Estimating the recreation use values of National Parks

Jeff Bennett*

Abstract

A comprehensive application of the travel cost method (TCM) to the estimation of the recreation use values of Dorrigo and Gibraltar Range National Parks is outlined. As well as providing value estimates that are useful for the development of park acquisition and management policy, the application also provides some important lessons for the future use of the TCM. So long as some key assumptions relating to the value of travel time and site congestion are shown to hold, then a stream-lined version of the TCM can be used. The questionnaire required to implement the abridged version is brief, thus encouraging a better response rate. Survey and analysis costs are therefore likely to be lower, making the TCM a more cost-effective decision making tool.

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* Associate Professor, School of Economics and Management, The University of New South Wales, Canberra ACT 2600 and Principal, Environmental and Resource Economics, "Manandawara", Gundaroo NSW 2620

1. INTRODUCTION

Most of the goods and services provided by protected natural areas such as National Parks and Nature Reserves are normally not directly bought and sold in conventional markets. Because of this characteristic, dollar estimates for the values of these goods and services are not readily available. Without dollar estimates of the benefits of natural ecosystems protection, decision making regarding the establishment of new parks and the management of existing parks is made more difficult. Comparisons between alternative options are complicated by the lack of a single unit of measurement for the benefits and costs involved. Without dollar estimates of the benefits that flow from conservation options, there is a danger that those options will be either ignored in decision making or inaccurately valued. Inappropriate allocations of resources are then likely and society's well-being would be compromised.

To provide information relevant to decision making, economists have developed techniques designed to estimate the value of marketed and non-marketed goods and services in dollar terms. The estimation of marketed goods' benefits and costs is relatively straightforward and well practiced by economists. It involves the analysis of observed market supply and demand conditions. The estimation of non-marketed benefits and costs[1] is less straightforward. Two types of non-market valuation techniques have been developed:

- Related market or revealed preference techniques; and,
- Stated preference techniques.

Where specific relationships exist between the non-marketed benefits or costs under consideration and other marketed goods, the nature of the relationship can be used to infer values for the non-marketed benefits or costs. Techniques using these relationships are the related market methods. One of these methods is the Travel Cost Method (TCM). The TCM is designed specifically to estimate, in dollar terms, the values people enjoy from visiting a recreation site. These recreational values are one type of "use value" that are provided by National Parks. The method is based on the relationship that exists between the non-marketed use values and the marketed goods and services that are purchased as complements to a site visit. These goods and services primarily relate to the travel undertaken to make the visit. Hence the name Travel Cost Method.

Where no relationships are found to exist between non-marketed goods and any marketed goods, economists have sought to estimate values through examination of peoples' stated preferences. The best-known of these techniques is the Contingent Valuation Method (CVM). It involves respondents to a questionnaire being asked hypothetical questions regarding their willingness to pay for the non-marketed good under investigation. The

[1] Note that economists use the notion of opportunity costs to define costs. Opportunity costs are the value of the foregone option when a choice is made. Hence costs are defined in terms of foregone benefits. Therefore, recreational values generated from a natural area will be a benefit when a proposal to protect the area is being considered but a cost if a development proposal is being analysed.

CVM has been used to estimate the non-use values of protected areas. These values include existence, option, quasi option and bequest benefits. It has also been used to assess use values and the combination of use and non-use values - the total value of protected areas.

In this paper, a study aimed at estimating the recreation values provided by two National Parks - Dorrigo National Park and Gibraltar Range National Park is detailed. Both of these parks are located in the north east of New South Wales and make up part of the Central Eastern Rainforest Reserves (Australia) World Heritage Area. Because recreational values are targeted, the revealed preference based Travel Cost Method is appropriate. The study was carried out by Environmental and Resource Economics for the NSW National Parks and Wildlife Service in 1995.

Dorrigo and Gibraltar Range National present two very different case studies for the application of the TCM. Dorrigo is a high visitation, well developed park which caters almost entirely for visitors who stay for less than one day. In contrast, Gibraltar Range caters more for long stay campers with minimal facilities in a more remote location on the edge of a declared wilderness area

2. THE METHODOLOGY

In its simplest from, the TCM uses data collected from site users as to their place of residence and their costs of travelling to the site to estimate the function:

$$Vi / Ni = f(TCi) \qquad \text{Equation 1.}$$

where: Vi is the number of visits made to the site by people from a region 'i';
Ni is the population of region i, and,
TCi is the average costs of travelling to the site from region i.

From this equation, it can be observed how the visitation ratio (Vi/Ni) would change if a hypothetical fee of varying magnitude was to be charged for entry to the site. To do this it is necessary to assume that site visitors would respond to an entrance fee in the same way as they respond to higher travel costs. Thus for a particular region where the current average travel cost was $15, the visitation ratio predicted given a $5 entrance fee would be the visitation ratio predicted by the estimate of Equation 1 for a region where the current travel costs are $20.

By performing these extrapolations and summing total visitation numbers from across all regions at a range of different hypothetical entrance fees, an ordinary or Marshallian demand curve for the use of the site can be constructed. The area under this demand curve is an estimate of the total consumers' surplus enjoyed as a result of peoples' use of the site. A simple division of this total by the number of people currently using the park gives an estimate of the average per person benefit. This figure can then be extrapolated to

cover the population of users that is relevant to the time period context of the particular policy issue at hand

As has been noted, the TCM is critically dependent on the assumptions that people visiting a site would react to a visitation fee in the same way as they would to an additional cost of travelling to the site. However, the method also involves a number of other important assumptions

1. All visitors have the same benefit from the site and this is equal to the travel cost of the most distant user
2. The consumer surplus (the net benefit) of the most distant user is zero.
3. People in each region take the same quantity of visits at the same monetary cost.

