An economic analysis of resident firearms deer hunting in Arizona

AN ECONOMIC ANALYSIS OF RESIDENT FIREARMS DEER HUNTING IN ARIZONA

by

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ABSTRACT

This study estimates the value of the resident firearms deer hunting resource in Arizona. The resource is evaluated by both the consumers' surplus and nondiscriminating monopolist methods. This study and the analysis are a distinct departure from the gross expenditures method of analysis. The primary objective was to obtain values for the resource by using secondary data collected by the Arizona Game and Fish Department in a theoretical framework which is consistent with current economic thought.

Demand analysis was applied to the data in order to accomplish the specified objectives. The end result of the analysis is values for this particular type of resource use in Arizona. The empirical investigation and end results did in fact substantiate the premise that the secondary data are sufficient to evaluate the deer hunting resource in Arizona by accepted economic methods.

CHAPTER 1

THE PROBLEM

Introduction

Total participation in outdoor recreation has been growing significantly in the past and will continue to grow in the future. The Bureau of Outdoor Recreation (U. S. Dept. of Interior, 1967) predicts that participation will increase 160 percent between the years 1965 and 2000. This projected increase in demand is attributed to increases in population, incomes, leisure time, consumer mobility, and possibly to changes in tastes and preferences. The impact of the projected change in demand has far-reaching effects on future natural resources planning.

Increases in population, productivity, and affluence have also caused natural resources to be used at rapid rates. Concern stems from the belief that natural resources have a finite supply. Thus, it would be appropriate to examine the natural resource problem so as to be able to allocate resources in a manner which would be most efficient in the long run. Emphasis should be placed on all types of natural resource studies in order to make decisions which could fulfill society's goals concerning the quality of life and natural resource development.

Since outdoor recreation is land and water based, other interests such as farming, ranching, timber, and mining compete for areas that make suitable recreation sites. Economic values for these alternative uses are rather easily determined by observing the prices of their

products as they are sold in the market. However, outdoor recreation is rarely sold in a competitive market. Thus, studies should be attempted to determine economic prices for recreation that can be compared to the prices of the alternative products of the natural resources if an efficient allocation of the resources among the competing uses is to be made.

Hunting and fishing are subsets of outdoor recreation for which participation rates have been changing. For example, in the period from 1960 to 1965, participation in hunting and fishing for Arizona residents rose 50 percent (Davis, 1967). During this time period, participation in deer hunting has also been changing. The purpose of this study is to examine the changes in participation of deer hunting in Arizona over the period 1960 to 1970 and to determine the resource values in use for deer hunting in the state.

Economic Research on Outdoor Recreation

It has been felt that outdoor recreation did not have the necessary characteristics of a normal economic commodity. The prominence of aesthetics, lack of data, and the absence of a conventional market have impeded the use of economic concepts for analysis. There are, however, traits of outdoor recreation that lend themselves to formal economic analysis. The most prominent trait is that recreation satisfies a particular type of consumer want, a characteristic similar to that of other marketed commodities. Also, the quantity of recreation consumed is a decision made by the individual and is a function of basically the same factors that determine the consumptive patterns of other economic goods.

Recreation based resources are also characterized by a scarcity of supply which is typical of other goods. As mentioned earlier, there is definite competition for desirable recreation sites. Since competition implies scarcity, it can be reasoned that there is an associated economic value.

Outdoor recreation in any form is a product of the natural environment. This does not imply that it is not managed by man. However, it is an activity which is consumed directly by the individual doing the recreating. In this context, outdoor recreation is both produced and consumed at the same point in time. The nature of the product is further characterized by the presence of intangibles. These intangibles are difficult to describe and quantify into meaningful economic terminology. However, they are an integral part of the whole recreation experience and must be included in the quantification process.

The prominence of aesthetics was once felt to be a problem peculiar to economic studies of outdoor recreation. However, other commodities have aesthetic qualities attached to them. For example, an athletic event is a commodity which is a total aesthetic experience. The basic difference between the athletic event and outdoor recreation is that the athletic event has a set price that must be paid before participation will occur. Therefore, the problem in economic studies of outdoor recreation research is not the inability to quantify aesthetics but rather the absence of a conventional market place.

Classification of Recreation Areas

In understanding the nature of the product, a classification scheme presented by Clawson and Knetsch (1966) can be applied to forms of outdoor recreation. The classification of the type of resource is an important consideration for demand analysis. The visitation to the area is similar to the purchase of any other consumer good. In the case of the normal consumer good, the individual consumer can differentiate between types and quantities of various commodities. The consumers of outdoor recreation are faced with the same decisions that are faced by consumers of marketed goods. Potential recreators must choose between competitive types of recreation such as skiing or hunting, or they can consider a complementary recreation experience that might include camping, fishing, and water skiing in a single trip.

