Seafood Industry Council

Assessing the costs of a marine reserve: A case study of the paua fishery at Nugget Point

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EXECUTIVE SUMMARY

This report presents an assessment of costs that would be incurred if a marine reserve were established at Nugget Point on the Southland coast. A reserve was first proposed at this location in 1992, although no proposal is currently active. This assessment has been performed for illustrative purposes only.

Our assessment is limited to costs arising from associated impacts on the commercial paua fishery. It is not intended to estimate the full cost of the proposed reserve, but to demonstrate a methodology for assessing such impacts and to provide a reliable illustration of the magnitude of the associated costs through focusing on a single commercial fishery.

Impacts of the proposed marine reserve fall in two main categories, a) a long-term reduction in the available resource due to reduced fishing grounds, and b) additional effects, such as job losses and increased fishing costs for the remaining fishers. Our analysis indicates that the most significant cost is associated with the reduction in available resource. We anticipate that the reduction in resource will be accompanied by a corresponding reduction in fisher numbers, allowing remaining fishers to maintain consistent catch rates. Consequently the additional impacts are largely encapsulated by the loss of direct employment opportunity in the nearby communities.

Historically the paua beds at Nugget Point contribute approximately 8% of the annual commercial catch in the PAU5D quota management area (QMA). Accordingly, the minimum expected long-term reduction of the resource is 8% of the total commercial catch from the QMA. Based on current export value, and an appropriate economic multiplier reflecting associated indirect impacts on the economy, the net present value of the lost resource is $8.6 million.

The upper bound on commercial catch from the QMA is the Total Allowable Commercial Catch (TACC) set on an annual basis by the Minister of Fisheries. The minimum expected long-term reduction described above assumes a near perfect correlation between the creation of the marine reserve and a corresponding adjustment of the TACC (or a corresponding voluntary reduction in take by the industry). This is the least cost scenario and is unlikely to be achieved. Marine reserves are not created under the same management framework under which the fisheries are administered, the TACC setting process is influenced by many factors and does not necessarily occur annually for each stock. We have considered alternative scenarios where the TACC and industry behaviour do not immediately reflect the impact of the reserve. The affects considered include additional pressure on the remainder of the fishery and further long-term reductions in the resource. The net present value of the lost resource ranges between $8.6M and $16.7M across all scenarios considered.

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1. BACKGROUND

1.1 STRUCTURE OF THE FISHERY

The paua fishery is managed under the Quota Management System (QMS). Nugget Point is in the PAU5D Quota Management Area (QMA). PAU5D was created in the 1995/1996 fishing year, when the previous QMA PAU5, encompassing Fiordland, Stewart Island and Southland/Otago was split into three separate QMAs. The existing commercial catch was divided equally between the new QMAs, the initial TACC for each QMA being set at 147.66 tonnes. PAU5B (Stewart Island) and PAU5D (Southland/Otago) have both experienced a subsequent decline in the fishstock. The TACC for PAU5B has been progressively reduced to 90 tonnes, the PAU5D TACC has been similarly reduced to 114 tonnes in the 2002/2003 fishing year and is proposed to fall further to 89 tonnes in the 2003/2004 fishing year.

Approximately one third of the PAU5D fishery is fished by small quota holders who harvest the Annual Catch Entitlement (ACE) arising from their own quota. The majority of these small quota holders were allocated quota when paua first entered the QMS. A few larger companies control the remaining quota. Over time the control of quota is consolidating in the hands of these larger enterprises. Typically these companies engage contract divers. They sell the ACE they control to the divers and buy back the paua harvested. Because ACE sales are frequently not free-market trades, the published ACE trade (or equivalently for prior years quota lease) prices are unreliable as indicators of ACE value.

Paua is harvested by diving; scuba is not allowed. Small operators tend to operate from a small trailer launched boat on comparatively accessible coastline such as is found in PAU5D. Some companies operate bigger vessels, capable of staying at sea for several days and with special holding tanks for paua. Use of such vessels is typically restricted to more remote areas such as Fiordland, where the companies are not competing with smaller operators.

Paua fishing is a year round activity, however it is not a full-time occupation for most fishers.

There is no enforceable or strong voluntary territorial division ('patches') within PAU5D. However the smaller local operators tend to fish the paua beds close to their base.

