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AN ECONOMIC VALUATION OF THE SOUTH AFRICAN LINEFISHERY

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Economic data collected during 1995 and 1996 in a national survey of shore-anglers and skiboat fishermen is used to provide an economic assessment of aspects of recreational, subsistence and commercial linefishing on the South African coastline. Results show that more than 90% of shore-anglers have incomes which lie in the highest two quintiles of the distribution of incomes, and that <5% of rock-and-surf anglers were members of a household that was in poverty. Estimated mean income of commercial skiboat operators also fell into the upper 40% of incomes, but the estimated incomes earned by their crew barely exceeded the poverty line. A low income elasticity of demand was estimated for fishing trips by recreational anglers, predicting that the growth in demand for recreational fishing trips will slow with economic growth. The price elasticity of demand was also estimated to be low, indicating that the levying of an annual licence fee will not be effective in reducing effort. The macroeconomic importance of the recreational and commercial fishery was estimated from expenditures on fishing trips and income earned by commercial operators and crew, and when multiplier effects are taken into account, the fishery is estimated to contrbute 1.3% of the GGP of the coastal economics, and to generate employment for 131 500 people. Shore-angling was found to be most significant, contributing 76% of the GGP attributable to the fishery.

According to Van der Elst (1993), a management plan for marine linefish in South Africa should be founded on: regulations based on scientific knowledge, an equitable distribution of the benefit of linefish resources among the participants, a prohibition on the sale of fish by recreational fishermen, and the development of species-specific management regulations. Clearly, economic factors will feature prominently as a background to the formulation of management plans which are founded on principles like these. Since democratization of South Africa in 1994, concerns with poverty and inequality have become important issues in national policy formation, and those relating to equity and access will in future play an important role in shaping the direction of fisheries management policy. Therefore, the need for data on the economics of the coastal linefishery in general becomes apparent, and in addition, of linefishing as a subsistence activity and as a generator of employment.

This study presents an overview of a benchmark economic evaluation of shore and skiboat fisheries. It forms part of a national evaluation of linefishery participation and management in South Africa (Brouwer *et al*. 1997, Lamberth *et al*. 1997, Sauer *et al*. 1997). Using techniques derived from the microeconomic theory of demand, this report analyses the determinants of the demand for fishing trips, the likely response of anglers to certain forms of regulation, and the demand for recreational linefishing. The macroeconomic impact of a fishery is usually measured by estimating the contribution of the fishery to employment and the gross geographic product (GGP) of the region, or to the gross domestic product (GDP) of the economy. Multipliers, adduced from input-output tables, can be applied to estimates of output or expenditure to estimate the total contribution (both direct and indirect) which the fishery makes to the GDP and employment. This study addresses those macroeconomic issues.

SAMPLING TECHNIQUES

For sampling purposes, the South African coastline was divided into four regions, and further into subregions (see Lamberth *et al.* 1997 for further details). Three patrols were carried out daily for each month during 1995 and 1996 in each subregion and randomized according to time and direction of the patrol. Sampling was stratified according to the ratio of 6 weekdays : 7 weekend days : 1 public holiday. Security considerations at the inception of the study prevented the sampling of the Transkei coast. The sampling technique is detailed in Brower *et al*. (1997).

The questionnaire used for shore-anglers collected

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Table I: Characteristics of shore-anglers and recreational skiboat operators

Characteristic of anglers	Shore-anglers	Skiboat-anglers
White (%)	63	89
Male (%)	98	100
Mean age (years)	40	41
Mean individual income (Rand per year)	54 700	82 300
Mean household income (Rand per year)	102 000	111 300
Mean years fished	21	16
Club member (%)	17	48