Despite the relatively restrictive nature of these assumptions, the TCM has enjoyed widespread use internationally. One possible reason for this is its comparative simplicity. Yet the basic description of the methodology given above belies its complexity. A number of factors are critical in determining the nature of the problem under analysis. The way in which the TCM is applied is therefore determined by these factors, which are detailed below

2.1 Zonal vs Individual Model

Equation 1 was specified with "i" referring to the zone or region from which each site visitor has travelled. This formulation of the TCM involves the dilution of information provided by visitors through the aggregation of responses into zones. Estimating equation 1 is therefore a rather "heavy handed" way of explaining people' behaviour. Clearly, individuals' decisions to visit a site are determined on the basis of many factors - their income, age, sex, educational achievement, occupation, life cycle stage, etc - in addition to the cost of the trip. Aggregating responses across each zone prevents the use of these other factors in the process of explaining visitation rates. To avoid this loss, one version of the TCM bases the estimation of Equation 1 on "i" being each respondent. The dependent variable therefore becomes the number of visits to the site undertaken by each respondent in a defined time period. The list of independent or explanatory variables is expanded beyond TC1 to include the factors such as age, income etc as detailed above. The development of the ordinary demand curve then proceeds in the normal way except that the values for all the explanatory variables other than TC1 are held at their means as TC1 is varied as if it were inclusive of an entrance fee.

The success or failure of the individual model is dependent on the nature of the site under investigation. If a site is used on a recurrent basis by a large proportion of its visitors it is likely that the individual model will be most appropriate. However, where a site is used predominantly by once only visitors, the individual model will be unsuitable - if most visitors have only visited once, an estimation of the number of visits to the site per person will be irrelevant. In such circumstances, the zonal model, despite its bluntness, will be the appropriate version.

The decision as to which version is best suited therefore relies on an understanding of visitation patterns. If that is not available before the TCM is initiated, it is necessary to design the TCM questionnaire so that both versions can be implemented. The question necessary to implement the individual version - "How many times have you visited this site in the last year?" - provides the necessary information to determine if it or the zonal method is most appropriate.

2.2 The value of time

One of the most vexed issues in the travel cost literature is the question of how, if at all, the value of a visitor's time should be incorporated as a cost of the visit. The economic principle involved is that of opportunity cost. Where a visitor would have otherwise used their time to do something of value, then that foregone value should be incorporated as part of the travel costs of the trip.

This logic is counteracted by the argument that travel to a site can be, in itself, something that a visitor may value. Hence, to determine if it is necessary to consider the supplementation of other travel costs with the value of travel time, the degree to which respondent enjoy their travel time must be addressed in the TCM questionnaire.

If visitors indicate that they do not enjoy their travel time, then the value of their opportunity cost of time must be addressed. This entails determining the activity which would be undertaken by the visitor had they not travelled to the site. The TCM questionnaire must therefore ask what was the next best preferred activity of each visitor. Where this is identified as going to work to earn income which would otherwise not be paid, the appropriate opportunity cost is the marginal wage rate. However, if the next best activity is either staying at home or undertaking an alternative recreation - and so not earning any additional income - the appropriate opportunity cost of time is zero. In other words, there is no value lost because the alternative is on a par with the activity undertaken.

2.3 Congestion impacts

When a site becomes congested, visitation rates must be explained not just through the demand for visits but also with reference to the marginal cost or supply situation. With congestion, an individual's presence at a site creates marginal costs for other visitors. It is the interaction of these cost factors with demand that determines visitation rates. Because the TCM involves the estimation of demand alone, in the presence of congestion costs, the method is invalidated. In other words, the information secured through the TCM relates to forces of both supply and demand but because congestion causes unknown shifts in the supply curve through the imposition of additional marginal costs, the true demand curve cannot be determined. The supply-demand system becomes "under-identified" and the resultant TCM estimates will be unreliable. It is therefore important that a TCM questionnaire checks that congestion is not a severe problem.

2.4 Multiple purpose trips

In many instances, a visit to a site is not the sole purpose of a trip. The travel costs incurred during a trip are therefore not always directed at the enjoyment of the site under investigation. To include all the costs in the TCM would result in an overestimation of the site's use value.

To deal with this problem, the costs of a trip must in some way be apportioned between the different purposes of the trip. There are (at least) two ways of carrying out this apportioning. One is to allocate the costs of travel according to the time spent on the various purposes of the trip. Hence, the travel costs that relate to a particular site are equal to the total costs of the trip multiplied by the ratio of time spent at the site to the total time away from home.

An alternative way of apportioning costs is to do so with reference to the visitor's perception of the importance of the visit to the site relative to the other activities undertaken in the course of the trip. This is an admittedly more subjective approach to the apportioning task, both on the parts of the visitor and the analyst. For the visitor, a subjective scaling of relative importance is required. For the analyst, the qualitative scaling must be converted to a quantitative adjustment factor. Importantly, however, the process does enable recognition of the possibility that the importance of a visit may not be simply a function of time allocation.

3. LOGISTICS

The implementation of the TCM involves the administration of a questionnaire to a sample of site visitors. In the questionnaire, the factors influencing the manner in which the TCM is applied must be addressed in addition to the basic questions relating to respondents' travel costs and points of origin.

The questionnaire design[2] was structured around a self administered survey, ie respondents were handed a questionnaire on their arrival at the site and are then left to complete their answers. One questionnaire was issued to each group visiting the parks. A group was defined as people who had travelled to the site together.

The questionnaires were distributed in both Parks over the period of the Easter public holidays and the subsequent week of school holidays (14 - 23 April 1995). A further weekend of surveying was carried out on 29 -30 April 1995. Questionnaires were handed to all groups of visitors to the parks over the survey period. 2019 questionnaires were distributed in Dorrigo NP and 483 in Gibraltar Range NP. Questionnaires were both collected on site and mailed back.

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[2] Copies of the questionnaire are available from the author.

Acceptance of completed questionnaires through the mail was extended to 30 May. In total, 1375 completed questionnaires were received from the Dorrigo survey and 268 from Gibraltar Range. This represents return rates of 68% and 56% respectively.

