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PROFITABILITY OF DEMERSAL TRAP FISHERY

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AN ASSESSMENT OF THE PROFITABILITY OF A DEMERSAL TRAP FISHERY IN THE WATERS ADJACENT TO THE NORTHERN TERRITORY

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SUSTAINABLE FISHERIES

THE DEPARTMENT OF PRIMARY INDUSTRY AND FISHERIES IS COMMITTED TO THE PRINCIPLES AND PRACTICES OF SUSTAINABLE FISHERIES

Definition:

Sustainable fisheries is the use of practices and systems which maintain or enhance:

- the economic viability of fisheries production;
- the natural resource base; and
- other ecosystems which are influenced by fisheries activities.

Principles:

1. Fisheries productivity is sustained or enhanced over the long term.
2. Adverse impacts on the natural resource base of fisheries and associated ecosystems are ameliorated, minimised or avoided.
3. Harmful residues resulting from the use of chemicals for fisheries are minimised.
4. The nett social benefit (in both dollar and non-dollar terms) derived from fisheries is maximised.
5. Fisheries systems are sufficiently flexible to manage risks associated with the vagaries of climate and markets.

SUSTAINABLE FISHERIES IN THE NORTHERN TERRITORY

CONTENTS

1. EXECUTIVE SUMMARY

- A promising fishery may be developed in the 'box area' using traps, droplining or a combination of both. The fishery is principally aimed at supplying fish to the higher priced segments in interstate fresh fish markets.

- A series of trials undertaken by a local company Seanorth Pty Ltd using the Robert R have been encouraging despite a number of adverse factors. Further research and development work has continued since the surveys.

- Two hypothetical boats have been used in this study to examine the profitability of trapping only though the economics of droplining would be very similar. Under the 'base' scenario the displacement hull boat gave an annual return to capital of 37.8 per cent while the planing hull boat gave an annual return to capital of 22.2 per cent. The higher profitability of the displacement hull is largely due to its ability to conduct longer fishing trips and fish for a larger proportion of the year.

- Given the potential for higher catch rates, the profitability of both boats looks attractive. Profitability is quite sensitive to catch rates but even more sensitive to fish prices. A 20 per cent increase in catch rate is required to give the same increase in profitability as a 10 per cent increase in price. This indicates the need to focus on fish quality more than catch rate.

- Other parameters which are important to profitability are time spent in the fishery each year, length of fishing trips, capital cost of the boat used and labour efficiency (which translates into the number traps that can be worked). Fuel prices is not a major factor affecting profitability.

2. INTRODUCTION

This bulletin reports on the use of a computer spreadsheet program to analyse the profitability of a fishery which at the start of the study appeared to have prospects for viable expansion. Initial expectations have subsequently proved correct with average catch rates (for droplining) and prices exceeding those used in this report. While earlier research concentrated on trapping, droplining later showed more promising catch rates. The cost structure and hence profitability of these fishing methods is very similar. Indeed, only cosmetic changes were required to modify the computer program for droplining.

During the course of the study, budgets and sensitivity analyses generated using the program were discussed with and given to several fishermen interested in entering the fishery. For some of these fishermen custom data was entered for their own situation and some used the budgets generated to approach banks for finance.

While this report concentrates on one fishery the program can be used for other trapping/droplining fisheries in the Northern Territory and elsewhere. All that is required is the data to feed into the computer. This service is offered to existing and potential NT fishermen for the trapping/droplining fishery. For new fisheries the computer program can be modified and enquiries of this nature are welcome.

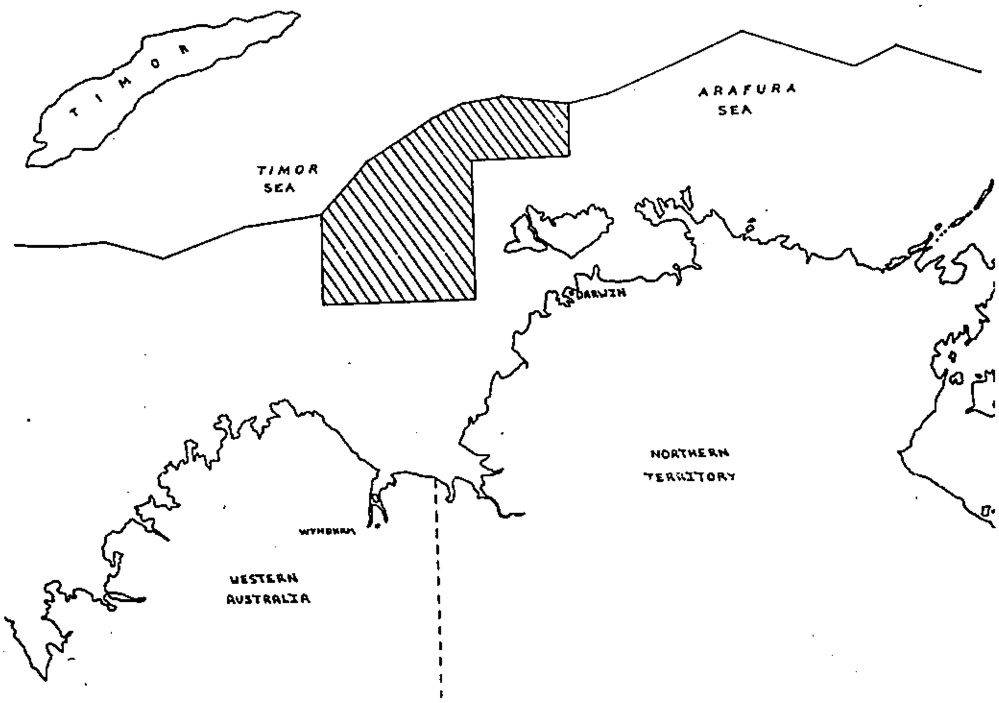
In the following sections the profitability of two hypothetical boats is presented along with an analysis of the effect of important variables on profitability. Sections 3.1 to 3.11 detail the assumptions used in calculating the level of profitability. While parts of the text may seem a bit dry to some the report attempts to provide the reader with all of the information used in the calculation of the results. It should be noted that the audience for this bulletin ranges from fishermen to researchers (both scientists and economists) to administrators. It cannot be all things to all people. The most important part of the report is the results and sensitivity analysis. These show the relative importance of various changes in costs and performance parameters. In essence they can give an insight into the physical and financial management of a boat in a fishery before doing it. For those in the fishery they show which aspects of management to concentrate on.

