BRIDGING THE GAP BETWEEN ECONOMIC THEORY AND FISHERIES MANAGEMENT - A CASE STUDY OF THE SOUTH AUSTRALIAN SNAPPER FISHERY

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Abstract

In South Australia, commercial and recreational fishers compete to catch Snapper from a single stock. To distribute this resource appropriately, the widely accepted conceptual framework for optimizing the net benefits from resource allocation is applied. That is, by finding the point at which the marginal net economic values of the recreational and commercial sectors are equal, the optimal allocation between the competing users can be found.

Research results indicate that given certain assumptions, the net economic benefits from Snapper fishing in SA could be increased if catch was reallocated from the commercial to the recreational sector. The sensitivity analysis carried out on the results demonstrated little change due to the shortfall between the marginal commercial economic benefit curve and the estimated recreational marginal willingness to pay.

Keywords: fisheries, resource allocation, South Australia, Snapper

A Contributed Paper to the 50th Annual Conference of the Australian Agricultural and Resource Economics Society

Sydney, 8-10 February 2

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1. Introduction

Fisheries are characterised as a common property resource – where the property rights are not conveyed to any single owner and no single fisherman can exclude others from exploiting the resource. Open access to a resource can result in overexploitation, thus causing avoidable losses to the fishery, fishers and broader sustainability.

Over the years, fish stocks within the waters of South Australia have been consequently managed by Government in perpetuity on behalf of the current and future generation of South Australians. These stocks are exploited within biologically acceptable levels and regenerate at rates dependent on the population dynamics, life history of the species and the rate of extraction. Productive fish stocks also rely on the maintenance of sustainable ecosystems and habitat.

The objectives of fishery management are therefore to protect the fish stock, maximise the financial returns from the resource and provide optimum distribution of the resource between various (and often competing) user groups.

In 2002 a consultancy by Mcleod and Nicholls (2004) recommended a framework for analysing and optimising the socio-economic benefits of resource allocation between recreational and commercial fishing uses. The framework was underpinned by finding the resource allocation at which the marginal net economic values from commercial and recreational fishing are equal. At that allocation, the net economic benefits from fishing can be maximised.

This paper attempts to bridge the gap between economic theory and fisheries management by applying the conceptual framework to a case study of the South Australian Snapper fishery. Actions such as this enable a better understanding of the optimum distribution between the recreational and commercial sectors, and thus help in the pursuit of sustainable fisheries management.

The paper is organised as follows. Section two provides a brief summary of the Snapper fishery in South Australia while section three overviews the theory used and provides a brief explanation of what constitutes an appropriate measure of economic value. Section four analyses the necessary data and applies the theoretical framework to the South Australian Snapper fishery with the aim of discovering the optimal allocation between the two competing sectors. Implications of the research results to current Snapper policy mechanisms are discussed in section five and then a conclusion follows.

2. The Snapper Fishery in South Australia

Among other sources, the discussions in this section are derived primarily from Fowler et. al. (2004) and Jones and Doonan (2005).

Although Snapper are distributed widely in Australia, those found in South Australian waters appear to be from a single stock that is genetically different from adjoining stocks in Victoria. For this reason Snapper in South Australia are managed as a single stock.

The South Australian Snapper stock reproduces in late spring/summer and there is considerable variation in recruitment to the fishery between fishing seasons; with the 1991, 1997, and 1999 seasons resulting in strong recruitment to the fishery. The 1991 year class appears to have sustained the fishery in the St Vincent and Spencer Gulf for several years.

Snapper are a significant recreational fishing species with the most recent information on the recreational fishery coming from the National Recreational and Indigenous Fishing Survey (NRIFS), but more specifically the South Australian Regional Information Report (Jones & Doonan 2005). This report identified that fishers devoted 43,249 hours of targeted fishing effort on Snapper annually, but 315,993 hours of non-targeted fishing effort during which Snapper were taken and retained. It was estimated that in one financial calendar year (2000/01) 441,586 Snapper were captured and that of these approximately 74% were released. The Spencer Gulf accounted for over 80% of the total Snapper harvested.

Recreational Snapper fishers are restricted by a minimum size limit of 38cm and restrictions apply on the numbers of small (38-60cm) and large (>60cm) Snapper they are allowed to retain. In addition, they are restricted by the gear restrictions outlined in the South Australian Recreational Fishing Guide.

One major limitation of the recreational Snapper fishery is that information is not collected on a regular basis. It is also the case that no comparable information exists that could indicate any past and current trends regarding the state of the fishery.

Commercially, Snapper are caught as part of the Marine Scalefish fishery with 92% of the 2000/01 catch the result of targeted effort (Fowler et. al. 2004). Of the 412,700 kg of Snapper caught in the 2003/04 fishing season 76.9% was caught using handlines, 20.7% using longlines, and 2.5% using other methods. The use of all nets to target Snapper was prohibited in 1993.

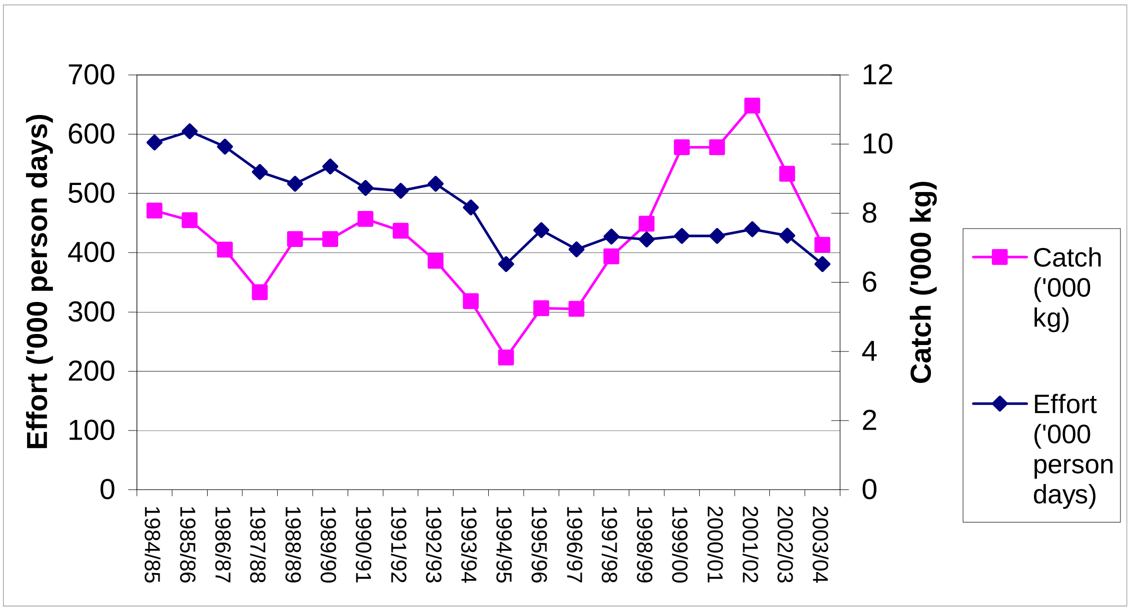
Commercial Marine Scale fishers are currently restricted by a combination of input and output controls. The output control is a minimum legal length of 38cm, with input controls restricting commercial long line fishers to setting 400 hooks per day and handline fishers are restricted to 2 handlines per fisher that are restricted to 3 hooks per handline.

