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EX-ANTE EVALUATION OF ROCK LOBSTER FISHERY MANAGEMENT ARRANGEMENTS

Roger EDWARDS
Australian Rural Management Services Pty Ltd
14c Birdwood St
Netherby SA 5062

Jon PRESSER
Primary Industries South Australia
GPO Box 1671
Adelaide SA 5001

ABSTRACT

The standard fishery bio-economic model assumes constant prices of fish, costs of fishing, sustainable yield and yield curve. In practice none of these things are ever known for sure and difficulties arise in using most models in fisheries management as they often fail to capture the essence of the decisions facing fishermen.

The research outcome has been the development of a static spreadsheet model which allows the testing of impacts of alternative catch management arrangements. The model is suited to a 'what if' approach, with alternative arrangements being tested for a range of industry parameters determined by the user.

The model allows us to creep around the range of possible economic outcomes from a hypothetical bio-economic model. The aim being to highlight the direction of movement in industry returns.

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SANZRLFA, (1992) Northern Zone Rock Lobster Fishery Review. Draft Report 2 - Introduction to the Review.

SANZRLFA, (1993) FRDC "Ex-Ante Evaluation of Rock Lobster Fishery Management Arrangements", Project No. 92/124.

1. INTRODUCTION

The development of a framework for economic analyses was primarily intended for use in assessing and judging catch management strategies for the South Australian Northern Zone Rock Lobster Fishery (SANZRLF).

Assessment and judgement involves assimilating and analysing new information and lessons from experience or past information. Good judgement is an integral part of good decisions. Success, especially in management of fisheries, often requires good fortune as well.

2. THE ECONOMIC REASONING FOR FISHERIES MANAGEMENT

Fisheries are managed because regulated use of common property resources is claimed to be more economically efficient than unregulated use and open access. Without proper regulation, over-exploitation of the resource and inefficient use of labour and capital can occur.

Benefits from an individual acting to conserve the resource are shared by all fishermen, and costs from exploiting by one fishermen are borne by all fishermen. Therefore, under open access, which means no formal or informal measures to restrict utilisation of the resource, the 'tragedy of the commons' is inevitable. This is the reasoning underlying management efforts in Australian fisheries (SETFIA, 1990).

With management, the opportunity exists to use the resources required in catching fish more efficiently by restricting total fishing effort. The net return to the resource can be increased. This is the standard fisheries economic model used in many studies of open access solutions since it was first explained by Gordon (1954).

A fundamental goal of biological assessment is the estimation of the long term yield of a fishery, be it the maximum sustainable yield (MSY) or maximum economic yield (MEY) and there are two general methods used to estimate them. One of the methods requires information on a large number of biological parameters, including growth, mortality, recruitment etc.. If there is 'good' information available for all of these factors then this may be the superior method (Prescott and Lewis, 1992). However, there is usually insufficient information available to allow its application.

The other method is known as surplus production modelling. This method ignores many of the biological processes that occur in a population and relates observed catches to a range of actual effort figures. The bio-economic model is an attempt to show the various relationships between the biological nature of the fish stock and the effects of fishing it. A model is a simplification set up so that the features of the fishery can be thought through; the aspects which vary can then be incorporated and the model hopefully made more realistic.

If the long run year in year out yield curve can be determined along with costs of production and prices, then net return can be established using the traditional MEY model. Unfortunately with all theoretical models there is usually a large gap between the conceptual analysis of what happens and what occurs in practice. The standard bio-economic model assumes constant prices of fish, costs of fishing, sustainable yield and associated yield curve. In practice none of these things are ever known for sure. Even if they were, they could change daily as unpredictable influences come into play.

The implication is that economic results for fisheries and predictions about possible economic outcomes from changing a management system are unlikely to be quantified with confidence. The potential results will be changing constantly. Difficulties often arise because most bio-economic models fail to encompass the practicalities of real life management and the obvious difficulties in estimating the yield function of fish populations.

Kearney (1989) summarised the position from a biological perspective when he said:

> The study of fish populations is an imprecise science. Even unexploited fish populations fluctuate in response to environmental changes such as season, rainfall and major oceanographic disturbances. When man's influence interacts and the delicate balance between predator, prey and the total ecosystem is changed it is impossible to predict with confidence what the long term effects will be. It is therefore impossible to be precise in estimating future resource abundances and yield projections - particularly when one is working in an environment such as the sea - you can't even see the animals you are studying!