2.1 Background

Demersal trapping has been investigated as a potential new fishery as part of a program to expand the fishing industry in the Northern Territory. The investigation has been aided considerably by a series of trapping trials conducted by a local joint venture company, Seanorth Pty Ltd. Initial catch rates using traps have been encouraging despite a number of adverse factors. More recent commercial experience using droplines has achieved even better results.

During the trials several areas were trapped. The best catch rates were made in the 'box area' (shaded area in Figure 1) which is northwest of Darwin, near the edge of the 200 mile Exclusive Economic Zone. The box area has been set aside for development of passive fisheries and excludes demersal fin fish trawling. The size of this area is quite large in relation to the catch potential of individual boats though only a small part of the region has been investigated at this stage.

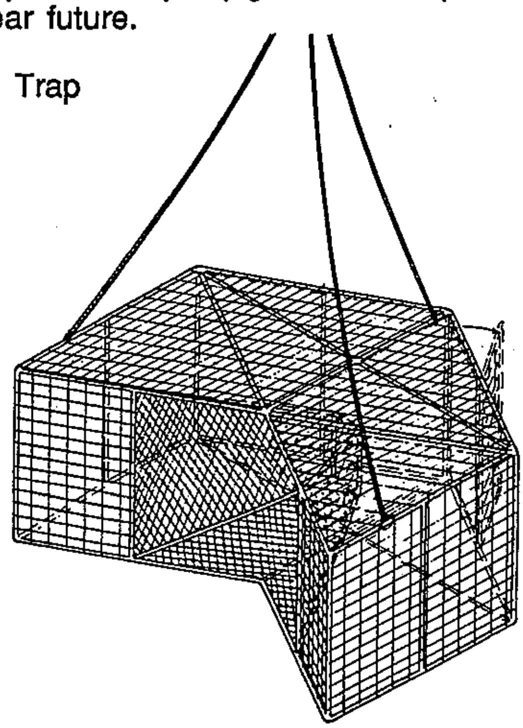
Figure 1. Map of Northern Australian Waters showing Box Area



The main fish species caught in this region are two Pristipomoides species which are commonly known as the gold-band snappers. These fish are of high eating quality and have a relatively long shelf life. They are therefore quite suitable for the interstate fresh fish market.

The traps used during the trials were small bottom traps, an example of which is shown in Figure 2. Several trap designs were used during the trials (for further details Fishnotes on the subject will soon be published). All were two metres or less across their widest dimension and between 75cm and 90cm deep. The suitability of other types of traps (eg habitat traps and floating traps) will be investigated in the near future.

Figure 2. Arrowhead Trap



2.2 **Method of Analysis**

The profitability of trapping was assessed using a computer model on the spreadsheet program SMART. The program has previously been used to assess the profitability of other fisheries but required some modification for the trap fishery. Given a set of physical and financial input parameters the program calculates an annual budget showing income, cash costs and non-cash costs. This enables calculation of four measures of profitability.

(1) Annual cash surplus - which is income less cash costs. This shows the expected change in cash position over a year and the amount available for interest and debt repayments.

(2) Annual profit or loss - which is income less cash costs less depreciation. Profit or loss shows how a business is performing with regard to both the enterprise's cash and capital position.

(3) Surplus over breakeven cost - which is annual profit or loss less the opportunity cost of capital. Surplus over breakeven cost allows for a cost to be allocated for the use of capital. The cost of capital is the return the capital would give in its next best use. For example, it may return 12 per cent in a bank account. After allowances for depreciation and opportunity cost of capital are deducted (ie. surplus over breakeven cost) the amount remaining can be regarded as the return to management.

(4) Annual return to capital - which is annual profit or loss as a percentage of the starting value of capital. The return to capital is normally calculated from a development cashflow budget (ie internal rate of return). In this study it was considered that there would be no advantage in going further than an annual budget because there is a degree of uncertainty about income and costs, and little evidence to suggest patterns from year to year.

It should be noted that, interest is not treated as a cash cost when determining of the annual profit level. When calculating profitability the interest cost refers to the 'cost' of having capital tied up in a capital item, such as a boat. The actual cash interest cost depends on the debt situation of individual owners and will vary from boat to boat. The cash interest cost is very important in calculating long-term cashflows for individual boats but it has no bearing on the level of profitability as defined here.

2.3 The Examples

The profitability of two hypothetical boats are examined in this study. One is a displacement hull (DH) boat of 16-20 metres length and refrigeration capacity of 5 tonnes or more. The other is a planing hull (PH) boat of 12-15 metres length and refrigeration capacity of 2.1 tonnes. The two boat types were compared because they both have potential advantages in the fishery and without experience in the fishery it was difficult at the beginning of the study to determine which boat would be more profitable.

