# CHAPTER VIII – TN 5: POTENTIAL FUNCTIONS IN EVALUATING THE NEED FOR RECREATION FACILITIES

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## ABSTRACT

Planning the provision of recreation facilities is currently hampered by a relative lack of preceding research and a marked absence of established standards. To evaluate recreation opportunities provided by sites such as provincial and federal parks in Canada the authors suggest a method of quantifying each opportunity, a measure they call the *Opportunity Quotient*, that can be applied to any location.

The paper discusses the philosophy underlying the *Opportunity Quotient* and the problems its use entails. It treats the *Opportunity Quotient* from the assumption that competition for recreation resources is best measured at the recreation sites themselves, but it also offers an alternative formulation based on assuming that the competition for resources is exerted at the point of residence of each individual, and that it is this force which drives one away from home to seek recreation opportunity.

A practical example of using 'the quotient' to assess opportunities is given, based on the Windsor—Quebec Urban Corridor project of Environment Canada.

## MEASURING RECREATION OPPORTUNITY

The combination of pressures upon limited physical resources and increased public awareness and desire for leisure activities throughout the 1960's and 1970's have resulted in great concern with recreation and provision of facilities for recreation pursuits. Individuals and governments are now actively involved with studying and planning in these areas. The classical planning problems of evaluating the present situation and determining the needs and wants of the population have assumed new importance. In the recreation field, however, the difficulty of coping with these problems is amplified by the relative lack of previous research and the marked absence of established standards.

Evaluation of the recreation opportunities provided by recreation sites (such as provincial and federal parks in Canada) is of current interest to the Outdoor Recreation and Open Space Division of the Lands Directorate, Environment Canada. To this end, a method of quantifying the opportunity is suggested which, when applied, yields a measure called the Opportunity Quotient. Insofar as the quotient can, in principle, be calculated for any point in the country, the spatial variation in the level of opportunity can be mapped. This paper focuses on rationalizing the formula used to define the quotient.

## THEORY

Opportunity for recreation is obviously dependent upon the relationship between the supply of recreation sites and the demand for them. In fact, the ratio between a measure of supply and a measure of demand can reasonably be called an index of opportunity. But a crucial and most difficult problem in defining a particular index is establishing a means of effectively representing both factors in such a fashion that values of the ratio for different places really reflect their differing levels of recreation opportunity. (Comments in this CORDS Vol. 2 indicate that some hold the view that the measure need only be relevant to policy, and may have nothing to do with "really" reflecting difficult levels of opportunity.)

In urban areas, a commonly used measure of recreation opportunity is the ratio of total city park acreage to total city population. Such a ratio is often compared to some accepted planning norm of park acres per thousand people (see TN 26). Even at the city level, it can be argued that this ratio fails to take into account variations in access to a park as a function of distance from home to parks. Clearly a family within 100 yards of a city park is likely to make more use of it than a family whose closest park is a mile or two distant. An additional limitation of the above approach is the concentration on park acreage as a measure of supply, to the exclusion of any other park characteristics, such as the nature of a park's facilities. At the scale of regional and national parks, the same considerations of access and park facilities remain relevant. Therefore, an index is required which incorporates these elements, in addition to just volume being considered in measuring the supply/demand ratio.

MEASURE DEFINITION

To begin, consider a single location. What is sought is an index of opportunity of people living at a location to use public recreation facilities, expressed in terms of the supply as measured by the number of facilities available to them, the characteristics of these facilities and their accessibility from these locations. The index should include a measure of demand for these same facilities, so that the extent of pressure on, or competition for them, is known and used to adjust the supply measure. In this paper, the only facilities considered are parks.

An index of location i's supply provided by a single park j, discounted by the distance between the park and i can be defined as A(j)/D(i,j), where A(j) is the attractiveness of park j and D(i,j) is the distance from to j. Given that ratio, an obvious way to measure origin is total supply is to add together all the A(j)/D(i,j) ratios for parks accessible to that origin (within some arbitrary distance). (On problems with the convergence of the sums of such ratios see TN 3.)

The multiplying factor park attractiveness is used in the formula to imply that "something" about a park really determines the effective supply of park-based activities to the public. The more attractive a park to potential users, the more likely people are to use it, and therefore the more effective it is in adding to the supply people perceive. The determination of a park's level of attractiveness is a considerable problem in itself which is not pursued here. A discussion of various methods of estimating park attractiveness is to be found in Chapter III of this volume. Frequently, though, simple variables which are assumed to be closely correlated with park attractiveness, such as park acreage or number of campsites, are used as expedient surrogates of attractiveness, for lack of estimates of attractiveness itself (see TN 9).

