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Economic Treatment of Recreational Congestion

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Abstract

Recreation economics treats spatial problems of varying dimensionality. Travel cost models, once fashionable but no longer so, take recreation sites as point destinations, ideally, located rationally in relation to population. One-dimensional problems, concerning extent of trails, have received little attention. As a problem of land-use competition, planar extent of site is the most important: unless congestion is a negative externality, recreational needs can be met with little allocation of land. Evidence on the existence of congestion problems is mixed, though claims that there is no problem are dismissed by deeper investigation. Tree cover may reduce the sense of congestion, depending on its type. Optimal distribution of recreationists within a space is arguably best achieved by allowing free choice of movement: there is no compelling evidence that management reduces negative externalities of congestion. Charging for access may be both more efficient than exclusion, and no less equitable.

Keywords: Spatial economics, optimal use, distribution

Introduction

Since about 1990, spatial aspects of recreation economics seem to have become of less interest. Travel cost analysis, once the dominant model, has been sidelined by the popularity of contingent valuation and the controversies surrounding its validity. (When was the last travel cost presentation at an SSFE meeting, for example?) Congestion of recreation sites, a popular research topic of the 1970s and 1980s, has been displaced by ecological carrying capacity and sustainability.

At the same time, spatial aspects have grown *more* important in outdoor recreation policy. Most of the British Forestry Commission's forests, planted prior to 1980, were located more than 50 km from major population centres (Grayson *et al*., 1973). Yet since 1990 twelve major community forests have been designated with the primary objective of providing recreational opportunities to populations previously lacking them (Countryside Commission, 1994, 1997a). The Countryside and Rights of Way Act 2000 is expected to permit access to about 1.5 million ha of "open country". However, this does not include forested land, and there is concern that most of the area is still relatively remote from heavily populated regions.

Meanwhile the Forestry Commission has effectively made timber production subsidiary to community involvement and recreational and environmental objectives, although nominally timber production has equal status (Forestry Commission, undated; National Assembly for Wales, undated). But if recreation is to justify the continuation of forestry - widely seen as unprofitable in the UK (Price, 2004) - then the recreational contribution of marginal hectares needs to be re-examined. What recreational opportunities are lost or degraded if the remotest parts of forests, or even the remotest forests, are "restored" to open land - as conservation organisations are now proposing? Does it matter to recreationists if they are crowded into a smaller area of intensively used forests?

After a brief review of the zero-dimension (point location) and single-dimension (trail provision) aspects of outdoor recreation, this paper concentrates on the two-dimension aspect (spatial extent) of recreation resources and issues of crowding or congestion. To what extent do these constitute a case for designating more land for recreation? If congestion is a problem, should it be managed by physical regulation or economic instruments? With a given size of resource and number of recreationists, in what circumstances is management to redistribute use of the site desirable?

The paper abstracts from other aspects of recreational carrying capacity - ecological vulnerability and limitations imposed by physical facilities such as access roads, car parks and toilets.

"Point" and linear recreation

For three decades following publication of Clawson's seminal paper in 1959 (Clawson, 1959; Clawson and Knetsch, 1966), all recreation economists "did" travel cost models. The recreation site was a point in space, as were all origins of recreational visits. Widely interpreted as yielding an absolute value for a site, on the whole Clawson's method gives a value in relation to the next best alternative site (Price 1978). That is to say, the spatial aspect includes implicitly not only origin-destination distance, but the spatial distribution of substitute sites. With clustered sites, the method tended to over-state, and with systematically spaced sites to under-state the contribution of a site to a system of recreational resources (Connolly and Price, unpubl.). The economics of point location might now be said to focus on travel cost saving (time, fossil fuels, road space, road traffic accidents) by locating new resources close to poorly served populations.

Linear recreation sites do not require substantial dedicated land area - about 600 ha for the entire UK longidstance trail network. Nor under UK law is public ownership of the land they cross necessary. Instead, the resources needed are those for design, designation and management - particularly costs of maintaining gates and stiles at field boundaries. There are also substantial costs of maintaining path surface in ecologically vulnerable zones. However, it should be noted that most of the network runs on pre-existing rights of way along which there would in any case be an obligation to maintain boundary crossings (on the land-owner) and path surface (local highway authority). Much of the remainder utilises routes across open-access land which were well-used long before official designation of the trails. In particular, the lengths showing severe erosion damage are generally popular mountain climbs on which long-distance walkers form a small proportion of the users.