With technical and stock considerations underpinning any fishery economic analysis, and with the dearth of good information about the stock, it is easy to understand that the results of even the best economic analyses will sometimes bear a tenuous relationship to reality.

Therefore the most practical approach is to explore a range of possibilities using all currently available information, and make judgements about the results which emerge from the analyses.

3. THE SOUTH AUSTRALIAN NORTHERN ZONE ROCK LOBSTER FISHERY - THE CASE STUDY

For many years the Northern Zone fishery has operated under an input control system, namely a defined season from November 1 to May 31; restrictions on minimum fish size and the taking of spawning females; pot design; limited entry; and maximum and minimum pot holdings for each licence

Total catch increased from 1986-87 to 1991-92 by 63 per cent to 1220 tonnes. Potlifts and catch rate per potlift increased by around 33 per cent for the same period. A total of 3950 pots are licensed for use and an average of 185 days of the 212 days available were fished in 1991/92. Adjustment of fishermen out of the fishery has occurred and 81 licenses remained in 1993, compared with 108 licences which existed in 1980.

Amongst fishermen there are desires to establish management strategies which better allow improved efficiency in catching operations together with the flexibility in catching times to capture price premiums on offer outside the current season.

There are a number of features about the Northern Zone fishery which render application of the standard bio-economic model less than useful. They include:

* insufficient stock relationship information;

* no information about the proportion of investments in boats and gear which is attributable to the catching of other species such as shark, marine scale fish species and king crabs;

* no information about how changes in the supply of lobsters in a particular period will affect price; and

* no information about how diminishing returns impact on fishing operations. That is, as effort increases so costs will increase and returns for an extra unit of cost may decline.

However, some economic analyses can still be of use in showing the direction of movement in industry net return from changes in fishery parameters for a given set of assumptions or circumstances. Economic analyses may also be useful in highlighting those parameters which have the largest impact, thereby providing direction for further fine tuning of the key relationships.

4. THE STUDY APPROACH

The SANZRLF was used as a case-study in the development of a framework for the evaluation of alternative management strategies. A postal survey was undertaken of all fishermen who held a licence to fish for rock lobster during the 1991/92 season The survey collected demographic information (age, fishing port, experience), technical information (catch data, gear details), and financial information (investment, fishing and business expenses) Statistics and information on catch history (weight, numbers), and fishing effort (potlifts, days fished) were extracted from the South Australian Research and Development Institute (SARDI) database of 'Catch and Effort Records'.

A 'what if?' approach has been adopted in that the many unknowns about the fishery mean a number of guesses about catch, fishermen's response to change, and changes in costs of production, have been made. That is: for a given catch range, periodic catch rates, costs of fishing and prices and a change to fishing operations, what is the relative magnitude and direction of movement in industry net return in a given year?.

In essence we are creeping around the range of possible economic outcomes from an hypothetical bio-economic model which is based on a mix of 'hard' and 'soft' data. To the extent that the model is a reasonable approximation to reality, the aim is to then highlight changes which may improve efficiency and economic performance in the fishery, while maintaining potential catch at around current levels.

A number of assumptions and guesses have been necessary in order to capture the impacts of alternative catch management systems. For example, it is not known what will happen to important parameters such as catch rates and price should catching operations shift from the current season to the winter months. More importantly it is not known how individual fishermen will respond to the changes.

The purpose of undertaking the research was to provide information about possible relative ranking of alternatives under the same set of assumptions, and also to show the direction of movement in net industry return from a change. Of particular interest were the relative potential economic performances of the industry under existing management arrangement, under fishing time management arrangements and under quota. Assessment of the current performance was the starting point or measuring stick against which alternatives were analysed and ranked.

The research outcome has been the development of a static industry model which allows the testing of impacts of alternative catch management arrangements under conditions where fishermen are assumed to be rational and seek to maximise profit. The model is tempered by the numerous practical considerations which have been raised by fishermen.

It ought to be noted here that results relate to industry as a whole and the 'average' fisherman and it should also be remembered that the average fishermen is yet to be located. As well, little information is generated about the distributional impacts of changes between fishermen. However, the strength of the spreadsheet approach adopted is that the model can be used to examine individual impacts given sufficient cost of fishing and catch rate information for that individual.

