



The Economic Value of Recreational Use in Protected Areas

Collected Studies From New South Wales

**Conservation Economics Unit
NSW National Parks and Wildlife Service**

March 2002

ACKNOWLEDGEMENTS

This report was prepared by Glen Christiansen and Nicholas Conner as part of the ongoing work of the Conservation Economics Unit, NSW National Parks and Wildlife Service (NPWS). Some of the information presented in this report is based on earlier research reports produced for the NPWS by Professor Jeff Bennett (see Bennett, 1995a, and 1995b), and Robert Gillespie (see Gillespie, 1997).

The Conservation Economics Unit would also like to thank NPWS staff who collected data and provided other information for the studies described in this report.

PREFACE

In 1995, the NPWS commissioned a study into the economic value of the recreational use of Dorrigo National Park and Gibraltar Range National Park (see Bennett, 1995a). The information obtained from this study was used to establish a database of the non-market use and non-use benefits (economic values) of protected areas managed by the NPWS.

Since this initial research, studies have also been carried out on a number of other protected areas across New South Wales to add to this database. It is intended that this information will help policy-makers and protected area managers incorporate these otherwise unpriced values of protected areas into decisions about the most efficient way of allocating scarce resources to provide protected areas for the community.

The present report summarises the results of ten studies that have been carried out by the NPWS Conservation Economics Unit to assess the economic value of recreational use in protected areas in New South Wales.

CONTENTS

1. INTRODUCTION	9
2. THE TRAVEL COST METHOD	11
2.1 Survey Approach and Data Collection	12
2.2 Calculating The Present Value of Benefits.....	12
3. NSW NATIONAL PARKS AND WILDLIFE SERVICE STUDIES	15
3.1 Dorrigo National Park	15
3.2 Gibraltar Range National Park	16
3.3 Minnamurra Rainforest Centre, Budderoo National Park	17
3.4 Hartley Historic Site	18
3.5 Montague Island Nature Reserve	19
3.6 Warrumbungle National Park.....	20
3.7 Sturt National Park	21
3.8 Kinchega National Park.....	22
3.9 Mutawintji National Park	23
3.10 Myall Lakes National Park	24
4. SUMMARY AND DISCUSSION	25

1. INTRODUCTION

Every year, many thousands of people visit national parks and other protected areas in NSW for recreational purposes. The value, or satisfaction, they gain from these recreational experiences is one of the many economic values or benefits associated with these areas.

Many of these economic values are not traded in conventional markets, and therefore are difficult to measure in monetary terms. Without a market price, these benefits are often ignored in decisions about the allocation of resources to protect the natural and cultural environment. Excluding these values from decisions may result in the failure of the market to achieve optimum resource allocation. This market failure may lead to the degradation of the natural resource through over-use, or under-use or under-investment in the management and development of the resource.

Without information about these values it is difficult for protected area managers to justify expenditure of public funds on activities that, in many cases, do not provide a financial return, but nevertheless contribute to social welfare through the economic benefits they provide (Lockwood and Lindberg, 1996).

Economists have developed a number of valuation techniques to overcome the problem of non-market values. One such technique is the Travel Cost Method (TCM). This approach is a 'related market' technique, as it uses data on observed expenditures in related markets to infer the non-market values of the amenity being measured (Lockwood and Lindberg, 1996). The 'related market' is the market for those goods and services which are consumed in the process of carrying out a recreational activity.

Since the conception of the Travel Cost Method by Harold Hotelling in 1949, and its development in the 1950s and 1960s by Marian Clawson and Jack Knetsch (see Sinden & Worrell, 1979), this approach has been used in a wide number of applications internationally, including assessing visitor willingness to pay to visit Dhaka Zoological gardens in Bangladesh, the annual value of viewing elephants and other wildlife in Kenya in relation to the level of park entry fees, and the tourism benefits of park visitation in Vietnam (Emerton, 2001).

Australian applications include studies of Mt. Macedon and Grampian State Forest in Victoria, Fraser Island and the Great Barrier Reef in Queensland, and Adelaide beaches in South Australia (see NSW Environment Protection Agency, 2001).

In New South Wales, the National Parks and Wildlife Service (NPWS) has used the Travel Cost Method to estimate the economic value of recreational use in a number of protected areas in the NPWS estate, including the following locations.

Study Area	Study Year
Dorrigo National Park	1995
Gibraltar Range National Park	1995
Minnamurra Rainforest Centre, Budderoo National Park	1996
Hartley Historic Site	1997
Montague Island Nature Reserve	1998
Warrumbungle National Park	2001
Sturt National Park	2001
Kinchega National Park	2001
Mutawintji National Park and	2001
Myall Lakes National Park	2001

These studies are summarised in the following sections of the report. Section 2 of the report provides an overview of the Travel Cost Method, including a discussion of the methodology used in the NPWS studies. This is followed in Section 3 by a description of each of the study areas and presentation of the results of each study. The final section of the report (Section 4) provides a summary of the results of these studies and a discussion of how these results might be applied in resource allocation decisions.

2. THE TRAVEL COST METHOD

The Travel Cost Method estimates economic values associated with ecosystems or sites that are used for recreation. Economic value is measured by the maximum amount of money, or some other unit of exchange, that an individual would be willing to give up in order to obtain some particular good or service (King & Mazzotta, 2001). This is often referred to as ‘willingness to pay’. **Consumer’s surplus** is the net economic value obtained by an individual from consuming or using a particular good or service, including environmental resources. It is measured and defined as the difference between the maximum an individual would be willing to pay for the good or service, and the amount they actually pay to use or consume it (see Appendix 1).

The Travel Cost Method uses travel-related costs as a proxy for the value associated with visiting a site, to measure the willingness to pay for natural resources and services such as protected areas, and to estimate the recreational demand for a particular amenity.