As to why resources should be devoted to *expanding* the network of trails, one answer is a qualitative one: more trails enable aficionados to reach more different places, through more different types of scenery. But to my knowledge the willingness to pay for this facility has hardly been thought about, let alone assessed. The costs of maintenance are known, but not how they would increase with expansion of the network. Would a greater route length reduce ecological pressure below significant thresholds, thus avoiding damage and repair costs? Or would the spreading of pressure leave some trails with insufficient usage to maintained a trodden-out route? Do gates and stiles and paths and traversed land depreciate with use or with the lapse of time? If the former, a greater length of trail itself implies no increase of cost: if the latter, it does. At one time some work was done on congestion of wilderness trails in the USA (Shechter and Lucas, 1978). A greater route length would relieve this. Much of what is said in the following sections about the reality of problems and management solutions also applies to management of congestion on trails. However, one survey of trail users in the UK (Countryside Commission, 1997b) found that only 5% had had their enjoyment impaired by the presence of other walkers, and it is doubtful whether designation of more trails would significantly reduce this small number.

Recreation and congestion: making more space

Unless crowding is a negative externality, recreation needs can be met with little allocation of land. Many management problems (information, security, fire, repair) are alleviated by spatial concentration of use. If there is conflict between recreational use and biodiversity conservation, this can be minimised by confining recreation to the robustest parts of the site.

On the other hand, if congestion is a negative and mutual externality, extending the recreational space may be worthwhile. The classic analysis is attributed to Fisher and Krutilla (1972), and is represented in figure 1. The heavy line represents the locus of feasible management strategies: as the number of experiences supplied increases, so the quality of experience deteriorates, and a lower demand curve is relevant.

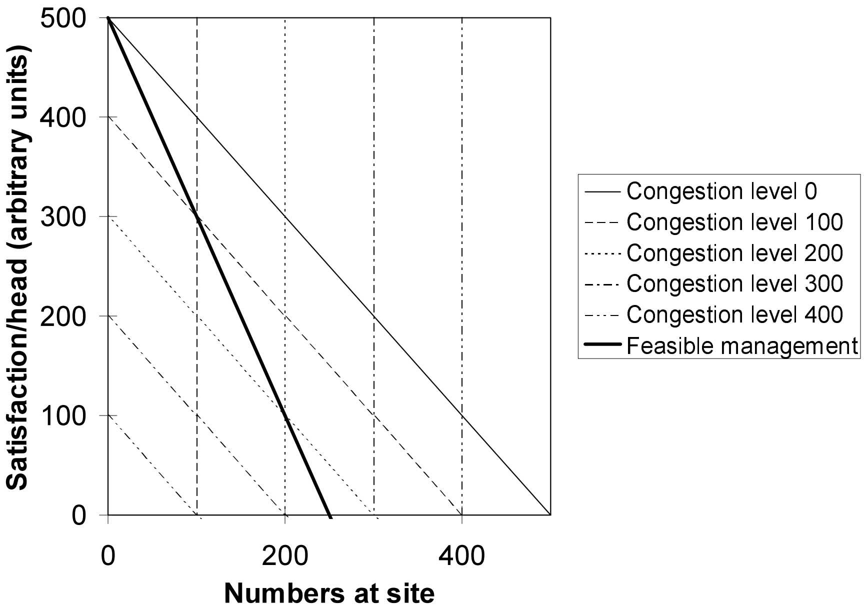

Figure 1. Demand (sloping) and supply (vertical) functions: various levels of congestion

Without regulation of use, recreationists will increase visits while the marginal satisfaction (net of access costs) exceeds zero, that is, to 250 visitors. A marginal reduction in visits brings little net loss, but improves the satisfaction to the remaining visitors. In this case maximum total satisfaction is achieved if usage is regulated to 167 visitors.