4. ANALYSIS - DORRIGO NATIONAL PARK

The average number of trips made by groups to the park in the previous twelve months was 0.65. The median was zero (73% of respondents) and the standard deviation 1.6. This distribution of group visits indicates clearly that the individual TCM is inappropriate to the Dorrigo case study - the concentration of groups are once-off visitors and so an estimation of the relationship between visit frequency and travel costs would be pointless.

Over 90% of respondent groups indicated that their travel time had been "very enjoyable". Furthermore, less than 1% of group leaders indicated that their alternative to visiting the park was to go to work. These results show that a zero opportunity cost of time is appropriate to the TCM in this application.

Congestion is a severe problem for 8% of respondents but the majority of groups (76%) were unaffected by the number of other visitors in the park. Many of the comments given by respondents on the last page of the questionnaire related to problems created by noisy visitors (especially children) scaring away the birds at the forest walk. It is therefore apparent that congestion is approaching the stage where it could raise doubts as to the validity of the TCM. Easter is the busiest time of the year at Dorrigo National Park and so the problem can be seen as a seasonal one.

On the basis of these factors, the zonal TCM was pursued with a zero opportunity cost of travel implied.

The relationship existing between the rate of visitation per head of population and the travel costs of visitors from each zone is fundamental to the TCM. Its estimation must take into consideration three critical issues:

- defining total trip travel costs;
- the apportioning of the total trip travel costs to account for visitors engaged in multiple purpose trips; and,
- the selection of the most appropriate functional form for the relationship.

Three approaches were taken to the task of defining total trip travel costs:

1. total trip expenses as reported by each respondent (TEREP);
2. total trip distance as reported by the respondent, multiplied by the running costs per kilometre of a standard family car (14.63c for a Holden Commodore VR series - NRMA, 1994) (D$REP); and,
3. On the basis of the measured average distance from each zone to park and return, multiplied by the running cost value (D$Z).

Two approaches were taken to the task of apportioning total costs:

1. Total costs are multiplied by the ratio of time spent in the park to total trip time (TIME); and,
2. Total costs are multiplied by an index of the relative importance of the Dorrigo National Park portion of the trip (QUAL). This index is based on responses to two questions which sought respondents' qualitative assessment of the relative importance of their stay at the park. If the Dorrigo stop is the sole purpose of the trip, the index is set equal to 1. If the respondent is engaged on a multipurpose visit, the index is set equal to 1/2 if, relatively, the Dorrigo stop is "very important", 1/3 if "somewhat important", 1/4 if "a little important" and 1/5 if "not very important". This is a qualitative and hence somewhat subjective index but one that is based on respondents' rankings.

The selection of the most appropriate functional form is necessarily a matter of econometric analysis. Two functional forms were tried - the linear and the double log.

Table 1 sets out the alternative specifications of the travel cost visit rate relationship.

The statistical data set out in Table 1 show that the double logarithmic form is preferable to the linear form across the whole range of independent variables. The double logarithmic form yields higher R squared, t and F statistics. Similarly, the reported distance based independent variables appear to provide better explanatory power than the reported expenditures. The qualitative index for apportioning total trip costs outperforms the time based adjustment. There would appear to be little statistically to separate clearly the performance of the zonal based distance equations from the respondent reported distance equations. Both yield similar R squared, t and F statistics. This indicates a general level of accuracy on the part of respondents in their reporting of trip distance. Preference is given to the reported distance equations because of their stronger basis in the survey response. The overall preferred estimation of the visitation rates is therefore:

$$\underset{\qquad\quad(12.18)}{\text{LOG VIS} = 7.555} \; \underset{(-13.34)}{- \; 2.003 \; \text{LOG D\$REP (QUAL)}}$$

The estimated relationship, and the observed points are depicted in Figure 1.

Table 1. The travel cost - visitation rate relationship

Independent Variable	Coefficient (t statistic)	Constant (t statistic)	R squared %	F
TEREP	-0.058	5.774	38.3	6.84
(TIME)	(-2.62)	(3.38)		
LOG TEREP	-2.666	10.59	48.7	10.46
(TIME)	(-3.23)	(3.05)		
TEREP	-0.004	2.96	20.9	2.91
(QUAL)	(-1.71)	(2.81)		
LOG TEREP	-1.922	9.938	82.9	53.31
(QUAL)	(-7.3)	(6.83)		
D$REP	-0.334	7.907	61.7	17.69
(TIME)	(-4.21)	(5.02)		
LOG D$REP	-2.898	7.753	54.6	13.21
(TIME)	(-3.63)	(3.35)		
D$REP	-0.027	3.575	31.2	4.99
(QUAL)	(-2.23)	(3.28)		
LOG D$REP	-2.003	7.555	94.2	178.01
(QUAL)	(-13.34)	(12.18)		
D$Z	-0.259	6.618	38.0	6.74
(TIME)	(-2.60)	(3.26)		
LOG D$Z	-3.382	9.259	60.9	17.11
(TIME)	(-4.14)	(3.86)		
D$Z	-0.003	3.058	26.4	3.95
(QUAL)	(-1.99)	(3.10)		
LOG D$Z	-1.576	8.689	95.2	217.19
(QUAL)	(-14.74)	(13.63)		

Notes:

- The first line of the independent variable indicates the basis of the calculation of total trip travel costs whilst the second line in brackets indicates the mechanism used to adjust for multiple purpose trips.
- Where the log form of the independent variable (the travel cost variable) is indicated, the dependent variable (visitation rate) is also in log form.
- a 't' statistic, indicated in brackets under the coefficients and the constants, over 1.96 in absolute value terms indicates significance at the 95% level.
- The R squared statistic indicates the percentage of variation on the dependent variable that is explained by the estimated equation.
- The F statistic indicates the significance of all coefficients in the equation. A value over 3.84 indicates significance at the 95% level.