Clawson and Knetsch (1966) classify the areas of outdoor recreation into three basic types. These types are user oriented, resource based, and intermediate. These types are differentiated on the basis of general location, activity, when use occurs, size of the area, and the agency of responsibility. This study assumes that the resource, an area suitable for deer hunting, is what motivates hunters to participate in this form of recreation. In the Clawson and Knetsch classification scheme, deer hunting in Arizona would be classified as resource based with the following characteristics:

1. General location could be several hundred miles from origin but always within the state;
2. Major activity is deer hunting;

3. Major use occurs during a specified season;
4. Size of area is thousands of acres; and
5. The agency of responsibility is the Arizona Game and Fish Department.

Classification of outdoor recreation types allows the researcher to differentiate between the types of recreation consumed. Since the single activity of deer hunting can be isolated, economic studies of that activity are possible. Demand studies can be made and these studies become important considerations for understanding the economic implications of deer hunting to the State of Arizona.

Objectives of This Study

The basic question to be answered in this thesis is; what is the value of deer hunting as a natural resource to the State of Arizona? The specific objectives of this study are to:

1. Derive demand estimates for deer hunting for each Arizona Game and Fish Department Game Management unit for each of the years 1960, 1965, and 1970;
2. Aggregate the estimates derived in objective (1) into regional and statewide demand estimates;
3. Examine shifts in demand from 1960 to 1965 and from 1965 to 1970;
4. Determine the value of deer hunting in areas, regions, and the state by the consumers' surplus and nondiscriminating monopolists methods for each of the three base years; and
5. Draw implications from the results of the study.

Known economic concepts and appropriate statistical methods will be used in order to attain these objectives. The economic concepts, pertinent literature, and statistical procedures will be discussed in the following chapters.

CHAPTER 2

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

Demand

In general, a demand curve for a specific commodity relates the alternative quantities that would be purchased at alternative market prices for that commodity at a given point in time. The basic principle behind demand is that the quantity demanded varies inversely with the price. For example, at a high price, a relatively small quantity will be demanded. At a lower price, more of the commodity will be taken. A typical linear demand curve would look as shown in Figure 1.

If all other things are held constant, a change in price for commodity "A" would cause a change in the quantity of commodity "A" demanded as described by the demand curve in Figure 1. Changes in the factors other than the price of the commodity in question may cause a complete shift in the demand curve either to the right or left of the current demand curve. A shift to the right of the current position of the demand curve would indicate an increase in demand; a shift to the left would indicate a decrease in demand. Economic theory tells us that demand shifters are changes in income, population, the prices of other competing or complementary commodities, and consumer tastes and preferences.