information about the race, gender and age of the angler, number of fishing trips per year, club membership, knowledge of regulations, species targeted, actual catch and willingness to pay for a licence. A question on occupation was used to classify the economic status of the respondent. Occupations were coded into the 13 occupational categories of the Living Standards Survey (LSS) of 1993[1], and average household and personal incomes were imputed to each respondent from the mean income of the occupation, race, gender, age and region of residence cell of the LSS. The questionnaire distinguished day trips from trips of a longer duration. For day expeditions, the angler was asked for the postal code of residence, mode of transport, number of people on the trip, and the actual daily expenditure on bait and refreshments. Travel costs per person on the trip were imputed after estimating the distance travelled (for private motor transport, the Automobile Association rate of R0.413 per km was used). Anglers on trips of a duration of more than one day were asked for their postal code of home residence, as well as the point of departure for the trip surveyed. Questions were included on total expenditure on the vacation (excluding transport), number of people on the vacation, days fished and duration of the vacation. The vacation cost per angler per day was estimated as the sum of the vacation cost per days fished (including the total travel cost) and the daily expenditure on each fishing trip. Where a beach vehicle was used, its value was probed. Questions were included on the monthly expenditure on tackle, annual expenditure on rods and reels, and the total value of the anglers equipment.

Roving creel surveys of fishing effort have been shown to suffer a pronounced avidity bias (Thomson 1991). The mean values reported below for travel cost, cost per day, annual days fished and expenditure on tackle and equipment were adjusted for avidity using the technique suggested by Jessen (1978), Nowell *et al*. (1988) and Thomson (1991):

$$T/N = n/\sum(1/T_i) \quad ,$$

where T is the total number of trips for the population, N is the number of anglers in the population, n is the sample size and T_i is the number of trips taken

Table II: Frequency of the occupational categories in South Africa relative to the frequency of Black and White shore-anglers and recreational skiboat operators, and the frequency of occupational categories sampled in the questionnaire

Occupational category	Frequency (%)						
	Whole population of South Africa[1]	Shore-anglers			Skiboat anglers		
		Black	White	Sample	Black	White	Sample
Retired	12.7	10.7	16.3	14.2	0	8.5	9.1
Unemployed and not economically active	43.5	10.7	4.7	7.1	0	1.1	1.0
Professional/semi and technical	5.9	8.6	11.7	10.7	12.5	13.3	12.8
Managerial/executive and administrative	2.7	8.1	14.2	12.0	12.5	30.0	29.6
Clerical and sales	6.2	7.4	7.1	7.2	0	8.2	8.1
Transport and related	2.3	2.7	2.3	2.5	12.5	0.4	0.7
Service	6.5	7.0	10.0	8.8	0	6.7	7.1
Farming and related	2.2	7.4	5.9	6.4	0	7.0	6.7
Artisan, apprentice and related	3.2	16.3	11.4	13.2	50.0	19.3	19.5
Foremen, supervisors and mining	1.3	3.6	3.9	3.8	0	3.7	3.7
Operators and semi-skilled	4.0	9.8	6.8	7.8	0	0	0
Labourers	9.4	2.7	0.3	1.2	0	0	0
Students/scholars[2]	–	4.7	5.5	5.2	0	1.9	1.7

[1] Based on occupational data collected in the 1993/94 Living Standard Survey (LSS)
[2] Students/scholars were excluded from the distribution of occupations

[1] The LSS was designed to measure household income and expenditure, and 8 000 households were sampled. It was supervised by the World Bank and was undertaken by the South African Labour and Development Research Unit of the University of Cape Town.

Table III: Distribution of household income of recreational anglers relative to the household income by quintile of the national income, derived from the Living Standards Survey of 1993

Fishing activity	Bottom quintile	2nd quintile	3rd quintile	4th quintile	Top quintile
			Anglers (%)		
Shore-angling	1.9	2.8	5.2	16.3	73.8
Skiboat angling	0	0	0	3.0	97.0
			Mean household income (Rand)		
Shore-angling	3 200	7 200	14 000	32 400	128 500
Skiboat angling	–	–	–	31 400	156 300

annually by angler *i*.

The adjusted expenditures were obtained from:

$$Z/N = \sum^{n}(Z_i/T_i)/(1/T_i) \quad ,$$

where Z is the estimate of total expenditure for all anglers per trip and Z_i is the reported expenditure by angler *i*.

