AARES Conference, Gold Coast, January 1997.

Efficient Pricing of Recreation in National Parks: a Queensland Case Study

by D. J. Beal and S.R. Harrison

(D. J. Beal is Senior Lecturer in Finance, Faculty of Commerce, University of Southern Queensland, Toowoomba. S.R. Harrison is Associate Professor, Department of Economics. University of Queensland, Brisbane.)

Abstract

Queensland national parks have two prime purposes, the protection of biodiversity and the provision of areas for outdoor recreation. As visiting national parks for recreational purposes has become more popular, the potential for conflict between the two goals has been enhanced.

Whilst managerial policy has been defined under the *Nature Conservation Act, 1992*, comprehensive management strategies involving a microeconomic contribution have not been implemented to achieve the policy. This study builds on the foundation that national parks provide two general classes of services: conservation of biodiversity and recreational services. Conservation of biodiversity may be treated as a pure public good and, as such, is best funded through the budgetary process. The study hypothesises that recreational services, on the other hand, may be treated as private goods and their provision is most equitably funded by the users.

For any particular national park, economically appropriate entry fees for both day visitation and overnight camping are those which equate marginal social cost of recreation with average revenue. At these prices, the capacity of the park to supply recreational opportunities will just equal recreational demand. Charging and recovering the full social cost of recreational use will necessarily restrict output below the output which would be indicated when incomplete cost data are taken into consideration. However, such restriction is necessary to achieve the goals of conservation of biodiversity and ecologically sustainable use.

Introduction

National parks are reserved for two purposes, the protection of biodiversity and the provision of areas for outdoor recreation. In Queensland, the *Nature Conservation Act, 1992*, the legislation under which national parks are managed, states in s. 17 that park managers must provide for the permanent preservation of the area's natural condition to the greatest possible extent, protect and present the area's cultural and natural resources and their values, and ensure that the only use of the area is nature-based and ecologically sustainable[1]. The protection of biodiversity[2] is currently thus the primary objective and park managers in the State are legally obliged to manage in accordance with those legislated principles.

Consistent with the previous objective of government provision of areas for outdoor recreation was the policy (originally) of free and uncontrolled entry of users[3]. Uncontrolled entry of visitors is no longer viewed as an efficient management strategy because managers have a reduced chance of success in achieving the protection of biodiversity with that strategy in place.

Visitors to national parks draw on water supplies, produce wastes in the form of 'grey' water which natural organisms are expected to convert to non-pollutant matter and solid wastes which must be disposed of somewhere, compact and denude the soil surface, make tracks and contribute to soil erosion. If the demands made by visitors are in excess of the capacity of the natural environment to accommodate them, degradation occurs and biodiversity may be jeopardised.

Although many disciplines may be involved in the management of the conflict between relatively unrestrained visitor access and ecological sustainability, economics can contribute to the solution. Currently, microeconomic theory is contributing little to a satisfactory solution in Queensland, in that neither the zero day entry fee to most parks nor the camping fee recover the management

---

[1] *Ecologically sustainable use* is defined in s. 11 of the *Nature Conservation Act, 1992* as use within an area's capacity to sustain natural processes while maintaining the life-support systems of nature and ensuring the benefit of use to the present generation does not diminish the potential to meet the needs and aspirations of future generations.

[2] *Biodiversity* may be defined as the variety of life and its processes. The concept includes all living organisms, the genetic differences among them, and the communities, ecosystems and landscapes in which they live (Sattler, 1993). Biodiversity is essentially needed to retain the ability of species to continue evolving in the face of varying threats, and human society is regarded as not sustainable without the retention of biodiversity (Eidsvik, 1992).

[3] In Queensland, overnight campers have been charged fees since June 1987. The initial fee scale was structured according to the standard of facilities provided, with the fee for the highest standard (e.g. Girraween National Park with hot showers) being $7.50 per site per night for groups of up to six people. In December 1994, a new fee for campers of $3 per person per night regardless of group size and park facilities was introduced. Day visitors to most parks are allowed entry free of charge.

agency's cost of provision of recreational services in parks. Moreover, the zero day entry fee tends to encourage management to disregard the cost of externalities caused by day visitors.

The aims of the study are thus to develop and test a theoretical market model for national park recreation so that implications for the management of national parks may be examined. The novelty of the approach taken in this study is the recognition of the dual role of national parks and the development of a strategy designed to achieve optimal outcomes in the pursuit of conflicting managerial goals. In addition, because of the joint provision of recreational services to both day and overnight visitors, an innovative unit of output is developed and applied.

The major 'product' of national parks, conservation of biodiversity, is regarded as a pure public good and the cost of providing it may be properly funded by general taxation[4]. In contrast, recreational use of national parks may be treated as private goods and the cost of providing services to visitors may be isolated from the totality of costs of the managing agency. In line with Baumol's (1980) argument that those who benefit most from the public provision of goods should contribute the most for an equitable outcome, the study hypothesises that visitors should contribute towards the recovery of the components of managerial costs which relate directly to the provision of recreational services.

Charging less than social cost is acknowledged to lead to overuse or the production of an output greater than the social optimum. In line with the emphasis placed on the importance of the retention of biodiversity, this study develops the approach that the social cost of recreation services should be recovered by the managing agency. This strategy will necessarily restrict output to the social optimum and external cost to a consensual maximum. This strategy will give managers a greater chance of achieving the legislated and ethical goal of ecological sustainability.