The displacement hull can stay out for longer trips because of its larger refrigeration and fuel capacity, and is less affected by bad weather. The planing hull, on the other hand, can get out to the remote grounds and back much quicker, and return with fresher fish. The speed of the PH boat is particularly useful where fresh fish prices on interstate markets are temporarily high, for example during a period of bad weather in southern fisheries. The type of boat used however will depend on many factors. Some fishermen will already own a boat of a particular type. It may be more economical and/or time saving to use the boat you've got rather than sell it and find one more suitable. The fishermen may prefer the boat he owns to the one he doesn't. For those looking at buying a boat for the fishery, particular types of boat may be better value for money. An example is the smaller planing hull boats being sold from the West Australian crayfish industry. The various assumptions used for each boat type are detailed in the following chapter.

3. INPUT PARAMETERS AND COSTS

This chapter details the physical and financial assumptions used in this report. Prices are based on those levels prevailing in mid 1989. It is necessary to specify these assumptions as they all have an effect on profitability. Some readers may prefer to skip this chapter and go on to the results and sensitivity analysis. Those readers interested in going into the fishery will need to judge the results against difference in their own situation versus the assumptions used here.

In this and following chapters the displacement hull boat will be referred to as the DH boat and the planing hull boat will be referred to as the PH boat for the sake of brevity.

3.1 Fishing Strategy

Both vessels are assumed to undertake fishing trips of a fixed number of days. The DH boat undertakes trips of 10 days (port to port). This trip length is limited by the need to land the fish at the interstate wholesale market within 14 days of capture. It should be noted that this trip length is at the upper limit for the interstate fresh fish market and would require a high standard of quality control. The PH boat is assumed to undertake fishing trips of 6 days (port to port). The shorter trip length for the PH boat was chosen because this type of boat is more likely to have trip length limited by refrigeration or fuel capacity.

The longer trip length favours the profitability of the DH boat though there are other complicating factors which affect this relationship. The shorter trip length of the PH boat may enable a higher price to be achieved because its catch would be fresher.

The DH boat spends 4 days in port between trips while the PH boat spends 3 days in port between trips. Time in port between trips represents a greater proportion of time in the fishery for the PH boat and therefore has an adverse effect on profitability.

The DH boat spends 1.5 days of each trip steaming to and from port whereas the PH boat spends only 0.75 days. This is an advantage of the PH boat as it spends a greater proportion of each trip actually fishing. This, however, assumes that the PH boat travels to and from grounds at planing speeds. In practice a skipper may steam at displacement hull speeds.

Both boats operate on a basis of spending a certain number of days in the fishery each year rather than a fixed number of trips per year. The DH boat is assumed to spend 270 days in the fishery (including time normally spent in port between trips) while the PH boat spends 240 days in the fishery due to a lesser ability to handle bad weather. Factors affecting the number of days not spent in the fishery per year include time lost due to breakdowns, bad weather, maintenance requirements and holidays. It should be noted that the 240 or 270 days does not refer to an unbroken period from the time a fisherman starts fishing during a year till the time he finishes. It refers to the period spent fishing plus the time normally spent steaming to and from port, and the time normally spent in port after each trip. Periods during the fishing season when say bad weather or breakdowns prevent a boat from leaving port are not counted as time spent in the fishery. Given the base assumptions, the time actually spent fishing (ie traps or lines in the water) is only 56-58% of the "time spent in the fishery".

Breakdowns and bad weather often curtail fishing trips thus reducing the proportion of time in the fishery spent fishing. It is assumed that for both hull types, an average of 10 per cent of fishing time is lostbetween trips due to these causes. The loss is equivalent to having fishing time reduced by half for one trip in every five. This allowance does not include time lost due to breakdowns, bad weather, etc, merely the effect of shortened fishing trips. Time lost due to the former causes is accounted for by the parameter 'number of days spent in the fishery'.

Details of the assumptions relating to fishing strategy are presented in Table 1.

Table 1. Fishing strategy

	Displacement Hull	Planning Hull
Length of trips (from port to port)	10.0 days	6.0 days
Steaming time to and from port (both ways)	1.50 days	0.75 days
No. of days spent in port before and after each trip (average)	4.0 days	3.0 days
Number of days spent in the fishery per year (allowing for breakdowns, bad weather, repairs and maintenance, etc).	270 days	240 days
Percentage by which length of fishing trips is reduced by breakdowns, bad weather, and other factors which cause the boat to return to port with less than a full load or earlier than anticipated.	10%	10%

3.2 Capital Costs

Capital items are divided into four categories:

- boat
- gear (traps, lines, floats etc)
- vehicles
- other (ice making machine)

The major capital item is the boat. The same starting value, salvage value and expected life are used for both hull types. The starting value used is $200 000. There is a large potential for variation in this figure depending on the size of the boat, its age, how well equipped it is, the supply and demand for particular boat types, etc. The life of the boat from purchase to sale is estimated at 8 years. This is a suitable time horizon given the uncertainty which prevails in the fishing industry. The salvage value after 8 years is estimated at 75 per cent of the starting value or $150 000 nominal value. Given an inflation rate of 7 per cent, this is equivalent to the same boats, having a real depreciated value of $112 000 after 8 years.

Gear is valued at $5 000 and includes ten traps complete with lines, floats, etc, at $500 each. Traps are estimated to have a life of two years if not lost earlier. The salvage value shown in Table 2 is an estimation of the value of replacing lost for lost traps at the end of a two year period. The cost of replacing lost traps is included in the repairs and maintenance cost for gear.

A service vehicle is included as part of each enterprise. It would be used to transport ice to the boat, the catch to the airport or coldstore and general running around for supplies. This vehicle is assumed to have a starting value of $20 000 and a salvage value of $8 000 after 8 years.