5. DATA SOURCES

A socio-economic survey was designed in conjunction with SARDI and fishermen, pilot tested and then sent to the 84 licence holders in August 1992. The survey was aimed, *inter alia*, to collect detailed information on the costs and inputs of fishing, fishing effort and catch, and on fishing gear. Individual fishermen's monthly revenue and prices received were not collected as part of the survey.

A response rate of 62 per cent was achieved (ie 52 survey forms were completed and returned). The response to the survey covers 62 per cent of the total number of pots licensed in 1991/92, and around 50 per cent of licence holders from within each pot holding range.

Results were collated and analysed on a computer spreadsheet program. A number of economic measures were determined, including operating and overhead cost, and net return per potlift, per day fished and per kilogram of lobster captured, as well as the return on investment. The analyses were made for each individual and then averaged across the industry for the current catch management arrangement.

Survey results, where possible, were checked against other external or independent sources of information such as the SARDI Catch & Effort Database. Two important measures, namely average catch rate per potlift and average days fished for the 1991/92 season (1.51kg and 187 days respectively) compared well with the SARDI statistics of 1.52kg and 185 days. The similarity of the two measures establishes confidence in the survey results providing a fair representation of the industry.

The approach taken in this analysis, with regard to establishing a catch range to which management strategies can be tailored, was to determine a 'target' range based on industry catches. The average annual reported catch for the five years to 1992-93 was around 1000 tonnes and ranged from 810 tonnes in 1987/88 to a high of 1221 tonnes in 1991-92 (SARDI).

The range used in this study is the potential range that is likely under current management arrangements using the average monthly catch rates calculated since the 1987/88 season. This is estimated to be around 1060 tonnes. In other words, if all fishermen fished every day of the current (1992/93) season and lifted all of their pots each day except 17 days lost for weather, the potential total catch for the season, using the average monthly catch rates over the last five years, is around 1060 tonnes.

This can be represented mathematically as follows:-

> *Potential Catch = (5 year average monthly catch rate/potlift or estimated winter catch rate) x (Total available days per month - less days lost to weather) x (Number of Pots) x (Pot Efficiency)*

All management options and regulations are adjusted so that the potential catch calculated is at or about the 1000 to 1100 tonnes potential.

The lack of a substantial biological model that could predict the consequences of changing fishing effort on fish population and catch rates means that it is impossible to predict with any accuracy the longer term financial consequences of any changes in effort, whether they be voluntary or enforced. The basis for any economic assessment can, therefore, only be from a logical viewpoint based on good judgement and 'best bets' and the experiences of fishermen and researchers. The model of the fishery operations allows for specification of many possible variables. The sensitivity of economic performance including break even analyses can be tested.

6. THE BIO-ECONOMIC MODEL

The computer model that was developed to investigate the impact of changing regulations and management on the SANZRLF is described as a bio-economic model as it allows for the specification and consideration of the effects on the subsequent catch rates of lobster from altered fishing patterns during the year, and calculates the consequent changes in fishing costs and returns. It was developed on a spreadsheet program and is divided into four sections: the input data; the catch rate calculator; the financial calculator; and the output data.

The year is separated into 48 time periods, with 4 time periods in every month. Periods 1, 2 and 3 are the first three weeks of each month (ie days 1-7, 8-14, 15-21 respectively), while the time period 4 is from the 22nd day to the end of the month. Data and results are respectively entered and reported by time period.

Model Facilities

The structure of the model is such that it is designed to allow catch management scenarios to be tested. Parameters which can be varied are:-

(a) the 'structure' of the industry - i.e. the number of licensed fishermen, fishing vessels operating and total pots in the industry,

(b) the costs of fishing;

(c) the predicted catch rates for any month outside of the current season;

(d) the net price per kilogram of lobster in any period;

(e) the percentage of pots that are 'double pulled' in any period;

(f) the carryover catch caught after a closure and the timing of capture;

(g) the efficiency of pots;

(h) days lost from inclement weather, and

(i) the timing of fishing activities during a full twelve month period.

Each of these parameters are explained in detail under 'Data Entry' in Section 7. Output Data is explained in Section 8. First, it is necessary to describe the 'calculators' in the model.

The Catch Rate Calculator

One of the fundamental problems with attempting to model the SANZRLF is the lack of information of the impacts on subsequent catch rates of changing fishing activities in a particular period. That is, insufficient information exists about the total population to accurately determine if, and to what extent, adjusting fishing effort (and thereby catch) in one period will affect the possible catch in following periods.

