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Factors Affecting Quality and Location Values for Resident Deer Hunting in Utah

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FACTORS AFFECTING QUALITY AND LOCATION VALUES FOR RESIDENT DEER HUNTING IN UTAH

by

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Finally, to an old man, a sheep herder by profession and a mountain man by choice, I extend a son's thanks for the character of heritage and love of wildlife taught to me in the Idaho wilderness.

Jim C. Wrigley

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ABSTRACT

Factors Affecting Quality and Location Values For
Resident Deer Hunting in Utah

by

Jim C. Wrigley, Master of Science

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Major Professor: Dr. E. Boyd Wennergren
Department: Agricultural Economics

Application was made of the economic rent method of resource valuation for the resident deer hunt in Utah. Total economic, location and quality rent values were estimated for all hunting units. These values incorporate the relationship existing between the variable use cost and the units of activity associated with the site.

Data were collected by mail survey from hunters following the 1970 season. Approximately 2033 questionnaires were used in the analysis. Additional data were collected from the Utah Division of Natural Resources.

The total rent value estimated from the model was approximately $3,326,238.00. Eighty-five percent of the total was attributed to quality and 15 percent to location. Total rent values were highest for Unit 2 (Cache, Unit 1 (Box Elder) and Unit 6 (Lost Creek).

It was hypothesized that variations in quality value could be explained by variations in site specific factors. The factors were made subject to multiple regression analysis and the number of bucks, two and one-half years of age and greater taken by resident hunters, was found to be the most significant. Variation in this variable and the others in the model explained 71.3 percent of the variation in the site quality value.

To test the sensitivity of capacity in the model, an additional set of capacity constraints were estimated and used in the least-cost program. This gave a higher least cost allocation as the hunters were forced to incur a higher transfer cost. In this allocation the location value increased as the quality value decreased. Multiple regression analysis indicated that 83.3 percent of the variation in site quality was due to variations in site specific factors.

(143 pages)

INTRODUCTION

The demand for outdoor recreation in the United States has been increasing as a result of increased population, higher per capita income, improvements in the transportation system, and perhaps more importantly, the increase in disposable leisure time. Clawson (1959), projected that by the year 2000, both population and spendable income will double. With the advent of heavy industrialization and the transfer of the agrarian labor force, the average work week in the United States has decreased steadily from 70 hours in 1850 to 40 hours in 1950. Future projections suggest an even shorter working day and week with longer, more widespread amounts of leisure time. There is a movement at the present time to shorten the labor week to 36 hours.

The years following World War II have seen a dramatic increase in attendance in public parks, forests, and campgrounds. Trends have been established, approximating an annual increase of 8 to 10 percent. If such trends continue, it is predicted that by the year 2000, 3.4 billion visits will be made annually to the national forest system. It is also estimated that from 5 to 8 percent of all family expenditures are now allocated to recreation and that each year 4 to 5 billion dollars are spent for outdoor recreation activity. In 1900, the average traveler covered around 500 miles per year, whereas today, the total is slightly over 5,000 miles per year. Predictions of an average travel rate per year of 9,000 miles by the year 2000 are commonplace, a consequence of the improvement of transportation as well as the predicted increase in available leisure time (Clawson, 1958).

The upward trends in recreation activity intensify the need for new and better ways to value recreation resources as a means of establishing suitable criteria for allocation of scarce public funds. However, the evaluation of benefits derived from recreation is a problem in as much as the use of public resources are not always rationed by entrance of other quid pro quo fees due to a lack of marketing pricing. In the public sector recreation is usually provided at a nominal cost so that expenditures do not provide a meaningful guide to consumer values or willingness to pay. It is in this sense that a satisfactory measure of social benefits (opportunity cost) is lacking. However, it is these same social costs and benefits that are relevant to investment decisions in the public sector.

Most authors interested in recreation planning are in agreement that the presence of intangibles (aesthetics) is not a critical obstacle to the evaluation of recreation benefits. The chief obstacle to the evaluation of recreation benefits lies in the fact that recreation is a public good which historically speaking has not been subject to conventional market pricing.

For a number of years, economists have attempted to devise suitable methodology for attaching values to the recreational use of resources. Most of these attempts have centered on consumer demand. That is, valuation techniques have been based on the estimation consumer demand curves and the theoretical implications related to their analysis. Despite considerable progress, no completely acceptable method has been developed which will allow us to measure the significant contributions to value of the quality component of recreation. Management decisions are normally made with the ultimate objective of changing the quality of a recreation site. Investment of scarce public funds into alternative sites are constantly in the forefront of these decisions. Some measurement of the change in site quality relative to a change in investment is needed to aid progress in this field. Analytical methods are needed which will permit the estimation of quality values and the identification of their major components. Indentification of these quality units is vital in that they are needed to internalize the social costs of quality production activities. Thus, there is a continuing need to refine and extend research efforts in this area. This need constitutes the justification for this thesis, with the analysis designed to extend the scientific knowledge of evaluation techniques and qualitative expansion in this important research area.

OBJECTIVES

The objectives of this thesis are:

1. To make empirical estimates of economic values related to location and quality for the Utah deer hunt (1970).

2. To determine the significant site characteristics contributing to variation in site quality for Utah deer hunting.

REVIEW OF LITERATURE

> While it is true that a great deal (perhaps the greater part) of what has been done in the name of "conservation policy" turns out, upon subjection to economic analysis, to be worthless, or worse, it is nevertheless also true that economic theory can offer a formulation of the conservation objective sufficiently clear and percise to permit the derivation of rational policies in the future. Such a formulation, like the application of economic theory in other fields of policy, can be no match for the passionate romanticism with which the question has been invested in political platforms and public discussion, but some of the policies of the past and present are sufficiently egregious to convince even dedicated conservationists of their error or, at least, insufficiency. Perhaps it is too much to hope that in their hour of confusion and despair, the protectors of nature might turn to economics for succor, but even idealistic hopes have the quality of spring eternal. (Gordon, 1958, p. 110-111).

Harold Hotelling (1949) made what is considered to be the first attempt to develop a methodology for evaluating recreation in his recommendation to the National Park Service. As a first step, he outlined the need for the identification of zones surrounding a given park expressed in terms of the average cost of travel to the park. Given that all groups within each concentric zone would have similar cost, Hotelling assumed that the cost of the most distant zone would establish the average group or visitor value of the recreation site. The most distant zone cost represents the gross benefit received for each visitor in the intra-marginal zones with the difference between the individual travel costs and these benefits being the bases for demand curve development. From this demand curve is derived the consumer surplus. This consumer surplus is an estimate of resource valuation.

The proposed development of the upper Feather River Basin in California provided a significant area of study for Trice and Wood (1958). Suggesting that the primary benefits of recreation are personal and highly varied, they reasoned that, therefore, they are not readily measurable in dollar terms. This fundamental assumption is concurred in by virtually all who have given consideration to the problem.

They stated that the method proposed for valuation purposes should contain the following characteristics:

1. The value should be in terms of a standard unit of time and easily expressed in dollars.

2. The value should be representative of recreational enjoyment for which there is no recreationist expenditure and no direct reimbursement by the state.

3. The value should be separately derived and independent of costs for providing the recreational facilities.

4. The value should consist of a single figure which is representative of the recreationists in the area under study with emphasis on the group as a whole without regard to recreation for or to individual differences as to their capacity to enjoy the recreational benefits.

5. The value must be peculiar to the area under consideration even though similarity within areas may exist.

6. The value should be reasonable in amount and readily subject to the test of properly informed people.

The methodology used for the Feather River Project was similar to that proposed by Hotelling in 1949. Trice and Wood used concentric distance zones and the volume of activity to define the social benefits accruing from recreation. The most distant zone established the gross resource value for all recreationists. In addition, the visits to the park from the most distant zone set a "bulk line" value of recreation provided by the park, Trice and Wood (1958, p. 202) stated:

> A total figure for free recreational value attributed to the park would be a summation of travel costs differences between the maximum or bulk line cost.

In their study, this bulk line was accepted as being the

90th percentile and all recreational values were established relative to this cost.

Clawson's method for approximating a demand curve was published in 1959, following the Trice and Wood work. By assuming that entrance into the park was free and by making the costs of visits variable, he plotted the number of visits per 100,000 population from each origin to a selected park against the cost associated with reaching the site. Using this procedure, Clawson designated variable costs as the independent variable and the number of visits per 100,000 population as the dependent variable.

Essentially using the method proposed by Hotelling (1949), Clawson (1959) stated three assumptions which underlie his demand curve estimation:

1. It is a static concept in that population, income, tastes and means of travel remain unchanged.

2. The marginal value of money remains constant regardless of the amount of product (recreation) an individual purchases.

3. Price alone is the limiting factor which determines the volume of activity (number of visits).

Based upon the observed variable cost-use relationship, Clawson derived a demand curve by varying the fee per visit and calculating the impact on the use of the recreation site. If fees were increased, the number of visits per 100,000 population would decrease accordingly. Likewise, the reverse exists for a decrease in the fees. In this way, Clawson's demand curve measures the relationship existing between the number of visits and the assumed entrance fees and is a suitable method of valuation. This resource value was the greatest total revenue which could be extracted by monopolistic pricing, given the demand estimate. In deriving the demand curve for the sites, consideration was given to the assumption that:

1. The recreation site user would view an increase in the fees rationally and in the same manner as any variable cost change.

2. The experience of the user from one location zone provides an indivation of the actions of recreators in other location zones, if money and time were held constant.

Robert K. Davis (1963) made application of a different technique to get "willingness to pay." Called the consumer survey method, it consists of five types of questions:

1. Details of the trip including expenditures, time, visits, budget activities, etc.

2. The respondent's outdoor recreation habits aside from the trip.

3. Open end questions pertaining to the reasons for choosing the site, the degree of utility, and the respective areas of substitution.

4. Personal information including leisure time, types of residence, education, income and occupation.

5. Reference in outdoor recreation including individual willingness to pay.

This method is simular to Clawson's idea and argument but the measure of consumer surplus or individual willingness to pay was obtained by direct interview of the user. Recreationists were asked the maximum price they would be willing to pay for the amount of recreation being taken. Based both on what the observed data and the data indicating what people were willing to pay, Davis constructed two demand curves.

These are:

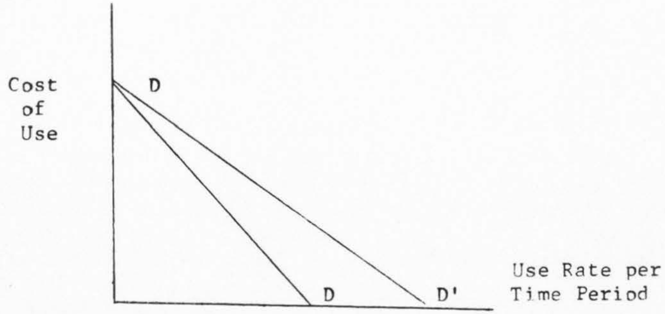

Figure 1. Illustration of the demand curves based on individual willingness to pay.

DD represents the demand curve constructed from the observed consumer reactions, and DD' the demand curve based on individual willingness to pay.

Davis defined the area between these two curves as the consumer surplus attributable to the site and a valid monetary measure of the recreation benefit.

Knetsch (1963) examined the approaches to the problem of providing information on the demand relationships and value. After reviewing the Clawson demand curve, he stated:

> The first comment we might make on the method relates to some of its more or less implicit restrictions. One of the strongest is the assumption that the demand schedule is essentially the same for all distance groups...realistically there is little reason for believing that this would be the case. (Knetsch, 1963, p. 390)

Knetsch gave consideration to those factors that would cause distortion to this assumption such as income, age, population densities, availability of alternative parks, or other substitutes and socio-economic factors.

He agreed that the value or benefit derived from the use of a resource is given by the value it holds for the consumer and is determined by his willingness to pay, stating, "the demand curve does seem to give the relevent information." (Knetsch, 1963, p. 392). However, he gives attention to two other factors which should be noticed. The first is the appropriate accounting of benefits followed by the possible capitalization of potential benefits in land resources. In conclusion, Knetsch felt that these problems could be solved with more and better information and, therefore, the method as a whole was sound.

William G. Brown (1964) expanded an interest in the Clawson approach, when he analyzed the relationship between average variable costs per day and the number of days taken per unit of population for various distance zones in connection with the salmon-steelhead fishery in Oregon. This curve corresponds to Clawson's (1959, p. 7) demand curve "for the recreation experience as a whole," and was, according to Brown (1964, p. 21), "an oversimplification as there may have been factors other than cost which affected the number of per capita visits in the more distant areas, for example, time, alternative sites, etc."

By projecting the number of salmon-steelhead fishing days taken by fishermen from various distant zones and using a graduated scale of prices, Brown plotted the increased fishing costs per day against thousands of fishing days per given time period. This curve corresponds to Clawson's derived demand curve for visits to national parks at various assumed fees.

By stratifying the sample according to family income, he was able to identify other variables along with the statistically significant influences exerted by income.

Wennergren (1964) made an improvement in the theoretical implication of demand analysis for recreation. He stated that "most if not all, commodities have some degree of aesthetic value associated with their use or consumption and yet are subject to economic valuation." (Wennergren, 1964, p. 303)

In this study, individual user travel and on-site cost of a particular boating site were used as a substitute for price as a determinant of the quantity consumed.

Based upon this formulation, Wennergren argues that a boater will allocate his boating expenditures both at the site and in total, such that the marginal value per dollar expended at the various alternative sites visited during the season is equal. Distinguishing between individual and aggregate boater demand, Wennergren (1964, p. 309) states:

> The level of elasticity of the individual schedules is a function of the income of the individual, his taste preferences and quality factors associated with the site.

Wennergren used the concept of consumer's surplus as a measure of site resource value for boating activities, after defining a statistical demand function in the Hotelling tradition.

Omer J. Carey (1965) reviewed the progress and problems of outdoor recreation economics. Criticizing the method of evaluation proposed by Hotelling and used by Trice and Wood, Carey (1965, p. 175) stated that; "it doesn't measure the value of recreation, rather it is a value derived from the value of the service and goods received."

Carey pointed out the oversimplification of assuming that the on-site experience is the recreation benefit involved in the trip and that to charge the entire cost of the trip to recreational opportunity, though there may have been visits to alternative recreation areas included in the same trip, departed from the reality of estimation procedures. However, Carey (1965, p. 176) agrees as do most authors that "the consumer surplus approach requires at least the qualification that the marginal utility of money be constant and that individual perference scales be identical."

As for the willingness to pay as a measure of recreation benefit, Carey refers to Clawson and outlines the following criticism:

1. It is assumed that the experience of visitors from one zone provides an indicator of what people of other zones would do if cost in time and money were equal.

2. It is assumed that the recreation experience involves only one major recreation site.

3. The demand curve may vary among visitors due to the differing preference scale and more simply because of differing reasons for the visit.

Carey suggested that the consumer survey method as a means to estimate the willingness to pay is an expensive method both in terms of time and money, but nevertheless, it does hold some distinction of the Clawson method.

Again, the Clawson weakness of inability to deal with a newly-developed or planned recreation site is present.

Seckler (1966) analyzed the abuses created by different authors concerning the treatment of outdoor recreation evaluation. He confesses a strong sympathy with those who argue the qualitative aspect of recreation experience. In comparing the three methods (consumer surplus, marginal cost to marginal utility, and non-discriminatory monopoly), he concludes that, if the marginal utility curve is identical to the statistical demand curve, the second method would be most valuable.

Peter H. Pearse (1968) described an indirect method of getting consumer surplus. Criticizing the basic assumption of demand curve estimation, Pearse (1968, p. 85) states:

> There is a critical assumption that not only the recreationist but also the whole population from which recreationists are drawn, have similar characteristics and preferences."

Adding that:

> Several attempts have been made to overcome the rigidity of these latter assumptions about similarities in preferences by incorporating variables related to income levels, availability of substitute areas, congestion and so on. But specification of the different effects has met with limited success in large part because of multi-collinearity between such variables as distance, time and cost and difficulty of

> measuring such factors as congestion, availability of alternatives and quality of site. (Pearse, 1968, p. 87.)

Pearse confines his calculations to the evaluation of the recreationists themselves, but his end objective is the derivation of the consumer surplus just as in the case of previous authors. He introduces the assumption that:

> The recreationist who pursues the activity in question and has similar income also has similar preference for recreation and incurs similarly marginal cost per recreation day. (Pearse, 1968, p. 90)

In quantifying the willingness to pay for the access to a particular site, Pearse stratifies his sample on the basis of income levels and within the different classes, visitors are ranked according to fixed cost. The visitor with the highest travel cost is assumed to have no consumer surplus. He states:

> Each intramarginal recreationist in this group will continue to purchase recreation until his fixed cost is raised to exceed that of the marginal visitor.
>
> The maximum toll that each visitor would be prepared to bear is the difference between his fixed cost and that of the highest cost visitor in the same income class. (Pearse, 1968, p. 87)

But again, in its conclusion, this new approach utilizes the consumer surplus measure of recreation value.

Wennergren and Fullerton (1969) advanced a new approach to the values. They applied the concept of economic rent to the analysis and through its basic evolutionary place in the development of economic theory, important and fruitful questions pertaining to resource values were answered.[1]

Stating that the implications of the economic rent concept are applicable to the problems of recreation resource valuation, they reasoned:

> Recreation sites possess quality and location characteristics, similar to those related to agricultural lands used in the earlier formulation of the rent concept. They produce a commodity of value which is scarce in supply. Resource values may logically be generated on the basis of economic rent values arising from location and quality characteristics, in the same sense that more productive agricultural land extracts rents relative to less productive lands. Higher quality recreation sites generate rents relative to lower quality sites. Furthermore, recreation sites located most advantageously to user origins extract location rents or, conversely, user origins located most advantageously to a recreation site extract rents relative to those located less advantageously or more distant. The rent value for any given user origin and is measured by their respective transportation costs. (Wennergren, Fullerton, 1969, p. 7)

They formulated empirical procedures to accommodate recreation data commonly available in the form of the

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[1]Empirical use of the location rent model was made by Braulio Rodreguez (1970) in his studies of the economic rent values for pheasant hunting in Utah.

recreationist site activity whose origin is spatially related to a site. Their total rent value contained elements of both location and quality. To separate the location factor, the total observed activity at the various origins was redistributed by using a least-cost programming technique. The residual of the total economic rent and that attributed to location was then expressed as that value attributable to quality.

Conceptually, Wennergren and Fullerton expressed quality differences in their model by differences in the quantities purchased at a single price or by differences in prices which consumers are willing to pay for the given quantities. They stated:

> Recreationists continually choose among recreation sites of varying quality. The fact that they choose sites of greater distance from their place of residence in preference to sites more advantageously located is clear indication of differential site quality. If not, why would recreationists select sites other than that site most advantageously located? (Wennergren, Fullerton, 1970, p. 16)

In Conclusion, this new approach, though contemporary, is encompassing and realistic in its focal objectives of developing methodology for laying a conceptual foundation for the existence of site quality values in recreational resource use, and as such constitutes the basis for the work to be advanced through the remainder of this study.

SUMMARY OF THE LITERATURE

A review of the literature concerned with recreation demand estimation and resource valuation suggests four methods which, to date, have been used in attempting to place economic values on non-market priced resources. These methods are all oriented toward consumer values. The methods reviewed include the following: consumer surplus (discriminating monopolist), monopoly revenue (non-discriminating monopolist), consumer survey, and economic rent. Beardsley (1968) summarized the first three methods.

Consumer surplus

A demand curve (DD') can be drawn based upon the variable cost of use and use rate per time period as observed from the behavior of visitors from various origins.

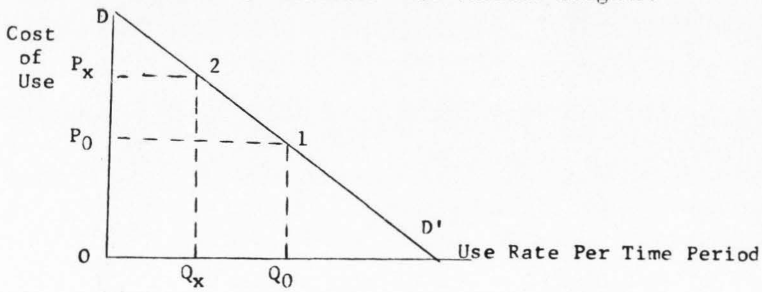

Figure 2. Illustration of consumer surplus based on the demand curve.

This is a typical Marshallian demand curve to which is applied the usual assumptions that:

1. The income and tastes remain constant for the persons involved.

2. The marginal utility of money remains constant for individuals and between different persons.

3. Additional units of the commodity encounter diminishing marginal utility at some point.

A visitor living at some location (1) incurs a cost per unit of recreation at this site (Po) and purchases Q_0 units per time period. For this purchase of all units previous to the $Q_0{}^{th}$ unit, for example, the $Q_x{}^{th}$, he also incurs a cost of P_0 but he would have willingly paid as much as P_x, as do visitors at origin 2, which represents the gross utility of the $Q_x{}^{th}$ unit purchased.

The excess utility (consumer surplus) which he obtained is:

$$Q\ P_x \ - \ Q\ P_0 \ = \ P_0\ P_x$$

As the consumer purchases additional units, Q_x approaches Q, and the surplus utility (consumer surplus) per unit is zero.

Mathematically, the total consumer surplus for the visitor in question equals the integral of the demand curve (DD') from Q_0 to 0, minus the integral of the price (P_0P from Q_0 to 0).

This analysis relies upon five basic assumptions:

1. Visitors attempt to maximize their satisfaction with their available income and resources.

2. Visitors have perfect knowledge, or at least behave as though they do, regarding the cost of use of the site and the satisfaction derived from it.

3. The utility derived from use of the site at some point diminishes at the margin.

4. Measurement units of cost and utility are equivalent, permitting the derivation of net utility.

5. The utility obtained from a unit of use of the site is the reason for the visitor's decision to purchase it.

Monopoly revenue

This model derives the value of outdoor recreation opportunity in terms of it's monetary price in the usual market sense. It is based upon the same demand curve (DD') as in the consumer surplus model. The initial demand curve is derived in the same manner with the same assumptions. From this curve, a second demand curve D_1D_1' is estimated showing the relationship between a hypothetical schedule of entrance fees for use of the recreation site and the number of users who would visit the site at each price. This formulation is illustrated in Figure 3.

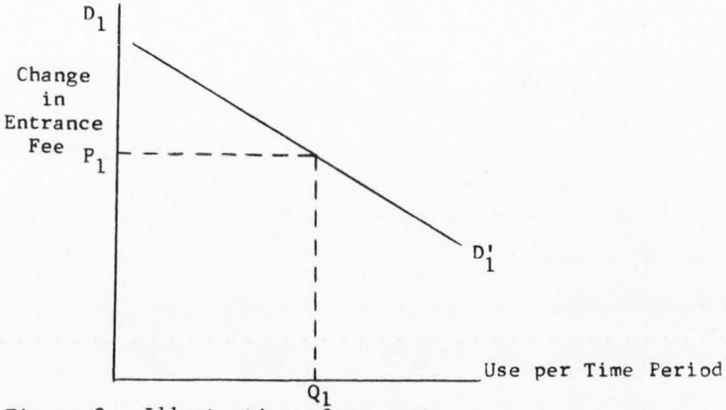

Figure 3. Illustration of monopoly revenue based upon the demand curve.

Two additional assumptions implicit in demand curve D_1D_1' as derived from DD' in Figure 2 are as follows:

1. A visitor living at location 1 presently pays P_0 per unit of use and purchases Q_0 units. If an entrance fee equal to P_0P_x were imposed on the site, they would react by purchasing Q_x units as do visitors at location 2. Similarly, the reactions of visitors at all locations to the fee increase may be determined. The total units of

use sold at this entrance fee is plotted as one point on DD_1. In like manner, additional fee increases are postulated and the results plotted as points on DD_1.