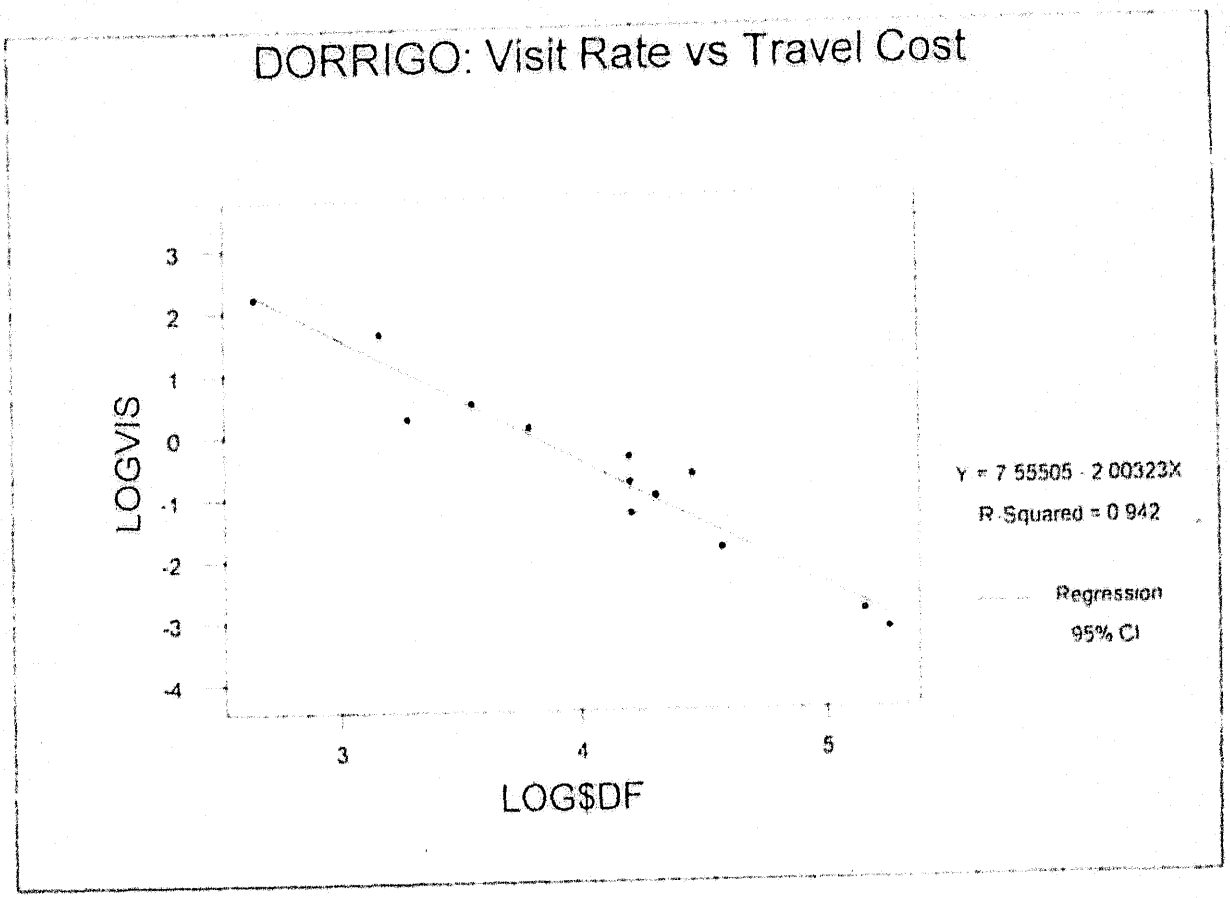

Figure 1. The Travel Cost Relationship - Dorrigo National Park

From the estimated relationship between travel costs and the visitation rates across zones, the demand curve for recreational visits at Dorrigo National Park is derived. By adding varying amounts of additional travel costs to simulate the imposition of varying entrance fees, the travel cost - visitation rate equation can be used to estimate the total number of visits made by people from across all zones that would still visit the Park.

Additional travel costs of amounts between $5 and $80 were used to simulate entrance fees and the resultant visit numbers calculated. This relationship between fee and visit numbers was then estimated using regression analysis. The two forms of this relationship that were estimated were:

FEE = 78.9 - 0.021 VISITS
(14.45) (-8.20)
R squared = 81.8 %
F = 67.24

and

LOG FEE = 15.912 - 1.693 LOG VISITS
(23.24) (-18.12)
R squared = 95.9%
F = 328.32

Again the double log form is preferred on the basis of superior R squared, F and t statistics.

The Dorrigo demand curve is displayed in Figure 2.

The area under the demand curve so estimated is equal to the consumers' surplus generated by the recreational experience enjoyed by those surveyed at Dorrigo National Park. It represents the amount the surveyed visitors would be willing to pay for their experience at the park, in excess of what they have to pay. In the case of Dorrigo National Park, what users have to pay is zero. The consumers' surplus is the economic value of the surveyed visitors use of the park.

The consumers' surplus for the surveyed respondents is calculated by integrating the demand equation, given cut off values for visits and fee to avoid the problems created by the exponential nature of the equation at each of the axes.

With a cut off fee of $100 and a cut off number of visits of 4700, the total consumers' surplus is equal to $81,435. This amounts to a per visit consumer surplus of $17.33.

To calculate an estimate of the annual recreation use value for Dorrigo National Park, it is necessary to extrapolate from the survey results. This requires information on the number of visits made per annum to the park, and an assumption that the surveyed visitors are representative of the population of visitors across the full year. Whilst it is impossible, given the information available, to test the latter assumption, surveying was extended beyond the Easter and school holiday period to ensure a more representative sample.