To increase supply while staying on the same demand curve requires designation of extra recreational space. The intuitive response, not infrequently articulated, may be that extra open-access recreation sites will soon become as congested as the original ones. However, it is easy enough to show that expanding the recreational space available will both:

· increase the number of recreational experience; and

· reduce the congestion encountered (Price 1981a).

Is more recreational space really needed?

But in the 1970s a variety of emerging evidence cast doubt on whether the effects of crowding at recreation sites were negative. (Haas and Nielsen, 1974; Shelby and Nielsen, 1975; Manning and Ciali, 1980; Shelby, 1980). A travel cost study by Vaux and Williams (1978) showed, apparently, a greater consumers' surplus at congested than at uncongested sites. Most extraordinarily, a survey at Tarn Hows, a popular and well-wooded recreation site in the English Lake District, showed that the greater the numbers at the site, the less congested

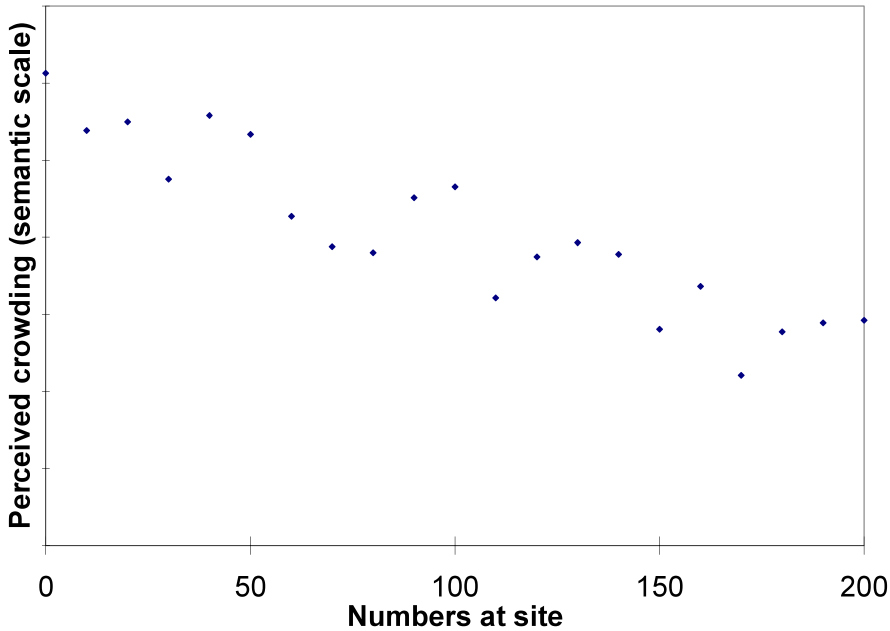

Figure 2. The kind of result found at Tarn Hows

In the words of an eminent forestry academic of the time: "People *like* congestion - you always find more of them at congested sites."

However, recreation psychologists soon advanced several hypotheses to explain these divergences from expectation (Heberlein and Shelby, 1977). Our work in the Forest of Dean, Gloucestershire, England found much evidence in favour of several of these named hypotheses. Questionnaires were combined with behavioural studies and objective measures of visitor density. The responses of 491 visitors were disaggregated in various ways, and the different parameters of regression relationships used to test the validity of the hypotheses. The following sections summarise results. Much fuller accounts are given in Chambers (1984), Chambers and Price (1986) and Price and Chambers (2000).

Environmental and psychological confounding

The relationship between actual density of recreationists and satisfaction is rather indirect. The configuration of the ground and vegetation affect the numbers present who can actually be seen. Psychological factors influence whether large visible numbers are interpreted as crowded or not, and also whether a given perceived level of crowding should be considered a source of dissatisfaction. Table 1 shows individual steps of the relationship, indicating that statistical explanation is good for individual links of the causal chain, but much less satisfactory between the ends of the chain, along which important explanatory variables are not included. Here, and elsewhere, relationships are shown between actual density, *D*, measured by angle gauge; numbers in sight, *N*, obtained by counting; and perceived density, *P*, and satisfaction, *S*, derived from questionnaires.