Paua are sedentary and tend to aggregate. Divers are able to move among areas and target paua beds, consequently measures of effort have not shown significant increases despite the ongoing decline in the fishstock.[1]

Local consumption of commercially caught paua is negligible. Almost 100% of the commercial catch is processed (bleached and canned) and exported. The value of the paua resource is driven by the world market. Accordingly we have assumed that the export price is not sensitive to changes in the quantities of paua harvested in New Zealand.

[1] Ministry of Fisheries 2002 PAU5D Stock Assessment.

1.2 NUGGET POINT

A marine reserve at Nugget Point was first proposed in 1992. The proposal is not currently active. Nugget Point is being used in this case study for demonstration purposes only.

The boundaries of the proposed Nugget Point marine reserve are not definitive. However past proposals include the rocky coastline between Tirohanga and Cannibal Bay. This area falls within Ministry of Fisheries Statistical Areas P5DH25 and P5DH26. The area of the proposed reserve covers approximately half the coastline of each statistical area, but in each case significantly more than half the rocky coastline that provides a suitable environment for paua.

We have attributed half the reported catch from each stat area to the proposed marine reserve area for the purpose of this analysis. For the 2001/2002 fishing year this corresponds to 12 tonnes of catch or 8% of the total commercial catch in the QMA. The 2001/2002 catch of ACE holders with a registered address in the nearby towns of Owaka and Kaka Point was 9% of the total PAU5D catch for that year.

2. METHODOLOGY

Our methodology proceeds in four sequential steps as described below.

2.1 SPECIFICATION OF THE BASE SCENARIO

The first step defines the base scenario. The analysis focuses on the benefit that will be derived from the PAU5D resource in the event that the marine reserve does not proceed. It serves as a benchmark against which the impact of the marine reserve can be measured.

2.2 IDENTIFICATION OF ALTERNATIVE SCENARIOS

In this step we postulate alternate scenarios in the event the reserve is created and seek to identify quota effects and additional costs borne by the industry over and above the base scenario.

2.2.1 Effects on Quota

The most clearly identifiable cost to the industry is a long-term reduction in the expected TACC.

Depending on the response of the Minister in setting the TACC and the response of the industry to the creation of the reserve, additional impacts may include a delayed or reduced recovery in the fishstock due to additional pressure on the remaining biomass.

2.2.2 Additional impacts

In addition to quota effects, the industry may face a variety of additional impacts for each of the scenarios determined above. These will vary depending on the nature of the scenario. Additional impacts may include the following:

- Marginal operators may be forced to exit the fishery entirely if they are no longer able to sustain their business under the reduced quota available.
- Large operators may lay off contract divers in proportion to the reduction in ACE available to them.
- Fishers local to Nugget Point may incur increased travel costs if they remain in the fishery.

2.3 QUANTIFICATION OF COST STREAMS

In this step we quantify the cost streams associated with the alternate scenarios postulated in the previous step. Our methodology for determining the cost of a reduction in the TACC is outlined below.

These measures primarily identify the costs borne by the front-line of the industry, the fisher or quota holder. Additional costs are borne by supporting industries and host communities. We apply an appropriate economic multiplier to assess the full impact on GDP.

2.3.1 Cost of a TACC reduction

In any future year the lost value due to a reduction in the TACC is measured as the expected total profit arising from the harvesting, processing and sale of the TACC quantity had the reduction not occurred, less the expected corresponding profit where the TACC reduction has occurred. This is represented as:

(1) Lost Value = $Q * (P - C) - Q' * (P' - C')$

Where Q is the TACC quantity without the TACC reduction and Q' is the TACC quantity with the TACC reduction. P and P' are the price per unit received with and without the reduction respectively and C and C' are the associated cost per unit of harvesting and processing the catch, with and without the reduction respectively.

Equation (1) determines the difference in pre-tax profit attributable to the TACC reduction. It is appropriate to ignore tax when determining the total economic impact of the TACC reduction on the New Zealand economy, since in this context tax represents a transfer between parties within the New Zealand economy.

