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A theoretical framework for resource sharing between commercial and recreational fishers

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Abstract

Achieving an efficient allocation of fishery resource stocks between commercial and recreational fishers is often hampered by incomplete information about the economic value of these fisheries to the community. Economic data for Australia's recreational fishing sector are currently not readily available in a form that can be used for resource allocation decisions. The little data that are available provide a limited picture of the economic value of the sector. This is largely due to the non-market nature of goods produced by recreational fishing. This paper provides a theoretical framework for how non-market values associated with recreational fishing can be derived using the travel cost method. It then combines this with economic information from the commercial sector to assess the effect of changes in allocation of a fish stock between recreational and commercial fishers. The framework assumes that the commercial and recreational catch is regulated via a total allowable catch. The paper also highlights some of the impediments of using this framework in applied analysis. The description of the travel cost method in a recreational fishing context is supported by a summary of some recent work undertaken by ABARES in valuing game fishing activities in eastern Australia.

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1 Introduction

Economic data for the recreational sector can help measure the economic value of the sector, evaluate its contribution to the broader economy and assist managers with considering resource access and allocation between recreational and commercial fisheries. The value of the sector is a measure of social welfare and is measured using net economic value. The term 'contribution' refers to the gross change in the economy that can be attributed to a particular sector.

Recreational fishing is a popular activity. The most recent national recreational fishing survey estimates that about 3.4 million Australians engage in recreational fishing each year, directly contributing an estimated $1.8 billion to the economy (Campbell & Murphy 2005; Henry & Lyle 2003). Studies on expenditure data for recreational fishing at the Australian state jurisdictional level are also available as are some site-specific non-market valuation studies. The lack of a consistent or regular methodology for collecting economic information on recreational fishing highlights the need for more consistent economic data on recreational fishing. This deficiency has recently been recognised in Georgeson et al. (2015), where a framework for future regular national recreational fishing surveys was presented.

In this paper a distinction is made between economic output and economic contribution. Gross value of production (GVP) is a measure of economic output of commercial fisheries and recreational fishery expenditure is a measure of the economic output of recreational fisheries. Similarly to commercial fisheries, expenditure by anglers on recreational fishing represents the sum of all intermediate inputs, and associated value added, required to produce the recreational fishing experience. Economic output is not a measure of the economic contribution that a sector makes to the overall economy, measured in terms of contribution to gross domestic product (GDP). Only the value-added component of expenditure is relevant.

Expenditure data can be used for a range of purposes, including as an input to economic models to measure the regional or national impact of recreational fisheries on income levels, employment and the economy more broadly. A contribution analysis provides information on the relative economic size of a sector and the resulting flow of economic activity through the economy (Watson et al. 2007). Expenditure data are also an essential input to travel cost analyses, which is an economic valuation technique suited to measuring the use value that anglers place on being able to fish in specific locations.

The multifaceted nature of the recreational sector's output makes estimating the total economic value of the recreational fishing sector complicated. Commercial fishers produce goods that are traded on the market, where the market determines the food value of the fish produced. Recreational fisheries typically produce a recreational service, where the value a fisher derives from participating in a fishing activity is a composite of a range of values—including enjoyment of the outdoors, satisfaction of catching your own fish and food value of the fish caught. These values are non-market in nature and are difficult to measure in dollar terms. Importantly, fisheries resource users other than recreational fishers also share many of these non-market values; these values are often overlooked when valuing the commercial fishing sector.

The non-market nature of goods produced by fishing—particularly recreational fishing—makes it difficult to compare the economic value associated with recreational fisheries with the economic value of other sectors, including commercial fisheries. Making such comparisons between sectors requires application of a non-market valuation methodology.

A number of methods have been developed to estimate non-market use and non-use values, broadly classified into ‘revealed preference’ and ‘stated preference’ methods. Frequently used revealed preference techniques in the economics literature include methods such as the hedonic pricing method and travel cost method. These methods are suited to calculating the non-market use value associated with use of a resource. Revealed preference methods value non-market benefits and costs by observing consumers’ behaviour in markets for related goods and services. Stated preference methods are able to estimate both the use and non-use values associated with use or existence of a resource. Popular techniques used in this framework of analysis include choice modelling and contingent valuation techniques. These methods rely on asking people to state their preference for non-market impacts using hypothetical contexts.