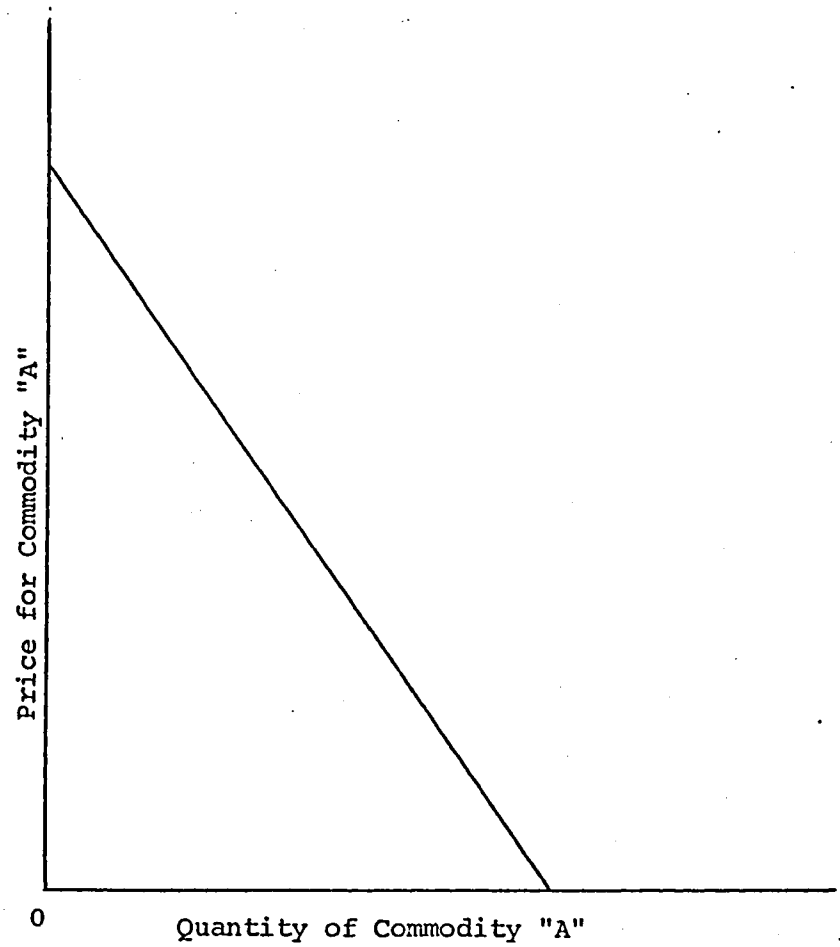

Figure 1. Typical Linear Demand Curve (Hypothetical)

Elements of Recreation Demand

Recreation demand is simply a modification of conventional consumer demand. The basic notion of the relationship between price and quantity remains unchanged. Clawson, in Clawson and Knetsch (1966), defines the demand for recreation as a schedule of volume in relation to a price.

For recreation demand, the quantity variable or volume is usually in terms of use. The use of recreation areas can be measured by such things as visits, trips, or user days. The concept of the use of a recreation site is only part of what Clawson calls the whole recreation experience. The whole experience includes anticipation and preparation for the trip, travel to the site, the actual on-site experience, travel back from the site, and recollection of the experience. Clawson maintains that all five phases are present in every major outdoor recreation activity. Furthermore, Clawson says that one part cannot be separated from the others and that as economists, we measure what people do in terms of the total recreation experience consumed and costs involved.

The major difference between the demand for recreation and ordinary consumer demand is that of defining prices. In the conventional type of demand, the price of the commodity is established by a functioning market mechanism wherein the equilibrium price occurs at the point where supply is equated with demand. In contrast, most forms of outdoor recreation have no conventional market mechanism. Alternative quantities of recreation are not offered for sale at alternative prices. Consumer prices are either totally absent or set by administrative fiat.

Wennergren (1967) further explored the early work by Clawson by closely examining the problem of pricing outdoor recreation. Wennergren establishes the fact that outdoor recreation is not a free good. He further asserts that there are certain time and money costs which regulate the consumption of outdoor recreation. These money costs can be used as surrogate or substitute prices.

The premise behind the use of a surrogate price relates to an accepted economic concept. Consumers of any economic good must receive utility from that good at least equal to the cost paid. Hence, the use of costs as a surrogate price is justified.

A problem arises in determining which costs are to be included as the surrogate price. There are two cost-related decisions that a potential recreator must face. First, there is the long run decision to participate in some form of outdoor recreation. This would necessitate the decision to purchase items of a fixed nature including such items as camping equipment, a recreation vehicle, and other special sporting equipment. These expenditures on items, which may be used for more than one trip and in more than one time period, are traditionally called fixed costs. Once these costs have been incurred, they are not affected by the decision to actually participate in a particular recreation activity. Because they are unaffected by a short-run participation decision, they, in turn, do not themselves affect the short-run decision.

The second decision that the individual must face is of a short-run nature. Here, within a given period of time, the individual must decide what form of recreation he will participate in and at what site.

In this case, the important considerations are time, travel costs, and any additional on-site costs. The travel costs and any additional expenditures are called variable costs (the costs affected by the short-run decision to recreate) and are the pertinent costs for the surrogate price.

Wennergren believes that the use of variable costs as the surrogate price is analogous to the short-run decisions made under the theory of the firm. This theory shows that in the short-run, the marginal costs are a function only of the variable costs and that the marginal costs are the decision variables. The decision of how much to produce is not affected by the fixed costs. This means that variable costs only are the pertinent costs in estimating the demand for recreation.

In the process of relating variable costs to a schedule of volume, a demand curve can be formulated. Hotelling (1949), one of the pioneers in demand studies for outdoor recreation, defined concentric zones around a recreation site such that the costs of travel from each zone to the site are equal. These costs, related to the number of visitors, could then be used to estimate points on a demand curve.

Clawson and Knetsch (1966) use Hotelling's concept in developing the demand for any outdoor recreation experience. The authors state that the estimation of demand must proceed in two steps. We first must estimate statistical demand curves for the total recreation experience from which the demand curve for the recreation resource itself can be derived.

Clawson and Knetsch define the demand for the total recreation experience as the functional relationship between costs per visit and the number of visits per capita from the area of origin. In their analysis, population, income, facilities of transportation, distribution of recreation areas, and tastes and preferences are assumed to be constant.