Added to this is the lack of information about 'catchability' as the season progresses. Catch statistics show a marked decline in catch rates from February through to May. This raises the question; Is this due to lobsters not 'crawling' into the pots even though they may be 'available' or, have they all been caught by the end of the season or, is it a combination of both of these factors?

This question was explored with case-study fishermen and biologists, together with their estimates of the effect on subsequent catch levels following closures within the current season. Guesses of the proportion of lobsters that would not be captured in a closed period that would carryover and be captured in subsequent periods varied from zero to 100 per cent, depending on a wide range of factors. The catch rate calculator in the model allows an estimation of the number of lobsters that will be captured in any period based on specified assumptions regarding 'availability' and 'catchability' of rock lobster.

Prior to considering any adjustments in fishing effort, the average catch for any period is determined from Catch & Effort Statistics recorded since 1987/88 season. The potential catch for any period is also calculated using these catch rates and the adjusted potlifts determined from the new management restrictions.

The potential catch can be further modified for 'pot efficiency'. That is, if it is expected that a change to the management system will effect how well the pots are used and, therefore, the resultant catch rate per pot lift, this impact can be allowed for by increasing or decreasing the pot efficiency accordingly.

If a period is not fished, or if the potential catch is less than the historical average catch, then the uncaught proportion of the average catch for that period is transfered to subsequent periods, according to specified catchability and carryover estimates. This carryover into subsequent periods is then added to the potential catch of those periods.

There are three important assumptions of this catch rate calculator.

1. There is only an adjustment in future available catches if the potential catch in any period is less than the average catch for that period. If the potential catch, given the parameters of management, is greater than the average for the period, then the effect on available catch in following periods is not accounted for.

2. The carryover of uncaught lobsters is not cumulative. If a period is closed, then the extra fish that were carried over from a previously closed period escape capture for the rest of the season.

3. As there are limited statistics for average catch and catch rates in the winter months, the carryover is estimated on the potential catch (calculated using inputted catch rates) for tho e periods.

The catch rate calculator can be represented mathematically as follows:

(1) No Carryover:-

Adjusted Catch Rate = (Historical Average Catch Rate/Potlift or estimated Winter Catch Rate/Potlift) x (Pot Efficiency Factor)

(2) With Carry Over:-

Adjusted Catch Rate = ((Historical Average Catch Rate/Potlift or Estimated Winter Catch Rate/Potlift) x (Pot Efficiency Factor))+
((Carryover tonnes) ÷ (Total Potlifts))

The Financial Calculator

The financial calculator of the model determines the potential returns and costs of fishing under new management arrangements given the adjustments in likely catch (from the catch rate calculator).

The estimated revenue from lobster fishing is a simple multiplication of the catch for the period, and the estimated net price paid for lobster in that period. An important assumption made in the financial calculator of the model is that: the average price paid for lobster in any period is not affected by the quantity caught in the Northern Zone in that period or previous periods. In other words, the demand is perfectly elastic.

Total catch in tonnes per period is determined as follows.

Total Tonnes per Period = (Adjusted Catch Rate/potlift) x
(Number of Potlifts/day) x (Number of days/period less days lost to weather)

Tonnes per period are summed to produce the total tonnes caught for the year.

Variable costs including fuel, repairs, bait, wages and rations vary depending on how the alternative catch management arrangements influence fishing activities. For example, if a system involves allocating more pots for each operator and working less days then the fuel costs related to potlifts will increase while the rations related to days on the water will decrease. If days are lost during fishing periods due to weather the daily costs are counted while potlift costs are not.

Overhead cost allowances for operator labour and management, and depreciation on the average value of boats and gear, are standardised across the industry.

The return per period is calculated as follows:

> *((Tonnes per Period) x (Net Price/kilogram)) - ((Number of days x Boat Numbers x Boat Variable Cost/Day) + ((Number of Days - Days lost to weather) x (Number of Potlifts/day)) x (Variable Cost/Potlift)))*

where;

(a) days is the number for each period,
(b) boat numbers is the number of boats in a period,
(c) days lost is the sum of the specified days lost to weather in a period, and
(d) potlifts/day is the pot number/boat adjusted for double lifting and percentage of fleet fishing.

The return per kilogram is calculated as follows:

> *(Return per period) ÷ (potential catch for the period)*

Returns from all periods are summed to produce total industry return from which overheads are deducted to produce industry net return. The difference between the net return from the current arrangement and the result from the alternative arrangement is then divided by the licence numbers to give extra return per licence.