2. Along the curve D_1D_1', gross revenue from fee collections equals PQ (price times quantity), for all possible levels of fees and the corresponding levels of use.

The total revenues from fee collections are calculated at each combination of price and quantity. The price and quantity combination which yields the maximum revenue is assumed to represent the resource value. It is this value which could be realized by a private monopolist who owned the site and sold the use of it in such a manner as to maximize his gross revenue.

Consumer survey

The consumer survsy method is much like the monopoly revsnue valuation except for the manner in which the demand curve (D_1D_1) is established. This method attempts (to estimate recreation benefits by direct on-site questioning) of users concerning their willingness to pay for the use of the site. The demand curve, D_1D_1' is constructed as follows:

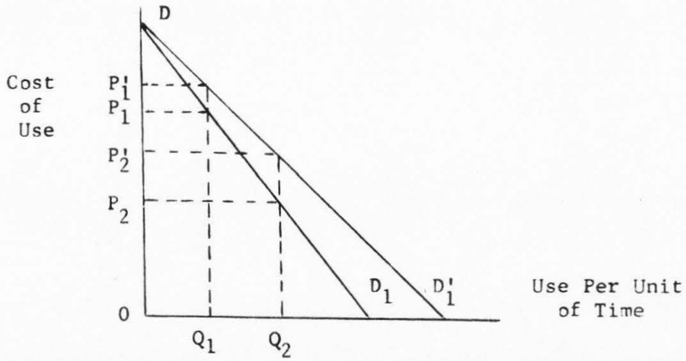

Figure 4. Illustration of the consumer survey method of valuation based on the willingness to pay.

DD_1 is the demand curve constructed from the observed data.

In an interview process, individual recreationists indicated that they were willing to pay a price of P_1' for quantity Q_1 instead of the observed price of P_1 and price P_2' for quantity Q_2 instead of the observed price of P_2. This procedure establishes a higher demand curve based on willingness to pay.

Given this new demand curve (DD_1'), the "market values" realized are similar to those in the monopoly revenue approach. The difference being that the consumer surplus is defined as the area between the two demand curves.

Economic rent

The concept of economic rent as applied by Wennergren and Fullerton (1969) and empirically tested by Rodriguez (1970) is a logical approach to valuation. This being that recreation resources generate use values just as do agricultural resources. All such values are of the same general type.

Location value is generated in the sense that if a selected recreation site for a given type of activity has various origins spatially distributed at different distances from the site, the closer the origin to the site the greater the advantage or location rent it enjoys relative to alternative origins. Quality values refer to the payment or retribution to the conditions under which the recreation activity is consumed. The conditions involve the characteristics of the site which attract and accommodate users due to natural environment, size of area, man-made facilities, camping tables, boat launching, etc. These things represent quality variations which could be expected to influence the consumer to pay more or less for the recreation experience at the selected site. Rents arise because of differences in these quality factors.

The actual conditions of the model, relative to the characteristics of quality will be explained later as they relate to the conceptual model.

THE CONCEPTUAL MODEL

To support the consistency of the conceptual model to be presented as an estimation of recreation site value, the logic and relevance of rent theory will be examined as it relates to natural resource value and use. This presentation follows that as outlined by Wennergren and Fullerton (1969).

Concept of economic rent

The concept of economic rent has an evolutionary place in the development of economic theory and a historic role in dealing with questions related to the valuation of productive factors, especially natural resources such as land. Ricardo (1817), in his formulation of the rent concept in relation to corn land values in England, is generally given credit for the initial effort. Ricardo's work argued that only the most fertile lands would be brought into production and that with only one productive class of land no economic rent would accrue through its use. However, rent would arise on these lands when increasing population and demand pressures produced increased product prices and resulted in less productive lands being brought into production. Ricardo (1817, p. 35) stated that:

> If all land had the same properties, if it were unlimited in quantity, and uniform in quality, no charge could be made for its use, unless where it possessed peculiar advantages of situation. If it only then, because land is not unlimited in quantity and uniform in quality, and because, in the progress of population, land of an inferior quality or less advantageously situated is called into cultivation, that rent is ever paid for the use of it. When in the progress of society, land of the second degree of fertility is taken into cultivation, rent immediately commences on that of the first quality, and the amount of that rent will depend on the difference in the quality of these two portions of land. When land of the third quality is taken into cultivation, rent immediately commences on the second, and it is regulated as before by the differences in their productive powers. At the same time, the rent of the first quality will rise, for that must always be above the rent of the second by the difference between the produce which they yield with a given quantity of capital and labor. With every step in the progress of population, which shall oblige a country to have recourse to land of a worse quality, to enable it to raise its supply of food, rent on all the more fertile land will rise.

Thus, economic rent levels are determined relative to the least productive land and can be defined as the difference between selling price and unit production costs incurred on the most productive land.

Ricardo's explanation of economic rents assigns much importance to the differences in land quality but little attention was given the location factor. Petty and Von

Thunen (1966) emphasized this important factor when they observed the location effect of equally fertile lands more distant to the established markets.

The modern concept of economic rent still defines a logical theory consisting of the differences between selling price and unit production costs expended in using the most productive resource. The difference in land rents may be explained by differences in quality, fertility, accessibility and location.

Rent values in recreation resource use

The implications of the economic rent concept and the respective factors which give rise to economic rent values are applicable to the problems of recreation resource valuation. The logic of their use in a recreation setting can be illustrated by the following model:

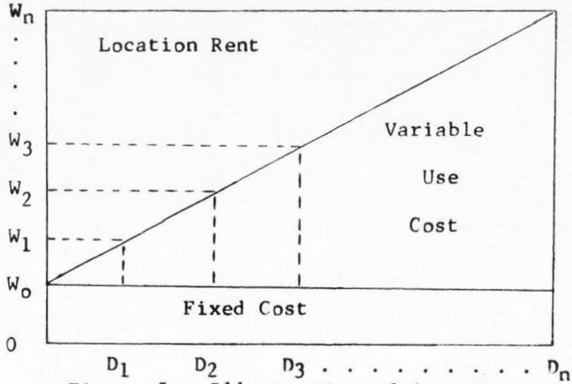

Figure 5. Illustration of location rent

where:

D_o . . . . D_n = the distance from various origins (O_1 ... O_n) to the site.

W_o . . . . W_n = the variable use costs from the origin (O_1 ... O_n) to the site.

D_oD_n . . . . = the distance from the most distant use origin to the site.

W_oW_n . . . . = the variable use cost.

OW_o . . . . = the fixed cost of recreational use for the site.

The rent generating factors are related to the variable costs of distance associated with the site. Since points of origin are spatially related to the site, those origins most closely located extract an economic rent relative to that origin most disadvantageously located with respect to the site. For example, recreationists living at an origin which is zero miles from the site, have fixed costs of OW_o. At this origin, the variable-use costs are zero and recreationists, therefore, extract a rent in relation to the most distant origin which has a distance cost of W_n. The rent is equal to $W_n - W_o$ and is extracted for each unit of activity (the hunting trip). As the recreationist's point of origin moves outward from the site (say to D_1), the fixed costs still remain constant, but the distance cost increases to W_oW_1. The rent per unit of activity at D_1 is also extracted in relation to origin D_n with its distance cost of W_n. The rent is less than that of the previous site since it is equal to $W_n - W_1$. It can be seen that as distance increases, the rent per unit of activity decreases until at the most distant origin (D_n) there is no rent ($W_n - W_n = 0$).

As in the case of other applications of the rent model, recreation sites possess quality and location characteristics similar to those related to agricultural lands used in the earlier formulation of the rent concept. They produce a commodity of value which is scarce in supply. Resource values may logically be generated on the basis of economic rental values arising from location and quality characteristics. That is, in the same sense that more productive agricultural land extracts rents relative to less productive lands, higher quality recreation sites generate rents relative to lower quality sites. Furthermore, a recreation site located most advantageously to user origins generates location rents or, conversely, user origins located less advantageously to a recreation site extract rents relative to those located less advantageously or more distant. The rent value for any given user origin is expressed relative to the highest cost user origin and is measured by the differences in their respective use costs.

Quality implications in the conceptual model

Reasons for site selection and the factors which give rise to a ranking of one site above another are explicity considered in the choice procedures of consumers. The recreation consumer is faced with a choice among various alternative sites with each presenting different factors which affect his level of satisfaction. Micholson (1967, p. 512) stated that:

> If a single consumer or producer at a single point in time pays, or is willing to pay, different prices for two different grades of a particular commodity, the difference in price must represent a true difference in quality. For, if he knowingly pays more for one grade, he must consider it is worth just that much more to him than the other; and his assessment is sufficient.

The recreationist is willing to pay higher prices for higher levels of quality which in turn generate a higher level of satisfaction. To do this, it is necessary to assume that there is no time implication in the selection process which would invalidate the previous proposition. Time is fixed in this sense, for if it were not it would be virtually impossible to guarantee that the difference in price represents a true difference in quality.

The quality effect can be considered by examining the conditions of utility maximization under which selected recreation activity is consumed. An upward shift in the total utility curve is reflected directly in an upward shift in the marginal value curve for the good in guestion. Analytically, the same situation can be presented in recreation consumption.

If a consumer faces two alternative deer hunting sites with different levels of quality, the quality differential is reflected in the marginal value utility curves for the two sites. The site of highest quality has the higher marginal utility curve and can bs represented as follows:

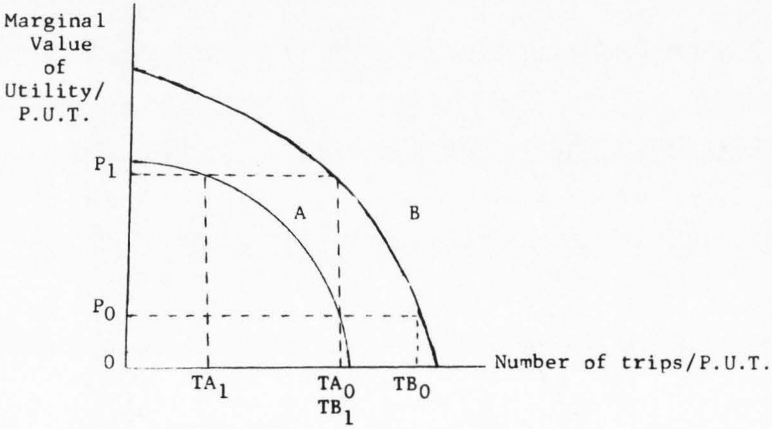

Figure 6. Effect of quality on the marginal utility value curve for deer hunting

where:

1. A equals marginal utility value curve for site A.

2. B equals the marginal value utility curve for site B.

If a consumer faces a choice between sites A and B for deer hunting, and assuming that the use costs of both sites are equal, a consumer would be expected to prefer site B to site A. He would be expected to take more trips to site B than to site A. He would be expected to take more trips to site B than to site A since both sites would involve equal use cost (P_0). From Figure 6, it can be seen that the difference in number of trips (OTB_0 - OTA_0) taken between site B and site A can be considered an expression of quality advantage site B has over site A because both sites involve the same cost.

Likewise, another situation is presented when site B is located at a greater distance from the origin where a higher price (P_1) is incurred. A consumer facing the same good with different levels of quality and price holds the differential price to be a measure of quality. The difference in expenditure (variable use costs) between two recreation sites can be viewed as a measure of quality and is represented by P_0P_1 in Figure 6. For a given level of expenditure (trips), the consumer would be willing to pay $OP_1 - OP_0$ for higher quality sites.

The concept of economic rent aids in explaining the value placed upon land resources as well as many of the incentives that exist for resource ownership. It influences the allocation of land resources between individuals as well as between competing uses. The scope of the economic rent concept not only applies to the payment made to the land by participating in the productive process as does any other production factor, but elements of economic rent can also be identified in the distribution of the cost related to the development, maintenance, and improvement of the quality found in the resource in question.

In identifying the nature of economic rent Barlowe (1958, p. 156) suggested:

> Ricardo's explanation of the rent in terms of differences in land quality deals only with one factor that affects rent-paying capacity. Location is another important rent determinant.

Thus, it is clear that in addition to the quality measures (productivity) already discussed, consideration must also be given to location factors.

1. The location of an origin relative to its objective market site can generate rents relative to the highest cost or no rent site.

2. Sites with differing productive capacity give rise to different quality or productivity rents. Then it would appear that total value of a resource is the product of both a location and a quality or productivity rent.

3. Recreation resources generate use values just as do agricultural resources and such values are of the same general type.

Location value is generated in the sense that if a selected recreation site for a given activity has various origins spatially distributed at different distances from the site, the closer the origin to the site the greater the advantage or location rent it enjoys relative to other origins.

Explanatory variables

A recent article by Lancaster (1966) presented a conceptual approach to consumer theory which is somewhat a departure from traditional theory. He stated that:

> The chief technical novelty lies in breaking away from the traditional approach that goods are direct objects of utility and, instead, supposing that it is the properties or characteristics of the goods from which utility is derived. (Lancaster, 1966, p. 133)

Drawing on the ideas expressed by Lancaster, it is suggested that the site characteristics within a given recreation site be incorporated into the consideration of recreation quality and the estimation of quality values.

Quality values refer to the payment or retribution to the conditions under which the recreation activity is consumed. These conditions involve the characteristics of the site which attract and accommodate users due to natural features of size, topography, production, etc., and as such represent quality factors which the consumer pays for in order to enjoy the recreation experience at the selected site. Variables which have been variously called opportunity, availability and accessibility in the demand formulation for a specific recreational resource are included.

Site characteristics

Empirical application of the location model will be made later in this study using the Utah resident deer hunt. Variables or factors that are postulated to give a specific site advantage over another will be used to determine the significant components of site quality. These variables in general form are:

1. Size of area. Deer herd units which enjoy a greater endowment of range should, *ceteris paribus* have an advantage in quality and thus a higher value and consumer attractiveness relative to its neighboring herd units.

The size of area relative to seasonal deer usage should indicate some positive correlation with quality. Conceptually speaking, the differences in amount of summer and winter range are indicators of site quality.

Summer range controls the production of the deer herd utilizing the area to the extent of providing a basis for production. However, its relation to winter range which controls the seasonal carryover of base animals is the most important in terms of long-term value. Inasmuch as site quality is production oriented, winter range should be found to positively influence the unit's activity due to an increased capacity for hunters. The winter months are the most critical times to the overall wellbeing of the deer herd. Abundant winter range will insure a greater survival and carryover of stock animals. This variable, when found in substantial amounts, should maintain the herd production and reduce the possibility of cyclical instability, For these reasons, it is hypothesized that the size of area relative to summer and winter range will be positively correlated with site quality.

2. Ownership of summer range. Most deer hunting activity is consumed on the summer range. The type of ownership found on this range could greatly influence the

degree of hunter accessibility and opportunity. Conceptually it would follow that public ownership is more accessible than private and therefore, would have a positive effect upon site quality.

3. Ownership of the winter range. The impact of a growing population and its urban sprawl intruding into prime agricultural areas and marginal lands adjacent to deer ranges is becoming increasingly acute. General human encroachment of the winter deer range greatly affects the overall well-being of the animals at a time when all available resources are needed just to ensure survival. It is postulated that the overall effect for deer hunting quality will be negative as the conversion of winter range from public to private ownership takes place. Competition for the lower slopes and lands adjacent to the cities usually does not contain provisions for the continuity of wildlife enhancement. Therefore, widespread private ownership of winter range should create a decrease in the level of hunting quality.

4. Hunter success. As any method of valuation for a non-market priced resource requires the interaction of the hunter-consumer and the resource, differences in perception of site characteristics may exist. For example, high

hunter success at one site maybe more attractive to the consumer. On the other hand, this increase in herd mortality could greatly decrease the production of the herd in future time periods, and therefore, decrease hunter activity and resource value. Hunter success is a good indicator of quality to the consumer in the short run, because his purpose for taking the hunting trip is to kill a deer. Sites with a history of success are preferable and will most likely gain more activity, thus giving the site a higher value.

In general, hunter success defines the parameters of overall production for a deer herd and is of paramount importance in establishing the rate of use of a given site. From the hunter-consumer point of view, sites having a long history of good success and/or sites that were highly successful in recent years are preferable and likely more valuable in both monetary terms and public regard. It is hypothesized that deer hunting quality will increase in proportion to the level of hunt success. This variable, possibly more than any other, incorporates the broad spectrum of recreator attitudes toward preservation and maintenance of the resource. In many instances, minimal information as to the expected or historical success can directly influence site selection and the individual "willingness to pay" of the hunting public.

5. Non-resident Participation. Localized attitudes of society appear to sanction the belief that non-resident use of a recreation site adversely affects the quality of the resource for the resident users. Quality analysis has to cope with defining any economic irreversibility and determine the point at which the quality value lost from residence use is greater than that gained from non-residence use. Where this line of demarcation is to be drawn is difficult to determine. It is postulated in this analysis that non-resident participation will be negatively correlated to site quality. The destruction of site quality relative to resident hunters results in the overall destruction of the economic value of the recreational resource in the eyes of these same resident hunters.

6. Length of the hunting season. Site quality is a function of the amount of recreation activity. The activity is enhanced by longer seasons as it is more apt to appear in greater volume in sites with longer hunting seasons. It is postulated that quality value increases as the length of the season increases. This is due mainly to the increased probability of higher levels of activity.

7. Deer kill per square mile of area. Wildlife production is a declared purpose of the state's public resource administrators. This percept has guided most aspects of management primarily in the quantitative objective of supplying more hunting for more hunters. Deer kill per square mile of area measures the efficiency of this objective as it incorporates other aspects of hunter success and site characteristics. As the area within the biological boundaries of the herd unit is fixed, other intensive practices are required to change this production ratio. It is hypothesized that given the deer herds established area, the greater the number of kills in relation to the land base, the greater will be the quality value.

8. Hunter congestion. Obviously, a major component of quality is the element of escape from public competition, the assurance of solitude, and the enjoyment of the recreation site without disturbance. The hunter maybe paying to recapture a qualitative value which is diminishing in some highly-populated areas. The emergence of vast numbers of hunters taking to the field during the limited hunting season introduces the concept of dis-utility due to overcrowding. This factor receives increasing emphasis today despite increasing costs and other limitations to recreation capacity.

Overcrowded conditions at one site caused by demand-peaking conditions of opening days and weekends, could well encourage the hunter to seek an alternative site. Therefore, it is postulated that a negative correlation should exist between the degree of crowding and quality. That is, as the number of hunters per square mile of deer herd area increases, the value of site attributed to quality will decrease accordingly.

9. Trophy production ability. A social consciousness attaches importance to the trophy-producing ability of a given hunting area. The primary objective of the hunting trip is to kill a deer with a trophy head. Tradition has endeared this aspect of hunting into the very heart of the society and changed a sport of basic food gathering to one of "luxury" and ego maximization.

A site, which is able to produce bucks, and more preferably, bucks two and one-half years of age and greater, enjoys a distinct advantage over alternative sites due to an increased probability of getting a "big rack of horns." Therefore, it is postulated that the greater the probability of producing trophy-sized animals, the greater will be the level of quality. Positive correlation of this variable with quality will afford the greatest opportunity for surrogating the aesthetic appreciation applicable to the recreational hunting activity.

10. Average length of trip. To some it is readily observable that the average length of the hunting trip may not be a characteristic inherent to the hunting site. However, time plays an important role in quality measurement, as greater travel distance requires greater amounts of time and greater still, amounts of quality in order to maximize hunter utility. In this sense, this variable becomes an important site characteristic. A true dynamic test of the location model should contain some measure of the value of time at the margin.

It is hypothesized that, ceterus paribus, the quality value of the experience will increase as the length of the hunting trip increases.

The preceding quality propositions can be considered in the conceptual model as site characteristics whose significance in wildlife management and envioronmental ethic is attracting attention. In summary, Dasmann (1966, p. 21) states the case for quality management:

> Today a new wage of interest in conservation is sweeping across America, bringing new challenges to all who have been professionally engaged in conservation work. In the old conservation movement, we were concerned with questions

of quantity of natural resources, with saving enough forestland, with producing enough wildlife, with keeping our farms yielding enough food to meet our needs. These old conservation problems have not entirely been solved, although we have made great progress. The new conservation, however, is concerned not so much with quantity as with the quality...of the overall experience.

METHODOLOGY[2]

Quality and location rents exist for land used in recreation activities and is a basis for determining resource value. The methodology presented here estimates the total annual economic rent for a site and separates this value into component parts due to location and quality.

A theoretical basis for this methodology lies in the fact that rent values related to total observed site activity includes both quality and location values. The methodology proposes a means of estimating the total rent value and associated location value for a particular recreation site. The indicated residual of these two values is then attributed to site quality. In essence, the methodology replicates calculation of economic rents consistent with the rent model illustrated in the conceptual model.

Observed distribution of activity table

Table 1 reflects the distribution of activity between origins and sites as it might be observed for a given type of recreation activity (deer hunting). The matrix form

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[2]This methodology was first developed by Wennergren and Fullerton (1969) and a later empirical test was made by Braulio Rodriguez (1970).

indicates the combination of sites visited by hunters of various origins. Each cell indicates the number of trips from a given origin to a given site. Table 1 represents a composite expression of these relationships.

Table 1. Observed distribution of activity

	S_1	S_2	.	.	.	.	S_m	
O_1	X_{11}	X_{12}					X_{1m}	B_{1m}
O_2	X_{21}	X_{22}					X_{2m}	B_{2m}
O_3	X_{31}	X_{32}					X_{3m}	B_{3m}
.								
.								
.								
O_n								B_{mm}
	X_{n1}	X_{n2}	.	.	.	.	X_{nm}	

where:

O_i = points of origin for people coming to enjoy the selected recreation experience (where i = 1 to n)

S_j = sites where people enjoy recreation experience (where j = 1 to m)

X_{ij} = the volume of observed activity between site i and origin j. This volume of activity is defined in terms of an established unit (trips, hunter days, etc.)

B_i = the total volume of activity (total number of trips) from any origin i.

X_{nj} = the total number of trips taken to a j^{th} site.

Expected value table

The predetermined goal of this procedures is to reflect distribution of activity among sites and origins such that the distribution cost (variable travel cost) is minimized.

To obtain this information, a least-cost linear program is used. The solution discussed is a least-cost situation in which the known variables are:

1. The different origins spatially distributed at different distances from alternative recreation sites.

2. The variable travel cost from any origin to any recreation site.

3. The total units of activity generated from any origin.

4. The capacity of each recreation site.

The programming procedure alters the distribution of the units of activity (trips) such that there exists a minimum cost in transportation among all the recreation sites and origins. In essence, the programming procedure takes the trips from the various origins to the various sites as observed and hypothetically reallocates the trips from the origins to a new distribution of sites. This new distribution of trips from origins to sites is based upon a least-cost distribution. Mathematically, it is as follows:

1. Let subscript i indicate the origin area (i=1..n)

2. Subscript j indicates the destination area (j=1..
m)

3. X_i = number of trips from origin i

4. X_j^d = capacity of site j

5. X_{ij} = number of trips from origin i to site j

6. C_{ij} = per unit transportation cost from origin i
to site j

7. C = total cost of transportation

So, given:

$$X_i, X_j^d, C_{ij}$$

X_{ij} is found for all i and j which minimizes

$$C = \sum_{i=1}^{n} \sum_{j=1}^{m} X_{ij} C_{ij}$$

subject to these restrictions

$$X_i = \sum_{j=1}^{m} X_{ij}$$

$$X_j^d = \sum_{i=1}^{n} X_{ij}$$

$$\sum_{i=1}^{n} X_1 = \sum_{j=1}^{m} X_j^d$$

$$X_{ij} \geq 0$$

The underlying reasons for applying this procedure to the situation in which activity among sites and origins is at a minimum cost is as follows:

1. There are two arrays in which the first represents all possible origins and the second represents all sites which have provided recreation experience for the origins in question. These are combined in matrix form.