The items needed in order to derive the demand for the whole recreation experience for a hypothetical example are listed in Table 1. The costs from a particular zone to the recreation area are assumed to be the same for every visitor within the zone. The number of visits is put on the basis of per 1,000 population from the zone of origin. This is done in order to remove the differences in population from one zone to another. By plotting costs from column (4) against the corresponding number of visits per thousand population in column (5), a demand curve for the total recreation experience can be determined. This curve is shown in Figure 2.

Table 1. Prices and Quantities for Statistical Demand (Hypothetical)

	(2)	(3)	(4)	(5)
Zone	Population of Zone	Cost from Zone to Recreation Area	No. of Visits	Visits/ 1000 Pop.
1	1,000	$1.00	500	500/1000
2	4,000	3.00	1,200	300/1000
3	10,000	5.00	1,000	100/1000
			2,700	

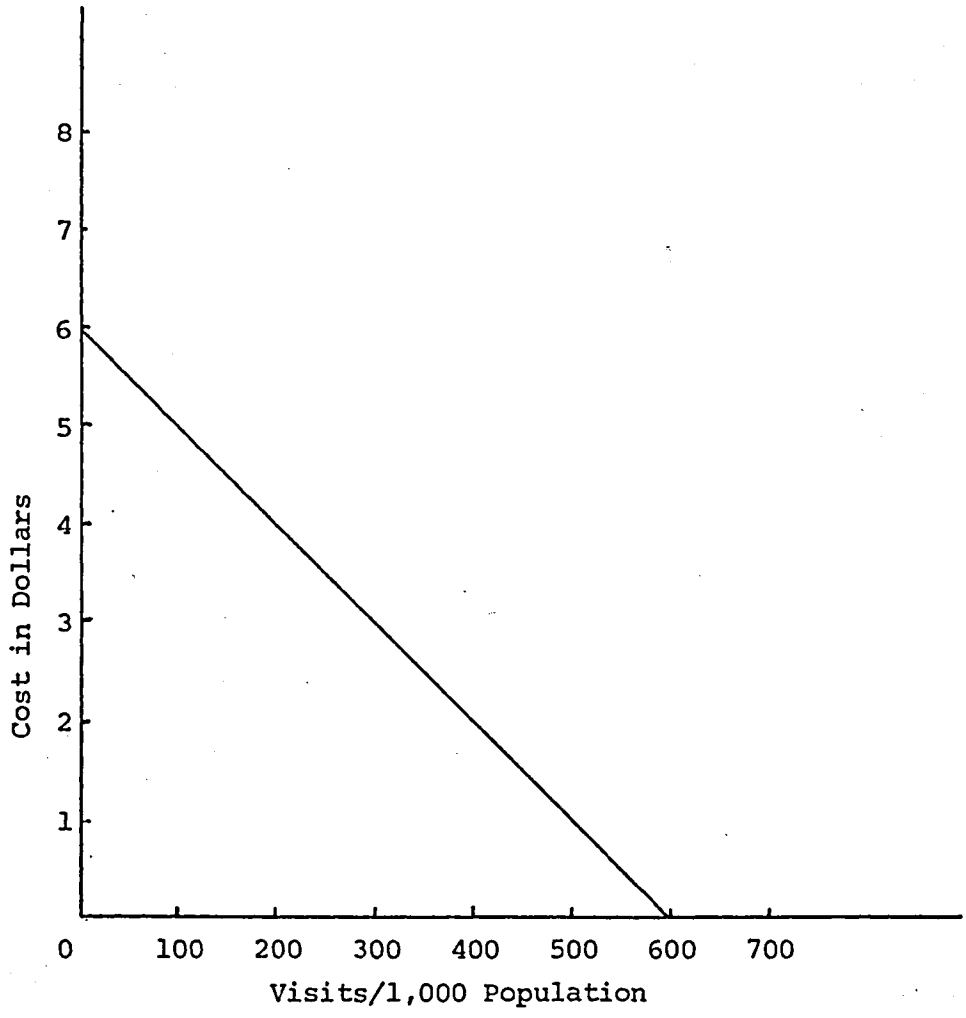

Figure 2. Demand Curve for the Total Recreation Experience (Hypothetical)

The second step in the analysis is that of developing a demand curve for the resource site itself. This demand curve is derived from the demand curve for the recreation experience based on the assumption that the resource users would react to changes in costs at the site in the same manner to which they react to costs for the recreation experience as a whole. In developing the demand curve for the resource, the total projected number of visits is calculated at each posited increased interval of cost. The resulting demand curve is in terms of added costs and total quantities of visitation.