In Queensland, the Department of Environment (DoE) administers national parks through its National Parks and Wildlife Service (NPWS). DoE has a regional structure. Southwestern Queensland is a new administrative division which is located in the southern half of the State mostly west of the Great Dividing Range. It was designated in 1992. This region covers a little less than half the land mass of the State, and contains a total area protected in declared national parks of 2.6 million ha which constitutes 43% of the protected lands in the State. These lands comprise about

[4] The appropriate quantity of conservation of biodiversity in aggregate and of taxation to fund it are not the subject of this study. However, the retention of an appropriate amount of biodiversity by the limitation of ecological cost in each park to a level acceptable to the community is built into the economic model developed.

20 large parks and many smaller parks. The resident population of the region is small, but the easterly parks close to the more populous areas have high visitation rates. With the rapidly-increasing interest in ecotourism and nature-based recreation, the growing use of natural areas close to the major population centres, and the attractive parks in the area, this region presents an excellent microcosm for study.

This paper is organised so that the next section, necessarily briefly, reviews some of the relevant research, the following section develops the market model, the fourth section applies the model to two representative parks located in the region and discusses efficient prices. The final section considers some implications for park pricing in general and examines some limitations of the study.

Previous Research into Market Models and Efficient Pricing of Protected Areas

A knowledge of both cost structure and demand is vital to making pricing decisions, and price is the mechanism by which allocation of private goods and services is usually achieved. The efficient allocation of resources, sometimes referred to as Pareto-efficient or Pareto-optimal, occurs when no more changes can be made to the allocation to improve the lot of any economic agent. Pareto optimality occurs in the world of private goods when there is exchange, production and allocation efficiency.

The efficient provision of public goods occurs when price is set at the point where marginal social cost equals marginal social benefit. The latter is indicated by the aggregated demand curve, which is the vertical summation of all consumers' demand curves[5]. In the interests of optimal resource allocation, many economists have recommended that publicly-provided goods be priced at marginal cost (see, for example, Musgrave and Musgrave, 1984: 734). Daniels (1987) advocated that the USDA Forest Service reduce campground prices in western Montana to the equivalent of marginal cost to increase efficiency, even though there may be budget constraint.

In cases where marginal cost is less than average cost, pricing at marginal cost would necessitate a subsidy from external sources. Wilman (1988) argued, in line with Ramsay (1927), that prices should be set to exceed marginal cost so that the prices of goods with the most inelastic demands are raised the most, and the ratio of mark-up percentages of any two such goods should equal the

[5] Vertical aggregation, as explained in the section above, is necessary because of the non [illegible] characteristic of the consumption of pure public goods.

inverse of the ratio of their demand elasticities. It follows then that the optimal percentage mark-up of price over marginal cost varies inversely with elasticity. This principle may be usefully applied in pricing different services within one park, for example, camping rights and day use, so long as they have different elasticities (Scoccimarro, 1992: 62). Berg and Tschirhart (1995) argued, however, that Ramsey pricing might be viewed as unduly discriminatory in the society of the 1990s.

Two-tier pricing has been advocated by a number of workers as a second-best solution, generally for public utilities (Coase, 1970) and specifically for public recreation facilities (Rosenthal, Loomis and Peterson, 1984; Wilman, 1988). Under this system, the entry fee is set at marginal cost and visitors are charged an additional licence or permit fee, perhaps annually, to cover fixed costs. As another variation of the pricing model, Scoccimarro (1992) developed a peak-load pricing scheme for the Green Mountains section of the Lamington National Park in southeast Queensland.

A number of researchers have been concerned with the effects of pricing on revenue and equity. Huszar and Seckler (1974) reported a 20% to 25% reduction in attendance at a museum when fees were charged, but a net increase in revenue. Adams et al. (1989) examined changes in participation rates, revenues and willingness-to-pay for a public pheasant-stocking program for hunters in Oregon and found a revenue-maximising fee would not cover costs because of a substantial decline in participation by lower income groups. Walsh, Peterson and McKean (1989) found increased park entry fees depressed local visitation rates and precluded the entry of low income earners. Kerr and Manfredo (1991) proposed and tested an attitudinal-based model for pricing recreational services and concluded attitudinal research would contribute improvements to existing pricing models.

The National Parks and Wildlife Service in New South Wales introduced a comprehensive schedule of new and higher entry fees to its most popular parks in June 1992. After a period of steady growth in estimated visitor numbers in the decade before 1992, the NPWS regards visitation as having stabilised or perhaps fallen marginally (no more than by 5%) since 1992 (Starling, 1995). Evaluation of the effect on demand of increased entry fees is impeded by the difficulty in collecting accurate visitor numbers where annual permits are sold and gatekeepers do not record such entries. In addition, factors such as poor snowfalls during some seasons in the popular Kosciusko National Park have had a great influence on visitor demand. Parks close to Sydney which are popular for day visits have experienced both growth in demand (e.g. Royal National Park) and decreases in demand (e.g. Ku-ring-gai Chase National Park) (Starling, 1995).

Similar impacts of changes in pricing policy have been observed for indoor recreation facilities. For example, the management of the Powerhouse Museum in Sydney, a museum of applied arts and sciences, found it difficult to make a precise judgement on the effect of introducing fees for the first time, because records of attendance had not been kept before the introduction of fees (Kollington, 1995). Fees for entry were introduced in September 1991. The recorded attendances for the three years 1991-92 to 1993-94 were 744,000, 589,000 and 639,000 (Museum, 1992, 1994). Attendance during the second of these years exhibited an apparent decrease of 20% but, in the third year, attendance increased by 8%. The pattern of an initial decrease after the introduction of new or higher use fees followed by a gradual increase in use as time goes by, and potential users become accustomed to the fee structure, seems to be a reasonable expectation. To overcome any public perception of inequity, the museum allows free entry on the first Saturday of each month (Museum, 1994).