The most widely applied method to determine the economic value of recreational fishing is the travel cost method. Similarly to all revealed preference approaches to valuation, the travel cost method underestimates the total net economic value as it only measures the use values. However, the method is relatively inexpensive to apply at a local level and provides a good indication of potential non-market benefits of the recreational sector. It also relies heavily on site-specific expenditure data, which are frequently collected as part of recreational fishing surveys.

Expenditure data provide little information for determining efficient resource access and allocation arrangements between users, including recreational and commercial fishers. In the case of a resource sharing issue between two or more sectors, the net benefit or net economic value of each sector in a particular area needs to be considered and evaluated at different allocations to determine whether the changes in allocation can provide an increase in net benefits. Many of the non-market methods available are site-specific in their application and provide a measure of value applicable for a specific point in time and for a set resource allocation. With additional information about the relationship between the participation rates, expenditure and catch, the net economic value of changing resource allocation can be determined. Each recreational fishing site is different and would require its own estimates of value to be useful for developing resource sharing arrangements.

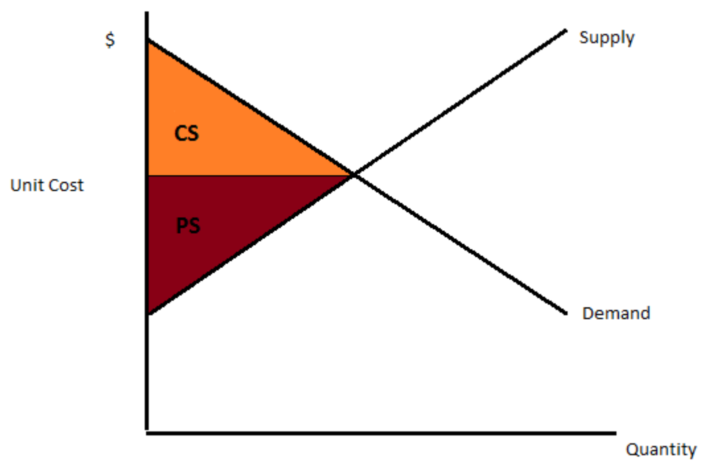
This paper provides a theoretical framework for how non-market values associated with recreational fishing can be derived using the travel cost method. It then combines this with economic information from the commercial sector to assess the effect of changes in allocation of a fish stock between recreational and commercial fishers. The framework assumes that the commercial and recreational catch is regulated via a total allowable catch. Difficulties in using this framework in a policy sense are highlighted.

2 Theoretical model for addressing fishery resource allocation issues

Total economic value of a good or service is the level of satisfaction people derive from consuming that good or service. This satisfaction is expressed through people's total willingness to pay for the good or service, which is often above what they actually pay. The net economic value is part of the total economic value and includes consumer and producer surplus. Consumer surplus is the net willingness to pay, which is the difference between what consumers actually pay (expenditure measured in market price) and what they would be willing to pay (represented by their total willingness to pay). Producer surplus is the amount received by sellers for providing goods and services less the resource costs of bringing those goods and services to market.

With the availability of price and quantity data, the demand and supply functions for a good can be determined and the net economic value can be estimated. In Figure 1 the net economic value is the sum of consumer surplus (CS) and producer surplus (PS) for a hypothetical fish market. Consumer surplus (net willingness to pay) is the value to buyers of purchasing fish (total willingness to pay) minus the amount paid by buyers. Producer surplus is the amount received by sellers for supplying fish minus the cost of this supply to sellers. The vertical axis (Unit cost) represents the price for fish and the horizontal axis (Quantity) represents the number of fish consumed.

Figure 1 Concept of net economic value



CS Consumer surplus. **PS** Producer surplus.