The following example will clarify the notion of developing the demand curve for the resource. For example, let the total quantity of visits at the existing prices equal 2,700. By adding increments of one dollar to each original price, the corresponding quantity of visits can be determined. The quantities for each zone at each level of added costs are summed up to the total number of visits as shown in Table 2. The points of added cost and total visits as shown in Figure 3, are points on the demand curve for the resource itself. It is this demand curve for the resource that is important in evaluating the resource. Estimates of value may be made by both the consumers' surplus and non-discriminating monopolistic methods as described below.

Consumers' Surplus

Alfred Marshall (1947) is credited with the development of the concept of consumers' surplus in economic theory. Simply defined, consumers' surplus measures the surplus satisfaction that a consumer receives from a commodity above the price that he actually paid for that

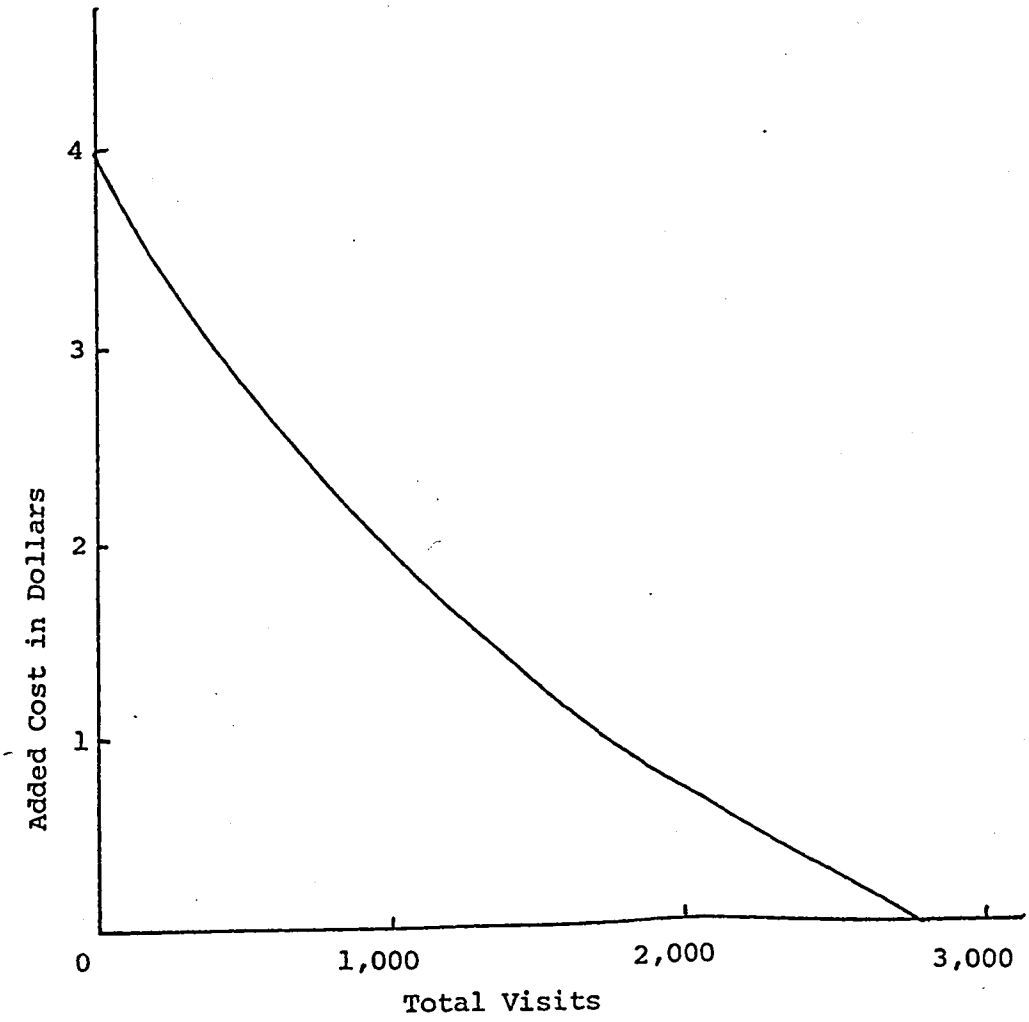

Figure 3. Demand Curve for the Resource (Hypothetical)

commodity. In Marshall's analysis, it is assumed that the marginal utility for money is constant. This is done so that the price of the commodity can be used as a measure of utility. The central idea behind consumers' surplus is that the consumer has in his mind a price that he would be willing to pay rather than to go without a certain commodity. The price that the person is willing to pay is usually greater than the price he does pay. Since price is a measure of utility, the difference in price that the individual is willing to pay and the price that he does pay is a measure of surplus satisfaction.