There is also a total prohibition on the taking of Snapper in all waters of South Australia from midday on the first of November until midday 30th of November. Fishers taking Snapper incidentally during these closure periods are required to return them to the water immediately. This closure applies to both recreational and commercial fishers.

Figure 1 shows the historical commercial catch and effort data in the SA Snapper fishery.[3] It is clear that commercial effort in the fishery has been declining since the 1984/85 fishing season, but since 1996/97 it has been relatively stable. On the other hand catch has fluctuated significantly over the same period and in recent seasons, both catch and effort have fallen.

[3] Effort is measured and reported in person days. A person day = number of persons who were fishing using a license or in a boat each day multiplied by the hours fished.

Figure 1: Historical catch and effort in the SA Snapper fishery



Regardless of the seasonal maximum sustainable catch of Snapper from the fishery, the focus of this paper is to calculate the optimal allocation of the Snapper resource that would maximise the economic benefits of this catch.

3. An Approach to Resource Allocation

The total economic value of fishing includes not only the benefit derived from directly using the resource but also intrinsic values. Economic value is therefore a bundle of use, option and existence values:

- Use values are those derived by people who fish for the resource or go with people who fish for the resource;
- Option values are held by people wanting the resource to be available for future use; and
- Existence (intrinsic) values are the associated value from knowing a resource is there for its own sake.

Given the objective of this paper is to determine the optimal allocation assuming at least a sustainable yield, it is the use value that is needed to calculate the optimal allocation. If the objective instead were to change the threshold sustainable yield in some way, then the other components of economic value (i.e. option and existence values) would also be of interest.

Commercial economic value of a fisheries resource can be described as the value to society from the use of the resource. This can be found by calculating the difference between the total amount consumers are willing to pay and the resource cost of the output. This can be partitioned into two components: consumer and producer surplus. In contrast, the gross value of production is often confused with economic value, yet it does not take into account the values to society from the consumption and production of the resource.

Just as the value of production has been the most common form of misconception regarding the commercial economic value of fisheries, tourism dollars and recreational fishing expenditure have also been commonly misused.

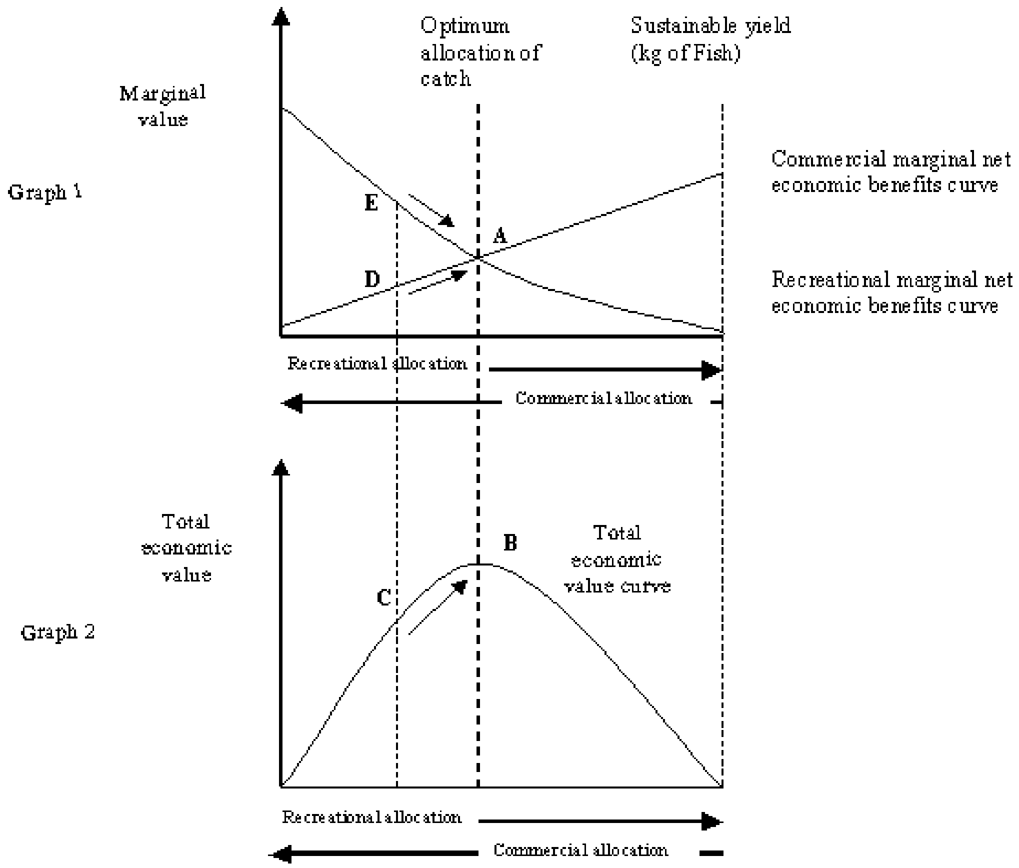
Fishers in the recreational sector may harvest the resource for a variety of reasons. To catch fish is important, but for most it is not the "be all and end all" of fishing. In fact, results from the NRIFS illustrate that catching fish is usually not the prime reason an angler goes fishing. It found that 32 per cent of South Australian respondents fished primarily to relax and unwind; 17 per cent regarded their motivation for fishing to be with family, while 15 per cent suggested that they fished for sport. Other motivations included the feeling of being outdoors, with friends, and the solitude involved in fishing (Jones and Doonan, 2005).

Unlike the commercial fishing sector, the economic value of recreational fishing is not revealed in the market place. Economists use 'willingness to pay' (WTP) as a means of measuring monetary values for environmental benefit/damage that is not revealed. One of the most common methods for estimating recreational fishers WTP is a simulated market approach (or stated preference approach) called a Contingent Valuation (CV). This approach collates information from responses to surveys that simulate the market place. In particular, the CV asks direct questions on "what they are willing to pay (or willing to accept) for some change in a provision of a good or service (i.e., fish catches)". This creates a hypothetical market for the resource in question.

3.1. Optimizing the Net Economic Value

So far the discussion has focussed on calculating the economic value of both the recreational and commercial sectors. By finding the point at which the marginal net economic values of each sector are equal, the greatest net benefit from fishing can be attained (Mcleod and Nichols, 2004). Figure 2 is used to illustrate this point.

Figure 2: An illustration of an optimum allocation of a resource between commercial and recreational fishers



The marginal net economic value (or marginal net economic benefit) is the value gained from each additional kilogram of catch consumed or caught (and kept) by a sector. According to the law of diminishing marginal utility, as a recreational fisher acquires more fish, the marginal utility gained from each extra fish will decline. That is, the first fish caught yields greater satisfaction than the second, and the second yields greater than the third and so on. Hence there is a downward sloping marginal WTP curve (see Graph 1 of Figure 2).

In Graph 1 of Figure 2 the commercial allocation of sustainable catch runs from right to left. The marginal net economic value curve for the commercial fishery slopes downward, illustrating the assumption that the marginal net value from each additional commercial fish diminishes. In other words, as more fish are caught by professional fishers the marginal return per fish declines.