The methodology is based on the inverse relationship between the rate of visitation to a site and the costs associated with travelling to that site; i.e. visitation to a site decreases as travel costs increase. The TCM is based on the critical assumption that visitors to a site would consider an entrance fee in the same way that they would consider an increase in travel costs. Thus, the demand curve for recreational use for a site can be derived by simulating the imposition of a range of hypothetical entrance fees and observing the effect on visitor numbers. The consumers’ surplus, or net economic benefit enjoyed by visitors to the site, can then be estimated by measuring the area under the plotted **demand curve** and subtracting from this any entrance fee that users of the site may actually pay (see Appendix 1).

The opportunity costs of travel time is an important issue when applying the TCM. King and Mazzotta (2001) explain that “defining and measuring the opportunity cost of time, or the value of time spent travelling, can be problematic. Because the time spent travelling could have been used in other ways, it has an ‘opportunity cost’. This should be added to the travel cost, or the value of the site will be underestimated. However, there is no strong consensus on the appropriate measure - the person’s wage rate, or some fraction of the wage rate - and the value chosen can have a large effect on benefit estimates. In addition, if people enjoy the travel itself, then travel time becomes a benefit, not a cost, and the value of the site will be overestimated.”

Taking the opportunity costs of travel time into consideration, two models have been tested. These are:

- the *vehicle costs model* which considers vehicle costs only; and
- the *travel time model* which includes basic vehicular travel costs plus the opportunity cost of travel time.

The two different travel cost models were applied to all study areas with the exception of Dorrigo National Park and Gibraltar Range National Park where only the vehicle costs model was used.

A more detailed description of the TCM methodology is given in Appendix 2.

2.1 Survey Approach and Data Collection

The data needed to carry out the various NPWS travel cost studies described in this report was collected through visitor surveys. These surveys were administered by NPWS staff and tour guides, and in some cases by University students conducting research. In all cases, a sufficient sample size was sought to ensure that the results were statistically sound.

The questionnaire used in each study comprised six questions, to be completed by the visitors themselves.

The survey questions were designed to collect the following information to estimate and apportion travel costs for use in the models:

- Question One:* to identify group size and make-up (to determine the number of adults and children and to calculate the opportunity cost of travel time).
- Question Two:* to identify the respondent's usual home base and postcode (to allow zone specification using the zonal model - see Appendix 2).
- Question Three:* to determine the mode of travel to allow estimation of vehicle travel costs.
- Question Four:* to determine whether the visit to the study area was the sole purpose of the individual's or group's trip (to apportion travel costs – see Appendix 2).
- Question Five:* to determine the importance of the site visit relative to other activities on the trip (to apportion travel costs in the case of multipurpose trips).

Once the surveys were completed, the data was then manipulated to determine the relationship between travel costs and visitation numbers from different travel zones. This relationship forms the basis for deriving the demand, and a demand curve, for recreational use for the site in question. The annual consumers' surplus is calculated from this demand curve.

2.2 Calculating The Present Value of Benefits

An important objective of the studies described in this report was to consider the recreational value of the study areas over time into the future. In order to consider the annual value of the study areas beyond a single year, it was necessary to

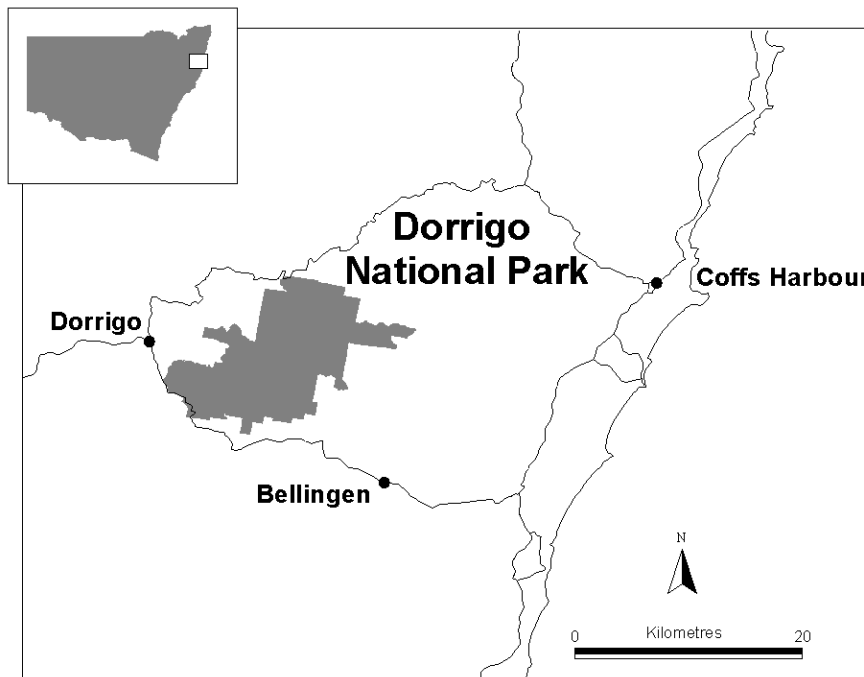
aggregate the expected stream of benefits that would occur over time. Discounting procedures were then used to account for the time value of benefit flows. (Discounting allows future benefits to be considered as a present value i.e. in today's dollars). The New South Wales Treasury recommended discount rate of 7% was used to calculate the annual consumer surplus value for each study, and the present value of benefits was then calculated.

The following section of the report describes each of the study areas and the results obtained, in turn.

3. NSW NATIONAL PARKS AND WILDLIFE SERVICE STUDIES

3.1 Dorrigo National Park

Dorrigo National Park is located 4 kilometres east of Dorrigo township in northern New South Wales. The park comprises 11,871 hectares of wet sclerophyll forest, stretching from the northern tablelands to the coastal plain. Features of the park include a Rainforest Centre and scenic boardwalks.



