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ABSTRACT

Staniford, A.J. and Siggins, S.K. 1990. An economic survey of Class M Marine Scalefish licence holders: 1986/87. Fish. Res. Pap. Dept. Fish. (Sth. Aust) 21:84p.

Personal interviews were used to collect data on financial performance and characteristics of Class M marine scalefish licence holders during the 1986/87 financial year. Licence holders generally used small boats (averaging 6.0m) to catch fish. The most important species taken were King George whiting, garfish, snapper and calamary. Most licence holders sold their fish within South Australia, although some exported small quantities interstate. The average amount of capital invested by licence holders ($54,326 including licence value) was low relative to other fisheries. Average capital invested (including licence value) by net fishers ($61,134) was higher than that invested by line fishers ($49,417).

Over one third of licence holders (36.5%) had outstanding loans during 1986/87. The most common purpose for borrowing money was to purchase boats (28.2% had obtained loans for this purpose). Most loans (33.3% of licence holders) were obtained from banks as personal loans or bank overdrafts.

Labour was employed by 58.8% of the fishers surveyed. The percentage of net fishers employing labour (82.6%) was greater than that of line fishers (46.5%). The average amount paid in wages was $1,832, with net fishers outlaying $5,439, significantly more than line fishers ($279). The type of labour used most frequently by licence holders was non-family employed crew and paid family labour.

Over one third (37.1%) of licence holders obtained part-time employment in 1986/87. The incidence of part-time employment was greater for line fishers (46.2%) than net (23.0%) and net/line (24.4%) fishers. The average number of weeks worked by all licence holders in part-time employment was 9.7. Line fishers worked, on average, a greater number of weeks in non-fishing employment (12.8) than net fishers (3.0).

Annual income levels, after deducting expenses, were low. The average full equity return for all licence holders was $4,205. Net fishers received higher average annual incomes ($9,393) than line fishers ($2,153). The rate of return to operator labour, capital and management (excluding licence value) also varied according to type of fishing method; net fishers earned an average of 33.2% compared to line fishers 7.7%. Income and the rate of return received by individual licence holders varied greatly.

Potential causes of variation in economic performance were analysed using quartile analysis. The results indicated that the most efficient fishers, measured as rate of return to operator labour, capital and management excluding licence value, tended to be licence holders characterised by high gross incomes. These operators were also able to generate higher returns per boat-day fished compared to less efficient fishers. There was no significant difference between the cash operating costs per boat-day of fishers ranked according to their rate of return.

Licence holders with below average rates of return tended to be older fishers.

Fish income and cash operating costs were dependent on days fished. Also income, measured as full equity return, increased as boat-days increased. However, boat-days fished did not influence the economic performance of licence holders, measured as rate of return to operator labour, capital and mangement and the return to cost ratio.

It is argued that low average returns of licence holders implies that the fishery is economically over-exploited, and that an appropriate policy response is to reduce fishing effort and the number of commercial fishers. Also, given the greater economic efficiency of net fishing relative to line fishing, it is proposed that as the number of fishers are reduced, remaining licence holders be permitted to use both nets and lines. A line licence reclassification scheme to amalgamate line licences and a net licence tender scheme to reduce the number of net fishers is proposed to achieve these objectives. To ensure that the benefits from rationalising the Class M marine scalefish fishery are retained, it will be necessary to prevent fishing effort in other commercial fisheries and the recreational fishery from expanding and off-setting the decline in the Class M fishery.

INTRODUCTION

The marine scalefish fishery includes all species of fish, crustaceans, molluscs and other animals occurring in marine waters of South Australia, excluding those species for which separate managment plans have been enacted (i.e. prawns, rock lobster, abalone, shark, southern bluefin tuna and scallops). Commercial fishers holding Marine Scalefish (Class M), Restricted Marine Scalefish, Rock Lobster, Prawn, Lakes and Coorong, Southern Bluefin Tuna, South-east Trawl, Great Australian Bight Deepwater-Trawl and Miscellaneous licences are permitted to take marine scalefish (see Jones et.al 1990 for further details on access arrangements to the marine scalefish fishery). For certain classes of licences, regulations restrict:

1. the species permitted to be taken (e.g. prawn fishers can only sell calamary or slipper lobster);

2. the area where fishing can occur (e.g. Lakes and Coorong licence holders are permitted to sell fish caught along the Coorong beach), or;

3. the end use of the fish taken (e.g. tuna licence holders are permitted to take marine scalefish other than tuna for the purpose of using them as bait for poling).

Some Class M marine scalefish licence holders also have limited access to species managed under separate management plans e.g. the shark fishery, managed by the Commonwealth government.

In 1987/88, the total landed value of marine scalefish taken in South Australia (excluding the Commonwealth managed tuna and shark fisheries) was $12.995m (Jones et. al 1990, p117). The most important species taken by South Austalian commercial fishers, ranked according to value of production, were King George whiting ($3.7m), garfish ($1.4m), snapper ($1.2m), calamary ($0.8m), Australian salmon ($0.7m) and crabs ($0.66m), (Jones et. al 1990). Class M marine scalefish licence holders took 75.9% of the total value of production ($9.865m), while restricted marine scalefish fishers took 3.2% ($0.428m). Most of the remaining fish were taken by rock lobster licence holders (Jones et. al 1990, p 42).

This study focussed exclusively on the Class M Marine Scalefish fishery. The fishery is a multi-method fishery. The main fishing methods used are hand lines, haul nets, gill nets, squid jigs, long lines, shark nets and crab traps. A licence endorsement system has been implemented, whereby fishing methods permitted to be used by individual licence holders are recorded as endorsements on their licences, thereby restricting the fishing methods and amount of gear that individual licence holders are permitted to use. As a result, four categories of licence holders can be defined: those that use mainly hauling nets or small mesh nets (net fishers), those that use mainly lines (line fishers), those that use both hauling/small mesh nets and lines (net/line fishers) and those that use mainly other methods e.g. crab pots, fish traps, shark nets etc.

The Class M marine scalefish fishery has been managed as a limited entry fishery since 1977. Licence transferability was introduced in 1982; however, netting endorsements are non-transferable (family transfers excepted). Net fishers leaving the fishery are required to surrender their net endorsement, thereby converting their licence from a net or net/line licence to a line-only licence.

Licence holders generally fish in inshore waters (within the three nautical mile State limit), although some fishing occurs in deeper waters (e.g. fishing for shark or deep-sea trevalla).

The South Australian government undertook to review policy arrangements in the fishery in 1988/89 (Anon 1987). The research reported in this paper was initiated to assist in this review and to recommend future management options for the fishery. The specific objectives of the research were:

1. to collect economic data on the fishery,

2. to examine the effect of the restrictions on fishing methods, effected through the licence endorsement system, on economic performance of licence holders in the fishery, and

3. to identify management changes that could improve economic efficiency in the fishery.

METHODS

Sampling Frame

The sampling frame or target population for the survey was defined as Class M marine scalefish licence holders who use mainly nets or lines in inshore waters, and who fished for at least 30 days during the 1986/87 financial year. A list of (509) Class M licence holders who fished in the marine scalefish fishery during 1986/87 was obtained from licensing and catch and effort records held by the Department. The sampling frame was determined by excluding licence holders from this list who spent at least 50% of total boat days fished using shark nets, fish traps, crab nets or traps and cockle rakes and/or who fished less than 30 days during the year. The number of licence holders in the sampling frame was 387.

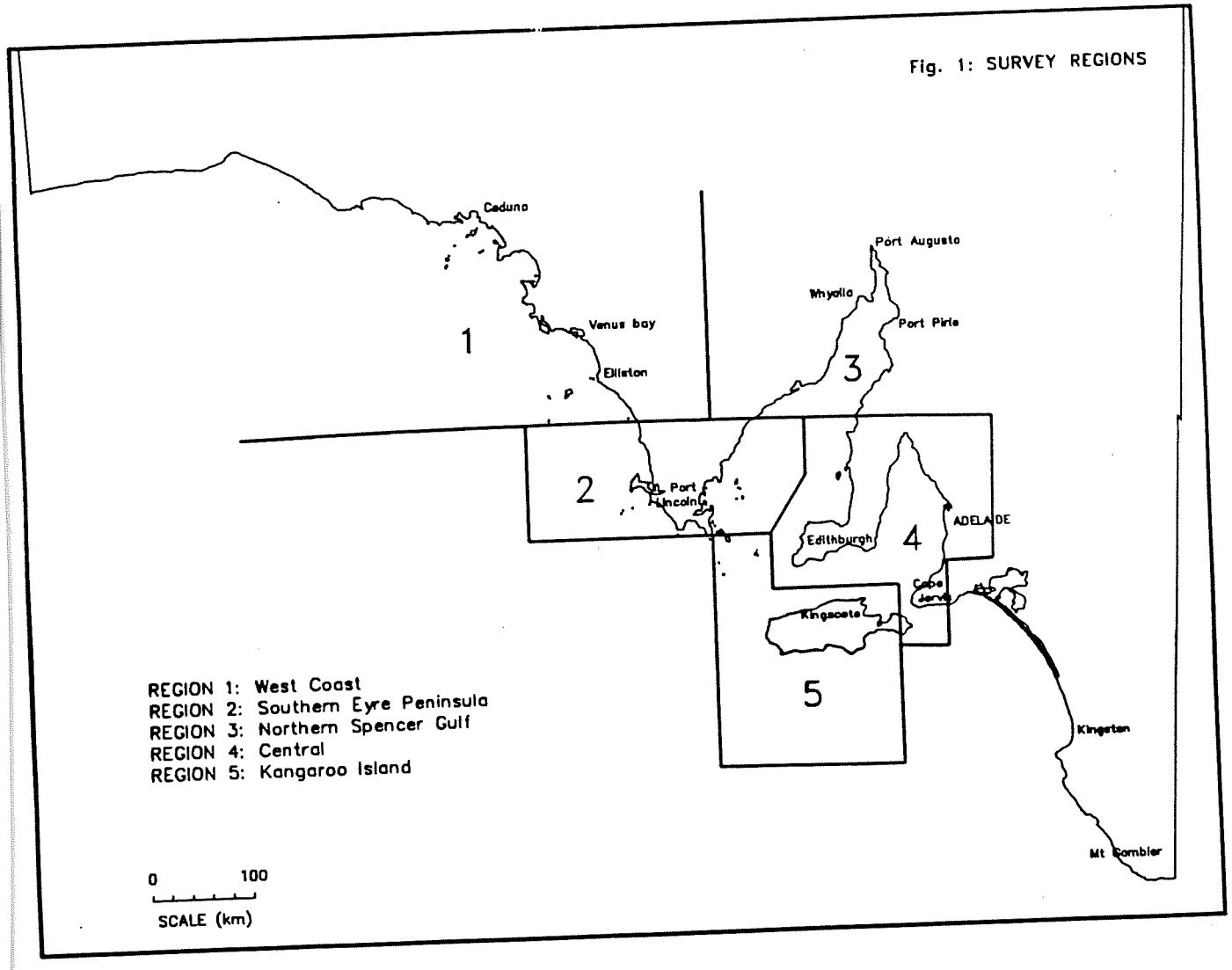
Sample Design

In preparation for using a stratified random survey design, the sampling frame was stratified into 30 strata. The criteria used were area fished, fishing method used and the amount of time spent fishing.

1. Area Fished

Five regions were defined:
(a) Region 1 - West Coast.
(b) Region 2 - Southern Eyre Peninsula.
(c) Region 3 - Northern Spencer Gulf.
(d) Region 4 - Central.
(e) Region 5 - Kangaroo Island.

A map delineating these regions is provided in Figure 1.



Fishing effort data were used to allocate licence holders to regions. Licence holders were allocated to the region where they recorded the greatest number of boat days fishing. In situations where an equal number of boat days were spent in more than one region, licence holders were allocated to the region where the greatest catch was taken.

2. Type of Fishing Method Used

Licence holders were classified into three groups according to fishing method used - net, line or net/line fishers. A line fisher was defined as a licence holder who did not use haul or gill nets during the year. Devices frequently used by line fishers were hand lines, long lines, squid jigs and dab nets. A net fisher was defined as a licence holder who used haul and/or gill nets on at least 80% of the boat days fished. While net fishing was the main method used by these fishers, some net fishers also did small amounts of line fishing. The remaining licence holders in the sampling frame were defined as net/line fishers.

3. Boat Days Fished

Licence holders were allocated to two strata according to boat days fished. The first stratum (S1) included all licence holders fishing more than 210 boat days during the year. Remaining licence holders (those fishing from 30 to 210 boat days) were placed in the second stratum (S2).

A sample size of 100 was selected for the study. Licence holders forming the S1 stratum (those fishing greater than 210 boat days during 1986/87) were completely enumerated. Random sampling was used to select licence holders in stratum S2. The survey was designed to minimise the relative standard error of estimates subject to the constraint on the number of licence holders in the sample (100), and to provide similar standard errors across sampled strata. The survey design was developed using estimates of the likely variability of the data to be collected, obtained from a similar study reported in BAE (1985)[1]. The sample size determined for each stratum, and the associated population size, are provided in Table 1.

Method of Collecting Data

A personal interview questionnaire (Appendix 1) was used to collect information on the costs and returns of fishing activities in the 1986/87 year. Fishers selected for the survey were interviewed between October 1988 and January 1989.

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[1] The survey design was developed by Mr. G. Tucker, Australian Bureau of Statistics.

Table 1.

Sample design and estimated population by strata.

Region		Fishing Method: Net S1[a]	Net S2[b]	Line S1	Line S2	Net/Line S1	Net/Line S2	All Types
1	Sample	1	4	7	8	0	4	24
	Population	1	6	7	74	0	6	94
2	Sample	1	5	1	6	2	4	19
	Population	1	14	1	19	2	9	46
3	Sample	0	7	0	7	3	4	21
	Population	0	38	0	29	3	13	83
4	Sample	2	7	2	8	1	6	26
	Population	2	36	2	80	1	20	141
5	Sample	0	1	0	6	0	3	10
	Population	0	1	0	19	0	3	23
6	Sample	4	24	10	35	6	21	100
	Population	4	95	10	221	6	51	387

a Stratum 1 (S1): licencees fishing more than 210 boat days during 1986/87.

b Stratum 2 (S2): licencees fishing from 30 to 210 boat days during 1986/87.

Response Rate

Usable data were obtained from 75 of the 100 licence holders selected for interviewing. Twenty five additional licence holders were selected from those licence holders who were not selected in the first draw as replacements for the non-respondents. A further 12 responses were obtained from the second draw sampling, taking the final sample size to 87.

Estimation of Population Averages and Relative Standard Errors

Let N_h denote the population size of stratum h;

n^*_{h1} denote the sample size drawn in stratum h;

n_{h1} denote the number of responses obtained from the first draw;

n^*_{h2} denote the number of licence holders selected from the remaining $(N_h - n_{h1})$ licence holders for the second draw to replace those for whom data were unavailable ($n^*_{h2} = n^*_{h1} - n_{h1}$);

n_{h2} denote the number of responses obtained from the second draw;

h denote stratum (h = 1 ..... H);

i denote observations within a stratum;

x_{hi} denote the ith observation in stratum h.

Total sample taken in stratum h is

$$n_h = n_{h1} + n_{h2} \qquad (1)$$

The probability of a licence holder being included in the first draw (P_1) is

$$P_1 = n^*_{h1}/N_h \qquad (2)$$

A licence holder selected in the first draw was excluded from selection in the second draw. Thus the probability of inclusion in the second draw (P_2) is

$$P_2 = \text{P (non selection initially) X P (selection in the second draw)}$$

$$= (N_h - n^*_{h1})/N_h \cdot n^*_{h2}/(N_h - n^*_{h1})$$

$$= n^*_{h2}/N_h \qquad (3)$$

The total probability of selection of a unit after the second draw (P) is

$$P = \text{P (selection in the first draw) + P(selection in the second draw)}$$

$$= n^*_{h1}/N_h + n^*_{h2}/N_h$$

$$= (n^*_{h1} + n^*_{h2})/N_h \qquad (4)$$

For selections in the first draw, $n^*_{h2} = 0$ and the probability of selection is n^*_{h1}/N_h.

Letting observations be weighted by the inverse of their probabilities of selection, appropriate weights are Nh/n^*_{h1} for units selected on the first draw and $N_h/(n^*_{h1} + n^*_{h2})$ for units selected on the second draw.

Cumulative weights in the stratum are

$$N_s = n_{h1} \cdot N_h/n^*_{h1} + n_{h2} \cdot N_h/(n^*_{h1} + n^*_{h2}) \tag{5}$$

If there is non-response in the second draw, $N_s \neq N_h$.

Thus these weights should be adjusted by a factor of N_h/N_s. Appropriate weights are therefore

$$w_{h1} = (N_h/n^*_{h1}).(N_h/N_s), \text{ and}$$

$$w_{h2} = (N_h/(n^*_{h1} + n^*_{h2})).(N_h/N_s)$$

where w_{h1} denotes the weight applied to observations selected on the first draw in stratum h and w_{h2} denotes the weight applied to observations selected on the second draw in stratum h. These weights preserve the relativities between probabilities of selection and also ensure that the sum of weights for each stratum is equal to the population size N_h.

The mean of a stratum h is estimated using

$$\bar{x}_h = \sum_i w_{hi}\, x_{hi} / \sum w_{hi}$$
$$= \sum_i w_{hi}\, x_{hi}/N_h \tag{6}$$

The mean of any partition of the data set is

$$\bar{x}_p = \sum_{h=1} \sum_{i=1}^{nh} w_{hi}\, x_{hi} \Big/ \sum_{h=1} N_h \tag{7}$$

The weighted variance for the stratum is

$$V^2_{xh} = \sum_i w_{hi}\, (x_{hi} - \bar{x}_h)^2/(n_h - 1) \tag{8}$$

Applying the finite population correction factor, the variance for any stratum is

$$Var(x_{hi}) = ((N_h - n_h)/N_h).\, V^2_{xh} \tag{9}$$

The variance of the mean of the stratum is

$$Var(\bar{x}_h) = (((N_h - n_h)/N_h).\, V^2_{xh})/N_h \tag{10}$$

and the variance of the total for the stratum is

$$Var(x'_h) = N_h^2(((N_h - n_h)/N_h)\, V^2_{xh})/N_h$$
$$= N_h((N_h - n_h)/N_h)V^2_{xh}. \tag{11}$$

Note that if $w_{hi} = N_h/n_h \; \forall \; i \in h$, then equation (8) can be rewritten as

$$V^2_{xh} = \sum_i w_h(x_{hi} - \bar{x}_h)^2/(n_h - 1)$$

$$= w_h \sum_i (x_{hi} - \bar{x}_h)^2/(n_h - 1)$$

$$= (N_h/n_h).S^2 \qquad (12)$$

where S^2 denotes the sample variance of the stratum

$$S^2 = \sum_i (x_{hi} - \bar{x}_h)^2/(n_h - 1).$$

Substituting equation (12) into equation (11), the variance of the total for the stratum is

$$\text{Var}(x'_h) = (N_h/n_h).N_h.((N_h - n_h)/N_h).S^2$$

$$= N_h^2.((N_h - n_h)/N_h).S^2/n_h \qquad (13)$$

which is the classic number raised estimator of variance for the population total in a stratified sample design (Scheaffer, Mendenhall and Ott 1979, p. 64).