Apart from pricing studies, there is a voluminous literature on theoretical aspects of demand and demand estimation methods such as the travel cost method (TCM). The supply component of the market has been much less studied and the literature significantly smaller in volume. Supply behaviour typically depends on administrative decisions by government rather than responses to market forces.

Development of the National Parks Market Model

The developed national parks market model relies on the separation of the benefits provided by parks to users from those provided to non-users and is concerned only with the users market. A market model can normally be expected to incorporate demand and supply components, and the following sections examine these forces.

Demand for Recreational Services in Parks

Demand has a large number of determinants, such as the attractiveness and characteristics of individual parks, the availability of substitutes, the tastes of potential users and their income, and other factors such as travel time to individual parks and size of the population of potential visitors. Demand will differ for each park. In addition, many parks produce more than one product in that both camping and day visitation are allowed[6]. Moreover, demand for recreation in parks can be highly influenced by the actions of the management agency.

[6] The various activities that may be enjoyed in parks may be viewed as separate products, but for simplicity, and in accord with normal pricing arrangements, the type of visit is considered the basis of product distinction.

Demand curves for these recreational products will have different price elasticities. Moreover, the demand for day visitation in parks reasonably close to large population centres will be generally more price elastic than the demand for camping, because potential day visitors may react to an entry price increase by seeking out substitute recreation venues. On the other hand, for isolated parks where accommodation has been built nearby to service visitors who do not wish to camp in the park, demand for day visitation is likely to be less price elastic, because visitors have made a greater commitment of funds to visit the park where commercially available accommodation is used and the entry fee is a small proportion of the total holiday expenditure.

An estimate of the aggregate demand curve for each park is necessary for managers to appreciate the impact of visitors on the ecosystems of the park. How can a manager disaggregate the use of toilets and any consequent ecological impact or track wear into the component impacts by day visitors and camping visitors? An aggregate demand curve may be estimated for each individual park by horizontal summation of the demand curves for camping and for day visitation. Whilst horizontal summation of demand curves is a conventional device in microeconomics, it is usually applied to functions which relate to a homogeneous product. In this case, day visits and camping visits are different products, but they can be related to each other and are produced largely by joint costs[7]. Moreover, the aggregation of the demand curves for the two products relies on the ability to convert the units of output in which demand is measured to standard units.

Supply of Recreational Services

In the market model developed here, three functions of the park management agency are recognised, viz. management of the estate, management of the natural environment and management of recreation. Further, costs incurred purely to supply recreational services are distinguished from the costs of the other functions. The arbitrary allocation of the cost of infrastructure shared between functions is avoided by recognising only the incremental costs relating to recreation. The supply function included in the model thus relates only to recreation services.

The management agency provides services enjoyed by both users and, somewhat paradoxically, non-users. It supplies estate, recreational infrastructure and services to visitors, but also supplies

[7] It would be possible to aggregate demand for all parks to estimate a regional aggregate demand curve, but there is no point in doing so, because it has no practical purpose in this model. The model is concerned with the determination of prices for individual parks within the region.

estate, infrastructure and services to non-visitors to conserve biodiversity, retain habitat for other species, conserve cultural heritage, and so on.

Expenditure on recreation infrastructure, that part of plant and equipment used to maintain recreation areas, day-to-day recreation management and interpretation for visitors constitute an identifiable group of costs directly related to use. This division among all the costs incurred by the agency identifies the additional costs that providing recreational opportunities imposes and establishes a basis for equitable cost recovery. To identify legitimate relevant and irrelevant costs, some costs must be disaggregated. Labour cost, for example, must be allocated between recreation, estate management and natural resources management. Similarly, the cost of operations must be allocated among the three functions.

The model which follows is constructed on the premise that the costs which are relevant to the entry pricing decision are the costs of providing the recreation function in parks. It could well be argued that some portion of the joint overhead costs, that is, the costs of management of the estate and natural resources, should also be attributed to users, but theory provides no guidance to the proportion.

The Behaviour of Costs

The model is developed for a group of parks of different character managed by a single agency. The chief executive controls the budget allocations for all parks, and thus controls the cost structure for each individual park. Hence, parks in the region can be likened to a multi-plant firm. In addition, each park produces a range of products, of which some are unique in the view of some visitors. Some products will stem from the knowledge, wants and physical abilities of visitors and others will be produced by the ecological and access characteristics of the park. Thus, parks in the region could also be characterised as a multi-product firm. The argument which follows essentially characterises parks in the region as a multi-product firm with different products produced in different plants.

Regional management has control of the allocation of labour and capital between parks. All the policy decisions and the tasks undertaken in parks which ensue from those decisions relate to the three main functions. The timing of work on the construction and maintenance of infrastructure and on natural resource management is reasonably flexible, so labour can be drawn from these areas to the recreation function in peak visiting periods. So long as the overall allocation of workers between parks is maintained at a level where there are no workers in excess of those needed to perform the work load in a particular park, the availability of the other two functions suggests that the employment of labour on the recreation function is likely theoretically to be highly efficient.

Consequently, the marginal cost of labour for providing recreation services is likely to approach a constant figure. Because the cost of labour is the chief component of the costs of the recreation function, the shape of the agency's marginal cost function (MAC) will be influenced principally by the behaviour of that cost. Recreational infrastructure and plant can be closely matched to output requirements; thus annual unit cost of capital may be expected to be constant over a range of capacities.