Table 2. Values for Total Quantity of Visits and Added Costs (Hypothetical)

	Number of Visits at Added Cost Per Unit					
Zone	0	$1.00	$2.00	$3.00	$4.00	$5.00
1	500	400	300	200	100	0
2	1,200	800	400	0	0	0
3	1,000	0	0	0	0	0
Total Visits	2,700	1,200	700	200	100	0

Mathematically, consumers' surplus can be determined by finding the integral of the demand curve and subtracting out the amount of satisfaction that is received at the actual price paid. Given the demand curve in Figure 4 and a price paid and quantity taken of Po and Qo respectively, the consumers' surplus value can be determined by the following formula:

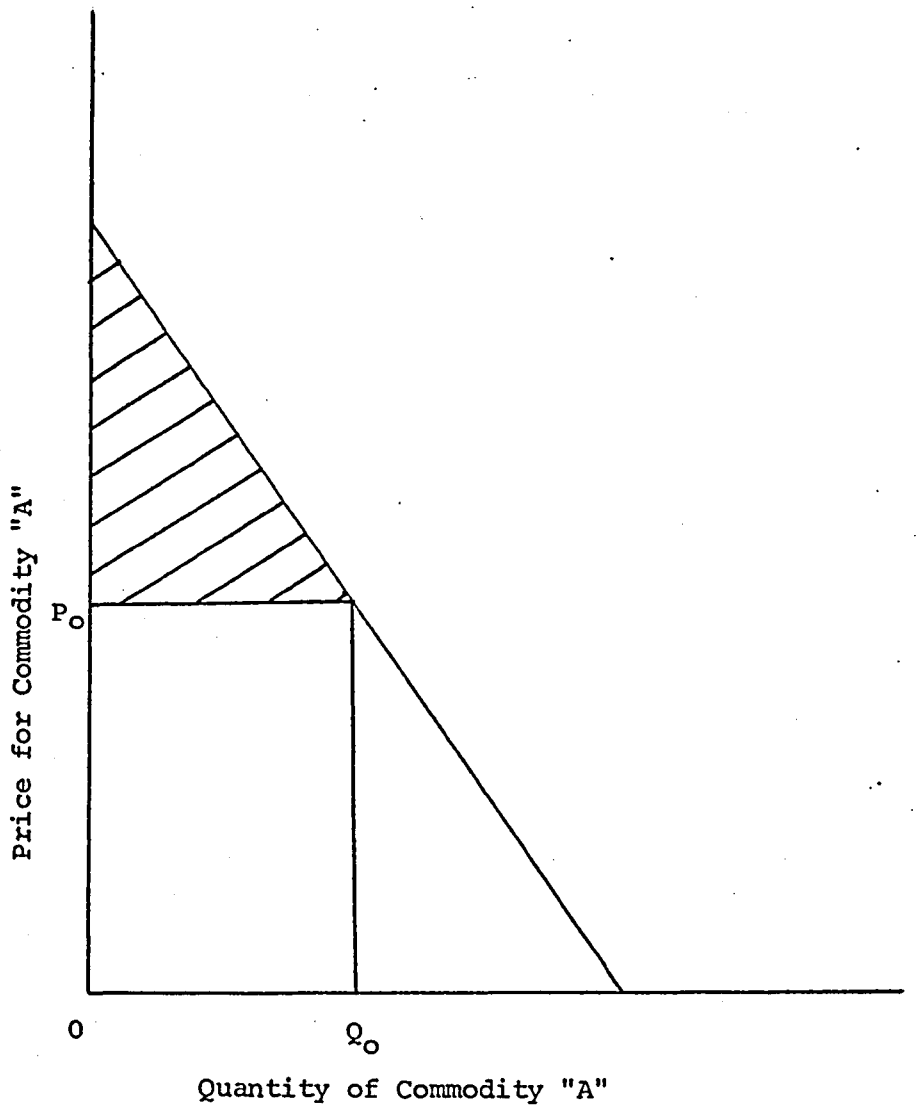

Figure 4. Relationship of Consumers' Surplus to Demand

$$\int_{o}^{Qo} f(Q)\,dQ - (Po)(Qo) = \text{Consumers' Surplus}$$

The consumers' surplus value corresponds to the shaded portion under the demand curve in Figure 4.

In recreation demand, consumers' surplus is a form of net evaluation for the resource involved. Justification for use of net surplus is the fact that it measures the value of the resource to the consumer over and above the price at acquisition. This then represents the value which is generated by the resource. For this study, the consumers' surplus will be determined by taking the integral of the demand curve for the resource. Since price is in terms of added cost and quantity is in terms of total participation, the total area under the curve represents the net surplus value of the resource.