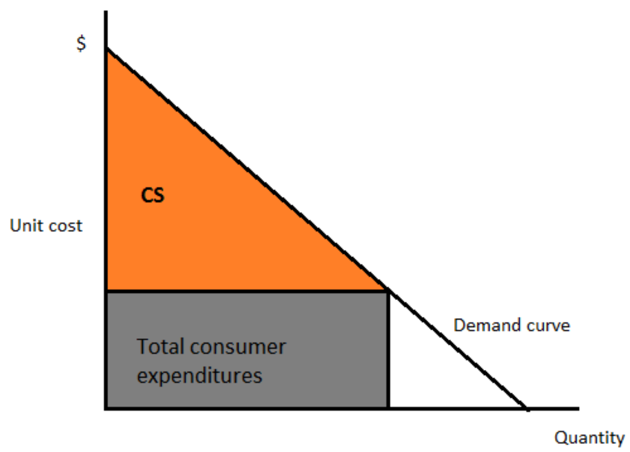
Unlike commercial fishers, who sell their catch in organised markets, recreational fishers do not pay directly for their fishing experience and, therefore, do not reveal the associated value they gain from catching fish. This makes estimation of net economic value difficult. Therefore, non-market valuation techniques are often used to estimate fishers' willingness to pay for recreational fishing. Recreational fisheries usually provide a range of values that can be categorised into use and non-use values. The net economic value derived from recreational fisheries is composed of an aggregation of both these type of values.

For recreational fisheries, the direct use value represents the value fishers derive from participating in recreational fishing activities. Indirect use values from recreational fisheries include maintaining sustainable and ecologically healthy fisheries (Tietenberg 2010). Non-use values include the value the community places on knowing that these fisheries exist, that options for future use are retained and that these environmental assets can be bequest to future generations (Perman et al. 1999). Estimating the full range of these values is complex and economic analysis to date has mostly focused on estimating direct use value.

A travel cost method is a common method used to estimate recreational use value (TEEB 2011). It has been applied in a large number of non-market valuation studies (Garrod & Willis 1999; Haab & Mcconnell 2002; Ward & Beal 2000) including for recreational fishing (Ezzy & Scarborough 2011; Hailu et al. 2011; Rolfe & Prayaga 2006; Shrestha, Seidl & Moraes 2002; Pascoe et al. 2014).

The travel cost method is based on expenditure to visit a site to participate in recreational activity. Due to the absence of price information on the value of the fishing trip, the demand for the activity is derived indirectly by assuming that the travel cost of a recreational fishing trip can be used as an alternative for price. Consumer willingness to pay for fish increases with each additional good but at a decreasing rate. This applies to situations in which fish are used either for food or for recreational activity. This means the additional satisfaction from consuming fish or participating in additional recreational fishing trips gets smaller, the more the consumption or recreational fishing continues. The changes in quantity of fish consumed or quantity of recreational fishing trips made over time affects the relationship between the price of a fish or price of a trip. This relationship is commonly used to indirectly determine the demand function for recreational goods, allowing for measurement of their net economic value in terms of consumer surplus (Figure 2). The vertical axis represents the unit cost of a fishing trip and the horizontal axis represents the number of fishing trips (quantity) pursued at each unit cost level.