However, returning to the main theme, in defining a sum of A(j)/D(i,j) ratios, something has been implied about the relative importance of attractiveness compared to distance in terms of the effect of these factors on supply. Assume for the moment that the major determinant of attractiveness is park size. As it stands, the implication is that one park of say 200 acres at 1 mile from i contributes no more to i's supply than another park of 2 million acres at 10,000 miles. Or, put another way, two origins would be implied to be equally supplied if one had a 200 acre park a mile away and the other had a 2 million acre park 10,000 miles away. The questionable validity of such an assumption leads one to consider what the weights are which should be applied to the size and distance terms to make the relative values of different A/D ratios more "realistic".

In the context of the example the question is more properly defined as: How do people trade off size against distance when evaluating their access to supply? If empirical evidence is available as to the nature of the trade-off between attractiveness and distance the earlier expression may be appropriately modified to give, for example, $A^a/D^d$, or some other such combination of transformations. For example, if the appropriate function was Γ, then in the above example about two parks, the smaller at one mile would contribute $200/1^2$, i.e. 200, to one origin's supply measure whereas the large park at 10,000 miles would now contribute only $2{,}000{,}000/10{,}000^2$, i.e. 0.02, to the other origin's supply measure. Obviously, vastly different conclusions are reached about the relative supply to different places, depending on the relative "weight" given to attractiveness and distance. Since the assumption of any other weights, in what follows the function, $A^a/D^d$, that is added up to get a supply measure, is defined in the "non-committal" ψ(A/D) (if could be f(A,a,D,d) but that would not suggest division).

To this point there has been no consideration of the effect of the presence of numerous users at the same park site and the possible reduction in the individual's opportunity to enjoy a park's facilities as the number of competing users at a park increases. A park surrounded by several nearby cities is likely to be frequently crowded, and, because of the congestion, the kinds of benefits that such a park is thought to provide are likely to be less available than if the same were close to only one small town. Thus, the potential supply offered by a park j to an origin defined as ψ(A(j)/D(i,j)) should be discounted when the number of users at j, U(j), is large. The nature of the relationship of crowding and supply unfortunately requires empirical verification. Still, it seems plausible that disutility and use are related so that the larger the size of the park (S). and its facilities, the lower the disutility associated with a given U(j), a positive monotonic increasing S-shaped curve. Regardless, a generalized definition of the potential supply discounted by the number of competing users is:

( 1 ) $P( i,j ) = \psi_1( 1 )( A( j )/D( i,j ) )/\psi_2( U( j )/S( j ) )$

Equation 1 defines in some way the opportunity for people at origin i to use park j. An estimate of their opportunity to use all parks, called their "Opportunity Ratio", is given as:

( 2 ) $OR(i) = \Sigma_j ( \psi_1( A( j )/D(i,j )/\psi_2( U( j )/S( j ))$

WHERE j=1, NP; and

NP = the number of parks within some arbitrary distance of i (see TN 3) or the number of parks within the jurisdictional area to which the planning is related.

This statistic gives a measure of the effective access which residents at i have to park recreation facilities, and can, of course, be calculated for all origins.

Given that exact forms of the functions $\psi_1$ and $\psi_2$ can be specified, numerical values of OR(i) can be calculated and plotted on a map and used to indicate the extent of regional and local variation in access to park facilities. Such a map has value to planners considering locations for new parks. However, since these scores are dimensionless ratios, it facilitates reading of the map if these ratio scores are standardized around a convenient value; e.g. a mean score normalized to 10 or 100. Using the latter value for the mean enables an origin's percentage deviation from the study area's average value to be directly read from a map. Here such normalized quotients are referred to as Opportunity Quotients (OQ).

DISCUSSION

The usefulness of OQ depends, of course, on the function in Equation 2 resembling reality in some sense or other and, in the final analysis, the real level of outdoor recreation opportunity for any origin is what the people there perceive this level to be. The statistic, therefore, ought to have the same spatial pattern of variation as perceived recreation opportunity. The degree of correspondence between the two depends largely on two factors. Firstly, the general form of the functions in Equation 2, in particular, must be realistic, i.e. the variables in this equation must be the relevant ones and they must be combined in a fashion that corresponds to perceptual reality. Seconδy, the weightings involved in $\psi_1$ and $\psi_2$ in Equation 2 must have empirical validity. This is not the place to enter into a discussion of how to ensure these requirements are satisfied. Nevertheless, the validity of the map of Opportunity Quotients depends on the above conditions being met.

AN ALTERNATIVE FORMULATION

The above discussion of the Opportunity Quotient has been based on the assumption that the competition for recreation resources is best measured at the recreation sites themselves, and that competition is a force which can "hold people away" from a potential site. This is the measure that is referred to as U(j) in Equation 2.