Table 1. Interrelationships of satisfaction and various measures of density

Regression of	On	Equation	R^2	Probability
Numbers in sight	√ Actual density	$N = 4.27 + 56 \times \sqrt{D}$	0.534	0.0001
Perceived density	Numbers in sight	$P = 2.96 + 0.00236 \times N$	0.233	0.0001
Satisfaction	Perceived density	$S = 6.39 - 0.431 \times P$	0.147	0.0001
Satisfaction	√ Actual density	$S = 5.14 - 0.0541 \times \sqrt{D}$	0.013	0.02

A more systematic bias occurs when attractive environments or favourable weather attract both high visitor numbers and high levels of satisfaction. Uniformly good conditions through the study period avoided the weather problem, and the site problem was circumvented by disaggregating the data by site - with improvement for two sites as shown by the statistical relationships in table 2. The non-significant relationships will be discussed later.

Table 2. Satisfaction–density regressions disaggregated by site

Sites in regression	Equation	Sample	R^2	Probability
All	$S = 5.14 - 0.0541 \times \sqrt{D}$	491	0.013	0.02
Speech House	$S = 4.61 + 0.0143 \times \sqrt{D}$	128	0.001	NS
Wenchford	$S = 5.23 - 0.0437 \times \sqrt{D}$	87	0.015	NS
Mallards Pike	$S = 5.82 - 0.208 \times \sqrt{D}$	125	0.057	0.01
Beechenhurst	$S = 5.36 - 0.137 \times \sqrt{D}$	151	0.051	0.01

Vegetational influence

The claim is often made that forests are more effective than open vegetation at absorbing crowds. Our objective data tended to support this: the density measured using an angle gauge device changed as follows as the sweep enclosed successively larger areas:

· in broadleaved woodland with dense understorey, recorded density fell rapidly

· in grassland on folded topography, recorded density fell more slowly

· in old conifer woodland with little understorey, on flat terrain, there was no change in recorded density.

This result was supported by the greater degree of explanation, greater statistical significance and larger slopes parameters of relationships between variables at the grassland and conifer sites (table 3).

Table 3. Regressions of numbers in sight and perceived density on actual density in different vegetation types

Site character	Equation	Sample	R^2	Probability
Broadleaved I	$N = 19.0 + 0.224 \times D$	128	0.316	0.0001
Broadleaved II	$N = 32.3 + 0.176 \times D$	87	0.180	0.0001
Coniferous	$N = 7.69 + 0.889 \times D$	125	0.475	0.0001
Grassland	$N = 14.7 + 0.604 \times D$	151	0.491	0.0001
Broadleaved I	$P = 3.74 + 0.00650 \times D$	128	0.069	0.005
Broadleaved II	$P = 3.98 + 0.00203 \times D$	87	0.015	NS
Coniferous	$P = 2.68 + 0.0648 \times D$	125	0.239	0.0001
Grassland	$P = 3.25 + 0.0231 \times D$	151	0.170	0.0001

Cognitive dissonance

According to Festinger (1957), people redefine motives and satisfactions when circumstances might otherwise imply that they had made wrong choices. Thus when people have invested time and effort in journeying to a site, they may feel it would evince irrationality to claim that they were not satisfied with the experience so gained.

Analysis of our data disaggregated by distance from trip origin shows clearly that there are indeed weak adverse relationships between crowding and satisfaction for those who travelled longer distances, whereas those from close at hand were more prepared to express *dissatisfaction* with crowds. By contrast, there was no such trend in the relationships between perceived density and numbers in sight: at all distances visitors *noticed* the crowds.