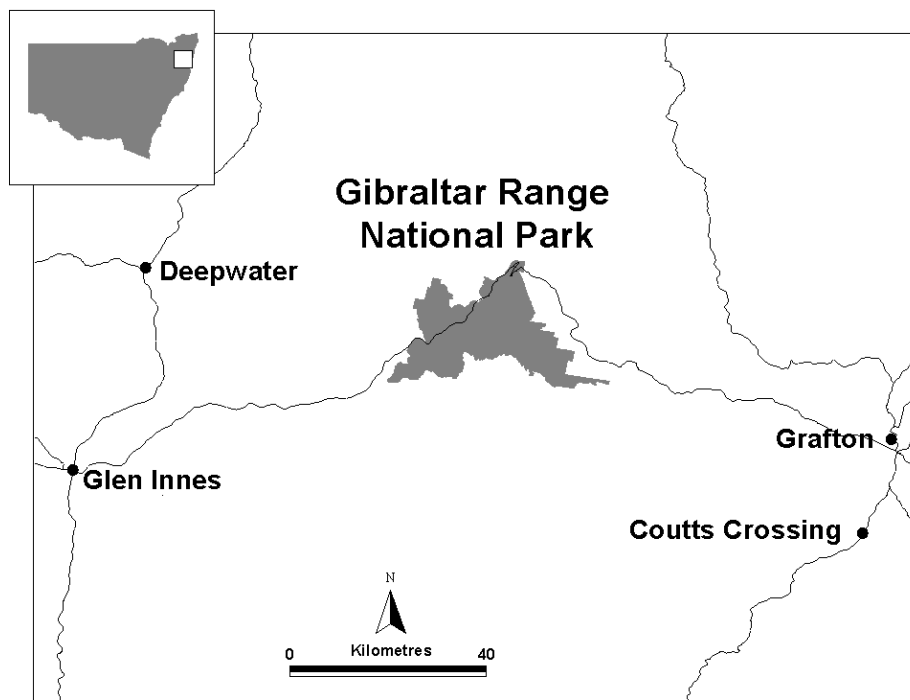
Results of the Study

Only the vehicles costs model was applied to this study area. It was estimated that the economic value of recreational use per visit for Dorrigo National Park was \$34.35 per person. With around 160,000 visitors to the park at the time of the study, this figure was extrapolated to give an annual recreational use value for the park of \$5.5M.

The present value of recreational use benefits for Dorrigo was calculated to be \$78.5M.

3.2 Gibraltar Range National Park

Gibraltar Range National Park is 25,346 hectares in size and is located on the Gwydir Highway 70 kilometres east of Glen Innes. Wet and dry sclerophyll forests, together with extensive stands of heath and swamp communities are the predominant forms of vegetation. The area is noted for its high number of rare and threatened plants, such as the Gibraltar Waratah (*Telopea aspera*). The Park predominantly consists of a high granite plateau which has weathered to form dramatic scenery with tors, boulders and balancing rocks.

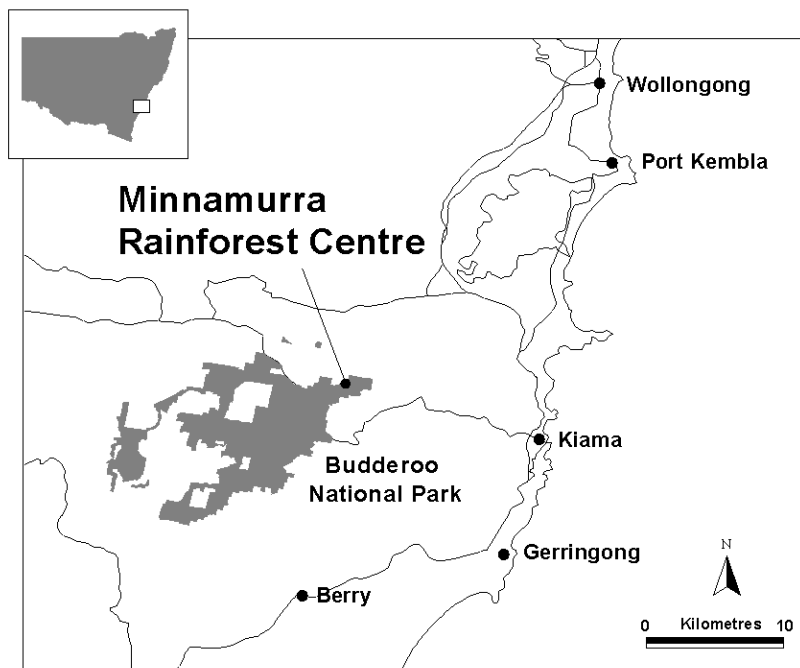


Results of the Study

As with the Dorrigo National Park study, the travel time model was not applied to Gibraltar Range National Park. Considering vehicle costs only, the estimated recreational value per visit to Gibraltar Range National Park was \$19.30 per person. Annual visitation at the time of the study was 40,000 visitors. This amounts to an annual community benefit of around \$0.76M. The present value of recreational use of the park is approximately \$11M.

3.3 Minnamurra Rainforest Centre, Budderoo National Park

The Minnamurra Rainforest Centre is located in Budderoo National Park, 130 kilometres south of Sydney and 15 kilometres west of Kiama, at the foot of the Illawarra escarpment. The vegetation of the site is dominated by subtropical and warm temperate rainforest types, and provides habitat for 70 bird, 20 mammal, and 11 native reptile species. The National Park also has significance for Aboriginal cultural heritage. Budderoo National Park is 5,846 hectares in size. Annual visitation to the Park is estimated at 140,000 visitors.