An ice making machine is included as part of the capital as ice is relatively expensive to purchase. A new ice machine is worth $17 500 and is assumed to have a salvage value of $5 000 after 8 years. Making ice rather than purchasing it was used as this is the cheapest alternative, particularly if the machine is shared between two or more boats, and family or under utilised labour is used to pack the ice. The cost of purchased ice is around 28 cents/kg compared to an estimated cost of 12-14 cents/kg for making your own (includes ownership costs).

Details of the assumptions relating to capital costs and depreciation are presented in Table 2.

Table 2. Capital cost assumptions for both displacement and planing hull boats

	Starting Value ($)	Life (Years)	Salvage Value ($)
Boat	200 000	8	150 000
Gear	5 000	2	2 500
Vehicles	20 000	8	8 000
Ice Machine	17 500	8	5 000

Opportunity cost of capital = 15%

The opportunity cost of 15% is a measure of the return the owner would expect to receive if the capital was placed in an alternative investment. Hence, it is the minimum return the owner would expect to receive from an investment in fishing. If the boat and other capital items are financed by borrowing, then the appropriate opportunity cost would be the interest rate charged on those borrowings. The opportunity cost used here is low compared to current interest rates but in the longer term, interest rates are expected to fall. The opportunity cost is calculated on the starting value of capital.

3.3 Repairs and Maintenance Costs

Repairs and Maintenance (R&M) costs are specified as a percentage of starting capital value per trip, per year, per major refit, or some combination of these. The percentages used for both hull types are the same and are specified in Table 3. The number of years between major refits is required to calculate the annualised cost for this item which is treated as a cash cost in the profit and loss budget. There is a dearth of data for the R&M costs of a boat in this type of fishery. The estimates used here are expected to be generous except in the case of a very old boat.

Table 3. Repairs and maintenance cost assumptions for both displacement and planing hull boats

	Starting Value ($)	% R&M per trip	% R&M per year	% R&M per major refit
Boat	200 000	0.0	6.0	12.0
Gear	5 000	3.0	0.0	***
Vehicles	20 000	***	5.0	***
Ice Machine	17 500	***	5.0	***

No. of years between major refits = 2 years

3.4 **Fuel and Lubricant Costs**

Fuel costs are determined by specifying the rate of fuel consumption for main and auxiliary engines for three situations (catching, steaming, and lying in port). The number of hours the engines will run in each function is calculated from information specified in the section on fishing strategy. The fuel consumption rates are higher for the main engine of the PH boat because of the greater power required to keep the boat on the plane. On the DH boat the fuel consumption rates for the auxiliary engine are higher due to the larger refrigeration capacity. The steaming time for the PH boat is estimated to be half that of the DH boat though in practice some skippers of PH boats may steam at displacement hull speeds.

Large organisations or fishermen associated with them could purchase fuel at a substantial discount to the price used here. Lubricant cost is calculated as five per cent of fuel cost. The fuel cost and usage assumptions used in the study are presented in Table 4.

Table 4. Fuel cost and usage

Engine and function	Consumpt'n (L/hr)	Hours run (per day)	Consumpt'n (L/hr)	Hours run (per day)
Boat - catching	13	12	18	12
- steaming	37	***	100	***
Auxilliary				
- on grounds	10	24	7	24
- steaming	10	24	7	24
- in port	10	12	7	12
Hours steaming to and from port (hours each way)	18 hours		9 hours	
Fuel Cost (cents/litre)	30 cents		30 cents	
Fuel Capacity	10 000 litres		4 500 litres	

3.5 **Labour Costs**

Labour costs in the fishing industry are now largely based on shares of the catch. Two methods of determining the payment to each crew member may be used. One method is that a percentage of the catch value is allocated for distribution amongst the crew and the percentage of that payment going to particular crew members depends on their function on the boat. An alternative method is to base payments to the crew on a set value per kilogram of fish landed. In this study, the former method is used.

It is assumed that there is a crew of three people on the PH boat and four on the DH boat. Each crew consists of one person who is the skipper come engineer and the rest as deckhands. The crew's share of the catch is the same for both boats at 25 per cent of the value of the catch. The crew on the PH boat will have to work harder or the boat set up be more efficient but each crew member should be paid more. One less crew is used on the PH boat due to more limited accommodation availability compared to the DH boat. The cost of food is assumed to be taken out of the crew's share so there is no cost to the boat. Other arrangements to deduct costs from the crews share may be necessary for tax reasons but would have to be offset by an increased share of the catch being paid to the crew.

3.6 Marketing Costs

The target markets for this fishery are the interstate wholesale markets. The fish are airfreighted to these markets at an estimated cost of 90¢/kg of fish (after allowing for the weight of packaging and ice). The airfreight cost will vary between markets and possibly the time of year. Airlines now have stringent guidelines on packaging of seafood. The cost of such packaging is around 23¢/kg. In addition, the cost of absorbent gel pouches which double as ice packs, is around 25¢/kg of fish. Commission is assumed to be 10 per cent of the wholesale price but in practice can be expected to vary depending on a number of factors such as volume, price of the fish etc.

Details of the assumptions relating to marketing costs are presented in Table 5.