In Graph 2 the vertical axis shows the total economic value for the commercial and recreational sector. The horizontal axis records the allowable catch. The possible commercial and recreational shares of the sustainable yield run in opposite directions, such that at any point the sum of the two shares equals the sustainable yield.

At point A in Graph 1 the marginal commercial and recreational economic value intersect. At this point, any change in allocation results in the overall economic benefit declining. This is because the economic cost of reducing one sectors allocation will be greater than the economic benefit received by the other sector. Graph 2 shows that the total economic value would be maximised at point B and the corresponding point A in Graph 1. Any movement away from this allocation will result in a decrease in the total economic value of the fishery.

However, if the marginal recreational and commercial economic values were at points E and D on Graph 1, then the total economic value from the fishery would be at a level (point C on Graph 2) that is less than what could be attained if the allocation was optimal (at point B). In this circumstance the allocation between the competing users is suboptimal.

By reallocating the resource from one sector to the other, such that the marginal economic values from the competing sectors are equal (points D and E move to point A), the total economic value of the fishery can be maximised (point B could be reached).

4. A Case Study: The South Australian Snapper fishery

4.1. Estimating the marginal net economic value of recreational Snapper

In 1997, the South Australian Centre for Economic Studies (SACES) used a contingent valuation study to estimate the WTP of the recreational fishing sector for Snapper. This is the only previous study found that has attempted to elicit the economic value of recreational Snapper in South Australia. Therefore this 1997 SACES report forms the basis of the economic value of recreational Snapper used in this paper.

The report calculated that the marginal WTP per Snapper kept was estimated at $61.53. Therefore, if the average Snapper kept weighed 2.14 kg, this marginal value would be $28.75 per kg of Snapper kept. However, the sample from which the point estimate of the marginal WTP for Snapper was calculated consisted of only 91 observations. In fact, of these 91 interviews 69 were conducted at a Snapper fishing tournament. To control for any bias caused by the number of interviews conducted at the Snapper tournament, the authors included a dummy variable in the regression (SACES, 1997).

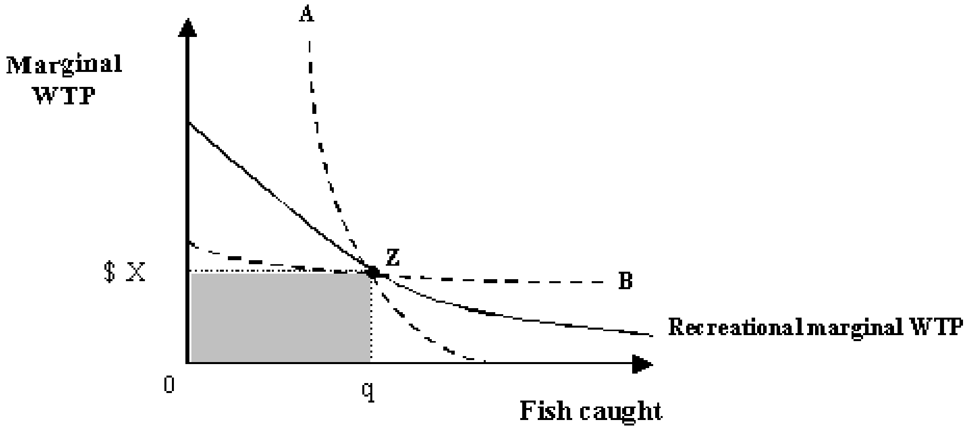
Another study undertaken by SACES in 1999 also used the contingent valuation method to estimate the marginal WTP of various species in New Zealand, including Snapper. Using a much larger sample size than that of the South Australian study (1,044 interviews) the marginal WTP for Snapper in New Zealand was estimated to be $5.73. This is much lower than the $61.53 per Snapper caught in South Australia and could be a result of various factors including the larger sample size, differing species features and differing recreational Snapper fishing characteristics.

The catch and release, or sporting value, of Snapper has not been calculated in this analysis due to the lack of available information. Even though the catch and release fishery does hold economic value, this should not impact the allocation of Snapper between the commercial and recreational sector, given the sustainable management of the Snapper stock. However, the mortality associated with released Snapper will need to be factored into the total allowable catch to ensure overfishing does not occur that could possibly impact the Snapper allocation. More research would need to be undertaken to determine the impact of released Snapper mortality on allocation between the commercial and recreational sector.

The consumer surplus accrued from recreational fishing depends upon the shape of the marginal WTP curve. But rather than depicting a marginal WTP curve, the calculation by SACES (1997) represents one estimate of the marginal WTP for Snapper taken from a sample of the population.

The position of Z in Figure 3 (below) illustrates the point estimate of the marginal WTP for Snapper at some number (q) of fish caught and kept. Since only one marginal value exists, the exact shape of the marginal WTP curve is unknown and cannot be estimated from current information.[4] According to the law of diminishing marginal utility, the curve can be assumed to be downward sloping. However, its elasticity is unknown and therefore the curve could be quite inelastic (curve A in Figure 3) or be more elastic (curve B in Figure 3).

Figure 3: Recreational marginal WTP curves with differing elasticity's



From May 2000 till April 2001 the latest data on recreational fishing in South Australia was collected as part of the NRIFS. In the report was information on both average catch weight and total catch of Snapper (including both kept and released) (Jones and Doonan, 2005). The average catch weight of Snapper used in our analysis was 3.2kg, whereas the SACES report in 1997 used 2.14kg.[5]

Since the latest recreational data is available for 2000/01, the marginal WTP per Snapper kept was adjusted for inflationary pressures until this date and was updated with the latest average catch weight. This produced a marginal WTP estimate of $21.13 for a kg of Snapper in 2000/01.

[4] To more accurately calculate the recreational economic value, the integral of the marginal values from 0 to q is required. However, given the econometric method used by SACES (1997), estimating the functional form of the recreational fishers marginal WTP would be extremely difficult (SACES, 1999, pp.120).
[5] The previous estimate (2.14kg) was obtained from David McGlennon of SARDI. It was based on the average recreational Snapper caught from April 1995 to March 1996 in the Northern Spencer Gulf and was used in the SACES report in 1997 (SACES, 1997, pp. 46). However, according to Jones and Doonan (2005) the latest statistics report the average catch weight at 3.2 kg.

The marginal WTP was calculated from surveys completed in 1997. In our analysis we have only taken into account inflationary pressures. However, it is quite likely that other factors have influenced the recreational value of snapper since these surveys took place. Some potential factors could include changes in coastal populations and the age of fishers, the nature of Snapper fishing, technology used by recreational fishers (e.g. echo sounders and GPS systems), incomes and the number of recreational fishers in South Australia.

To take into account these changes, a new Contingent Valuation study would need to be conducted. However, due to the complexity and time needed to undertake a study such as this, it may be reasonable to use the current calculation as a policy guide in starting allocation negotiations.

4.2. Estimating the marginal net economic value of commercial Snapper

The economic value of the commercial Snapper fishery can be defined as the sum of the producer and consumer surplus calculated using industry demand (marginal benefit) and supply (marginal cost) curves.

In this section a commercial Snapper fishing supply curve will firstly be estimated, followed by the estimation of a commercial Snapper fishing demand curve. Using these two estimated functions, a marginal commercial economic value function for Snapper fishing will be subsequently derived.