The export market sets the price received as the New Zealand commercial paua catch is almost exclusively exported. Any reduction in catch due to the proposed marine reserve is not significant in terms of world supply and we can assume the price received is not affected by this event, hence:

(2) $P' = P$

The cost of harvesting and processing catch is made up of fixed and variable components, e.g. processing plant and fishing vessels are fixed costs, packaging and fuel are variable costs. Cost per unit is made up of the variable cost associated with each unit plus an equal allocation of the fixed cost across all units. Variable costs reduce in proportion to quantity, but Cost per unit will increase as quantity is reduced since the allocation of fixed cost per unit will increase. The degree of the increase is determined by the ratio of fixed to variable costs in the initial per unit cost.

Although a reduction in TACC due to the proposed reserve may be significant in terms of the PAU5D quota management area, paua processing facilities in the region do not rely exclusively on a single QMA, rather they process catch from several QMAs in the region. On this scale a TACC reduction due to the proposed marine reserve will not significantly affect the quantity of paua processed at any facility. The allocation of fixed processing costs will not change significantly and per unit processing costs in the region will be relatively unaffected.

The PAU5D fishery is characterised by a number of relatively small vessels and individual fishers, the majority of whom do not own quota. Capital costs are comparatively low and it is likely that a significant reduction in the TACC will result in some non quota-holding fishers exiting the fishery. As fishers exit the fishery the cost of their equipment is no longer attributable to per unit harvesting costs, resulting in a stable harvesting cost per unit.

Overall the per unit harvesting and processing cost is dominated by variable costs for TACC reductions of the magnitude considered. We assume that the cost per unit is not significantly affected by such a reduction, hence:

(3) $C' \approx C$

Applying the assumptions represented by equations (2) and (3), equation (1) can be re-stated as:

(4) Lost Value = (Q – Q') * (P – C), or

(5) Lost Value = ΔQ * (P – C)

To determine lost value we need to evaluate the term (P – C) in equation (5). This term represents the per unit profit available from harvesting and processing paua for export. We find we can use the value of ACE as a surrogate for this term, the rationale for this view is explained below.

The quota system creates a property right that in turn grants the quota owner an annual right to fish in the form of ACE. The value of ACE accrues from the inherent value in the resource over and above a normal profit margin at each stage of the value chain. Figure 1 below illustrates a breakdown of the price received. Thus with the exception of a normal profit margin for the processor, all profit is captured in the ACE value.

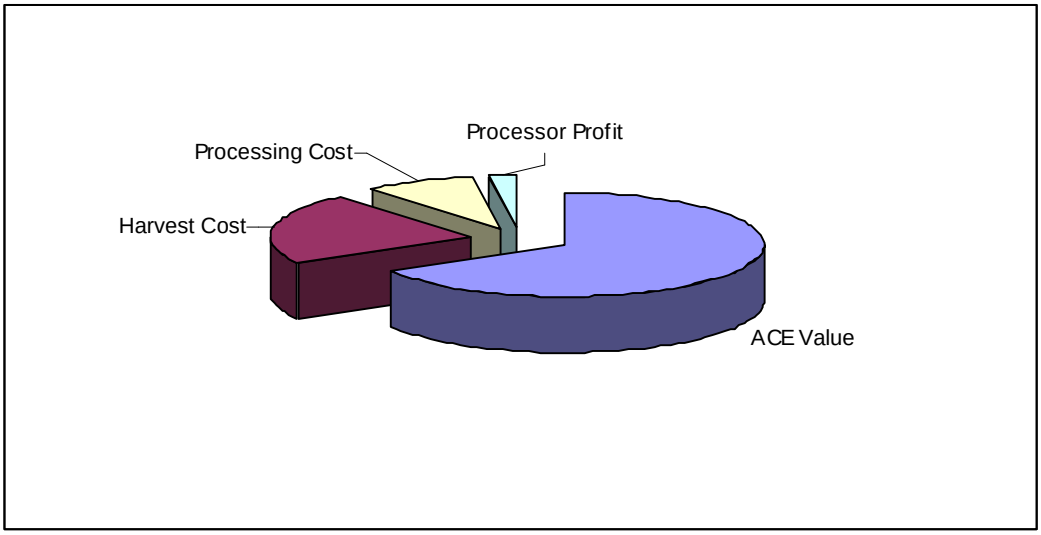

Figure 1: Breakdown of Price Received[2]

No additional profit is indicated for the fisher harvesting the paua. The harvest costs consist of the fisher's labour plus direct costs. We do not expect this activity to generate profit in excess of costs plus an appropriate wage for the fisher. In the case of a quota holder fishing his or her own ACE, any excess return earned is captured in the value of the ACE to the fisher. For a contract fisher, buying ACE from a quota holder and selling the catch back to the quota holder, the quota holder will structure the transactions such that the fisher covers costs and receives an appropriate wage rate, and any additional profit is returned to the quota holder. In either case additional profit accrues to the quota holder as represented in the value of ACE.