NPWS personnel at Dorrigo National Park maintain records of the number of people visiting the park. Currently, approximately 160,000 people use the park each year. On this

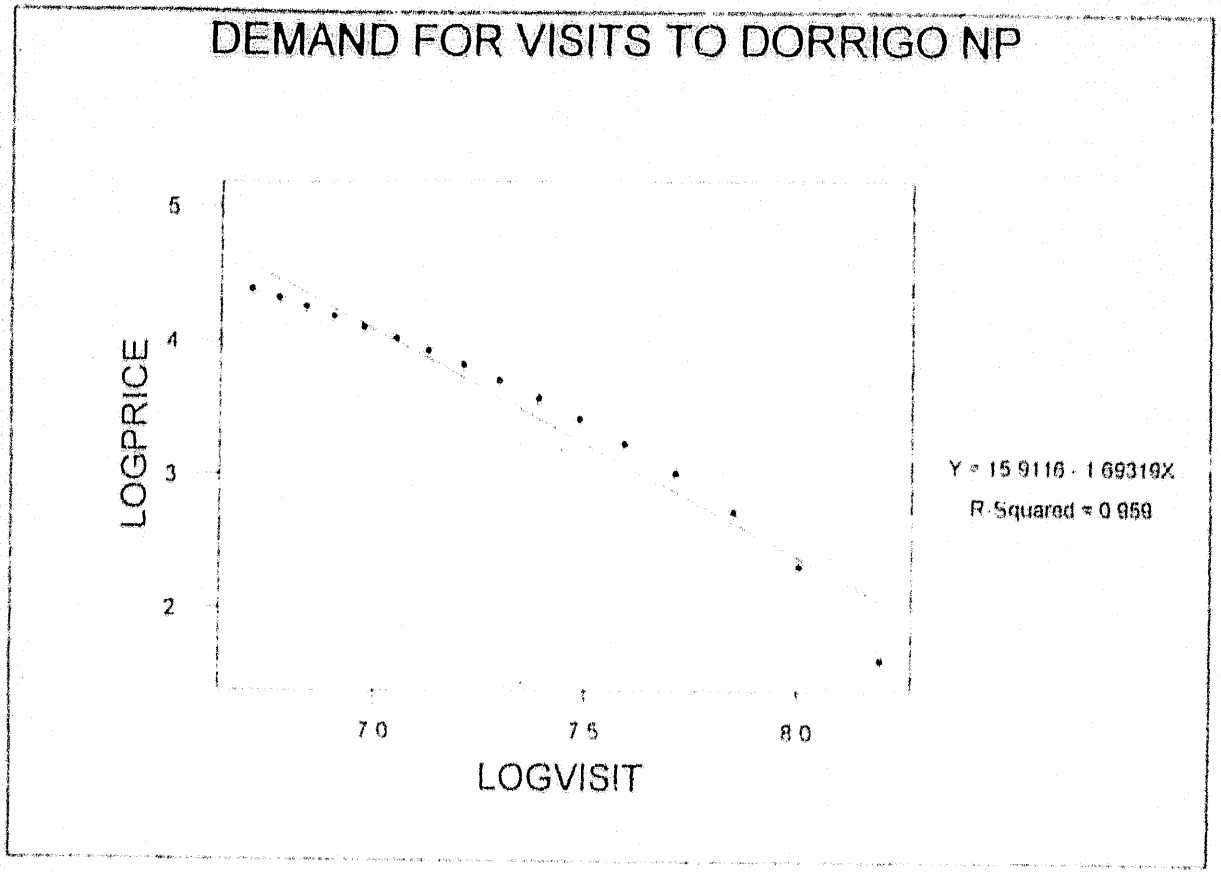

Figure 2. The demand for visits to Dorrigo National Park

basis, the economic value of recreation use of Dorrigo National Park is estimated to be $2,772,800 per annum.

To extend this value analysis beyond a single year, it is necessary to aggregate the expected stream of values that will occur through time. In order to account for the time value of benefit flows, the process of discounting must be applied. Assuming that the annual value of recreation use of Dorrigo National Park remains the same through time, the present value (or discounted value) of the stream of benefits over time is equal to almost $40m. This calculation is based on the use of NSW Treasury's recommended discount rate of 7%.

It is conceivable that the annual recreational use value for the Park will not stay constant over time. Most likely it will rise. The principle factors that would drive such a trend are:

- increasing population levels;
- increasing average real incomes; and,
- a continuation of the shift in preferences toward outdoor recreational activities.

With rising annual benefits through time, the present value estimate would also rise. There is a very important limitation to the extent to which the present value of recreation use can increase. After a certain level of visitation is reached, congestion will become apparent. At

peak times, this is beginning to be the case at Dorrigo. With congestion, the per visit benefit will fall, either because of the diminished experience that the Park is able to provide or because some mechanism has been introduced to reduce congestion. Such mechanisms as rationing, either by queuing or the issuance of permits, or the levying of an entrance have the effect of reducing the consumer surplus that is enjoyed.

The results presented are based on one estimation of the relationship between the rate of visitation from each zone and travel costs. The other models derived above are based on alternative measures of travel costs and apportioning of costs to the Dorrigo National Park visit. To determine if the estimation of consumers' surplus is robust to alternative measurement paths, a sensitivity analysis is necessary. This involves the re-calculation of the consumer surplus on the basis of the full range of alternative travel cost relationship estimations. The results of these re-calculations are displayed in Table 2.

Table 2. Consumer surplus sensitivity.

Alternative travel cost measure	Consumer surplus (per visit) : $
LOG D$REP (QUAL): preferred form	17
LOG TEREP (TIME)	21
LOG TEREP (QUAL)	19
LOG D$REP (TIME)	10
LOG D$Z (TIME)	10
LOG D$Z (QUAL)	11

The use of the alternative travel cost relationship estimates has an impact on the magnitude of the calculated consumer surplus. The use of total expenditure rather than vehicle costs alone has the expected impact of increasing the consumer surplus. Using measured distance on a zonal basis rather than individual reported distance has a rather stronger downward impact. Finally, it is apparent that the apportioning of total costs using the qualitative adjustment based on relative importance is a more generous approach to consumer surplus than the time based approach. Given that the extent of the qualitative apportioning is subjectively determined by the analyst - in so far as the ratings of relative importance by respondent must be given some quantitative expression by the analyst - an adjustment to account for this could be made.