Recreational skiboat skippers were asked additional questions, including the value of the rig, the running cost of the skiboat per trip and the cost of its annual maintenance. Further, commercial skiboat operators were asked for the size of crew employed per trip, wage payment per trip and ownership of the rig.

THE FISHING POPULATION

The characteristics of recreational anglers are summarized in Table I. White anglers predominate in shore fishing and skiboat activities, and the overwhelming majority of them are male. The average years fished by shore and skiboat anglers were 21 and 16 years respectively: angling is a sport in which most participants begin young and continue throughout their lives. The estimated household income was R102 000 and R111 300 for shore and skiboat anglers respectively. (In November 1997, R4.81 = US$1). Given that the mean income of households in South Africa in 1995 was R33 600[2], on average, recreational anglers represent a far more affluent group than the population taken as a whole.

This finding is confirmed by the frequency of occupational groups (Table II) and the relative incomes (Table III). The unemployed and those who were not economically active are underrepresented on a proportional basis within the sample of recreational anglers. There is a clear class dichotomy in the sample in terms of occupational status of participants, with a proportionate overrepresentation of professionals and managers, and of production workers (which include the artisan/foreman/operator categories). It is apparent from Table III that recreational anglers are drawn from the higher quintiles of the national income distribution, with 90% of shore and 100% of recreational skiboat operators having household incomes which lie in the highest two quintiles of the distribution of incomes of all households in South Africa.

Previous studies of poverty have shown that the household poverty line is approximately equal to the level of household income at the upper boundary of the second quintile of the distribution of incomes of

Table IV: Distribution of motivation for recreational anglers by quintile of the national income

Motivation	Bottom quintile	2nd quintile	3rd quintile	4th quintile	Top quintile
			Shore anglers (%)		
Food	1.68	3.18	5.14	17.40	72.59
Recreation	2.07	2.28	6.14	16.39	73.12
Livelihood	0.55	2.76	4.42	32.60	59.67
			Skiboat anglers (%)		
Food	–	–	–	1.85	98.15
Recreation	–	–	–	3.36	96.64
Livelihood	–	–	–	0	100.00

[2] Estimated from the LSS mean of R27 736 in 1993, imputed for 2 years at 10% per annum.

Table V: Fishing activities and some economic aspects of shore-anglers and commercial and recreational skiboat anglers

Fishing activity	Shore-anglers[1]		Skiboat anglers	
	Day trip	Overnight trip	Commercial	Recreational
Days fished (per year)	11.8	6.0	119	27
Distance travelled (km)	73	270	44	93
Cost per day, excluding travel (Rand)[2]	20.91	133.36	296[3]	432[4]
Cost of travel per trip (Rand)[5]	60	223	36	77
Tackle (Rand per month)	24	34	213	270
Rod and reel (Rand per year)	110	89	574	1 159

[1] Shore data adjusted for avidity bias using the method proposed by Thomson (1991)
[2] Includes expenditure on tackle, rods and reels
[3] Excluding wages and interest, but including maintenance
[4] Including accommodation costs of overnight trips
[5] All vehicles costed at a rate of R0.413 per km

South African households. While approximately 40% of South African households are in poverty (Whiteford and McGrath 1994), the survey shows that only 4.7% of households with a member who is a shore-angler are in poverty. When the results of the survey are extrapolated to the national population (excluding Transkei), approximately 20 000 South African households that are in poverty depend on shore-fishing to make a contribution to their subsistence, and their catch contributes approximately 9% of household income. This is on the assumptions that poor households participating in linefishing have the mean income of their quintile, have success and trip frequency rates equal to the mean of African anglers in KwaZulu-Natal, and value the catch at R10 per kg. Linefishing is therefore a very significant component of income for a large number of households who live in poverty in South Africa.