Downstream the paua processor must make a reasonable profit on their operations. However by comparing the value of ACE to the export price, it is evident that this profit

[2] Based on discussions with industry participants.

component is only a few percent of the total profit in the value chain. The remainder of the profit is captured in the ACE value.

Using the value of ACE as a surrogate for per unit profit we get:

(6) $(P - C) \approx P_{ACE}$

Where P_{ACE} is the value of ACE.

Substituting equation (6) into equation (5), we have:

(7) Lost Value $\approx \Delta Q * P_{ACE}$

2.3.2 Value of ACE

To utilise equation (7) above we require an estimate of the value of ACE, P_{ACE}. We cannot take published trade prices at face value as in many instances the relationship between fishers and quota holders is not at arms length and the recorded trade price does not represent true market value. In other instances ACE trades are between unrelated parties and the trade price will be indicative of the fair market value for ACE. We expect that trade prices between related parties will typically be below market value. For example in the case of fishers purchasing ACE from a quota holder/processor to whom they will subsequently sell back their catch, a value above market price would expose the fisher to greater risk and financing costs than they would encounter buying ACE on the open market, making the deal comparatively unattractive.

We assume that the highest ACE trade prices are the best indicators of the true value of ACE. In both the 2000/2001 and 2001/2002 fishing years the highest PAU5D ACE trade price was $40,000 per tonne.

2.3.3 Implied Discount Rate

We use the value of quota, obtained from published quota trade prices, and the estimate of P_{ACE} discussed above to determine an implied discount rate.

Published quota trade prices are considered a more reliable estimate of quota value than ACE trade prices are of ACE value. Although some quota trades between related parties may not be conducted at arms length, the introduction of ACE has reduced the frequency of such trades. This is evident in the 2001/2002 prices, where the highest quota trade price exceeds the weighted average trade price by just 11%, compared to 201% for the corresponding ACE figures. We have used the 2001/2002 weighted average quota trade price, $204,117, as the basis of our calculations[3]. This is a conservative estimate as it likely that the true market value for quota lies somewhere between this value and the top quota trade price. If we consider the top quota trade price to be the upper bound for the true market value and repeat our analysis using this value instead of the weighted average quota trade price, the effect is to increase the estimated costs attributable to the proposed marine reserve by 11-17%.

[3] Source: FishServe “Quota Monitoring System Report” for September 2002, PAU5D

Since quota is a property right that gives rise to ACE on an annual basis, we expect the quota price to equal the net present value (NPV) of all generated ACE, allowing for tax and reflecting an appropriate discount rate.

Applying this expectation to the projected TACC levels outlined in our base scenario, using a tax rate of 33% and a value for P_{ACE} of $40,000 per tonne, we obtain an implied real, post-tax discount rate of 8%. This rate sits comfortably within the normal range of 4% to 15% range for fisheries[4].

2.3.4 Sensitivity Analysis

Because of the uncertainty inherent in the ACE value we perform sensitivity analysis on this derived value. Each scenario is evaluated using P_{ACE} at $30,000, $40,000 and $50,000 per tonne.

Because we expect the relationship between quota prices, ACE value and the discount rate discussed above to hold regardless of ACE value we recalculate the applicable discount rate for each scenario. The resulting discount rates are given in Table 1 below.