2. The same recreation activity is offered at any of the sites. This implies the assumption that the recreation "commodity" (deer hunting) is in a sense homogeneous.

3. The total demand from any origin is expressed in terms of an established unit of activity (number of trips).

4. Site capacities are defined in terms of the same units which are used to define demand.

5. Variable travel and on-site costs from any origin to any site are known. This cost can be expressed in terms of the total mileage per unit, (cost per mile per unit, etc.) depending on the conditions under which the research is conducted.

6. Assuming there is only a single best route connecting sites and origins, it is possible to relate origins to the demand for any site such that distribution cost among sites and origins will be minimized. To accomplish this, it is necessary to establish a least-cost distribution of expected activity. The expected value table has the

following features:

Table 2. Expected distribution of activity

	S_1	S_2	S_3	.	.	.	.	.	.	.	S_m	
	C_1	C_2	C_3								C_m	
O_1	X^o_{11}	X^o_{12}	X^o_{13}									B_1
O_2	X^o_{21}	X^o_{22}	X^o_{23}									B_2
.												
.												
.												
.												
O_n	X_{n1}	X_{n2}	X_{n3}								X^o_{nm}	B_n

where:

O_i = the same origins defined in the observed table (i = 1 to n)

S_j = the same sites defined in the observed table (j = 1 to m)

B_i = the same amount of activity defined in the previous table of observed activity which is distributed at a minimum cost (i = 1 to n)

C_j = is the capacity established for any site j defin in terms of the units of activity. (j = 1 to m)

X_{ij} = the amount of activity from origin i to site j (i = 1 to n and j = 1 to m) which is determined by the least-cost programming procedure for the recreation activity (visits) among sites j and origin i. This amount of activity is defined in terms of the same unit used to define capacity and demand (trips).

<u>Calculation of economic rents and quality residual</u>

Both the observed and expected value tables must be arranged as follows:

1. In both tables for a selected site S_j, the origins are ranked according to the distance from the selected site. Thus, for site S_j, origins O_1, O_2, and O_3 . . . O_n have to be ordered according to distance. It maybe assumed that O_1 is the nearest origin, and O_n the most distant.

2. Calling W_1, W_2, and W_3 . . . W_n the cost of transportation from origin O_1, O_2 . . . O_n to site S_1, and Z_1, Z_2 . . . Z_n, the total volume of activity for origins O_1, O_2 . . . O_n to site S_1; and M_1, M_2 . . . M_n the rent per unit for the site with respect to the origins O_1, O_2 . . . O_n. In order to calculate the total resource value, this procedure is applied first to the observed value table as follows:

$$\begin{array}{lcl} W_n - W_1 = M_1 & \Big\| & M_1 \cdot Z_1 = N_1 \\ W_n - W_z = M_2 & \Big\| & M_2 \cdot Z_2 = N_2 \\ \vdots & \Big\| & \vdots \\ W_n - W_n = 0 & \Big\| & 0 \cdot Z_n = 0 \\ & & \overline{\sum_{i=1}^{n} N_i} \end{array}$$

where:

N_1 = the total rent per origin i.

$\sum_{i=1}^{n} N_i$ = the total rent value for all origins associated with site S_1.

3. Following the same procedure for the expected value table, the location rent for the site in question is obtained. $\sum_{i=1}^{n} Y_i$ is the total location rent for S_1 in question.

4. Having $\sum_{i=1}^{n} N_i$ as the total rent value and $\sum_{i=1}^{n} Y_i$ as the location rent value, the value attributed to the quality factors is obtained by subtraction. That is:

$$\sum_{i=1}^{n} N_i - \sum_{i=1}^{n} Y_i = Q_i$$

where:

Q_i = the total annual rent value due to quality for site S_i.

The rationale for the methodological procedure is that the site total rent value is composed of location and quality components. Thus, the observed table and its associated rent value contains both location and quality values. The redistribution of hunter activity in a least-cost manner as expressed in step 2, and which gives rise to the expected value table, defines the allocation of hunter activity which would be expected if location were the only criteria used in selecting alternative hunting sites. Conceptually, hunters motivated only by cost or distance consideration would follow a least-cost pattern of site usage without concern for quality. Therefore, the value generated by the least-cost distribution can logically be attributed to location. Since the observed activity table contains both quality and location values, the subtraction of the location value leaves a residual value which can be attributed to site quality.

Importance of the capacity constraint

The capacity of a recreation site is the single greatest determinant of the site's total economic value, this being due to economics and dis-economics associated with population density. Misinterpretation can severely alter present and future values and their respective analysis.

Capacity for a given site may be defined in several ways. Site capacity (number of hunting trips taken from various origins to a site) is used as the constraint in the least-cost allocation process. It is expressed in this analysis as the observed activity. It could be very easily expressed in hunter days, trips standardized by some quality component, or ideally by biological controls. But for the present purpose, it is said to equal the total amount of observed activity statistically sampled at the site.

If in some way capacity is underestimated, then during the least-cost distribution trips from nearby origins will be forced to other more distant sites. For the system, this would tend to increase the location value and underestimate the quality value as simultaneously, the location value of alternative sites would be raised.

Capacity is a function of the overall production of the site and as such may be highly intercorrelated with certain characteristics associated with quality rent production. The capacity is expressed in the units of activity (hunter trips) and as the quality values are a function of distance, a degree of intercorrelation may exist between the site characteristics of quality and these units. Such an interdependency must be removed before any pure effect of the site characteristics on site quality can be identified and tested statistically. Deterioration in this said quality value does not come about suddenly, but rather gradually; therefore, capacity is fixed for a given time period and may be of little importance apart from peak demand days. It is suggested, however, that there is a much greater flexibility due to physical limitations to capacity than is often considered. Any degree of accuracy obtained in predicting site quality can only logically be obtained after capacity is removed. The main difference in the quality-capacity relationship is that one quality is expressed in differential variable cost, whereas capacity is expressed in terms of total units of activity (trips).

DATA COLLECTION AND METHOD OF ANALYSIS

The data for the study were collected from two major sources.

1. Mail questionnaire. Data were collected from mail questionnaires distributed to resident Utah hunters following the 1970 deer hunting season. A total of 4104 questionnaires were sent to a sample of hunters drawn randomly from a master sample of approximately 30,000 which was previously randonly selected from holders of 1970 deer hunting licenses by the Utah Department of Natural Resources, Wildlife Resources Division. A total of 2033 questionnaires were returned and used in the study. This represents a 49.6 percent return.

The data gathered from the mail questionnaires were used in the linear program and is consistent with the methodology section to develop estimates of resource value. Information was obtained as to the hunter's city origin, the various herd units (sites) hunted during the season, the number of trips taken to each unit and other trip expenses (cost of ammunition, cost of lodging). Additional information pertaining to occupation and income was also gathered from the questionnaire. However, these latter data were not used as it was not responded to in any degree of accuracy.

Standardized distances from origins to sites were calculated by the use of a hand-operated odometer utilizing the most direct routes as measured on a published road map. A common, centrally-located point within each herd unit was used as a common measuring point in calculating mileage to that herd unit (site). To reflect in-site travel by out-of-site hunters, a constant mileage was added to all out-of-site hunters. This constant was equal to the average in-site travel distance of all hunters from origins within the site boundaries. The major cities used in calculating the standard distances and their respective calculations of in-site travel are shown in Table 3.

The variable cost of travel was independently estimated at $.10 per mile travelled. This figure is consistent with standard rates as established by various businesses and the Internal Revenue Service. It contains no provisions for time costs of travel and the opportunity costs of alternative hunting sites.

2. Utah Division of Natural Resources Investigations. After derivation of the quality residuals for each site, techniques of regression were used to determine the

Table 3. Average miles traveled from the main city in each deer unit to the hunting site

Herd Unit	Major City	Mileage	Herd Unit	Major City	Mileage	Herd Unit	Major City	Mileage
1	Kelton	30	26	Vernal	22	49	Marysvale	30
2	Round Valley	30	27-a	Duchesne	21	50	Circleville	30
3	Avon	30	27-b	Dragerton	24	51-a	Angle	32
4	Benson	28	28-a	Bonanza	26	51-b	Boulder	20
5	Woodruff	20	28-b	Sego	30	52	Hanksville	25
6	Croyden	17	29	Lawrence	21	53	Oak City	20
7	Ogden	18	30-a	Moab	26	54	Centerfield	30
8	Porterville	12	31-a	Monticello	28	55	Flowell	30
9	Farmington	20	31-b*	Natural Bridges	31	56-a	Manderfield	25
10	Holliday	20	32	Scofield	20	56-b	Greenville	24
11	Lark	20	33	Watts	28	56-c	Symeths	30
12	Grantsville	20	34	Huntington	29	57-a	Panquitch	10
13	Jericho	20	35	Orangeville	28	57-b	Parawan	15
14	Eureka	27	36	Ferron	30	58	Springdale	20
15	Pleasant Grove	22	37	Tucker	35	59	Glendale	16
17	Mapleton	23	38	Milburn	14	60-a	Kanab	35
18	Thistle	13	39	Ephriam	20	60-b	Escalante	30
19	Pineview	20	40	Mayfield	20	61-a	New Harmony	25
20	Woodland	14	41	Payson	20	61-b	New Castle	20
21	Wallsburg	16	42	Wales	22	61-c	Enterprize	25
22	Roosevelt	20	43	Salina	22	62-a	Knolls	30
23-a	Soldier Springs	20	44	Fremont	13	62-b	King Canyon	30
23-b	Tabiona	20	45	Fremont Junction	19	62-c	Squaw Spring	35
24*	Hayden Peak	20	46	Lyman	25			
25	Manilla	20	47	Annabella	30			

*In the unit where there were no cities, a major geographical feature was used to measure the standardized mileage.

independent variables which explain the variation in quality among the 74 hunting sites in Utah. The form of this relationship is represented mathematically by:

$$Y = f\ (X_i)$$

where:

Y = the response or dependent variable (quality)

f = the assumed form of the function (i.e., linear, quadratic, etc.)

X_i = the i^{th} independent variable (i = 1 . . . n)

The data used in the above analysis were obtained from the Utah Division of Natural Resources through direct interview and access to their independent investigations.

Data were collected pertaining to the following categories:

1. Herd unit size.
2. Range ownership.
3. Hunter success.
4. Hunter congestion.
5. Administrative policies.

The data collected from this source represented a cross section of hunter questionnaires, checking station interviews, and field surveys made entirely by the Utah Division of Natural Resources and their professional staff. All data applied to observations from the 74 herd units. These units are consistent with those as established by the Division administration.

The data gathered from this source are found in the Appendix, Table 15, along with the mathematical formulation of the variables.

The data gathered from the first source and used in the linear programming procedures were kept in terms of the sample size with no expansion to state totals until after all analysis was completed.

RESULTS OF THE STUDY

Estimations of quality and location rents were made for 73 deer hunting units in Utah. The distribution of the units hunted and those for which the location and quality values were made is consistent with those units as established by the Utah Division of Natural Resources. Individual estimates of quality and location value were made for all hunting units with the exception of Unit 30-b, the La Sol-Dolores region. Statistical sampling did not record any activity in 1970, although administrative personnel report moderate usage.

To avoid unnecessary duplication, illustration of the procedure for deriving quality and location values for a site or herd unit will be presented for one herd unit only. The estimates for the remaining sites are presented in the Appendix, Table 14.

Herd Unit 1 (Box Elder), which includes all of the area in northern Utah on and adjacent to the Promontory and Raft River Mountains, will be used in illustrating the methodology used in the analysis. All estimates are based on the sample data to reduce rounding error and fluctuation in values to be used in subsequent multiple regression analysis. The sample data are not expanded to state totals at this point. A complete sample estimation of all site values will be presented later in Table 5, with the total state estimations found in Table 13.

From the mail questionnaire, the volume of activity from various origins to the site (Herd Unit 1) was observed. This volume of activity is reported in Table 4. Column 1 shows the various origins hunting at Unit 1. Column 2, the adjusted round trip mileage travelled by hunters from the various origins to Unit 1, is listed according to distance. Taking the most distant origin (in this case St. George) as the marginal origin, Column 3 is formed by subtracting the distance of each of the intermediate origins from the St. George distance. This gives the location advantage in miles of each origin hunting in Herd Unit 1 relative to the most distant origin reporting use. Column 5 is the translation of the location advantage to value by multiplying this advantage by the level of activity, Column 4, and by $.10, the assumed travel cost per unit. This gives the rent value produced at site 1 by each origin. The sum of these rents per origin gives the total annual economic rent value associated with the Box Elder unit. This sample total value is $4,176.00.

Table 4. Total economic, location and quality rents for resident deer hunting, Unit 1, Box Elder, 1970

		(A) Observed Activity			(B) Least-Cost Activity		
Origin	Adjusted Miles (Round Trip)	Location Advantage (Miles)	# of Trips	Total Rent/Origin @ $.10/mi	Location Advantage (Miles)	# of Trips	Location Rent/origin @ $.10/mi
Yost	10	886	1	$89.00	128	1	$13.00
Mendon	88	808	1	81.00			
Fielding	88	808	1	81.00	50	2	10.00
Bear River	120	776	1	78.00			
Honeyville	120	758	1	78.00			
Promontory	138	409	1	76.00			
Kenilworth	187	698	1	41.00			
Brigham City	198	687	9	682.00			
Richmond	209	686	1	69.00			
Logan	210	670	4	274.00			
Roy	226	670	2	134.00			
Hooper	226	670	1	67.00			
Clinton	226	670	1	67.00			
Sunset	226	670	1	67.00			
Syracuse	226	670	2	134.00			
Ogden	240	656	13	853.00			
Liberty	265	631	1	63.00			
Tremonton	185	711	2	142.00			
Bountiful	304	592	1	59.00			
Garland	185	711	2	235.00			
Centerville	304	592	1	58.00			
Salt Lake City	308	588	4	58.00			
Kearns	320	576	1	111.00			
Granger	320	576	1	222.00	0	1	0.00
Kaysville	342	554	2	55.00			
Lark	342	554	4	54.00			
Orem	348	548	1	57.00			
Lehi	360	536	1	54.00			
Manila	609	287	2	57.00			
St. George	896	0	2				
Huntsville	70				68	1	7.00
Cleveland	102				36	63	227.00
			68	$4176.00		68	$257.00

Quality Rent (A - B) = $3919.00

To calculate the location value, the observed trip activity was reallocated on the basis of minimum variable travel cost distribution. The B section of Table 4 gives information as to the distribution of activity between the observed origins and Unit 1 such that the cost of hunter transportation is at a minimum. This method defines the distribution of trips among origins related entirely to location. The quality factors related to the activity are left out. Calculation of the rents based on the expected distribution of activity gives an estimate of the location value. In the Box Elder case, the sample value is $257.00. It should be noted that the number of origins using the site decreases in this stage. This occurs as origin activity is reallocated to their respective minimum cost sites.

To obtain the quality value relative to the total annual economic rent, the location rent is subtracted from the total rent value. In this case, the sample quality value is $4,176.00 - 257.00 = $3,919.00.

Based upon the sample total economic rent, the highest values for resident deer hunting were found in Unit 2 (Cache), 17.9 percent; Unit 1 (Box Elder), 6.0 percent; Unit 6 (Lost Creek), 4.4 percent; and Unit 31-a (San Juan-Blue Mountain), 3.9 percent of the total value respectively. Units 29, 60-b and 62-a were found to have the lowest values, each representing 0.00 percent of the total; Units 62-b, 62-c, (the remainder of the West Desert) followed closely with each representing 0.2 percent of the total value. The sample total value for the state was $69,691.00 .

Of the total quality value, Unit 2 (Cache) again had the highest value with 19.0 percent of the total. Units 1 and 6 followed with 6.6 percent and 4.9 percent respectively. The lowest quality values were found in Units 56-b (South Beaver) and 62-a (West Desert), each displaying a -0.1 percent. Units 29 and 60-b were found to have no quality value.

In order to explain the reasons that made Unit 2 (Cache) appear with the highest quality rent value, one must view the basis on which the calculations were made and the variables which are important in explaining quality.

The Cache Unit had the highest number of observed trips with 220. The most distant origin found to be utilizing this unit was 656 miles away. There was one trip taken from this origin (see Appendix, Table 14). In expressing the location rent value, the farthest distance traveled from any origin to Unit 2 was 115 miles. The difference in mileage and the number of trips taken above the minimum necessary to minimize the cost of distribution is one important reason for the higher quality value and is an expression of the quality.

A similar situation arises in the explanation of the lower quality value. It is observed that the farthest distance traveled to Unit 56-b (South Beaver) was 198 miles. On the other hand, the greatest distance traveled for the least-cost distribution was 313 miles. The difference here is expressed relative to alternative hunting sites and their respective capacities. This is consistent with the logic and theory advanced by Von Thunen (1966). As the capacity at one site fills to the maximum, the "spill over" is forced to go to that alternative site judged to be the next best in terms of variable transportation cost. As this site approaches capacity, the identical situation occurs again until all hunters are placed at a hunting site. Occurrances of the capacity constraint are seen not only in the linear programming distribution, but this phenomena can also be identified in the observed data. Salt Lake City was observed to reach "capacity" in the first distance zone and then shift its spillover to the second. Similar situations, although not so pronounced, were observed in other major origins (those origins containing major amounts of population) in the state.

Table 5 summarizes the location and quality values as a percentage of the total site value. Of the total economic rent, the quality value represented 85 percent and the location 15 percent. Unit 56-b (South Beaver), which ranked very low in total economic rent, had the highest portion of its value represented by location rent. This value was 134 percent of the total and explains the negative sign given the quality value. However, Unit 56-b seems to be an atypical case. This presence of a negative quality value seems related to three factors:

1. The site's proximity to population centers causing people to travel greater distances in the least-cost distribution.

2. The absence of quality factors which attract hunters.

3. The quality values are directly related to the assigned capacities and this major determinant of quality was allowed to vary among the various sites.

Additional high location values were observed in Units 20 (Kamas), 88 percent; Unit 43 (Salina), 82 percent; Unit 14 (East Tintic), 81 percent; and Unit 25 (Daggett), 63 percent.

Units 60-a (Paunsaugant) and 61-b (Dixie--West Pine Valley), situated in the extreme southern part of the state

Table 5. Percentages of location and quality rents for 73 deer hunting units in Utah, 1970

	Herd Unit	Quality Value	Percent	Location Value	Percent	Total Economic Rent
1	Box Elder	3919.00	.94	257.00	.06	4176.00
2	Cache	11329.00	.91	1150.00	.09	12479.00
3	Mantua	1355.00	1.00	.00	.00	1355.00
4	Wellsville	345.00	.87	53.00	.13	398.00
5	Woodruff	723.00	.93	54.00	.07	777.00
6	Lost Creek	2906.00	.95	159.00	.05	3065.00
7	Ogden River	1191.00	.97	36.00	.03	1227.00
8	East Canyon	1806.00	.96	76.00	.04	1882.00
9	Davis County	360.00	.98	8.00	.02	368.00
10	Salt Lake	287.00	.79	104.00	.21	491.00
11	Heaston	589.00	.84	112.00	.16	701.00
12	Stansbury	1070.00	.77	320.00	.23	1390.00
13	Mt. Vernon	943.00	1.00	.00	.00	943.00
14	East Tintic	24.00	.19	102.00	.81	126.00
15	Timpanogas	607.00	1.00	.00	.00	607.00
17	Hobble Creek	1372.00	.96	56.00	.04	1428.00
18	Diamond Fork	687.00	1.00	.00	.00	687.00
19	Coalville	1828.00	.94	107.00	.06	1935.00
20	Kamas	279.00	.22	1006.00	.88	1205.00
21	Heber	1347.00	.73	492.00	.27	1839.00
22	Lake Fork	1075.00	1.00	.00	.00	1075.00
23-a	Aventoquin	726.00	.99	8.00	.01	734.00
23-b	Currant Creek	1622.00	1.00	.00	.00	1622.00
24	Blacks Fork	105.00	1.00	.00	.00	105.00
25	Dagget	230.00	.37	396.00	.63	626.00
26	Ashley-Vernal	594.00	.62	369.00	.36	963.00
27-a	Minnie Mead	272.00	.94	17.00	.06	289.00
27-b	Range Creek	169.00	.82	37.00	.18	206.00
28-a	Book Cliffs-No.	350.00	.58	255.00	.42	605.00
28-b	Book Cliffs-So.	169.00	.98	8.00	.02	172.00
29.	San Rafael	.00	.00	.00	.00	.00
30	Lasal Mtn.	1656.00	.86	266.00	.14	1922.00
31-a	San Juan-Blue Mtn.	1820.00	.90	200.00	.10	2020.00
31-b	San Juan-Elk Ridge	208.00	.57	57.00	.43	365.00
32	Price River	604.00	.80	150.00	.20	754.00
33	Gorden Creek	105.00	1.00	.00	.00	105.00
34	Huntington	159.00	1.00	.00	.00	159.00
35	Joe's Valley	117.00	.51	111.00	.49	228.00
36	Muddy-Ferron	136.00	.68	64.00	.32	200.00
37	Lake Fork	535.00	1.00	.00	.00	535.00
38	Fairview	668.00	.95	32.00	.05	700.00
39	Ephraim	422.00	.93	31.00	.07	453.00
40	Twelve Mile	287.00	.57	219.00	.43	506.00
41	Nebo Mtn.	1839.00	.83	381.00	.17	2220.00
42	South Nebo	1826.00	.89	237.00	.11	2063.00
43	Salina	202.00	.18	892.00	.82	1094.00
44	Fish Lake	220.00	.46	258.00	.54	478.00
45	Last Chance	112.00	1.00	.00	.00	112.00
46	1000 Lakes	152.00	1.00	.00	.00	152.00
48	Monroe Mtn.	288.00	1.00	.00	.00	588.00
49	Marysvale	292.00	.70	125.00	.30	413.00
50	Antimony	305.00	1.00	.00	.00	292.00
51-a	Boulder Mtn.	343.00	.42	243.00	.58	484.00
51-b	Boulder, South	64.00	.91	5.00	.09	379.00
52	Henry Mtn.	.00	1.00	.00	.00	64.00
53	Oak Creek	446.00	.66	230.00	.34	676.00
54	Fillmore	69.00	.55	58.00	.46	127.00
55	Kanosh	788.00	.84	153.00	.16	941.00
56-a	North Beaver	574.00	.89	90.00	.11	644.00
56-b	South Beaver	-60.00	-.34	234.00	1.34	174.00
56-c	Mineral Range	654.00	.64	371.00	.36	1025.00
57-a	Parowan, Cottonwood	863.00	.80	215.00	.20	1078.00
57-b	Parowan, Main Cyn.	1322.00	.96	53.00	.04	1375.00
58	West Zion	1265.00	.97	39.00	.03	1304.00
59	East Zion	157.00	1.00	.00	.00	157.00
60-a	Paunsangant	151.00	.99	2.00	.01	153.00
60-b	Kaiparowits	.00	.00	.00	.00	000.00
61-a	Dixie, E. Pineview	513.00	.82	114.00	.18	627.00
61-b	Dixie, W. Pineview	626.00	.99	2.00	.01	628.00
61-c	Dixie, Terry Ox-view	669.00	1.00	.00	.00	669.00
62-a	West Desert	-16.00	.00	16.00	.00	000.00
62-b	West Desert	159.00	1.00	.00	.00	159.00
62-c	West Desert	112.00	1.00	.00	.00	112.00
Total		$59,585.00	.85	$10,030.00	.15	$69,691.00

and distant from most major population centers had quality rents which represented 99.0 percent of their total economic rents. Units 2, 4, 7, 8, 9, 13, 15, 17, 18, 24, 33, etc., showed similar high quality and low location values.

In general, the model provides what appears to be consistent results in distinguishing between location and quality values. It suggests that quality values are the most important in determining the total value for deer hunting in Utah. Also, the model is capable of generating negative values when faced with an absence of quality factors.