7. DATA ENTRY

Before achieving results a number of essential data are required. The following data entry areas of the model are explained and illustrated with reference to the spreadsheet model. The data that are shown relates to the fishery under the current management arrangements and fishing performance, and an alternative example of a 'Pulse Fishing' arrangement.

Industry Structure

The industry structure relates to the number of fishermen, vessels and pots in the industry. From this the average number of pots per fishing vessel is calculated. The total number of pots, vessels and licences can be varied with a pot adjustment percentage as can the efficiency in catching of all pots.

RANGE NAME:(IS) INDUSTRY STRUCTURE Item	ALTERNATIVE MANAGEMENT ARRANGEMENT	CURRENT MANAGEMENT ARRANGEMENT
Number of Fishermen	81	81
Number of Vessels	81	81
Total Number of Pots	4345	3950
Pot Adjustment +/- %	+10%	N/A
Average Pots/Vessel	54	49
Change in Pot Efficiency +/- %	-2%	N/A

Fishing Costs

Fuel and repair costs are a function of both the number of fishing days and the fishing effort (number of potlifts). Fuel costs are incurred 'steaming' between port and/or anchorage to fishing grounds, and varies with the number of days fished. Also, fuel cost is incurred while setting and pulling pots, and is related to the number of pots on board the vessel, and thus is a function of potlifts.

Repair costs have similar relationships to the number of fishing days and the number of pots. Repairs to motor and vessel are assumed to be related to the number of fishing days, while repairs and replacement of fishing gear is determined by the number of pots, and therefore potlifts. The estimated current replacement value of the fishing fleet is used to calculate the industry's insurance costs, while the value of other assets (not including pot values) is included when depreciation is calculated.

Annual business administration costs is an allowance for such cost items as licence fees, office costs, vehicle costs and other overheads. It does not include interest payments on borrowed monies. Operator allowance is a return to the operator to reward him/her for the management and general operating of the fishing business for the year.

Crew costs including skippers are assumed to be on a catch-share basis and is therefore directly proportional to the value of the catch. Bait and tackle costs are a function of the number of potlifts.

RANGE NAME:(IC) INDUSTRY COST STRUCTURE		
	$/day (plus)	$/potlift
Fuel	$51.00	$0.51
Repairs	$61.50	$0.42
Insurance Premiums	$30/$1000 value	
Depreciation	10% of capital	
Business Administration Costs	$25,000/year	
Operator Allowance	$60,000/year	
Crew Costs(including Skippers)	22% of gross catch value	
Bait & Tackle Costs	$1.75/lift	
	Average	Total
Vessel value	$151,333	$12,257,973
Licence Value	$682,716	$55,300,000
Other Assets	$68,500	$5,548,500
Totals	$902,549	$73,106,473

Prices

As described earlier in the report, the year is segmented into 48 periods. The average prices per kilogram paid to fishermen in each period can be entered into the model. There is no relationship linking the average price received for lobster to the amount supplied.

RANGE NAME:(WP) WEEKLY NET PRICES $/kilogram				
Month	Week 1	Week 2	Week 3	Period 4
Nov	18.00	19.00	20.00	19.00
Dec	18.50	18.25	18.00	17.50
Jan	17.50	17.25	17.00	16.75
Feb	16.50	16.25	16.00	16.50
Mar	17.00	17.50	18.00	18.50
Apr	19.00	19.50	20.00	21.00
May	22.00	23.00	24.00	25.00
Jun	30.00	30.00	30.00	30.00
Jul	30.00	30.00	30.00	30.00
Aug	30.00	30.00	30.00	30.00
Sep	30.00	30.00	30.00	30.00
Oct	25.00	25.00	25.00	25.00

Historical and Estimated Catch Rates, Carryover and Catchability

Catch rates for the months of November through to May are predetermined in the model from historical 'Catch and Effort' statistics. However, for the winter months where there are limited historic catch and effort data on which to base estimates of catch rates, it is necessary to input some conservative 'guesses'.

The concept of carryover of uncaught average catch, and the 'catchability' of this carryover was explained earlier. Two types of estimates are required in this area. The first is the percentage of uncaptured lobster that will be caught in subsequent periods. These estimates are entered in the '% Caught After No Fishing' input area.

The second is the percentage of this carryover that will be captured in each of the subsequent 4-week periods. The model allows this to be specified for up to 5 following months. These estimates are entered in the 'Catch in Subsequent Months' input area.

