	0.62	0.88	0.95
Fixed and operating costs from Table 2:	$/vessel	933	2703	3871	5976	7695	12205	5612.90
	$/lb.	1.85	1.34	1.71	1.39	0.80	1.14	1.12
Total Costs:								
Respondent's opportunity cost:	$/year	1371	4666	9943	12284	17950	29656	12870.14
	$/lb.	2.73	2.31	4.39	2.85	1.87	2.77	2.57
Prevailing wage opportunity cost:	$/year	1335	4313	8341	10926	13659	21620	10355.90
	$/lb.	2.65	2.14	3.68	2.53	1.42	2.02	2.07

When the respondents' estimates are used, however, there appear to be strong diseconomies of size in these opportunity costs; unit opportunity costs for length class 6 are approximately double those of length class 1. This result reflects the fact that respondents with larger vessels reported much higher daily opportunity costs for captain and crew as well as the large number of days fished by class 6 vessels.

When these opportunity costs are added to the fixed and variable costs of Table 2, one obtains estimates of total annual and total unit costs which are also shown in Table 4. Using prevailing wage rates to calculate the opportunity costs of the captain and crew results in total unit costs which range from $1.42 for length class 5 to $3.68 for length class 3. Some economies of size appear to exist especially if length class 3 is excluded. Conversely, if the respondents' estimates of opportunity cost are used, no economies of size are apparent; the diseconomies in opportunity costs offset the economies in other operating costs and in fixed costs as discussed earlier.

Gross and Net Income Measures

The gross value of lobsters caught averaged $7,854 and ranged from $860 to $15,946 for length classes 1 and 6, respectively. Prices received did not vary in any systematic way between length classes so that gross value measures closely parallel those of total catch. Dollars per vessel in length class 6 were 18 times those of vessel class 1. Dollars per pot day fished in length class 6 were only 41% as great as in vessel class 1.

Before calculating net income measures, it is necessary to acknowledge a problem of cost allocation since lobstermen may use their vessel to "produce" other products including charter boat rentals. The question of joint cost allocation is an old one to which economic theory provides an answer only at the margin. Given our interest in how fishermen perceive their cost structure and the constraints imposed by the questionnaire method, there is no correct procedure. We have accepted respondents' cost allocation. Whether their allocations are "correct" can be answered if at all, only by intensive analysis of individual firms.

Respondents were asked to indicate the percentage of their costs, which they would charge against lobster revenues. Their estimates of this percentage were generally 90% or higher with the exception of class 1 for which only 86% was indicated (Table 5). These percentages were applied to total costs of Table 2 to obtain estimates of costs allocated to lobstering (Table 5).

Returns to labor and management were obtained by substracting costs allocated to lobstering from value of the lobster catch. These returns have been expressed in dollars per vessel, dollars per vessel-day and dollars per man-day (Table 5). Annual returns to labor and management ranged from $-54 to $7,358 per vessel with a mean of $2,649 per vessel. When adjustment is made for number of days fished and/or man-days

Table 5

Gross Income, Returns to Labor and Management and Profits by Vessel Class

Item	Units	Vessel Class 1	2	3	4	5	6	Means
Fixed and variable costs from Table 2:	$/vessel	933	2703	3871	5976	7695	12205	5612.90
Allocation to lobstering:	%	98	95	86	90	95	90	92.74
Costs allocated to lobstering:	$/vessel	914	2568	3329	5378	7310	10984	5205.40
Value of lobster catch:	$/vessel	860	2966	4100	8108	14668	15946	7854.10
Returns to labor and management:	$/vessel	- 54	398	771	2730	7358	4962	2648.70
	$/vessel-day	-4.15	9.05	5.17	20.68	52.56	22.45	20.43
	$/man-day	-4.03	7.42	5.17	16.54	37.01	15.81	16.75
Opportunity cost to captain and crew								
(1) respondents	$/vessel	438	1963	6072	6308	10255	17451	7156.50
(2) prevailing wages	$/vessel	402	1610	4470	4950	5964	9415	4743.00
Profits when estimate of opportunity cost is:								
(1) respondents	$/vessel	-492	-1565	-5301	-3578	-2897	-12489	-4507.80
(2) prevailing wages	$/vessel	-456	-1212	-3699	-2220	-1394	- 4453	-2094.30

fished, the superiority of larger vessels is somewhat reduced since days fished and crew size are much greater for larger vessels. In general, it appears that returns to labor and management on larger vessels are adequate to provide a modest income level. For the smallest vessels the return is essentially zero. For intermediate length classes, returns to labor and management are positive but too low to sustain an adequate standard of living.

Returns to labor and management do not measure economic rent or pure profits since no deduction has been made for the opportunity costs of captain and crew. When this deduction is made, the residual profits are negative without exception for all length classes irrespective of the opportunity cost measure selected. Mean profits using respondents' estimates of opportunity cost are much more negative (-$4,508) than profits using the prevailing wage rates measure (-$2,094). Moreover, the range of profits across length classes is much greater using the former measure. The opportunity cost of crew has relatively little effect on these results because differences in crew sizes and in daily opportunity costs for crew are rather modest. The opportunity cost of the captain does have a substantial effects on profits because all vessels have a captain and because respondents' estimates of the daily opportunity cost of captain vary considerably between length classes.

Summary and Conclusions

A mail questionnaire was sent to a sample of fishermen to determine technological and economic characteristics of the fleet. Substantial differences exist between vessel length classes for several non-economic variables. These in turn give rise to substantial differences in cost structures of the various length classes. Specifically there are economies of size for costs exclusive of opportunity cost of captain and crew. When these opportunity costs are included there are little or no diseconomies of size, depending on the measure used for these opportunity costs. We conclude that these results on size economies are suggestive and the question of opportunity costs for captain and crew deserves close scrutiny in future work.

The issue of size economies has direct policy implications in that coastal fisheries are often regarded as substitutes for public welfare programs. A large number of allegedly "inefficient" fishermen is sometimes asserted desirable on ethical grounds. There is a tendency in the economics literature to regard such policies as economically inefficient. In limited entry schemes, the demise of small units is presumed economically efficient and sometimes forced by policy measures. Yet, if there are differences in opportunity costs, economic efficiency is not inconsistent with heterogeneous fleets. With constant costs heterogeneity of fleets is a matter of indifference from an efficiency standpoint.

Two measures of net income were calculated and found to vary greatly between vessel classes. Returns to labor and management are modest but generally positive. Economic rent appears, however, to have been driven to negative values by declining catch per unit effort and by recent sharp increases in input costs. This conclusion applies with either basis of calculating opportunity costs of captain and crew.

We have had uneven success with the mail questionnaire method. In part the difficulties experienced are attributable to a prior decision to preserve the anonymity of respondents. Unfortunately, this precluded follow-up visits or re-surveys of nonresponses. We conclude that improvements can and should be made in procedures. These would include clarification of questions, increased sample size to improve reliability and periodic interviews to test the validity of the mail questionnaire method. Particular attention must be given to the problem of nonresponse.

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