ACE Value (per tonne)	Discount Rate
$30,000	6%
$40,000	8%
$50,000	10%

Table 1: Discount Rates for alternate ACE values

2.3.5 Economic Multiplier

We have used a region specific economic multiplier calculated by McDermott Fairgray Group[5] from Statistics New Zealand data. The selected multiplier is specific to the Statistics New Zealand industry grouping "Ocean and Coastal Fishing and Fishing Consultants" and determined specifically for the Southland region. It is a type 2 multiplier measuring the direct, indirect and induced impact on gross regional product for a given change in added value. The direct effect is the loss in added value due to the reduced resource, indirect effects are the corresponding reductions in supporting industries, and induced effects are downstream effects caused by the resulting reduction in household income. The value of the multiplier used is 2.55.

4 Harte, M., S. Larkin, G. Sylvia and K. Quigley. 2000. Discount Rates, Decision-Making and Obligations to Future Generations under the Fisheries Act 1996. Report to the New Zealand Ministry of Fisheries

5 The New Zealand Seafood Industry Council, Economic Assessment for New Zealand Regions, McDermot Fairgray Group Ltd, May 2000.

2.4 DETERMINE NET PRESENT VALUE OF COST STREAMS

Finally the applicable time frame is determined for each cost stream and the implied discount rate applied to obtain the NPV of the identified costs. The resulting costs are aggregated to arrive at an estimate of the total cost of the proposed marine reserve in each of the scenarios.

3. SCENARIOS

3.1 ASSUMPTIONS

We have created the base case and scenarios based on the assumptions outlined below. Although there is a degree of uncertainty in these assumptions the important result is the difference between the base case and each scenario, and the range of the results.

3.1.1 Long-Term Yield

The Minister of Fisheries is required to set the TACC for each quota species and QMA so as to move the fishstock towards a level that will provide the Maximum Sustainable Yield (MSY). The Ministry of Fisheries 2002 stock assessment for PAU5D states that no estimate of MSY has been made for PAU5D. Historically paua TACCs have not risen once reduced. The 2002 stock assessment shows a high likelihood of a recovery of the fishstock at the proposed 2003/2004 TACC of 89 tonnes. In the absence of the Nugget Point marine reserve we assume that no further TACC cuts will be required and the TACC will stabilise at 89 tonnes.

3.1.2 Recovery Time

The 2002 stock assessment indicates a period of five years for a recovery to occur. In scenarios where we have raised the TACC we have assumed a five-year delay from the setting of the prior TACC before TACCs can be raised.

3.1.3 Timing

In all scenarios we have assumed the Nugget Point marine reserve is created at the start of the 2003/2004 fishing year.

3.2 BASE CASE

In the base case we determine the export value of the total PAU5D resource assuming the Nugget Point marine reserve does not proceed. We assume that the proposed TACC cut to 89 tonnes for the 2003/2004 fishing year goes ahead and that the long-term TACC stabilises at this level.

3.3 SCENARIO A, PROPORTIONAL REDUCTION

In this scenario we assume that either the TACC is adjusted down by 8% to coincide with the introduction of the marine reserve, or failing this that the industry voluntarily shelves 8% of their quota. The practice of shelving quota, where fishers collectively agree not to fish their full annual entitlement has been previously implemented in other South Island paua fisheries. In either case the effect is a long-term 8% reduction in total catch from PAU5D.

3.4 SCENARIO B, DELAYED RECOVERY

In this scenario there is no reduction in TACC or voluntary quota shelving to compensate for the resource removed by the creation of the marine reserve. This results in greater fishing pressure in the remaining area of PAU5D. The anticipated recovery of the fishery does not occur and the TACC is reduced further after five years to 69 tonnes. This is a reduction of 22%, which is the same magnitude as the previous two TACC reductions.

Subsequently the fishstock recovers and the TACC is increased in two further steps to the same long-term level as in Scenario A, i.e. 8% less than the proposed 89 tonnes.

3.5 SCENARIO C, NO RECOVERY

As for scenario B, we assume no reduction in the TACC or voluntary quota shelving at the time the marine reserve is created. The increased fishing pressure in the remaining area of PAU5D delays the recovery of the fishery and the TACC is reduced after five years to 69 tonnes. In this scenario the lower TACC becomes entrenched and the long-term effect is a 22% reduction in total catch from PAU5D.

4.1 QUOTA EFFECTS

Figure 2 below shows the projected catch under each of the scenarios described above.