The variance of the mean of any partition of the data set is

$$\text{Var}(\bar{x}_p) = \sum_h \text{Var}(x'_h)/(\sum_h N_h)^2 \qquad (14)$$

The relative standard error of the estimated mean of any partition of the data set is

$$\text{RSE}(x) = (\sqrt{\text{Var}\ (\bar{x}_p)}/\bar{x}_p).100 \qquad (15)$$

Statistical Analysis

Non-parametric statistical techniques were used to analyse data and to compare estimates between strata. It was initially proposed to use analysis of variance for this purpose. Data were tested to determine whether the assumptions of normality and homogeneity of variances were appropriate. The normality assumption was tested using the Kolmogorov-Smirnov test and the homogeneity of variance assumption was tested using Bartlett's F test and the maximum variance/minimum variance F test. Results indicated that for most variables, these assumptions were violated, implying that analysis of variance was not an appropriate method for analysing the data.

Results from two non-parametric tests are provided. The Kruskal-Wallis test is used to test the hypothesis that the partitions of tha data set come from the same population or from identical populations with respect to averages (Siegel 1956). The calculated statistic has a chi-squared distribution with n-1 degrees of freedom. A k-sample median test is used to test the hypothesis that the median of the different groups is the same. This statistic also has a chi-squared distribution with n-1 degrees of freedom. Critical values of chi-square for the 5%, 1% and .01% level of significance for 2 degrees of freedom are 5.99, 9.21 and 13.82. Statistical results were obtained using SPSS.

RESULTS

Presentation of Results

Results are presented as averages per licence holder operating in the fishery in 1986/87. To facilitate comparison of results between licence holder categories, data are provided for net, line and net/line fishers. Averages for all fishers surveyed are also provided (all types).

Definition of Terms

Business Unit

The business unit to which the results refer is the individual licence holder operating in the fishery.

Capital Invested

Licence holders were asked to provide estimates of capital invested in boats and fishing gear. Capital invested in boats was defined as the total gross value of the boat, motor and (where applicable) trailer. Values of motor vehicles were provided separately. Fishing gear such as nets, lines, radios, electronic gear (sounders and radar), freezers, fish bins and sundry gear were categorised as other gear. Total value of capital invested by each licence holder was obtained by summing the market values of boats, motor vehicles and other gear. Estimated values were converted to $1986/87 using the implicit price deflator for gross national expenditure.

Fish Income

Fish income was defined as returns gained from the sale of marine species caught by licence holders operating in the fishery. Catch details were obtained from catch records submitted by the licence holder to the Department. Licence holders were asked to estimate the value of their catch.

Survey data on income obtained from other sources (e.g. non-fishing employment or investment income etc.) were not obtained. Thus estimates of total return and fish income are identical.

Trip Costs

Trip costs include charges for fuel, labour (family and non-family), bait, ice and provisions. These costs are the variable costs associated with the fishing operation. An allowance for the wage of the owner-operator was excluded from these estimates.

Boat Costs

Boat costs were those costs incurred in maintaining the productive capacity of the boat and include repairs and maintenance of boats, motor vehicles and other gear.

Administrative Costs

Administrative costs include charges for telephone, stationery, accounting services, electricity and subscriptions.

Miscellaneous Costs

Miscellaneous costs include interest charges, insurance costs, licence fees, motor vehicle costs (registration and insurance), marketing costs (freight and commission charges) and any other operating costs not included elsewhere.

Depreciation

Depreciation is the cost of the decline in productive services from capital items maintained during the survey year. Licence holders were asked to provide estimates of the replacement cost, age and expected life of different capital items. Depreciation was estimated from these data using the diminishing balance method. Estimated values were converted to $1986/87 using the implicit price deflator for gross national expenditure.

Cash Operating Costs

Cash operating costs were defined as the sum of trip, boat, administrative and miscellaneous costs.

Cash Operating Surplus

Cash operating surplus was calculated by deducting cash operating costs (excluding an owner-operator allowance but including payments for family labour) from fish income. It is a measure of the amount of cash available for the licence holders consumption or investment expenditure.

Return to Operators Labour, Capital and Management

The return to operators labour capital and management was calculated by deducting depreciation from cash operating surplus. It represents the monetary return accruing to capital invested in the business and the return to the labour and managerial skills of the licence holder.

Full Equity Return

Full equity return was calculated by adding interest payments incurred by the business unit to the return to operators labour, capital and management. It measures the return that would have been earned by the business unit if all capital had been fully owned by the licence holder. It is therefore a measure of the total returns to owner labour and capital employed in the business, and allows a comparison of such returns across all licence holders in the fishery.

Rate of Return to Operators Labour, Capital and Management

The rate of return to operators labour, capital and management was obtained by dividing the full equity return by the market value of boats, motor vehicles and other gear, and multiplying by 100.

Debt and Equity

Business equity was derived by deducting total debt from the capital value of the business unit. The equity ratio expresses the business equity as a proportion of total capital invested. Only those debts relating specifically to the business unit were taken into account.

Survey Response

The number of licence holders from whom responses were obtained and the population by fishing method type are provided in Table 2. The proportion of the population sampled was greatest for net/line fishers (38.6%) followed by net fishers (25.5%) and line fishers (17.3/%). Survey responses were obtained from 22.5% of the total population.

A survey response was not obtained from the completely enumerated stratum of net fishers in Region 2 (see Fig 1). As there was only one licence holder in the population in this stratum, and comparable data representative of the fishing activity undertaken were unavailable, the stratum was deleted from the analysis. The population size to which the results apply was thus reduced from 387 (Table 1) to 386 (Table 2).

Validation of the Survey Results

The Department of Fisheries routinely collects catch and fishing effort data from all licence holders in the fishery. Price data are also calculated from data provided by fish processors. From these data, census values for the sampling frame of boat days fished and landed catch value for the survey year were obtained (Table 3). The census values were then compared to estimated values obtained from the survey data (Table 3). Estimates of landed catch value were obtained from the survey data by deducting freight and marketing costs from fish income. Standard errors were used to define 95% confidence intervals for the survey estimates.

Table 2.

Sample size and target population.

Type	No of Licence Holders Interviewed	No of Licence Holders in Population	% of Population Interviewed
Net	25	98	25.5
Line	40	231	17.3
Net/Line	22	57	38.6
Total	87	386	22.5

Table 3.

Validation of survey data.

	Estimated Mean From Survey Data	Standard Error	95% Confidence Interval	Census Estimate[a]	Level of Significance[b]
BOAT DAYS					
Net	117.2	9.5771	98.0 - 136.4	119.1	NS
Line	112.6	7.6829	97.2 - 128.0	113.0	NS[b]
Net/Line	149.4	8.560	3132.3 - 166.5	128.5	S
All Types	120.8	6.1848	108.4 - 133.2	116.8	NS
INCOME[c]					
Net	29175	2855.38	24004 - 35426	27951	NS
Line	13407	2241.48	8294 - 17890	12153	NS
Net/Line	22794	2380.35	18033 - 27555	25008	NS
All Types	18933	1564.75	15804 - 22063	18103	NS

[a] Source: South Australian Department of Fisheries.
[b] NS denotes not significant at the 5% level; S denotes significant at the 5% lev
[c] Defined as fish income minus freight and commission costs.

With the exception of boat days fished for net/line fishers, the census values fall within the 95% confidence interval for the mean of each partition of the data set according to type of fishing method, implying that they are not significantly different from the survey estimates of these variables. There is also no significant difference between the survey and census estimates for all groups. The comparison indicates that the survey estimates for line and net fishers are an accurate representation of the population. Respondents for the net/line fishery, however, appear to be biased toward fishers recording above average boat days fished. The overall effect of the bias is small due to the relatively low number of net/line fishers in the total population (51, Table 1). This is verified by the finding that the estimates for the fishery as a whole (all types) are reliable. The bias in the net/line fisher group may have been reduced if a larger sample was taken. However, in the survey design used, the percentage of population sampled in this group was the highest of all groups (Table 2). The bias may be due to heterogeneity within this type classification.

Characteristics of Fishing Activities

The average number of boat days fished by all licence holders in the sample was 121 (Table 4). Net/line fishers reported the largest number of boat days fished (149). Net and line fishers recorded an approximately equal number of boat days fished (113 and 117). There was a large variation in number of boat-days fished by individual licence holders. The minimum number of boat-days fished by net, line and net/line fishers was 40, 34 and 31; the maximum number of days fished by net, line and net/line fishers was 247, 296 and 296.

Labour intensity was calculated as the ratio of man-days to boat-days. A higher ratio indicates that the fishing operation is more labour intensive. As shown in Table 4, labour intensity was greater for net fishers (1.60) followed by net/line fishers (1.51) and line fishers (1.19). Variation in labour intensity reflects the different requirements for labour of line and net fishing.

Average length of the main boat used in the fishery was 6.0 metres (Table 4). Line fishers had, on average, longer boats (6.1 metres) than either net fishers (5.4 metres) or net/line fishers (5.0 metres). However, the results from the Kruskal Wallis test indicate that the distribution of boat lengths for each type of fishing method was not significantly different at the 5% level.

Table 4.

Average Characteristics of fishing activities and licence holders: 1986/87.

	Fishing Method					
	Net	Line	Net/line	All Types	KW Test[b]	Med Test[c]
Boat Days Fished	113 (7)[a]	117 (8)	149 (6)	120 (5)	17.945	15.629
Man Days	182 (8)	139 (12)	231 (8)	164 (7)	39.618	24.324
Length of Main Boats (m)	5.4 (4)	6.1 (10)	5.0 (6)	6.0 (6)	5.917	10.647
Age of Licence Holder (yrs)	44 (7)	40 (9)	44 (6)	42 (6)	11.056	13.758
Years Spent Fishing	22 (14)	17 (18)	25 (10)	19 (10)	28.927	12.174
Labour Intensity	1.60 (5)	1.19 (5)	1.51 (2)	1.34 (3)	59.225	54.187

[a] Values in parentheses are relative standard errors.

[b] Kruskal Wallis test.

[c] Median test.

The average age of licence holders in 1986 was 41.7 years (Table 4). Line fishers were younger, on average, (40.0 years) than either net fishers (44.3 years) or net/line fishers (43.8). With the exception of family transfers, netting endorsements are not transferable. The higher average age of net fishers relative to line fishers suggests that licence holders with netting endorsements may be retaining their licences and continuing fishing, rather than transfering out of the fishery and surrendering their netting endorsement. This conclusion is supported by data on licence transfers (Table 5) which indicate that since licence transferability was introduced in 1982, the number of net entitlements that have been transfered (and thus surrendered) has declined. Also the proportion of total licence transfers involving surrender of a netting endorsement per annum has declined from 34.5% at 30 June 1983 to 10.7% at 30 June 1988. It is concluded that the current policy of non-transferability of netting endorsements is encouraging an aging population of net fishers.

Licence holders, on average, have extensive fishing experience. The average number of years spent commercial fishing was 19.2 (Table 4). Line fishers recorded the least fishing experience (16.6 years) relative to net (21.9 years) and net/line (24.8 years) fishers. This result is consistent with the finding above that line fishers were younger than net fishers, and is probably due to the restrictions on net transfers which require new entrants to the fishery to take up line only rather than net licences.

Catches of Selected Species

The average individual catch of all species taken by marine scalefish licence holders in 1986/87 was 6,209 kg (Table 6). King George whiting was the most important species caught (averaging 1,553 kg or 25.0% of the total catch). Garfish and snapper were the second and third most important species accounting for 15.0% (930 kg) and 14.7% (910 kg) of average total catch respectively. Calamary catches amounted to 12.0% of average total catch (744 kg).

Catches varied according to the type of fishing method used. Smallest catches were taken by line fishers (averaging 3,658 kg). The main species taken by line fishers were King George whiting (34.6% of their average total catch), calamary (23.4% of average total catch) and snapper (21.8% of average total catch). Only small amounts of 'other species' were caught by line fishers (7.3% of average total catch). These results are averaged data for all line fishers; the relative importance of individual species varied according to the region where fishing occurred.

Net fishers reported the highest catches; average total catch was 10,803 kg. The main species caught by net fishers were garfish (28.7% of average total catch) and King George whiting (18.2% of average total catch). Net fishers also caught large amounts of 'other species' (tommy ruff and mullet etc.) equivalent to 37.4% of average total catch.

Table 5.

Licence transfers in the Marine Scalefish Fishery.

Date	Line Licence transfers	Net Licence Family transfers	Total transfers	Net entitlements surrendered	Net entitlements surrendered as a % of total transfers
30.6.83	81	6	87	30	34.5
30.6.84	58	6	64	27	42.2
30.6.85	73	11	84	21	25.0
30.6.86	63	8	71	13	18.3
30.6.87	53	10	63	5	7.9
30.6.88	67	8	75	8	10.7

Source: Derived from Jones et. al (1990).

Table 6.

Catches of selected species: 1986/87 (average per licence holder).

Species	Net	Line	Net/line	All Types
KING GEORGE WHITING				
Quantity (kg)	1969 (13)[a]	1264 (15)	2010 (11)	1553 (9)
% of Total Catch	18.2	34.6	23.2	25.0
SNAPPER				
Quantity (kg)	682 (40)	798 (36)	1757 (27)	910 (22)
% of Total Catch	6.3	21.8	20.3	14.7
GARFISH				
Quantity (kg)	3099 (21)	111 (57)	519 (34)	930 (19)
% of Total Catch	28.7	3.0	6.0	15.0
YELLOWFIN WHITING				
Quantity (kg)	209 (17)		97 (42)	67 (16)
% of Total Catch	1.9		1.1	1.1
SHARK				
Quantity (kg)	87 (59)	360 (51)	471 (43)	308 (37)
% of Total Catch	0.8	9.8	5.4	5.0
CALAMARY				
Quantity (kg)	721 (18)	857 (77)	331 (13)	744 (53)
% of Total Catch	6.7	23.4	3.8	12.0
OTHER SPECIES				
Quantity (kg)	4036 (20)	267 (30)	3463 (16)	1696 (13)
% of Total Catch	37.4	7.3	40.0	27.3
ALL SPECIES (kg)	10803 (13)	3658 (21)	8649 (12)	6209 (10)

[a] Values in parentheses are relative standard errors.

Table 7.

Percentage of licence holders selling King George whiting, snapper and garfish to alternative markets.

Species	% of licence holders marketing to		
	South Australian Country	Adelaide	Interstate
King George Whiting	70.3 (8)a	30.6 (18)	3.5 (32)
Snapper	36.1[b](16)	28.2 (22)	2.3 (59)
Garfish	28.5 (18)	22.2 (23)	0.7 (80)

[a] Values in parentheses are relative standard errors.

b Percentages for each species may sum to less than 100% if some licence holders do not catch that species or greater than 100% if some licence holders sell fish on two or more markets.

Table 8.

Sales of King George whiting, snapper and garfish catches between South Australia and interstate markets.

Species	Total Catch	Sold in South Australia		Sold Interstate	
	kg	kg	% of Catch	kg	% of Catch
King George Whiting	599,458	581,702	97.0	17,756	3.0
Snapper	351,260	331,960	94.5	19,300	5.5
Garfish	359,019	358,980	99.9	38,000	0.01

Average total catch of net/line fishers (8,649 kg) was less than that recorded for net fishers and over twice as much as that observed for line fishers. The main species caught were 'other species' (40% of average total catch), King George whiting (25.0% of average total catch) and snapper (20.3% of average total catch). Net/line fishers caught small amounts of garfish (519 kg or 6.0% of average total catch) relative to net fishers (3,099 kg or 28.7% of average total catch).

Sales of Fish by Licence Holders

Details of fish sales by licence holders of King George whiting, snapper and garfish between country, Adelaide and interstate markets in 1986/87 are provided in Tables 7 and 8. The region of sales do not indicate the region where fish were finally purchased prior to consumption. However, as most licence holders are located in country regions, the data provide an indication of the level of marketing activity of fishers.

Most licence holders sold their fish to South Australian country and Adelaide markets (Table 7). For example, 70.3% of licence holders sold King George whiting to country buyers and 30.6% sold to Adelaide buyers. For snapper and garfish, 36.1% and 28.5% of licence holders sold to country buyers and 28.8% and 22.2% sold to Adelaide buyers. Only a small percentage of licence holders sold fish directly to interstate markets; 3.5%, 2.3% and 0.7% of licence holders marketed King George whiting, snapper and garfish interstate.

The estimated total catch of King George whiting, snapper and garfish taken by the survey population, and the quantity and percentage of total catch of these species sold by licence holders to South Australian and interstate buyers is provided in Table 8. Most of the catch (97.0%, 94.5% and 99.9% of king George whiting, snapper and garfish) was sold by licence holders to South Australian buyers. Small quantities of snapper (19.3 tonnes) and King George whiting (17.8 tonnes) were sold interstate. However, these sales accounted for only 5.5% and 3.0% of total catch. Almost all garfish were sold in South Australia (99.9%).

These data indicate that marine scalefish licence holders sold most of their fish within South Australia to local country buyers. Few licence holders sold fish directly to interstate markets.

Capital Invested

Average capital investment by net and net/line fishers in 1986/87 (including licence value) was $61,338 and $62,175 (Table 9). This was significantly higher than that reported for line fishers ($49,417).

Estimates of licence value were obtained from licence transfer data provided by licence holders to the Department of Fisheries. Average licence transfer price during 1986/87 was $26,700. As net endorsements were not transferable, the average licence transfer price was assumed to be the same for all types of fishing method (net, line and net/line). However, individual transfer prices varied according to the endorsements on the licence e.g. long-lines, fish traps etc.

Average capital invested in boats, vehicles and other gear by net and net/line fishers was approximately the same ($34,634 and $35,475). Line fishers, however, reported significantly lower levels of capital invested in boats, vehicles and other gear (averaging $22,717). Greater capital investment reported by net and net/line fishers was due to a higher value of other gear (including nets) and greater investment in boats (net fishers often had more than one boat with each boat set up with different types of nets).

Variations in the average proportion of capital invested in boats, motor vehicles and other gear by licence holders in each type category are indicated in Table 10. Value of boats varied from an average of 38.4% for net/line fishers to an average of 52.7% for line fishers. The average for all licence holders in the fishery was 49.6%. This result demonstrates that the investment in a boat was a large component of total investment of licence holders.

Table 9.

Capital investment (average per licence holder): 1986/87.