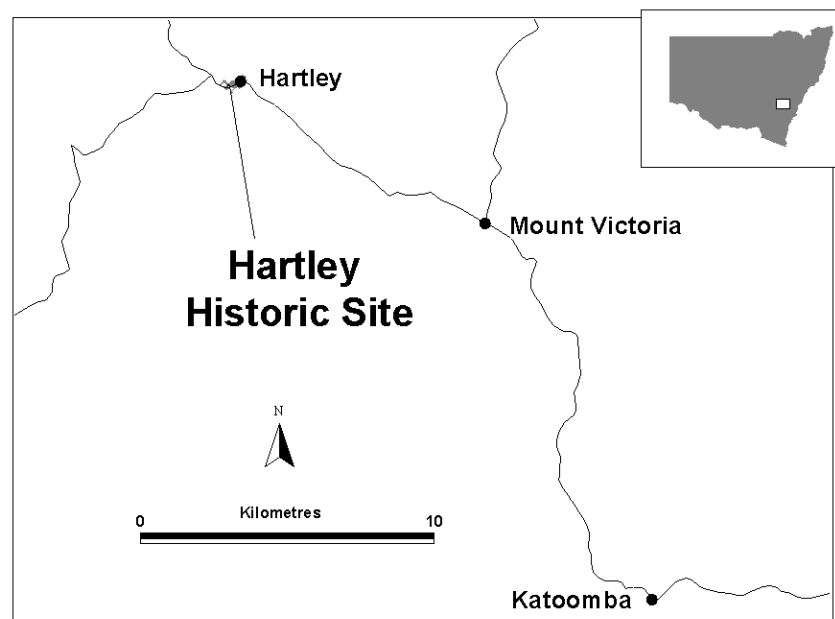


Results of the Study

The economic value of recreational use for the Minnamurra Rainforest Centre was calculated to be approximately \$28 per person for the vehicle costs model, and \$44 per person for the travel time model. The annual value for each model is \$3.9M and \$6.2M respectively. The present value figures were \$56M for the vehicle costs model, and \$89M for the travel time model.

3.4 Hartley Historic Site

Hartley Historic Site is a small, largely unoccupied 19th century village situated 140 kilometres west of Sydney at the base of Victoria Pass, just off the Great Western Highway. The site is compact and discrete, and covers approximately 13 hectares. The village was one of the first colonial settlements west of the Blue Mountains, and played a significant role as a major regional centre in the mid-1800s.



Results of the Study

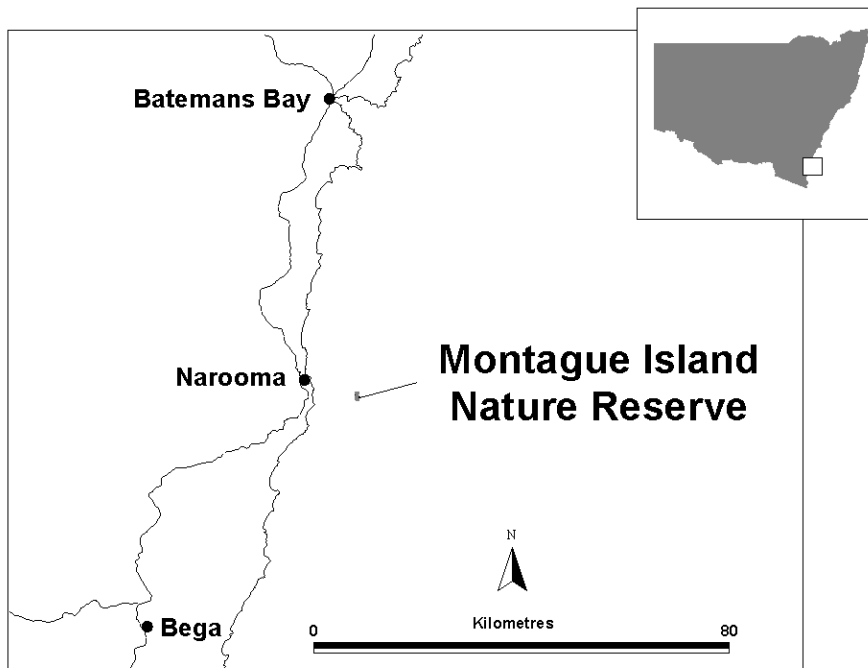
The results of the Hartley travel cost study showed that the economic value of recreational use per visit for the vehicle costs model and the travel time model was approximately \$38 and \$50 respectively. With some 29,700 visitors travelling to the site each year, these figures can be extrapolated to an annual value of \$1.1M and \$1.5M for the respective models. The present value of this benefit was \$16M for the vehicle costs model and \$21.3M for the travel time model.

3.5 Montague Island Nature Reserve

Montague Island Nature Reserve occupies a small island, located 9 kilometres to the southeast of the coastal town of Narooma on the South Coast of New South Wales, approximately 350 kilometres south of Sydney. The Reserve is 81 hectares in size with an annual visitation rate of around 4,300 people.

The island contains numerous Aboriginal sites, including artefact scatters and middens. As well as being significant to local Aboriginal communities, these sites have high research value because of their potential to provide information about Aboriginal use of island resources.

Montague Island is one of the most important breeding areas along the NSW coast for sea birds, and is an important haul-out site for Australian and New Zealand Fur Seals.



Results of the Study

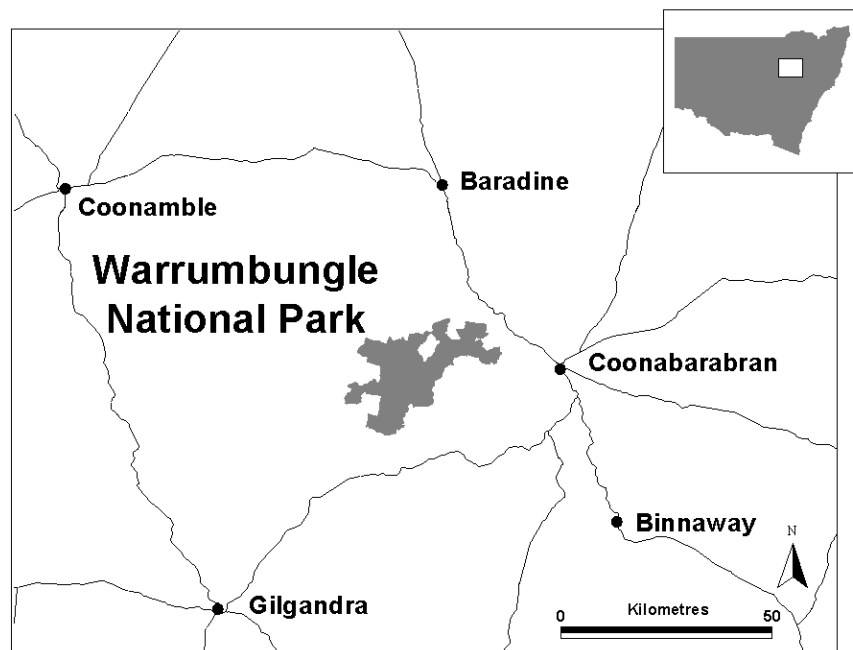
The results of the study showed that the economic value of recreation use for the vehicle costs model was \$16.91 per person. This extrapolates to an annual value of approximately \$43,363. Using the travel time model, the value per person was \$24.27, which equates to an annual value of \$62,607.