One can make an alternative assumption which treats the competition factor in a different sense. In this case, one assumes that the "pull" of resources is exerted at the point of residence of each individual, and that it is this force which draws one away from his home to seek recreation opportunities. Because there can be no simple measure of this competition, one must measure it through the use of a surrogate, here chosen to be the population potential. This statistic, long employed by geographers, distributes the "pressure" exerted by a population over space, usually in a negative exponential fashion.

The measurement of the outdoor recreation supply available at any point i is performed as indicated in Equation 2 above, except that the surrogate of park attractiveness, A(j), used here is the natural logarithm of park size (ln S(j)). The justification of this transformation is that the strength of a person's perception of the stimulus of park size is believed to be directly related to the natural logarithm of the park size rather than to the park size itself. (See TN 9 for references to the literature.) This transformation has the effect of giving relatively more weight to the smaller parks and playing down the importance of the larger ones.

Under these assumptions, an equation analogous to Equation 2 is written as:

( 3 ) $OR(i) = ((\Sigma \ln(S(j)) / D(i,j^{\delta})/(\Sigma P(k) / D(i,k)^{\gamma})$

WHERE NK = the number of population centres within some arbitrary distance of a location (not necessarily a city - just a point in space); and the sums are for j=1 to NK.

$\delta$ and $\gamma$ = two constants, usually ranging between 1.0 and 2.5 but not necessarily equal; and other terms are as previously defined.

One should note that this equation is for computing an CR(i) for any arbitrary location i based on the cities and parks that are located within range of i, regardless of whether or not anyone lives at location i.

It is not relevant to speak of this measure as indicating the response of "the people" at i to their facilities, but rather the ratio reflects how a person at i would "perceive" the availability of parks around the location in comparison to the "degree" given that there were people around. The measure defined by Equation 2 has the more "straight forward" behavioural interpretation of indicating what the "effective" combined opportunities to participate at any location appear to be to a person at location i. The difference is subtle but important.

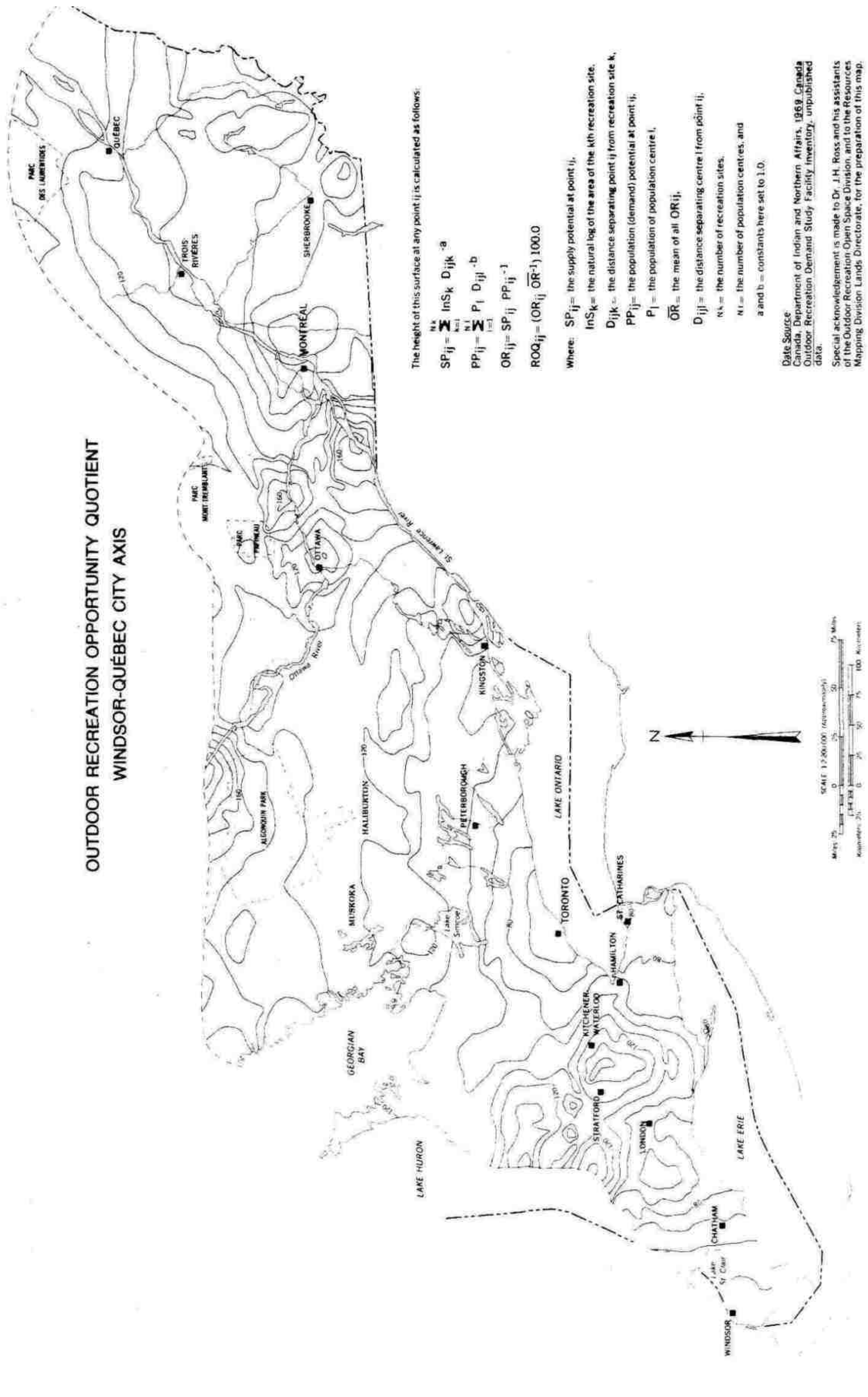
It should be noted that the interpoint distances (D(i,j), D(i,k)) utilized may be actual road distances (where available), Manhattan distances (or other Minkowski metrics), time distances or actual geographic distances. In this study the authors have utilized the latter. In the absence of firm knowledge about the values of $\delta$ and $\gamma$ in Equation 3, the values of 1.0 have been used to develop a real map.