Type of Investment	Fishing Method					
	Net	Line	Net/line	All Types	KW Test[c]	Med Test[d]
Boats, motor vehicles and gear	34634 (8)[a]	22717 (14)	35475 (18)	27626 (8)	36.919	25.272
Licence[b]	26700	26700	26700	26700		
Total	61334	49417	62175	54326	38.422	18.028

[a] Values in parentheses are relative standard errors.

[b] Estimated from licence transfer data provided by licence holders to the Department of Fisheries.

[c] Kruskal Wallis test.

[d] Median test.

Table 10.

Percentage of investment (excluding licence value) attributed to boats, motor vehicles and other gear: 1986/87 (average per licence holder).

Gear	Fishing Method					
	Net	Line	Net/line	All Types	KW Test[b]	Med Test[c]
Boats (%)	49.1 (6)[a]	52.7 (6)	38.4 (7)	49.6 (4)	12.496	7.006
Motor Vehicles (%)	20.2 (13)	25.2 (18)	32.4 (12)	25.0 (11)	25.849	28.842
Other Gear (%)	30.7 (11)	22.1 (13)	29.2 (8)	25.4 (8)	16.360	32.094
Capital Invested ($)	34634 (8)	22717 (14)	35474 (18)	27626 (8)		

[a] Values in parentheses are relative standard errors.

[b] Kruskal Wallis test.

[c] Median test.

The average percentage of capital invested in motor vehicles and other gear by all licence holders was similar (25.0% and 25.4%). However, the proportion of capital invested in other gear by line fishers (22.1%) was lower than that for net and net/line fishers (30.7% and 29.2%). As indicated above, this was due primarily to the value of nets owned by net and net/line fishers.

Loans

Over one third (36.5%) of licence holders in 1986/87 had outstanding loans relating directly to their fishing operations (Table 11). The proportion of net/line fishers with loans (42.3%) was higher than that for line (38.5%) or net (28.4%) fishers. The average amount owed by each licence holder with an outstanding loan at the 30 June 1987 was $7,421. Net fishers with loans exhibited larger outstanding balances ($11,669) than line ($6,454) and net/line ($6,081) fishers.

Table 11.

Characteristics of licence holders with loans.

	% of licencees with loans	Average amount outstanding for licencees with loans
Net	28.4 (35)[a]	11669 (8)
Line	38.5 (24)	6454 (6)
Net/line	42.3 (24)	6081 (6)
All Types	36.5 (17)	7421 (5)

[a] Values in parentheses are relative standard errors.

The majority of licence holders with loans held only one loan (75.4%), although 19.9% held two loans and 4.7% held three loans (Table 12). The percentages of total licence holders in the fishery holding one, two and three loans was 27.5, 7.3 and 1.8 (Table 12).

Table 12.

Frequency distribution of number of loans held.

Number of loans	Number of licence holders	% of number of licence holders with loans	% of total number of licence holders in thefishery
1	106	75.4	27.5
2	28	19.9	7.3
3	7	4.7	1.8
TOTAL	141	100	36.5

Table 13.

Percentage of licence holders with loans by loan purpose: 1986/87.

Loan Purpose	Fishing Method			
	Net	Line	Net/line	All Types[b]
Boat & Gear	23.0 (46)[a]	28.8 (31)	42.3 (24)	28.2 (22)
Licence	1.0 (0)	10.2 (44)		6.4 (42)
Motor Vehicle	5.5 (83)	7.2 (58)	2.6 (58)	6.1 (45)
Fishing Equipment		0.4 (0)		0.3 (0)
Working Capital	7.3 (70)	1.5 (78)		2.75 (54)

a Values in parentheses are relative standard errors.

b Sum of percentages for each type of fishery exceeds the total reported in Table 12 as some licence holders had more than one loan.

Table 14.

Percentage of licence holders with loans by type of loans: 1986/87.

	Fishing Method			
Type of Loan	Net	Line	Net/line	All Types
Bank Overdraft	10.2 (71)[a]	24.0 (37)	7.0 (87)	18.0 (32)
Term Loan		1.5 (78)	10.5 (37.3)	2.4 (37)
Personal Loan	27.4 (37)	12.6 (74)	24.8 (33)	18.2 (35)
Hire Purchase			2.6 (58)	0.39 (57)
Credit Cards	2.9 (80)	0.43 (0)		0.98 (59)
Interest Free	1.0 (0)	4.0 (0)		2.7 (0)

[a] Values in parentheses are relative standard errors.

Table 15.

Percentage of licence holders with loans by lending source: 1986/87.

Lending Source	Fishing Method			
	Net	Line	Net/line	All Types
Bank	27.4 (37)[a]	34.5 (26)	38.1 (25)	33.3 (18)
Finance Company		1.7 (86)	6.8 (49)	2.0 (49)
Private Funding	1.0 (0)	4.0 (95)		2.7 (85)
Other		0.4 (0)		0.3 (0)

[a] Values in parentheses are relative standard errors.

The majority of loans were taken out to purchase boats; 28.2% of licence holders in the fishery had loans for this purpose (Table 13). A smaller proportion of licence holders had also taken out loans to purchase a licence (6.4%) and a motor vehicle (6.1%).

Most loans were obtained as personal loans or bank overdrafts. The proportions of licence holders in the fishery having personal and bank overdraft loans was 18.2% and 18.0% (Table 14). The main source of loan funds for licence holders was banks; 33.3% of licence holders in the fishery obtained loans from a bank (Table 15).

Labour

Over one half (58.8%) of licence holders in the fishery employed labour during the 1986/87 financial year. The average amount paid by each licence holder in wages was $1,832 per annum. Consistent with previous results (Table 4), data obtained on labour usage indicates that net fishing was more labour intensive than line fishing (Table 16). The proportion of licence holders employing labour was significantly greater for the net fishery (82.6%) than the line (45.6%) and net/line (67.5%) fishery. Also the average amount paid in wages by net fishers ($5,439) was significantly higher than that paid by line ($279) and net/line ($1,923) fishers.

The type of labour most frequently used by licence holders was non-family employed crew, varying from 22.7% for line fishers to 48.8% for net fishers (the average of all licence holders was 30.0%). Paid family labour was used by 20.4% of licence holders. A few licence holders employed spouses (6.1%), partners (4.0%) and unpaid labour (4.2%).

Over one third (37.1%) of licence holders obtained additional paid employment during the 1986/87 financial year (Table 17). The highest incidence of alternative employment occurred in the line fishery, where 46.2% of licence holders worked in other jobs. Incidence of alternative employment in the net and net/line fishery was lower and approximately equal (23.0% and 24.4%).

The average number of weeks worked in alternative employment was 9.7 (Table 17). Net fishers recorded the least amount of time working in alternative employment (averaging 3.0 weeks). The greatest amount of time spent in alternative employment was recorded by line fishers (averaging 12.8 weeks). Net/line fishers spent an average of 8.8 weeks working in other jobs.

Costs and Returns

Costs and returns recorded by licence holders in the 1986/87 financial year are presented in Table 18. The average fish income of all licence holders in the fishery was $20,188. Highest average fish incomes were earned by net fishers ($31,855). Net/line fishers also earned above average incomes ($24,660), while line fishers earned the smallest incomes (averaging $14,135 or 44.3% of that earned by net fishers).

Table 16.

Percentage of licence holders employing labour by type of labour and wages paid: 1986/87.

	Fishing Method					
	Net	Line	Net/line	All Types	KW Test[b]	Med Test[c]
Spouse	1.0 (0)[a]	4.0 (59)	23.4 (33)	6.1 (30)	41.072	32.011
Family	34.7 (32)	17.1 (49)	9.4 (32)	20.4 (28)	17.503	20.129
Crew	48.8 (23)	22.4 (39)	28.7 (26)	30.0 (20)	23.543	25.222
Partner	7.4 (72)	1.5 (78)	8.4 (63)	4.0 (42)	8.290	8.491
Unpaid	4.4 (102)	1.6 (86)	14.0 (53)	4.2 (43)	19.311	19.356
Licencees employing labour	82.6 (8)	46.5 (22)	67.5 (15)	58.8 (11)	37.135	
Wages paid	5,439 (21)	279 (53)	1,923 (28)	1,832 (17)	71.806	38.472

[a] Values in parentheses are relative standard errors.

[b] Kruskal Wallis test.

[c] Median test.

Table 17.

Non-fishing employment by licence holders.

Variable	Fishing Method			
	Net	Line	Net/line	All Type
Proportion of licence holders with other jobs (%)	23.0 (38)[a]	46.2 (22)	24.4 (33)	37.1 (18
Average number of weeks worked in other jobs (weeks)	3.0 (36)	12.8 (28)	8.8 (44)	9.7 (23

[a] Values in parentheses are relative standard errors.

Average total cash operating costs exhibited similar trends to fish income according to type of fishing method used. The average cash operating cost for all licence holders in the fishery was $11,522. Average costs incurred by net fishers ($19,115) were significantly greater than those incurred by net/line ($13,643) and line ($7,777) fishers.

The main factors contributing to higher average cash operating costs of net and net/line fishers relative to line fishers were higher average fuel, labour, repairs and maintenance and marketing costs. Average fuel costs of net and net/line fishers were $4,361 and $3,527. Average fuel costs for line fishers were only $2,549. The variation in fuel costs indicates that net fishing was more fuel intensive than line fishing (note that from Table 4, the number of boat-days fished by net and line fishers was approximately equal).

Net and net/line fishers also spent significantly greater amounts on labour ($5,439 and $1,923 on average) compared to line fishers ($279).

Average repairs and maintenance expenditure by net and net/line fishers ($3,697 and $2,295) was significantly greater than that expended by line fishers ($1,560). This is attributed to higher capital investment in boats, vehicles and other gear by net and net/line fishers relative to line fishers (Table 9).

Table 18.

Components of Costs and Returns ($).

Variable	Fishing Method					
	Net	Line	Net/line	All Types	KW Test[b]	Med Test[c]
TOTAL RETURNS						
Fish Income	31855 (10)[a]	14135 (17)	24660 (10)	20188 (10)	59.995	43.379
CASH OPERATING COSTS						
TRIP COSTS						
Labour Payments	5439 (21)	279 (53)	1923 (28)	1832 (17)	71.806	38.472
Fuel and Lubricants	4361 (10)	2549 (21)	3527 (8)	3154 (11)	42.292	30.419
Other	140 (28)	331 (19)	322 (31)	281 (15)	67.223	57.387
TOTAL Trip Costs	9940 (14)	3158 (19)	5772 (12)	5266 (10)	53.204	31.507
BOAT COSTS						
Repairs and Maintenance	3697 (15)	1560 (13)	2295 (13)	2210 (9)	55.411	39.661
Other	249 (78)	37 (90)	73 (61)	96 (56)	12.302	39.315
TOTAL Boat Costs	3946 (15)	1596 (12)	2368 (12)	2307 (8)	58.288	39.315
ADMINISTRATIVE COSTS						
Administrative Costs	674 (9)	527 (14)	1097 (10)	649 (8)	57.928	61.148
MISCELLANEOUS COSTS						
Interest	519 (36)	570 (24)	542 (18)	553 (18)	2.520	3.773
Marketing	2139 (28)	728 (37)	1866 (21)	1254 (18)	46.507	53.304
Insurance	329 (29)	158 (32)	300 (17)	223 (18)	17.432	8.839
Motor Vehicle	768 (19)	576 (15)	1061 (16)	696 (10)	15.409	12.253
Food	329 (5)	245 (12)	306 (5)	276 (7)	167.788	31.352
Other	471 (31)	217 (18)	332 (20)	298 (15)	5.710	3.380
TOTAL Miscellaneous	4556 (16)	2495 (16)	4406 (13)	3300 (9)	41.748	23.820
TOTAL CASH OPERATING COSTS	19115 (13)	7777 (14)	13643 (10)	11522 (8)	69.194	66.637

[a] Values in parentheses are relative standard errors.
[b] Kruskal Wallis test.
[c] Median test.

Average marketing costs (freight and commission) were significantly larger for net and net/line fishers ($2,139 and $1,866) compared to line fishers ($728). Also the proportion of marketing costs as a percentage of total return was greater for net and net/line fishers (6.7% and 7.6%) than that for line fishers (5.2%). These differences were due mainly to variation in catches between the groups.

While there were statistically significant differences in the average costs by type of fishing method for other items listed in Table 18, the absolute values were small relative to overall cost, implying that their effect on average cash operating cost was also small.

Average cash operating costs were summarised according to trip, boat, administrative and miscellaneous costs (Table 18). Trip costs (fuel and labour) were the largest of these cost categories averaging 45.7% of total cash operating costs of all licence holders (Table 19). Miscellaneous and boat costs contributed on average 28.6% and 20.0% of cash operating costs. The percentage contribution of trip, boat, administrative and miscellaneous costs to average cash operating costs varied according to fishing method. However, the relative ranking of each cost type was the same for net, line and net/line fishers (i.e. trip costs were the most important followed by miscellaneous costs, boat costs and administrative costs).

Table 19.

Relative importance of cost categories.

Type of Costs	Fishing Method			
	Net %	Line %	Net/Line %	AllTypes %
Trip	52.0	40.6	42.3	45.7
Boat	20.6	20.5	17.4	20.0
Administrative	3.5	6.8	8.0	5.6
Miscellaneous	23.8	32.1	32.3	28.6

Economic Performance

Data describing average economic performance of licence holders in the marine scalefish fishery are provided in Table 20. Average cash operating surplus for all licence holders was $8,666. Even though net and net/line fishers incurred greater costs than line fishers, they also earned proportionately greater fish incomes, causing their average cash operating surplus ($12,729 and $11,016) to exceed that for line fishers ($6,358). The estimated average cash operating surplus in the marine scalefish fishery is low relative to estimates available for the Southern Zone rock lobster and South-east trawl fisheries (Table 21). However, the average capital invested by marine scalefish licence holders is also low relative to these other fisheries.

Table 20.

Summary of performance measures.

Variable	Fishing Method Net	Line	Net/Line	All Types	KW Test[b]	Med Test[c]
Total Return ($)	31854 (10)[a]	14135 (17)	24660 (11)	20188 (8)	42.841	55.753
Cash Operating Costs ($)	19116 (13)	7777 (14)	13644 (10)	11522 (8)	64.928	67.299
Cash Operating Surplus ($)	12739 (12)	6358 (23)	11016 (15)	8666 (11)	32.030	16.458
Depreciation ($)	3866 (9)	4775 (9)	4215 (11)	4461 (6)	11.757	20.686
Return to Operator Labour, Capital and Management ($)	8873 (14)	1583 (95)	6801 (22)	4204 (23)	41.298	8.823
Full Equity Return ($)	9392 (13)	2153 (71)	7343 (22)	4757 (13)	39.777	11.128
Debts ($)	3320 (43)	2487 (24)	2571 (22)	2711 (19)	2.024	4.387
Equity Ratio	0.89 (6)	0.89 (3)	0.89 (5)	0.89 (3)	2.266	0.000
Return to Cost Ratio	1.46 (4)	1.07 (11)	1.40 (7)	1.22 (6)	21.348	8.823
Rate of Return to Operator's Labour, Capital and Management (%)	34.9 (15)	10.3 (102)	34.8 (27)	20.1 (32)	18.139	7.245

[a] Values in parentheses are relative standard errors.
[b] Kruskal Wallis test.
[c] Median test.

Table 21.

Financial performance of licence holders in the South East Trawl Fishery (1980/81 data inflated to $1986/87) and the Southern Zone Rock Lobster Fishery (1982/83 data inflated to $1986/87). Average per licence holder[a].

Variable	South-East Trawl[b]	Southern Zone Rock Lobster[c]
Gross returns	223,960	78,121
Cash operating costs	159,866	53,054
Cash operating surplus	64,094	25,066
Depreciation	21,040	8,736
Return to Operator Labour, Capital and Management	43,054	16,330
Capital invested[d]	397,700	155,453

[a] The consumer price index was used as the inflator.
[b] Source: BAE (1984).
[c] Source: BAE (1985).
[d] Includes the value of boat only.

Average cost of depreciation per licence holder was $4,461 (Table 20). Net fishers exhibited significantly smaller average depreciation costs ($3,866) than line fishers ($4,775). As nets are typically repaired rather than replaced, the cost of maintaining nets was included in annual repairs and maintenance expenditure resulting in reduced depreciation costs for net fishers.

Estimates of the average return to operator labour, capital and management and the average full equity return are provided in Table 20. The difference between these two estimates of income is the average amount of loan interest paid by licence holders. This was approximately the same for all types of fishers, varying from $519 for net fishers to $570 for line fishers.

Comparisons of income generated by licence holders categorised according to type of fishing method are best made using full equity return, as this measure is independent of debt level (see Definition of Terms). Average full equity return for all licence holders in the fishery was $4,204 (Table 20). Consistent with trends in cash operating surplus, the average full equity return was greater for net and net/line fishers ($9,392 and $7,343) relative to line fishers ($2,153). Thus while average net income levels in the marine scalefish fishery were low, net fishers earned significantly greater incomes than line fishers. Actual net incomes earned by individual licence holders varied, depending on debt levels and the amount of interest they were required to pay.

The estimates of economic performance presented in Table 20 are averages for the fishery. .There was a large variation in the value of these variables across licence holders. Variation in full equity return for net, line and net/line fishers is indicated in Tables 22, 23 and 24. The percentage of net, line and net/line fishers recording a negative return in 1986/87 (< $0) was 15.1%, 42.7% and 16.3%. Some licence holders earned returns of $20,000 or greater (23.5%, 0.4% and 9.2% of net, line and net/line fishers). As well as demonstrating the range in return, these data also reinforce the finding that income levels in the line fishery were significantly lower than those in the net and net/line fisheries.

Table 22.

Frequency distribution of full equity return for net fishers: 1986/87.

Full Equity Return	Frequency	Percent	Cumulative Percent
-$5,000 to -$1	15	15.1	15.1
$0 to $4,999	29	29.3	44.4
$5,000 to $9,999	11	11.3	55.7
$10,000 to $14,999	14	14.7	70.4
$15,000 to $19,999	6	6.17	6.5
$20,000 to $24,99	17	17.2	93.6
>$25,000	6	6.4	100.0
Total	**98**	**100.0**	

Economic efficiency of the different types of fishing methods was examined by comparing the rate of return to operator labour, capital and management on capital invested (excluding licence value) and the return to cost ratio for each type of fishing method. The rate of return to operator labour, capital and management measures the net income generated per dollar invested in boats, motor vehicles and other gear. As an estimate of the value of a marine scalefish licence with a net endorsement was unavailable (net endorsements were not transferrable), licence value was excluded in calculating the rate of return. This is also consistent with previous analyses of economic performance in fisheries (BAE 1984, 1985).