The present value of the benefits for the two models was \$623,000 and \$900,000, respectively.

3.6 Warrumbungle National Park

Warrumbungle National Park is located in central-western New South Wales, some 500 kilometres to the northwest of Sydney, and 33 kilometres west from Coonabarabran. The Park is 23,200 hectares in area.

The Park contains remnants of ancient volcanoes, and a diversity of landforms which create habitats for a wide range of flora and fauna. It provides extensive views of the surrounding landscape, including the Siding Springs Observatory, and is popular for rock climbing, bushwalking, and photography.



Results of the Study

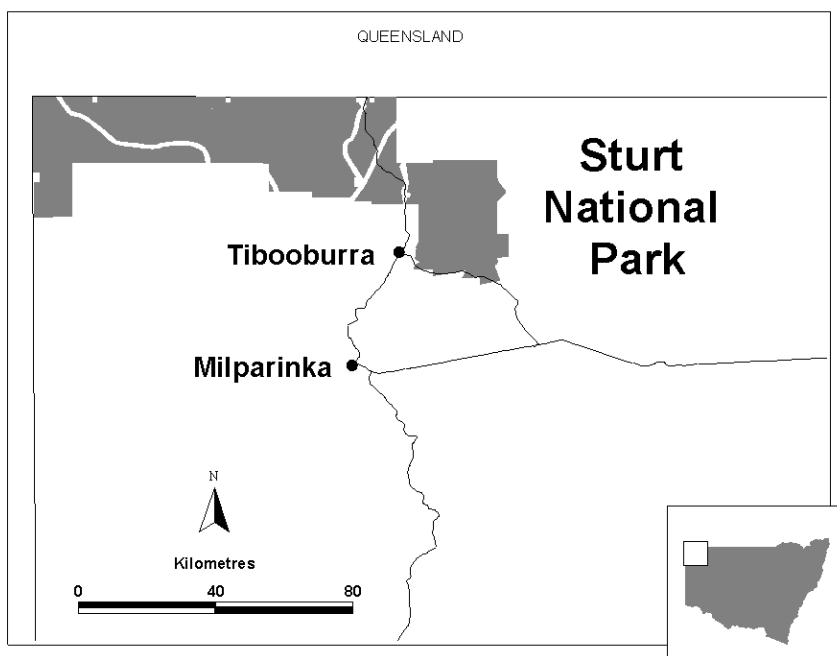
The results of the travel cost study for Warrumbungle National Park showed that the economic value of recreation use for the vehicle costs model was \$40.95 per visitor. The result for the travel time model was \$61.25 per visitor. With an estimated 50,000 visitors to the park each year, the annual value of recreation use is \$2M for the vehicle costs model and \$3M for the travel time model.

The present value of recreational use for the two models was estimated to be \$29.2M and \$43.7M respectively.

3.7 Sturt National Park

Sturt National Park is located in the far northwest corner of New South Wales, about 330 kilometres north of Broken Hill. It extends to the north, east and west of the township of Tibooburra and is bounded by the Queensland border to the north and the South Australian border to the west. Established in 1972, Sturt National Park covers over 310,046 hectares of semi-desert country.

Sturt National Park offers opportunities for driving, walking, and camping in a remote arid landscape. The easily visible wildlife is a major attraction, as are seasonal wildflower displays and the park's historic features. The park also contains a number of camping sites, and basic paid accommodation.



Results of the Study

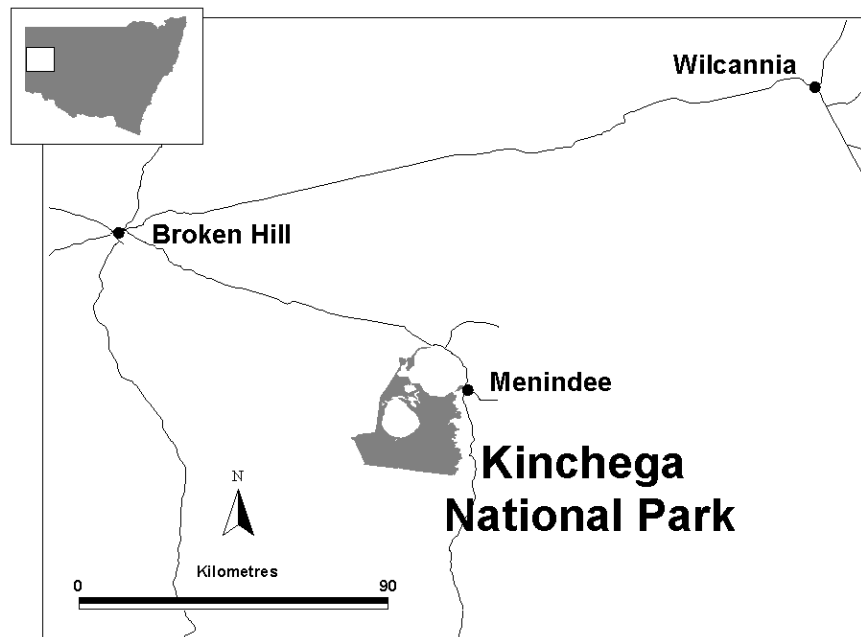
The economic value of recreational use per visit using the vehicle costs model was estimated at \$69.90 per person. This equates to an annual value of \$2.4M. The consumer's surplus per person for the travel time model was estimated at \$77.73 per visitor. The annual value was estimated to be \$2.7M.

The present value of recreational benefits was \$34.9M for the vehicle costs model and \$38.8M for the travel time model.

3.8 Kinchega National Park

Kinchega National Park is situated 113 kilometres southeast of Broken Hill, and a few kilometres southwest of the township of Menindee. The Park is approximately 44,260 hectares in size, extending southwards from Menindee for approximately 62 kilometres along the Darling River. Lake Menindee and Lake Cawndilla, two of the largest lakes in the Menindee Lakes Storage Scheme, lie within the park. Kinchega National Park was formally established as a national park in 1967. Annual visitation to the park is estimated at 7,000 visitors per year.