The motivation for shore-fishing and skiboat angling is presented in Table IV. If livelihood can be interpreted as selling catch, then only 4% of recreational anglers admitted to selling their catch, and <3% of that group were among households in poverty. Recreational fishing appears to be a major reason for fishing trips, even for poor anglers, and the catch was valued as a source of food by approximately one-half of the anglers in every quintile.

Economic aspects of fishing trips are summarized in Table V. Shore-anglers on day trips fish on average 12 days per year, whereas anglers on overnight trips fish on average six days per year. Recreational and commercial skiboat operators have a higher level of activity, fishing for 27 and 119 days per year respectively. When all angler-related costs of fishing trips (including travel) are taken into account, the average cost per day of shore-anglers on day trips is R81 per trip, whereas shore-anglers on overnight trips have fishing expenditures of R133 per day and total travel cost of R223. The daily trip costs of the commercial skiboat operators are predictably lower than the recreational skiboat operators, when payments to crew are excluded, and the latter incur higher daily travel costs than the commercial operators.

Table VI lists selected data for commercial skiboat operators. Almost 80% of skippers are white and 83% of them own their own boat. On average, five crew members are employed per trip and they receive an estimated mean wage of R63 per trip when the value of the catch shared is imputed. Crew members therefore receive an average annual income of R7 500, which is close to the household poverty line. On average, a skiboat owner/skipper earns a gross income of R460 per trip, which, with a participation rate of 119 trips per year, is equivalent to a gross income of R54 600 per annum. This income places them in the upper 40% of the distribution of incomes in South Africa, similar to the mean income of a typical 40-year-old white employee in the production worker/foreman occupation category.

THE DEMAND FOR RECREATIONAL FISHING

On the assumption that there are no stock externalities in the recreational fishery (stock externalities result when increased fishing effort by individual participants affects the fishing stock such that catch per day is adversely affected and the participants' demand curves are so affected), a demand relationship for fishing trips may be estimated, where the level of quantity demanded (Q) is related to price (P), income (I) and a vector of other relevant variables (Z), including measures of quality such as fishing success. In recreational fishing studies, Q is usually measured as the number of fishing trips and P is measured in terms of trip-related costs. Assuming no

Table VI: Characteristics of commercial skiboat operators

Characteristics	Skipper	Crew
Percentage white	79.7	–
Years fished	15	–
Number of trips per year	119.0	–
Mean crew size per trip	1	5
Mean crew wage per trip (Rand)	–	63
Annual income of crew (Rand)	–	7 500
Value of catch per trip (Rand)	955	–

stock externalities ensures that anglers will not engage in ever-increasing effort to harvest diminishing stocks.

The estimated equations provide information on how the demand for fishing trips (or outlay on fishing trips) will be affected by changes in cost per trip, income of recreational anglers, and when success is included in the equation, can be used to provide an estimate of the responsiveness of demand to change in catch.

Demand equations were estimated for shore-anglers and recreational skiboat anglers. Two forms of demand equations were estimated. The functional form of the equations was found to fit the data best. As this form is similar to that of other studies of similar nature, sound comparisons could be made. The first equation is a conventional demand form for the number of trips:

$$\ell n Q_i = a_0 + a_1 \ell n P_i + a_2 \ell n I_i + aZ + e_i \quad , \qquad (1)$$

and the second equation estimates the demand outlay per trip:

$$\ell n P_i = b_0 + b_1 \ell n Q_i + b_2 \ell n I_i + bZ + e_i \quad , \qquad (2)$$

where a_0 and b_0 are the intercept terms in the regression,
a_1 and b_1 are the estimated coefficients on $\ln P_i$ and Q_i respectively,
a_2 and b_2 are the estimated coefficients on $\ell n I_i$,
a and b are the estmated coefficients for the vector of other relevant variables, Z
e_i is the error term,
Q_i is the number of fishing trips demanded by the ith angler,
P_i is the expenditure on the sampled fishing trip by the ith angler, and
I_i is the estimated income of the ith angler.