Table 4. Regressions of satisfaction and density, disaggregated by distance of origin

Distance zone (km)	Equation	Sample	R^2	Probability
0–20	$S = 7.23 - 0.56 \times P$	162	0.236	0.0001
20–60	$S = 6.59 - 0.33 \times P$	194	0.136	0.0001
60–180	$S = 4.97 - 0.23 \times P$	71	0.030	0.1362
>180	$S = 6.39 - 0.31 \times P$	64	0.102	0.0112
0–20	$P = 2.11 + 0.026 \times N$	162	0.245	0.0001
20–60	$P = 4.34 + 0.020 \times N$	194	0.200	0.0001
60–180	$P = 3.20 - 0.036 \times N$	71	0.200	0.0047
>180	$P = 3.75 + 0.036 \times N$	64	0.300	0.0004

No expectations

If people have no expectations of what crowding will be like, they may not respond adversely to whatever it is that they find. (Unfortunately our questionnaires did not allow us to distinguish the sub-set of this group who were unpleasantly surprised.) Table 5 shows a remarkably different parameter of response to numbers in sight for the two categories.

Table 5. No-expectations hypothesis and regressions of satisfaction on numbers in sight

Category of visitor	Equation	Sample	R^2	Probability
Had expectations	$S = 5.35 - 0.0145 \times N$	250	0.062	0.0002
No expectations	$S = 4.91 - 0.00145 \times N$	241	0.001	NS

Product shift

If the intended recreational activity (e.g. bird watching) turns out to be unsuitable to the conditions of crowding actually found, recreationists may engage in a different, more compatible activity (e.g. joining in a fun run). We did not include questions about intended and actual activity and motivations for any difference, so offer no evidence here.

Displacement

Another group of individuals modifies its behaviour in quite a different way. Instead of adapting their activity to the condition of the site, they design visits to sites to accord with their desired activities. Thus crowd-averse visitors may

· move on if the site is found to be crowded on arrival (studies of stay-time at car parks showed, to a slight degree, more rapid onward movement at times of high crowding)

· visit at off-peak times (see table 6)

Table 6. Regressions of satisfaction on perceived density: off-peak and peak

Time of day	Equation	Sample	R^2	Probability
Off-peak	$S = 6.56 - 0.45 \times P$	177	0.21	0.0001
Peak	$S = 6.25 - 0.35 \times P$	314	0.11	0.0001

Questions about visitors' perception of crowding also allowed a crowd aversion index to be established. The greater the crowding was *perceived* to be for any *actual* visitor density, the greater the value of the index. Disaggregating the data by crowd aversion index showed clearly that populations do contain psychological sub-groups whose response to crowding is negative and strong. This response may be masked by variation in crowd aversion when the data are not disaggregated.

Table 7. Satisfaction–density regressions disaggregated by crowd-aversion

Crowd aversion index	Equation	Sample	R^2	Probability
< 0.8	$S = 5.50 - 0.0068 \times N$	115	0.021	0.1261
0.8 to 1.6	$S = 5.35 - 0.0122 \times N$	147	0.042	0.0129
1.6 to 3.2	$S = 5.66 - 0.0296 \times N$	114	0.173	0.0001
> 3.2	$S = 5.24 - 0.0492 \times N$	115	0.150	0.0001

At times of lesser *real* crowding, crowd-averse visitors are likely to constitute a greater proportion of interviewees, who are therefore likely to express low satisfaction even with low crowding: at times of greater crowding, the expectedly less crowd-averse visitors perceive less crowding and so express greater satisfaction. This mechanism explains many of the results obtained in the 1970s, especially the perverse results at Tarn Hows.

Displacement between sites also explains the results of Vaux and Williams (1979), given that the travel cost method measures site value in relation to the value of substitute sites. At times of great congestion such as public holidays, crowd-averse recreationists are displaced to remoter sites, more costly to access. At such times these sites may be quite crowded, but they allow a much better experience relative to the extremely congested sites lying closer to population centres.

By contrast, visitors to the Speech House site seemed to respond, if anything, positively to crowding, while those at Wenchford were neutral (see table 2). These sites are known to be recreation focuses, and people go there to have a good time in the company of many others.

Managing congestion at a site of given extent

There is enough evidence above to suggest that recreational congestion is a problem, to the extent that at least a significant proportion of visitors perceive it as such. Self-interested decisions - on whether to come to the site or to go elsewhere or to stay at home, and on how to distribute themselves through the site - will not in these circumstances produce the optimal use of the site. Some management actions may be justified.