Figure 2 Concept of estimating the net economic value for recreational fishing



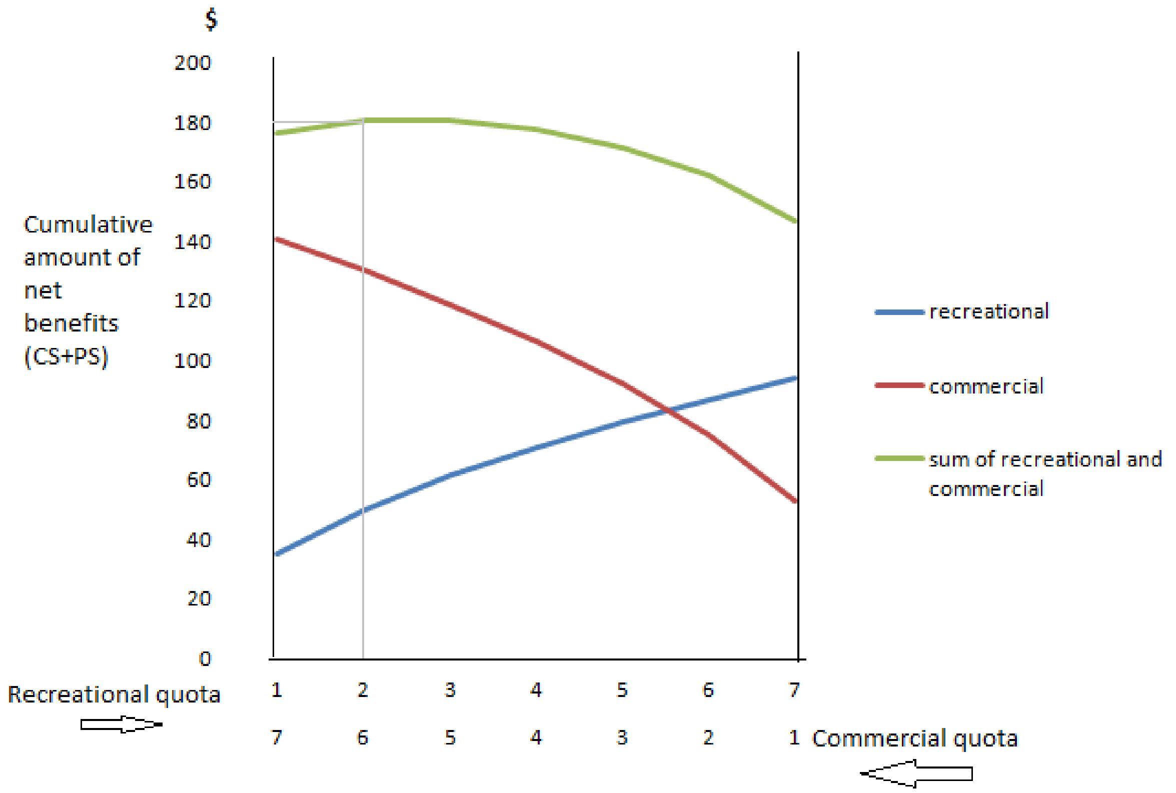
CS Consumer surplus

An average consumer surplus per trip per fisher can be estimated from the travel cost method and multiplied by the number of recreational trips undertaken to a certain location over a period of time to obtain the net economic value of recreational fishing at a particular location. This net economic value of recreational fishing can be compared with the net economic value of commercial fisheries at the same location and the effect of a potential change in allocation can be estimated as presented in Figure 3. By estimating the net economic value of both sectors for different resource allocation scenarios, the option that maximises the net social benefits across the two sectors can be chosen. Such estimations are generally recommended where there are competing users and any changes in resource allocation in terms of quota or resource access for a certain resource or location would result in an increase in economic welfare.

Figure 3 presents how quota (or resource access) can be shared between commercial and recreational fisheries in a way that maximises net social economic benefits for a hypothetical example where there is eight units (for example, tonnes) of total allowable catch (TAC) to be shared between the fisheries. There are three possibilities: allocate all of the TAC to the recreational sector; allocate all of the TAC to the commercial sector; or share the catch between the commercial and recreational sector. As drawn, net social benefits are not maximised by allocating all of the TAC to either sector, despite the net benefit of allocating the total TAC to the commercial sector ($150 million) being greater than the net benefits that would be derived by allocating the total TAC to the recreational sector ($100 million). In addition, any sharing arrangement does not need to be equal—that is, the allocation between commercial and recreational sector does not need to be shared equally between the two sectors.