Statistical components of site quality

The quality variable, as it is used in the rent model, relates to the quality of the activity found in a given herd unit. The estimates resulting from the model are designed to measure a given level of activity as it reflects quality differences among sites. In order to accomplish the objective, it is necessary to concentrate on the total system[3] and its characteristics, rather than the activity

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[3]System is used throughout this study to refer to the collection of deer hunting areas. Site will be used in a more specific sense to refer to an individual deer hunting area.

undertaken. With this objective in mind, the following model was postulated for the system as a whole:

$$Q_i = b_o + b_i X_i$$

where:

i = the number of hunting sites ($i = 1 - 74$).

X_i = the independent variables observed at the i^{th} site.

Q_i = the total quality rent per trip observed from the i^{th} site. The independent variables were classified on the basis of size, ownership, hunter success, congestion and administration criteria.

Size

X_1 = the amount of summer range in the i^{th} hunting site expressed in square miles.

X_2 = the amount of winter range in the i^{th} hunting site expressed in square miles.

X_{10} = the land area of the i^{th} hunting site.

Ownership

X_3 = the amount of summer range in public ownership in the i^{th} hunting site.

X_4 = the amount of summer range in private ownership in the i^{th} hunting site.

X_5 = the amount of summer range in state ownership in the i^{th} hunting site.

X_6 = the amount of winter range in public ownership in the i^{th} hunting site.

X_7 = the amount of winter range in private ownership in the i^{th} hunting site.

X_8 = the amount of winter range owned by the Utah Division of Natural Resources in the i^{th} hunting site.

Hunter success

X_{12} = the ratio of the number of buck deer taken by resident hunters and the total land area in the i^{th} hunting site.

X_{13} = the ratio of the number of doe deer taken by resident hunters and the total land area in the i^{th} hunting site.

X_{15} = the ratio of the number of buck deer taken by non-resident hunters and the total land area at the i^{th} hunting site.

X_{16} = the ratio of the number of doe deer taken by non-resident hunters and the total land area at the i^{th} hunting site.

X_{17} = the ratio of the percent resident hunter success and the number of trips taken to the i^{th} hunting site.

X_{18} = the ratio of the percent non-resident hunter success and the number of trips taken to the i^{th} hunting site.

X_{19} = the ratio of the number of buck deer, two and one-half years of age or greater taken by resident hunters and the number of trips taken to the i^{th} hunting site.

X_{20} = the ratio of the number of buck deer, two and one-half years f age or greater taken by non-resident hunters and the number of trips taken to the i^{th} hunting site.

Congestion

X_{11} = the ratio of the number of resident hunters a-field and the total land area at the i^{th} hunting site.

X_{14} = the ratio of the number of non-resident hunters afield and the total land area at the i^{th} hunting site.

Administrative

X_9 = the length in days of the hunting season of the i^{th} site as established by State Wildlife administrators.

An additional variable that is not directly a characteristic of the site was added to establish the relationship of time to quality. This variable was X_{21}, the ratio of the average length of the hunting trip expressed in days and the number of trips taken to the i^{th} hunting site.

Multiple regression estimation procedures were used to determine the statistically significant components of quality. The hypothesized model was examined on the basis of the distribution of the residuals, the statistical significance of the partial regression coefficients,[4] the sign of the partial regression coefficients, and a consideration of the amount of the variation explained by the model as expressed by its coefficient of multiple determination (R^2). All independent variables were examined for significant interrelationships with other independent variables in the model. This was accomplished by examining the simple correlation coefficients between independent variables. A simple correlation coefficient of .70 or greater[5] between two independent variables was considered as a high intercorrelation between the two.

A stepwise deletion mode was used. Independent variables explaining very little of the total multiple coefficient were removed from the model due to their low

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[4]A F-test is conducted on each of the partial regression coefficients and if the coefficient is statistically different from zero at a probability of .90 or more, the partial regression coefficient is considered significant.

[5]The selection of $r \geq .70$ as an indication of a high intercorrelation between two variables is both arbitrary and incomplete. It is incomplete because the two simple correlation coefficient measures only the linear relationship between two variables. It is arbitrary because there is no way of determining whether a simple correlation coefficent is high or not in terms of one variable's effect on another in the rent model.

contributions to the model sum of squares. In this way, independent variables exhibiting a high interrelationship were re-examined as to their correlation coefficient and significance level and ultimately removed from the model.

The above procedure was utilized in examining each model. On the basis of this examination, a final model was selected for the total system.

Statistical analysis of the quality variables

One of the objectives of the study was to explain site quality through variations in various site characteristics. It can be seen in preceeding sections that a difference exists in quality found at various deer hunting sites. This statistical analysis documents the evidence.

In the primary stages of the stepwise regression, all variables were included in the model. Table 6 is an analysis of variance for this initial model before further stepwise deletion removed variables. In this initial effort using the F-test ($F_{(1,49,\ 1-\ .90)} = 2.84$) for significance only X_{21} (the number of bucks two and one-half years of age or greater taken by residents) was found significant. The correlation matrix (Table 7 indicated that part of this insignificance was due to intercorrelation among variables. For example, X_{11} (the number of hunters per square mile of

Table 6. Analysis of variance and means for deer hunting site quality.

Source of Variation	Degrees of Freedom	Mean Square	F-Ratio	Partial Coefficient	Standard Coefficient	Average Coefficient	Rank of Significance
X_1	1	-341.192	-.5839	-5646.680	-27926.1	268.54	23
X_2	1	-341.195	-.5839	-5646.700	-58354.9	332.94	22
X_3	1	885.186	1.5149	-104.815	-.7572	.7527	8
X_4	1	587.277	1.0050	-81.0020	-.5733	.20788	10
X_5	1	416.859	.7134	-102.057	-.1330	.0335	15
X_6	1	159.226	.2725	12.203	.0943	.5887	18
X_7	1	513.716	.8792	26.159	.1859	.306	13
X_8	1	761.738	1.0336	306.092	.0900	.0025	9
X_9	1	50.287	.0860	-.3881	-.0297	10.35	19
X_{10}	1	-341.194	-.5839	5646.6900	67744.8	601.48	21
X_{11}	1	23.330	.0399	.3787	..0516	6.015	20
X_{12}	1	528.350	.9042	-3.506	-.1966	2.3106	11
X_{13}	1	985.766	1.6870	10.649	.2336	.8918	7
X_{14}	1	1207.830	2.0670	49.782	1.0699	.5640	3
X_{15}	1	272.957	.4671	-42.071	-.3540	.2504	16
X_{16}	1	1150.750	1.9690	-89.116	-.6107	.1500	4
X_{17}	1	1340.016	2.2933	-2015.600	-.4068	.0041	2
X_{18}	1	519.910	.8898	1461.750	.1796	.0039	12
X_{19}	1	18092.190	30.9632	9.136	.7044	1.9765	1
X_{20}	1	271.611	.4648	-5.792	-.0906	.3898	17
X_{21}	1	1037.395	1.7754	1068.498	.4434	.0124	5
Model	22	3879.078					
Error	48	565.031					
TOTAL	70	1606.588					
			Constant (B_0)	134.2830		26.933	
					R^2 = .759		

Table 7. Correlation matrix illustrating the degree of interrelationship among all variables considered in the quality model

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}	X_{17}	X_{18}	X_{19}	X_{20}	X_{21}	Q_i
X_1	1.00	.124	-.187	.153	.006	-.263	.138	.150	-.077	.519	-.244	-.279	-.132	-.225	-.224	-.189	-.096	-.123	.120	-.071	-.115	.097
X_2		1.00	.116	-.145	.129	.297	-.290	-.067	-.043	.913	-.516	-.475	-.454	-.096	-.064	-.079	.318	.470	.218	.335	.343	-.051
X_3			1.00	-.976	-.240	.659	-.681	.029	-.128	.023	-.227	-.201	-.181	.297	.292	.275	.114	.098	-.191	.291	.126	-.228
X_4				1.00	.055	-.651	.711	-.032	.143	-.062	.250	.229	.197	-.273	-.270	-.260	-.102	-.110	.213	-.260	-.134	.232
X_5					1.00	-.021	-.080	-.043	-.040	.113	-.043	-.063	-.017	-.100	-.088	-.056	-.052	.094	-.097	-.152	.056	-.031
X_6						1.00	-.863	-.094	-.348	.147	-.418	-.294	-.421	.326	.326	.324	.247	.183	-.218	.355	.265	-.240
X_7							1.00	.019	.319	-.193	.526	.407	.497	-.274	-.262	-.285	-.208	-.202	-.292	-.320	-.254	.298
X_8								1.00	-.050	.369	-.095	-.036	-.106	.039	.034	.026	-.060	-.057	.020	-.029	-.067	.102
X_9									1.00	-.069	.231	.221	.316	.035	.063	.010	-.067	-.175	.155	.153	-.192	.062
X_{10}										1.00	-.345	-.524	-.446	-.175	-.148	-.146	.234	-.013	.069	.259	.247	-.003
X_{11}											1.00	.848	.876	-.131	-.175	-.136	-.300	-.351	.125	-.392	-.367	.049
X_{12}												1.00	.671	.333	-.002	.036	-.265	-.288	.193	-.312	-.326	.018
X_{13}													1.00	-.212	-.255	-.198	-.264	-.307	.176	-.398	-.320	.123
X_{14}														1.00	.981	.679	-.108	-.034	-.025	.435	-.130	.047
X_{15}															1.00	.947	-.117	-.014	-.499	.491	-.139	.031
X_{16}																1.00	-.088	-.008	.012	.425	-.103	.055
X_{17}																	1.00	.248	.175	.075	.683	.056
X_{18}																		1.00	.250	.348	.583	.405
X_{19}																			1.00	.036	.244	.750
X_{20}																				1.00	.111	.090
X_{21}																					1.00	.237
Q_i																						1.00

area) was intercorrelated with X_{12} (the number of bucks taken by resident hunters per square mile) at .848. This indicated that these variables were not entirely independent as one was a subset of the other and vice versa.

Further stepwise deletion of variables was undertaken. Each independent variable was taken in turn to determine the extent to which it explains variation in site quality of deer hunting. Those contributing the least to the total model sum of squares were removed from the model. In this way, results consistent with the a priori expectation that quality value of a deer hunting site is some function of the site's individual characteristics were obtained.

The significant variables arising from this model are listed in Table 8, with the resulting analysis stated as follows:

1. X_{19}. The number of bucks two and one-half years of age or greater taken by resident deer hunters per trip is the most important variable in terms of explaining variations in site quality. It was found to be statistically significant at the .0005 level on the basis of the F-test. In terms of correlation with the various independent variables, no important dependency exists. However, there was a positive correlation (.75) with the dependent variable,

Table 8. Analysis of variance for prediction of deer hunting site quality

Source of Variation	Degrees of Freedom	Mean Square	F-Ratio	Level of Significance	Partial Coefficient		Standard Coefficient	Average Coefficient	R^2	Increase in R^2
X_{19}	1	42718.84	81.849	.0005	B_{21}	9.0516	.6978	1.9766	.563	.563
X_{17}	1	7856.65	15.053	.0005	B_{17}	-2824.07	-.5699	.00418	.569	.006
X_{21}	1	8206.6	15.724	.0005	B_{23}	1504.219	.6243	.0124	.636	.067
X_{12}	1	4130.95	7.915	.01	B_{12}	-4.9006	-.2748	2.3106	.645	.009
X_{13}	1	3215.03	6.159	.025	B_{13}	11.3676	.2493	.8918	.657	.012
X_{14}	1	2638.38	5.055	.05	B_{14}	37.056	.7964	.5640	.673	.016
X_3	1	3184.98	6.102	.025	B_3	-25.8839	-.1869	.7527	.698	.025
X_{16}	1	1583.01	3.033	.10	B_{16}	-88.5084	-.6066	.1500	.713	.015
Model	8	10012.76			B_0	15.0065				
Error	62	521.921								
TOTAL	70	1606.588						R^2 = .713		

quality rent per trip. It should be noted that the coefficient of X_{19} relative to site quality is positive. Thus, in general, the tests are consistent with the hypothesis that more bucks of trophy age are associated with a higher value of quality at the different sites.

2. X_{17}. Another significant result contained in Table 8 concerns the percent of resident hunter success per trip. This variable was found to share a degree of dependency with X_{21}, the length of the trip. There exists a positive correlation of .683 between these two variables. The partial regression coefficients estimated on the resident hunter success was found to be statistically different at the ten percent level or less and be negative in sign. This is the reverse of the hypothesis that increased hunter success is associated with increased site quality value.

In general, it follows that any human endeavor that affects the mortality rate of deer herds other than the process of natural selection has a damaging effect upon the overall quality of the site and is of paramount importance in any policy established by public resource administrators.

3. X_{21}. The average length of the hunting trip was found to be insignificant at all levels of probability when compared to site quality in a linear fashion. However, a

redefinition of the variable into a quadratic form allowed a level of significance of .0005 to be achieved. An increase of 6.7 percent was observed in the total R^2. As indicated, the preceding variable shared a degree of interdependence as well as a slightly positive (.582) correlation with the percent of non-resident hunter success per trip. The partial regression coefficient indicated a highly positive correlation with site quality.

Due to the quadratic nature of this variable, one could speculate that as the length of the hunting trip increases, quality increases at a decreasing rate. This is due to the decreasing marginal value of time. Graphically, this relationship may be presented as follows:

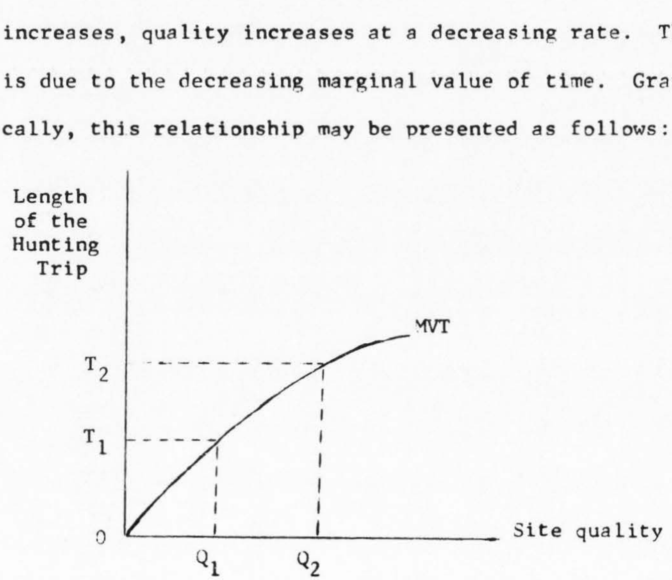

Figure 7. Illustration of the Quadratic Relationship of Variable X_{21} (the average length of the hunting trip) and Site Quality.

The change in site quality from Q_1 to Q_2 will require an increase in the length of the hunting trip higher relative to the initial increase OT_1.

In general, this time variable upholds the hypothesis of the rent model that some degree of utility or di-utility will be had given the distance to a particular hunting site on an a priori basis. The varying amounts of quality value would appeal to all levels of time in greater or lesser amounts relative to the amount of time involved.

4. X_{12}. The number of bucks killed by resident hunters per square mile of area was found to be significant at the .01 level. One variable found to be intercorrelated with X_{12} was X_{11} (number of resident hunters per square mile) at .848. However, this variable was found to be insignificant with its variation explained by X_{12}. The variable X_{13} (number of does taken by resident hunters per square mile) displayed a minor degree of correlation (.671) with X_{12}, but did not show significant power to alter the basic independency of this variable. The partial regression coefficient displayed a moderately negative sign with an overall contribution to the total multiple coefficient.

In general, the number of bucks killed by residents per square mile of area was judged to be an independent variable that is inversely related to site quality.

5. X_{13}. The number of does taken by resident hunters per square mile was found significant at .025 with a positive partial coefficient. An increase of 1.2 percent was observed in the R^2. A highly positive intercorrelation (.876) with X_{11} (number of resident hunters per square mile) was found, but of no consequence as X_{11} was found to be insignificant with its total variation being explained by X_{13}. A basic independency was maintained by this variable (X_{13}) and indicated that site quality would increase as the number of does taken by resident hunters increased.

6. X_{14}. The number of non-resident hunters per square mile was found significant at.05. A moderate degree of interdependence (.679) was observed with X_{16} (number of does taken by non-residents per square mile). However, this variable is independent as indicated by criterion stated earlier. The partial regression coefficient indicated a positive relationship to site quality and increased the total R^2 by 1.6 percent. This was in direct opposition to the postulated relationship indicated in preceding sections.

Apparently, the non-resident hunter, who is faced with higher costs relative to resident hunters, exhibits a keen sense for quality characteristics. The high partial coefficient indicates that non-resident hunters are more responsive to characteristics of site quality. Therefore, it would seem that this variable (X_{14}) may serve as a proxy for other physical or socio-economic factors. These relationships should easily be appreciated since they are dominant indicators of qualitl as well as restricting factor on site capacity.

7. X_3. The amount of public-owned summer range was found to be negatively correlated with site quality and in direct opposition to the initial hypothesis. Significant at a level of .025 and adding 2.5 percent to the total multiple coefficient of regression, X_3 is a major physical characteristic of site quality. Intercorrelation studies indicated that public summer range was an independent variable.

In general, this variable could very well be an indicator of more directly accessible land and higher intensive domestic cultivation. Proxies for physical characteristics of feed production and ultimate increased capacity may be contained within this variable.

8. X_{16}. The number of does taken by non-residents per square mile of area proved to be significant as the .10 level. An increase in the R^2 is 1.5 percent was observed.

No problems of interdependency among other variables was found. The partial regression coefficient was highly negative as hypothesized. It is interesting to note that non-resident doe hunting or the removal of the hunting experience from any utility level of trophy hunting, decreases the site quality. This is the reverse of the identical experience for resident hunters and may be due in part to the higher costs and differing expectation levels of this type of hunter. Lower quality as indicated by this variable may be useful in policy formulation with respect to the non-resident hunters.

The foregoing analysis suggests that recreation site quality is significantly influenced by several site factors. However, various other variables were found that deserve some mention. Among these are:

1. X_2. In several previous regression models in the study, the amount of winter range was found to be significant at the .05 level and possess a highly-positive partial regression coefficient relative to site quality. In the final model winter range fell out of the analysis. This may have been due to the method of formulating some of the variables, as the amount of winter range was found to be highly interrelated (.913) with X_{10}, the total area of

the herd unit. As many of the variables were standardized relative to total area, most of the variation in winter range was removed. Therefore, winter range, although seemingly unimportant in this model, does display a basic correlation with site quality.

2. X_9. It is interesting to note that the length of the hunting season as established by resource administrators is negatively relative to site quality. Having a partial regression coefficient of -.3881 documents the slightly quality-damaging effect of extended hunting season. However, it should be mentioned that overall variation indicated by this variable is captured by other quality indicators.

3. The ratio of summer range to winter range (X_1/X_2) was found to be non-significant in further analysis. However, it is interesting to note that the sign of the partial coefficient was negative. This indicates that the closer the ratio is to unity, the higher the quality value will be. This is due to the overall stabilizing (sustained yield) effect upon deer herd production. Again, the interdependency with the size characteristics may have removed the effect of this variable.

In overview, the amount of quality rent value for an individual deer hunting unit is estimated by the following model:

$$Q_i = 15.0065 + 9.0516\ X_{19} - 2824.07\ X_{17} + 1504.219\ X_{21}$$
$$-4.9006\ X_{12} + 11.3676\ X_{13} - 37.056\ X_{14} - 25.8839\ X_3$$
$$-88.5084\ X_{16}$$

This foregoing prediction equation is accurate to the 71.3 percentile and significant at .01 level or less. The model as formulated has excellent explanation and predicting power as indicated in previous sections.

<u>Digression on capacity</u>

In order to gain some idea of the sensitivity of the model to different capacity assignments, an alternative set was calculated. These capacities were re-established a second time based upon a standardized probability of hunter success at each origin. The calculation of site capacity is as follows:

$$T_s = DK_s \cdot ATDK$$

where:

T_s = capacity in trips to a site assuming an equal probability of hunter success at all sites.

DK_s = the number of deer kills observed per site.

ADTK = the average number of trips per deer killed (state average).

Numerically:

1. Total trips in state (TT) = 2753

$$\text{or } TT = \sum_{i=1}^{n} T_i$$

where (T_i) is the observed number of trips taken by origin i.

2. Total deer killed in the state (TDK) = 848

$$\text{or } TDK = \sum_{j=1}^{m} DK_j$$

where (DK) is the observed number of deer killed in the j^{th} site.

3. Average number of trips per deer kill on a state average (ATDK).

$$ATDK = \frac{TT}{TDK} = \frac{2753}{848} = 3.2465$$

4. The capacity at any site assuming an equal probability of hunter success is $T_x = DK_x \cdot ATDK$

for Deer Herd Unit 1 (Kelton) there were 29 observed kills.

Therefore: $T_s = 29 \times 3.2465$

$= 94$ trips

This method was repeated for all deer hunting units. Table 9 lists these standardized calculated capacities and the resulting estimated value as compared to the observed capacity as obtained from the data.

Utilizing the methodology stated in previous sections, the calculated units of activity were reallocated again in

Table 9. Comparison of quality and location values using differing capacities for resident deer hunting in Utah, 1970

		(a) OBSERVED CAPACITY			(b) STANDARDIZED CAPACITY		
Herd Unit	Total Rent	Observed Trips	Location Rent	Quality	Calculated Trips	Location Rent	Quality Rent
1	4176.00	68	257.00	3919.00	94	1718.00	2458.00
2	12479.00	220	1150.00	11329.00	182	1141.00	11338.00
3	1355.00	39	0.00	1355.00	6	0.00	1355.00
4	1398.00	22	1150.00	345.00	10	0.00	398.00
5	777.00	33	0.00	723.00	39	115.00	622.00
6	3065.00	60	53.00	2906.00	78	420.00	2645.00
7	1227.00	44	54.00	1191.00	29	0.00	1227.00
8	1882.00	73	159.00	1806.00	68	656.00	1226.00
9	368.00	70	36.00	360.00	42	3.00	365.00
10	491.00	73	76.00	387.00	75	131.00	360.00
11	701.00	69	8.00	589.00	40	63.00	638.00
12	1390.00	80	104.00	1070.00	75	337.00	1053.00
13	943.00	45	112.00	943.00	45	0.00	943.00
14	126.00	19	320.00	24.00	13	0.00	126.00
15	607.00	34	0.00	607.00	39	0.00	607.00
17	1428.00	32	102.00	1372.00	19	56.00	1372.00
18	687.00	58	0 00	687.00	55	0.00	687.00
19	1935.00	106	56.00	1828.00	146	55.00	1880.00
20	1285.00	96	0.00	279.00	88	532.00	753.00
21	1839.00	42	107.00	1347.00	32	0.00	1839.00
22	1075.00	48	1006.00	1075.00	39	0.00	1075.00
23A	734.00	59	492.00	726.00	45	209.00	525.00
23B	1622.00	117	0.00	1622.00	104	0.00	1622.00
24	105.00	12	8.00	105.00	13	0.00	105.00
25	626.00	56	0.00	230.00	97	1617.00	-991.00
26	963.00	40	0.00	594.00	58	349.00	614.00
27A	289.00	16	396.00	272.00	19	26.00	263.00
27B	206.00	30	369.00	169.00	42	6.00	206.00
28A	605.00	27	17.00	350.00	39	255.00	350.00
28B	172.00	9	37.00	169.00	19	364.00	-192.00
29	0.00	3	0.00	0.00	3	4.00	-4.00
30	922.00	61	8.00	1656.00	78	252.00	1670.00
31A	2020.00	38	0.00	1820.00	42	398.00	1622.00
31B	365.00	6	266.00	208.00	3	0.00	365.00
32	754.00	47	200.00	604.00	39	38.00	716.00
33	105.00	9	57.00	105.00	6	0.00	105.00
34	159.00	21	150.00	159.00	26	18.00	141.00
35	228.00	20	0.00	117.00	26	91.00	137.00
36	200.00	14	0.00	136.00	13	38.00	162.00
37	535.00	57	111.00	535.00	52	0.00	535.00
38	700.00	25	64.00	668.00	23	24.00	676.00
39	453.00	30	0.00	422.00	26	0.00	453.00
40	506.00	33	32.00	287.00	49	344.00	162.00
41	2220.00	108	31.00	839.00	123	463.00	1757.00
42	1094.00	75	219.00	1826.00	84	567.00	1496.00
43	1094.00	66	381.00	202.00	101	869.00	225.00
44	478.00	22	237.00	220.00	29	167.00	311.00
45	112.00	7	892.00	112.00	6	28.00	84.00
46	152.00	7	258.00	152.00	10	0.00	152.00
48	588.00	33	0.00	588.00	49	8.00	580.00
49	413.00	14	0.00	288.00	3	10.00	403.00
50	292.00	15	0.00	292.00	6	0.00	292.00
51A	484.00	17	125.00	205.00	10	0.00	484.00
51B	384.00	9	0.00	379.00	6	5.00	379.00
52	64.00	3	0.00	64.00	3	10.00	54.00
53	676.00	38	230.00	446.00	78	555.00	121.00
54	127.00	17	58.00	69.00	19	0.00	127.00
55	941.00	28	153.00	788.00	36	153.00	788.00
56A	644.00	17	90.00	574.00	6	0.00	644.00
56B	174.00	20	234.00	-60.00	6	0.00	174.00
56C	1025.00	30	371.00	654.00	23	348.00	677.00
57A	1078.00	29	215.00	863.00	10	69.00	1009.00
57B	1375.00	30	53.00	1322.00	23	21.00	1354.00
58	1304.00	26	39.00	1265.00	26	60.00	1244.00
59	157.00	11	0.00	157.00	10	0.00	157.00
60A	153.00	6	2.00	151.00	3	0.00	153.00
60B	0.00	1	0.00	0.00	3	0.00	0.00
61A	627.00	15	114.00	513.00	13	72.00	555.00
61B	628.00	14	2.00	626.00	6	2.00	626.00
61C	669.00	11	0.00	669.00	6	38.00	631.00
62A	0.00	8	16.00	-16.00	6	12.00	-12.00
62B	159.00	8	0.00	159.00	3	0.00	159.00
62C	112.00	13	0.00	112.00	10	0.00	112.00
TOTALS:	$69691.00	2753	$10,030.00	$59,585.00	2753	$12717.00	$56,974.00

a least-cost manner. Being subject to the new capacity constraints, different location values were obtained. It is interesting to note that the minimum cost allocation increased from $26,674.00 to $30,502.00, a difference of $3,838.00. This was brought about by the greater degree of distribution subject to the standardized hunter success.