NAME RANGE:(CR) CATCH RATES AND CARRYOVER

Month	Estimated Catch Rates(kg/lift)	% Caught After No Fishing	Catch in Subsequent Months 1 - 5					Total Caught
			M1	M2	M3	M4	M5	
Nov	1.40	.4	.7	.2	.1	0	0	100%
Dec	1.44	.4	.7	.2	.1	0	0	100%
Jan	1.53	.5	.7	.2	.1	0	0	100%
Feb	1.50	.6	.7	.2	.1	0	0	100%
Mar	1.43	.5	.7	.2	.1	0	0	100%
Apr	1.18	.4	.7	.2	.1	0	0	100%
May	0.98	.35	.7	.2	.1	0	0	100%
Jun	0.78	.3	.7	.2	.1	0	0	100%
Jul	0.59	.25	.7	.2	.1	0	0	100%
Aug	0.49	.2	.7	.2	.1	0	0	100%
Sep	0.49	.25	.7	.2	.1	0	0	100%
Oct	0.49	.25	.7	.2	.1	0	0	100%

Fishing Season and Days Lost from Weather

The fishing season is determined simply by opening or closing periods during the year. A period not fished is entered as <0>, while fishing a period is entered as <1>. Estimated days lost due to weather are entered as absolute numbers in the appropriate period.

RANGE NAME:(FS) FISHING SEASON					DAYS LOST - WEATHER				
Periods Fished/Not Fished					Days Lost/Period				Total Days Fished
	Wk 1	Wk 2	Wk3	Pd4	Wk1	Wk2	Wk3	Pd4	
Nov	0	0	1	1	1	1			15
Dec	1	1	1	0			1	2	20
Jan	1	1	0	0		1			13
Feb	1	1	0	1			1		21
Mar	1	0	1	1			1		22
Apr	0	1	1	1			1	1	21
May	1	1	1	1	1	1	1	2	26
Jun	1	1	1	1	1	1	2	2	24
Jul	1	1	1	1	2	2	2	2	23
Aug	1	1	0	0	3	3	3	.	8
Sep	0	0	0	0	3	3	3	3	0
Oct	0	0	0	0					
Total Days:	Season - 225				Lost - 32				193

Percentage of Fleet Fishing in any one period and Double Pulling

The proportion of the fleet available to fish in any 1 week period of any month can be set in the model. It is a facility that can be used to test impacts of parts of the fleet fishing in different periods. Entering <1> in a particular period signifies all the fleet available for fishing, while <.5> for example, limits fishing activity for only half of the fleet. Actual fishing activity in any period is then determined by the 'Season' selected. The double pulling factor is entered as a percentage of pots that are likely to be double pulled.

RANGE NAME:(FD) % FLEET FISHING & DOUBLE PULLING					
	% of Fleet Fishing				% Double Pulling
Month	Week 1	Week 2	Week 3	Period 4	
Nov	1	1	1	1	0
Dec	1	1	1	1	0
Jan	1	1	1	1	0
Feb	1	1	1	1	0
Mar	1	1	1	1	0
Apr	1	1	1	1	0
May	1	1	1	1	0
Jun	1	1	1	1	0
Jul	1	1	1	1	0
Aug	1	1	1	1	0
Sep	1	1	1	1	0
Oct	1	1	1	1	0

8. OUTPUT DATA

Output data can cover any of the input areas as well as a wide range of industry results. The main output table includes summarised industry results for gross returns, net return and extra return per licence. Days fished, potlifts, catch and days lost to weather are also reported

Other specific output tables cover fishing margin per kilogram lifted and adjusted catch rates by period. Given the nature of spreadsheet modelling it is possible to produce print outs of many other results including total weekly tonnes, costs and returns. The user will determine the appropriate information to be printed in conjunction with results.

Industry Results

This output table is the major end point of data entry and calculations. It shows the impact of alternative arrangements on a number of key industry indicators. The results are placed adjacent to results from the current system for easy comparison

While making changes to a system in the data input area, results in this table can be monitored to follow the impacts of the changes.