In this hypothetical example, granting a TAC of six units to the commercial sector and two units to the recreational sector maximises net social benefits at around $180 million ($50 million for the recreational sector and $130 million to the commercial sector), which is higher than either sector can generate on its own. This allocation is unique in that the marginal benefit of an incremental movement to that allocation offsets the marginal loss experienced by the sector losing quota. At all other allocations it pays to adjust the allocation toward the optimum because the gains of the winning sector would be higher than the losses of the other sector, which is a condition for moving toward a 'Pareto optimum'. The optimal allocation shown in Figure 3 is difficult to determine in practice; however, the presented model can provide information on whether any intended changes in allocation can lead to an improvement in net benefits. The presented example is just one possible outcome for a particular location, targeting a particular stock. Every location will be unique and lead to a different maximal allocation, with the final allocation depending on the marginal benefit attained from an additional unit from the respective sectors, and how this benefit changes as additional units of quota are allocated. In some cases it may be socially optimal for the entire TAC to be taken by one sector. This will be the case where the net benefit attained by one sector from fishing is always greater than the loss accruing to the alternate sector across all feasible allocations of the TAC. An example would be a commercial species that recreational fishers rarely target despite the resource being available to them, indicating a low total net benefit and marginal benefit from targeting for recreational fishers. In this scenario, it is optimal for the entire TAC to be taken by the commercial sector. The converse is true for a species that offers high sport value but little commercial value, which will result in recreational fishers taking the entire TAC.

Figure 3 Total net benefits from allocation of quota between commercial and recreational fisheries



CS Consumer surplus. **PS** Producer surplus.
Source: Adapted from Edwards (1990)

Resource allocation questions are necessarily complex. Expenditure data collected is unlikely to be able to be used on its own to address specific resource allocation questions. Consequently, a more uniform collection of expenditure data with the possibility of application in the travel cost method could help with estimating consumer surplus for recreational fisheries more cost-effectively.

3 Travel cost method and its application to the theoretical model

The estimates obtained from the travel cost method can be a useful input to a standard cost–benefit analysis framework where the objective is to determine the effect of a potential change in allocation between commercial and recreational fishers for a specific fish resource. More specifically, the cost–benefit analysis framework is based on estimating the value of consumer surplus and producer surplus that make up the net economic value. When measuring the economic benefits of resource allocation, the net economic value of each choice can be measured and compared.

The travel cost method uses observed consumer behaviour relating to demand for recreational goods to estimate the non-market benefits that individuals derive from participating in recreational activity (Ward & Beal 2000). These benefits are estimated from the underlying demand function, evaluated through the method, for consumption of the recreational good. This demand function is estimated from survey responses on the cost of travel to access the environmental good and the visitation rate. As expected from economic consumer theory, quantity demanded for recreational goods is inversely related to the price of access to the good because the longer the distance travelled to visit a site, the higher the cost of travel and the lower the rate of visitation (Randall 1994).

Because the travel cost method is based on expenditure to visit a fishing site and participate in the activity, the models tend to underestimate (because they only value the use values) the consumer surplus—the area under the evaluated demand function—of the recreational good (Randall 1994). The travel cost method concentrates on expenditure to participate in a recreational activity rather than on the whole non-market benefits, including non-use values. Other common problems with applying the travel cost method are choice of dependent variable, multi-purpose trips, multi-destination trips, calculation of distance costs, holidaymakers versus residents, availability of substitute sites that may affect values, and time and sampling biases. Despite these issues, the travel cost method is the most common method used to estimate the value of recreational fishing because it provides a reasonable minimum value of consumer surplus.

Application of travel cost method

An example of an application of a travel cost method to value recreational fishing is presented in Ward et al. (2012). This study focuses on game fishing in two regions on the east coast of Australia—Bermagui and Port Stephens.

A survey was developed to gather information about game fishers' willingness to pay for game fishing trips. The dependent variable for the travel cost method applied in the study was frequency of trip visits to the study site (the number of game fishing trips per year). A one-year-period model was used to estimate consumer surplus obtained from the game fishing activity. To include resident game fishers, a game fisher trip was defined as an angler travelling to a Bermagui or Port Stephens access point (boat ramp or marina) to spend time game fishing before returning home or to the place of origin of the trip.

The demand function for the 'average' game fisher visiting the site was estimated using the Poisson and negative binominal regression models that take into account the relationship between price of travel cost and socioeconomic factors. Both approaches use regression analysis that takes into account the relationship between price of travel, time cost and game fisher characteristics.