Generally speaking, the least-cost distribution of hunting trips was similar to the earlier model. The individual site values for this distribution indicate the sensitivity of site quality. Where the capacity for trips was increased, a higher location value was given and a lower quality rent. The reverse exists for those units with lower capacity.

Unit 25 (Daggett) measured the largest change. An increase in capacity from 56 trips to 97 trips increased the location rent from $396.00 to $1,617.00, and reduced the quality value to -$991.00 from $594.00. Units 28-b (Book Cliffs, South) and 29 (San Rafael) showed similar changes in f uality value of $169.00 to -$192.00 and $0.00 to -$4.00 respectively. Unit 56-b (South Beaver) registered an increase in quality, from -$60.00 to $174.00 with a decrease in overall capacity. Unit 62-a, (West Desert) rose only slightly from -$16.00 to -$12.00.

The total location rent value based on the statistical sample increased to \$12,717.00 from \$10,030.00 while the total quality rent value decreased from \$59,585.00 to \$56,974.00.

Using the quality rent values obtained from the calculated capacities as the dependent ariable, the independent variables hypothesized in former sections were again made subject to multiple regression testing. A stepwise deletion process was again undertaken with the results presented in Table 10.

Again these results were consistent with a priori hypothesis. However, a greater degree of sensitivity was achieved. The variables found to be significant were also independent as indicated by the correlation matrix in Table 11.

Variables judged significant in this model in order of their importance are:

1. X_{20}. The number of bucks two and one-half years of age and greater killed by non-resident hunters per trip is a measure of all-around trophy production. As in the preceding model, this measure of trophy availability was the most important variable in terms of variation in all-around site quality. Significant at the .0005 level on the

Table 10. Analysis of variance for site characteristics of deer hunting quality based upon the calculated capacity of the site. Summary of the stepwise regression.

Source of Variation	Degrees of Freedom	Mean Square	F-Ratio	Level of Significance	Partial Coefficient		Coefficient	Coefficient	R^2	Order of Importance
X_{20}	1	119,115.3	215.25	.0005	B_{20}	10.6956	1.2882	3.6916	.593	1
X_{15}	1	7,014.42	12.68	.001	B_{15}	-171.0812	-1.1003	.2504	.694	2
X_{6}	1	5,717.54	10.33	.001	B_{6}	-36.3417	-.2148	.5887	.747	3
X_{8}	1	4,052.08	7.32	.01	B_{8}	667.8126	.1502	.0025	.771	4
X_{14}	1	2,654.94	4.79	.05	B_{14}	39.6017	.6505	.5640	.791	5
X_{10}	1	1,826.99	3.30	.10	B_{10}	-.0163	-.1493	601.4789	.800	6
X_{18}	1	3,139.29	5.67	.025	B_{18}	-230.8638	-.2131	.0364	.808	7
X_{5}	1	1,664.71	3.008	.10	B_{5}	100.1497	.0997	.0335	.817	8
X_{21}	1	1,931.57	5.67	.10	B_{21}	51.998	.1643	.1144	.820	9
X_{12}	1	2,413.30	3.008	.05	B_{12}	8.6018	.3686	2.3106	.822	10
X_{19}	1	1,909.01	3.490	.10	B_{19}	-1.2848	-.1958	13.556	.825	11
X_{11}	1	1,549.79	4.361	.10	B_{11}	-2.8149	-.2934	6.0152	.833	12
Model	12	13,370.56			B_{0}	52.59642				
Error	58	553.378			$F(1.58.1 - \alpha = .90) = 2.79$					
Total	70	2,750.61						$R^2 = .833$		

Table 11. Correlation matrix illustrating the degree of interdependence of all variables and the calculated quality rent.

	X_5	X_6	X_8	X_{10}	X_{11}	X_{12}	X_{14}	X_{15}	X_{18}	X_{19}	X_{20}	X_{21}	Q
X_5	1.0	-.021	.043	.114	-.043	-.063	-.100	-.060	.120	-.093	-.145	.078	-.066
X_6		1.0	-.094	.147	-.418	-.294	.326	.325	.295	.346	.379	.356	.032
X_8			1.0	.004	-.095	-.086	.039	.033	-.071	-.076	-.030	-.078	.137
X_{10}				1.0	-.545	-.524	-.175	-.148	-.025	.186	.251	.237	.177
X_{11}					1.0	.748	-.131	-.175	-.425	-.273	-.403	-.422	-.166
X_{12}						1.0	.033	-.002	-.349	.134	-.320	-.369	-.159
X_{14}							1.0	.780	-.006	.225	.439	-.106	.080
X_{15}								1.0	-.025	.244	.497	-.106	.106
X_{18}									1.0	.173	.376	.576	.237
X_{19}										1.0	.311	.386	.116
X_{20}											1.0	.133	.769
X_{21}												1.0	.575
Q													1.0

basis of the F-test, a positive partial regression coefficient (10.6956) and its explanation of 59.3 percent of the total R^2 documented this importance. No problems of intercorrelation were observed so this variable is truly independent. As in the initial model, this variable pertaining to the trophy buck production of a site was highly correlated (.769) with the amount of site quality. This variable, as did its similar counterpart in the preceding model, maintains the hypothesized expectation that positive trophy production is associated with higher site quality values.

2. X_{15}. The number of bucks taken by non-resident hunters per square mile of area was found to explain 10 percent of the total R^2. However, in direct reverse to the frequency of trophy production (X_2) a negative partial regression coefficient was observed. This coefficient of -171.0812 is highly negative and was significant at a level of .001. The correlation matrix indicated that no problems of interdependency exist.

The rent values estimated for the hunting sites were based upon resident hunters only. Therefore, it is possible that non-residents entering this form of recreation, causes a degree of competition to occur with the resident population. This competition forces the resident hunter to seek alternative sites with different levels of quality to maximize his total experience.

3. X_6. Public ownership of winter range presents a paradox in discussing quality. Being significant at the .001 level and explaining 5.3 percent of the total R^2, X_6 makes a major contribution to the model. However, its partial regression coefficient of -36.3417, is in direct opposition to the hypothesis presented earlier. Many factors could influence this, such as more intensive range uses. Also public winter range may create problems of competition. It may be that this range is poor in vegetation and terrain type with the lower slopes and valleys having fallen into private ownership leaving higher areas and national forest to the public. This does little to enhance wildlife production and is negatively related to site quality.

The history of Utah and its wildlife resource indicates this. Nevertheless, the uncertainty of growing population and urbanization of foothill ranges offers reasons for further study of this variable.

4. X_8. The amount of winter range owned by the Utah Division of Natural Resources was found to be most interesting

both in terms of explaining variation in quality value and public policymaking. Significant at the .01 level, X_8 has a partial regression coefficient of 667.8126. This highly positive coefficient is in accordance with .the a priori expectations. No problems of intercorrelation were indicated and an increase of 3.6 percent was observed in the total R^2.

The positive partial coefficient of this variable has great prospective when viewed in terms of wildlife management. Strategically-located sections of fish and game winter range could greatly enhance the quality value of a site. Increased production and winter carryover would increase the site capacity and thus, increase quality. This variable is a stabilizing factor as indicated by the nature of the capacity standardized to hunter success.

5. X_{14}. The number of non-resident hunters per square mile of area is an indicator of site congestion and is significant at the .05 level. Minor intercorrelation (.78) was observed with X_{15} (the number of bucks killed by non-resident hunters per square mile), but this interdependency can be termed a causal effect. Having a partial regression coefficient of 39.6017, this variable displays a positive correlation with site quality and increases the total R^2 by 2.0 percent. Contrary to the resident

indicator of congestion (X_{11}), this increasing effect can be explained in terms of total numbers. Non-residents do not appear in sufficient numbers to affect congestion in a negative manner. Also, the non-resident hunter who is faced with higher use costs may display a better knowledge of site quality and his appearance at the site may serve as a proxy for these unidentified characteristics.

6. X_{10}. The total area of the deer herd unit was judged to be significant at the .10 level. The correlation matrix indicated that X_2 (the size of the winter range) was intercorrelated at a level of .988. However, X_2 was judged to be insignificant in terms of the F-test and was deleted from the model. No other interdependency exists. An increase of 1.0 percent was observed in the total R^2. The slightly negative partial regression coefficient (-.01628) indicates the diversity found in the types of range at the hunting sites. The largest herd units in terms of total size are found in the west desert. In these sites, hunter capacity is low as is the quality value. As this variable indicates site quality, it cannot be improved by increasing the total amount of land resources in the area. A more land-intensive range policy would serve better.

7. X_{18}. Non-resident hunter success per trip was found to be significant at .025 and contributing .8 percent to the total R^2. No intercorrelation exists with other variables. Interesting in this analysis is the negative partial coefficient of -230.8638. It should be noted that this was the sign given the resident hunter success in the earlier model. As with resident hunter success, any artificial addition to the deer herd mortality rate reduces the quality value of a hunting site. This is due to the decreasing effect that a reduction in animal numbers places upon the long-term quality production process. Overhunting, will in the long run, decrease the quality value although site activity may increase for a short period.

8. X_5. State ownership of winter range was found to be significantly related to site quality. Significant at the .10 level and explaining .9 percent in the total R^2, indications of more intensive range management practices are again brought forward. The very nature and use of the state's land holdings document this hypothesis. Policy considerations again become prevalent as the positive partial correlation indicates. No interdependency was found among the other independent variables.

State land exhibits a stabilizing effect upon deer hunting site quality. As most state lands are in agricultural-oriented uses, vegetation and terrain acceptable for deer herd maintenance and production is observed. Also hunter access and opportunity is easier, than contributing to higher quality value.

9. X_{21}. The average length of the hunting trip was found significant at the .10 level in this model as compared to the .0005 level in the previous analysis. An increase of .5 percent was observed in the total R^2. As in the previous analysis, a positive partial coefficient (51.998) indicated the quadratic nature of this variable relative to site quality. The interpretation of the variation in site quality as influenced by variations in the length of the trip is the same as that reported in the initial model.

10. X_{12}. The number of bucks taken by resident hunters per square mile of area was judged to the significant at the .05 level of probability. A partial regression coefficient of 8.6011 indicated a positive correlation with site quality. This variable displayed some intercorrelation with X_{11} (the number of resident hunters per square mile of area) but was causal in nature.

To the resident hunter, the killing of a buck is one of the primary reasons for taking a hunting trip. Sites that have a high probability of getting a buck are preferred and, therefore, higher in quality value.

11. X_{19}. The number of bucks two and one-half years of age and greater taken by resident hunters per trip was judged to be significant at the .10 level of probability. However, in this model where site capacity is standardized to resident hunter success, the partial regression coefficient is negative. This may be due in part to the standardization process where everyone has the equal probability of getting a deer. The chance for selectivity in hunting is removed. In this way, the trophy aspect of deer hunting does not add to the utility of the hunt and is a negative indicator of quality.

12. X_{11}. The number of resident hunters per square mile was judged to be significant at the .10 level and is an indicator of site congestion. Having a partial regression coefficient of -2.8149, this negative congestion factor indicates the adverse affects of high hunter density upon site quality.

Increased numbers of hunters mean increased hunter pressure, increased deer mortality and an overall damaging effect upon the hunting site. This "over capacity" reduces the quality value of the site both in terms of production and hunter utility. Hunters may be forced to seek an alternative site when hunter density reaches a certain point as outlined by demand peaking conditions.

In summary, the estimated quality rent value for an individual deer hunting unit where capacity is standardized for resident hunter success is given by the following model:

$$Q_i = 52.59642 + 10.6956\ X_{20} - 171.0812\ X_{15} - 36.3417\ X_6 + 667.8126\ X_8 + 39.6017\ X_{14} - .01628\ X_{10} - 230.8638\ X_{18} + 100.1497\ X_5 = 51.998\ X_{21} + 8.6011\ X_{12} - 1.2848\ X_{19} - 2.8149\ X_{11}$$

The multiple R^2 of .833 indicates that variations in site characteristics judged to be significant in this model, explain 83.3 percent of the variation in site quality. The R^2 is statistically significant at the .01 or less level of probability.

The foregoing model indicates the sensitivity of hunter capacity in the valuation method used. The models based on the differing capacities are summarized in Table 12.

Projection of state totals

As indicated earlier, all values were kept in terms of the sample size. This was done to minimize the effects of rounding error on the regression analysis. To project

Table 12. Comparison of the variables found significant in the regression analysis of quality rent based on the observed and calculated capacity.

Variables		OBSERVED CAPACITY		CALCULATED CAPACITY	
		Level of Significance	Rank of Importance	Level of Significance	Rank of Importance
Public Summer Range	X_3	.025	7	*.9995	21
State Winter Range	X_5	*.50	10	.10	8
Public Winter Range	X_6	*.75	20	.001	3
Fish and Game Winter Range	X_8	*.25	9	.01	4
Total Area	X_{10}	*.85	17	.01	6
Resident Hunter per Square Mile	X_{11}	*.75	22	.10	12
Resident Bucks per Square Mile	X_{12}	.01	4	.05	10
Resident Does per Square Mile	X_{13}	.025	5	*.75	13
Non-Resident Hunters per Square Mile	X_{14}	.05	6	.05	5
Non-Resident Bucks per Square Mile	X_{15}	*.50	15	.001	2
Non-Resident Does Per Square Mile	X_{16}	.10	8	*.75	14
Resident Hunter Success per trip	X_{17}	.0005	2	*.75	16
Non-Resident Hunter success per trip	X_{18}	*.50	12	.025	7
Resident Bucks 2½ years per Trip	X_{19}	.0005	1	.10	11
Non-Resident Bucks 2½ years per Trip	X_{20}	*.50	21	.0005	1
Length of Trip	X_{21}	.0005	3	.10	9
Constant (B_o)		15.0065		52.59642	
Degrees of Freedom		70		70	
R^2		.713		.833	

* Indicates the variables that were found to be insignificant at the .10 level. This level of significance shown is that observed when the variable was deleted from the stepwise regression.

the estimated values to state totals, the following method was used.

Given:

Resident Licenses sold (1970)	172,643
Data Sample Size	2,033
Hunters in Sample	1,862
Number of Trips in Sample	2,753
Non-hunters in Sample	171

therefore:

$$\frac{\text{Resident Licenses Sold (1970)}}{\text{Data Sample Size}} = \text{Sample projection factor for the number of hunters}$$

numerically:

$$\frac{172,643}{2,033} = 84.9203$$

This value gives the projected number of hunters. As capacity is expressed in hunter trips, it was necessary to make the conversion. The estimated number of trips taken per hunter is:

$$\frac{2,753}{1,862} = 1.4785$$

It was still necessary to handle the problem of more than one person per car trip. The sample showed that each trip involved an average of 2.6285 hunters. With this information, the sample projection factor was found to be:

$$\frac{\frac{172,643}{2,033} \times \frac{2,753}{1,863}}{2.6285} = \text{Sample projection factor for all values}$$

$$\frac{84.9203\ (1.4785)}{2.6285} = 47.7668$$

That is, a single observation in the sample was equal to 47.7668 observations in the state. All values were multiplied by 47.7668 to give the total value which are summarized in Table 13.

Table 13. Comparison of estimated site values projected to state totals

Herd Unit	Observed Capacity		Standardized Capacity		Projected Total Annual Economic Rent
	Projected Quality Rent	Projected Location	Projected Quality Rent	Projected Location	
1	187198.00	12276.00	117410.00	82063.00	199516.00
2	541150.00	54931.00	541579.00	54501.00	596082.00
3	64724.00	0.00	64724.00	0.00	64724.00
4	16479.00	2531.00	19011.00	0.00	19011.00
5	34535.00	2579.00	29710.00	5493.00	37115.00
6	138810.00	2531.00	126343.00	20062.00	146405.00
7	56890.00	1719.00	56890.00	0.00	56890.00
8	86266.00	3630.00	58562.00	31335.00	89897.00
9	17196.00	382.00	17434.00	144.00	17578.00
10	18485.00	4967.00	17196.00	6257.00	23454.00
11	28134.00	5349.00	30475.00	3009.00	33485.00
12	51110.00	15285.00	50298.00	15097.00	66396.00
13	45044.00	0.00	45044.00	0.00	45044.00
14	1146.00	4872.00	6018.00	0.00	6019.00
15	28994.00	0.00	28994.00	0.00	28994.00
17	65536.00	2674.00	65536.00	2674.00	68211.00
18	32815.00	0.00	32815.00	0.00	32816.00
19	87317.00	5111.00	89801.00	2627.00	92429.00
20	13326.00	48053.00	35968.00	25411.00	61380.00
21	64341.00	23501.00	87843.00	0.00	87843.00
22	51349.00	0.00	51349.00	0.00	51349.00
23-a	34678.00	382.00	25077.00	9983.00	35061.00
23-b	77477.00	0.00	77477.00	0.00	77478.00
24	5015.00	0.00	5015.00	0.00	-5016.00
25	10986.00	18915.00	-47336.00	77238.00	39902.00
26	28373.00	17625.00	39328.00	16670.00	45999.00
27-a	12992.00	812.00	12562.00	1241.00	13805.00
27-b	8072.00	1767.00	9839.00	286.00	9840.00
28-a	16718.00	12180.00	16718.00	12180.00	38899.00
28-b	8073.00	382.00	-9171.00	17387.00	8216.00
29	0.00	0.00	-191.00	191.00	0.00
30	79101.00	12705.00	79770.00	12037.00	91908.00
31-a	86935.00	9553.00	77477.00	19011.00	96489.00
31-b	9935.00	2722.00	17434.00	0.00	17435.00
32	28851.00	7165.00	34201.00	1815.00	36016.00
33	5015.00	0.00	5015.00	0.00	5016.00
34	7594.00	0.00	6735.00	959.00	7695.00
35	5588.00	5302.00	6444.00	4346.00	10891.00
36	6496.00	3057.00	7738.00	1815.00	9553.00
37	25555.00	0.00	25555.00	0.00	25555.00
38	31908.00	1528.00	32290.00	1146.00	33437.00
39	20157.00	1480.00	21638.00	0.00	21638.00
40	13709.00	10460.00	7738.00	16431.00	24170.00
41	87843.00	18199.00	83926.00	22116.00	106042.00
42	87222.00	11320.00	71459.00	27083.00	98543.00
43	9648.00	42607.00	10747.00	41509.00	52267.00
44	10508.00	12323.00	14855.00	7977.00	22833.00
45	5349.00	0.00	4012.00	1337.00	5350.00
46	7260.00	0.00	7260.00	0.00	7251.00
48	28086.00	0.00	27704.00	382.00	28087.00
49	13756.00	5970.00	19250.00	477.00	19728.00
50	13947.00	0.00	13947.00	0.00	13948.00
51-a	9492.00	11607.00	21399.00	0.00	21399.00
51-b	18103.00	238.00	18103.00	238.00	16384.00
52	3057.00	0.00	2579.00	477.00	3057.00
53	21303.00	10986.00	5779.00	26510.00	32290.00
54	3295.00	2770.00	6066.00	0.00	6066.00
55	37640.00	7308.00	37640.00	7308.00	44949.00
56-a	27418.00	4299.00	30761.00	0.00	30762.00
56-b	-2866.00	1117.00	8311.00	0.00	8311.00
56-c	31239.00	17721.00	32338.00	16622.00	48961.00
57-a	41222.00	10269.00	58196.00	3295.00	51483.00
57-b	43147.00	2531.00	64676.00	1003.00	65679.00
58	60425.00	1862.00	59421.00	2866.00	62288.00
59	7499.00	0.00	7499.00	0.00	6499.00
60-a	7212.00	95.00	7308.00	0.00	7308.00
60-b	0.00	0.00	0.00	0.00	0.00
61-a	24504.00	5445.00	26510.00	3439.00	29950.00
61-b	29902.00	95.00	2902.00	95.00	29998.00
61-c	31955.00	0.00	30140.00	1815.00	31956.00
62-a	-764.00	764.00	-573.00	573.00	0.00
62-b	7594.00	0.00	7594.00	0.00	7595.00
62-c	5349.00	0.00	5349.00	0.00	5350.00
TOTALS:	$2,846,185.	$479,101.	$2,721,466.	$607,450.	$3,326,238.

SUMMARY

The primary objective of this study was to make empirical estimates of economic rent values related to location and quality for the Utah resident deer hunt. A secondary objective was to use regression analysis to analyze variations in site quality values and determine the major site characteristics contributing to variation in this value.

The theoretical model incorporates the relationship existing between the variable use cost associated with various origins, sites and units of activity. The model is based on the logic of economic rent and is consistent with the methodology advanced by Wennergren and Fullerton (1969). They stated that the value of any particular use for a land resource is reflected in the total economic rent. The source of this rent is location and quality values.

The Wennergren-Fullerton methodology enables the calculation of total rent value relative to the most distant user of the site. A least-cost redistribution of the units of activity utilizing linear programming techniques enables the calculation of the location rent values.

The residual of total rent and this location rent is said to be the value attributable to site quality.