Data on the success per trip (S_i), as measured in kg of fish caught, are available for the KwaZuluNatal region and a success variable $\ell n S_i$, could therefore be included in the analysis. Success data is also available for the recreational skiboat fishery.

Whether Equation 1 or Equation 2 is the appropriate model depends on the individual angler's choice process. If the number of trips (Q) is chosen after the site, and therefore travel cost is specified, Equation 1 is the appropriate form. If anglers choose travel distance or cost (P) by choosing a fishing site after Q is determined, then Equation 2 is appropriate. In reality, Q and P are most likely to be endogenous to an individual angler, so that ideally a multi-equation model should be estimated that would include many competing fishing sites, as well as the determinants of the choice of residential location. The present data do not allow for such a model to be estimated. Therefore, Equations 1 and 2 are estimated as single equation models. Equations 1 and 2 were estimated using ordinary least squares (OLS)[3].

Dummy variables were created to estimate the effects on the demand for fishing of gender, race group, club membership and years of experience. The omitted category is female gender, African race, non-club member and 0–4 years of experience. A success variable, measured on the natural logarithm of kg of fish caught, can be introduced into the demand equations for shore-fishing in KwaZulu-Natal and for recreational skiboat anglers. The value of equipment (including the rig for skiboat anglers) was divided by the personal income of the angler, and is entered as a surrogate for the relative enthusiasm of the angler. In estimating costs per skiboat trip, the value of the catch was subtracted from the cost of the trip, and success, as measured by the natural logarithm of kg of fish caught, was entered as an independent variable.

The results of the regressions, with number of trips ($\ell n Q$) as the dependent variable, are presented in Table VII and the regressions, with cost per trip ($\ell n P$) as the dependent variable, are presented in Table VIII. These regressions represent the entire sample, for the shore-based linefishery and recreational skiboat sector, as well as the rock-and-surf fishery in the KwaZulu-Natal sample.

The results must be interpreted with caution, because the magnitude of the coefficient in the equations used can be affected by the regression model fitted, and alternative specifications have not as yet been analysed for the present data set. Furthermore, while the regressions reported herein perform acceptably, the model may not have the same level of explanatory power, or the significance of exogenous variables may

[3] Because grouped data were used to estimate the values for I_i, the variable nI_i was weighted by $\sqrt{n_i}$ (the number of anglers in the cell) to correct for heteroscedasticity and to ensure reliability of the significance tests.

Table VII: Log-linear demand relationships of fishing trips regression equations for shore-anglers and skiboat recreational anglers for the whole of South Africa and for KwaZulu-Natal

Variable	Regression statistic (*t* value)		
	Shore-anglers		Skiboat anglers
	South Africa	KwaZulu-Natal	Recreational
Constant	2.547**	2.798**	7.847**
	(6.330)	(6.728)	(13.099)
Log trip cost (ℓn P)	–0.1691**	–0.1519**	–0.8378**
	(6.519)	(3.592)	(8.776)
Log income (ℓn I)	–0.1012**	–0.1354**	0.0061
	(4.358)	(3.777)	(0.088)
Male gender ($G1$)	0.6559*	–	–
	(2.174)		
Coloured population ($R2$)	–0.6548**	–0.2634	–
	(3.848)	(0.802)	
Indian population ($R3$)	–0.6645**	–0.6904**	–
	(4.053)	(3.873)	
White population ($R4$)	–0.6719**	–0.2619	–
	(4.179)	(1.365)	
Club member ($C1$)	0.1917*	–0.0018	–
	(2.121)	(0.010)	
Overnight trip ($T1$)	–0.7836**	–1.176**	–1.096
	(9.622)	(8.581)	(5.864)
5–9 years experience ($E2$)	–0.0241	0.0288	0.1941
	(0.230)	(0.183)	(0.725)
10–19 years experience ($E3$)	0.2251*	0.0415	0.2627
	(2.415)	(0.299)	(1.381)
20+ years experience ($E4$)	0.1040	0.0291	0.2682
	(1.174)	(0.219)	(1.338)
Log equipment value (ℓn K)	0.3417**	0.4651**	0.2165*
	(12.645)	(11.207)	(2.021)
Log success (ℓn S)	–	0.0061	0.1155
		(0.577)	(1.865)
n	1 799	774	138
F	41.89**	31.27**	32.06**
Adjusted r^2	0.2144	0.3197	0.6446