The sample was biased toward longer distance visitors and tournament participants. However, a small number of local visitors participating in the tournaments could reflect the actual situation. Another limitation of this study was that the fishing equipment, food, accommodation, mooring fee, boat fuel and other expenditure that respondents reported could not be taken into account in the travel cost method because some respondents reported a group cost. The overall travel cost method of analysis appears to be suitable for valuing recreational trip demand.

Several functional forms are available to estimate the trip generation function; for example, linear, quadratic, semi-log and double-log forms. Count data models are commonly used to calculate consumer surplus using the Poisson or negative binominal regression distributions (Ward & Loomis 1986). The Poisson and negative binominal regression distributions are described in this section.

If μ is the rate of expected number of game fishing trips in a given period of time and y is the rate of occurrence of game fishing trips in a given period of time, the relationship between the expected count (μ) and the probability of observing any observed count (y) is specified by the Poisson distribution

$$\Pr(y|\mu)=\frac{e^{-\mu}\mu^{y}}{y!} \quad \text{for } y=0,1,2,\ldots\ldots$$

where $\mu>0$ is the sole parameter defining the distribution (Long & Freese 2006, p. 351).

If visitors who differ in their rates of visits are combined, the univariate distribution of visits will be overdispersed (that is, the variance is greater than the mean; Long & Freese 2006, p. 358). Differences in rates of visits can be a result of other factors such as gender, income or other socio-demographic characteristics. To account for such differences these factors need to be specified as independent variables.

Often the Poisson model does not fit observed data due to overdispersion. To address overdispersion the negative binomial regression model is applied. The negative binomial regression model adds a parameter, α, that reflects unobserved heterogeneity among observations. Starting from the Poisson model:

$$\mu_i=\exp(\beta_0+ \beta_1 x_{i1}+ \beta_2 x_{i2}+ \beta_3 x_{i3})$$

The negative binomial regression model adds an error, ε, that is assumed to be uncorrelated with the x's

$$\mu_i = \exp(\beta_0+ \beta_1 x_{i1}+ \beta_2 x_{i2}+ \beta_3 x_{i3})\exp(\varepsilon_i)$$

The Poisson model and the negative binomial regression model have the same mean structure.

The test for overdispersion was conducted. The hypothesis tested was: $H_0:\alpha=0$. Because $\alpha>0$ there is significant evidence of overdispersion (Long & Freese 2006, p. 351).

Because of the zero truncated nature of the game fishing trip data, the zero truncated Poisson and zero truncated negative binomial regression models were the most appropriate to use (Cameron & Trivedi 1986; Cameron & Trivedi 1998; Creel & Loomis 1990; Grogger & Carson 1991; Hellerstein & Mendelsohn 1993; Hellerstein 1991; Winkelmann 2000).

The mean individual consumer surplus value per visit representing angler is calculated as:

$-1/\beta$

where β is the coefficient on travel cost.

Sample characteristics

The socio-demographic characteristics of respondents were very similar between survey sites (Table 1 and 2). For categorical variables like age, weighted averages were estimated from the frequency of responses for the midpoint of each category. The average age of respondents was around 44 years and the average years of education was 12. Most respondents were male and most travelled by four-wheel drive. Their average annual household income was relatively high (over $100 000) and most of the respondents belonged to a game fishing club.

Table 1 Demographic characteristics of tournament respondents

Characteristic	**unit**	**Bermagui**	**Port Stephens**
Respondents	no.	158	149
Gender (male)	%	91	94
Average age	no.	44	43
Average years of education	no.	12	12
Self-employed	%	36	52
Average household income	$	104 000	126 000
Club member	%	85	96
Game fishing was main reason for travel to this site	%	97	96
Came with friends	%	55	49
Came with family	%	35	31

Table 2 Characteristics of tournament respondents

Characteristic	**unit**	**Bermagui**	**Port Stephens**
Number of respondents	no.	158	149
Days spent game fishing in this location on this trip	no.	4	5
Average number of game fishing days in the location in the past year	no.	11	9
Average number of game fishing trips in the past year to that site	no.	4	6
Average distance travelled one way	km	470	282
Travelled by four-wheel-drive	%	73	53
Travelled by boat to this destination	%	3	8
Own or part own the boat used on this trip	%	44	42

Travel cost

Zero truncated Poisson and zero truncated negative binomial models were tested for tournament respondents. Two different versions of the models were compared. The travel cost based on the fuel cost, the fuel usage of an adequate mode of transport and the number of kilometres travelled in a return trip to Bermagui or Port Stephens was used in the model. Based on respondents' postcodes the number of kilometres respondents travelled was verified using Google maps (Table 3).