Data was collected from a total of 4,104 questionnaires sent to a sample of Utah resident deer hunters drawn randomly from a master sample of approximately 30,000 randonly-selected license holders in 1970. A total of 2033 questionnaires (49.6 percent) were returned and used in the study. Data was gathered from the questionnaires with respect to hunter origin, sites visited, number of trips taken and other trip expenses. Using this information, together with standardized distances, an assumed variable cost of travel ($.10 per mile), estimations of total economic rent and its quality and location components were made for all deer hunting units in Utah. Site capacity was assumed to be equal to the number of trips observed from the data. The values were left in terms of sample size throughout the study to reduce errors in the regression analysis. They were projected to state totals after all analysis was completed. The total value of deer hunting in Utah was found to be $3,326,238.00. Location rent was $479,101.00 with $2,846,185.00 being the value attributable to quality factors. This quality value represented 85 percent of the total value.

Sites visited by more distant origins generated the highest quality values. This was the case for Herd Unit 2 (Cache) which had the highest total quality value representing 17.9 percent of the state total. Unit 2 was followed by Unit 1 (Box Elder), 6.0 percent; Unit 6 (Lost Creek), 4.4 percent; and Unit 31-a (San Juan--Blue Mountain), 2.9 percent. The lowest quality values were found in Units 56-b (South Beaver) and 62-a (West Desert) with each displaying -.001 percent.

Multiple regression analysis indicated that 71.3 percent of the variation in site quality value was due to variations in site specific factors. In order of importance these were:

1. The number of bucks two and one-half years of age and greater killed by resident hunters per trip. This variable measured a 56.3 percent increase in the total R^2.

2. Resident hunter success per trip.

3. The average length of the hunting trip.

4. The number of bucks taken by resident hunters per square mile of area.

5. The number of does taken by resident hunters per square mile of area.

6. The number of non-resident hunters per square mile of area.

7. The amount of public owned summer range.

8. The number of does taken by non-resident hunters per square mile of area.

Value estimations were also made based on site capacity standardized by uniform hunter success. These values were similar to those based on the observed capacity estimates.

Quality rent was somewhat lower at $2,721,466 (81.8 percent), and the location rent value increased to $607,450 (18.2 percent). The total value was $3,326,238, the same as that for the observed capacity.

Multiple regression analysis of the variations in quality value based on standardized capacity indicated that capacity was sensitive in the rent model. This sensitivity was indicated by an increased R^2. Variations in site specific characteristics explained 83.3 percent of the variation in site quality. In order of importance, these factors were:

1. The number of bucks two and one-half years of age and greater taken by non-resident hunters per trip.

2. The number of bucks taken by non-resident hunters per square mile of area.

3. The amount of winter range in public ownership.

4. The amount of winter range owned by the Utah Division of Natural Resources.

5. The number of non-resident hunters per square mile of area.

6. The total area of the herd unit.

7. Non-resident hunter success per trip.

8. The amount of winter range in State ownership.

9. The average length of the hunting trip.

10. The number of bucks taken by resident hunters per square mile of area.

11. The number of bucks two and one-half years of age and greater taken by resident hunters per trip.

12. The number of resident hunters per square mile of area.

In summary, the economic rent approach to resource valuation provides results consistent with theory. The major components of total value can be separated, with the quality value being explained by site specific factors.

CONCLUSION AND RECOMMENDATION FOR FURTHER STUDY

The economic rent approach to resource valuation is a realistic and consistent method and represents a forward step in the field. The problem of resource quality, which is important to resource development and management, is given proper treatment as it can be separated and identified. The fact that only net values are derived by this approach allows one to speculate on optimality in development and management.

The variations in site quality can be explained conceptually and empirically by variation in specific site characteristics. Most of the factors are subject to management. The model highlights interrelationships among sites, making it possible to measure the affect of deterioration or improvement at a given site by monitoring shifts in the value for the whole system of sites. These shifts in value would come about by changes in the site characteristics (parameters) of quality.

Certain site variables are more important than others as they are more likely to change in the short run. The identification of these variables is greatly aided by the sensitivity of site capacity and for the most part are capacity oriented. A broader understanding of this capacity constraint can only lead to a greater accuracy in the valuation.

The equation form of the site characteristics explaining variations in quality value is static in nature and thus, somewhat limited in use. However, it does serve as a production fuction for recreation at the various sites. Shifts in the individual factors of this function can provide an indicator for future use, provided that a probability of use is attached. The obvious areas needing further research are:

1. Refine the definition of site capacity as the model is highly sensitive to this important component.

2. Determine the value of Utah deer hunting to nonresident hunters and compare this value to a possible loss in value to the resident hunter. The non-resident hunter is an important indicator of site quality and, therefore, needs to be totally identified with regard to any future optimization of social welfare.

3. Determine the effects of induced changes in the site-specific factors of site quality.

4. Give a dynamic nature to site characteristics of quality. This could be done by estimating the probabilities of taking a hunting trip given the significant site

factors of quality. This would lead to the estimation of demand curves inherent to a particular site and would be helpful in quantifying data pertaining to all basic non-market priced resources.

RECOMMENDATION TO MANAGEMENT

The economic rent valuation model is of unequaled importance in resource management. The derivation of net total values is a great aid in promotions toward securing appropriations of scarce public funds for future development when competing with other agencies. The separation of the quality component of value aids in comparing various sites empirically, and gives a basis for future investment. Questions of optimality in investment could be answered by the use of this method.

Specific recommendations to management agencies concerned with deer hunting recreation are:

1. Redefine the units of activity used in their analysis to be one visit to the hunting site equals one trip.

2. Redesign the mail questionnaire to include data on hunter origin, sites, trips, number of people in a car etc.

3. Estimate the value of deer hunting for a number of years to provide data for a comparison of variation in site quality due to variation in site characteristics.

4. Expand the emphasis upon capacity measurement to

enable a more accurate estimate of value to be found, and a definition of congestion to be achieved.

5. Refine the data collection procedure for site characteristics so that a greater sensitivity in the individual parameters of these factors can be achieved.

In general, it is noted that some of the most urgent problems in fish and wildlife management are inadequately understood and, therefore, inadequately coped with. Good economic analysis and a capability to undertake such research should be sought by agencies responsible for management of the biological stock of our environment. In a society now aware of the necessity to maintain environmental quality, such a capability is essential if they are to play their role effectively.

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APPENDIX

Table 14. Total, location and quality rent values for all deer hunting units in the state of Utah, 1970

		(A) Observed Activity			(B) Least Cost Activity		
Origin	Adjusted Miles (Round Trip)	Location Advantage (Miles)	# Trips	Total Rent/origin @$.10/mi.	Location Advantage (Miles)	# Trips	Location Rent/origin @$.10/mi.
Herd Unit 1 - Box Elder							
Yost	10	886	1	$89.00	128	1	$13.00
Mendon	88	808	1	81.00			
Fielding	88	808	1	81.00	50	2	10.00
Bear River	120	776	1	78.00			
Honeyville	120	758	1	78.00			
Promontory	138	409	1	76.00			
Kenilworth	187	698	1	41.00			
Brigham City	198	687	9	682.00			
Richmond	209	686	1	69.00			
Logan	210	670	4	274.00			
Roy	226	670	2	134.00			
Hooper	226	670	1	67.00			
Clinton	226	670	1	67.00			
Sunset	226	670	1	67.00			
Syracuse	226	670	2	134.00			
Ogden	240	656	13	853.00			
Liberty	265	631	1	63.00			
Tremonton	185	711	2	142.00			
Bountiful	304	592	1	59.00			
Garland	185	711	2	235.00			
Centerville	304	592	1	58.00			
Salt Lake City	308	588	4	58.00			
Kearns	320	576	1	111.00			
Granger	320	576	1	222.00	0	1	0.00
Kaysville	342	554	2	55.00			
Lark	342	554	4	54.00			
Orem	348	548	1	57.00			
Lehi	360	536	1	54.00			
Manila	609	287	2	57.00			
St. George	896	0	2				
Huntsville	70				68	1	7.00
Cleveland	102				36	63	227.00
			68	$4176.00		68	$257.00
Quality Rent (A - B) = $3919.00							
Herd Unit 2 - Cache							
Logan	24	632	92	5814.00	91	113	$1028.00
Smithfield	38	618	4	247.00	77	4	31.00
Hyrum	42	614	3	184.00	73	6	44.00
Paradise	42	614	1	61.00			
Richmond	50	606	1	61.00	65	2	13.00
Lewiston	62	594	1	59.00			
Brigham City	73	583	21	1224.00	42	8	34.00
Willard	74	582	3	175.00			
Clarkston	75	581	1	58.00			
Trenton	78	578	2	116.00			
Ogden	115	541	36	1948.00	0	87	0.00
Pl. View	125	531	1	53.00			
Roy	127	529	5	265.00			
Clearfield	127	529	2	106.00			
Layton	130	526	4	210.00			
Kaysville	132	524	10	524.00			
Bear River	157	499	3	150.00			
Tremonton	157	499	2	100.00			
SLC	184	472	6	283.00			
Sandy	214	442	1	44.00			
Clinton	223	433	8	346.00			
Bountiful	252	404	7	283.00			
Riverton	261	395	1	40.00			
Provo	276	380	2	76.00			
St. John	331	325	1	33.00			
Centerfield	470	186	1	19.00			
Moab	656	0	1	0.00			
			220	$12,479.00		220	$1150.00
Qaulity Rent (A-B) = $11,329.00							

Table 14. Continued

Origin	Adjusted Miles (Round Trip)	(A) Observed Activity: Location Advantage (Miles)	(A) # Trips	(A) Total Rent/origin @$.10/mi.	(B) Least Cost Activity: Location Advantage (Miles)	(B) # Trips	(B) Location Rent/origin @$.10/mi.
Herd Unit 3 - Mantua							
Logan	48	370	5	$185.00			
Brigham City	54	364	20	728.00			
Newton	58	360	2	72.00			
Ogden	62	356	6	214.00	0	39	0
Tremonton	68	350	1	35.00			
Roy	73	345	1	35.00			
Bountiful	130	288	1	29.00			
Salt Lake	132	286	2	57.00			
Dragerton	418	0	1	0.00			
			39	$1355.00		39	0
Quality Rent (A-B) = $1355.00							
Herd Unit 4 - Wellsville							
Mendon	6	224	6	134.00			
Logan	14	216	2	43.00			
Newton	20	210	1	21.00			
Tremonton	34	195	5	98.00			
Brigham City	50	180	3	54.00	2	5	1.00
Ogden	92	138	2	28.00			
Roy	99	131	1	13.00			
Salt Lake	160	70	1	7.00			
Provo	230	0	1	0.00			
Mendon	6				46	6	28.00
Newton	20				32	6	19.00
Lewiston	35				17	2	3.00
Clarkston	35				17	1	2.00
Trenton	52				0	2	0.00
			22	$398.00		22	53.00
Quality Rent (A-B) = $345.00							
Herd Unit 5 - Woodruff							
Woodruff	20	378	4	$151.00	136	4	$54.00
Logan	139	259	2	52.00			
Ogden	156	242	11	266.00	0	18	0.00
Kaysville	157	241	3	72.00			
Hyrum	159	239	1	24.00			
Roy	167	231	3	69.00			
Brigham City	198	200	2	40.00			
Newton	217	181	1	18.00			
Bountiful	224	174	1	17.00			
Salt Lake	227	171	4	68.00			
Dragerton	398	0					
Liberty	87						
Plain City	104						
Pleasant View	104						
			33	$777.00		33	$54.00
Quality Rent (A-B) = $723.00							
Herd Unit 6 - Lost Creek							
Morgan	35	574	6	$344.00			
Kaysville	77	532	3	160.00	6	5	3.00
Ogden	83	526	29	1525.00	0	29	0.00
Roy	88	521	4	208.00			
Bountiful	101	508	13	660.00			
Provo	190	419	4	168.00			
Cedar City	609	0	1	0.00			
Farmington	17				66	16	106.00
Henefer	17				66	1	7.00
Mtn. Green	35				48	9	43.00
			60	$3065.00		60	$159.00
Quality Rent (A-B) = $2906.00							

Table 14. Continued

Origin	Adjusted Miles (Round Trip)	(A) Observed Activity: Location Advantage (Miles)	# Trips	Total Rent/origin @$.10/mi.	(B) Least Cost Activity: Location Advantage (Miles)	# Trips	Location Rent/origin @.10/mi.
Herd Unit 7 - Ogden River							
Liberty	17	331	2	$66.00			
Kaysville	35	313	2	63.00	0	23	$0.00
Ogden	42	306	22	673.00			
Morgan	46	302	1	30.00			
Roy	53	295	4	118.00			
Clearfield	58	290	1	29.00			
Plain City	62	286	3	86.00			
Bountiful	94	254	2	51.00			
Salt Lake	113	235	4	94.00			
Provo	183	165	1	17.00			
Centerfield	348	0	2	0.00			
Clinton	17	0			17	21	36.00
			44	$1227.00		44	$36.00
Quality Rent (A-B) = $1191.00							
Herd Unit 8 - East Canyon							
Morgan	12	346	1	$35.00	49	8	$39.00
Coalville	20	338	1	34.00			
Mtn. Green	35	323	1	32.00			
Ogden	61	297	9	267.00	0	31	0.00
Roy	50	308	3	92.00	11	34	37.00
Kaysville	66	292	3	88.00			
Salt Lake	70	288	23	662.00			
Clearfield	77	281	1	28.00			
Clinton	80	278	4	111.00			
Kearns	82	276	1	28.00			
Murray	88	270	2	54.00			
Midvale	90	268	1	27.00			
Bountiful	90	268	12	322.00			
Copperton	91	267	1	27.00			
Woods Cross	96	262	1	26.00			
Provo	140	218	2	43.00			
Centerfield	348	10	6	6.00			
Castle Dale	358	0	1	0.00			
			73	$1882.00		73	$76.00
Quality Rent (A-B) = $1806.00							
Herd Unit 9 - Davis County							
Layton	20	122	1	12.00			
Woodscross	20	122	2	24.00			
Kaysville	20	122	3	37.00	2		
Farmington	20	122	6	73.00		40	8.00
Salt Lake City	33	109	12	131.00			
Mtn. Green	35	107	1	11.00			
Ogden	40	102	7	71.00			
Kearns	55	87	1	9.00			
Bountiful	142	0	37	0.00			
Clearfield	22				0	30	0.00
			70	$368.00		70	$8.00
Quality Rent (A-B) = $360.00							
Herd Unit 10 - Salt Lake							
Murray	15	80	2	16.00	28	35	98.00
Sandy	18	77	11	85.00			
Park City	20	75	2	15.00			
Salt Lake	24	71	49	348.00	19	3	6.00
Kearns	27	68	1	7.00			
Granger	27	68	2	14.00			
Layton	75	20	2	4.00			
Roy	87	8	.1	1.00			
Tooele	92	3	2	1.00			
Ogden	95	0	1	0			
Bountiful	43				0	35	0.00
			73	$491.00		73	$104.00
Quality Rent (A-B) = $387.00							

Table 14. Continued

Origin	Adjusted Miles (Round Trip)	(A) Observed Activity: Location Advantage (Miles)	# Trips	Total Rent/origin @$.10/mi.	(B) Least Cost Activity: Location Advantage (Miles)	# Trips	Location Rent/origin @.10/mi.
Herd Unit 11 - Heaston							
Tooele	14	143	7	100.00			
Stockton	20	137	10	137.00			
Copperton	20	137	3	41.00			
Riverton	20	137	6	82.00			
Sandy	20	137	1	14.00	18	62	$112.00
Lehi	30	127	5	64.00			
Alpine	32	125	2	25.00			
American Fork	44	113	1	11.00			
Plsnt. Grove	47	110	1	11.00			
Magna	56	101	5	51.00			
Midvale	62	95	3	29.00			
Provo	71	86	1	9.00			
Salt Lake	98	59	19	112.00			
Hunter	98	59	1	6.00			
Clinton	122	35	1	4.00			
Orem	134	23	2	5.00			
Brigham City	157	0	1	0.00			
Murray	38	0			0	7	0.00
			69	$701.00		69	$112.00

Quality Rent (A-B) = $589.00

Origin	Adjusted Miles (Round Trip)	(A) Observed Activity: Location Advantage (Miles)	# Trips	Total Rent/origin @$.10/mi.	(B) Least Cost Activity: Location Advantage (Miles)	# Trips	Location Rent/origin @.10/mi.
Herd Unit 12 - Stansbury							
Grantsville	20	232	7	162.00	72	8	58.00
Tooele	20	232	21	487.00	72	29	209.00
Magna	70	182	5	91.00	22	24	53.00
Granger	86	166	3	50.00			
Kearns	86	166	1	17.00			
Salt Lake	92	160	23	368.00	0	19	0.00
Midvale	104	148	1	15.00			
Murray	110	142	1	14.00			
Bountiful	111	141	4	56.00			
Syracuse	125	127	1	13.00			
Sandy	128	124	2	25.00			
Roy	137	115	1	12.00			
Layton	140	112	3	34.00			
Ogden	163	89	1	9.00			
Copperton	167	85	1	9.00			
American Fork	179	73	1	7.00			
Wendover	182	70	1	7.00			
Provo	184	68	2	14.00			
Logan	252	0	1	0.00			
			80	$1,390.00		80	$ 320.00

Quality Rent (A-B) = $1,070.00

Origin	Adjusted Miles (Round Trip)	(A) Observed Activity: Location Advantage (Miles)	# Trips	Total Rent/origin @$.10/mi.	(B) Least Cost Activity: Location Advantage (Miles)	# Trips	Location Rent/origin @.10/mi.
Herd Unit 13 - Mt. Vernon							
Tooele	21	326	8	261.00	0	45	0.00
Midvale	104	243	1	24.00			
Springville	104	243	1	24.00			
American Fork	108	239	1	24.00			
Lehi	108	239	1	24.00			
Provo	117	230	5	115.00			
Delta	126	221	1	22.00			
Orem	129	218	3	65.00			
Payson	137	210	1	21.00			
Dugway	144	203	1	20.00			
Sandy	147	200	5	100.00			
Magna	157	190	1	19.00			
Riverton	165	182	1	18.00			
Granger	174	173	1	17.00			
West Jordan	175	172	1	17.00			
Murray	177	170	5	85.00			
Salt Lake	187	160	2	32.00			
Grantsville	189	158	1	16.00			
Centerfield	191	156	1	16.00			
Ogden	256	91	2	18.00			
Willard	296	51	1	5.00			
Logan	347	0	1	0.00			
			45	$943.00	0	45	0.00

Quality Rent (A-B) = $943.00

Table 14. Continued

Origin	Adjusted Miles (Round Trip)	(A) Observed Activity Location Advantage (Miles)	# Trips	Total Rent/origin @$.10/mi.	(B) Least Cost Activity Location Advantage (Miles)	# Trips	Location Rent/origin @$.10/mi.
Herd Unit 14 - East Tintic							
Mona	20	158	1	16.00	119	1	12.00
Glenwood	25	153	1	15.00			
Provo	85	93	5	47.00			
Orem	95	83	1	8.00			
Delta	98	80	1	8.00			
Pleasant Grove	103	75	1	8.00			
Mtn. Green	104	74	2	15.00			
South Jordan	139	39	1	4.00			
Murray	154	24	1	2.00			
Riverton	160	18	1	2.00			
Salt Lake	172	6	1	1.00			
Bountiful	174	4	1	0.00			
Midvale	178	0	2	0.00			
Kearns	139				0	5	0.00
St. John	70				69	13	90.00
			19	$126.00		19	102.00
Quality Rent (A-B) = $24.00							
Herd Unit 15 - Timpanogas							
American Fork	14	199	4	80.00			
Pleasant Grove	20	193	4	77.00			
Lindon	20	193	2	39.00			
Orem	24	189	9	170.00			
Alpine	26	187	3	56.00			
Spanish Fork	35	178	1	18.00			
Provo	36	177	6	106.00			
Springville	48	165	1	17.00			
Midvale	53	160	1	16.00			
Murray	70	143	1	14.00			
Salt Lake	73	140	1	14.00	0	34	0.00
Dragerton	213	0	1	0.00			
			34	$607.00		34	$0.00
Quality Rent (A-B) = $607.00							
Herd Unit 17 - Hobble Creek							
Mapleton	21	501	1	50.00			
Springville	21	501	3	150.00			
Provo	29	493	12	592.00			
Orem	41	481	3	144.00			
Pleasant Grove	49	473	1	47.00			
Lehi	61	461	2	92.00			
American Fork	61	461	1	46.00			
Murray	100	422	1	42.00			
Salt Lake	115	407	5	204.00			
Layton	164	358	1	36.00			
Logan	275	247	1	25.00			
St. George	522	0	1	0.00			
Bountiful	125				0	22	0.00
Woods Cross	69				56	10	56.00
			32	$1428.00		32	$56.00
Quality Rent (A-B) = $1,372.00							

Table 14. Continued

Origin	Adjusted Miles (Round Trip)	(A) Observed Activity: Location Advantage (Miles)	(A) # Trips	(A) Total Rent/origin @$.10/mi.	(B) Least Cost Activity: Location Advantage (Miles)	(B) # Trips	(B) Location Rent/origin @$.10/mi.
Herd Unit 18 - Diamond Fork							
Spanish Fork	42	104	13	135.00			
Mapleton	48	178	1	18.00			
Springville	48	178	10	178.00			
Provo	61	165	7	116.00			
Orem	73	153	6	92.00			
Pleasant Grove	81	145	1	15.00			
Payson	87	139	1	14.00			
Salem	87	139	1	14.00			
American Fork	93	133	1	13.00			
Sandy	128	98	1	10.00			
Murray	132	94	1	9.00			
Salt Lake	150	76	5	38.00			
Kearns	152	74	2	15.00			
Bountiful	169	57	1	6.00			
Roosevelt	188	38	2	7.00			
Midvale	191	35	1	4.00			
Farmington	209	17	1	2.00			
Ogden	220	6	1	1.00			
Roy	226	0	1	0.00			
Mtn. Green	226	0	1	0.00			
Brigham City	87				0	58	0.00
			58	$687.00		58	0.00
Quality Rent (A-B) = $687.00							
Herd Unit 19 - Coalville							
Coalville	20	276	5	138.00			
Henefer	52	244	1	24.00			
Park City	70	226	1	23.00			
Kamas	90	206	11	227.00			
Salt Lake	102	194	25	485.00	13	82	107.00
Taylorsville	102	194	1	19.00			
Pleasant Grove	104	192	2	38.00			
Tooele	107	189	1	19.00			
Murray	112	184	4	74.00			
Ogden	115	181	9	163.00	0	24	0.00
Boutiful	121	175	3	53.00			
Riverdale	121	175	1	18.00			
Roy	121	175	5	88.00			
Midvale	122	174	2	35.00			
Provo	122	174	4	70.00			
Kearns	124	172	1	17.00			
Clearfield	127	169	9	135.00			
Riverton	132	164	3	49.00			
Farmington	133	163	1	16.00			
Clinton	139	157	1	16.00			
West Point	139	157	4	63.00			
Kaysville	146	150	4	60.00			
Layton	146	150	4	60.00			
Lehi	153	143	1	14.00			
Brigham City	157	139	1	14.00			
Sataquin	174	122	1	12.00			
Bear River	244	52	1	5.00			
Price	296	0	1				
			106	1,935.00		106	$107.00
Quality Rent (A-B) = $1,828.00							
Herd Unit 20 - Kamas							
Kamas	14	230	5	$115.00	93	10	$930.00
Heber City	61	183	4	73.00			
Midvale	87	157	2	31.00	20	38	76.00
Murray	101	143	5	72.00	0	48	0.00
Salt Lake	107	137	54	740.00			
Orem	112	132	3	40.00			
Provo	124	120	2	24.00			
Bountiful	127	117	5	59.00			
Riverton	137	107	3	32.00			
Magna	144	100	4	40.00			
Ogden Woo	156	88	3	26.00			
Woods Cross	160	84	2	17.00			
Roy	166	78	2	16.00			
Springdale	244	0	2	0.00			
			96	$1285.00		96	$1006.00
Quality Rent (A-B) = $279.00							