* $p < 0.05$
** $p < 0.01$

change when applied to subsamples of shore or skiboat anglers. The empirical findings for the demand price models are slightly stronger than the demand for trip models, although all the equations have F-statistics significant at the 99% confidence level. The estimates of the parameters for travel cost and frequency coefficient (a_1 and $b_1 < 0$) have the expected negative sign and are statistically significant, and the regression for shore-anglers indicates that travel cost and frequency are significantly inversely related. The results show that income for shore-anglers is a significant, positive determinant of travel cost, but that income has a negative effect on the demand for trips. The interpretation is that anglers with higher income travel greater distances to fish, but do not fish with greater frequency. This result can be explained by the higher opportunity cost of time for anglers with higher incomes. Studies of anglers in the U.S.A. have shown a lack of significant income effects on demand frequency but not on demand price (Vaughan and Russell 1982, Agnello 1987). In contrast, the present study shows that the income coefficient in the KwaZulu-Natal sample is greater in the demand frequency equation than in the demand price equation, although both have values <1.

The dummy variable used to capture the effect of race group in the shore-angling equation shows that non-African anglers demand fewer fishing trips per year than African anglers, after standardizing for all other characteristics of the anglers, but that they spend more time per trip. The dummy variable for levels of experience in the demand frequency equation shows in general that anglers with greater experience demand a greater number of trips per year than novices, but the demand price equation shows that experienced anglers make less costly trips than novices. The dummy variable for overnight trips had a predictably negative relationship in the demand fre-

Table VIII: Log-linear demand relationships of price regression equations for rock-and-surf anglers and skiboat recreational anglers for the whole of South Africa and for KwaZulu-Natal

Variable	Regression statistic (t value)		
	Shore-anglers		Skiboat anglers
	South Africa	KwaZulu-Natal	Recreational
Constant	1.054**	1.595**	7.075**
	(2.878)	(4.440)	(29.543)
Log trip frequency (ℓn Q)	−0.1374**	−0.1098**	−0.4462**
	(6.519)	(3.592)	(8.776)
Log income (ℓn I)	0.0801**	0.0471	−0.0658
	(3.823)	(1.536)	(1.318)
Male gender ($G1$)	0.3052	–	–
	(1.121)		
Coloured population ($R2$)	0.6781**	0.5376	–
	(4.426)	(1.931)	
Indian population ($R3$)	0.6219**	0.8059**	–
	(4.209)	(5.366)	
White population ($R4$)	0.4471**	0.4224**	–
	(3.078)	(2.599)	
Club member ($C1$)	0.0810	−0.0016	–
	(0.993)	(0.010)	
Overnight trip ($T1$)	1.366**	1.729**	0.1666
	(20.081)	(16.509)	(1.090)
5–9 years experience ($E2$)	−0.0269	−0.4528**	0.1004
	(0.284)	(3.406)	(0.513)
10–19 years experience ($E3$)	0.1044	−0.1391	0.2485
	(1.240)	(1.179)	(1.799)
20+ years experience ($E4$)	−0.1729*	−0.3550**	0.2386
	(2.167)	(3.156)	(1.636)
Log equipment value (ℓn K)	0.1480**	0.1414**	0.2064**
	(5.877)	(3.748)	(2.670)
Log success (ℓn S)	–	−0.0054	0.0531
		(0.600)	(1.165)
n	1 799	774	138
F	71.3**	49.7**	21.32**
Adjusted r^2	0.3194	0.4305	0.5427

* $p < 0.05$
** $p < 0.01$

quency relationship and a positive one in the demand price question: shore-anglers, as well as skiboat anglers, who make holiday trips demand fewer trips per year, but spend more time per trip.