On the basis of this reasoning, it is anticipated that MAC tends to be constant over a wide range of output in all parks. This would suggest total cost is linear. Because fixed costs are only a small component of total cost of recreation, average agency cost (AAC) is sharply decreasing at minimal outputs and approaches marginal cost at low outputs. Average cost would then be greater than marginal cost at all outputs, but only by a small increment, depending on the size of the fixed cost component which must be allocated over output.

External Cost of the Recreation Function

As well as costs internal to the management agency, externalities or external costs arise for which the management agency bears no financial responsibility (Walsh, 1986). Such costs may take the form of loss of benefits or amenity to parties external to the managing agency. They could include costs of congestion to visitors as envisaged in club theory (Buchanan, 1965), costs borne now and in the future by neighbours and costs borne by society ultimately in the loss of biodiversity. The external costs to neighbours may take the form of community disruption by the influx of visitors such as congestion on roads and the cost of repair of gravel roads after damage by four-wheel drive vehicles in wet weather, polluted surface water within parks flowing downstream, and the spread of weeds by visitor traffic.

Ecological costs resulting from damage to ecosystems ultimately may prove of greater importance than the other external costs. Postulating that a cost is imposed on society by ecological damage has been supported by a great deal of research, but the cost is difficult to quantify. Economic measures of loss generally attempt to measure the cost of the provision to the owner of a damaged asset of a level of well-being equivalent to that enjoyed before the damage (Kopp and Smith, 1993).

An estimate of the cost of ecological damage should theoretically be the value of lost services from the time of the damage to the time of natural recovery or the sum of the value of lost services and the cost of restoration, if restoration is technically feasible and is attempted to assist, or shorten the period before, natural recovery.

Marginal external cost (MXC) is hypothesised to be an increasing function of output. The slope of this function will be different in each park, because of variation in ecological characteristics and differences in the amount and type of infrastructure. For any individual park, it is possible that the ecosystems are sufficiently robust and the infrastructure sufficiently large that MXC originates at some non-zero level of output, but for simplicity this possibility will be ignored.

Theoretically, an aggregate regional MXC curve could be computed by the horizontal summation of MXC curves for all parks in the region. Horizontal summation will give a curve which relates the aggregated quantities of output to each cost level. Summation is necessary because the model incorporates the proposition that the regional manager monitors the behaviour of regional marginal social cost (MSC), which is determined in part by the behaviour of regional MXC, and decides what is the maximum acceptable level ecologically and in accord with the requirements of the *Nature Conservation Act, 1992*. The maximum acceptable level of MSC in turn will translate into capacity constraints in individual parks.

Integration of Demand and Supply

Supply and demand in the recreation market may be integrated into a market diagram which can be applied to determine the equilibrium quantities and prices of recreation services in parks of different character. Figure 1 illustrates the model in diagrammatic form.

The national park in Panel 1 represents parks with little or inadequate infrastructure, fragile ecosystems or both, so that MXC rises steeply with output. In contrast, the park in Panel 2 represents parks with adequate infrastructure or ecosystems robust enough that MXC increases more slowly with increases in output. For simplicity, only two classes of parks are illustrated in the model. In reality, every park would have an unique MXC, the slope of which would reflect its particular circumstances.

MAC is assumed to be constant over the relevant range of output for the region and for all parks. AAC for the region falls sharply over low levels of output to approach constancy and converge towards MAC. These costs are managed by staff at regional headquarters, not by park staff. Hence, costs are determined by the region (panel 3) and passed down the line to individual parks.

The MXC curve for the region is the horizontal summation of individual park MXC curves, and thus the regional MXC depends on factors within individual parks. The MSC curve is the vertical summation of the MAC and MXC curves, in both the individual parks and the region as a whole. The ASC curve is the vertical summation of AAC and AXC curves, which are not shown in Figure 1 for clarity of illustration. The attributes of individual parks and the management strategies in place thus affect these social costs and the social cost functions of the region are the summation of those for the individual parks. The parks in Panels 1 and 2 represent two possible situations.

In Figure 1, VN is the maximum MXC which regional management believe complies with ecological, social and the requirements of the *Nature Conservation Act, 1992*. Output in each park is not allowed to rise to a level where this maximum MXC (and MSC) is exceeded. The capacity for each park is set at that level of MSC, and capacity is thus determined by its current state of development and ecological fragility. It would be possible to change the slopes of the MXC and consequently the MSC functions in any park by, for example, changing the amount of capital investment, either in infrastructure to reduce congestion or by introducing better technology to reduce the risk of environmental degradation[8]. Under conditions of constant costs, infrastructure, and technology, Qr is the maximum capacity for the region and Qa and Qb the capacity maxima for the representative parks.

The supply curves for each park thus become vertical at the point where the capacity constraints cut the MSC curve. The supply curves for each of the representative parks are thus ABC and EYG respectively, and WNK is the supply curve for the whole region.

Aggregate demand for each park is the sum of demand for camping and demand for day visits. Price elasticity of aggregate demand is hypothesised to differ between parks. There are three

[8] An example of this may be the redevelopment and reconstruction of the toilets to include modern technology such as aerobic composting.

possibilities with respect to the equilibrium of supply and demand in each park. At the point of maximum capacity, demand may exceed supply, demand may equal supply or demand may be less than supply. In Panel 1, demand is depicted to exceed supply at the maximum capacity Qa, but Pa must be charged if price is to be used as the rationing mechanism. If a lower price is charged, there will be more demand than it is possible to satisfy, and some form of non-price rationing must be used. In Panel 2, demand is depicted to be less than maximum capacity. If price is set at MSC, Qc will be demanded at a price of Pb.