The Park has a variety of outstanding cultural features. These include Aboriginal sites dating back thousands of years, as well as many other more recent sites. Historic sites dating from European settlement are also prominent. The Park is also home to a diverse range of plant and animal species.



Results of the Study

The travel cost study for Kinchega National Park estimated the value of recreational use for the vehicle costs model at \$44 per visitor or \$0.3M per year. The results for the travel time model were \$57.21 per visitor and \$0.4M per annum.

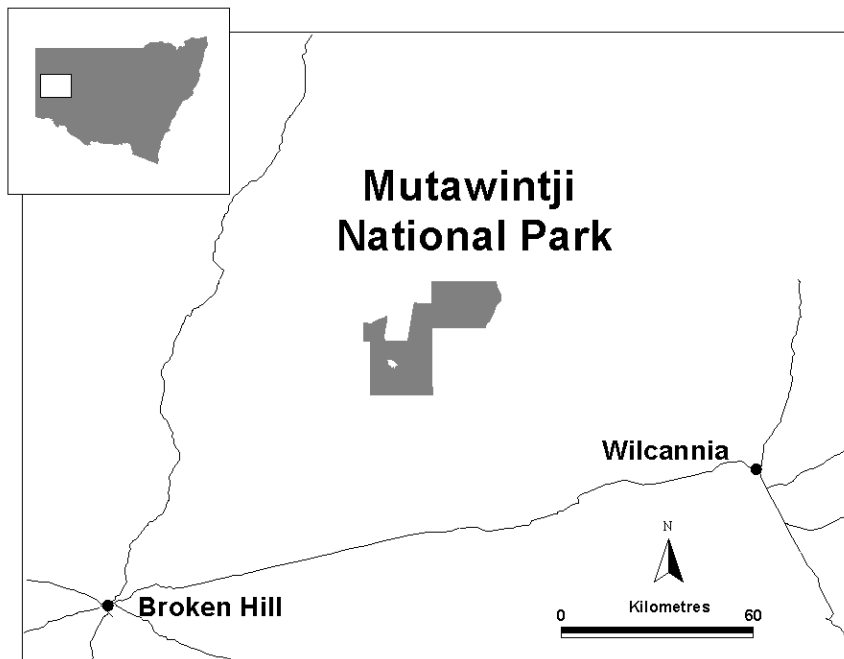
The present value of recreational use for the park was \$4.4M for the vehicle costs model and \$5.7M for the travel time model.

3.9 Mutawintji National Park

Mutawintji National Park is located 130 kilometres northeast of Broken Hill, towards White Cliffs. The park is approximately 68,912 hectares in area and contains the Mutawintji Historic Site (486 hectares). The Park was formally gazetted in 1983. The title of the Mutawintji lands was handed back to the traditional Aboriginal owners in 1998.

The Park is dominated by the Byngano Ranges and is characterised by gorges lined with river red gums and scattered rock pools. Beyond the ranges, the landscape comprises saltbush and mulga plains.

A large number of archaeological sites have been recorded in the park. These include Aboriginal art sites, both painted and engraved, camp sites consisting of hearths and artifact scatters, scarred trees, stone arrangements and quarries.



Results of the Study

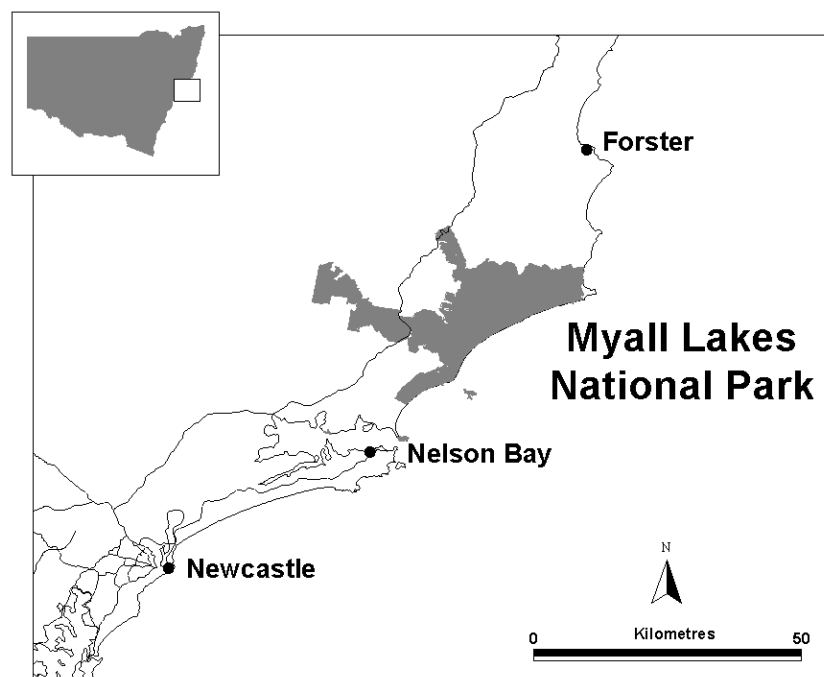
The results of the travel cost study for Mutawintji National park showed that the economic value of recreational use using the vehicle costs model was \$52.73 per visitor and \$66.68 per visitor for the travel time model. With an estimated 12,000 people visiting the park each year, the annual value of recreational use for the vehicle costs model was estimated to be \$0.6M per year. For the travel time model, the estimate was \$0.8M per year.

The present value of recreational use for Mutawintji National Park was \$9M for the vehicle costs model and \$11.4M for the travel time model.

3.10 Myall Lakes National Park

Myall Lakes National Park is over 44,172 hectares in size and is located approximately 50 kilometres north of Newcastle and 30 kilometres south of Forster. The dominant feature of the Park is a lake system which comprises 10,000 hectares of waterways, including the Bombah Broadwater, Boolambayte Lake and Myall Lake.