Table 14. Continued

		(A) Observed Activity			(B) Least Cost Activity		
Origin	Adjusted Miles (Round Trip)	Location Advantage (Miles)	# Trips	Total Rent/origin @$.10/mi.	Location Advantage (Miles)	# Trips	Location Rent/origin @.10/mi.
Herd Unit 21 - Heber							
Pleasant Grove	63	511	2	$102.00			
Orem	83	491	6	295.00			
Provo	95	479	9	431.00			
Murray	124	450	1	45.00			
Salt Lake	134	440	11	484.00			
Kearns	136	411	5	206.00			
Bountiful	139	435	1	44.00	0	2	0.00
Farmington	161	413	1	41.00			
Kaysville	177	397	2	79.00			
Ogden	204	370	1	37.00			
Sunset	205	369	1	37.00			
St. George	574	0	1	0.00			
Wallsburg	16				123	40	492.00
			42	$1839.00		42	$492.00
Quality Rent (A-B) = $1,347.00							
Herd Unit 22 - Lake Fork							
Arcadia	30	450	1	45.00			
Blue Bell	35	445	2	89.00			
Myton	40	440	1	44.00			
Neala	40	440	3	132.00			
Roosevelt	56	424	4	170.00			
Duchesne	106	374	3	112.00			
Vernal	116	364	2	73.00			
Mountain Home	140	340	1	34.00			
Kearns	263	217	1	22.00	0	48	0.00
Provo	304	176	1	18.00			
Midvale	321	159	2	32.00			
Murray	327	153	3	46.00			
Salt Lake	347	133	13	173.00			
Bountiful	350	130	1	13.00			
Riverton	368	112	2	22.00			
Clearfield	370	110	2	22.00			
Kaysville	390	90	1	9.00			
Tooele	409	71	1	7.00			
Price	416	64	1	6.00			
Woods Cross	420	60	1	6.00			
Newton	480	0	2	0.00			
			48	$1075.00		48	0.00
Quality Rent (A-B) = $1075.00							
Herd Unit 23-a - Aventoquin							
Duchesne	78	211	7	148.00			
Wellington	99	201	1	20.00			
Elmo	100	190	1	19.00			
Price	107	192	12	218.00			
Spanish Fork	115	174	2	35.00			
Springville	117	172	1	17.00	12	7	8.00
Payson	122	167	1	17.00			
Provo	129	160	2	32.00	0	52	0.00
Orem	139	150	4	60.00			
Heber City	140	149	1	15.00			
American Fork	145	144	1	14.00			
Salt Lake	219	70	13	91.00			
Kaysville	226	63	1	6.00			
Bountiful	238	51	3	15.00			
Magna	243	46	1	5.00			
Roy	244	45	1	5.00			
Pleasant Grove	255	34	5	17.00			
Farmington	288	1	1	0.00			
Ogden	289	0	1	0.00			
			59	$734.00		59	$8.00
Quality Rent (A-B) = $726.00							

Table 14. Continued

Origin	Adjusted Miles (Round Trip)	(A) Observed Activity: Location Advantage (Miles)	# Trips	Total Rent/origin @$.10/mi.	(B) Least Cost Activity: Location Advantage (Miles)	# Trips	Location Rent/origin @$.10/mi.
Herd Unit 23-b - Currant Creek							
Tabiona	20	287	1	29.00			
Duchesne	78	229	6	137.00			
Kamas	80	227	1	23.00			
Heber	101	206	2	41.00			
Price	139	168	1	17.00			
Orem	158	149	5	75.00			
Pleasant Grove	165	142	3	43.00			
Provo	165	142	4	57.00			
Salt Lake	167	140	56	784.00	0.00	117	0.00
Murray	173	134	5	67.00			
Lehi	173	134	1	13.00			
American Fork	173	134	1	13.00			
Springville	177	130	1	13.00			
Midvale	187	120	5	60.00			
Bountiful	187	120	5	60.00			
Spanish Fork	189	118	2	24.00			
Magna	189	118	2	24.00			
Kearns	193	114	5	57.00			
Copperton	202	105	1	11.00			
Kaysville	207	100	1	10.00			
Ogden	215	92	4	37.00			
Roy	227	80	1	8.00			
Woods Cross	238	69	2	14.00			
Brigham City	257	50	1	5.00			
Logan	307	0	1	0.00			
			117	$1622.00		117	0.00
Quality Rent (A-B) = $1622.00							
Herd Unit 24 - Blacks Fork							
SLC	243	114	3	$35.00			
Bountiful	262	95	1	10.00			
Provo	265	92	1	9.00	0	12	0.00
Ogden	265	92	3	28.00			
Roy	267	90	1	9.00			
Clearfield	283	74	2	15.00			
Logan	357	0	1	0.00			
			12	$105.00		12	$0.00
Quality Rent (A-B) = $105.00							
Herd Unit 25 - Dagget							
Vernal	159	451	1	45.00			
Dutch John	160	450	1	45.00	104	1	10.00
Manila	165	445	2	89.00	99	10	99.00
Magna	454	156	2	31.00			
Murray	492	118	2	24.00			
Salt Lake	503	107	18	193.00			
Kearns	507	103	3	31.00			
Bountiful	515	95	8	76.00			
Midvale	525	85	3	26.00			
Farmington	534	76	1	8.00			
Provo	535	75	1	8.00			
Clinton	551	59	1	6.00			
Kaysville	564	46	5	23.00			
Ogden	574	36	5	18.00			
Clearfield	580	30	1	3.00			
Brigham City	610	0	2	0.00			
Beaver	129				135	13	176.00
Neola	158				106	6	64.00
Blue Bell	199				65	3	20.00
Arcaidia	204				60	1	6.00
Myton	214				50	1	5.00
Duchesne	256				8	20	16.00
Tabiona	264				0	1	0.00
			56	$626.00		56	$396.00
Quality Rent (A-B) = $230.00							

Table 14. Continued

Origin	Adjusted Miles (Round Trip)	(A) Observed Activity: Location Advantage (Miles)	# Trips	Total Rent/origin @$.10/mi.	(B) Least Cost Activity: Location Advantage (Miles)	# Trips	Location Rent/origin @$.10/mi.
Herd Unit 26 - Ashley-Vernal							
Vernal	22	438	16	701.00	97	38	369.00
Jensen	48	412	1	41.00			
Neola	54	406	1	41.00			
Roosevelt	92	368	1	37.00			
Price	230	230	1	23.00			
Provo	340	120	3	36.00			
Salt Lake	382	78	11	96.00			
Farmington	385	75	1	8.00			
Sandy	404	56	1	6.00			
Bountiful	410	50	1	5.00			
Pleasant View	450	10	1	1.00			
Ogden	452	8	1	1.00			
Kaysville	460	0	1	0.00			
Duchesne	119				0	2	0.00
			40	$963.00		40	$369.00
Quality Rent (A-B) = $594.00							
Herd Unit 27-a - Minnie Muad							
Bluebell	20	380	1	38.00			
Duchesne	73	327	2	65.00			
Price	114	286	2	57.00	25	5	13.00
Castle Dale	114	286	2	57.00			
Orem	238	162	1	16.00			
Pleasant Grove	252	148	1	15.00			
Salt Lake	327	73	4	29.00			
Kaysville	338	62	1	6.00			
Magna	341	59	1	6.00			
Dugway	400	0	1	0			
Mtn. Home	98				41	1	4.00
Heber City	139				0	10	
			16	$289.00		16	$17.00
Quality Rent (A-B) = $272.00							
Herd Unit 27-b - Range Creek							
Dragerton	24	360	8	29.00	31	12	37.00
Wellington	50	334	1	33.00			
Price	55	329	6	20.00	0	18	0.00
Castle Dale	55	329	1	33.00			
Orem	227	157	1	16.00			
Pleasant Grove	239	145	1	15.00			
Hunter	262	35	1	4.00			
Copperton	262	35	1	4.00			
Salt Lake	297	87	6	52.00			
Tooele	384	0	4	0.00			
			30	$206.00		30	$37.00
Quality Rent (A-B) = $169.00							
Herd Unit 28-a - Book Cliffs North							
Roosevelt	58	497	1	50.00	252	9	227.00
Vernal	156	399	9	359.00			
Duchesne	206	349	4	140.00			
Provo	310	145	2	29.00	0	17	0.00
Murray	511	44	2	9.00			
Salt Lake	516	39	6	23.00			
Clinton	534	21	2	4.00			
Bountiful	555	0	1	0.00			
Jensen	35				275	1	28.00
			27	$605.00		27	$255.00
Quality Rent (A-B) = $350.00							

Table 14. Continued

Origin	Adjusted Miles (Round Trip)	(A) Observed Activity: Location Advantage (Miles)	(A) # Trips	(A) Total Rent/origin @$.10/mi.	(B) Least Cost Activity: Location Advantage (Miles)	(B) # Trips	(B) Location Rent/origin @.10/mi.
Herd Unit 28-b - Book Cliffs South							
Green River	114	563	1	56.00			
Orem	443	234	1	23.00			
Draper	487	190	1	19.00			
Tooele	503	174	1	17.00			
Salt Lake	522	155	4	62.00			
Hyrum	677	0	1	0.00			
Dragerton	160				28	3	8.00
Coalville	188				0	6	
			9	$172.00		9	$8.00
Quality Rent (A-B) = $169.00							
Herd Unit 29 - San Rafael							
Ftn. Green	237	0	3	0.00	0	3	0.00
Price	97						
			3	$0.00		3	$0.00
Quality Rent (A-B) = $0.00							
Herd Unit 30 - Lasal Mtn.							
Moab	87	540	27	1458.00	140	19	266.00
Monticello	180	447	2	89.00			
Green River	189	438	2	88.00			
Dragerton	308	319	4	128.00			
Salina	313	314	1	31.00			
Alpine	465	162	1	16.00			
Provo	467	160	1	16.00			
Riverton	521	106	1	11.00			
Midvale	534	93	1	9.00			
Salt Lake	556	71	9	64.00			
Park City	565	62	1	6.00			
Woods Cross	595	32	1	3.00			
Mtn. Green	617	10	1	1.00			
Kaysville	620	7	1	1.00			
Tooele	622	5	2	1.00			
Farmington	624	2	2	0.00			
Ogden	627	0	4	0.00			
Price	227				0	42	
			61	$1922.00		61	$266.00
Quality Rent (A-B) = $1656.00							
Herd Unit 31-a - San Juan-Blue Mtn.							
Monticello	52	728	13	946.00	107	17	182.00
Blanding	128	652	3	196.00			
Aneth	134	646	7	452.00	25	7	18.00
Moab	169	621	3	186.00	0	14	0.00
Green River	308	572	1	57.00			
Clinton	519	261	1	26.00			
Midvale	534	246	1	25.00			
Kearns	541	230	1	24.00			
Roy	600	180	1	18.00			
Salt Lake	630	150	5	75.00			
Bountiful	631	149	1	15.00			
Mendon	780	0	1	0.00			
			38	$2020.00		38	$200.00
Quality Rent (A-B) = $1820.00							

Table 14. Continued

Origin	Adjusted Miles (Round Trip)	(A) Observed Activity: Location Advantage (Miles)	# Trips	Total Rent/origin @$.10/mi.	(B) Least Cost Activity: Location Advantage (Miles)	# Trips	Location Rent/origin @$.10/mi.
Herd Unit 31-b - San Juan-Elk Ridge							
Monticello	132	578	2	116.00			
Aneth	162	548	1	55.00	64	1	6.00
Moab	241	469	2	94.00			
Salt Lake	710	0	1	0.00			
Blanding					138	3	41.00
Manksville	122				104	1	10.00
Greenville	226				0	1	0.00
			6	$365.00		6	$57.00
Quality Rent (A-B) = $208.00							
Herd Unit 32 - Price River							
Scofield	20	286	1	29.00	64	16	102.00
Price	50	256	12	307.00			
Spanish Fork	92	214	2	43.00	22	22	48.00
Springville	92	214	1	21.00			
Provo	104	202	3	61.00	0	0	0.00
Orem	114	192	1	19.00			
Pleasant Grove	124	182	2	16.00			
American Fork	132	174	2	35.00			
Riverton	158	148	1	15.00			
Sandy	182	124	1	12.00			
Heber	192	114	1	11.00			
Salt Lake	193	113	12	136.00			
Bountiful	207	99	2	20.00			
Kearns	238	68	3	20.00			
Tooele	259	47	1	5.00			
Ogden	263	43	1	4.00			
Brigham City	306	0	1	0.00			
			47	$754.00		47	$150.00
Quality Rent (A-B) = $604.00							
Herd Unit 33 - Gorden Creek							
Price	24	150	7	105.00	0	9	0.00
Orem	174	0	1	0.00			
Provo	174	0	1	0.00			
			9	$105.00		9	$0.00
Quality Rent (A-B) = $105.00							
Herd Unit 34 - Huntington							
Price	49	197	4	$79.00	0	21	0.00
Payson	130	116	1	12.00			
Provo	144	102	4	41.00			
Kearns	197	49	2	10.00			
Murray	223	23	1	2.00			
Salt Lake	227	19	9	15.00			
Bountiful	246	0	1	0.00			
			21	$159.00		21	0.00
Quality Rent (A-B) = $159.00							
Herd Unit 35 - Joe's Valley							
Castle Dale	20	312	1	31.00			
Wellington	52	280	1	28.00			
Price	170	162	2	32.00	214	4	86.00
Provo	177	155	2	31.00			
Orem	183	149	2	30.00			
Salt Lake	262	70	9	63.00			
Bountiful	266	66	2	13.00			
Ogden	332	0	1	0.00	0	15	0.00
Huntington	20				246	1	25.00
			20	$228.00		20	$111.00
Quality Rent (A-B) = $117.00							

Table 14. Continued

		(A) Observed Activity			(B) Least-Cost Activity		
Origin	Adjusted Miles (Round Trip)	Location Advantage (Miles)	# of Trips	Total Rent/Origin @ $.10/mi	Location Advantage (Miles)	# of Trips	Location Rent/origin @ $.10/mi
Herd Unit 36 - Muddy-Ferron							
Ferron	56	378	4	22.00			
Mt. Pleasant	130	314	1	31.00			
Price	140	294	1	29.00			
American Fork	214	220	3	66.00			
Sandy	259	175	1	18.00			
Bountiful	300	134	2	27.00			
Ogden	364	70	1	7.00			
Logan	434	0	1	0.00			
Castle Dale	35				52	12	62.00
Elmo	67				20	1	2.00
Scofield	87				0	1	0.00
			14	$200.00		14	$ 64.00
Quality Rent (A-B) = $136.00							
Herd Unit 37 - Lake Fork							
Helper	70	156	1	16.00			
Spanish Fork	90	136	7	95.00			
Springville	96	130	2	26.00			
Provo	102	124	14	174.00	0	57	0.00
Orem	114	112	10	112.00			
Pleasant Grove	122	104	5	52.00			
American Fork	130	96	1	10.00			
Salt Lake	191	35	12	42.00			
Midvale	202	24	1	2.00			
Granger	204	22	2	4.00			
Richfield	210	16	1	2.00			
Farmington	226	0	1	0.00			
			57	$535.00		57	$0.00
Quality Rent (A-B) = $535.00							
Herd Unit 38 - Fairview							
Fairview	20	223	2	45.00			
Mt. Pleasant	32	398	4	159.00			
Ephraim	64	366	4	146.00			
Springville	112	318	2	64.00			
Provo	118	312	4	125.00			
Lehi	148	282	1	28.00			
Midvale	191	239	1	24.00			
Kearns	206	224	1	22.00			
SLC	207	223	3	67.00			
Bountiful	233	197	1	20.00			
Cedar City	430	0	2				
Payson	52				20	16	32.00
Spanish Fork	72				0	19	0.00
			25	$700.00		25	$32.00
Qaulity Rent (A-B) = $668.00							
Herd Unit 39 - Ephraim							
Ephraim	14	243	2	$49.00			
Manti	20	337	1	34.00			
Fairview	54	303	1	30.00			
Mt. Pleasant	35	322	1	32.00			
Santaquin	132	225	1	23.00			
Provo	151	206	1	21.00			
Am. Fork	166	191	2	38.00			
Sandy	213	144	2	29.00			
SLC	243	114	14	160.00			
Bountiful	248	109	1	11.00			
Magna	263	94	1	9.00			
Kearns	265	92	1	9.00			
Clearfield	280	77	1	8.00			
Brigham City	357	0	1	0.00			
Alpine	115				15	7	11.00
Spanish Fork	120				10	20	20.00
Springville	130				0	3	0.00
			30	$453.00		30	$31.00
Quality Rent (A-B) = $422.00							

Table 14. Continued

Origin	Adjusted Miles (Round Trip)	(A) Observed Activity: Location Advantage (Miles)	# Trips	Total Rent/origin @$.10/mi.	(B) Least Cost Activity: Location Advantage (Miles)	# Trips	Location Rent/origin @$.10/mi.
Herd Unit 40 - Twelve Mile							
Salina	42	399	1	40.00			
Richfield	90	351	3	105.00			
Provo	201	240	4	96.00			
Orem	209	232	2	46.00			
Kamas	226	215	1	22.00			
Am. Fork	231	210	1	21.00			
Cedar City	234	207	2	41.00			
Sandy	259	182	3	55.00			
Murray	277	164	1	16.00			
SLC	281	160	10	16.00			
Bountiful	289	152	1	15.00	0	21	0.00
Park City	301	140	1	14.00			
Roosevelt	342	99	1	10.00			
Ogden	352	89	1	9.00			
Logan	441	0	1	0.00			
Ephraim	52				237	7	166.00
Mona	142				47	1	5.00
Spanish Fork	168				121	4	48.00
			31	$506.00		33	$219.00
Quality Rent (A-B) = $287.00							
Herd Unit 41 - Nebo Mtn.							
Santaquin	26	299	3	90.00	81	10	81.00
Payson	34	291	9	262.00			
Sp. Fork	53	272	10	272.00			
Nephi	56	269	3	81.00			
Pl. Grove	69	256	3	77.00	38	36	137.00
Springville	72	253	3	76.00			
Provo	76	249	12	299.00			
Orem	78	247	9	222.00	29	55	160.00
Am. Fork	98	227	3	68.00			
Moroni	102	223	1	22.00			
Centerfield	119	206	1	21.00			
Fariview	122	203	2	41.00			
Riverton	141	184	4	74.00			
Sandy	143	182	3	55.00			
Midvale	149	176	1	18.00			
Murray	144	170	1	17.00			
SLC	165	160	22	352.00			
Bountiful	181	144	2	29.00			
Woods Cross	184	141	3	42.00			
Kearns	187	138	3	41.00			
Clearfield	220	105	1	11.00			
Park City	221	104	2	21.00			
Farmington	224	101	1	10.00			
Ogden	235	90	1	9.00			
Brigham City	277	48	2	10.00			
Kaysville	325	0	3	0.00			
Draper	90				17	2	3.00
Copperton	107				0	5	0.00
			108	$2220.00		108	381.00
Quality Rent (A - B) = $1839.00							

Table 14. Continued

Origin	Adjusted Miles (Round Trip)	(A) Observed Activity: Location Advantage (Miles)	(A) Observed Activity: # Trips	(A) Observed Activity: Total Rent/origin @$.10/mi.	(B) Least Cost Activity: Location Advantage (Miles)	(B) Least Cost Activity: # Trips	(B) Least Cost Activity: Location Rent/origin @.10/mi.
Herd Unit 42 - South Nebo							
Wales	20	436	3	131.00			
Levon	25	431	1	43.00			
Ephraim	32	424	1	42.00			
Manti	40	416	2	83.00			
Nephi	56	400	7	280.00			
Fairview	74	382	1	38.00			
Centerfield	92	364	1	36.00			
Payson	104	352	1	35.00			
Santaquin	114	342	1	34.00			
Sp. Fork	122	334	3	100.00			
Provo	142	314	3	94.00			
Price	144	312	3	94.00			
Delta	150	306	1	31.00			
Orem	154	302	4	121.00			
Draper	184	272	1	27.00			
Riverton	185	271	2	54.00	0	32	0.00
Sandy	212	244	2	49.00			
Murray	222	234	3	70.00			
Midvale	223	233	2	47.00			
SLC	232	224	18	403.00			
Bountiful	248	208	4	83.00			
Kearns	254	202	6	121.00			
Park City	290	166	1	17.00			
Magna	298	158	1	16.00			
Brigham City	360	96	1	10.00			
Lewiston	420	36	1	4.00			
St. George	456	000	1	0.00			
American Fork	130				55	43	237.00
			75	$2063.00		75	$237.00
Quality Rent (A-B)= $1826.00							
Herd Unit 43 - Salina							
Salina	20	370	8	$296.00			
Aurora	20	370	1	37.00	212	1	21.00
Centerfield	30	360	2	72.00	202	14	283.00
Richfield	30	360	9	324.00	202	2	40.00
Bicknell	104	286	1	29.00			
Price	204	186	1	19.00			
Santaquin	207	183	1	18.00			
Wellington	214	176	1	18.00			
Orem	232	158	1	16.00	0	19	0.00
Provo	244	146	1	15.00			
Am Fork	274	116	1	12.00			
Sandy	292	98	5	49.00			
Riverton	309	81	2	16.00			
SLC	312	78	15	117.00			
Cedar City	326	64	1	6.00			
Bountiful	332	58	3	17.00			
Kearns	334	56	3	17.00			
Kaysville	356	34	2	7.00			
Clinton	372	18	2	4.00			
Roy	372	18	1	2.00			
Midvale	383	7	1	1.00			
Ogden	383	7	3	2.00			
St. George	390	0	1	0.00			
Axtell	20				212	15	318.00
Manti	52				180	4	72.00
Wales	87				145	4	58.00
Levon	87				145	1	15.00
Mount Pleasant	90				142	6	85.00
			66	$1094.00		66	$892.00
Quality Rent (A-B) = $202.00							

Table 14. Continued

Origin	Adjusted Miles (Round Trip)	(A) Observed Activity: Location Advantage (Miles)	(A) # Trips	(A) Total Rent/origin @$.10/mi.	(B) Least Cost Activity: Location Advantage (Miles)	(B) # Trips	(B) Location Rent/origin @$.10/mi.
Herd Unit 44 - Fish Lake							
Loa	20	432	3	130.00			
Fremont	20	432	1	43.00	305	2	61.00
Salina	74	378	3	113.00			
Richfield	116	336	3	111.00			
Panguitch	194	258	1	26.00			
Cedar City	324	128	1	13.00			
Roy	325	127	1	13.00	0	9	0.00
Delta	364	88	1	9.00			
W. Jordan	390	62	1	6.00			
SLC	404	48	3	14.00			
Mtn. Green	452	0	1	0.00			
Ogden	452	0	3	0.00			
Bicknell	20				305	2	61.00
Park City	174				151	9	136.00
			22	$478.00		22	$258.00
Quality Rent (A-B) = $220.00							
Herd Unit 45 - Last Chance							
Salina	73	355	2	71.00			
Provo	266	162	2	32.00			
Kearns	336	92	1	9.00			
Ogden	428	0	2	0.00			
Price	122				0	7	0.00
			7	$112.00		7	$0.00
Quality Rent (A-B) = $112.00							
Herd Unit 46 - 1000 Lakes							
Tremont	20	458	2	92.00			
Richfield	94	384	1	38.00			
Springville	348	130	1	13.00			
SLC	418	60	1	6.00			
Mtn. Green	452	26	1	3.00			
Kaysville	478	0	1	0.00			
Bicknell	20				0	7	0.00
			7	$152.00		7	$0.00
Quality Rent (A-B) = $152.00							
Herd Unit 48 - Monroe Mtn.							
Annabella	20	417	1	42.00			
Richfield	39	398	3	119.00	0	33	0.00
Koosharem	50	387	4	155.00			
Cedar City	203	234	1	23.00			
Orem	301	136	1	14.00			
Provo	309	128	13	166.00			
St. George	318	119	1	12.00			
Lehi	320	117	1	12.00			
Pl. Grove	333	104	1	10.00			
Murray	367	70	1	7.00			
Tooele	369	68	1	7.00			
SLC	374	63	2	13.00			
Centerville	396	41	1	4.00			
Bountiful	396	41	1	4.00			
Mtn. Green	437	0	1	0.00			
			33	$588.00		33	$0.00
Quality Rent (A-B) = $588.00							
Herd Unit 49 - Marysvale							
Richfield	79	356	11	392.00			
St. George	240	195	1	20.00			
Granger	429	6	1	1.00			
Sandy	435	0	1				
Annabella	52				313	1	31.00
Joseph	52				313	3	94.00
Bountiful	365				0	10	0.00
			14	$413.00		14	$125.00
Quality Rent (A-B) = $288.00							