The average rate of return to operator labour, capital and management in the fishery was 17.9%. Net and net/line fishers earned significantly greater rates of return (34.9% and 34.8%) than line fishers (7.7%). These results indicate that net fishers were more economically efficient than line fishers. There was a large range in the rate of return between licence holders using different fishing methods (Tables 25, 26 and 27). The proportion of net, line and net/line fishers earning negative returns was 15.1%, 58.7% and 22.3%. Thirty percent of net fishers earned a rate of return in excess of 40.0%. The proportion of line and net/line fishers earning returns greater than 40.0% was 22.9% and 32.4%. The minimum rate of return for net, line and net/line fishers was -12.2%, -84.0% and -19.5%; the corresponding maximum rates of return for net, line and net/line fishers were 510.3%, 184.1% and 157.9%.

Table 23.

Frequency distribution of full equity return for line fishers: 1986/87.

Full Equity Return	Frequency	Percent	Cumulative Percent
<-$5,001	53	22.8	22.8
-$5,000 to -$1	46	19.9	42.7
$0 to $4,999	38	16.6	59.2
$5,000 to $9,999	55	23.8	83.0
$10,000 to $14,999	36	15.7	98.7
$15,000 to $19,999	2	0.9	99.6
>$25,000	1	0.4	100.0
Total	**231**	**100.0**	

Table 24.

Frequency distribution of full equity return for net/line fishers: 1986/87.

Full Equity Return	Frequency	Percent	Cumulative Percent
<-$5,001	2	4.2	4.2
-$5,000 to -$1	7	12.1	16.3
$0 to $4,999	17	30.0	46.3
$5,000 to $9,999	12	20.4	66.6
$10,000 to $14,999	10	17.2	83.8
$15,000 to $19,999	4	7.0	90.8
$20,000 to $24,999	1	1.8	92.6
>$25,000	4	7.4	100.0
Total	**57**	**100.0**	

Table 25.

Frequency distribution of the rate of return to operator's labour capital and management for net fishers: 1986/87.

Rate of Return to Operator's Labour, Capital and Management	Frequency	Percent	Cumulative Percent
-.9% to -19.9%	15	15.1	15.1
0% to 19.9%	23	23.6	38.7
20% to 39.9%	31	31.3	70.0
40% to 59.9%	20	20.0	90.0
60% to 79.9%	6	5.7	95.8
>80%	4	4.2	100.0
Total	**98**	**100.0**	

Table 26.

Frequency distribution of the rate of return to operator's labour, capital and management for line fishers: 1986/87.

Rate of Return to Operator's Labour, Capital and Management	Frequency	Percent	Cumulative Percent
<-20%	37	16.0	16.0
-0.1% to -19.9%	62	26.6	42.7
0% to 19.9%	32	13.8	56.4
20% to 39.9%	48	20.6	77.1
40% to 59.9%	9	4.0	81.1
60% to 79.9%	38	16.3	97.4
>80%	6	2.6	100.0
Total	**231**	**100.0**	

Table 27.

Frequency distribution of the rate of return to operator's labour, capital and management for net/line fishers: 1986/87.

Rate of Return to Operator's Labour, Capital and Management	Frequency	Percent	Cumulative Percent
<-20%	3	5.9	5.9
-0.1% to -19.9%	6	10.3	16.3
0% to 19.9%	19	34.2	50.4
20% to 39.9%	10	17.2	67.6
40% to 59.9%	7	11.8	79.4
60% to 79.9%	1	1.8	81.2
>80%	11	18.8	100.0
Total	57	100.0	

The return to cost ratio indicates the return generated per dollar expended on operating costs and depreciation. Net and net/line fishers had significantly higher average return to cost ratios (1.46 and 1.40) than line fishers (1.07, Table 20). This result is consistent with the conclusion that net fishers were more economically efficient than line fishers.

Data describing the average debt and average equity ratio per licence holder are also provided in Table 20. The average debt of all licence holders in 1986/87 was $2,711. Debt varied, on average, from $2,487 for line fishers to $3,320 for net fishers, although the difference between types is not statistically significant at the 5% level. Average equity ratio (0.89) was relatively high and was the same for all types of fishing methods.

Quartile Analysis

Quartile analysis was used to identify factors influencing the variation in economic performance of licence holders, measured as the rate of return to operators labour, capital and management, and to examine the effect of variation in boat-days fished on economic performance. Quartiles are values which divide the population into four equal parts when individual units are placed in ascending order of magnitude. For example, the first quartile group (Q1) comprises 25% of licence holders in the target population with the lowest rate of return or the lowest boat-days fished. The fourth quartile group (Q4) consists of the 25% of boats in the target population with the highest rate of return or highest boat-days fished.

Results from the quartile analysis are presented for net, line and net/line fishers in Tables 29 to 40. Boundaries of quartile groups for the rate of return to operators labour, capital and management and boat-days fished for each type of fishing method were obtained using SPSS, and are reported in Table 28.

Quartile Analysis of Rate of Return to Labour, Capital and Management

For all types of fishing methods, fish income tended to increase across quartile groups, as the rate of return increased (Tables 29 to 31). The rate of increase between quartiles 3 and 4 (Q3 and Q4) was smaller than that recorded between quartiles 1 and 2 (Q1 and Q2) and 2 and 3 (Q2 and Q3), and declined for net/line fishers (Fig. 2).

Total cash operating costs followed a similar trend to fish income, increasing with increases in the rate of return (Tables 29 to 31). In accord with the fish income data, cash operating costs for net/line fishers in quartile 4 were smaller than those in quartile 3. Data presented in Table 19 indicate that the most important cost category was trip costs. With the exception of the net/line fishery, trip costs increased across quartiles (Tables 29 to 31). Other cost categories exhibited no obvious trend (Tables 29 to 31).

The results demonstrate that the most efficient fishers, measured by the rate of return to labour, capital and management, tended to have higher fish incomes than less efficient fishers. They also expended greater amounts to catch these fish. Thus the efficiency of individual licence holders appears to increase as business size increases, implying that improvements in efficiency may be dependent on the scale of operation. From Tables 32, 33 and 34, boat days also tended to increase across quartiles, providing further evidence that the scale of operation was a determinant of efficiency.

Table 28.

Boundaries of quartile groups: 1986/87.

Variable	Fishing Method	Quartile Group			
		Q1	Q2	Q3	Q4
Boat Days	Net	< 90.0	90.0 to 116.0	116.0 to 128.0	> 128.0
	Line	< 71.0	71.0 to 119.0	119.0 to 152.0	> 152.0
	Net/Line	< 117.0	117.0 to 140.0	140.0 to 173.0	> 173.0
Rate of Return to	Net	< 8.7	8.7 to 26.1	26.1 to 41.8	> 41.8
Operator's Labour	Line	< -13.2	-13.2 to 5.8	5.8 to 38.9	> 38.9
Capital and Management	Net/Line	< 7.2	7.2 to 16.5	16.5 to 50.8	> 50.8

Table 29.

Components of cost and return by rate of return to operator's labour, capital and management quartile groups in the net fishery ($): 1986/87 (average per licence holder).

Variable	Q1	Q2	Q3	Q4	Average
TOTAL RETURNS					
Fish Income	17380	28091	43499	43231	31855
CASH OPERATING COSTS					
TRIP COSTS					
Labour Payments	5154	3993	7274	6650	5439
Fuel and Lubricants	2911	5225	3908	5350	4361
Other	368	136	0	10	140
TOTAL Trip Costs	8434	9354	11182	12010	9940
BOAT COSTS					
Repairs and Maintenance	2290	4054	4648	4104	3697
Other	40	170	0	792	249
TOTAL Boat Costs	2331	4224	4648	4896	3946
ADMINISTRATIVE COSTS					
Administrative Costs	528	558	960	772	674
MISCELLANEOUS COSTS					
Interest	592	701	531	264	519
Marketing	1925	1628	3881	1769	2139
Insurance	320	247	180	586	329
Motor Vehicle	877	629	593	931	768
Fees	302	337	314	360	329
Other	605	733	224	265	471
TOTAL Miscellaneous	4623	4276	5722	4175	4556
TOTAL CASH OPERATING COSTS	15916	18412	22512	21854	19115

Table 30.

Components of cost and return by rate of return on operator's labour, capital and management quartile groups in the line fishery ($): 1986/87 (average per licence holder).

Variable	Q1	Q2	Q3	Q4	Average
TOTAL RETURNS					
Fish Income	4171	10520	19906	23519	14135
CASH OPERATING COSTS					
TRIP COSTS					
Labour Payments	50	162	95	902	279
Fuel and Lubricants	965	1945	2970	4700	2549
Other	64	405	521	383	331
TOTAL Trip Costs	1079	2512	3586	5986	3158
BOAT COSTS					
Repairs and Maintenance	1035	2058	1629	1243	1560
Other	9	157	2	0	3
TOTAL Boat Costs	1043	2215	1631	1243	1596
ADMINISTRATIVE COSTS					
Administrative Costs	579	507	612	523	527
MISCELLANEOUS COSTS					
Interest	446	523	867	561	570
Marketing	444	698	793	1159	728
Insurance	92	133	49	420	158
Motor Vehicle	250	770	585	840	576
Fees	205	389	225	187	245
Other	204	150	239	332	217
TOTAL Miscellaneous	1642	2664	2758	3500	2495
TOTAL CASH OPERATING COSTS	4343	7898	8587	11252	7777

Table 31.

Components of cost and return by rate of return on operator's labour, capital and management quartile groups in the net/line fishery ($): 1986/87 (average per licence holder).

Variable	Q1	Q2	Q3	Q4	Average
TOTAL RETURNS					
Fish Income	10342	16116	35989	32460	24660
CASH OPERATING COSTS					
TRIP COSTS					
Labour Payments	299	589	4225	659	1923
Fuel and Lubricants	2358	2198	5510	3832	3527
Other	509	21	541	228	322
TOTAL Trip Costs	3167	2807	10276	4719	5772
BOAT COSTS					
Repairs and Maintenance	2585	794	4146	1333	2995
Other	0	0	41	0	73
TOTAL Boat Costs	2585	794	4187	1333	2368
ADMINISTRATIVE COSTS					
Administrative Costs	794	813	1337	1108	1097
MISCELLANEOUS COSTS					
Interest	38	676	648	886	542
Marketing	109	1488	2790	3206	1866
Insurance	481	112	433	160	300
Motor Vehicle	492	525	2033	1074	1061
Fees	282	288	324	309	306
Other	178	578	451	110	332
TOTAL Miscellaneous	1579	3668	6680	5746	4406
TOTAL CASH OPERATING COSTS	8126	8082	22480	12906	13643

Table 32.

Summary of performance measures by rate of return to operator's labour, capital and management quartile groups in the net fishery: 1986/87 (average per licence holder).

Variable		Q1	Q2	Q3	Q4	Average
Total Returns	($)	17380	28091	43499	43231	31855
Total Cash Operating Costs	($)	15916	18412	22512	21854	19115
Cash Operating Surplus	($)	1465	9679	20987	21377	12739
Depreciation	($)	2825	3783	5429	3688	3866
Return to Operator Labour Capital and Management	($)	-1360	5896	15557	17689	8873
Full Equity Return	($)	-767	6597	16088	17953	9392
Capital Invested (excluding Licence Value)	($)	32579	32614	49800	28212	34634
Debts	($)	1934	4107	5677	2006	3320
Equity Ratio		0.94	0.89	0.79	0.91	0.89
Return to Cost Ratio		0.91	1.3	1.6	2.1	1.46
Rate of Return to Operator's Labour, Capital and Management	(%)	-2.26	19.5	32.4	95.5	34.9
Boat Days		86	121	93	145	113
Man Days		174	177	142	240	182
Length of Main Boat	(m)	7.2	5.9	5.8	5.3	5.4
Years Fishing		33	26	16	12	22
Age of Licence Holder	(years)	52	49	38	36	44

Summary of performance measures by rate of return to operators' labour, capital and management quartile groups in the line fishery: 1986/87 (average per licence holder).

Variable		Q1	Q2	Q3	Q4	Average
Total Returns	($)	4171	10520	19906	23519	14135
Total Cash Operating Costs	($)	4343	7899	8587	11251	7777
Cash Operating Surplus	($)	-172	2622	11319	12268	6358
Depreciation	($)	7086	5088	5067	3169	4775
Return to Operator Labour Capital and Management	($)	-7257	-2466	6252	9100	1583
Full Equity Return	($)	-6812	-1942	7118	9661	2153
Capital Invested (excluding Licence Value)	($)	17259	35874	28202	13728	22717
Debts	($)	2140	3176	3378	1871	2487
Equity Ratio		0.90	0.93	0.87	0.83	0.89
Return to Cost Ratio		0.30	0.78	1.5	1.7	1.07
Rate of Return to Operator's Labour, Capital and Management	(%)	-51.1	-3.3	25.0	70.9	10.3
Boat Days		86	117	126	155	117
Man Days		98	132	142	205	139
Length of Main Boat	(m)	5.5	8.2	5.7	5.6	6.1
Years Fishing		30	14	24	11	17
Age of Licence Holder	(years)	55	32	41	28	40

Table 34.

Summary of performance measures by rate of return to operators' labour, capital and management quartile groups in the net/line fishery: 1986/87 (average per licence holder).

Variable		Q1	Q2	Q3	Q4	Average
Total Returns	($)	10342	16116	35989	32460	14135
Total Cash Operating Costs	($)	8126	8082	22481	12907	13644
Cash Operating Surplus	($)	2216	8034	13508	19554	11016
Depreciation	($)	4703	5358	3559	2222	4215
Return to Operator Labour Capital and Management	($)	-2487	2676	9949	17331	6801
Full Equity Return	($)	-2450	3352	10597	18218	7343
Capital Invested (excluding Licence Value)	($)	53356	28995	32352	18242	35475
Debts	($)	108	3133	2345	5404	2571
Equity Ratio		1.00	0.89	0.96	0.67	0.89
Return to Cost Ratio		0.83	1.3	1.4	2.1	1.40
Rate of Return to Operator's Labour, Capital and Management	(%)	-8.1	11.6	38.5	108.8	34.8
Boat Days		91	146	194	156	149
Man Days		118	220	298	265	231
Length of Main Boat	(m)	5.3	5.7	6.3	5.4	5.0
Years Fishing		20	27	22	27	25
Age of Licence Holder	(years)	44	45	46	39	44

However, the finding that the rate of increase in fish income declined with increases in quartiles (Fig. 2) implies that there were other factors in addition to scale determining economic performance. Other factors contributing to improved economic performance of fishers in higher quartile groups could have been that:

(a) fish income earned per boat-day increased across quartiles and/or,

(b) cash operating costs per boat-day decreased across quartiles.

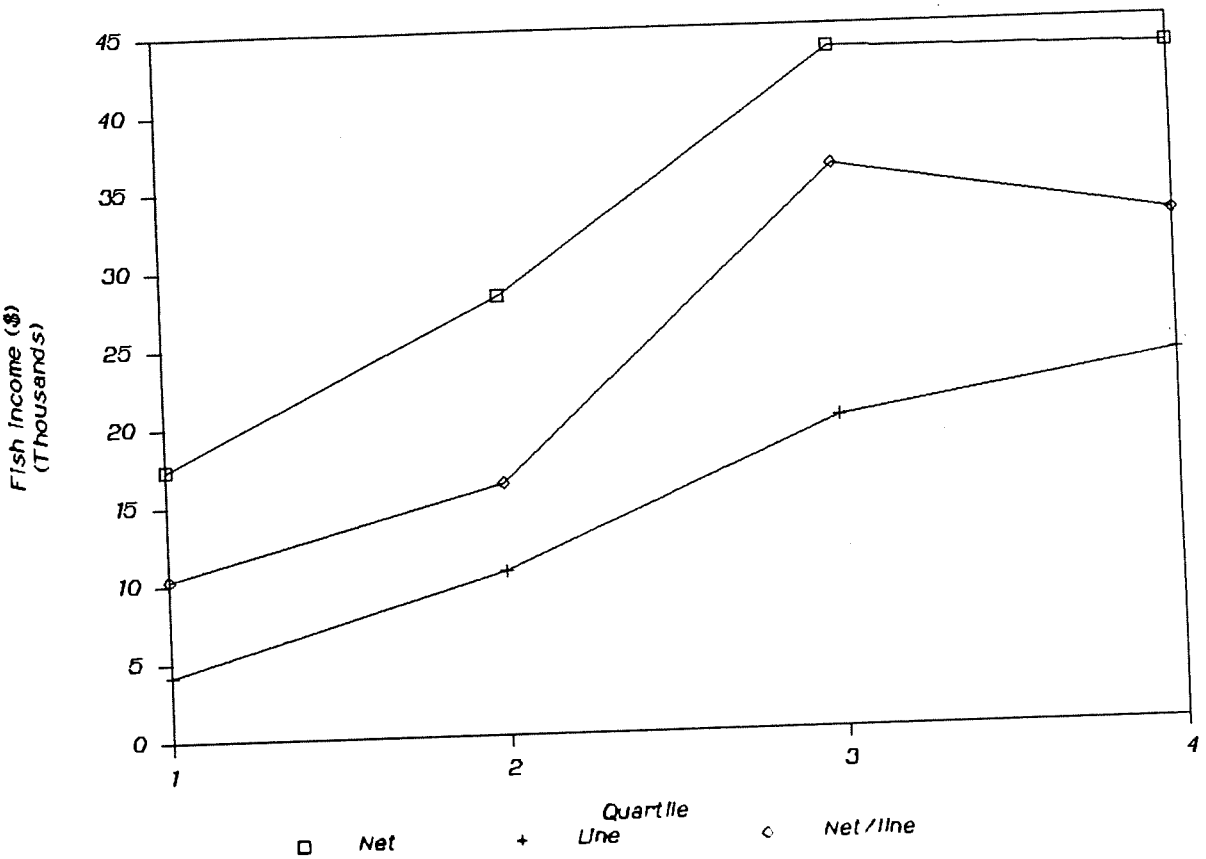

Figure 2: Trends in fish income by rate of return quartile groups.

In Figures 3 and 4, estimates of average fish income and cash operating costs per boat-day for each quartile are plotted. The Figures indicate no real trend for cash operating costs per boat-day across quartiles for all types of fishing methods. However, fish income per boat-day appears to increase across quartiles, implying that the most efficient licence holders were able to generate higher gross returns from each fishing day relative to less efficient fishers.