The park contains extensive waterways, dune systems and beaches and is a popular destination for recreational users. The estimated park visitation at the time of the study was 50,000 visitors per annum.



Results of the Study

The results of the travel cost study for Myall Lakes National Park showed the economic value per visitor for the vehicle costs model to be \$32.08. The result for the travel time model was \$49.70 per visitor. With an estimated 50,000 visitors currently visiting the park each year, the annual value of recreation use is \$1.6M for the vehicle costs model and \$2.5M for the travel time model.

The present value of recreation use for the two models was estimated to be \$23M and \$35.5M respectively.

4. SUMMARY AND DISCUSSION

The above studies have estimated the economic value of the recreational use of a range of NSW protected areas, using the Travel Cost Method. Table 1. below provides a summary of the results. The travel cost models used in these studies consider the vehicular travel costs alone, as well as the inclusion of the opportunity cost of travel time.

It needs to be recognised that the values presented in this report are estimates based on survey data, and involve both theoretical and empirical assumptions. Nevertheless, although they embody some degree of inaccuracy, these figures can be regarded as statistically robust estimates.

Table 1. Summary of results of NPWS Travel Cost Studies

Study Area	Annual Visitation	Consumers' Surplus per visitor	Annual Consumers' Surplus	Present Value of Future Benefits
		\$	\$	\$
Vehicle Costs Model				
Dorrigo NP	160,000	34	5.5M	78.5M
Gibraltar Range NP	40,000	19	0.76M	11M
Minnamurra RC	140,000	28	3.9M	56M
Hartley HS	30,000	38	1.1M	16M
Montague Island NR	2,580*	17	43,000	0.62M
Warrumbungle NP	50,000	50	2M	29M
Sturt NP	35,000	70	2.4M	35M
Kinchega NP	7,000	44	0.31M	4.4M
Mutawintji NP	12,000	53	0.63M	9M
Myall Lakes NP	50,000	32	1.6M	23M
Travel Time Model				
Minnamurra RC	140,000	44	6.2M	89M
Hartley HS	30,000	50	1.5M	21.4M
Montague Island NR	2,580*	24	63,000	0.9M
Warrumbungle NP	50,000	61	3M	43M
Sturt NP	35,000	78	2.7M	38M
Kinchega NP	7,000	57	0.4M	5.7M
Mutawintji NP	12,000	67	0.8M	11M
Myall Lakes NP	50,000	50	2.5M	35.5M

*Visitors to the Island associated with whale watching tours were excluded, as visiting Montague Island was not the primary reason for visitation. Actual annual visitation is 4,300.

The results of these studies are considered to be conservative for the following reasons:

- a) Other costs associated with travelling such as accommodation and provisions were not considered; if these costs were included in the analysis they would be expected to increase the total annual consumers' surplus.
- b) The present value of each site's recreational benefits is assumed to be constant over time. It is conceivable that the annual recreational use value for the parks

will not stay constant, but may actually rise over time due to a number of factors, including the following:

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

Increasing annual benefits over time would also mean an increase in the estimated present values. However, there is a very important limitation to the extent to which the present value of recreation use can increase, as after a certain level of visitation is reached, congestion will become more apparent. Congestion will result in a fall in the per visit benefit due to the diminished experience provided by the protected area (Bennett, 1995a).

The results of the studies described in this report have important practical implications for protected area managers:

1. where previously these values were unpriced and tended to be excluded in decision-making, they can now be included in the economic assessment of resource allocation options. The inclusion of non-priced values, such as the economic value of recreational use in protected areas, can lead to more economically efficient resource allocation decisions, which in turn can lead to increased benefits to individuals and the community as a whole.
2. The availability of environmental economic values also allows protected area managers to justify expenditure of scarce public funds on protecting and restoring the natural environment. In many cases, this spending is on environmental assets that do not generate a financial return, but are known to provide important social and economic benefits. Measuring economic values in monetary terms allows managers to demonstrate that expenditure on protected areas is a sensible use of public resources, provided that this expenditure does not exceed the benefits generated.

The magnitude of the above results highlights the importance of the need to consider non-market economic values in decisions on environmental protection and use.

As a public agency, the NPWS has a responsibility to the community to ensure that the benefits provided from the protection and use of environmental amenities in NSW are optimised. Part of this process involves the NPWS carrying out studies to quantify the economic value of protected areas for local communities and the wider public, and to demonstrate to planners and decision makers that protected areas such as national parks, nature reserves and historic sites, can provide economic benefits, whilst also conserving natural and cultural heritage.