Table 14. Continued

Origin	Adjusted Miles (Round Trip)	(A) Observed Activity: Location Advantage (Miles)	# Trips	Total Rent/origin @$.10/mi.	(B) Least Cost Activity: Location Advantage (Miles)	# Trips	Location Rent/origin @$.10/mi.
Herd Unit 50 - Antimony							
Kanarraville	159	379	1	38.00			
Cedar City	202	336	2	67.00			
St. George	302	236	1	24.00			
Manilla	340	198	6	119.00			
Orem	365	173	1	17.00			
Sandy	426	112	1	11.00			
Salt Lake	446	92	1	9.00			
Bountiful	468	70	1	7.00			
Ogden	538	0	1	0.00			
Richfield	87				0	15	0.00
			15	$292.00		15	0.00
Quality Rent (A-B) = $292.00							
Herd Unit 51-a - Boulder Mtn.							
Loa	134	478	4	$191.00			
Payson	333	279	1	28.00			
Sp. Fork	349	263	1	26.00			
Springville	353	259	1	26.00			
Orem	373	239	1	24.00			
Provo	381	231	2	46.00			
Am. Fork	393	219	1	22.00			
Copperton	429	183	1	18.00			
Mtn. Green	435	177	2	35.00			
SLC	452	160	2	32.00			
Logan	612	0	1	0.00			
Kooshorem	35				348	4	139.00
Ferron	122				261	4	104.00
Bountiful	383				0	9	0.00
			17	$484.00		17	$243.00
Quality Rent (A-B) = $205.00							
Herd Unit 51-b - Boulder Mtn. South							
Boulder	20	612	3	184.00	15	3	5.00
Panguitch	166	466	3	140.00			
Orem	414	218	1	22.00			
Sandy	612	20	1	2.00			
SLC	632	0	1	0.00			
Escalante	35				0	6	0.00
			9	$384.00		9	5.00
Quality Rent (A-B) = $379.00							
Herd Unit 52 - Henry Mtn.							
Hanksville	20	537	1	54.00			
Springville	460	97	1	10.00			
SLC	557	0	1				
Green River	122				0	3	0.00
			3	64.00		3	0.00
Quality Rent (A-B) = $64.00							

Table 14. Continued

Origin	Adjusted Miles (Round Trip)	(A) Observed Activity: Location Advantage (Miles)	(A) Observed Activity: # Trips	(A) Observed Activity: Total Rent/origin @$.10/mi.	(B) Least Cost Activity: Location Advantage (Miles)	(B) Least Cost Activity: # Trips	(B) Least Cost Activity: Location Rent/origin @$.10/mi.
Herd Unit 53 - Cak Creek							
Delta	65	310	11	341.00			
Nephi	82	293	1	29.00	147	13	191.00
Springville	192	183	1	18.00			
St. John	194	181	2	36.00			
Provo	196	179	2	36.00			
Orem	199	176	2	35.00	30	13	39.00
Pl. Grove	203	172	1	17.00			
Riverton	236	139	1	14.00			
Tooele	252	123	1	12.00			
Murray	262	113	1	11.00			
SLC	280	95	10	95.00			
Magna	288	87	1	9.00			
Bountiful	296	79	1	8.00			
Kearns	302	73	2	15.00			
Roy	375	0	1	0.00			
Dugway	229				0	12	0.00
			38	$676.00		38	$230.00
Quality Rent (A-B) = $446.00							
Herd Unit 54 - Fillmore							
Fillmore	70	228	2	46.00			
Santaquin	187	111	1	11.00			
Provo	201	97	1	10.00			
Orem	209	89	4	36.00			
Midvale	250	48	2	10.00			
Kearns	264	34	2	7.00			
SLC	281	17	4	7.00			
Tooele	298	0	1	0.00			
Bear River	193				96	6	58.00
Bountiful	289				0	11	0.00
			17	$127.00		17	$58.00
Quality Rent (A-B) = $69.00							
Herd Unit 55 - Kanosh							
Kanosh	25	577	1	58.00			
Fillmore	41	561	1	56.00	255	6	153.00
Richfield	88	514	4	206.00			
Joseph	118	484	3	145.00			
Panguitch	191	411	1	41.00			
Nephi	234	268	1	27.00			
Mona	242	360	1	36.00			
Am. Fork	283	319	1	32.00			
Bountiful	296	306	1	31.00	0	22	0.00
Ogden	318	284	1	28.00			
Midvale	324	278	1	28.00			
Riverton	328	274	1	27.00			
SLC	344	258	3	77.00			
Orem	361	241	2	48.00			
Kearns	366	236	2	47.00			
Clearfield	400	202	1	20.00			
Price	416	186	1	19.00			
Brigham City	452	150	1	15.00			
Park City	602	0	1	0.00			
			28	$941.00		28	$153.00
Quality Rent (A-B) = $788.00							
Herd Unit 56-a - North Beaver							
Greenville	20	488	5	$244.00			
Beaver	20	488	7	342.00	120	7	84.00
Cedar City	126	382	1	38.00			
St. George	248	260	1	26.00			
SLC	428	80	1	8.00			
Clinton	448	60	1	6.00			
Roy	508	0	1	0.00			
Fairview	139				1	6	1.00
Fountain Green	140				0	4	0.00
			17	644.00		17	$90.00
Quality Rent (A-B) = $574.00							

Table 14. Continued

Origin	Adjusted Miles (Round Trip)	(A) Observed Activity: Location Advantage (Miles)	# Trips	Total Rent/origin @$.10/mi.	(B) Least Cost Activity: Location Advantage (Miles)	# Trips	Location Rent/origin @$.10/mi.
Herd Unit 56-b - South Beaver							
Beaver	26	172	2	34.00	287	1	$29.00
Parowan	66	132	1	13.00			
Cedar City	106	92	10	92.00			
Fillmore	128	70	2	14.00			
Richfield	146	52	4	31.00			
St. George	198	0	1	0.00			
Greenville	20				293	7	205.00
Riverton	313				0	12	0.00
			20	$174.00		20	$234.00
Quality Rent (A-B) = $-60.00							
Herd Unit 56-c - Mineral Range							
Milford	28	428	10	428.00			
Beaver	80	376	9	338.00			
Greenville	86	370	2	74.00			
Parowan	140	316	1	32.00			
Richfield	158	298	2	60.00			
Delta	160	296	1	30.00	140	9	126.00
Fillmore	270	186	1	19.00			
Nephi	278	178	1	18.00			
St. George	202	164	1	16.00			
Tooele	356	100	1	10.00			
Salt Lake	456	0	1	0.00			
Milford	28				272	9	245.00
Orem	300				0	12	0.00
			30	$1025.00		30	$371.00
Quality Rent (A-B) = $654.00							
Herd Unit 57-a - Parowan-Cottonwood							
Panguitch	20	446	12	535.00	100	17	$170.00
Kanarraville	50	416	1	42.00			
Parowan	62	404	6	242.00			
Cedar City	100	366	7	256.00			
Midvale	445	20	1	2.00			
Kearns	459	7	1	. 1.00			
Salt Lake	166	0	1	0.00			
Kanab	70				50	9	45.00
Escalante	120				0	3	0.00
			29	$1078.00		29	$215.00
Quality Rent (A-B) = $863.00							
Herd Unit 57-b - Parowan-Main Canyon							
Parowan	20	512	10	512.00	53	10	53.00
Hatch	30	502	1	50.00			
Cedar City	73	459	12	551.00	0	20	0.00
Beaver	106	426	1	43.00			
Richfield	154	378	1	38.00			
St. George	180	352	1	35.00			
Provo	328	204	1	20.00			
Salt Lake	469	63	2	126.00			
Bountiful	532	0	1	0.00			
			30	$1375.00		30	$53.00
Quality Rent (A-B) = $1322.00							
Herd Unit 58 - West Zion							
Hurricane	38	604	4	242.00			
St. George	61	581	5	291.00	35	2	7.00
Kanarraville	68	574	2	115.00			
Cedar City	96	546	11	601.00	0	18	0.00
Parowan	134	508	1	51.00			
Salt Lake	623	19	2	4.00			
Bountiful	642	0	1	0.00			
Springdale	20				76	4	30.00
Beryl	87				11	2	2.00
			26	$1304.00		26	$39.00
Quality Rent (A-B) = $1,265.00							

Table 14. Continued

Origin	Adjusted Miles (Round Trip)	(A) Observed Activity: Location Advantage (Miles)	# Trips	Total Rent/origin @$.10/mi.	(B) Least Cost Activity: Location Advantage (Miles)	# Trips	Location Rent/origin @.10/mi.
Herd Unit 61-b - Dixie-West Pineview							
Modena	44	525	1	53.00	8	2	2.00
Cedar City	52	517	2	103.00	0	12	0.00
St. George	94	475	0	428.00			
Hurricane	126	443	1	44.00			
Kearns	569	0	1	0.00			
			14	$628.00		14	$2.00
Quality Rent (A-B) = $626.00							
Herd Unit 61-c - Dixie-Terry Ox View							
St. George	26	675	7	473.00			
Beryl	48	653	2	131.00			
Modena	54	647	1	65.00			
Ogden	701	0	1	0.00			
Clinton	229				0	11	0.00
			11	$669.00		11	$0.00
Quality Rent (A-B) = $669.00							
Herd Unit 62-a - West Desert							
Milford	452	0	8	0.00			
Kearns	52				23	7	16.00
Wendover	75				0	1	
			8	$0.00		8	$16.00
Quality Rent (A-B) = $-16.00							
Herd Unit 62-b - West Desert							
Delta	130	338	1	34.00	0	8	0.00
Milford	244	224	4	90.00			
Beaver	311	177	2	35.00			
Ogden	468	0	1	0.00			
			8	$159.00		8	0.00
Quality Rent (A-B) = $159.00							
Herd Unit 62-c - West Desert							
Tooele	365	207	2	41.00			
Alpine Salt	388	184	1	18.00			
Salt Lake	502	70	6	92.00			
Bountiful	522	50	2	10.00			
Clinton	567	5	1	1.00			
Ogden	572	0	1	0.00			
Milford	20				0	13	0.00
			13	$112.00		13	$0.00
Quality Rent (A-B) = $112.00							

Table 14. Continued

Origin	Adjusted Miles (Round Trip)	(A) Observed Activity: Location Advantage (Miles)	# Trips	Total Rent/origin @$.10/mi.	(B) Least Cost Activity: Location Advantage (Miles)	# Trips	Location Rent/origin @$.10/mi.
Herd Unit 59 - East Zion							
Orderville	20		1	2.00			
Springdale	70		4	28.00			
Cedar City	123		3	37.00			
Hurricane	148		1	15.00			
St. George	184		1	18.00			
Salt Lake	568	0	1	57.00			
Kanab	32				0	11	0.00
			11	$157.00		11	$0.00
Quality Rent (A-B) = $157.00							
Herd Unit 60-a - Paunsangant							
Orderville	44	481	3	144.00	0	5	
Santaquin	450	75	1	8.00			
Kearns	520	5	1	1.00			
Salt Lake	525	0	1	0.00			
Hatch	29				15	1	2.00
			6	$153.00		6	$2.00
Quality Rent (A-B) = $151.00							
Herd Unit 60-b - Kaiparowits							
Orderville	168	0	1	0.00			
Escalante	20				0	1	0.00
			1	$0.00		1	$0.00
Quality Rent (A-B) = $0.00							
Herd Unit 61-a - Dixie-East Pineview							
Hurricane	20	587	2	117.00	90	8	72.00
Cedar City	80	527	4	211.00	30	2	6.00
St. George	109	498	6	299.00			
Salt Lake	607	0	3	0.00			
Kanarraville	20				90	4	36.00
Kanosh	110				0	1	0.00
			15	$627.00		5	$114.00
Quality Rent (A-B) = $513.00							

Table 15. Data used in multiple regression analysis of site quality, 1970.

Herd Unit No.	Resident Hunters Afield Per Unit (Number)	Bucks Killed by Resident Hunters (Number)	Does Killed by Resident Hunters (Number)	Resident Hunter Success (Percent)	Non-Resident Hunters Afield (Number)	Bucks Killed by Non-Resident Hunters (Number)	Does Killed by Non-Resident Hunters (Number)	Non-Resident Hunter Success (Percent)	Length of the Hunting Season (Days)	Bucks Killed 2½ Years and Older (Percent)	Average Length of the Hunting Trip (Days)	Number of Trips Observed Per Site (Capacity) (Number)
1	4037	1503	824	.57	119	77	26	.85	10	.51	1.7	68
2	9342	2562	2029	.49	119	26	9	.28	20	.42	1.5	220
3	1548	570	263	.53	9		9	1.00	20	.54	1.4	39
4	1059	172	226	.37	9	0	0	.00	10	.39	1.5	22
5	2245	851	398	.55	26	17	0	.66	10	.37	1.9	33
6	4744	2281	1276	.75	60	51	9	1.00	15	.39	1.8	60
7	3250	842	489	.41	34	17	0	.50	10	.40	1.8	44
8	3042	1240	498	.57	43	34	0	.80	15	.39	1.6	73
9	2136	634	281	.42	9	0	0	.00	10	.26	1.3	70
10	3594	978	534	.42	34	9	9	.50	10	.35	1.5	73
11	3721	1557	45	.43	43	26	0	.60	10	.56	1.5	69
12	3603	1177	552	.48	26	9	0	.33	10	.42	1.6	80
13	2517	923	444	.54	51	26	9	.66	4	.43	1.6	45
14	1648	453	290	.45	17	9	8	1.00	4	.64	1.8	19
15	2191	588	299	.40	9	9	0	1.00	10	.41	1.7	34
17	2182	616	353	.44	34	0	9	.25	10	.36	1.7	32
18	3205	1295	489	.55	68	17	34	.75	10	.46	1.6	58
19	6808	2598	1240	.56	136	34	68	.75	10	.52	2.0	106
20	5703	1222	833	.36	51	26	0	.50	10	.56	2.2	96
21	3359	1132	435	.46	51	17	17	.66	10	.47	1.7	42
22	2779	815	362	.42	85	34	9	.50	10	.41	2.2	48
23a	2272	905	335	.54	102	68	17	.83	10	.50	2.1	59
23b	7722	2218	1295	.45	170	102	9	.65	10	.41	2.2	117
24	1177	281	163	.37	26	17	0	.66	10	.46	1.9	13
25	4391	1394	1032	.55	51	26	9	.66	10	.44	2.6	56
26	3141	1113	453	.49	119	34	34	.57	4	.42	2.0	40
27a	1113	416	253	.60	68	34	9	.62	10	.39	1.8	16
27b	2064	779	416	.57	383	272	68	.88	10	.60	1.9	30
28a	1684	688	326	.60	94	51	26	.81	4	.53	2.3	27
28b	335	163	54	.64	26	9	0	.33	4	.63	2.6	8
29	353	145	54	.56	0	0	0	.00	10	.50	1.5	3
30	3105	1358	697	.66	698	400	170	.81	15	.56	2.0	61
31a	2327	1141	362	.64	1805	920	528	.80	15	.55	2.3	38
31b	561	281	109	.69	902	494	247	.82	15	.51	1.7	6
32	2743	1141	425	.57	85	51	17	.80	10	.89	2.3	47
33	851	317	109	.50	43	26	9	.80	10	.53	1.0	9
34	1249	543	181	.58	26	9	9	.66	10	.55	2.1	21
35	1159	480	127	.52	94	43	9	.54	10	.53	2.6	20
36	769	326	136	.60	34	9	9	.50	10	.60	2.2	14
37	2164	869	371	.57	51	29	9	.66	10	.48	1.6	57
38	2489	960	308	.50	68	60	8	1.00	10	.62	2.0	35
39	1503	625	199	.54	68	43	0	.62	15	.44	1.9	30
40	2598	1159	516	.64	136	68	17	.62	15	.43	2.2	33
41	5558	2028	960	.53	102	34	34	.66	16	.56	1.7	108
42	3875	1439	824	.58	170	85	34	.70	10	.42	1.8	75
43	3693	1648	552	.59	885	451	281	.82	10	.58	2.2	66
44	1457	625	145	.52	264	94	94	.71	10	.73	1.7	22
45	453	199	118	.70	85	68	17	1.00	10	.60	1.7	7
46	235	154	36	.80	43	34	9	1.00	10	.30	1.7	7
48	2544	1041	398	.56	1481	570	553	.75	10	.47	1.8	33
49	516	190	72	.50	587	272	170	.75	10	.74	1.4	14
50	661	335	100	.65	400	179	77	.63	10	.60	1.7	15
51a	951	435	91	.55	341	187	111	.87	10	.51	2.0	17
51b	597	281	54	.56	434	196	128	.74	10	.50	1.7	9
52	263	91	45	.51	26	17	9	1.00	4	.55	2.7	3
53	1829	1195	18	.66	170	77	9	.50	10	.55	1.9	38
54	1720	779	226	.58	324	153	85	.73	10	.59	2.6	17
55	2580	1358	190	.60	1447	749	434	.81	10	.60	2.1	28
56a	883	344	54	.47	1022	358	307	.65	10	.62	1.5	17
56b	308	127	18	.47	417	187	179	.87	10	.59	1.4	10
56c	1123	516	91	.54	639	315	153	.73	10	.72	1.9	30
57a	1032	425	100	.50	911	366	247	.67	10	.59	2.0	29
57b	1584	597	154	.47	673	264	187	.67	10	.52	1.7	30
58	1331	670	136	.60	417	196	111	.73	10	.39	2.3	26
59	706	299	109	.57	392	179	85	.67	10	.47	1.8	11
60a	797	335	136	.59	349	179	77	.73	10	.43	1.7	6
60b	127	54	27	.64	17	0	0	.00	10	.62	1.0	1
61a	1023	489	91	.56	613	213	196	.66	10	.59	1.6	15
61b	1123	607	0	.54	324	153	9	.50	10	.70	1.7	14
61c	534	208	0	.39	179	111	0	.61	10	.60	1.7	11
62a			18									
62b			9									
62c	525	281	72	.47	204	43	43	.83	10	.44	1.8	13

Table 15. Continued

Herd Unit No.	Summer Range (Sq. Mi.)	Winter Range (Sq. Mi.)	Summer USFS BLM (Percent)	Summer Private (Percent)	Summer State (Percent)	Winter Fish and Game (Percent)	Winter Public USFS BLM (Percent)	Winter Private (Percent)	Winter State (Percent)
1	692	395	.45	.49	.06	.00	.32	.62	.06
2	726	192	.80	.20	.00	.00	.30	.60	.10
3	148	36	.30	.60	.10	.00	.10	.40	.50
4	68	16	1.00	.00	.00	.00	.80	.20	.00
5	309	224	.60	.40	.00	.00	.60	.40	.00
6	406	79	.05	.95	.00	.00	.00	.95	.05
7	229	49	.15	.80	.05	.00	.05	.90	.05
8	303	25	.05	.90	.05	.00	.00	.95	.05
9	72	19	1.00	.00	.00	.00	.70	.30	.00
10	166	44	.50	.30	.20	.00	.39	.39	.22
11	141	60	.00	1.00	.00	.00	.10	.90	.00
12	84	112	.85	.15	.00	.00	.85	.15	.00
13	191	86	.95	.05	.00	.00	.85	.15	.00
14	144	732	.58	.48	.02	.00	.65	.25	.10
15	244	52	.90	.10	.00	.00	.40	.52	.08
17	120	35	.90	.10	.00	.00	.65	.25	.06
18	136	94	.90	.05	.05	.00	.78	.19	.03
19	372	193	.05	.95	.00	.01	.00	.99	.00
20	440	21	.80	.10	.10	.00	.40	.53	.07
21	200	58	.40	.50	.10	.00	.11	.64	.25
22	454	338	.80	.03	.02	.00	.16	.20	.00
23a	452	246	.75	.15	.10	.07	.18	.35	.00
23b	817	507	.70	.20	.00	.00	.01	.71	.00
24	524		.75	.23	.02	.00			
25	526	577	.90	.10	.00	.00	.58	.12	.06
26	924	395	.80	.20	.00	.01	.63	.27	.08
27a	305	361	.75	.05	.05	.00	.59	.16	.04
27b	345	896	.15	.75	.10	.00	.76	.16	.08
28a	701	680	.60	.18	.12	.00	.77	.13	.10
28b	278	712	.85	.05	.10	.00	.82	.03	.15
29	203	2511	.90	.05	.05	.00	.90	.05	.05
30	187	851	.64	.11	.25	.00	.79	.08	.13
31a	153	1394	.98	.92	.99	.09	.60	.33	.07
31b	194	1132	1.00	.00	.00	.00	.82	.08	.10
32	583	92	.23	.75	.02	.00	.29	.64	.07
33	120	138	.70	.30	.00	.00	.65	.20	.15
34	110	34	.80	.20	.00	.00	.76	.11	.13
35	186	135	.95	.03	.02	.00	.91	.05	.04
36	120	137	1.00	.00	.00	.00	.96	.02	.02
37	170	53	1.00	.00	.00	.00	.22	.78	.00
38	104	75	.50	.50	.00	.00	.04	.96	.00
39	65	58	.80	.20	.00	.00	.16	.80	.04
40	122	69	.97	.03	.00	.00	.40	.34	.26
41	205	245	.85	.10	.05	.00	.29	.64	.07
42	164	223	.80	.20	.00	.00	.47	.43	.10
43	360	269	.85	.00	.15	.00	.77	.17	.01
44	115	76	.85	.10	.05	.00	.94	.01	.05
45	90	167	1.00	.00	.00	.00	.86	.08	.06
46	190	141	.95	.00	.05	.00	.73	.23	.04
48	270	228	.95	.00	.05	.00	.86	.04	.10
49	149	103	1.00	.00	.00	.00	.95	.02	.03
50	224	228	1.00	.00	.00	.00	.94	.01	.05
51a	475	374	1.00	.00	.00	.00	.90	.07	.03
51b	700	1026	1.00	.00	.00	.00	.91	.02	.07
52	23	257	.80	.04	.16	.00	.83	.02	.15
53	126	134	1.00	.00	.00	.00	.90	.10	.00
54	202	180	1.00	.00	.00	.00	.60	.30	.10
55	420	384	1.00	.00	.00	.00	.90	.05	.05
56a	118	102	1.00	.00	.00	.00	.80	.10	.10
56b	97	450	1.00	.00	.00	.00	.75	.15	.10
56c	96	1390	.90	.03	.07	.00	.72	.20	.08
57a	92	169	.99	.00	.01	.00	.90	.06	.04
57b	355	85	.89	.10	.01	.00	.65	.28	.00
58	242	334	.03	.95	.02	.00	.32	.61	.07
59	225	566	.49	.45	.06	.00	.62	.30	.08
60a	414	686	.80	.20	.00	.00	.85	.06	.09
60b	200	750	.85	.15	.00	.00	.92	.08	.00
61a	76	175	.98	.01	.01	.00	.77	.18	.05
61b	116	395	.94	.06	.00	.01	.87	.10	.03
61c	225	387	.96	.02	.02	.01	.88	.08	.03
62a									
62b									
62c	263	263	.81	.10	.09	.00	.81	.10	.09