RANGE NAME:(IR) INDUSTRY RESULTS		
OPTION 1 - 'PULSE FISHING' WITH A 10% POT INCREASE. ALL POTS OPERATED AT 2% LESS EFFICIENCY		
Item	Alternative Management Arrangement	Current Management Arrangement
Catch (tonnes)	1067	1066
Potlifts	838,585	770,250
Gross Returns($m)	21.66	19.72
Net Return($m)	3.56	2.35
Extra Return/licence ($)	14,964	
Days Fished	193	195
Days Lost - Weather	32	17
Total Season Days	225	212

Fishing Margin per Kilogram Lifted

This measure highlights the times of the year which promise the highest net return for each kilogram of lobster taken. To reveal winter estimates, periods must be fished in the 'SEASON' data entry area before returns will be calculated. The results can be used in conjunction with the fishing time and catch rates to guide the selection of profit increasing fishing times.

RANGE NAME:(FM) FISHING MARGIN - $/kg LIFTED				
Month	Week 1	Week 2	Week 3	Period 4
Nov	0.00	0.00	12.39	11.70
Dec	11.45	11.84	10.61	0.00
Jan	10.83	10.45	0.00	0.00
Feb	10.42	10.21	0.00	10.39
Mar	10.40	0.00	11.08	11.33
Apr	0.00	11.72	11.89	12.54
May	12.31	13.01	13.70	14.25
Jun	13.97	14.62	14.81	15.85
Jul	13.85	13.85	13.85	14.38
Aug	10.44	10.44	0.00	0.00
Sep	0.00	0.00	0.00	0.00
Oct	0.00	0.00	0.00	0.00

Adjusted Catch Rates

The adjusted catch rates are the resultant weekly catch rate estimates after a series of times are not fished. They provide a checking mechanism against historical catch rates.

RANGE NAME:(ACR) ADJUSTED CATCH RATES kg/period				
Month	Week 1	Week 2	Week 3	Period 4
Nov	0.00	0.00	1.59	1.53
Dec	1.61	1.55	1.49	0.00
Jan	1.69	1.71	0.00	0.00
Feb	1.95	1.94	0.00	1.93
Mar	1.67	0.00	1.73	1.61
Apr	0.00	1.37	1.38	1.31
May	1.06	1.04	1.02	1.01
Jun	0.81	0.80	0.80	0.79
Jul	0.59	0.59	0.59	0.59
Aug	0.49	0.49	0.49	0.49
Sep	0.49	0.49	0.00	0.00
Oct	0.00	0.00	0.00	0.00

9. SAMPLE RESULTS

Pot reductions

If reducing the catch or decreasing effort are objectives of management, then pot reductions can be used as a short term measure to achieve them. Percentage pot reductions have been made in the past in the Northern Zone and the economic impact of a further 5, 10, 15 and 20 per cent pot reduction have been tested with a nil carryover assumed. The results are presented in Table 1.

They are estimates of short term impacts and show that for each 5 per cent reduction in pots, the total catch reduces by around 55 tonnes. Average returns decline by around $8,000 per licence for each 5 per cent reduction.

Table 1
Pot Reductions

Pot reduction	5 %	10%	15%	20%
Average Profit Lost/Licence	-$8,219	-$16,437	-$24,656	-$32,874
Tonnes Caught	1013	960	906	853
Potlifts	731,738	693,225	654,713	616,200

Additional pots with time closure

A recent 10 per cent pot reduction in the Northern Zone is assumed to have reduced operational efficiency across the fleet. Within the current season it could be possible to recapture those efficiencies by reinstating the 10 per cent.

To maintain the current number of pot lifts thereby avoiding an increase in catch and effort, the season would need to be shortened via closures of selected periods. These could be at any time with the impact on catch being a function of catch rate at the time and any carryover of lobster into later periods after the closure.

Based on estimated returns per kilogram, the preferred times for closures are in November and February. The amount of time necessary to close will depend on carryover. The higher the carryover the longer the closures required to offset the pot increase and therefore maintain catch around current levels.

Less time on the water using more pots and catching the lobster when returns are higher per kilogram has the potential to improve returns on average through cost savings and higher prices. Results presented in the Table 2 show estimates of between $950 and $12,700 on average depending on times closed and carry over from increasing pots by 10 per cent and reducing time available for fishing.

Table 2
Increased Pots with time closure

	Carry Over			
	0 %	50%	75%	100%
Times Closed	Nov 1-21	Nov 1-21 Feb 1-14	Nov 1-21 Feb 1-21	Nov 1-30 Feb 1-28
Average Extra Profit/Licence	$959	$4,688	$9,767	$12,648
Tonnes Caught	1061	1054	1069	1060
Potlifts	769,065	708,235	682,165	612,645
Days Fished	177	163	157	141
Days Lost to Weather	14	14	13	13
Total Season Days	191	177	170	154

Winter Fishing

Price information collected from fisheries which market fish in periods not currently fished in the Northern Zone indicate that a minimum $25 and as high as $48 per kilogram can be achieved. Discussions with marketers suggest that $30 per kilogram is a reasonable average to expect in the winter months.