The demand equations for skiboat trips have large and significant intercept terms, which may indicate the effect on the demand for trips, the larger capital outlay of the rig and a need to use the equipment to keep it working. In the equation for skiboat anglers, demand price includes travel cost, tackle and boat, and a share of the annual maintenance cost of the rig, and demand price and frequency have the expected significant negative relationship. However, the income coefficients in the two relationships are not significant ($p > 0.05$).

The success variable that was included in the shore-angling equations for KwaZulu-Natal was positive, but not significant ($p > 0.05$). Even if the coefficient had been significant, its low value would indicate that marginal value of an extra kg of fish caught is extremely low, and the demand for fishing trips is not sensitive to the success rate per trip. Changes in the actual catch of the shore-anglers will have an insignificant effect on expenditure. In the demand frequency equation for skiboat anglers, the success variable is significant ($p < 0.05$), but its elasticity is small; it shows that a 100% increase in catch per trip would result in a 12% increase in the total number of trips per year.

The results of the demand equations raise important pointers for management policy. In future, the size of the White population is unlikely to grow and the growth rate of the Coloured and Indian populations are falling. Taking this and the low income elasticities of demand for recreational trips by both shore and skiboat anglers into account, it is predicted that the demand for fishing trips will grow at a slower rate than the population growth rate and growth of income.

The coefficient on the price variable (a_i) in the

demand frequency equation shows the price elasticity of demand for fishing trips, i.e. the percentage change in the number of trips divided by the percentage change in cost per trip. The elasticity of substitution for fishing trips can be inferred from the price and income elasticities; for South Africa, the demand price equation is −0.16. The inelastic coefficients show that the demand for trips will not fall if the cost per trip is increased by a relatively small amount. An annual licencing fee for anglers will therefore be an efficient generator of revenue, if the licences can be enforced. However, levying an annual licence fee, unless the number of licences is restricted, will not be effective in reducing effort. The present survey revealed that 51% of shore-anglers were willing to pay for a fishing licence. The average amount which they were prepared to pay was R33 per year.

The apparent low elasticity of price and quantity demand with respect to success indicates that a restriction on the total mass of the catch will not reduce fishing effort or expenditure on trips. Therefore, a global catch restriction would not be harmful to the economy that depends on the coastal recreational linefishery.

MACROECONOMIC DIMENSIONS

Storey and Allen (1993) argued that the macroeconomic impact of a recreational fishery on a region should be measured only by taking account of expenditure that is newly attracted into the region. Those authors suggest that the recreational expenditure of residents of the region would continue, as substitute activities would be found if the fishery did not exist. However, the very low elasticity of demand for recreational linefishing in South Africa casts doubt on the assumption that substitute activities could easily be found. Two estimates of the contribution of the recreational fishery are therefore made: the first estimates the contribution to GGP arising from the total expenditure and production of the fishery; the second follows the methodology of Storey and Allen (1993) and excludes the expenditure made by residents of the coastal regions on recreational angling.

In order to estimate the aggregate value of shore-angling, the population of anglers must be known. Van der Elst (1993) estimated that there were 365 000 recreational shore-anglers in South Africa in 1991, which he suggested would increase at a rate of 6% per year. The present finding of a very low income elasticity of demand and a predominance of white participants suggest that this growth rate is too high. Instead a 2% compound growth rate was applied to Van der Elst's estimate, which indicated an increase of shore-anglers to 412 000 in 1995. A telephone poll of all regional skiboat clubs in South Africa revealed that 7 920 members were recreational anglers. The number of commercial operators was estimated to be 3 097 (Sea Fisheries Research Institute, unpublished data).