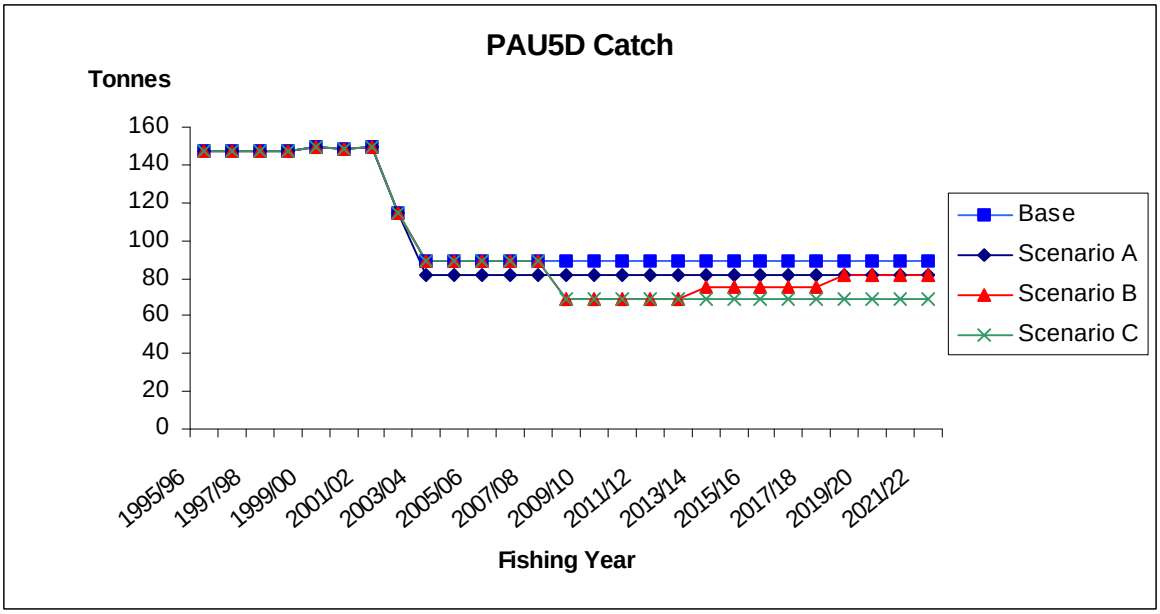

Figure 2: Total Catch from PAU5D, base case plus all scenarios

Figure 3 below shows the associated NPV for each scenario at ACE values of $30,000, $40,000 and $50,000 per tonne.