Charging versus exclusion

The economists' tool of charging to ration use may be preferred to physical exclusion with good reason (Price, 1981b). Exclusion of some arrivals entails visitors making more than one journey per realised visit. It may therefore be no less costly to recreationists than paying a substantial admission charge. Yet admission costs are transfers, and generate funds for useful site expansion and management, while travel costs are real resource costs, with externalities of road pollution, accidents and congestion.

Nor are equity issues in favour of physical regulation. Physical exclusion has a variable effective cost owing to the varied length of repeated journeys, unlike an admission cost, which is the same irrespective of journey length. Moreover, those who have furthest to travel will be relatively late in arriving, and therefore have lower probability of admission. Those who live far from the site therefore pay effectively more under regulation than under charging. Given the distribution of rich and poor in relation to rural recreation areas, the poor are likely to pay a higher premium under exclusion.

Given these difficulties of exclusion, it may be economically preferable not to regulate access, than to regulate by exclusion - particularly when site demand is inelastic (see Price (1981) for proof).

On the other hand, there is instinctive opposition to charging for what is regarded as *allermannsrätten* (even if access has no legal authority). Free access to a resource has a value in addition to that of the resource itself. Hence, perhaps, visitors to Durham Cathedral voluntarily contributed more per visit than the willingness to pay for entry that they declared in a contingent valuation exercise (Willis *et al*., 1993). In this context it is not so much the *actual* efficiency and equity effects of charging that matter, but the *perception* of these effects.

Distribution of visitors within the site

Zoning a site for various levels of usage is an appealing management strategy. To a degree recreationists organise themselves into zones of different crowding levels. However, it is not clear either that they do so in an optimal manner, or that management to modify the "natural tendency" of zoning is beneficial. A mathematical approach is developed below.

Initially, let the response to crowding be uniform among recreationists, and let it be represented as

$$\left[\begin{array}{c} individual \\ satisfaction \end{array}\right] = \frac{a}{[density]^b} \qquad (1)$$

b is the absolute of the elasticity of satisfaction, *s*, and for convenience satisfaction is given in arbitrary units such that $a = 1$. Let *n* be numbers per 100 ha.

$$s = \frac{1}{n^b} \quad \text{and} \tag{2}$$

$$\frac{GV}{GQ} = \frac{-E}{Q^{E+1}} \tag{3}$$

Let two 100-ha zones of the site exist such that in one the density is c times that in the other, N.

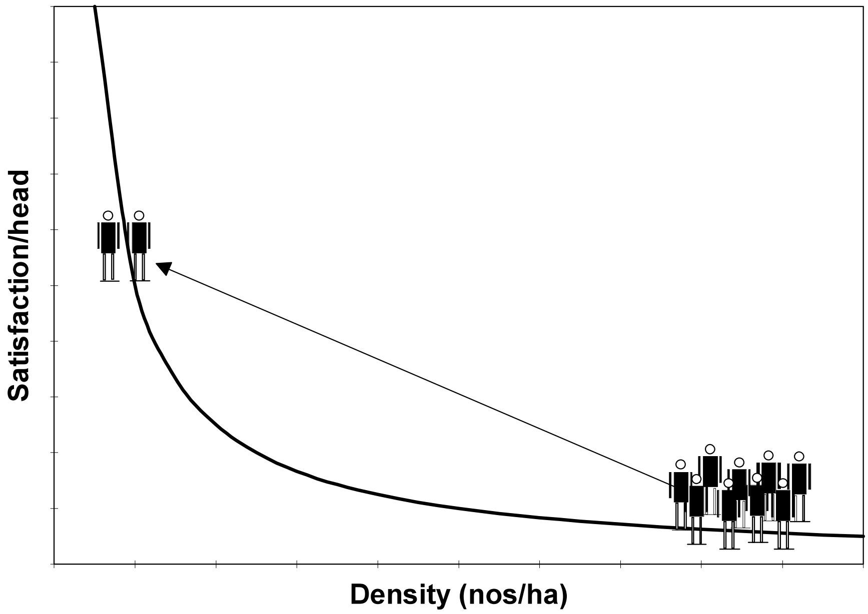

Figure 3. Redistribution of crowding within a site

Let N be >>1. Now let one user transfer from the more to the less crowded zone, this being the self-interested satisfaction-maximising tendency. For the transferer, from equation (2) the benefit is

$$[\textit{new satisfaction}] - [\textit{old satisfaction}] = \frac{1}{N^b} - \frac{1}{(cN)^b} \tag{4}$$