A commercial supply curve for the Snapper fishery

Many complications arise when estimating the supply curve for the commercial Snapper fishery, but the most significant appears to be the impact of fluctuations in the stock level and therefore catch. There are two approaches for overcoming this. Either many years of data can be collected so that the variation in the catch can be smoothed through complicated econometric techniques, or this variable can be held constant for a defined period (throughout one season). The difference in the information requirements between the two approaches is essentially the availability of time series data. Because of the limited supply data in the SA Snapper fishery, the short run supply curve (short run marginal cost of fishing) has been held constant for the 2000/01 fishing season. Therefore, it is assumed that there are no significant economies of scale associated with fishing for Snapper and 1 unit of labour will equal 1 unit of Snapper at any level of catch.

EconSearch prepares information on the economic indicators for the SA Marine Scalefish fishery on an annual basis (EconSearch 2002). Although this cost information is not separated by species, it can be split into four headings: (a) mostly gill/haul nets (b) a mixture of gill/haul nets and other methods (c) no gill/haul nets and (d) an average for all surveyed boats.

Because nets were banned for snapper fishing in 1993, Snapper fishing would come under (c) the no gill/haul nets banner. Given the data limitations, this is the best information currently available.

For the 2000/01 fishing season catch and effort were recorded as 578,000kg and 7,340 person days (Knight et al. 2004). Therefore, snapper catch per person day can be estimated as 78.75kg.

The variable cost of fishing is derived from EconSearch (2002) and is listed in Appendix B. For the purpose of this analysis it was assumed that all costs attributable to fuel, repairs & maintenance, bait, provisions, and labour were variable costs. In reality, costs such as repairs, maintenance and labour will most likely have a fixed cost proponent, thus the variable costs used in this report may be greater than the actual variable costs.

The cost of fishing data (EconSearch 2002) is provided as average figures per boat, whereas the catch and effort data is represented in person days. As the supply curve is defined as the marginal cost per kilogram of Snapper, the average weight of Snapper kept per boat day needs to be calculated. This is calculated by multiplying the average FTE employed per boat by the weight of Snapper kept per person day as listed above. This gives a figure of 94.5 kg of snapper kept per boat day.

Using the above figures, the short run marginal cost per kg of Snapper can be calculated as follows:

$$MC_S = {VC_F}/{BD_F C_S} \qquad \textbf{(1)}$$

where
$MC_S =$ Short run marginal cost of catching Snapper (per kg)
$VC_F =$ Variable cost of fishing (per boat day)
$BD_F =$ Boat days fishing
$C_S =$ Catch of Snapper (per boat day)

This equals a constant short run marginal cost of $2.43 per kg of Snapper kept as calculated in equation 1.

It should be noted that the EconSearch (2002) data used to calculate this estimate was obtained from a survey of 69 SA Marine Scalefish fishery license holders in May 2002 and represents only 15% of all license holders.

There are also three limitations associated with the information currently available to determine the commercial supply curve for Snapper: (1) The 'cost of fishing' information is in the form of an average for all species kept in the Marine Scalefish fishery and not specifically just Snapper. (2) Fishing costs are currently totals for the whole fishing season listed by expense type and there is no indication of how they would have changed if different quantities of Snapper had been caught in the 2000/01 fishing season. (3) This analysis used targeted fishing costs to represent 100% of the Snapper fishing costs, whereas 8% of Snapper is caught by untargeted fishing effort that will have different fishing costs.

Even given the above limitations and assumptions relating to the commercial supply curve, the data used provides a solid information base for the analysis.

A commercial demand curve for the Snapper fishery

Now that the supply curve has been derived, to calculate the marginal net economic value of the commercial sector the demand curve is also needed. By measuring the change in the quantity demanded for Snapper given fluctuations in price the appropriate demand curve can be estimated.

The average beach price and quantity of Snapper was taken from the South Australian Research and Development Institute (SARDI) in each fishing season from 1984-85 to 2003/04. From this data the demand function was determined as:

$$\text{Demand:} \quad Y = 9.1088 - 0.0048X \qquad \textbf{(2)}$$
$$R^2 = 0.6065$$

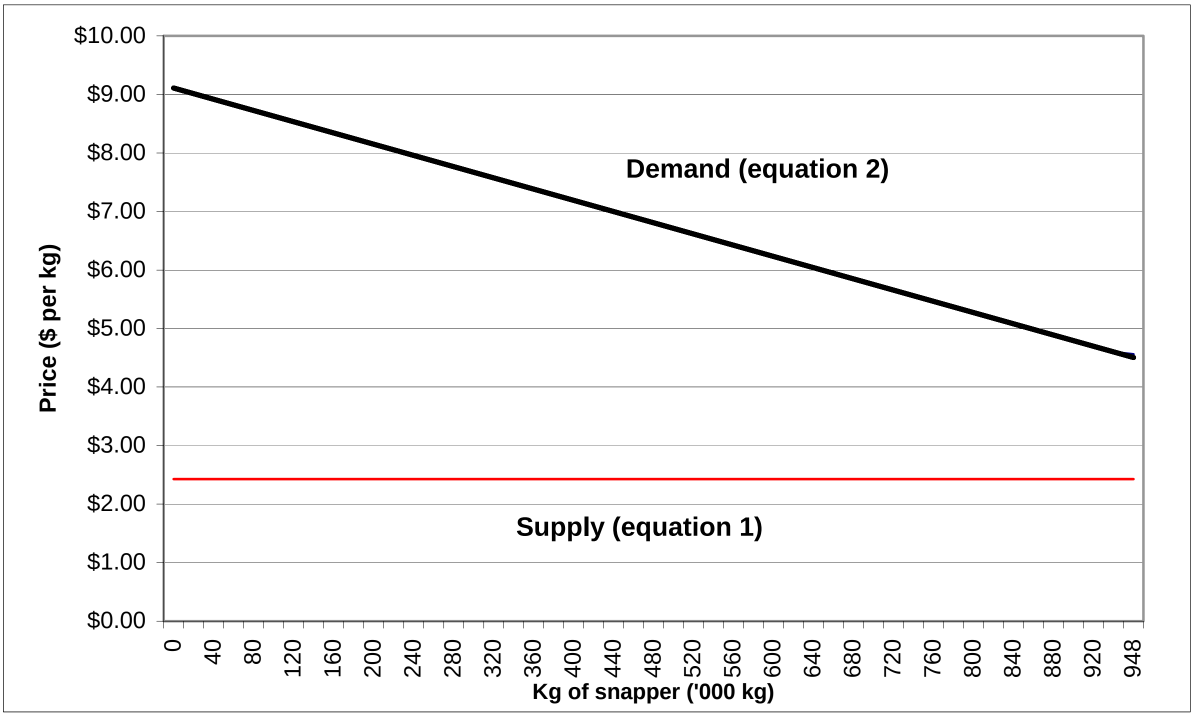
where Y is the price of Snapper and X is the amount of Snapper caught.

When using the average beach price per year to derive the demand curve, some variables might not be accounted for in this annual data. These include the variations in the quantity of snapper available during the relevant 2000/01 fishing season and the inter-seasonal demand.