Table 5. Marketing costs

Packaging	23 cents/kg of fish
Ice/Ice Packs	25 cents/kg of fish
Freight	90 cents/kg of fish
Commission	10% of market price

3.7 Other Costs

Other cost items include:

. ice (for use at sea)
. bait
. berthing and wharfage charges
. licence, registration and survey charges
. insurance
. sundry costs (eg legal accounting, communications etc)

No cold storage is allowed for in this study as it is assumed that produce is transfered directly from the boat to the airport. In certain circumstances it may be necessary or more efficient to put the fish into cold storage for a short period of time. Ice is used at the rate of 1.5kg of ice per kilogram of fish (gilled and gutted weight) for the DH boat. Only 1kg of ice per kilogram of fish is used for the PH boat due to the shorter trip length. The cost of ice (8¢/kg) includes the running cost of the ice making machine, packaging cost and the cost of labour to bag the ice. The cost of purchasing ice would be higher at 28¢/kg but would be offset by the reduction in depreciation and opportunity cost of owning the ice making machine. Bait is used at the rate of 2kg at the first lift of the day and 1kg for subsequent lifts giving a rate of 5kg/trap/day. The bait price of $1.30/kg is based on the landed cost of WA pilchards. It may be possible to land bait at a lower price by dealing directly with the boats catching the pilchards. In the longer term local sources of bait may become available at a lower price. Insurance is calculated at 4 per cent of starting value of the boat.

Details of the assumptions relating to other costs are presented in Table 6.

Table 6. Other costs

Ice for storage at sea (kg of ice per kilogram of fish)	
- Displacement Hull	1.0 kg
- Planing Hull	1.5 kg
Cost of making and bagging ice	8 cents/kg
Cold Storage	Nil
Bait - kg/trap/day	5kg
- price/cost	$1.30/kg
Berthing & Wharfage Charges	$2 900/year
Licence/Registration/Survey Charges	$ 400/year
Insurance	$8 000/year
Sundry Costs	$7 500/year

3.8 Refrigeration Capacity

The refrigeration method for both hull types is to store fish packed in ice in chillers. Fish may also be put into refrigerated brine during processing. Refrigeration capacity is assumed to be 2.1 tonnes for the PH boat. This is just enough for the base trip length and catch rate used. In practice there may be the opportunity to increase refrigeration capacity on a PH boat or purchase a boat with larger capacity from the outset. The effect of different catch rates and trip lengths on refrigeration capacity required, and the effect of limited refrigeration capacity are examined in the section dealing with sensitivity analysis. The refrigeration capacity of the DH boat is assumed to be large enough to hold the catch of a 10 day voyage, even at high catch rates.

3.9 Catch Rate

The average catch rate used for both boats is 11.8kg (whole landed weight) per trap per set. This is equivalent to around 5-7 fish per trap per set depending on size of the fish. The catch rate is based on achieving an average of 400kg (gilled and gutted weight) per day. This level has been exceeded on some days of the survey but is 16% above the average achieved, based on hourly catch rates during the survey. It is considered that once the grounds are known, and using good equipment and an efficiently set up boat, the average catch rate used here could be achieved and probably exceeded. Recent experience in the fishery has indicated that much higher average daily catch rates are possible using droplines.

3.10 Composition of Catch and Processing Strategy

The catch composition has the potential to vary considerably depending on the fishing grounds. Promising grounds yielded predominantly gold-banded snapper during the survey. Other major species were red emperor and rock cod. The composition used in this analysis approximates that achieved in the surveys. All fish are assumed to be gilled and gutted before chilling on ice. The weight loss from gilling and gutting is taken as 15 per cent. Details of the catch composition and processing strategy are presented in Table 7.

Table 7. Composition of catch and processing strategy

Species	% landed weight	% chilled on ice	% wt. loss in processing
gold-band snapper	60	100	15
red emperor	12	100	15
rock cod	22	100	15
mixed fish	6	100	15

3.11 Fish Prices

Fish prices used in this study are based on average prices which have been achieved, for good quality fresh fish in the Brisbane market and occasionally in Sydney. Breaking into other markets may initially involve lower prices until the fish species and the quality of trap caught fish become well known. Even so, prices can be expected to vary from week to week depending on the supply and demand situation in each market.

The current price of gold-band snapper is in the upper end of the market. If trapping or droplining develops into large fisheries then these prices may ease back. The average price for the catch is $6.56/kg. The lower value fish should probably be sold locally as the costs of marketing interstate amount to 31 per cent of the market price. The prices used in this study are presented in Table 8.

Table 8. Fish prices

Species ($/kg)	Prices
gold-band snapper	7.00
red emperor	8.00
rock cod	5.00
mixed fish	5.00

Average Price = $6.56/kg

4. RESULTS

4.1.1 Displacement Hull Boat

Given the assumptions detailed in Chapter 3, the DH boat would fish 21 trips each year spending an average of 7.7 days per trip fishing. Of the 270 days spent in the fishery each year, 159 days would be spent actually fishing. The boat would land 64 tonnes (gilled and gutted weight) of fish per year worth around $418 000. Cash costs, including an allowance for major refits, would be worth around $328 000. This would give an annual cash surplus (before capital and interest payments) of $90 043. Non-cash costs, including a 15 per cent opportunity cost on capital, would account for a further $41 000.

The major cash cost items are labour (31.9% of cash costs), marketing costs (39.6%), fuel (9.9%) and repairs and maintenance (7.0%). Bait and ice are lesser, but still significant, costs.

The annual return to capital* is quite high at 32.78%. The long term rate of return would be slightly lower, however, due to the learning phase required for new skippers in the fishery to find the most productive grounds. Nevertheless, this return is quite attractive.

4.1.2 Planing Hull Boat

Given the assumptions detailed in Chapter 3, the PH boat would fish for 29 trips each year spending an average of 4.7 days per trip fishing. Of the 240 days spent in the fishery each year, 135 days would be spent actually fishing. The boat would land 54 tonnes (gilled and gutted weight) of fish per year worth around $355 000. Cash costs, including an allowance for major refits, would be worth around $291 000. This would give an annual cash surplus (before capital and interest payments) of $64 458. Non-cash costs, including a 15 per cent opportunity cost on capital, would account for a further $41 000.