Table 3 Average expenditure on travel for each site

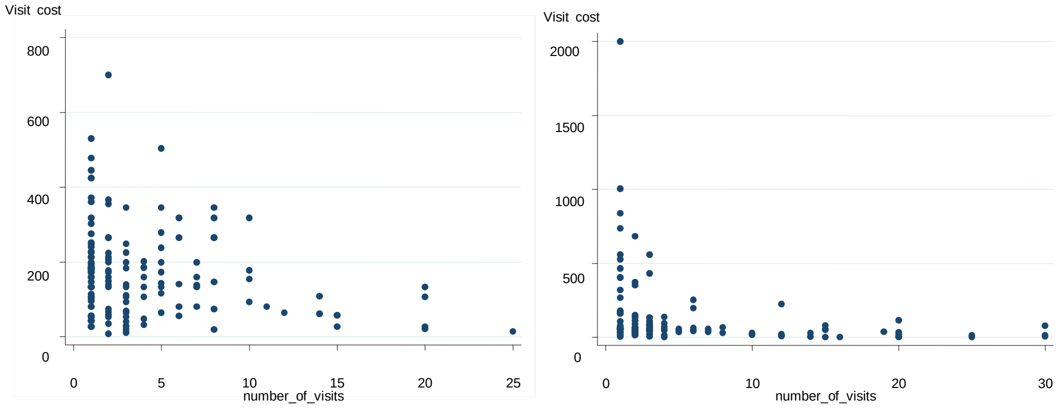
Variable	unit	Bermagui		Port Stephens	
		Average	Stand. dev.	Average	Stand. dev.
Travel distance)	km	470	391	282	672
Travel time	h	5.6	4.0	2.8	2.1
Travel cost including travel time	$	292	177	181	247
Estimated travel cost per trip	$	166	138	116	224
Number of adults in a vehicle	no.	2.7	1.5	2.5	1.6

A graphical presentation of the relationship between the number of visits and the visit cost is shown in Figure 4. As expected, this shows that the number of visits tends to diminish as the travel cost rises. However, this relationship is not linear and the data are characterised by overdispersion. One observation in the Bermagui sample and three observations in Port Stephens were identified as extreme values for the number of visits and were omitted from the dataset.

The results of a large number of models were compared using Akaike information criterion, Bayesian information criterion and log-likelihood tests. The best models with significant coefficients were selected for Port Stephens and Bermagui. The results reveal that the zero truncated negative binomial model, which accounts for overdispersion, outperformed the zero truncated Poisson model. The results of the best zero truncated negative binomial models for Bermagui and Port Stephens are presented in Table 4. Based on chi-squared statistics it can be concluded that all the estimated coefficients in the models presented in Table 4 are significant and of expected sign.

Figure 4 Distribution of relationship between costs and number of visits

(a) Bermagui (b) Port Stephens



Coefficients are signed as expected. For example, the number of trips declines as travel costs increase in both the Bermagui and Ports Stephens models. The Bermagui models indicate that the likelihood of undertaking game fishing trips increases when respondents are club members, if they come with family and if game fishing is not the only reason for the trip. The Port Stephens model indicates that younger respondents, respondents who came with family and who did not use a four-wheel drive for the trip are more likely to undertake a game fishing trip to this site. The Bermagui and Port Stephens models show significant overdispersion in the data.