Combining demand and supply

The marginal commercial economic value per Snapper kept can be derived by calculating the difference between the marginal cost and the marginal benefit at each quantity of total sustainable catch available. Figure 4 below shows the demand and supply curves used for the SA Snapper fishery as calculated in sections 4.1 and 4.2.

Figure 4: Commercial demand and supply curves for the SA Snapper fishery



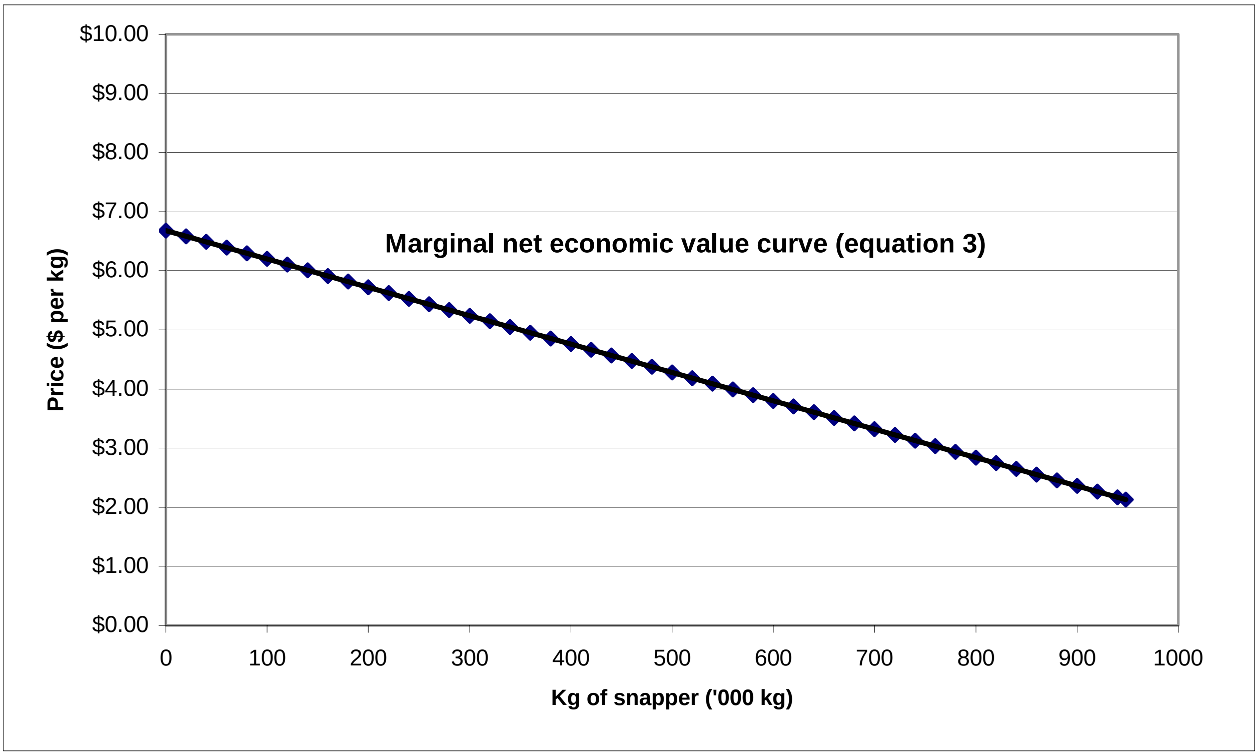
If the marginal economic benefit (MEB_S) of commercial fishing for Snapper is the difference between the marginal cost and marginal benefit at each quantity, then:

$$MEB_S = Y - MC_S \qquad \textbf{(3)}$$

where Y is the demand curve (equation 2) and MC_S is the short run marginal cost curve (equation 1).

By substituting equations 1 and 2 into equation 3, the marginal economic benefit of commercial fishing for Snapper in SA can be estimated as $MEB_S = 6.68 - 0.0048X$. This is represented graphically in figure 5 for each kg of Snapper caught.

Figure 5: Marginal net economic benefit of commercial Snapper fishing (equation 3)



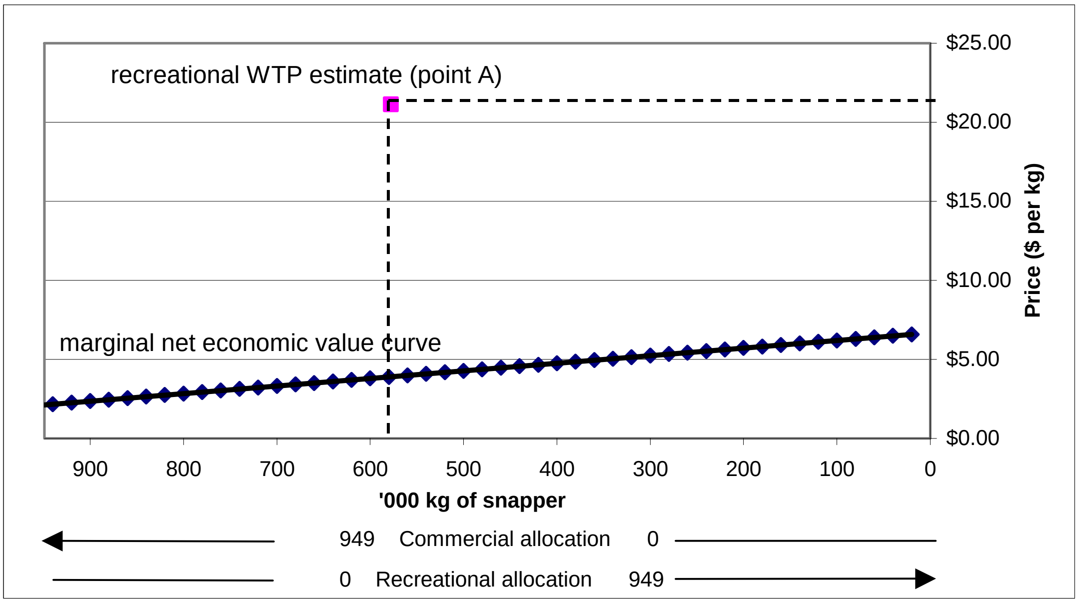
As illustrated above, the marginal commercial economic value curve is diminishing. However, rather than being a result of the addition to the total cost from catching each extra Snapper, this is actually a consequence of the downward sloping demand curve for Snapper. Since the short run marginal cost curve was assumed to be constant for this analysis, the marginal commercial economic value curve possesses the same slope as the demand function (equation 2) but has a different intercept on the marginal value axis.

4.3. Finding the Optimal allocation

In order to allocate appropriate shares between the competing sectors, a sustainable (or economically efficient) level of catch needs to be defined. According to the latest estimates, the commercial and recreational catch in the 2000/01 fishing season was 578,000kg and 371,000kg respectively. In the absence of other data, it was assumed the sum of these figures (949,000kg) would represent a total sustainable catch for the 2000/01 fishing season.[6]

The diagram below illustrates the marginal recreational benefits as compared to the marginal commercial benefits within this sustainable catch level. Figure 6 shows that the recreational allocation of Snapper runs from left to right, whereas the commercial allocation runs from right to left.

Figure 6: Recreational marginal WTP and the marginal commercial net economic value curve within a sustainable catch framework



Although we do not have enough information to derive the recreational marginal WTP curve, point A still provides enough information to determine the direction of any required reallocation.