After allowing for high numbers of days lost due to weather in winter, the costs of fishing and assuming relatively low catch rates at that time, profit advantage can be expected from changing fishing from high catch rates times when price has been lowest, to low catch rate times when price is higher.

Economic analyses conducted for a range of winter catch rates and prices indicate that with no extra lobster being caught, on average an extra profit of between $3,000 and $50,000 per licence could be earned by moving some fishing effort into the winter months away from the summer.

The results for one time management program are shown in Table 3. The system involves fishing from mid-January(75% carry over) through to the end of September.

Table 3
Summary Results Fishing Time Management System

	Carry Over			
Extra Profit/Licence	0 %	50%	75%	100%
Winter Price $25/kg	$3,950	$7,316	$9,204	$11,186
Winter Price $30/kg	$18,506	$20,577	$22,465	$24,448
Winter Price $35/kg	$31,767	$33,838	$35,726	$37,709
	Carry Over			
Other Results	0 %	50%	75%	100%
Tonnes Caught	1074	1066	1069	1072
Potlifts	916,400	857,150	833,450	805,800
Days Fished	232	217	211	204
Days Lost to Weather	51	49	48	48
Total Season Days	283	266	259	252

Individual Transferable Quota

It is estimated that under an ITQ system for a range of catch rates and winter prices that with no extra lobster being caught, on average, an extra profit of between $8,000 and $55,000 per licence could be earned before additional enforcement costs.

The major benefits could be achieved through matching catches to market price with no account of possible efficiency gains. The results are a function of estimated carryover and winter price and are shown in Table 4.

Table 4
Summary Results Individual Transferable Quota System

	Carry Over			
Extra Profit/Licence	0 %	50%	75%	100%
Winter Price $25/kg	$8,642	$14,036	$19,889	$25,706
Winter Price $30/kg	$21,903	$27,620	$32,804	$40,179
Winter Price $35/kg	$35,164	$41,402	$45,719	$54,653

	Carry Over			
Other Results	0 %	50%	75%	100%
Tonnes Caught	1070	1072	1064	1063
Potlifts	920,350	821,600	718,900	671,500
Days Fished	233	208	182	170
Days Lost to Weather	52	49	42	43
Total Season Days	285	257	224	213

10. SUMMARY

The development of this model has involved bringing together what is known about fishing practices, catches and economics of a lobster fishery, and establishment of the linkages between important parameters which might effect economic performance. As well, the capacity to test the impacts of the factors about which little is known has been incorporated into the model. A framework has been built in which the impacts of a myriad of alternative ways of managing the fishing of a limited lobster resource can be tested and analysed.

The model will not produce 'optimums' but will allow the user to test many 'what if' situations. Theoretical profit maximising fishing operations with no input controls can be tested, as can changes to input controls which move the fishery towards the same position. Cognisance is taken of the numerous complex practical and technical considerations which must underpin all economic models.

The model is not designed to determine distributional effects of changes but importantly the 'average' fisherman, individual fishermen, economists and/or scientists can all readily specify and test outcomes for the unique set of assumptions that they wish to explore.

The model can be used in other lobster fisheries given sufficient economic, lobster population and catch rate information. The most critical part of the model is the estimates of catch rates. The approach taken at this stage is easily understood by fishermen but will require refinement and upgrading in the future. An alternative approach to determining catch rates based on biomass estimates is currently being developed in conjunction with SARDI. It is envisaged that the alternative method will be added to the model thus providing the user with a choice in approaches.

The second part of this research project involved using the model to test alternative catch management systems. The danger undoubtedly will be individuals selecting numbers from the analyses and assuming they must be 'true'. Whilst the absolute magnitude of outcomes are unlikely to be predicted with precision, the model will be useful in exploring and identifying the direction of shifts in industry economic performance compared to the current system, and testing the sensitivity of the shifts to a range of variables.

The results of the analyses have been used by industry people to assess the impacts of trialing a closure during the 1993/94 season in the Northern Zone fishery. Practically, the trial was a success.

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