Obviously, the statistic defined by Equation 3 may be scaled in the same way as that defined by Equation 2, thus leading to a quotient representing a deviation from a known mean value.

## A PRACTICAL EXAMPLE

The practical example discussed below was calculated and mapped for the Windsor-Quebec Urban Corridor project of Environment Canada's Lands Directorate (Lands Directorate, 1974). In this example the work was performed according to the assumptions outlined in Equation 3. The sole change was that the points for which the Opportunity Quotient was calculated were assigned double subscripts to facilitate calculation and mapping.

The data utilized in the project are (1) population statistics incorporating all communities larger than 1,000 population situated within 500 miles of each of the points for which a particular OR(i) is computed, and (2) the CORDS Facility Inventory statistics on federally or provincially operated recreation sites (for details on these data see Volume III).



In order that the competition of USA recreationists might be taken into account, the population of each state was assigned to the state's capital, and this population taken used in computations if it met the distance constraint used. These population masses were then incorporated in the calculations. After calculation and scaling, the Opportunity Quotient was isoplethically mapped (see Figure 1).

The contours on the map join points at which OR(i)'s are equal: points at which people would perceive a constant ratio of the type described earlier in relation to Equation 3. Inspection of the map produced reveals two obvious patterns. The general influence of the USA population lying to the south and west, which exerts great pressure over the study area, is most pronounced in the Windsor-Chatham area, and decreases in strength to the east and north. It is also evident in the Niagara Peninsula and south eastern Quebec. The influence of the population concentrations near Toronto and Montreal are revealed by the east-west extent of the poorly served areas adjacent to them, and by the alignment of the "ridges" of opportunity separating them. The generally high degree of opportunity evident across the northern portion of the map reflects both the lower population pressure and the greater supply of recreation land provided by such parks as Algonquin, Mont Tremblant, Papineau and Laurentides.

CONCLUSION

The measurement of an intangible such as one's opportunity to participate in outdoor recreation is extremely complex and is hampered by both practical and theoretical problems. (The problem alluded to here is the one for which a solution is sought in TN 29 and should not be confused with the inventory problem discussed in TN 16.) The practical problems largely relate to data collection costs, particularly if variables such as park attractiveness have to be estimated using behavioral data on park choice (see Chapter III for a discussion of various methods of estimating- park attractiveness). The more serious problems are theoretical ones and centre around the problem of specifying a functional form for the Opportunity Quotient and of defining accurate estimates of its parameter values, such that there is a close correspondence between the value of the quotient and people's perceived recreation opportunity.

Two examples of alternative forms of the Opportunity Quotient based on rational argument have been suggested. Although only one has been mapped, it seem likely that there would be significant differences between two maps based on different forms of the quotient. Therefore the final selection of appropriate formulae will require them to be validated against perceptual information on recreation opportunities. To compound problems, serious methodological problems exist in trying to measure such perceptions. However, without such validation, the real meaning of any Opportunity Quotient will remain in doubt.