[6] When calculating the total sustainable catch in the future, the mortality of released Snapper will need to be taken into account, as these mortalities will constitute a loss to the Snapper stock.

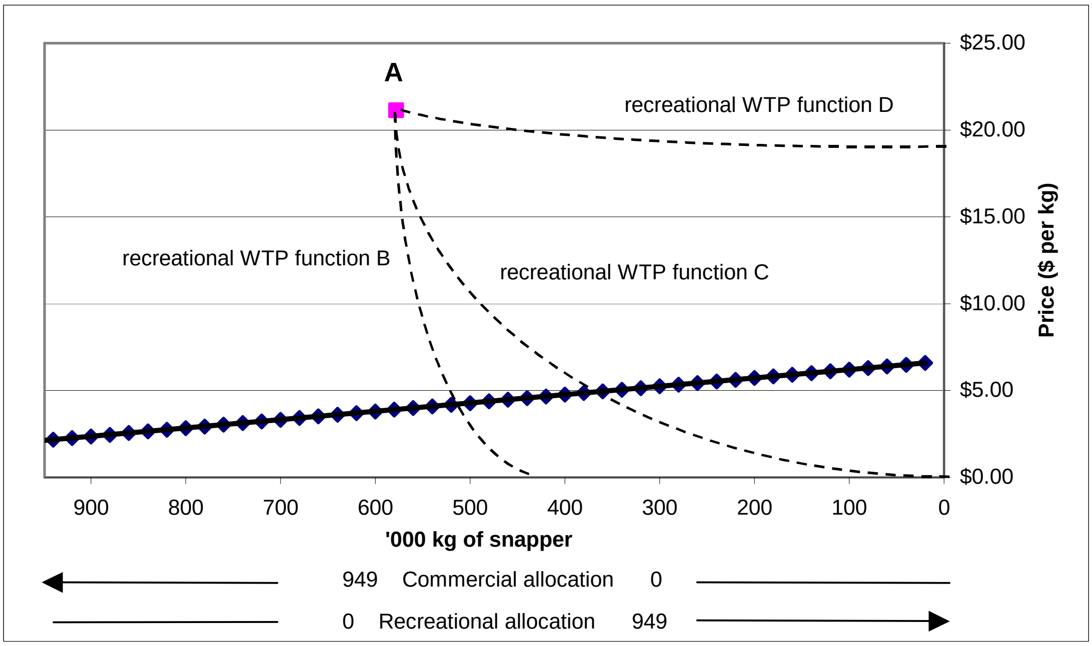
To illustrate, consider the position of point A in Figure 6. Although the recreational marginal economic benefit curve has not been derived, the law of diminishing marginal utility indicates that this curve should be downward sloping, and therefore can be assumed to intersect the commercial marginal net economic benefit curve somewhere to the right of point A in the area within the dotted lines. This indicates that the net benefits to the SA Snapper fishery can be increased if a proportion of the Snapper allocation were shifted from commercial to recreational fishers.

The quantity of reallocation that needs to occur is difficult to estimate. The required reallocation toward the recreational sector may range between a 1% to 100% transfer toward the recreational sector. The dotted line from point A to the horizontal axis represents a potential 100% transfer, while the dotted line from point A to the vertical axis indicates a minor transfer. These two dotted lines depict the area which the recreational marginal WTP curve may intersect the commercial marginal net economic value curve. It is at this intersection point that the economic benefits to the SA Snapper fishery can be maximised.

The lack of knowledge regarding the shape of the recreational curve is the primary reason behind the ambiguous percentage changes reported above. The dotted lines in figure 6 are used to demonstrate that the recreational fishers marginal benefits will diminish as he/she catches more fish, but the rate of the fall is unknown.

For example, the fisher’s marginal benefits could diminish quite quickly per kg of Snapper kept (this is illustrated by the recreational WTP function B in figure 7). This would mean that the optimal reallocation needed might only be a minor percentage change. On the other hand, if demand is relatively elastic the marginal benefits per Snapper kept may decrease at a slow rate (as illustrated by recreational WTP function D in figure 7). Whereby the satisfaction gained from keeping a second, third or even fourth Snapper may only be slightly below the first.

Figure 7: The optimal allocation with differing recreational demand elasticity's.



However, since recreational Snapper regulations are non-binding[7] but the recreational catch taken was still at 371,000kg (point A in figure 7). This may be indicating that recreational fishers have realised the marginal net economic benefits from increasing catch beyond this point are very low (the marginal WTP curve is inelastic). Meaning, recreational fishers realise that each additional fish caught beyond this quantity gives them significantly less satisfaction, thus they choose to catch no more than quantity A.

This behaviour is similar to that which could be expected from a fisher attempting to catch a trophy species (snapper is one species considered to be a trophy fish). Once a fisher acquires the trophy Snapper, the subsequent Snapper caught would yield quite a lot less satisfaction than the first. Therefore, we hypothesize that the marginal recreational willingness to pay curve is likely to intersect the marginal commercial economic value curve close to the dotted vertical line in figure 6. Yet in the absence of a recreational data set this cannot be tested, however it certainly leaves options for future research.

Sensitivity analysis of the reallocation findings indicated that changes in the commercial price and quantity data of Snapper had no impact on the reallocation findings (see Appendix C). In fact, this same finding would hold true given a large increase in commercial demand for

[7] Non-binding in this case means that recreational fishers are subject to some controls, however these do not control the total catch taken.

Snapper and changes in the constant marginal cost curve, since the recreational marginal WTP estimate is so much higher than the marginal commercial economic value curve.

Variations in Catch Per Unit Effort (CPUE) due to Snapper stock size fluctuations were also tested for their influence on the results. Catch rates per boat of 50 to 400 kilograms per day were used. Again, the sensitivity analysis showed that even a substantial change in the CPUE of the Snapper fishery would not impact the results of this analysis (see Appendix C).

Even when the recreational marginal WTP estimate was reduced by 50%, the possible range over which the reallocation of Snapper still occurred between existing levels and 100% of the total sustainable catch in favour of recreational fishers (see Appendix C).

In summary, the results show that a reallocation of snapper to the recreational sector would increase the total benefits to the Snapper fishery and because of the shortfall between the estimated marginal commercial economic benefit and the estimated recreational marginal WTP, the sensitivity analyses carried out had little impact on the results. However there was not enough data available to quantify the size of the required reallocation shift at this stage.

Assumptions

Under the approach outlined above, the following assumptions and limitations are relevant to the analysis. Each of these assumptions has the potential to change the marginal economic value of the commercial and/or the recreational fishing sector and therefore the optimum allocation of the Snapper resource in the future. Further assessment will be required to estimate the impact these variables will have on the stability and therefore usefulness of the current allocation recommendations.

- The combined recreational and commercial catch is the total catch available and it is sustainable. Thus, at the margin, competing users (recreational and commercial fishers) are playing a zero sum game. A fish caught/not caught by one user, would be not caught/caught by the other user and both sectors are assumed to have fixed shares of catch.

- Sustainable Snapper catch in 2000/01 is 949,000kg and is calculated by adding the recreational catch in 2000/01 (371,000kg) and the commercial catch in 2000/01 (578,000kg).