On the basis of this sensitivity analysis, it can be concluded that the estimation of consumer surplus is somewhat sensitive to the different measures of travel costs. However, the model selected on the basis of superior statistical performance (LOG

D$REP - QUAL) would appear to be yielding estimates that are in the mid-range and on the conservative side of the estimates that are based on respondents' reported expenditures.

5. ANALYSIS - GIBRALTAR RANGE NATIONAL PARK

The case of Gibraltar Range National Park is even less suited to the individual TCM than the Dorrigo case. The mean number of visits per annum by groups surveyed was only 0.58. The median number was zero and the standard deviation 1.26. The zonal model is clearly the most appropriate in this case.

87% of respondent groups stated that their time spent travelling had been "very enjoyable". Only one group leader indicated that their next best alternative to visiting the park was to go to work. These data support the use of a zero opportunity cost of travel time in this application.

Less than 5% of respondent groups were strongly concerned by congestion and very few respondents made mention of the level of congestion in their final page comments. It is unlikely that such a low level of concern would have an impact on the validity of the TCM results.

On the basis of these factors, the zonal TCM was pursued with a zero opportunity cost of travel time implied.

The estimation of the relationship between visitation rate and travel costs across the specified zones for Gibraltar Range National Park follows the same process as that taken for the Dorrigo National Park case.

Reported expenditures, reported distances converted to costs through the application of a 14.63c/km unit cost, and measured distance from each zone multiplied by costs are used as the three total travel cost bases.

Cost apportioning for multiple purpose trips uses the time based and the qualitative, relative importance factors.

Linear and double log functional forms were considered.

Table 3 sets out the alternative specifications of the travel cost - visitation rate relationship.

Table 3. The travel cost - visitation rate relationship.

Independent Variable	Coefficient (t statistic)	Constant (t statistic)	R-squared %	F
TEREP	0.000	0.414	0.0	0.0
(TIME)	(0.01)	(0.47)		
LOG TEREP	0.766	-5.30	1.3	0.07
(TIME)	(0.26)	(-0.26)		
TEREP	-0.004	1.14	32.4	2.4
(QUAL)	(-1.55)	(2.28)		
LOG TEREP	-3.339	15.05	62.0	8.14
(QUAL)	(-2.85)	(2.53)		
D$REP	-0.023	1.348	15.2	0.89
(TIME)	(-0.95)	(1.35)		
LOG D$REP	-4.17	13.43	35.1	2.7
(TIME)	(-1.64)	(1.44)		
D$REP	-0.014	1.32	39.8	3.3
(QUAL)	(-1.82)	(2.52)		
LOG D$REP	-3.705	13.394	66.3	9.85
(QUAL)	(-3.14)	(2.74)		
D$Z	-0.012	0.953	15.2	0.90
(TIME)	(-0.95)	(1.60)		
LOG D$Z	-2.266	6.605	28.4	1.98
(TIME)	(-1.41)	(1.09)		
D$Z	-0.001	0.956	46.6	4.37
(QUAL)	(-2.09)	(3.15)		
LOG D$Z	-1.792	8.189	69.5	11.41
(QUAL)	(-3.38)	(2.72)		

Notes:

- The first line of the independent variable indicates the basis of the calculation of total trip travel costs whilst the second line, in brackets, indicates the mechanism used to adjust for multiple purpose trips.
- Where the log form of the independent variable (the travel cost variable) is indicated, the dependent variable (visitation rate) is also in log form.
- a 't' statistic, indicated in brackets under the coefficients and the constants, over 1.96 in absolute value terms indicates significance at the 95% level.
- The R-squared statistic indicates the percentage of variation on the dependent variable that is explained by the estimated equation.
- The F statistic indicates the significance of all coefficients in the equation. A value over 3.84 indicates significance at the 95% level.

The double logarithmic functional form dominates the linear on the basis of superior R squared, F and t statistics. The trend observed in the Dorrigo case for distance based measures of travel costs to be statistically superior to reported expenditures is replicated for Gibraltar Range. The relative importance factor also appears to be statistically superior to the time based adjustment for multiple visits. Preference is given to the reported distance based measure of costs over the zonal measured distance on the basis of its foundation in the survey response. However, again, there is little statistically to distinguish between the two models. The preferred estimation of visitation rates is therefore:

LOG VIS = 13.394 - 3.705 LOG D$REP (QUAL)
(2.74) (-3.14)

The estimated relationship, and the observed points are depicted in Figure 3.