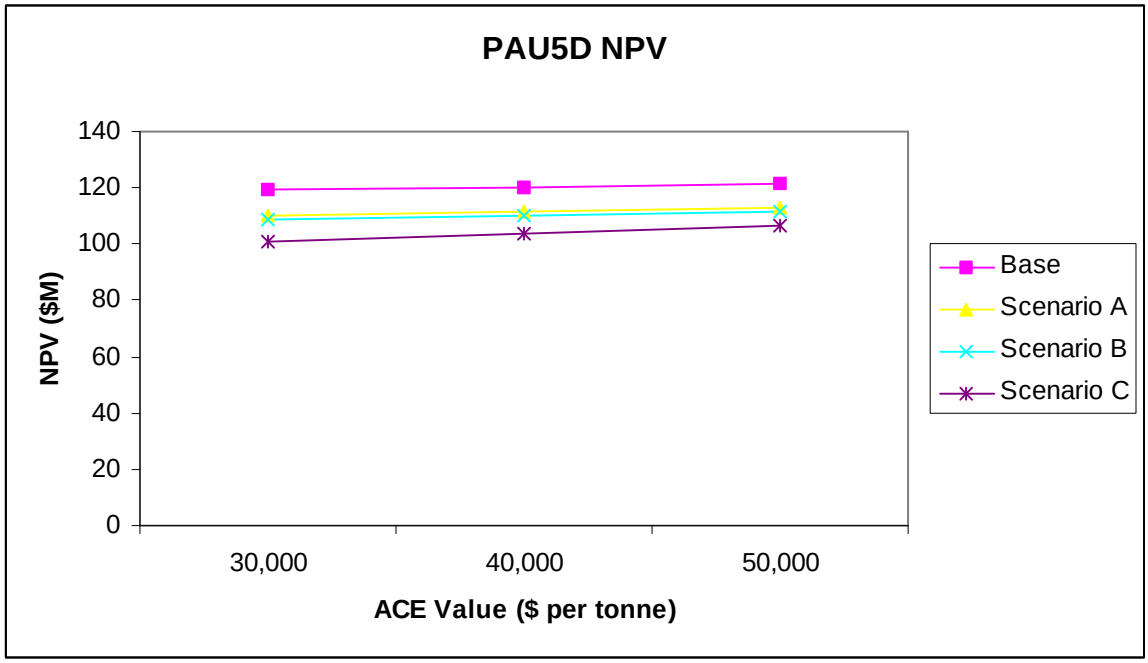

Figure 3: NPV of PAU5D, base case plus all scenarios

Table 2 below summarises the cost of each scenario attributable to the creation of the proposed Nugget Point marine reserve. Based on the assumptions described above we

attribute a reduction in GDP $8.6 million to the creation of the proposed reserve under scenario A with an assumed ACE value of $40,000 per tonne. The alternate scenarios B and C demonstrate the potential additional costs if the TACC does not reflect the creation of the marine reserve in a timely manner. This is a real possibility considering the independent frameworks for fisheries management and marine reserve creation. In scenario B the short-term income from over-fishing the remaining resource partially offsets the cost due to the subsequent delay in reaching equilibrium. This figure potentially underestimates the disruptive cost of further TACC reductions and expansions would have on the industry. Scenario C is nearly double the expected cost of scenario A.

ACE Value	Scenario A	Scenario B	Scenario C
$30,000	$8.7m	$10.8m	$18.6m
$40,000	$8.6m	$10.6m	$16.7m
$50,000	$8.5m	$10.2m	$15.0m

Table 2: Summary of Attributed Costs

4.2 NON-QUOTA EFFECTS

Under scenario A, we anticipate some fishers will quit the industry, with the reduction in employment being proportional to the lost resource. These are most likely to be non-quota holders. The main investment in the fishery of these fishers is typically the boat they use. The boats are not specialised and we can assume a ready market exists for these assets.

Under scenarios B and C, in the first five years only the non-quota effects are evident. Due to the ability of fishers to locate and target paua beds we assume that catch effort does not increase significantly despite the additional pressure on the remaining fishstock. Assuming local fishers stay in the fishery they will incur additional travel costs towing their boats to alternative launch sites near open fishing grounds. Compared to the cost due to lost resource determined above additional travel costs do not significantly affect the total cost. However local fishers are disproportionately affected making it more likely that these are the fishers who would quit the fishery.

The associated loss of income is already included in the cost estimates in the previous section by way of the economic multiplier applied. However we note that alternative employment opportunities in the area are limited and this loss of employment could have a disproportionately large effect on the local community.

In the next five years of scenarios B and C the TACC reduction is almost three times the reduction in scenario A, this will lead to a corresponding threefold reduction in employment, although the extra job losses will not be local to Nugget Point. This additional income loss is incorporated through use of the economic multiplier applied in the previous section.

5. CONCLUSION

This assessment has investigated the costs that would be incurred due to impacts on the commercial paua fishery if the proposed marine reserve at Nugget Point were to proceed. This assessment has been conducted for illustrative purposes. The Nugget Point marine reserve proposal is not active at this time. This assessment has considered impacts on the commercial paua fishery only, other commercial fisheries and recreational interests have not been considered.

We have found the most significant impact of the proposed marine reserve is the loss of resource represented by a long-term reduction in the Total Allowable Commercial Catch (TACC). In addition to the economic value lost through not exploiting this resource, there are flow-on effects through the economy attributable to the initial reduction in economic activity. These flow-on effects are captured by applying an economic multiplier to the lost value directly attributable to the reduced resource.

Under the most conservative scenario analysed we estimate the net present value of the loss to the New Zealand economy attributable to the resource reduction resulting from the proposed marine reserve to be $8.6M. In addition we have considered alternative scenarios where the TACC does not instantaneously reflect the reduction in resource. A likely outcome as TACC setting and marine reserve creation are independent processes. These alternate scenarios postulate increased pressure on the fish stock and slower recovery of the fish stock to sustainable levels. The net present value of the attributable loss ranges between $8.6M and $16.7M across all scenarios.