In Panel 1, the area SZTPa, the difference between total revenue and total social cost, is an economic rent which is captured by the management agency[9]. In Panel 2, the area RUFPb is an economic rent. An economic rent will be earned at all levels of output except where demand falls so low that it equals supply at the point of intersection of the ASC and MSC curves.

The graphical model indicates a socially optimal price of Pa for Park 1 and Pb for Park 2. The output of Park 1 will be Qa or the maximum possible output of the park under the given conditions of infrastructure and natural attributes. In Park 2, even though the capacity is Qb, only Qc will be demanded at the equilibrium price of Pb. The efficient entry price for Park 1 as predicted by this model is considerably higher than for Park 2. This is in accord with *a priori* expectations, because Park 1 is more fragile or has less infrastructure. It thus has a *scarcity of recreational opportunity* value, and a higher price would be expected.

The private sector profit-maximising marginal cost pricing model would induce park managers to charge higher prices than the optimal prices determined by this model. Setting marginal social benefit equal to marginal social cost indicates lower optimal individual park outputs and higher equilibrium entry prices. This policy by managers exrecising their monopoly power would constitute an artificial constraint on recreational outputs, and would be a socially inefficient outcome.

Once the efficient aggregate output for each park is determined, the equilibria for outputs of day visits and camping visits may be determined. The aggregate output figure may be disaggregated in the same ratio as the outputs were originally aggregated. Moreover, the equilibrium prices may be calculated with the prices for day visits being the prices determined by the model, and the

[9]Economic rent is strictly the price paid for the use of land or other natural resources which are completely fixed in supply. More generally, it is the amount earned by a factor of production beyond that needed to call the factor into supply.

prices for camping visits being a multiple of that in line with the conversion factor used for the analysis.

A New Unit of Output

The model relies on the ability to aggregate satisfactorily outputs of both day and camping recreation. A number of measures of recreational output are currently used internationally or have been used in the past. These have involved both spatial and temporal dimensions of recreational use. The spatial measures have included numbers of occupied sites, vehicles, groups, trips, visits or visitors, and the temporal measures have involved both days and hours of visit duration. Each measure developed has proved useful for a particular purpose, but difficulties have arisen when it has been necessary to combine two different measures such as vehicle numbers from one park and visitor numbers at another to gain an aggregate outcome.

The internationally recognised units in which the recreational output of parks can be measured and aggregated include visits, simple days and the weighted recreational visitor days (RVD). An RVD has been defined as 12 visitor-hours (Walsh, 1986: 68). Thus numbers of campers may be aggregated with numbers of day visitors, assuming they stay for 12 hours, and expressed in terms of RVDs, by doubling the number of camper-nights[10]. This process involves a conversion factor of two.

Obviously the standard units for demand must be acceptable as units for which to measure costs, because recreational services to day visitors and campers are produced as joint products. The legitimacy of the RVD and its underlying conversion factor is not a foregone conclusion, because the RVD unit puts emphasis only on the time visitors spend in the facility. Twelve people on site for one hour theoretically aggregate to one RVD, but it is doubtful if many park jurisdictions have the equipment or management strategies in place to measure and record the time of visits with the necessary accuracy. A better measure would put greater emphasis on the variation in inputs demanded by visitors to produce their individual recreation experiences. This is particularly necessary where a conversion factor is required so that numbers of campers and day visitors can be aggregated to make a total output figure meaningful in terms of resource use.

[10] A single camper staying three days equals three camper-nights. From DoE camping records for the period 1992 to 1994, the most popular length of stay in Queensland national parks is four nights. Campers are assumed to stay for whole 24 hour periods. Some campers would leave before staying the full 24 hours of their last day; others would stay for part of an additional day.

While the most commonly used conversion factor currently is two, a conservative estimate of the conversion factor for Girraween National Park and parks with similar visitor patterns is four (Beal, 1994). This factor was derived by investigation of the lengths of visits and potential ecological impacts of the two classes of visitors. The numbers of campers is multiplied by four to arrive at an output unit expressed in day-visitor equivalents. The numbers may then be validly added to make a total output figure, which is then expressed in terms of 'the average day visitor' and designated as the recreational visitor unit (RVU). Moreover, estimated demand curves for day visits and for camping may be horizontally summed to estimate an aggregate demand curve.

Application of the Model to the Southwestern Region of Queensland

Two parks of unlike character were selected in the Southwestern Region for testing the model. Girraween National Park is located in the Granite Belt of Queensland or the New England Tablelands biogeographic region in the Australia-wide context, about 300 km west of the most populous coastal conurbation in the State. It is a popular park with both day visitors and camping visitors, and contains bare granitic tors, wildflower displays in spring and some rare species for Queensland locations. The other park, Carnarvon Gorge National Park, is 800 km from the chief population centres, contains unique landscapes and rare species and is the most popular park for camping visits in the Region.

Estimation of Recreational Demand in Girraween National Park

Using travel cost methodology (TCM) to estimate demand functions, the equations representing demand for camping and day visits to Girraween National Park are, respectively, with Q measured in RVU (Beal, 1996a):

$$P = 47.23 - .00045\ Q\ \text{(camping)}$$

$$P = 9.08 - .0002\ Q\ \text{(day visits)}$$

In order to aggregate demand curves horizontally, as required in this study, the equations must be expressed so that Q is the left-hand side variable, because, for any given price, aggregate demand will be the sum of the demand for camping and the demand for day visits at that price. The two equations, when added together, will give the aggregate demand and the new equation may be manipulated to give the aggregate demand equation in the usual form with price as the left-hand variable.