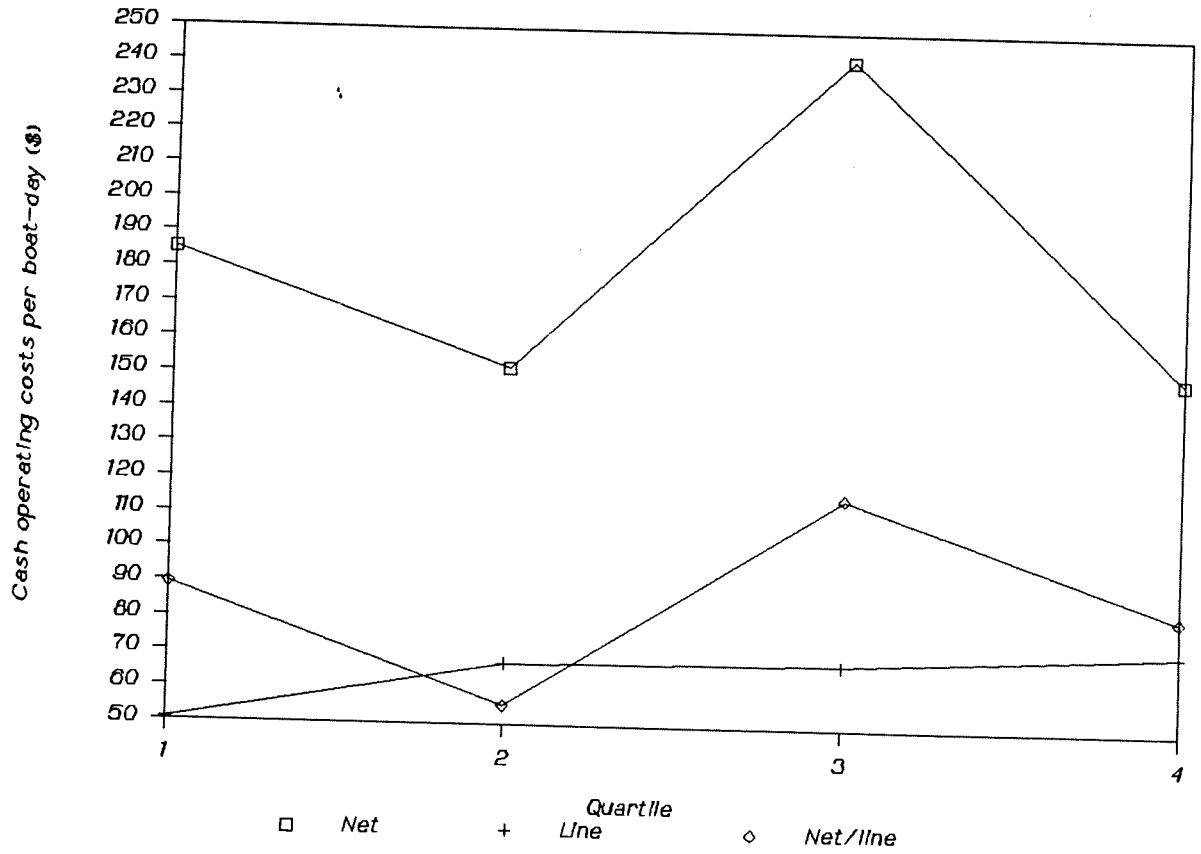

Figure 3: Trends in cash operating costs per boat-day by rate of return quartile groups.

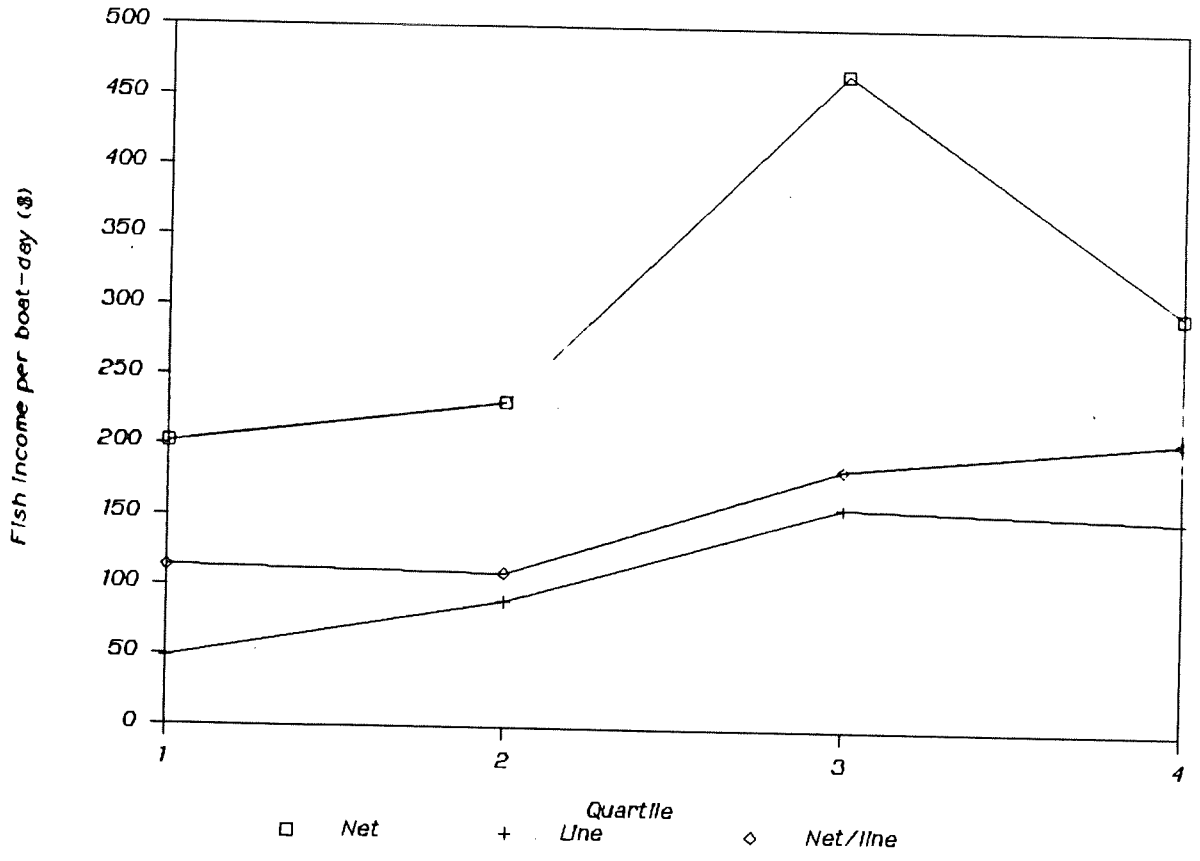

Figure 4: Trends in fish income per boat-day by rate of return quartile groups.

These hypotheses were formally tested using regression analysis. Average cash operating cost and fish income data for each quartile were pooled. An unconstrained regression model of the following form:

$$Y = a + bD + cQ + dDQ, \tag{16}$$

was estimated for each type of fishing method using the pooled data, where Y denotes fish income or cash operating cost, D denotes a dummy variable taking the value of 0 for fish income and 1 for cash operating costs, Q denotes quartile number and QD denotes a dummy slope shift variable for the quartile variable. A positive coefficient for c in equation (16) would be consistent with the hypothesis that fish income per boat-day increased across quartiles. Estimated parameters of the regression models and associated t-values are reported in Table 35.

The estimated c coefficient on the Q variable in equation (16) was positive for all types of fishing method (Table 35). The probability that the estimated c coefficients were significantly different from zero was .27, .007 and .04 for net, line and net/line fishers (two tailed test). Thus the results for the line and net/line fishers were significant at the 5% level, thereby supporting the hypothesis that the most efficient fishers (i.e. those in the higher quartiles) were able to obtain higher returns per boat-day than less efficient fishers. While the results for the net fishery were not statistically significant at the 5% level, the estimated coefficient had the expected positive sign.

It was previously hypothesised that there was no trend in cash operating costs per boat-day across quartile groups (Figure 4). According to this hypothesis, the sum of the c + d coefficients in equation (16) would be equal to zero, implying that:

$$c = -d. \tag{17}$$

Substituting equation (17) into equation (16), the following model can be derived,

$$Y = a^* + b^*D + d^*(QD - Q), \tag{18}$$

and an F test can be used to formally test the hypothesis (Doran and Guise 1984). Results obtained from estimating equation (18) are reported in Table 35.

Table 35.

Estimated regression models to test hypotheses on trends in fish income and cash operating costs per boat day (t-values in parentheses).

Parameter	Net		Line		Net/Line	
	Unconstrained	Constrained	Unconstrained	Constrained	Unconstrained	Constrained
Intercept	169.0 (1.493)	169.0 (1.669)	18.0 (0.877)	18.0 (0.898)	65.0 (1.987)	65.0 (2.187)
D	16.5 (0.103)	13.5 (0.123)	30.5 (1.051)	47.0 (2.170)	10.0 (0.216)	20.8 (0.646)
Q	52.4 (1.267)	-	37.7 (5.032)	-	35.8 (2.997)	-
QD	-53.6 (-0.917)	-	-31.1 (-2.935)	-	-31.5 (-1.865)	-
QD-Q	-	-52.4 (-1.417)	-	-37.7 (-5.149)	-	-35.8 (-3.298)
$\bar{R}^2$	0.21	0.37	0.85	0.86	0.74	0.78
RSS	34189.0	34196.2	1122.5	1340.3	2853.1	2945.6

Calculated F values for net, line and net/line fishers were 0.001, 0.970 and 0.016, all insignificant at the 5% level. Thus the data support the null hypothesis that there was no trend in cash operating costs per boat-day across quartile groups. It is concluded that the improved efficiency of fishers in the higher quartiles was not due to cost savings per boat-day fished.

The results also indicate that the estimated coefficients on the QD variable in the unconstrained model were negative and the estimated coefficients on the Q variable were positive for net, line and net/line fishers (Table 35). This result is consistent with the hypothesis that fish income per boat-day increased at a faster rate than cash operating cost per boat-day as quartile increased. This hypothesis was tested by comparing the following model, in which both coefficients were constrained to be equal,

$$Y = a + bD + cQ,$$

to equation (16). Regression results are presented in Table 36.

Results from the F test were significant for the line fishery (at the 5% level), but insignificant for the net and net/line fisheries: the calculated F values for the net, line and net/line fisheries were 1.16, 8.62 and 3.47. The critical F value (at the 5% level) with parameters 1 and 4 is 7.71. The low calculated F value obtained for the net fishery may be due to the less satisfactory regression results obtained for this fishery relative to the line and net/line fisheries (assessed according to significance of coefficients and R^2, see Table 36). Even though the results for the net and net/line fisheries were not statistically significant at the 5% level, the sign of the coefficients on the Q and QD variables indicate that fish income per boat-day increased at a faster rate than cash operating cost per boat-day as quartile increased.

Other factors that may contribute to the improved economic performance of fishers in the higher quartile groups are analysed in Tables 32 to 34. In the line and net/line fisheries, average depreciation tended to decrease across quartiles. This trend was not apparent for the net fishery. However, in all fisheries, average capital invested by fishers in the fourth quartile (Q4) was lower than that invested by fishers in the other quartiles. In the net/line fishery, average capital invested tended to decrease across quartiles. Thus there is some evidence that licence holders in the lower quartile groups were overcapitalised relative to the more efficient fishers; however, the lack of clear trends implies that capitalisation was not a major determinant of efficiency.

Average debt level and average equity ratio did not appear to be related to economic performance (Tables 32 to 34). Similarly, there was no trend in average boat length across quartiles. However, in all fisheries, the average age of licence holders decreased as the rate of return to operator labour, capital and management increased. Thus the most efficient fishers tended to be the younger licence holders.

Table 36.

Estimated regression models to test difference between the fish income and cash operating costs per boat-day coefficients (t-values in parentheses).

Parameter	Net		Line		Net/Line	
	Unconstrained	Constrained	Unconstrained	Constrained	Unconstrained	Constrained
Intercept	169.0 (1.493)	236.0 (2.774)	18.0 (0.877)	56.9 (2.285)	65.0 (1.987)	104.4 (3.416)
D	16.5 (0.103)	-117.5 (-1.827)	30.5 (1.051)	-47.3 (-2.511)	10.0 (0.216)	-68.8 (-2.977)
Q	52.4 (1.267)	25.6 (0.89)	37.7 (5.032)	22.2 (2.632)	35.8 (2.997)	20.1 (1.941)
QD	-53.6 (-0.917)	-	-31.1 (-2.935)	-	31.5 (-1.865)	-
$\bar{R}^2$	0.21	0.23	0.85	0.62	0.74	0.60
RSS	34189.4	41371.4	1122.5	3540.5	2853.1	5333.7

Finally, from Tables 32 to 34, fishers in the higher quartile groups exhibited higher average rates of return to operator, labour, capital and management and return to cost ratios relative to those in lower quartile groups. Thus their operations were more economically efficient than those in lower quartile groups. They also earned larger average incomes. Average cash operating surplus and full equity return increased across quartiles.

Quartile Analysis of Boat-days Fished

The effects of variation in boat-days fished on the economic performance of licence holders are analysed in Tables 37 to 42. Fish income increased with increases in boat-days for all fishing types. The lowest and highest fish incomes were recorded in the first and fourth quartiles. However, in all fisheries there was little variation in fish income between quartiles 2 and 3 (Q2 and Q3, Fig. 5).

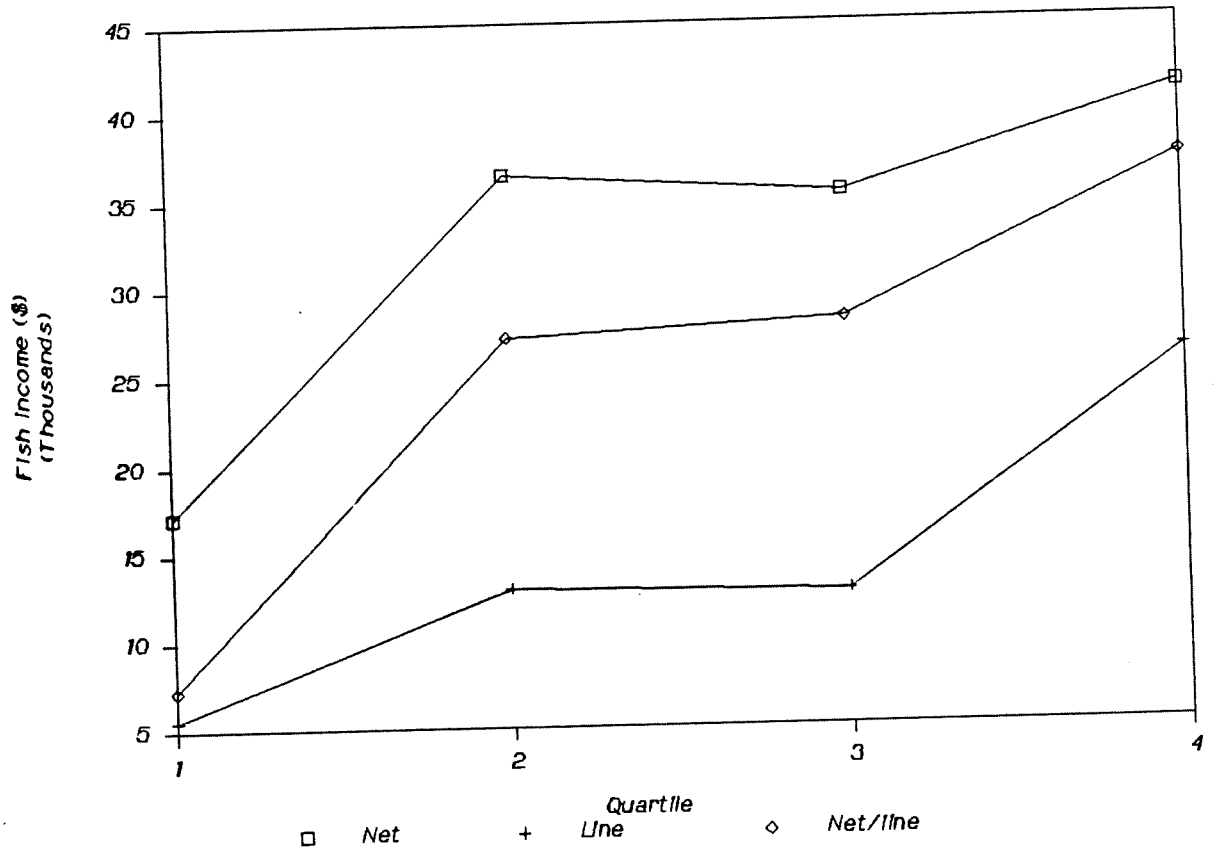

Figure 5: Trends in fish income by boat-day quartile groups.

With the exception of quartile 2 (Q2) for net fishers (licence holders in this quartile exhibited abnormally high labour payments and marketing costs), cash operating costs followed a similar trend to fish income; quartile 1 (Q1) and quartile 4 (Q4) licence holders had relatively low and high average cash operating costs, while licence holders in quartiles 2 and 3 had similar average cash operating costs which were approximately equal to the average for the respective fisheries (Fig. 6). The same trend was also evident for the major cost categories; trip, boat, administrative and miscellaneous costs (Table 37 to 39).

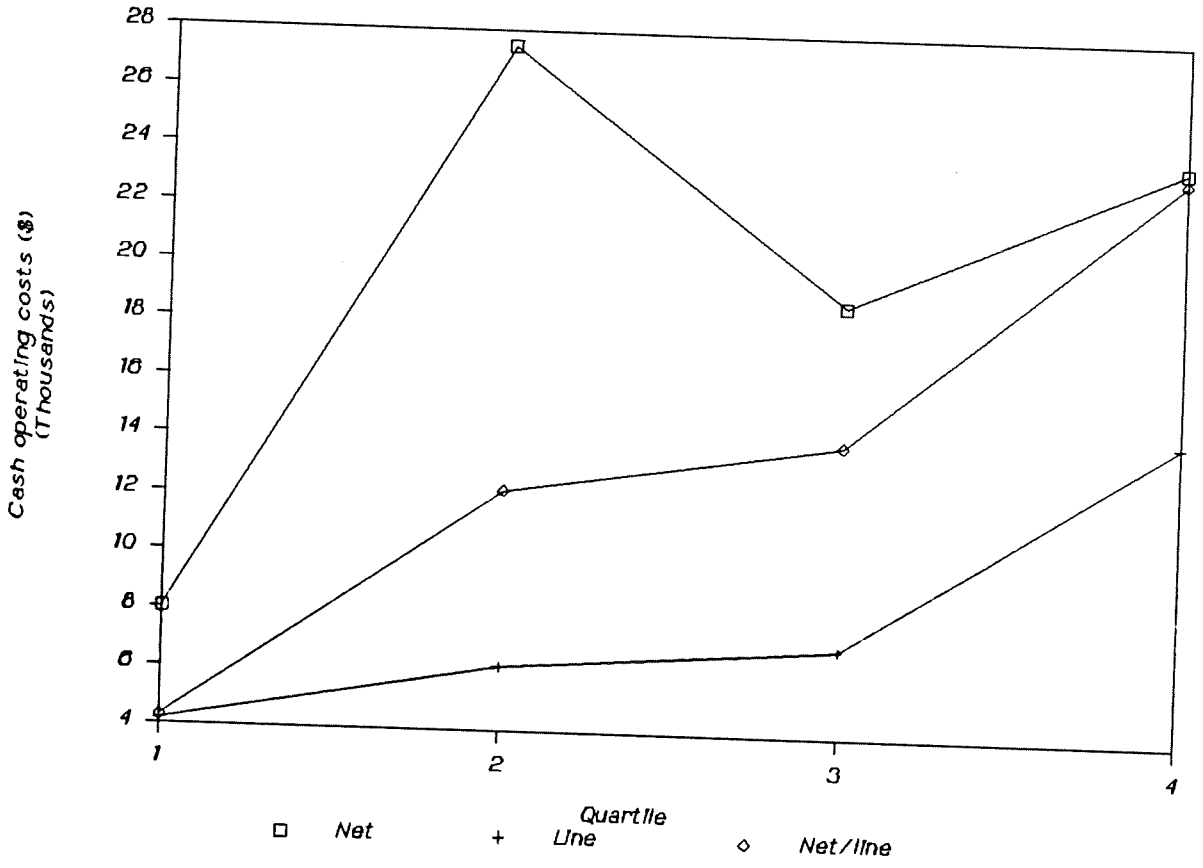

Figure 6: Trends in cash operating costs by boat-day quartile groups.