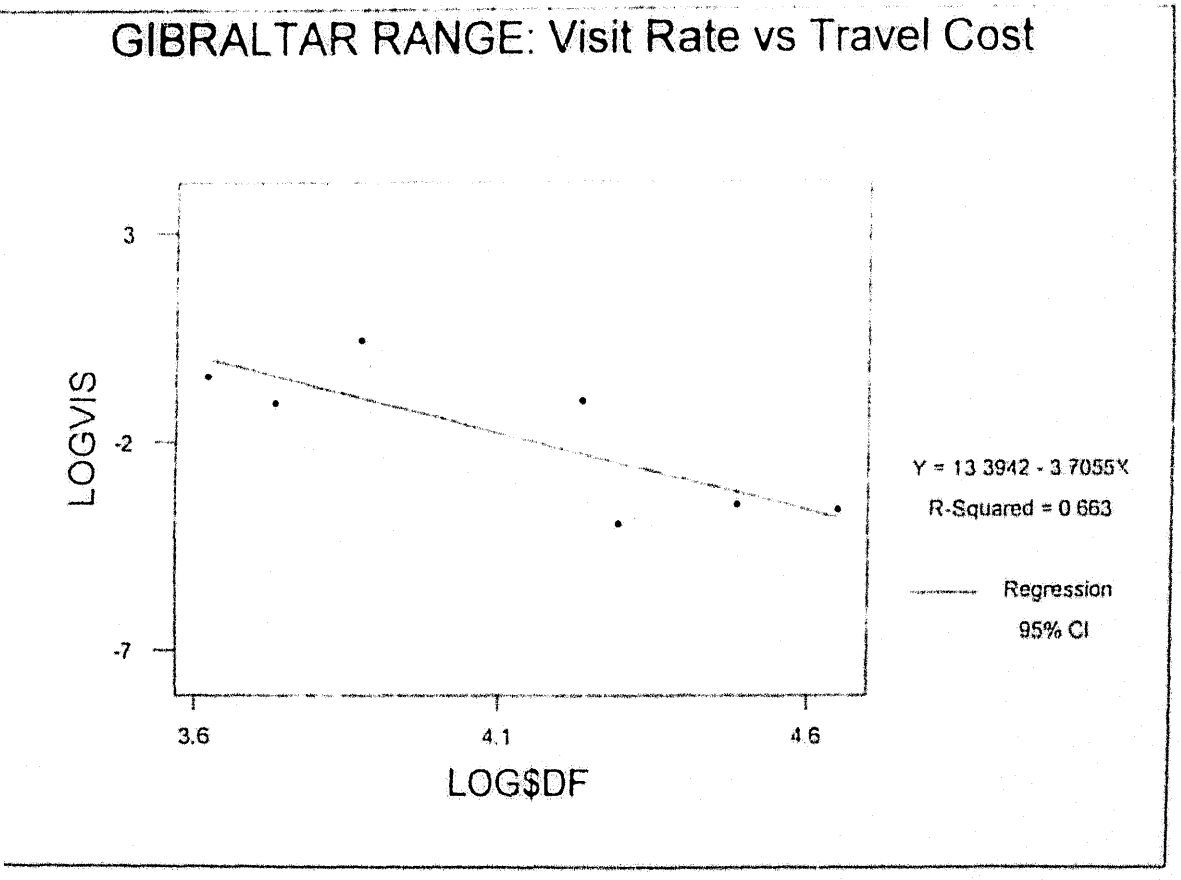

Figure 3. The Travel Cost Relationship - Gibraltar Range National Park

The same process that was used to develop the Dorrigo National Park demand curve for recreation visits was applied to the Gibraltar Range data. Hypothetical fees of between $5 and $80 were added to the travel costs for each zone and the estimated numbers of visits for each fee calculated using the visitation rate - travel cost equation. The resultant relationship between the fee and the number of visits was then estimated using regression analysis. Two functional forms for this relationship were considered:

FEE = 59.2 - 0.069 VISITS
(12.81) (-6.11)
R-squared = 71.3%
F = 37.29

and,

LOG FEE = 7.746 - 0.842 LOG VISITS
(28.45) (-15.74)
R-squared = 94.6%
F = 247.65

The second, double log functional form, is statistically superior on the basis of higher R squared, t and F statistics. The estimated demand curve is displayed in Figure 4.

To estimate the total consumers' surplus enjoyed by those surveyed at Gibraltar Range National Park, the area under the demand curve is calculated in the same way as was described for Dorrigo National Park.

With a cut off fee of $100 and a cut off number of visits of 1150, the total consumers' surplus is equal to $18,205. This amounts to a per visit consumer surplus of $15.83.

Extrapolating on the basis of this figure to estimate the annual recreational use benefit generated by the park, requires data on the number of visits made to Gibraltar Range National Park each year and it must be assumed that the survey respondents are representative of the total annual population of visitors. The latter assumption is impossible to test but to ensure that a reasonable cross-section of visitors was surveyed, some non-holiday visitors were sampled in addition to the holiday users.

Detailed records of total annual visitation at Gibraltar Range National Park are not kept. By extrapolating the results of the travel cost survey, NPWS personnel put the total number of visits to the park at approximately 40,000. On this basis, **the total annual recreation use value of Gibraltar Range National Park is $633,200.**