If, in relation to camping, $P_c = 47.23 - .00045Q_c$, then $Q_c = 104\,955 - 2222P_c$.

If, in relation to day visits, $P_d = 9.08 - .0002Q_d$, then $Q_d = 45\,273 - 4986P_d$.

To aggregate demand, $Q = Q_c + Q_d$

$$Q = 104\,955 - 2222P + 45\,273 - 4986P$$

$$= 150228 - 7208P$$

Inverting the function, $P = 20.84 - .00014Q$.

The aggregation of the two demand curves produces a kinked demand curve. The upper portion of the kinked curve has the same equation as the demand curve with the higher choke price, which is the demand curve for camping in this case. The equation for the curve below the kink is the aggregate demand curve.

Estimation of Costs and the Supply Function

Data for the cost to the management agency of providing recreational services were estimated using the accounting records, labour allocation sheets and officers' monthly reports to management. Labour costs were disaggregated according to function and computed for the recreation function. Operating and infrastructure costs were similarly computed for the recreation function. Data were collected for seven parks in the region over two accounting periods. This 'panel' data were then related to output, using OLS regression analysis (Beal, 1996b).

Estimates were also made of external costs, using a variety of techniques including simple estimates by visitors of congestion costs, estimates by local shire engineers of additional costs of road maintenance caused by visitation and estimates of additional expenditure and revenue foregone by the management agency to ameliorate ecological cost (Beal, 1995a).

MSC, the vertical aggregation of marginal agency cost and marginal external cost, was estimated to be $MSC = 0.92 + .000003\ Q$ with Q measured in RVU.

Estimation of Optimal Output and Equilibrium Prices for Entry to Girraween National Park

In a graphical representation of the model for Girraween National Park, the MSC line will cut the lower segment of the aggregate demand curve, and the optimal price and output may be calculated.

$$P = 20.84 - .00014\ Q$$

$$MSC = 0.92 + .000003\ Q$$

When P = MSC,

$$20.84 - .00014\,Q = 0.92 + .000003\,Q$$

$$.000143\,Q = 19.91$$

$$Q = 139\,230 \text{ RVU}$$

For an output of 139 230 to clear, $P = 20.84 - .00014\,(139\,230) = \$1.34$.

The equilibrium camping output at this entry price is:

$$P = 47.23 - .00045\,Q$$

$$1.34 = 47.23 - .00045\,Q$$

$$\therefore Q = 102\,000$$

The equilibrium number of day visits at this entry price is:

$$P = 9.08 - .0002\,Q$$

$$1.34 = 9.08 - .0002\,Q$$

$$\therefore Q = 38\,000$$

The demand for camping equates to about 25 000 camper-nights or approximately 10 000 campers per year. The estimated number of day visits needs no conversion and is 38 000 per year. The optimal price for day visit entry is $1.34, and the price for camping is about $8 per person[11].

Figure 2 illustrates the operation of the model for Girraween National Park. The demand curves for day visits and for camping are shown, together with the aggregated demand curve in bold print. MSC cuts the aggregate demand curve at approximately 139 000 RVU and at a price of $1.34. At that price, approximately 102 000 camping RVU will be demanded and 38 000 day visits.

The importance of the aggregation of demand for the estimation of external cost and its recovery by charging higher entry fees may be illustrated algebraically and by reference to Figure 2. The marginal external cost was estimated at .003 cents per 1000 RVU. Taken in isolation, the marginal day visitor at the equilibrium output of 38 000 RVU appears to be responsible for a marginal

---

11 The travel cost analysis for the estimation of the camping demand curve was conducted on the basis of fees *additional* to those currently being paid. However, the fee is difficult to determine, because the fee structure at the time was $7.50 per site for groups of up to six people. The individual fee thus ranged from $1.25 to $7.50. Each camper equates to 4 RVU per camper-night, and a current individual fee of about $2.50 is incorporated in the estimate here of about $8.

external cost of about 1½ cents, whilst the marginal camper appears to cause a marginal external cost of about 30 cents per RVU. This is not the case. Once camper numbers are converted to allow for campers' greater potential impact on the ecosystems of the park, the cost of the marginal visitor (*in terms of RVU units*) whether that person be camper or day visitor, will be the same. If the aggregation process had not been undertaken, the ***cumulative*** impact of both day and camping visitors would not be estimated. In relation to day visits, for example, with rising MXC, Figure 2 clearly shows underestimation of the impact, a lower cost and a higher output of about 40 000 RVU instead of the estimated 38 000 RVU. The higher the value of the slope coefficient of the MXC curve, the greater would be the underestimation of MXC, the unrecovered social cost and the degradation of the environment.

With the present structure of demand, the current infrastructure in the park and the present management, Girraween conforms to the type of park depicted in Panel 2 of the theoretical model. Demand cuts the finitely positively-sloped segment of the supply curve; the vertical section of the supply curve lies to the right at a higher output.

Estimation of Optimal Output and Equilibrium Prices for Entry to Carnarvon Gorge National Park

The price and output predictions for Carnarvon Gorge National Park made by using the model are estimated by the same methods as for Girraween National Park. The estimated demand curve for camping at Carnarvon Gorge is, with Q measured in RVU (Beal, 1995b):

$$P = 62.53 - .00025\ Q,$$

and the estimated demand curve for day visits is:

$$P = 95.28 - .01\ Q.$$

The kink in the overall demand curve occurs at $62.53, a price below which numbers of both camping and day visitors are positive. The part of the overall demand curve below the kink at $62.53 is the relevant curve for the analysis and has the equation:

$$P = 63.33 - .00024\ Q$$

Using this equation and the MSC equation computed for this park (MSC = 0.92 + .000009Q), and solving for Q, 250 000 RVU is the estimated equilibrium output. The recreation market will theoretically clear at an entry price of $3.17. Campers will demand 237 000 RVU of output and day visitors 9200 RVU. These demand figures equate to approximately 14 800 campers and 9200 day visitors. The equilibrium entry prices are $3.17 for day visitors and about $15.00 per day for campers.