Table 4 Negative binomial travel cost models for Bermagui and Port Stephens

Bermagui	**Coefficient**	**Std error**
Travel cost per trip (return)	–0.0030***	0.0009
Club member	1.1627***	0.3748
With family	0.7135***	0.2362
Game fishing as main reason	–1.0782**	0.7599
First time	–2.3149***	0.5512
Constant	1.0341***	0.7308
Number of observations	158	–
Log-likelihood	–323.11	–
Chi^2	41.72	–
Degrees of freedom	5	–
Alpha	1.6510	0.6760
Port Stephens	**Coefficient**	**Std error**
Travel cost per trip (return)	–0.0059***	0.0011
Age	–0.0179**	0.0083
With family	0.6448***	0.2554
Travelled by four-wheel-drive	–0.5003**	0.2481
First time	–1.9390*	1.1448
Constant	2.6413***	0.4843
Number of observations	149	–
Log-likelihood	–360.08	–
Chi^2	39.68	–
Degrees of freedom	5	–
Alpha	1.8649	0.6484

*** = significant at 1 per cent level, ** = significant at 5 per cent level, * = significant at 10 per cent level

Estimating game fishing trip value

The surveys were designed and samples selected on the basis of information provided by the Australian Fisheries Management Authority. The consumer surplus represents the difference of individual willingness to pay and actual expenditure on the game fishing trip. The consumer surplus for these demand models were estimated using the negative inverse of the travel–cost coefficient $1/\beta$ travel cost. The consumer surplus per trip and confidence intervals are presented in Table 5.

Wide confidence intervals for the Bermagui sample highlight the relatively small sample size to estimate count data models, combined with the high level of heterogeneity in the types of recreational users and visitation patterns.

Table 5 Consumer surplus

Component	unit	Bermagui	Port Stephens
Consumer surplus per trip	$	334	168
95% confidence intervals	$	207–869	123–265
consumer surplus per adult	$	124	67
95% confidence intervals	$	77–321	49–105

The consumer surplus of a trip to Bermagui was substantially higher than that of a trip to Port Stephens. Respondents valued a game fishing trip to Bermagui at $334 per group ($124 per adult) compared with $168 per group ($67 per adult) for Port Stephens.

The results obtained from the presented example of estimating consumer surplus show that the consumer surplus of recreational fishing differs among sites. However, the estimates of consumer surplus from this study are comparable to other studies of recreational activities. For example, Prayaga et al. (2010) estimated the consumer surplus of recreational fishing trips in the Great Barrier Reef Marine Park at $385 per group ($167 per angler). Rolfe and Prayaga (2006) estimated the value per person per recreational fishing trip at between $60 and $998 for three Queensland dams. Rolfe and Dyack (2011) estimated the value per group for trips to the Coorong at $714. Of particular relevance is the study by Ezzy and Scarborough (2011), which estimated the value of non-tournament game fishing trips to Portland for southern bluefin tuna at $132 per group ($33 per person).

The values estimated in this study, and other recreational values estimated using the travel cost method, can be used in further cost–benefit analyses of different resource access scenarios between recreational and commercial fishers or estimation of the total economic value of recreational fishing sector in Australia. Based on the estimates of consumer surplus, a total consumer surplus can be estimated by multiplying the average consumer surplus per person per trip by a number of trips to the specific region. This total consumer surplus for a specific allocation of resources can be compared with the total consumer and producer surplus of the commercial sector in a specific region or location. Any significant changes in fisheries allocations can affect both the consumer surplus of the recreational and commercial sector and the producer surplus of the commercial sector. Therefore, with any changes a new estimation of net total benefits for both sectors should be estimated and compared in order to make informed resource allocation decisions.

4 Summary

This paper explains a theoretical framework for resource allocation between commercial and recreational fisheries and explains that expenditure should not be interpreted as the economic value of the sector. The paper emphasises the importance of determining efficient allocation between commercial and recreational fisheries based on trade-off in net economic values. The general framework presented in this paper is based on economic theory and provides clarification of the concept and method applicable to cost–benefit analyses of fisheries allocation between competitive users. The paper also provides a useful guideline and understanding of how to incorporate recreational fishing into fisheries management decisions when both commercial and recreational fisheries coexist. However, addressing management issues requires reliable and consistent data that would allow estimation of consumer surplus and appropriate extrapolation of values to estimate the total net benefit. Given the complexity involved in collecting these data, the framework may not be practicable for all scenarios.

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