The major cash cost items are again labour (30.5% of cash costs), marketing costs (37.9%), fuel (11.7%) and repairs and maintenance (8.3%). Bait and ice are again lesser, but still significant, costs.

The annual return to capital* is a respectable 22.22%. As with the DH boat the long term rate of return would be slightly lower due to the learning phase of a new skipper entering the fishery.

Table 10 presents a detailed summary of annual income, cash costs, non-cash costs and other performance data for the example displacement hull (DH) and planing hull (PH) boats.

* Annual return to capital is based on the starting value of capital.

Table 10. Annual costs and returns

ANNUAL INCOME:	418164			355303		
CASH COSTS:	**$**	**% of cash costs**	**% of total costs**	**$**	**% of cash costs**	**% of total costs**
Fuel & Lubricants						
- fuel - fishing	7436	2.3	2.0	8505	2.9	2.6
- steaming to and from grounds	8299	2.5	2.2	15429	5.3	4.6
- auxilliary	16674	5.1	4.5	10044	3.5	3.0
- lubricants	1620	0.5	0.4	1699	0.6	0.5
	34029	10.4	9.2	35676	12.3	10.7
Labour						
- wages - master	0	0.0	0.0	0	0.0	0.0
- crew	0	0.0	0.0	0	0.0	
- shares of catch	104541	31.9	28.3	88826	30.5	26.8
- labour on-costs	0	0.0	0.0	0	0.0	0.0
- food	0	0.0	0.0	0	0.0	0.0
	104541	31.9	28.3	88826	30.5	26.8
Repairs & Maintenance						
- boat (incl. allowance for major refit)	18000	5.5	4.9	18000	6.2	5.4
- gear	3115	0.9	0.8	4286	1.5	1.3
- vehicle	1000	0.3	0.3	1000	0.3	0.3
- other	875	0.3	0.2	875	0.3	0.3
	22990	7.0	6.2	24161	8.3	7.3
Marketing						
- packaging	14661	4.5	4.0	12457	4.3	3.8
- ice/ice packs	15936	4.9	4.3	13541	4.7	4.1
- freight	57370	17.5	15.5	48746	16.8	14.7
- commission	41816	12.7	11.3	35530	12.2	10.7
	129784	39.6	35.1	110274	37.9	33.2
Other Cash Costs						
- ice (on board)	7649	2.3	2.1	4333	1.5	1.3
- bait	10328	3.1	2.8	8775	3.0	2.6
- berthing & wharfage	2900	0.9	0.8	2900	1.0	0.9
- licence/rego/survey	400	0.1	0.1	400	0.1	0.1
- insurance	8000	2.4	2.2	8000	2.8	2.4
- sundry	7500	2.3	2.0	7500	2.6	2.3
	36777	11.2	10.0	31908	11.0	9.6
Total Cash Costs	328121	60.4	88.9	290845	62.1	87.6

Table 10 (continued)

	DISPLACEMENT HULL			PLANNING HULL		
NON-CASH COSTS:	**$**	**% of non cash costs**	**% of total costs**	**$**	**% of total cash costs**	**% of total costs**
Interest on Capital (at 15%)						
(on average value - boat	26250	63.8	7.1	26250	63.8	7.9
over expected life) - gear	563	1.4	0.2	563	1.4	0.2
- vehicle	2100	5.1	0.6	2100	5.1	0.6
- other	1688	4.1	0.5	1688	4.1	0.5
	30600	74.3	8.3	30600	74.3	9.2
Depreciation						
- boat	6250	15.2	1.7	6250	15.2	1.9
- gear	1250	3.0	0.3	1250	3.0	0.4
- vehicle	1500	3.6	0.4	1500	3.6	0.5
- other	1563	3.8	0.4	1563	3.8	0.5
	10563	25.7	2.9	10563	25.7	3.2
Total Non-Cash Costs	41163	100.0	11.1	41163	100.0	12.4
TOTAL CASH & NON-CASH COSTS =	369284		100.0	332007		100.0
ANNUAL CASH SURPLUS = (income - cash costs)	90043			64458		
ANNUAL PROFIT/LOSS = (income - cash costs - depreciation)	79480			53896		
SURPLUS OVER BREAKEVEN COST = (income - cash costs - non-cash costs)	48880			23296		
ANNUAL RETURN TO CAPITAL = (annual profit/loss divided by) (starting value of capital x 100)	32.78%			22.22%		

	Displacement hull	Planning hull
Kilograms of whole fish caught per trap per set	11.8 kg/trap/set	11.8 kg/trap/set
No of traps	10 traps	10 traps
No. of sets per day	4 sets/day	4 sets/day
No. of trips per year =	21 trips	29 trips
No. of traps	10 traps	10 traps
No. of sets per day	4 sets/day	4 sets/day
No. of trips per year =	21 trips	29 trips
Maximum no. of days spent fishing per trip = Average	8.5 days	5.3 days

5. SENSITIVITY ANALYSIS

This chapter examines the sensitivity of profitability to changes in input parameters. The two measures of profitability reported in the analysis are profit/loss and annual return on capital. These terms are defined in section 2.2. The word 'profitability' used in the sensitivity analysis is used in general terms and discussion refers to both hull types unless otherwise stated.

It should be noted that the sensitivity analysis refers to changes in only one variable at a time. Fishing involves more variables and uncertainty than most industries so in practice several variables can be expected to move at one time. Small adverse changes in a couple of variables at the same time can have a similar effect on profitability as a large adverse change in one variable.