Conclusions

The estimation of efficient prices for entry to the case study national parks for either day or overnight visits indicates that currently the management agency is not recovering the direct costs of provision of recreational services nor is it charging economically efficient prices. Prices could be increased to recover direct costs and some or all of external cost. Inspection of the estimated demand curves reveals that entry prices could be increased significantly without jeopardising total revenue. Demand is inelastic over the relevant section of each of the estimated demand curves. Hence total revenue will increase with price increases.

Little emphasis has been placed in the literature on the mitigation of external and ecological costs by using park entry pricing as a tool for demand management. Incorporation of marginal external cost in the model increases efficiency by reducing output to the socially optimum level. It allows park managers to gain control of visitation levels and hence reduce output as necessary to achieve the goals of conservation of biodiversity and ecologically sustainable use. In the case of Girraween National Park, for example, the effect of pricing to recover MXC as well as MAC reduces the output of camping opportunities by approximately 1000 camper-nights per year and about 2000 day visitor 'places'.

One extension of Coase's (1960) work on the problem of social cost is the principle that the most efficient laws and social institutions place the burden of adjustment to externalities on those who can accomplish the adjustment at least cost. In the case of the externalities relating to visitation to national parks, the management agency supplies recreational opportunities, yet visitors create externalities which impact on other visitors, nearby residents, landholders and public authorities, and society as a whole. The management agency is in the best position to oversee adjustment, because of the uncertainty and cost associated with taking on this responsibility by these other parties. The implication for policy thus is that external costs impacting on visitors, neighbours and the natural environment may be ameliorated by internalisation by the management agency.

One of the advantages of setting socially optimal prices is that appropriate economic signals are available to private entrepreneurs and private investment relating to national parks may be encouraged. Whilst historical evidence may cause doubt that private enterprise can be trusted to maintain the high standards necessary to prevent ecological degradation when in control of natural resources without supervision, private enterprise may enter into partnership with government to provide some services[12].

The model developed above is a static model, and inherently many exogenous variables have fixed values in such models. The ecological values represented in each park, for example, are assumed to be constant for the purposes of analysis, even though degradation is a dynamic process. In addition, other parameters built into the model can be expected to change with the passage of time. The demand and cost curves will shift. The maximum acceptable MSC can be

---

[12] It could be argued that a lessee of a concession within a park providing visitors with food, for example, would not want to see higher entry fees introduced, lest those fees reduce visitor numbers and hence the lessee's sales revenue. However, in the longer term, providing the lessee has property rights of adequate duration, maintenance of the park in the best possible ecological condition is to the lessee's advantage.

expected to change, perhaps considerably if attitudes shift strongly towards or away from conservation. Nevertheless, the model can accommodate such changes and still be useful for predicting efficient prices and outputs.

Bibliography

Adams, R.M., Bergland, O., Musser, W.N., Johnson, S.L. and Musser, L.M. (1989), 'User Fees and Equity Issues in Public Hunting Expenditures: The Case of Ring-necked Pheasant in Oregon', *Land Economics*, 65(4): 376-385.

Baumol, W.J. (1980), 'Theory of Equity in Pricing for Resource Conservation', *Journal of Environmental Economics and Management*, 7(2): 308-320.

Beal, D.J. (1994), 'A New Unit of Measurement of Recreational Output of Natural Areas - the Recreational Visitor Unit (RVU)', *Australian Journal of Leisure and Recreation*, 4(3): 31-36.

Beal, D.J. (1995a), 'The Determination of Socially Optimal Recreational Outputs and Entry Prices for National Parks in Southwestern Queensland', unpublished Ph D thesis, University of Queensland, Brisbane.

Beal, D.J. (1995b), 'A Travel Cost Analysis of the Value of Carnarvon Gorge National Park for Recreational Use', *Review of Marketing and Agricultural Economics*, 63(2): 292-303.

Beal, D.J. (1996a), 'The Behaviour of Costs Relevant to Visitation at National Parks in Southwestern Queensland', *Economic Analysis and Policy*, 26(1): 1-24.

Beal, D.J. (1996b), 'Estimation of the Elasticity of Demand for Camping Visits to a National Park in Southeast Queensland by the Travel Cost Method', *Australian Leisure*, 7(3): 21-26..

Berg, S.V. and Tschirhart, J. (1995), 'Contributions of Neoclassical Economics to Public Utility Analysis', *Land Economics*, 71(3): 310-330.

Buchanan, J.M. (1965), 'An Economic Theory of Clubs', *Economica*, 32: 1-4.

Coase, R. (1960), 'The Problem of Social Cost', *Journal of Law and Economics*, 3: 1-44.

Coase, R.H. (1970), 'The Theory of Public Utility Pricing and its Application', *The Bell Journal of Economics and Management Science*, 1(1): 113-128.

Daniels, S.E. (1987), 'Marginal Cost Pricing and the Efficient Provision of Public Recreation', *Journal of Leisure Research*, 19: 22-34.