Table IX: Relative contribution of the recreational and commercial fisheries to the combined gross geographical product (GGP) of KwaZulu-Natal and the Eastern and Western Cape

Fishing activity	GGP		Number employed
	Rand (million)	Percentage	
Method 1			
Shore	1 653	76.3	99 180
Skiboats			
Recreational	128	5.9	7 680
Commercial	386	17.8	24 700
Total	2 167	100	131 560
Method 2			
Shore	83	17.5	4 980
Skiboats			
Recreational	5	1.1	300
Commercial	386	81.4	23 160
Total	474	100	28 440

[1] Backward linkages on GGP were estimated from the average fishing expenditure for all sectors. A coefficient of 0.823 was estimated from the coefficients of the regional input-output table of KwaZulu-Natal, the Eastern Cape and the Western Cape.

[2] The contribution of the commercial skiboat sector to GGP is estimated as value added plus the indirect contribution to GGP resulting from backward linkages from expenditures on inputs.

The estimated relative contributions of the recreational and commercial fisheries to regional GGP are shown in Table IX. Based on demand equations, the only items of expenditure included were those directly associated with the fishing trip (holiday expenditure on days not fished was excluded), as was expenditure on members of the party who did not fish. A broader approach is adopted here when evaluating the contribution of the fishery to the regional and national income: expenditure associated with the trip, such as the accommodation and transport of non-fishing partners, has been included, on the assumption that the trip was made to the coast primarily for fishing.

The two possible methods of estimation applied produce widely diverging results, because of the larger relative importance of the recreational expenditure on fishing by residents of the Provinces in which fishing takes place. Table IX shows that, if expenditure of resident anglers is excluded (Method 2), the contribution of the linefishery to the GGP of KwaZulu-Natal,

Eastern Cape and Western Cape is reduced from R2 167 to R474 million. If the relative importance of the sectors and the aggregate contribution of the linefishery are required, the method which includes the impact of all expenditure would seem to be most appropriate.

Taking the combined expenditure of residents of the same three coastal provinces into account (Method 1), shore-angling contributes the most in generating income and employment. Some 95% of the contribution of the shore-fishing sector accounts for the expenditure of residents of those three provinces. The skiboat fishery contributes in total 23.7% of the GGP of the linefishery. In aggregate, the fishery is an important source of income and expenditure, because those which are generated and the product produced both directly and indirectly account for 1.3% of the GGP of KwaZulu-Natal and the Eastern and Western Cape, and the employment of 131 560 people in the same provinces.

CONCLUSION

The results of this study shows that males predominate in shore and recreational skiboat angling in South Africa. Further, 63% of shore-anglers and 89% of recreational skiboat skippers were of the White race group. Given the dominance of Whites in the upper income deciles of South Africa's income distribution, it was not surprising to find that more than 90% of shore- anglers and 100% of recreational skiboat operators have incomes which lie in the highest two quintiles of the distribution of household incomes. Nevertheless, it was estimated that approximately 20 000 households in poverty in South Africa (excluding the Transkei) depend on shore-angling to make a contribution to their subsistence. Only a small proportion of this group admitted to selling their catch. Some 80% of commercial skiboat skippers were also of the White race group. Their estimated mean incomes were just above the lower bound of incomes of the top 40% of households, and the incomes of this group were approximately 50% of the estimated incomes of recreational skiboat anglers. By contrast, the incomes estimated to be received by the crew of the commercial operators would have placed their households close to the poverty line.

In aggregate, it was estimated that the fishery made an important direct and indirect contribution to the coastal economies, contributing 1.3% of GGP and generating employment opportunities for 131 500 people. Shore-angling was found the most significant, contributing 76.3% of the GGP attributable to the fishery.

Demand functions estimated for fishing trips showed that income elasticity of demand for fishing trips is low, and the study therefore predicts a slowing down in the growth of demand for fishing trips. A low value for the estimated elasticity of demand for fishing trips suggests that levying an annual licence fee will effectively generate revenue, but it will not reduce effort, and a licence fee will therefore not be an effective conservation measure on its own. The estimated demand equations suggest that success does not play a major role, and a restriction on catch will not reduce fishing effort, or have significant harmful effects on the economy which is dependent on the coastal recreational linefishery.

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