Table 37.

Components of cost and return by boat-day quartile groups in the net fishery ($): 1986/87 (average per licence holder).

Variable	Q1	Q2	Q3	Q4	Average
TOTAL RETURNS					
Fish Income	17135	36415	35289	41126	31855
CASH OPERATING COSTS					
TRIP COSTS					
Labour Payments	1388	10135	4932	5742	5439
Fuel and Lubricants	2895	5192	4199	5543	4361
Other	0	219	0	318	140
TOTAL Trip Costs	4283	15546	9131	11603	9940
BOAT COSTS					
Repairs and Maintenance	1246	4622	3328	6023	3697
Other	19	0	735	250	249
TOTAL Boat Costs	1265	4622	4063	6273	3946
ADMINISTRATIVE COSTS					
Administrative Costs	493	674	896	667	674
MISCELLANEOUS COSTS					
Interest	0	1048	663	389	519
Marketing	946	3314	1715	2821	2139
Insurance	249	231	151	734	329
Motor Vehicle	185	1113	1011	665	768
Fees	367	293	333	327	329
Other	230	616	832	220	471
TOTAL Miscellaneous	1977	6616	4705	5156	4556
TOTAL CASH OPERATING COSTS	8018	27458	18795	23699	19115

Table 38.

Components of cost and return by boat-day quartile groups in the line fishery ($): 1986/87 (average per licence holder).

Variable	Q1	Q2	Q3	Q4	Average
TOTAL RETURNS					
Fish Income	5572	12891	12658	26152	14135
CASH OPERATING COSTS					
TRIP COSTS					
Labour Payments	46	712	51	188	279
Fuel and Lubricant	1241	1920	2068	5145	2549
Other	45	250	389	684	331
TOTAL Trip Costs	1332	2882	2508	6018	3158
BOAT COSTS					
Repairs and Maintenance	1626	720	1910	2289	1560
Other	0	118	9	0	37
TOTAL Boat Costs	1626	838	1919	2289	1596
ADMINISTRATIVE COSTS					
Administrative Costs	252	328	634	951	527
MISCELLANEOUS COSTS					
Interest	289	616	481	915	570
Marketing	39	248	522	2154	728
Insurance	17	177	94	341	158
Motor Vehicle	212	625	256	1159	576
Fees	346	214	226	210	245
Other	50	258	358	217	217
TOTAL Miscellaneous	953	2138	1937	4997	2495
TOTAL CASH OPERATING COSTS	4163	6186	6998	14255	7777

Table 39.

Components of cost and return by boat-day quartile groups in the net/line fishery ($): 1986/87 (average per licence holder).

Variable	Q1	Q2	Q3	Q4	Average
TOTAL RETURNS					
Fish Income	7250	27158	28112	37157	24660
CASH OPERATING COSTS					
TRIP COSTS					
Labour Payments	243	1673	2789	3065	1923
Fuel and Lubricants	1503	3194	3350	6137	3527
Other	26	107	0	831	322
TOTAL Trip Costs	1772	4974	6139	10032	5772
BOAT COSTS					
Repairs and Maintenance	820	752	2440	3887	2295
Other	0	279	0	54	73
TOTAL Boat Costs	820	1031	2440	3941	2368
ADMINISTRATIVE COSTS					
Administrative Costs	457	1431	1134	1290	1097
MISCELLANEOUS COSTS					
Interest	0	970	419	934	542
Marketing	58	2126	1882	3845	1866
Insurance	264	131	167	533	300
Motor Vehicle	506	658	1374	1846	1061
Fees	287	305	303	339	306
Other	125	599	132	568	332
TOTAL Miscellaneous	1240	4789	4277	8064	4406
TOTAL CASH OPERATING COSTS	4289	12225	13990	23327	13643

Average boat-days in each quartile followed a similar trend to that observed above for fish income and cash operating costs (Fig. 7). Thus differences in fish income and cash operating costs across quartiles appear to be due mainly to variation in boat-days fished.

Variations in boat-days fished did not appear to have a large impact on the efficiency with which fish were produced by licence holders. In Figures 8 and 9, fish income and cash operating costs are deflated by boat-days. The figures reveal no obvious trends in the data, implying that fish income and cash operating costs per boat-day were not influenced by boat-days. Similarly, from Tables 40 to 42, there were no consistent trends in the rate of return on capital and the return to cost ratio across quartiles i.e. more efficient fishers did not necessarily fish more days.

Income, measured as cash operating surplus and full equity return, tended to increase across quartiles in all fisheries (Tables 40 to 42).

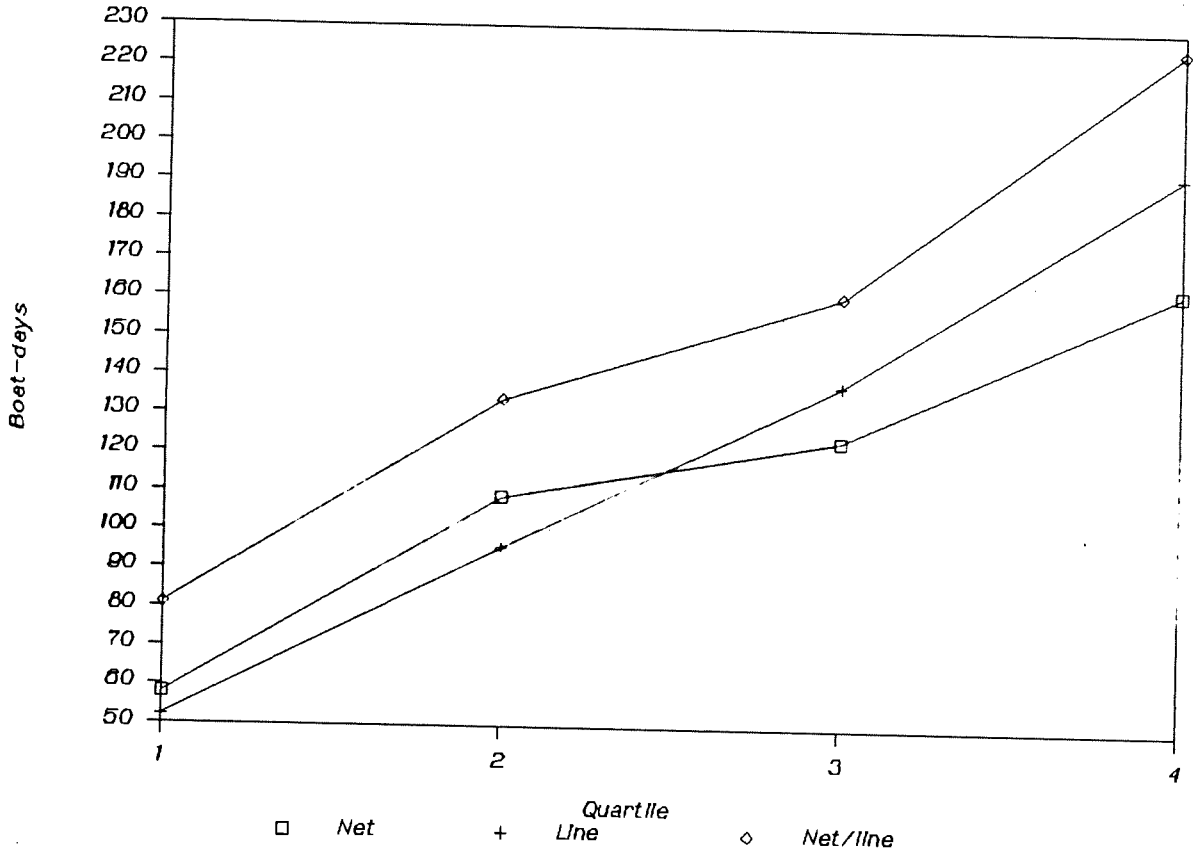

Figure 7: Trends in boat-days fished by boat-day quartile groups.

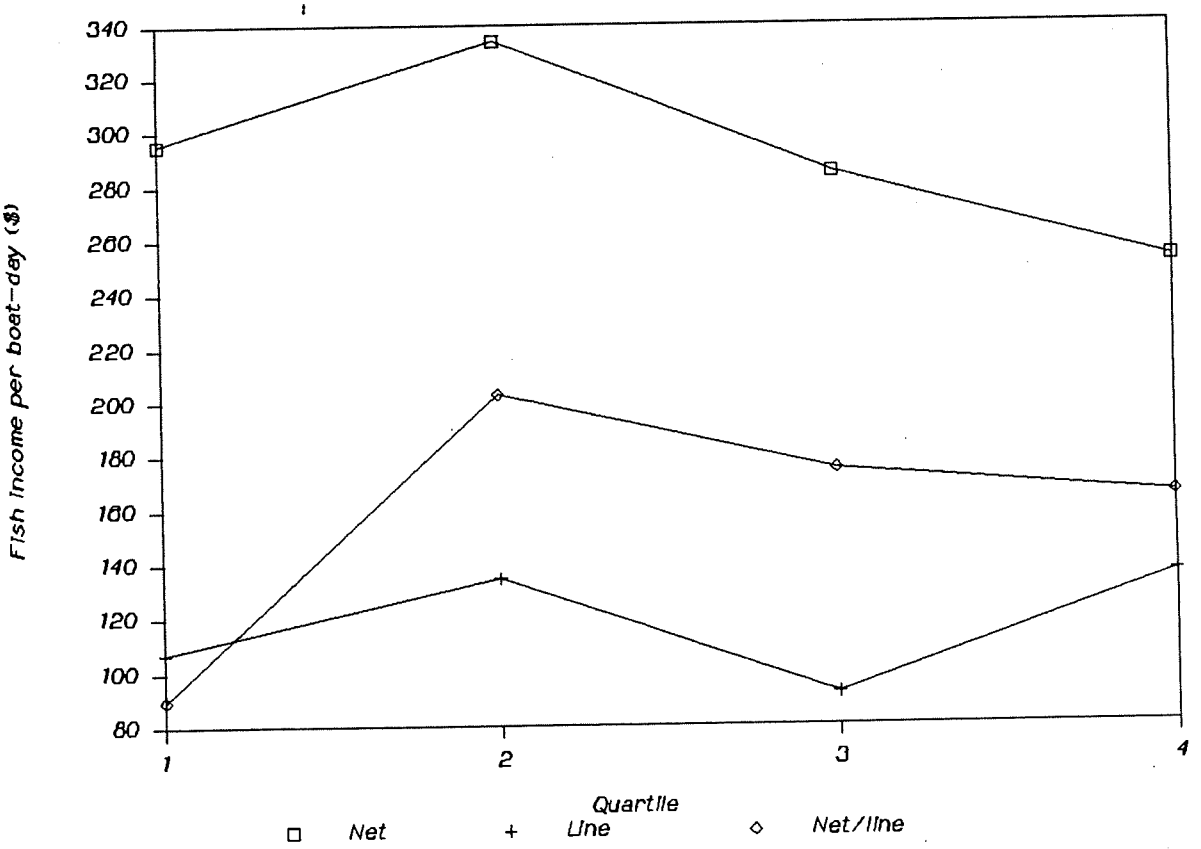

Figure 8: Trends in fish income per boat-day by boat-day quartile groups.

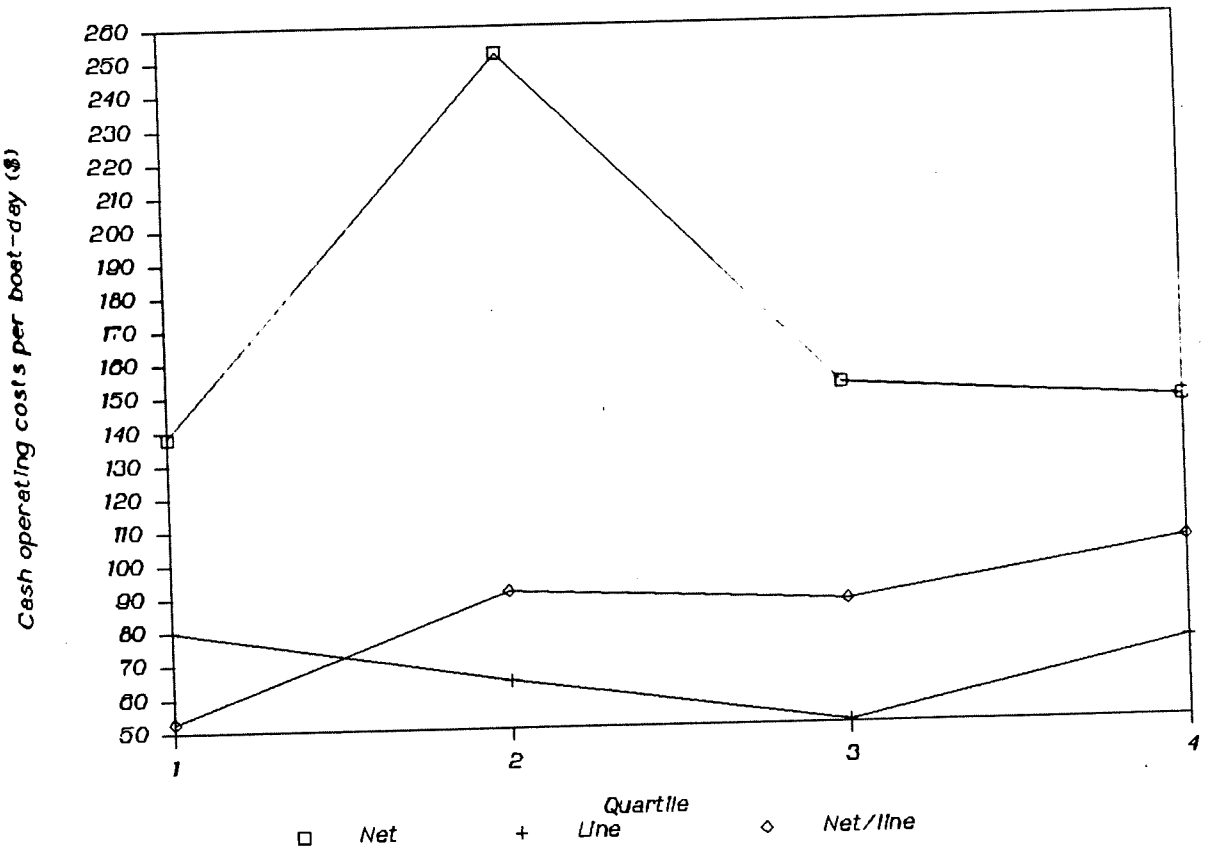

Figure 9: Trends in cash operating costs per boat-day by boat-day quartile groups.

Table 40.

Summary of performance measures by boat-day quartile groups in the net fishery: 1986/87.

Variable		Q1	Q2	Q3	Q4	Average
Total Returns	($)	17135	36415	35289	41126	31855
Total Cash Operating Costs	($)	8018	27458	18797	23699	19115
Cash Operating Surplus	($)	9117	8957	16492	17427	12739
Depreciation	($)	2893	3823	4672	4086	3866
Return to Operator Labour Capital and Management	($)	6224	5134	11820	13341	8873
Full Equity Return	($)	6224	6183	12483	13730	9392
Capital Invested (excluding Licence Value)	($)	32248	39659	32427	36015	34634
Debts	($)	0	5222	6316	1795	3320
Equity Ratio		1.0	0.82	0.76	0.97	0.89
Return to Cost Ratio		1.3	1.1	1.6	1.8	1.46
Rate of Return to Operators Labour, Capital and Management	(%)	14.9	11.4	41.6	77.1	34.9
Boat Days		58	109	124	163	113
Man Days		74	212	199	252	182
Length of Main Boat (m)		6.3	6.2	6.1	5.5	5.4
Years Fishing		34	20	16	19	22
Age of Licence Holder (years)		55	39	39	45	44

Table 41.

Summary of performance measures by boat-day quartile groups in the line fishery: 1986/87.

Variable		Q1	Q2	Q3	Q4	Average
Total Returns	($)	5572	12891	12658	26152	14135
Total Cash Operating Costs	($)	4163	6187	6999	14254	7777
Cash Operating Surplus	($)	1409	6704	5659	11898	6358
Depreciation	($)	4478	3883	5883	5140	4775
Return to Operator Labour Capital and Management	($)	-3070	2821	-225	6757	1583
Full Equity Return	($)	-2781	3437	256	7672	2153
Capital Invested (excluding Licence Value)	($)	19740	28099	19860	22199	22717
Debts	($)	1872	1972	2732	3747	2487
Equity Ratio		0.93	0.91	0.83	0.87	0.89
Return to Cost Ratio		0.67	1.3	0.91	1.4	1.07
Rate of Return to Operators Labour, Capital and Management	(%)	-18.5	25.1	-15.0	45.8	10.3
Boat Days		52	96	138	193	117
Man Days		60	119	139	241	139
Length of Main Boat (m)		5.3	7.4	5.4	5.9	6.1
Years Fishing		16	14	29	11	17
Age of Licence Holder (years)		47	33	49	34	40

Table 42.

Summary of performance measures by boat-day quartile groups in the net/line fishery: 1986/87.