Eidesvik, H. K. (1992), 'Strengthening Protected Areas through Philosophy, Science and Management: a Global Perspective', in J. H. M. Willison, S. Bondrup-Nielsen, C. Drysdale, T. B. Herman, N. W. P. Munro and T. L. Pollock (eds.), *Science and the Management of Protected Areas*, Elsevier, Amsterdam.

Huszar, P.C. and Seckler, D.W. (1974), 'Effects of Pricing a "Free" Good: a Study of the Use of Admission Fees at the California Academy of Sciences', *Land Economics*, 50: 364-373.

Kerr, G.N. and Manfredo, M.J. (1991), 'An Attitudinal Based Model of Pricing for Recreational Services', *Journal of Leisure Research*, 23(1): 37-50.

Kollington, T. (1995), Public Relations Officer, Museum of Applied Arts and Sciences, Sydney, personal communication.

Kopp, R. J. and Smith, V. K. (1993), 'Natural Resource Damage Assessment: The Road Ahead' in R. J. Kopp and V. K. Smith (eds.), *Valuing Natural Assets: The Economics of Natural Resource Damage Assessment*, Resources for the Future, Washington.

Museum (1992), (Museum of Applied Arts and Sciences), *Annual Report, 1991-1992*, Sydney.

Museum (1994), *Annual Report, 1993-1994*, Sydney.

Musgrave, R.A. and Musgrave, P.B. (1984), *Public Finance in Theory and Practice*, McGraw-Hill, New York.

Ramsay, F.P. (1927), 'A Contribution to the Theory of Taxation', *Economic Journal*, 37: 47-61.

Rosenthal, D.H., Loomis, J.B. and Peterson, G.L. (1984), 'Pricing for Efficiency and Revenue in Public Recreation Areas', *Journal of Leisure Research*, 16(3): 195-208.

Sattler, P.S. (1993), 'Protecting Queensland's Biodiversity' in C. P. Catterall, P. V. Driscoll, K. Hulsman, D. Muir and A. Taplin (eds.), *Birds and their Habitats: Status and Conservation in Queensland*, Queensland Ornithological Society Inc., St. Lucia, Brisbane.

Scoccimarro, M. (1992), 'An Analysis of User-Pays for Queensland National Parks', unpublished B.Econ.(Hons) thesis, University of Queensland, Brisbane.

Starling, J. (1995), NSW National Parks and Wildlife Service, personal communication.

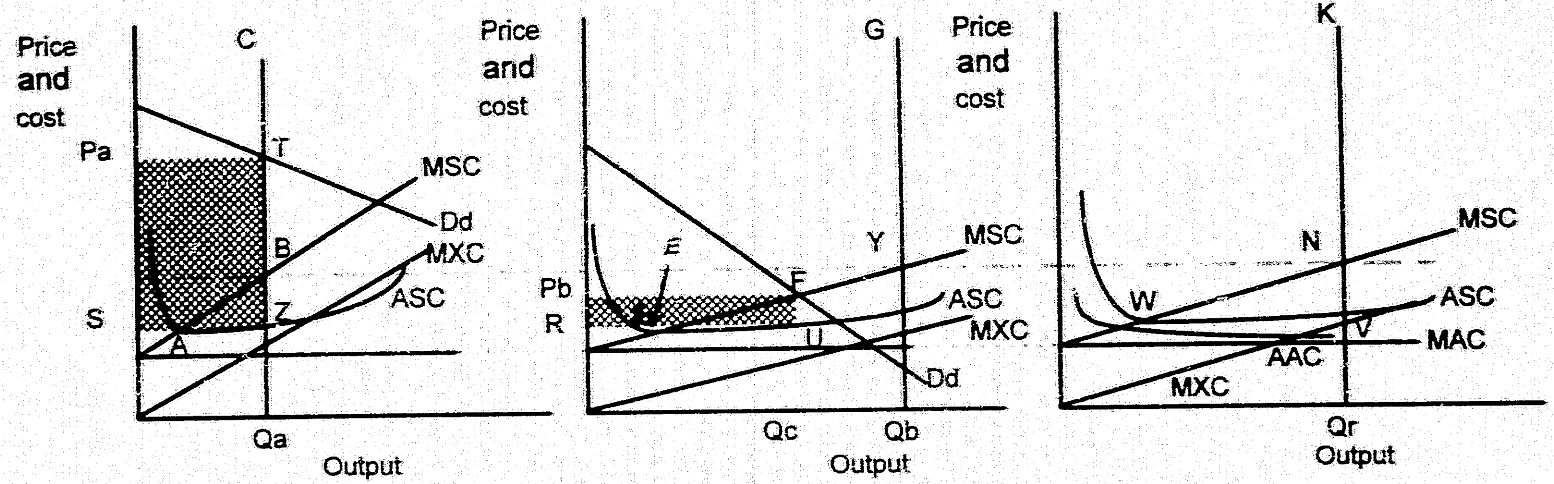
Walsh, R.G. (1986), *Recreation Economic Decisions: Comparing Benefits and Costs*, Venture Publishing, State College, Pennsylvania.

Walsh, R.G., Peterson, G.L. and McKean, J.R. (1989), 'Distribution and Efficiency Effects of Alternative Funding Methods', *Journal of Leisure Research*, 21(4): 327-347.

Wilman, E.A. (1988), 'Pricing Policies for Outdoor Recreation', *Land Economics*, 64(3): 234-241.

Figure 1

Theoretical market model of national parks within an administrative region of Queensland



Park with little infrastructure or fragile ecosystems

Panel 1

Park with adequate infrastructure or robust ecosystems

Panel 2

Region as a whole

Panel 3

Figure 2

Market model for recreation at Girraween National Park