Nondiscriminating Monopolist Value

The other method used for determining resource values for outdoor recreation is the nondiscriminating monopolist method. This model assumes the existence of a single monopolistic owner of the resource. The rational monopolistic owner would want to maximize the total revenue from the resource by charging a single price for the good since he cannot discriminate between consumers relative to the price he charges. The price that he would charge in order to maximize total revenue corresponds to the point of unitary elasticity on the demand curve. Unitary elasticity simply defines the point where price times quantity is maximized. Figure 5 shows the relationship between demand (D), marginal revenue (MR), and maximum total revenue (TR).

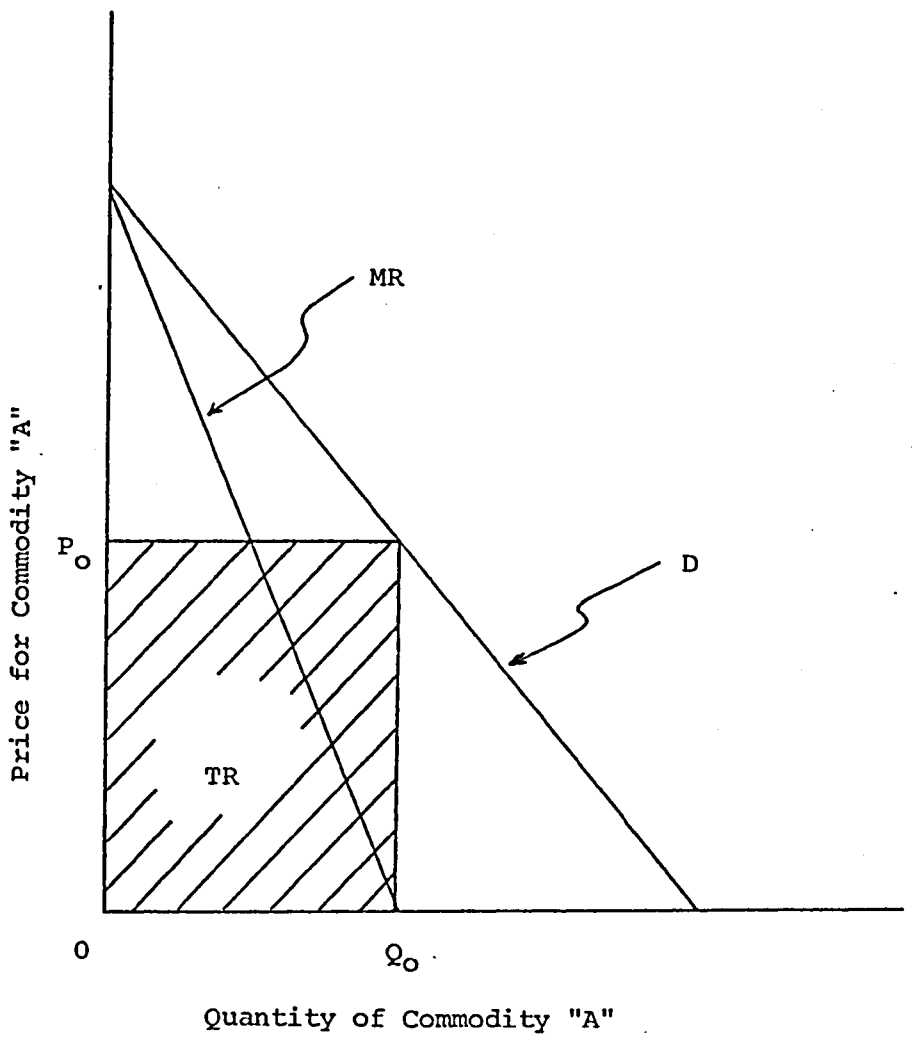

Figure 5. Relationship Between Demand, Marginal Revenue, and Total Revenue

The nondiscriminating monopolist value could also be determined by multiplying price times the corresponding quantity at various points along the demand curve. The point, where total revenue (price times quantity) is at a maximum, corresponds to the point where the nondiscriminating monopolist would operate.

This method also provides an important value estimate for resource planning. It defines a portion of consumers' surplus that could be extracted by an all powerful monopolist charging a single price. By using this method, the value of the resource would be the maximum net revenue that could accrue to an agency by charging a given fee.

Past Economic Studies on Outdoor Recreation

Brown, Singh, and Castle

A pioneering study in the field of recreation economics was the Oregon salmon and steelhead study by Brown, Singh, and Castle (1964). The authors used a sophisticated sampling technique whereby the questionnaires were sent to the various types of license holders at different times of the year. In the questionnaires, a careful distinction was made between fixed and variable expenditures. The variable expenditures were defined to be expenditures which were associated with fishing trips taken during a month. These expenses included transportation costs, food, lodging, charter boats, and guides. The authors stated that these were the important costs associated with the anglers monthly fishing trips.