Variable		Q1	Q2	Q3	Q4	Average
Total Returns	($)	7250	27158	28112	37157	24660
Total Cash Operating Costs	($)	4290	12225	13990	23327	13644
Cash Operating Surplus	($)	2960	14933	14122	11898	11016
Depreciation	($)	3260	6578	2381	13830	4215
Return to Operator Labour Capital and Management	($)	-300	8354	11741	9547	6801
Full Equity Return	($)	-2781	9325	12160	10481	7343
Capital Invested (excluding Licence Value)	($)	53798	34745	23866	34364	35475
Debts	($)	0	4756	2703	3487	2571
Equity Ratio		1.0	0.77	0.86	0.92	0.89
Return to Cost Ratio		1.1	1.5	1.7	1.4	1.40
Rate of Return to Operators Labour, Capital and Management	(%)	-0.2	59.7	51.1	40.2	34.8
Boat Days		81	134	161	225	149
Man Days		90	221	278	329	231
Length of Main Boat (m)		5.4	6.2	5.0	6.7	5.0
Years Fishing		30	18	29	26	25
Age of Licence Holder (years)		53	31	49	46	44

These results indicate that boat-days fished affected the absolute level of fish income, cash operating costs and net income received by licence holders. However, boat-days were not a major determinant of economic performance. This reinforces the conclusion made previously that there were other factors in addition to the scale of the operation, measured by boat-days fished, that influenced the economic performance of licence holders.

It is also apparent from Tables 40 to 42 that capital investment was not related to boat-days fished. Similarly, there was no relationship between length of main boat and boat-days fished. Thus boat length and total capital investment did not appear to constrain the number of boat days fished by individual licence holders.

There was no clear relationship between age and boat-days, implying that variation in age of licence holders was not a consistent determinant of fishing effort, measured as boat-days. However, in all fisheries, the average age of licence holders in quartile 1 (Q1) was above average i.e. older fishers tended to be concentrated in the lower quartile groups which were characterised by lower average boat-days fished.

Average debt level and equity ratio of licence holders appeared to be unrelated to boat-days (Tables 40 to 42). Thus the data do not support the commonly made assertion that licence holders with high debt levels apply large amounts of fishing effort (measured as boat-days) to enable them to meet their repayment commitments. This hypothesis was explored further by calculating the correlation coefficient between boat-days and debt level for all licence holders in each fishery. The estimated correlation coefficients for net, line and net/line fishers were 0.09, 0.16 and 0.39. The results for the line and net/line fisheries were significant at the 1% level (one-tailed test). However, the size of the coefficients indicate a weak correlation, implying that debt level was not the main determinant of fishing effort applied by individual licence holders.

DISCUSSION

The results presented in this study were obtained by sampling 87 licence holders in the marine scalefish fishery. The data collected relate to the 1986/87 financial year. Much of the economic information collected was derived from taxation returns. As the taxation system provides for favourable treatment of certain expenditures of licence holders, the absolute value of the estimated financial returns may be biased downwards. Thus the estimated returns should be interpreted as lower bound estimates. The bias should not affect results obtained from the comparative analysis of different types of fishers presented above, as the relative bias would be similar for all licence holders.

The average full equity return of licence holders in the fishery ($4,205) was low relative to general wage levels in the economy. The average weekly earnings of all South Australian employees in February 1987 was $350.30 (ABS 1987); approximately equivalent to $18,215 per annum. While the potential earnings of licence holders from alternative employment (opportunity cost of labour) may have been less than average weekly earnings, due to the regional location of licence holders, it appears that returns in the fishery would have been insufficient to pay a normal wage to the operator, let alone provide a return on capital invested.

Anderson (1980) has noted that fishers may place a positive value on the fishing way of life (a worker satisfaction bonus). Consequently, even if income levels are low, the value placed on the way of life may be sufficient to provide an adequate return to licence holders. No data are available to indicate the value placed by marine scalefish licence holders on their way of life. However, from the data presented above, the value attributed to the way of life would need to be very large to provide a comparable return with other sectors of the economy.

The low return recorded in the study year may have been due to a depressed market for fish or below average catches. There is evidence to suggest that both factors influenced net returns to licence holders. The real price of King George whiting was low in 1986/87 (Fig 10). Also catches of garfish and snapper declined (Table 43). However, these may have been offset by increases in the price and catch of other species. For example, the price of snapper increased in 1986/87 as did catches of shark, tommy ruff and 'other species' relative to previous years.

Table 43.

Annual production ('000kg) by species: 1983/84 to 1987/88.

Year	King George Whiting	Snapper	Garfish	Calamary	Shark	Other Species[a]	Total[a]
1983/84	726	466	436	160	1502	3678	6968
1984/85	597	471	430	187	1663	3345	6693
1985/86	654	455	439	192	1977	3667	7384
1986/87	656	405	389	202	2124	4556	8332
1987/88	589	333	381	206	2494	5325	9328

[a] Excluding Tuna

Source: S.A. Department of Fisheries

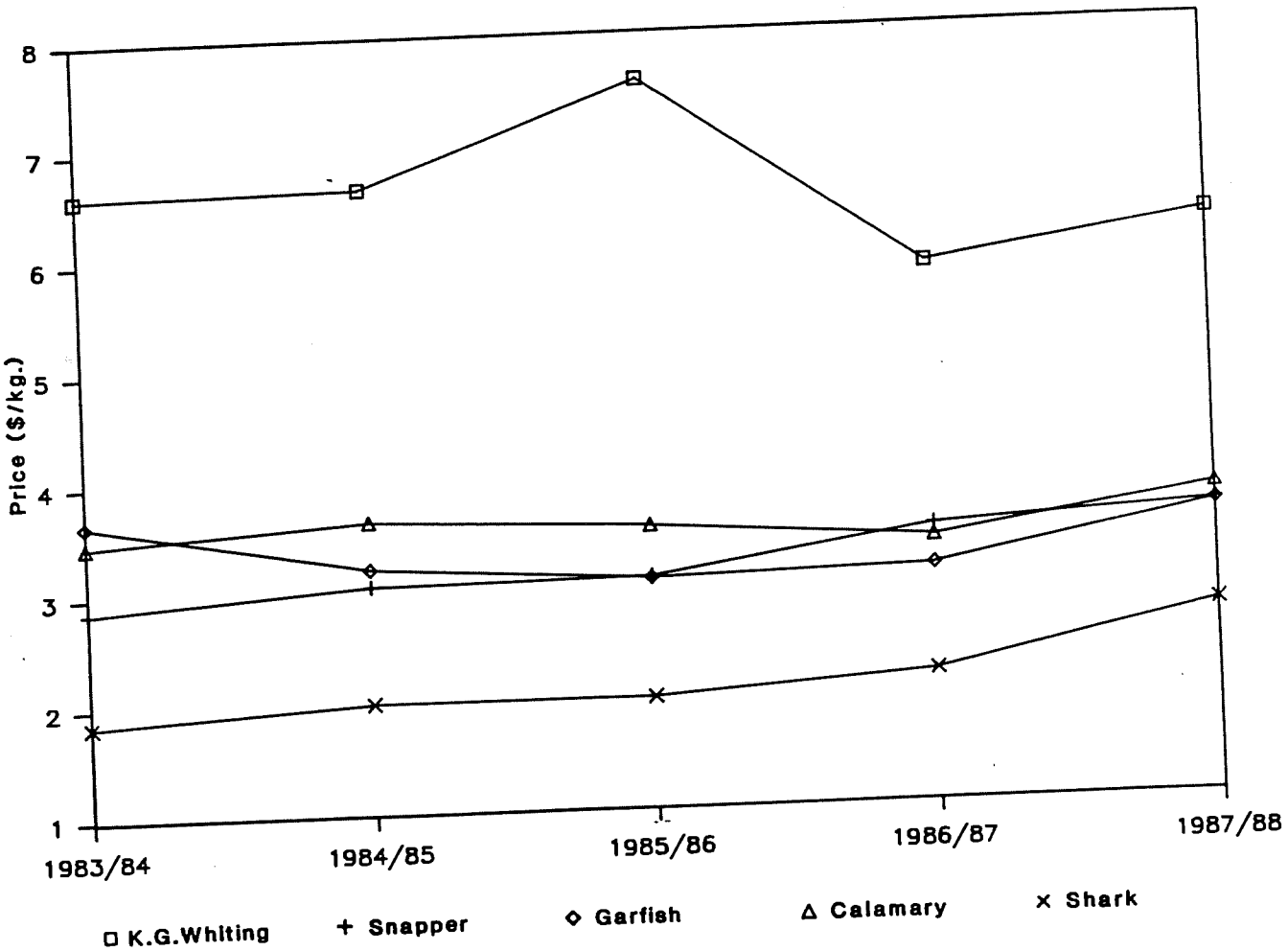

Figure 10: Average real price ($/kg, 1987/88) of selected fish species in the marine scalefish fishery: 1983/84 - 1987/88.

The combined effect on returns to licence holders of changes in catch and price of all species was assessed using value of production data. From Table 44, real value of production of fish taken by marine scalefish licence holders declined from $12.1m in 1985/86 to $11.6m in 1986/87 (a 4.3% decline). Real value of production increased in 1987/88 to $13.2m (a 13.8% increase). These data imply that returns to licence holders may have been abnormally low in 1986/87. Thus if the survey was undertaken in any other year, estimated returns to licence holders may have been greater than those reported above.

Table 44.

Trends in real value of production ($1987/88) in the marine scalefish fishery: (x $1,000) 1983/84 to 1987/88.

Licence	Species	1983/84	1984/85	1985/86	1986/87	1987/
M[a]	K/George Whiting	4102	3530	4427	3481	3365
	Snapper	1164	1255	1233	1260	1082
	Garfish	1575	1359	1332	1197	1366
	Calamary	511	628	621	617	724
	Shark	1325	1871	2343	2572	3290
	Other Species	1951	2077	2189	2449	3328
	Total	10628	10720	12145	11576	13155
B[b]	K/George Whiting	612	373	457	295	275
	Snapper	130	141	128	88	67
	Garfish	11	8	5	3	5
	Calamary	40	48	54	60	45
	Shark	4	3	5	4	6
	Other Species	47	50	45	30	30
	Total	844	623	694	480	428
Other	K/George Whiting	80	63	62	56	38
	Snapper	42	44	46	62	56
	Garfish	8	10	11	12	5
	Calamary	5	5	4	4	7
	Shark	1454	1457	1607	2041	3482
	Other Species	2498	1628	1949	2702	2602
	Total	4087	3207	3679	4877	6191
All licence holders	All species	15559	14550	16518	16933	19774

[a] Marine scalefish.
[b] Restricted Marine scalefish.

Source: S.A. Department of Fisheries

However, the real value of production in 1986/87 ($11.6m) remained greater than that recorded in 1983/84 ($10.6m) and 1984/85 ($10.7m). Moreover, even if real value of production in 1986/87 had increased to $13.2m as was recorded in 1987/88, the average additional gross income earned by each licence holder would have only been $2,985 (compared to an average of $20,188 as estimated). It is concluded that poor economic performance of licence holders was not due entirely to depressed market conditions or catch levels.

Increases in the cost of purchasing fishing inputs (e.g. fuel, repairs and maintenance services etc.) may have also contributed to low profitability in the survey year. Unfortunately, there are no data available to determine the likely impact of changes in costs on net returns in 1986/87.

An alternative and probably more likely explanation for poor returns in the fishery, derived from the economic theory of fisheries, is that too many resources (labour and capital) were used to harvest the available catch. This may be described as economic over-exploitation of the fishery.

A marine scalefish licence provides the licence holder with an access right to the fishery. With the exception of snapper and Australian salmon taken by nets, there are no restrictions on the amount of fish each licence holder is permitted to take. Consequently, no individual owns the fish. Rather the fish are a common resource exploited by those persons holding an access right to the fishery, with no single licence holder having an economic incentive to conserve stocks.

The common property nature of the fish resource encourages licence holders to increase fishing effort beyond the optimal level. Consider Figure 11 which depicts a simplified bio-economic model of a hypothetical single species fishery. The total revenue curve describes how the value of fish caught varies with changes in fishing effort. This curve is derived from a surplus production model of a fishery first developed by Schaefer (1954). The model is based on the assumption that the fishery is in an equilibrium state. It is also assumed that price is constant, and not influenced by changes in the amount of fish marketed[2]. The essential characteristic of the curve is that its slope declines as fishing effort increases, becoming negative beyond point B. The total cost line indicates how total cost increases as fishing effort increases. It is drawn as a straight line, implying that the cost of applying additional fishing effort (marginal cost) is constant. Total cost includes an allowance for a normal rate of return on labour and capital.

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[2] The assumptions of a single species fishery and a fixed price of fish are not appropriate for the marine scalefish fishery. However, these assumptions do not affect the conclusions drawn from the model. The effects on the analysis of relaxing these assumptions are discussed in Anderson (1986).

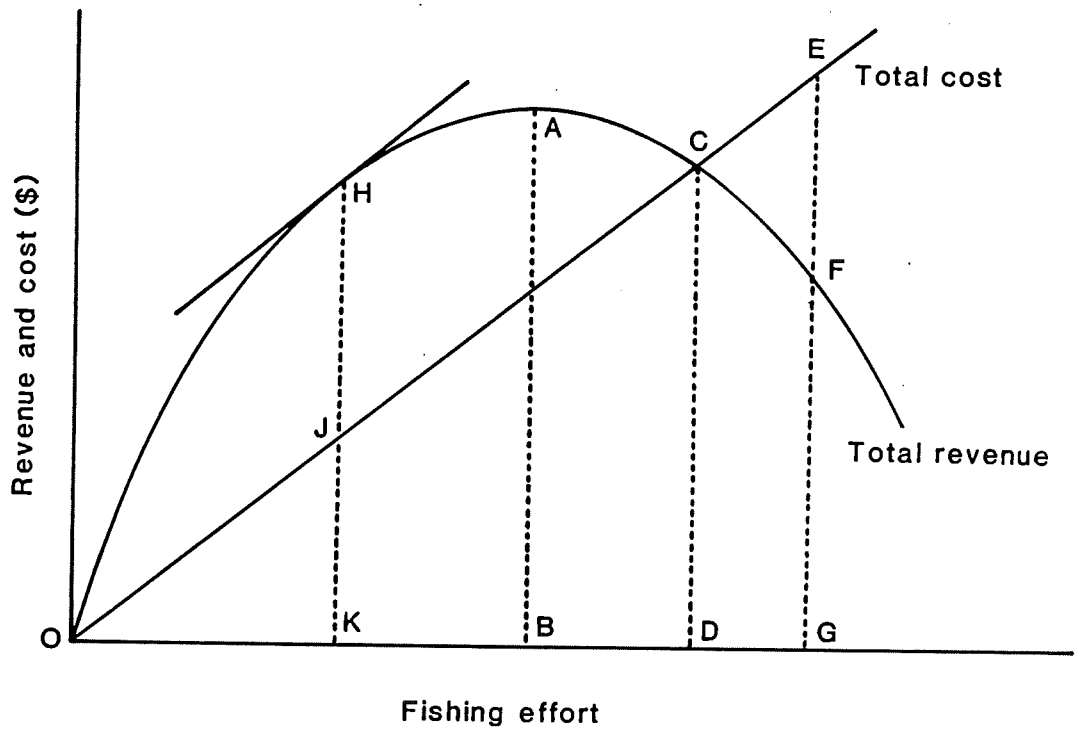

Figure 11: A simplified bio-economic model of a single species fishery.

The fishery reaches an equilibrium when total return is equal to total cost (D in Figure 11). This is termed the open-access equilibrium. At this point the level of profit obtained from the fishery is the same as that which could be obtained by employing the same resources elsewhere in the economy.

For levels of fishing effort below D, the return generated by fishing will exceed cost, implying that profit accruing to licence holders will be greater than that earned elsewhere in the economy. These above normal profits are termed economic rent. The amount of economic rent generated is equal to the vertical difference between the total return and total cost curves at a given level of fishing effort. For example, at point K, economic rent is equal to JH.

The economic rent produced by the fishery is maximised at K in Figure 11. At this point, the slope of the total return and total cost curves are identical. The optimal amount of fishing effort that should be applied in the fishery to maximise returns (economic efficiency) is K.

If licence holders voluntarily reduced fishing effort below D, economic efficiency would increase. However, due to competition among licence holders, this is an unstable equilibrium. There is strong incentive for individuals to increase their fishing effort to maximise their share of the available economic rent. A stable equilibrium is reached only when the economic rent is dissipated and total return is equal to total cost[3].

In some fisheries, the equilibrium level of fishing effort may be less than B in Figure 11. In these cases, the stock is not biologically over-exploited, implying that the sustainable yield will not be increased by reducing fishing effort. However, reductions in fishing effort will still generate economic benefits, by reducing crowding among licence holders. A reduction in crowding will increase catch rates and reduce the average cost of taking fish. In fisheries where the equilibrium level of fishing effort lies to the right of B, reductions in fishing effort will reduce crowding and will also increase the sustainable yield of the fishery.

For levels of fishing effort greater than D (e.g. G in Figure 11), total return will be less than total cost, implying negative returns. However, negative returns cannot be sustained indefinitely. Eventually licence holders will reduce fishing effort to the open access equilibrium.

The finding that income levels in the marine scalefish fishery are low (and perhaps negative once a return to operator labour and capital are considered) indicates that the fishery is operating at a point closer to D in Figure 11 than K. This implies that the fishery is economically over-exploited.

In conclusion, it appears that the low average return to licence holders observed in the fishery relative to the rest of the economy cannot be explained by bias in the data, seasonal factors or the positive value placed on the fishing way of life. Thus the most likely cause of low returns in the fishery appears to be economic over-exploitation. It follows that an appropriate means of improving returns (and economic efficiency) in the fishery is to reduce fishing effort (see Figure 11).

Fishing effort could be reduced by implementing policies to reduce the number of licence holders operating in the fishery. However, to ensure that the benefits are sustained, it would be necessary to prevent fishing effort in other commercial fisheries targeting the same fish species (e.g. the rock lobster and miscellaneous fisheries) and/or the recreational fishery from increasing and offsetting the reduction in fishing effort in the Class M fishery. Any increases in fishing effort from these other fisheries would reduce the potential benefits.

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[3] In a limited entry fishery, equilibrium is achieved when the average return per unit of fishing effort is equated with marginal cost. Consequently, economic rent may persist at equilibrium. However, the general conclusion that economic rent could be increased by reducing fishing effort continues to apply.

Also, as the marine scalefish fish resources are shared by Class M licence holders and fishers in these other fisheries, the benefits from reducing fishing effort in the Class M fishery would be shared by all persons operating in the fishery. Indeed, even if fishing effort in these other fisheries was contained at current levels, a proportion of the benefits would accrue to these other commercial and recreational fishers i.e. the benefits would not be retained exclusively by the Class M licence holders.

The survey results indicate that net fishers are more economically efficient than line fishers. They exhibit greater returns on capital invested and higher return to cost ratios relative to line fishers. Under current management arrangements, the number of licence holders in the marine scalefish fishery permitted to use nets is restricted. Also netting endorsements are non-transferable (family transfers excepted). Thus net fishers leaving the fishery are required to surrender their netting endorsements. This policy was introduced to contain and perhaps reduce net fishing effort. However, by converting net licences to line only licences, the policy is encouraging licence holders to use less efficient fishing methods, thereby depressing the average economic performance of licence holders in the fishery.