REFERENCES

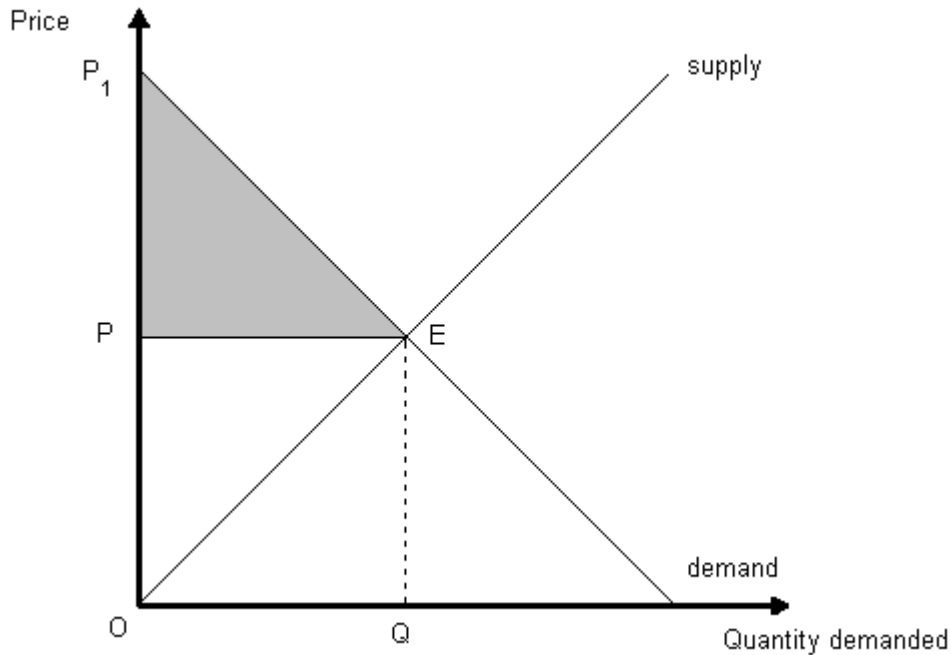
- Bennett, J. (1995a). *Economic Value of Recreational Use - Gibraltar Range and Dorrigo National Parks*. Environmental Economics Policy Unit, NPWS, Hurstville.
- Bennett, J. (1995b). *The Travel Cost Method of Estimating the Value of Recreational Use of Natural Areas*. An application manual prepared for the NSW National Parks and Wildlife Service. Environmental and Resource Economics, Canberra. Unpublished.
- Emerton, L. (2000). *The Use of Economic Valuation for Protected Area Management in the Lower Mekong - A Review of Experiences and Lessons Learned*. Protected areas review for the Lower Mekong Region - planning session presentation, Hanoi, September 2001. Unpublished paper.
- Gillespie, R. (1997). *Economic Value and Regional Economic Impact - Minnamurra Rainforest Centre, Budderoo National Park*. Environmental Economics Policy Unit, NPWS, Hurstville.
- Lockwood, M. and Lindberg, K. (1996). *Nonmarket Economic Value of Recreation in Eurobodalla National Park*. Johnstone Centre of Parks, Recreation and Heritage, Report No. 67. Charles Sturt University, Albury.
- Pass, C., Lowes, B., & Davies, L. (2000). *Collins Dictionary of Economics - 3rd ed.* Harper Collins, Glasgow.
- Sinden J., & Worrell A. (1979). *Unpriced Values - Decisions Without Market Prices*. Wiley Interscience, New York.

Website References

- NSW Environment Protection Authority. (2001). *Envalue - A Searchable Environmental Database*. <http://www.epa.nsw.gov.au/envalue>
- King, D. & Mazzotta, M. (2001). *Ecosystem Valuation*. http://www.ecosystemvaluation.org/travel_costs.htm

APPENDIX 1

Consumer surplus – the extra satisfaction, utility or value gained by consumers from paying a particular amount for a good or service that is lower than the amount they would have been prepared to pay.



At the equilibrium price P , utility (or consumer satisfaction) from the marginal unit of the good (Q) is just equal to its price; all previous units yield an amount of utility that is greater than the amount paid by the consumer, insofar as consumers would have been prepared to pay more for these intramarginal units than the market price (P). The total consumer surplus is represented by the shaded area PEP_1 (Pass et.al., 2000).

Demand Curve - relates price and quantity. It indicates how many units of a good will be purchased at different prices. In general, at higher prices, less will be purchased. Thus, the graphical representation of the demand function (often referred to as the demand curve) has a negative slope. The market demand function is calculated by adding up all of the individual consumers' demand functions (King and Mazzotta, 2001).

APPENDIX 2

The following discussion of the Travel Cost Method is taken from Bennett (1995a, p. 6-10).

“The Travel Cost Method (TCM) was developed conceptually by Harold Hotelling in 1949 but remained untried until 1959 when Marion Clawson modified and applied it to value recreation experiences. In its simplest form, 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:

$$V_i / N_i = f (TC_i) \dots \dots \dots \text{Equation 1.}$$

where: V_i is the number of visits made to the site by people from a region ‘i’;
 N_i is the population of region i; and,
 TC_i is the average costs of travelling to the site from region i.

From this equation, it can be observed how the visitation ratio (V_i/N_i) would change if a hypothetical fee of varying magnitude were 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 predicted visitation ratio with 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 for 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.

The approach used in the NPWS studies to generate the per annum consumer surplus per visit differs from that in the above description in that it involves the estimation of the demand curve for recreation over a full year. This requires the extrapolation of the travel cost relationship, which is estimated on the basis of the sample survey data, to a total yearly visitation basis. Hence, when the iterations of hypothetical fees are carried out, the resultant demand curve is estimated for a full year. Calculating the area under this demand curve then generates the total annual consumers’ surplus. This alternative approach differs from that detailed above in terms of when the extrapolation from survey data to annual estimates takes place within the sequence of the TCM. There is no conceptual difference between the two.” (Bennett 1995b, p. 24).

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, and these in turn determine the particular version of the TCM that is appropriate. These are described below.

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 their responses into zones. Estimating Equation 1 is therefore a rather heavy-handed way of explaining peoples' 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' representing 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 TC_i to include the factors detailed above (eg. age, income etc). The development of the ordinary demand curve then proceeds in the normal way, except that the values for all the explanatory variables other than TC_i are held at their mean value, as TC_i is varied as if it were inclusive of an entrance fee.

The success or failure of the individual model for TCM 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... because 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 choice of the most suitable model therefore relies on an understanding of visitation patterns. If this 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.

The value of time

One of the most vexed issues in the travel cost literature is the question of how (or whether), 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 respondents 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 will entail determining the activity which would be undertaken by the visitor had they not travelled to the site. The TCM questionnaire must therefore seek to identify what would be the next best preferred activity of each visitor. Where this is identified as travel to work to earn income which would otherwise not be spent, the appropriate opportunity cost will be 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 will be zero. In other words, there is no value lost because the alternative is on a par with the activity undertaken.

Congestion impacts

When a site becomes congested, visitation rates must be seen in the context of the marginal cost or supply situation, as well as the demand for visits. With congestion, an individual's presence at a site creates marginal costs for other visitors. It is the interaction of these cost factors with the demand for visits that determines visitation rates. Because the TCM involves the estimation of demand alone, the method will be invalidated where congestion costs are incurred. 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 significant problem for the site being studied.

Multiple purpose trips

In many instances, a visit to a site will not be the sole purpose of a trip. The travel costs incurred during a trip are therefore not always related solely to the enjoyment of the site under investigation. To include all such 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 approach 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. However, this is a more subjective approach to the apportioning task, both on the part 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.