For those remaining in the more crowded zone, from equation (3) the benefit of the transfer is

$$[\textit{number affected}] \times \left(- \left[\begin{matrix} \textit{rate of change of} \\ \textit{satisfaction with crowding} \end{matrix} \right] \right) = cN \times \frac{-(-b)}{(cN)^{b+1}} = \frac{b}{(cN)^b}$$

(5)

For those remaining in the less crowded region, the [dis]benefit of the transfer is

$$[\textit{number affected}] \times \left[\begin{matrix} \textit{rate of change of} \\ \textit{satisfaction with crowding} \end{matrix} \right] = N \times \frac{-b}{N^{b+1}} = \frac{-b}{N^b} \tag{6}$$

The summed change in benefit is thus (6) + (4) + (5) =

$$\frac{-b}{N^b}+\left\{\frac{1}{N^b}-\frac{1}{(cN)^b}\right\}+\frac{b}{(cN)^b}=\frac{1-b}{N^b}+\frac{b-1}{c^b\times N^b}=\frac{\left(c^b-1\right)}{c^b\times N^b}\times(1-b) \qquad (7)$$

Since $c > 1$, and $N > 0$, both numerator and denominator of the quotient in (7) are always positive; and summed benefit given by equation (7) is positive, zero or negative as b is less than, equal to, or greater than 1.

Empirically, responses to questionnaires (Price, 1979) suggest that $b = 1$ is close to reality. This indicates that there is no benefit in encouraging users to distribute themselves evenly throughout an area, but neither is there benefit in trying to differentiate density of use (except for ecological reasons). Also, with this parameter value, the total satisfaction (= [numbers] ´ [individual satisfaction]) derived from a site of given area is invariant with numbers at the site, since individual satisfaction is inversely proportional to density (= [numbers] / [site area]). This is in marked contrast to the result of Fisher and Krutilla (1972), as discussed above.

If, however, the users in the less crowded zone are more crowd averse than those in the more crowded one, the negative element in (6) is increased relative to the positive element in (5). Self-distribution may fail to achieve optimality, even where $0 < b < 1$. Moreover, attempts to improve the situation may fail, since *unselective* evening-out of densities may crowd the crowd averse, while dispersing the crowd tolerant.

However, to a degree the problem is self-regulating, especially if part of the population has a positive preference for a degree of crowding.

· Such crowd-seeking recreationists, by congregating in one part of the site, will automatically reduce the crowding experienced by the crowd averse.

· If parts of the site are less attractive by reason of accessibility or aesthetic quality, users will arrange themselves within the site so that the most crowd tolerant seek the most attractive locations, while the most crowd averse tolerate the less attractive ones. By "congesting" the best landscapes, the best use of them is made.

Nonetheless an optimal outcome is not guaranteed. For example, those most averse to congestion may also be most appreciative of landscape quality. This belief probably underlay the "honeypot site" strategy of the 1960s and 1970s in Britain: recreation sites were designated to intercept "the masses" before they could reach the high quality landscapes of the national parks. But here issues of justice are added to those of efficiency. Arguably, those whose preference for uncongested conditions makes them heavy demanders of spatial extent should "pay" for their requirements by accepting a recreational environment of lower quality or higher access cost. Applied on a large spatial scale, it was just such a recreation resource, remote and not particularly beautiful, that the Forestry Commission created in Britain in the middle years of the twentieth century.

Conclusion

The spatial economics of recreation are clearly far from being fully resolved. In many cases it seems that the relevant questions are not being asked any more. There is work even for the contingent valuation method to undertake. Yet there remain persistent resistance and puzzlement with aligning money and environmental scales (Clark *et al*., 2000). Sometimes it is not necessary to invoke money in resource choices: questions about recreationists' preferences among feasible management strategies (Price, 1979) may give enough information to assist improved efficiency of spatial resource use.

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