5.1 Fish Prices

Profitability is highly sensitive to fish prices. A fall of 20 per cent in average price (on its own) will make profitability unattractive. Fish prices are an important factor because a large percentage of any increase will go to the owner. The only costs which increase as fish prices increase are commission and the crew's share.

An additional factor is that fish quality and hence prices are under the control of the skipper and crew whereas other parameters have a large element of being beyond control.

One factor related to the importance of high prices to profit is that the marketing method used is also high cost. At an average price of $6.56/kg, the cost of marketing is around $2.04/kg or just over 30 per cent of income. Entrants to the fishery should consider marketing low value species locally or sending them frozen by road to interstate markets in order to reduce marketing costs and thereby increase the net price.

Although the profitability of the PH hull boat is lower than that of the DH boat, the shorter trips undertaken by the PH boat should result in higher average quality and price. An 8.0% increase in the average price for the PH boat (to average $7.09/kg) would increase profitability to the same level expected for the DH boat.

Table 11. Sensitivity of profitability to fish price

Displacement Hull					
Percentage Change in Fish Price	-20%	-10%	0	+10%	+20%
Average Fish Price ($kg)	5.20	5.85	6.56	7.15	7.80
Profit/Loss	4211	41846	79480	117115	154750
Annual Return to Capital (%)	1.74	17.3	32.8	48.3	63.8
Planing Hull					
Percentage Change in Fish Price	-20%	-10%	0	+10%	+20%
Average Fish Price ($kg)	5.20	5.85	6.56	7.25	7.80
Profit/Loss ($)	(10059)	21918	53896	85873	117850
Annual Return to Capital (%)	(4.5)	9.0	22.2	35.4	48.6

NB: Numbers in brackets are negative

5.2 Catch Rate

Profitability is also quite sensitive to catch rate though less sensitive compared to fish prices. The reason is that compared to changes in fish prices, the same percentage increase in catch rate would also involve increased costs of freight, packaging, ice packs and ice (for onboard storage). A 20 per cent increase in catch rate is roughly equivalent to only a 10 per cent increase in fish prices. This indicates that skippers should allocate higher priority to maintaining better product quality rather than increasing catch rate. Traditionally fishermen have leaned towards catching more fish rather than improving quality. A compensating factor for the lower sensitivity of profitability to catch rates is that relative to fish prices a larger percentage fall in catch rate is possible before profitability becomes unattractive.

The figures quoted above assume that refrigeration capacity is not a limiting factor. If it is limiting, as might be the case with a PH boat then profitability will be even less sensitive to increases in catch rate because trip length will be shortened as a result.

One factor not taken into account in this analysis is that higher catch rates may be achieved partially by working more traps and this would increase the cost of bait.

Table 12. Sensitivity of profitability to catch rate

Displacement Hull					
Catch Rate					
- (kg whole wt/ trap/set)	8.8	10.3	11.8	13.2	14.7
- (kg gilled & gutted wt/day)	300	350	400	450	500
Profit/Loss ($)	34686	57083	79480	100384	122781
Annual Return to Capital (%)	14.3	23.5	32.8	41.4	50.6
Planing Hull					
Catch Rate					
- (kg whole wt/trap/ set)	8.8	10.3	11.8	13.2	14.7
- (kg gilled & gutted wt/day)	300	350	400	450	500
Refrigeration Capacity Not Limited					
Profit/Loss ($)	15285	34590	53896	71914	91220
Annual Return to Capital (%)	6.3	14.3	22.2	29.7	37.6
Refrigeration Capacity Required (t)	1.575	1.84	2.1	2.36	2.63
Refrigeration Capacity Limited at 2.1 Tonnes					
Profit/Loss ($)	15285	34590	53896	62857	71989
Annual Return to Capital (%)	6.3	14.3	22.2	25.9	29.7
Days Spent Fishing Per Trip	5.25	5.25	5.25	4.67	4.2

5.3 Days Fishing per Year

Profitability is reasonably sensitive to the number of days spent in the fishery but this factor would be more important if profitability were lower. Annual return to capital increases by 5.3 - 5.9 per cent for increases of 30 days in the period of time spent in the fishery. This indicates that the lower number of days spent in the fishery by the PH boat accounts for just over half the difference in profitability between the two hull types.

Table 13. Sensitivity of profitability to days per year spent in the fishery

Displacement Hull					
Days in Fishery/ Year	210	240	270	300	330
Profit/Loss	50876	65178	79480	93782	108084
Annual Return to Capital (%)	21.0	26.9	32.8	38.7	44.6
Planing Hull					
Days in Fishery/ Year	180	210	240	270	300
Profit/Loss ($)	28112	41004	53896	66787	79679
Annual Return to Capital (%)	11.6	16.9	22.2	27.5	32.9

5.4 Reduction in Fishing Time

Profitability is only marginally sensitive to reduction in fishing time caused by breakdowns, bad weather, etc. However, if the effect of a particular factor (eg breakdowns) is considered to impact on the days spent in the fishery as well, then the effect of an unreliable boat on profitability becomes quite important. A 5 per cent decrease in average fishing time per trip decreases the annual return to capital by 1.2 - 1.4 per cent.

Table 14. Sensitivity of profitability to reduction in fishing time per trip

Displacement Hull			
Percentage reduction in Fishing Time	5%	10%	15%
Profit/Loss ($)	82526	79480	76191
Annual Return to Capital (%)	34.0	32.8	31.4
Planning Hull			
Percentage Reduction in Fishing Time	5%	10%	15%
Profit/Loss ($)	57153	53896	50397
Annual Return to Capital (%)	23.6	22.2	20.8

5.5 Length of Trips

Profitability is reasonably sensitive to the length of fishing trips. The effect of a one day reduction in length of fishing trips for the DH boat reduces annual return to capital by 3.7 - 5.0 per cent. The effect of a one day change in length of fishing trips for the PH boat gives a 3.4 to 7.7 per cent change in annual return to capital. The effect of changes in length of fishing trips on profitability increases as trip length decreases. This result is because as length of fishing trips decreases a one day reduction becomes a greater proportion of the remaining fishing time per trip.