- The recreational marginal WTP estimate has not changed since its calculation in 1997. Underlying economic and social conditions may have changed, but the value has only beeen adjusted to account for inflation.

- Commercial fishing operations are structured to maximise producer surplus and the analysis is static.

Limitations

The analytical framework used in this report is focused on a short run analysis of the SA Snapper fishery. Since variations occur in stock levels, costs of fishing and market conditions vary within and between seasons, our analysis provides only a snapshot of the fishery for a given point in time (Appendix A describes this point in more detail). Also, the lack of recreational Snapper fishing data causes difficulties. In particular catch and average catch weight of Snapper information was only available for 2001.

5. Conclusion

Our analysis has demonstrated that given certain assumptions some net economic benefit to South Australia could be achieved by allocating a larger share of Snapper to the recreational sector.

Currently, the Snapper fishery uses controls that do not control catch from either sector and therefore, at this stage, even if the quantity of the reallocation shift had been calculated it would not be possible to implement. However, once the sustainable catch is known and binding controls restrict effort, the resource allocation analysis could be updated regularly where feasible and the controls adjusted to distribute the Snapper resource to maximise the economic wellbeing in South Australia. This would require the collection and analysis of more rigorous, timely and complete data from the SA commercial and recreational fishing sectors.

If recreational fishing pressure increases into the future, policy options to more accurately control recreational fishing effort should be explored. Otherwise, recreational fishing effort can continually increase and the total effort in the recreational fishery may rise above economically efficient levels, reducing the economic benefits from the fishery. But at the current time, with recreational catch being below optimum levels compared to commercial fishing, this is not a priority.

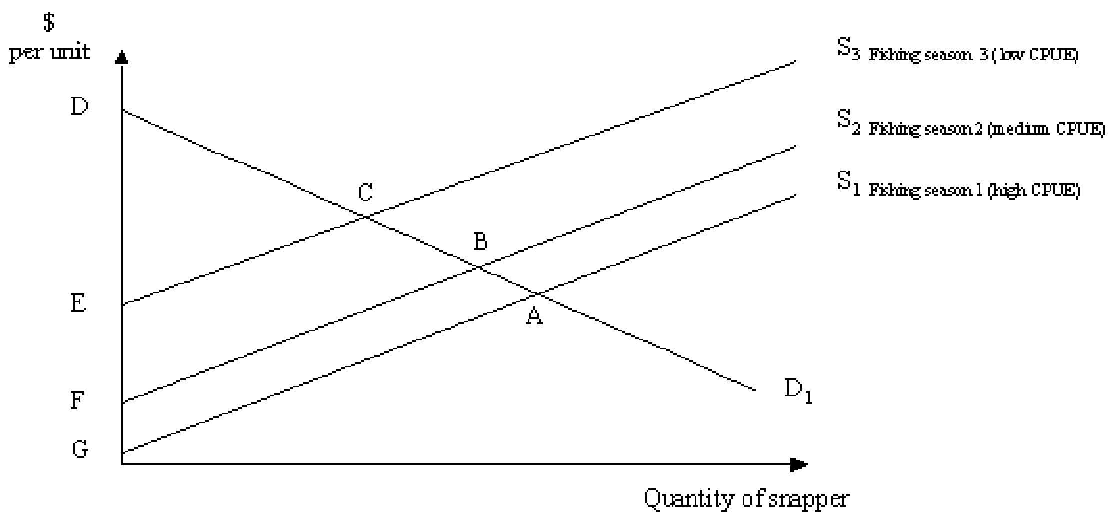
On the other hand, our analysis suggests that the commercial Snapper fishery is already above economically efficient levels vis-a-vis recreational catch. This analysis indicates that in order to improve economic efficiency commercial Snapper fishing could be reduced. Given current effort controls used in the fishery it is recommended that current management of the fishery be reviewed.

National and international experience shows that there are some policy options that may provide some benefit to the Snapper fishery. Three options include implementing further input controls, introducing an ITQ system or using a combination of both. Nonetheless, any policy changes should be implemented only if the benefits outweigh the costs involved.

Appendix A: Variations in CPUE between seasons

CPUE represents the catch in the fishery per unit of effort exerted. To illustrate the potential impact of changes in CPUE between seasons consider figure A1.

Figure A1: Movements in supply as a result of changes in average CPUE between fishing seasons



A change in CPUE will change the marginal cost of fishing and hence the dependent supply curve. This works in exactly the same way as introducing an updated piece of machinery into a factory. Because the cost of catching each kilogram of Snapper has changed, the resultant supply curve also changes.

For the purpose of this example, it has been assumed that CPUE decreases between fishing season 1 (S_1) and fishing season 2 (S_2) and again in fishing season 3 (S_3). This results in an upward shift in the supply curve as the cost of catching each kilogram of Snapper increases.

Figure A1 also illustrates how the shift in the supply curve between fishing seasons will affect the commercial economic value of the fishery. With the commercial economic value for fishing season 1 represented by the area ADG and fishing seasons 2 and 3 represented by the areas BDF and CDE respectively. This change in the commercial economic value between seasons will effect how the Snapper resource should be divided between the commercial and recreational fishing seasons.

Interrogation of the data revealed that CPUE does vary greatly between and indeed within seasons. It is for this reason that there is concern regarding the use of historical cost data between seasons to estimate an overall supply curve for the Snapper fishery.

Appendix B: Financial indicators

Table B1: Financial indicators (EconSearch 2002)

	2000/01	
	Boats with no Gill/Haul nets ($)	Average for all surveyed boats ($)
Gross Income	$36,186	$48,915
Costs		
Fuel	$4,597	$5,818
R&M	$3,217	$4,355
Bait	$1,145	$1,666
Provisions	$996	$1,166
Labour	$19,201	$22,193
Licence fee	$2,657	$3,596
Insurance	$1,445	$1,774
Intrest	$239	$269
Admin and other	$4,585	$5,411
Total cash costs	$38,082	$46,248
Cash operating surplus (excl unpaid labour)	$13,730	$18,132
Cash operating surplus (incl unpaid labour)	-$1,896	$2,667
Depreciation	$5,212	$7,704
Earnings before tax	-$7,110	-$5,037
Earnings before intrest and tax	-$6,827	-$4,768
Capital		
Fishing gear and equip	$41,724	$61,630
Licence value	$71,842	$84,223
total capital	$113,566	$145,853
Rate of return to fishing gear and equipment	-16.5%	-7.7%
Rate of return to total capital	-6.1%	-3.3%

2000/01	
Days fished (Julian Morrison email)	127
snapper fishing effort (person days)	7340
total catch (kg)	578000
kg of snapper per day	78.75
Total variable costs (highlighted)	$29,156
variable costs per day	$229.57
variable (marginal) cost per kg of snapper	$2.92

Appendix C: Sensitivity analysis

Figure C1: Demand sensitivity test – using demand equations from different data sets