A preferred policy would be to allow more licence holders to use both nets and lines. However, net fishing is more technically efficient than line fishing. Comparison of targeted catch rate data for King George whiting indicates that, on average, hauling net gear is 45% to 75% more efficient at catching fish than hand line gear in the same area during the same time period (Jones et. al 1990, p. 81). Thus if existing line fishers were permitted to use nets as well as lines, effective fishing effort would increase significantly. From the discussion above (Fig. 11), the fishery is already fully exploited, implying that a reduction in fishing effort is required. Thus before allowing line fishers to use nets, it would be necessary to reduce the total number of licence holders operating in the fishery.

Note that while all licence holders would be permitted to use nets under this proposal, net fishing would not completely replace line fishing. Some fishers would continue to use lines at selected times of the year and for some species because it would be the more efficient means of catching certain fish (e.g. snapper, calamary).

The survey results also indicate that the policy providing for non-transferability of net endorsements may be encouraging an aging population of net fishers, by impeding net licence transfers (Tables 4 and 5). As there is some evidence indicating that aged fishers apply less fishing effort (measured as boat-days) than younger fishers (see Table 40), the policy may assist to contain fishing effort. A reduction in fishing effort will assist to move the fishery toward the optimal level of fishing effort (K in Figure 11), thereby improving economic efficiency in the fishery.

The cost of this policy is that potentially efficient fishers, who could take fish more cost effectively than some existing licence holders, are unable to obtain net licences to enter the fishery. As a result, economic efficiency in the fishery is impeded. These losses could be minimised by allowing net endorsements to be transferable.

However, as transferability allows more efficient fishers to enter the fishery, it is likely that total fishing effort will increase beyond that currently applied by existing licence holders. As indicated in Figure 11, an increase in fishing effort will tend to move the fishery further toward D, thereby reducing economic efficiency. To prevent fishing effort from increasing following introduction of transferability of net endorsements, it would be necessary to implement a mechanism for retiring fishing effort e.g. a scheme to reduce the number of fishers licensed to operate in the fishery.

A potential impact of reducing the number of licence holders in the fishery is that unemployment may increase in some regions. This would be more pronounced in those regions where there are few alternative employment opportunities (e.g. the west coast of Eyre Peninsula). In these regions it is relevant to consider whether the cost of unemployment associated with a reduction in the number of licence holders in the fishery would exceed the resultant economic benefits. Indeed it could be argued that in regional areas where there may be limited full-time employment opportunities, it may be more economically efficient to maintain the existing number of licence holders in the fishery.

To simultaneously maintain the existing number of fishers in the fishery and contain fishing effort, it will be necessary to regulate to prevent licence holders from becoming too technically efficient. This could be done by, for example, continuing the current policy of non-transferability of net endorsements. This would eventually result in a line only fishery. As technology improves, further regulations would be required to contain effective fishing effort at the current level.

The survey results indicate that line fishing is significantly less economically efficient than net fishing. Thus establishment of a line only fishery would increase the average cost of taking fish and reduce the potential income that could be earned from the fishery. Also as many species of fish can only be profitably taken by net fishers e.g. tommy ruff, mullet, Austalian salmon, establishment of a line only fishery would reduce the total production in the fishery and alter the species composition of commercial fishers.

Finally many of the costs associated with increased unemployment occur in the short-run. Over time, retired fishers will obtain alternative employment, and in some cases may be better off. Campbell (Personal Communication, 1990) concluded that many fishers leaving the tuna fishery following introduction of an individual transferable quota scheme were able to improve their economic well-being.

It is concluded that maintenance of the existing number of licence holders in the fishery is likely to be a costly and inappropriate objective. A reduction in the number of operators will help reduce fishing effort and improve the total return from the fishery, provided fishing effort in the other commercial and recreational fisheries does not increase. By allowing licence holders to improve their efficiency, they will also be more competitive on commercial markets.

Policy Options

From the survey results obtained, it is concluded that a management scheme for the fishery should be implemented:

1. to reduce fishing effort. It was shown that the fishery was economically over exploited. Measures to decrease fishing effort would improve economic efficiency in the fishery:

2. to allow line fishers to use nets as well as lines. This would improve the economic performance of line fishers. Due to the increase in fishing effort that would occur if line fishers were permitted to use nets, this policy could only be introduced if total fishing effort was also reduced (e.g. by reducing the number of licence holders in the fishery):

3. to develop alternative methods of reducing fishing effort to the current policy which depends on the conversion of more efficient net licences to less efficient line licences, as net fishers leave the fishery. This policy is exacerbating the poor financial performance of licence holders in the fishery:

4. to allow net endorsements to be transferable. Transferability would establish a mechanism for potentially efficient fishers who are unable to obtain a net endorsement under the current management arrangements to enter the fishery. Due to the increase in fishing effort that is likely to occur if net endorsements were transferable, this option would need to be accompanied by measures to reduce fishing effort as discussed in 2. above.

A key component of all these proposals is the need to reduce fishing effort. Alternative policy instruments for reducing fishing effort in common property fisheries have been extensively discussed in the fisheries economics literature (e.g. Anderson 1986; Crutchfield 1979). Three main classes of controls identified in this literature are royalties, quotas and input restrictions.

Royalties, while being theoretically attractive, are often not practical to implement; determination of the appropriate tax and its collection and administration is difficult.

Quotas (especially individual allocated and transferable quotas) have been proposed as an efficient method of controlling fishing effort (Moloney and Pearse 1979). However, in the marine scalefish fishery, quotas are likely to be inappropriate; enforcement costs would probably be high due to the large number of licence holders operating in the fishery, and to the numerous markets and ports where fish can be unloaded. While the introduction of an individual transferable quota scheme would be expected to change the structure of the fishery (e.g. the number of quota holders and the average catch taken by each fisher) reducing the extent of these problems, it is considered that enforcement costs during the transitory phase would probably be too high, thereby reducing the attractiveness of the scheme. Also the multi-species nature of the fishery would require quota to be set for each species, and administrative mechanisms would need to be established to accommodate licence holders who exceeded their quota for particular species.

Current management arrangements in the marine scalefish fishery are based on input restrictions e.g. restrictions on the number of licences issued and the type of fishing gear permitted to be used by licence holders. Deficiencies of management policies based on input restrictions have been well documented (Anderson 1986). Input restrictions control only some facets of fishing effort (e.g. the number of licence holders or type of gear), allowing fishers to substitute unrestricted inputs for those that are restricted. Substitution of inputs reduces economic efficiency in the fishery (Anderson 1986). However, in fisheries where the benefits from a reduction in fishing effort obtained by implementing the restrictions outweigh the costs of lower efficiency and enforcing the regulations, input restrictions may be the best management option. Indeed this is considered to be the case in the marine scalefish fishery as it is structured at present where the cost of implementing a royalty or quota scheme would probably be too high for it to be cost effective. Thus in the short to medium term, management of the fishery should be based on input restrictions. In the longer term, provided input restrictions are successful in controlling fishing effort and rationalising the fishery (reducing the number of licence holders), consideration could be given to implementing more economically desirable policies, such as an individual transferable quota scheme.

Alternative input restrictions that may be appropriate are:

1. a transferable net reduction combined with a licence reclassification scheme

2. a buy-back scheme

3. a netting endorsement transferability scheme as suggested by the Marine Scalefish Working Group (Fletcher 1988)

4. a licence tender scheme.

The advantages and disadvantages of each option have been discussed in Jones et. al (1990).

The transferable net reduction, combined with a licence reclassification scheme was recommended by Jones et. al (1990) as the preferred policy. Under this option, line fishers would be permitted to obtain a net endorsement by purchasing a pre-determined number of licences from other line fishers. Net length permitted to be used by net fishers would be reduced and net length would become a transferable entitlement. Existing net fishers would be permitted to increase net length endorsed on their licenses by purchasing entitlement from other net fishers (who could leave the fishery). These provisions would facilitate a reduction in the number of net and line licence holders in the fishery, and would increase the number of fishers permitted to use both nets and lines. Net endorsements would also become transferable.

A major disadvantage with this scheme is that it would be difficult to administer and enforce the controls on net length given the different types of netting activities practised by licence holders (gill and haul netting). Also as with all input restriction schemes, opportunities would be created for licence holders to substitute non-restricted inputs for those that were controlled e.g. they could use a shorter net length and increase the number of fishing days. Thus the effect of the scheme on fishing effort is not clear and would need to be monitored. Finally, there may be insufficient economic incentive to encourage line fishers to purchase additional licences to upgrade to a net licence. They would only upgrade if the returns from upgrading their licence exceeded those obtained by continuing to operate as a line only fisher. Similarly, net fishers may be reluctant to purchase additional net length. Indeed at the present time, licence holders frequently use nets shorter than the 600m permitted by regulation, implying that there may be little incentive for them to purchase additional net length.

A variation of the option detailed in Jones et. al (1990) is to substitute a licence tender programme for the transferable net reduction scheme, and to modify the licence reclassification provisions to prohibit transfers of line only licences unless they were to be amalgamated to create a net permit i.e. line fishers would be unable to sell their licence as a line only licence.

The modifications of the licence reclassification provisions for line fishers would ensure that existing line only licences are amalgamated and reclassified as net and line licences when the present licence holders leave the fishery. However, existing line fishers would not be required to upgrade their licences and could continue fishing using the fishing methods currently endorsed on their licence. If they chose they could also purchase the required number of line only licences to have their licence reclassified as a net and line licence before they retired from the fishery.

With a net licence tender scheme, an appropriate number of net endorsements, taking into account the productivity of the fishery, would be offered for sale (by tender) to existing net fishers. Net fishers purchasing endorsements would be required to surrender their current non-transferable entitlement and would receive a transferable net endorsement. Net fishers who did not purchase a transferable net endorsement would be permitted to continue fishing indefinitely (using nets). However, their net entitlement would remain non-transferable, and they would be required to surrender their entitlement on leaving the fishery.

The modified licence reclassification provisions would reduce the number of line fishers in the fishery and provide a mechanism to allow line fishers to use both nets and lines, thereby improving their economic performance. The licence tender scheme would restrict the number of net fishers operating in the fishery, and would reduce the number of net endorsements below current levels. Monies obtained from tendering licences could be retained to fund future rationalisation programs in the fishery. This proposal would overcome the administrative difficulties of measuring and enforcing net length regulations associated with the preferred policy outlined by Jones et. al (1990). Opportunities for licence holders to substitute non-restricted inputs (e.g. time spent fishing, improved technology) for those that are restricted (the number of licences) would remain. However, if the scheme is successful in reducing the number of licence holders operating in the fishery, alternative policies to control input substitution (e.g. individual transferable quotas) may become feasible, and could be considered in developing future management programmes for the marine scalefish fishery.

Research to determine an appropriate number of net endorsements for the fishery, and the number of line licences that would need to be purchased by existing line fishers to upgrade their licence to include a net endorsement, would need to be undertaken before the policy could be implemented.

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APPENDIX 1

CARD 01 GENERAL

SURVEY NO ☐

REGION ☐

TYPE ☐

NUMBER OF DAYS FISHED ☐

1. Owners Name: ..... Surname Given Names

2. Postal Address: .....
.....
.....

3. Interview Address (if different from post address):
.....
.....
.....

4. Name of Person Interviewed:
.....

5. Telephone No: .....

6. Licence No: ☐☐☐☐

7. Did you operate this licence during 1986/87.

Yes ☐ Period: / / to / /

Months ☐

No ☐ Specify details and close interview

_____
_____
_____

SURVEY NO ☐ REGION ☐ TYPE ☐

8. Estimated current market value of boat, gear (including motor vehicles) and licence:

9. Estimated current market value of licence only:

10. Estimated current replacement value of boat and gear (including motor vehicles):

In the following questions, fish are considered to be sold at the time you lose authority to control their future destination. Thus fish sold to a country based fish processor are classified as being sold at South Australian country markets (even if the fish processor subsequently resells the fish on Adelaide or interstate markets). If you are responsible for transporting the fish to a fish processor/agent located in Adelaide (metropolitan area) or interstate, fish are considered to be sold in Adelaide or interstate markets respectively.

11. Did you catch King George Whiting? Yes ☐ No ☐

What percentage of your catch of King George Whiting is sold at:

South Australian Country Markets	1
Adelaide Markets	2
Interstate Markets	3

12. Did you catch Snapper? Yes ☐ No ☐

What percentage of your catch of Snapper is sold at:

South Australian Country Markets	1
Adelaide Markets	2
Interstate Markets	3

13. Did you catch Garfish? Yes ☐ No ☐

What percentage of your catch of Garfish is sold at:

South Australian Country Markets	1
Adelaide Markets	2
Interstate Markets	3

CARD 2

YEAR | | SURVEY NO | | REGION | | TYPE | |

CAPITAL INVENTORY

SEQ.	DESCRIPTION OR COMMENTS	ITEM CODE *	YEAR OF MANU-FACTURE	REPLACEMT COST	EST. RESIDUAL LIFE	ECONOMIC LIFE	ANNUAL DEPRECIATION	OPENING VALUE	DEPRECIATIN RATE	IF LEASED		
										LEASED DURING SURVEY PERIOD Y/N	YEAR LEASE	ANNL RENTL
		CODE	YEAR	$	YEARS	YEARS	$	$			YEAR	$
01												
02												
03												
04												
05												
06												
07												
08												
09												
10												
11												
12												
13										09	10	12
FLD		01	02	03	04	05	06	07	08			

* For several items: year of manufacture = 1986

ITEM CODES:

MB - Mother Boat
NT - Net
B1 - Boat 1
B2 - Boat 2
B3 - Boat 3
B4 - Boat 4
B5 - Boat 5
SH - Shed
MV - Motor Vehicle
OG - Other Gear
TR - Trailer
BI - Bins
RA - Radar
RD - Radio
FR - Freezer/ Cool Room

CARD 3

YEAR [ ] SURVEY NO [ ] REGION [ ] TYPE [ ]

FISH SALES

SEQ.	SPECIES	QUANTITY	GROSS VALUE	MARKET COSTS (Include Commission fees, Freight, Packing, Ice, etc.)	NET RECEIPTS
	CODE	KG	$		$
01					
02					
03					
04					
05					
06					
07					
08					
09					
10					
11					
12					
FLD	1	2	3	6	5

SPECIES CODE

KING GEORGE WHITING 1
SNAPPER 2
GARFISH 3
YELLOWFISH WHITING 4

TOTAL CATCH VALUE [ ]

CARD 4

YEAR ☐ SURVEY NO ☐ REGION ☐ TYPE ☐

LABOUR CARD

SEQ.	ALL LABOUR (LICENCE HOLDER/SKIPPER AND CREW)					LICENCE HOLDER ONLY		
	CLASSIF-ICATION	YEARS AS FISHER	SHARE PAID * (CREW)	COSTS INCURRED (CREW)	WAGES/ SALARIES PAID * (CREW)	OTHER JOB	WEEKS WORKED IN OTHER JOB	AVERAGE HRS PAID WEEK WRKD IN OTHER JOB
	CODE	YEARS	$	$.	$	Y/N	NO.	NO.
01								
02								
03								
04								
06								
FLD	1	2	3	4	5	6	7	8

* Enter values in either filed 3 and 4 or 5, depending on the method of payment.

CLASSIFICATION

LICENCE HOLDER	1
SPOUSE OF LICENCE HOLDER	2
OTHER IMMEDIATE FAMILY	3
EMPLOYED CREW	4
PARTNER	5

CARD 05

YEAR ☐ SURVEY NO ☐ REGION ☐ TYPE ☐

LIABILITIES/CREDIT SOURCE

	PURPOSE OF LOAN	TYPE OF LOAN	LENDING SOURCE	AMOUNT BORROWED	AMOUNT OF LOAN (CAPITAL) OUTSTANDING AT 30 JUNE, 198_
	CODE	CODE	CODE	$	$
SEQ. FIELD	1	2	3	4	5
01					
02					
03					
04					
05					

MAIN PURPOSE OF LOAN

Boat Purchase	1
Boat & gear purchase	2
Fishing gear purchase	3
Purchase of other fishing equipment	4
Working capital	5
Debt reconstruction	6
Personal (operator)	7
Other (specify)	8

TYPE OF LOAN

Bank overdraft	1
Term loan	2
Commercial bill/bank bill	3
Personal loan - Bank, Finance Co, Credit Union	4
Hire purchase	5
Credit cards	6
Other (specify)	7

LENDING SOURCE

Bank	1
Building Society/Credit Union	2
Finance Company	3
Postoral Companies, - Stock & Station agents	4
Insurance Companies, - Pension Funds, Trustee Accounts	5
Private	6
Other	7

CARD 06 YEAR [ ] SURVEY NO [ ] REGION [ ] TYPE [ ]

INCOME AND EXPENDITURE

ITEM DESCRIPTION	UNITS CODE	1986/87 86	COMMENTS	FIELD
INCOME				
Income from fish sold	$		From card 3	1 (6)
COSTS				
Administrative Costs	$			
- Accounting	$			2(4)
- Banking & Legal	$			3 (5)
- Electricity (Plant, Shed)	$			4(4)
- Stationery	$			5(3)
- Subscriptions	$			6(5)
- Telephone (Business)	$			7(4)
- Other	$			8(4)
Bait	$			9(3)
Marketing Costs (inc Freight, Commission, Selling Costs and packaging costs)	$		From Card 3	10(5)
Depreciation	$		To be calculated	11(4)
Food for crew	$			12(4)
Fuel, and lubricants	$			13(5)
Insurance				
- Boats	$			14(4)
- Motor Vehicles	$			15(4)
- Other capital items	$			16(4)
- Workers Compensation	$			17 (5)

CARD 06 YEAR [ ] SURVEY NO [ ] REGION [ ] TYPE [ ]

INCOME AND EXPENDITURE

ITEM DESCRIPTION	UNITS CODE	1986/87 86	COMMENTS	FIELD
COSTS				
Interest	$			1 8 (5)
Lease Payments (plant & equipment, rental costs)	$			1 9 (4)
Licence, Wharfage, etc				
- Licence fees	$			20(5)
- Wharfage charges	$			21(4)
- Other	$			22(4)
Motor Vehicle Registration	$			23(5)
Protective Clothing	$			2 4 (4
Rates and Taxes	$			2 5 (4
Repairs and Maintenance				
- Boat Survey & Gear Replacement	$			26(5)
- Boat & Equipment	$			27(5)
- Slipping Charges	$			28(4)
- Motor Vehicles	$			29(4)
- Other	$			30(4)
Payments to Crew	$		From card 4	3 1 (5
Other				
	$			3 2 (4
	$			3 3 (4
	$			3 4 (4
From Tax Return				
- Total Business Return	$			35(6)
- Total Business Exps	$			36(6)
- Net Business Returns	$			37(6)

* NB missing value -1