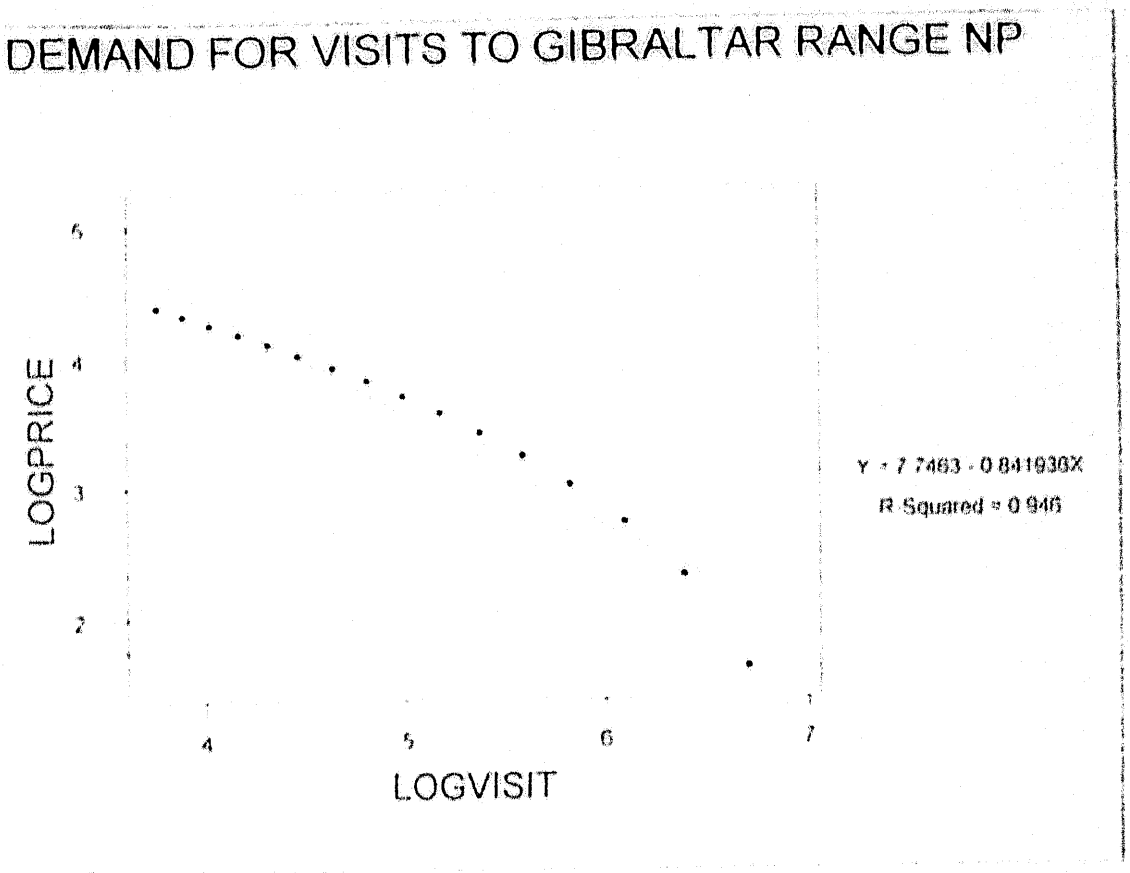

Figure 4. The demand for visits to Gibraltar Range National Park

Assuming that this annual value remains constant through time, the present value of recreation use of the Park is approximately $9m, given the NSW Treasury's recommended discount rate of 7%. Any increases in the annual recreation benefit, caused for instance by increasing population, increasing incomes (given that park recreation has a positive response to increases in income) and a continuation of the shift in preferences toward outdoor recreation, will increase this present value estimate.

As with the Dorrigo study, a sensitivity analysis is necessary to establish how robust the consumer estimates are to alternative forms of the travel cost relationship. Table 4 sets out the consumer surplus estimates derived for the range of travel cost measures used apart from LOG TEREP (TIME) which yielded an exceptionally poor statistical fit.

Some sensitivity is apparent in these results. The total reported expenditure form yields a higher value than the distance based measures as would be anticipated. Unlike in the Dorrigo results, the zonal distance measures yield estimates that are greater than the preferred form result and the direction of the effect of the QUAL versus TIME apportioning is not universal. However, the preferred form is again in the mid-range of the

estimates and represents a conservative approach when compared to the total expenditure based estimate.

Table 4: Consumer surplus sensitivity

Alternative travel cost measure	Consumer surplus (per visit): $
LOG D$REP (QUAL): preferred form	15
LOG TEREP (QUAL)	21
LOG D$REP (TIME)	11
LOG D$Z (TIME)	18
LOG D$Z (QUAL)	16

6. CONCLUSIONS

This study has demonstrated the practical application of the travel cost method to the task of estimating the economic value of the recreation use of Dorrigo and Gibraltar Range National Parks. The technique has been shown to be capable of providing value estimates for a non-marketed benefit through the use of observed patterns of individuals' behaviour in two very different settings. Dorrigo is a well developed, intensively used park which is managed primarily for day use visitors. Gibraltar Range provides more for the low key bush walker and camper seeking a wilderness experience. It is less intensively used than Dorrigo National Park.

Despite the marked differences in both the physical and visitation characteristics of the two Parks studied, the per visit recreational use values calculated were of the same order of magnitude. The factor that is crucial in driving the difference in total recreational use values between the two Parks is the rate of visitation. So long as congestion costs can be avoided, increases in visitation rates will increase the total value of recreation in the Parks.

It must be recognised that the estimates of value calculated in the two applications detailed here are indeed estimates. They are based on survey data. They involve both theoretical and empirical assumptions. Consequently, they should be regarded as embodying some degree of inaccuracy. However, in terms of statistical accuracy, the estimates are robust.

Whilst inaccuracies in this type of analysis are inevitable, it is important to note that the estimates provided have been calculated on a conservative basis. Two factors are worthy of particular emphasis.

- First, the form of the travel cost relationship selected for both case studies is based on vehicle costs alone as travel costs. The other costs of travelling such as accommodation and provisions are omitted and it has been shown that this pushes down the estimated benefit of recreation use.
- Second, no allowance has been made for the any cost associated with the time used when travelling to the parks. The rationale for this exclusion is that for most people there are no opportunity costs associated with their travel time. However, many travel cost studies have embodied a time cost and this is another factor that would increase the benefit estimates. The estimates reported here can therefore be regarded as lower bounds for the true value of recreation use.

Having regard to these caveats, the magnitude of the estimates of the use values of the two National Parks presented in this study indicates the importance of considering not just the marketed benefits and costs of resource allocation.

Decisions relating to the use of natural ecosystems need to draw on information regarding both market and non-market benefits and costs. If decisions are taken in ignorance of any of these components, it is likely that poor choices will result to the detriment of the community as a whole.

An additional conclusion that can be taken from the two case studies reported here is that, a simplified, more cost-effective, approach may be considered. The studies reported here show that a much simplified version of the questionnaire could provide sufficient information to yield reliable results. The sensitivity tests carried out show that the estimates calculated on a zonal distance basis are reasonably close to those calculated on a revealed travel distance basis. Hence, a simplified questionnaire would simply require information on the respondent group's place of residence, its size and a ranking of the importance of the specific visit to the site relative to the other purposes of the group's overall trip. These three pieces of information form the core requirements of the zonal TCM equations estimated in this study. If it can be reasonably assumed that the characteristics of visitors to the park being studied in future applications satisfy the criteria such as zero opportunity cost of time, travelled in own vehicle, no congestion costs etc, which were checked by specific questions in this study, then the simplified version will suffice.

A more complete exposition of the study reported in this paper, including details of the questionnaire used, is available in:

Bennett J. (1996) "The Economic Value of Recreation Use of Gibraltar Range and Dorrigo National Parks ' Occasional Paper, NSW National Parks and Wildlife Service, 43 Bridge St, Hurstville NSW 2220

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