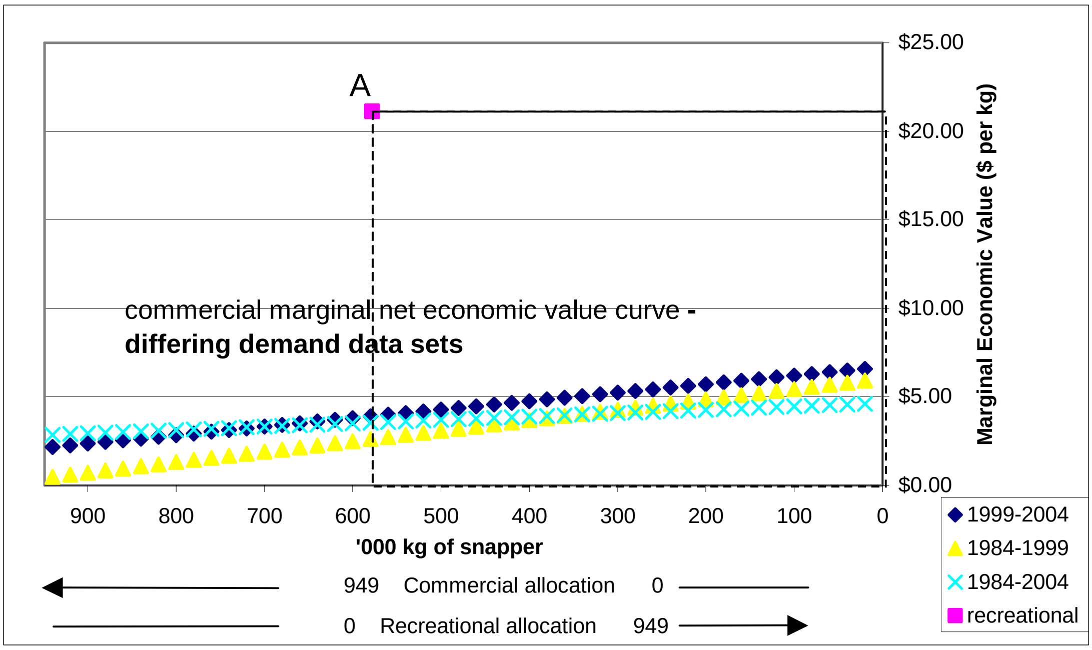


Figure C2: Variations in catch rates within a season

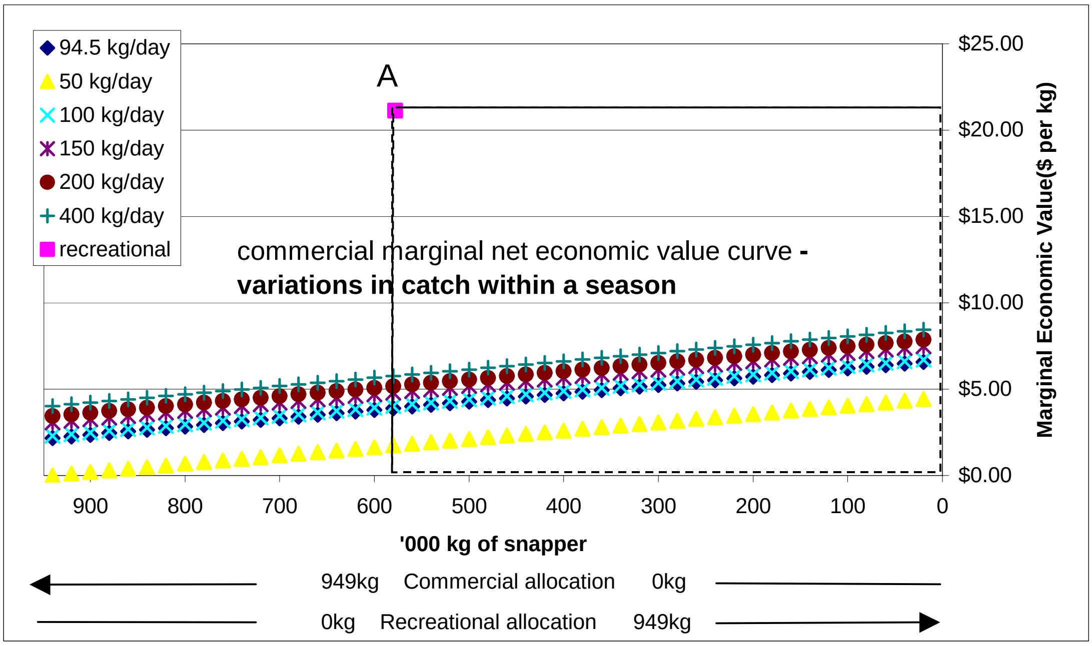
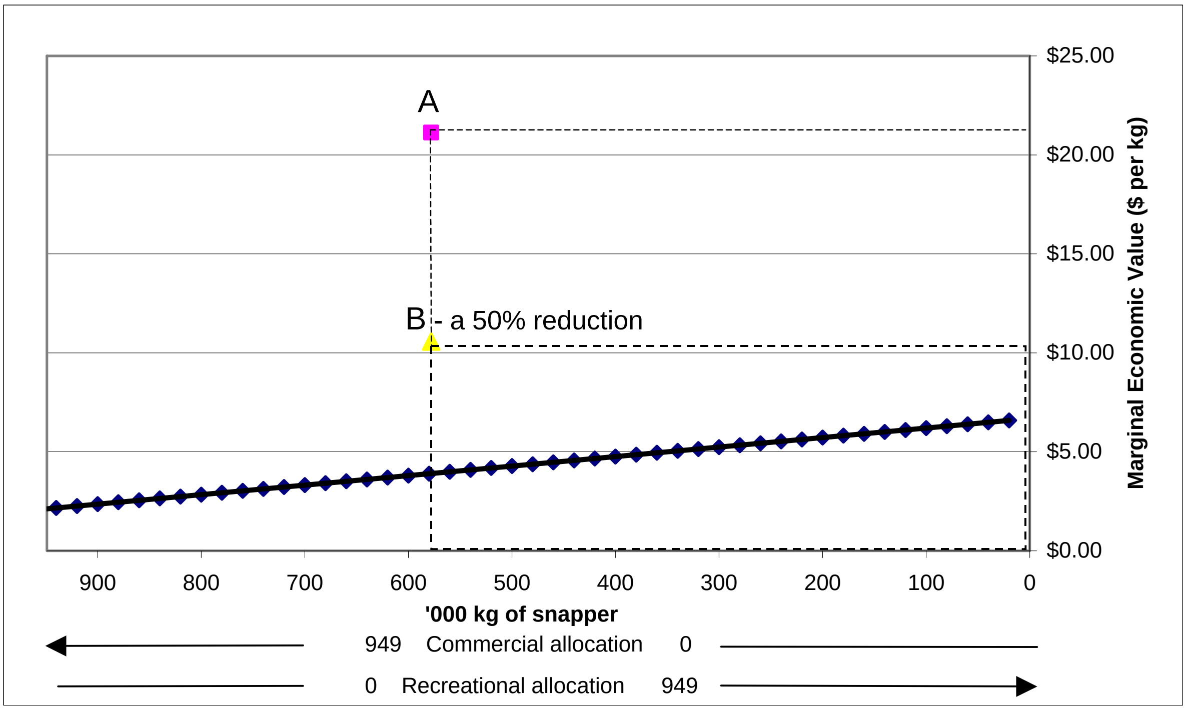


Figure C3: A 50% reduction in the recreational marginal WTP



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