For example:

Length of Fishing Trip (days from port to port)	5	6	7	8	9	10
Days Steaming per Trip	2	2	2	2	2	2
Days Actually Fishing per Trip	3	4	5	6	7	8
Percentage Reduction in Fishing Time if Trip Length Reduced by One Day	33	25	20	16.7	14.3	12.5

The annual rate of return of the two hull types are not directly comparable for the same length of fishing trip because the PH hull boat is assumed to spend one day less in port between trips and spends 30 days per year less in the fishery.

Air freight availability and the days interstate fish markets are open, will in practice have an effect on length of fishing trips. A flexible approach allowing for inevitable delays between trips and variation in catch rate may be necessary though buyers of high quality fish may be best served by a predictable regular service. Weekly trips would be an obvious way to provide a predictable regular service but would require much higher catch rates to be profitable.

It should be noted that the trip length used for the DH boat is at the limit for the interstate fresh fish market. This length would require strict quality control in fish handling, processing and storage, particularly in the first few days of fishing.

Table 15. Sensitivity of profitability to length of fishing trip

Displacement Hull						
Trip Length (days		7	8	9	10	
Profit/Loss ($)		48166	60281	70595	79480	
Annual Return to Capital (%)		19.9	24.9	29.1	32.8	
Planing Hull						
Trip Length (day)	4	5	6	7	8	9
Profit/Loss ($)	20437	39174	53896	65768	75545	83737
Annual Return to Capital (%)	8.41	16.1	22.2	27.1	31.1	34.5
Refrigeration Capacity Required (tonnes)	1.3	1.7	2.1	2.5	2.9	3.3

5.6 Increased Capital Cost

The major capital cost in most 'open' capital intensive fisheries is the boat. In this study we have used secondhand boat values but there is a large variation in the value of secondhand boats which might be used for this fishery. Given the same level of productivity parameters and costs (except depreciation) a 50 per cent increase in the capital value of boat will decrease the annual return to capital by around one third while there will be little change in annual profit. In practice there will be trade-offs against a higher priced boat such as lower cost of repairs and maintenance, and a reduction in time lost due to breakdowns. An increase in the starting value of the boats from $200 000 to $250 000 would decrease the annual return to capital by 4.3 - 6.2 per cent. A starting value of over $400 000 for a boat would obviously require higher catch rates and/or fish prices for profitable operation.

Table 16. Sensitivity of profitability to capital cost of the boat

Displacement Hull			
Starting Value ($)	200 000	250 000	300 000
Salvage Value ($)	150 000	187 500	225 000
Profit/Loss ($)	79 480	77 918	76 355
Annual Return to Capital (%)	32.8	26.6	22.3
Planing Hull			
Starting Value ($)	200 000	250 000	300 000
Salvage Value ($)	150 000	187 500	225 000
Profit/Loss ($)	53 896	52 333	50 771
Annual Return to Capital (%)	22.2	17.9	14.8

5.7 **Steaming Time**

The grounds proven during the Robert R's surveys are remote from Darwin. This means that a large proportion of each trip is spent steaming, particularly for the shorter trip lengths. Also, the cost of fuel is higher than would be the case if the grounds were closer. To test the effect of closer grounds on profitability, assumptions consistent with grounds being half the current distance from Darwin were fed into the program. This increased annual return to capital by 7.3 - 7.6 per cent. As the fishery develops no doubt closer grounds will be found but more distant grounds to the west may also need to be fished.

Table 17. Sensitivity of profitability to steaming time

	Base Assumptions	Closer Grounds
Displacement Hull		
Profit/Loss ($)	79 480	97 901
Annual Return to Capital (%)	32.8	40.4
Planing Hull	Base Assumptions	Closer Grounds
Profit/Loss ($)	53 896	71 635
Annual Return to Capital (%)	22.2	29.5

5.8 **Fuel Price**

Fuel price has a relatively small effect on profitability compared to most other factors considered in the sensitivity analysis. An increase of 5 cents per litre reduces annual return to capital by 2.3 - 2.5 per cent. The effect is small because fuel and lubricant costs represent only 9.9 - 11.7 per cent of cash costs.

Table 18. Sensitivity of profitability to fuel price

Displacement Hull				
Fuel Price (cents/litre) (net of rebates)	25	30	35	40
Annual Profit/Loss ($)	85152	79480	73809	68137
Annual Return to Capital (%)	35.1	32.8	30.4	28.1
Planing Hull				
Fuel Price (cents/litre) (net of rebates)	25	30	35	40
Annual Profit/Loss ($)	59842	53896	47950	42003
Annual Return to Capital (%)	24.7	22.2	19.8	17.3

5.9 **Extra Crew**

The DH boat is likely to be larger than the PH boat and therefore have more crew accommodation. In the base assumptions, the crew of the DH boat is 4 compared to 3 on the PH boat. If there were 5 crew on the DH boat it is estimated that an extra three traps could be worked. If the catch is increased proportionally to the number of traps and the crew's share is increased from 25 per cent to 30 per cent then the annual return to capital would be increased by 9.3 per cent to 42.1%. This is a relatively large increase and points to the importance of the boat setup being labour efficient. The more efficiently a boat is set up the more traps that can be worked (given adequate boat size) and fish that can be processed within an acceptable time.

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