The authors then developed a Clawson type demand curve for the fishing experience which related variable costs to days spent fishing. Estimation of the demand of the fishery resource itself was formulated by projecting the anglers' reaction to increased costs as described above. The new demand curve was in terms of added costs per angler day and total number of salmon-steelhead days. It was from this curve that an estimation of the net economic value was developed using the nondiscriminating monopolist method.

Wennergren

Wennergren's demand study for deer hunting in Utah (1965) was similar to the Oregon salmon-steelhead study. Wennergren related variable costs to the quantity of recreation consumed in terms of trips to a hunting area. The author developed the individual's demand curve on the basis that the rational hunter would take as many trips to a hunting area as are necessary to equate the variable expenses (marginal costs) to the marginal utility he derives from the recreation experience.

The author also developed a demand curve for the hunting area in terms of added costs and total calculated number of trips. Both the nondiscriminating monopolist value and the consumers' surplus value were estimated.

Garrett, Pon, and Arosteguy

These researchers used basically the same method as did the authors of both the Oregon and Utah studies. In their deer hunting study for Nevada (1970), the authors used their results in evaluating

different alternatives of Nevada rangeland use. They used the consumers' surplus value in benefit-cost studies for projects which were concerned with range rehabilitation. This particular study is significant to recreation studies because it is an attempt to compare recreation benefits with benefits derived from other alternatives.

Davis

Previous studies of hunting and fishing in Arizona have been based on the gross expenditures method. Davis (1967) stated that his study measures the direct contribution of hunting and fishing to the state's economy. The rationale for using this method is the feeling that the recreation experience is worth at least what the individual pays for it. These expenditures are summed to a figure called gross expenditures. This method has a serious fault which makes it irrelevant for economic evaluation. For example, if a hypothetical situation could be established whereby the recreation experience were abolished, it is likely that the money would be spent on some other good. This indicates that the recreation experience did not by itself generate the total gross expenditures.

Also, Brown, Singh, and Castle (1964) state that if the gross expenditure method is used, it is difficult to compare recreational benefits with benefits which might be received from alternative uses of natural resources. It would also be difficult to isolate and compare various forms of outdoor recreation such as camping as opposed to hunting if such items as camping equipment were used for both forms of recreation.

Since the gross expenditures method is not a good estimator of recreation benefits, the current Arizona deer hunting study follows the general Clawson method as used by the other empirical studies described. Therefore, it is believed that the results obtained from this study will be of greater economic significance to the agencies involved in public land use decisions in Arizona than have any previous Arizona hunting and fishing studies.

CHAPTER 3

RESEARCH PROCEDURE

In the preceding chapters, the objectives and theoretical framework were established. The general procedure for this study is based on the Clawson and Knetsch (1966) approach for the determination of recreational demand for the total experience and the subsequent demand for the resource itself. Although the Clawson and Knetsch method is used in this study, it was not possible to adhere strictly to the basic model. It is the purpose of this chapter to discuss the specific procedures in developing the models used in the attainment of the objectives in this study.

Generation of the Data

The Arizona Game and Fish Department has gathered annual data regarding the origin and distribution of the participants in the various forms of big game hunting within the state for the past fourteen years (Arizona Game and Fish Department, Annual). It was readily apparent that this information could be used in developing a simple economic model for the deer hunting resource in Arizona. The primary impetus behind this current study was the fact that the data are easily obtainable, and that through the use of simple arithmetic manipulations, the data could be used for meaningful economic analysis.

The demand relationship for deer hunting in Arizona is defined as a simple two-variable case as given in the following statement: the quantity of one-man hunts in Arizona game management unit j originating in county i is a function of the round trip transportation and on-site costs associated with making the hunt. That is,

$$Q_{ij} = f(X_{ij})$$

where, Q is the number of one-man hunts,

X is the total transportation and on-site costs,

i designates the county of origin of the hunter,

and, j designates the Arizona game management unit.

The Arizona Game and Fish Department game management units are shown in Figure 6. Game management units are combined into seven game and fish management regions for management purposes as shown in Figure 7 (management regions are not always contiguous with management unit boundaries). Arizona counties are shown in Figure 8 along with the major population center of each county.

Determination of the Quantity Variable

The quantity variable was derived from annual survey data published by the Arizona Game and Fish Department (1960, 1966, 1971). For example, Report 4 (1971, p. 27) gives the number of individual hunters and total hunter days in each game management unit for 1970, and Report 6 (1971, p. 34) gives the percent of hunters in each game management unit classified by county of origin. However, an individual hunter could have hunted in more than one unit. In that case, he would have been counted more than once. Thus, the total number of deer hunters

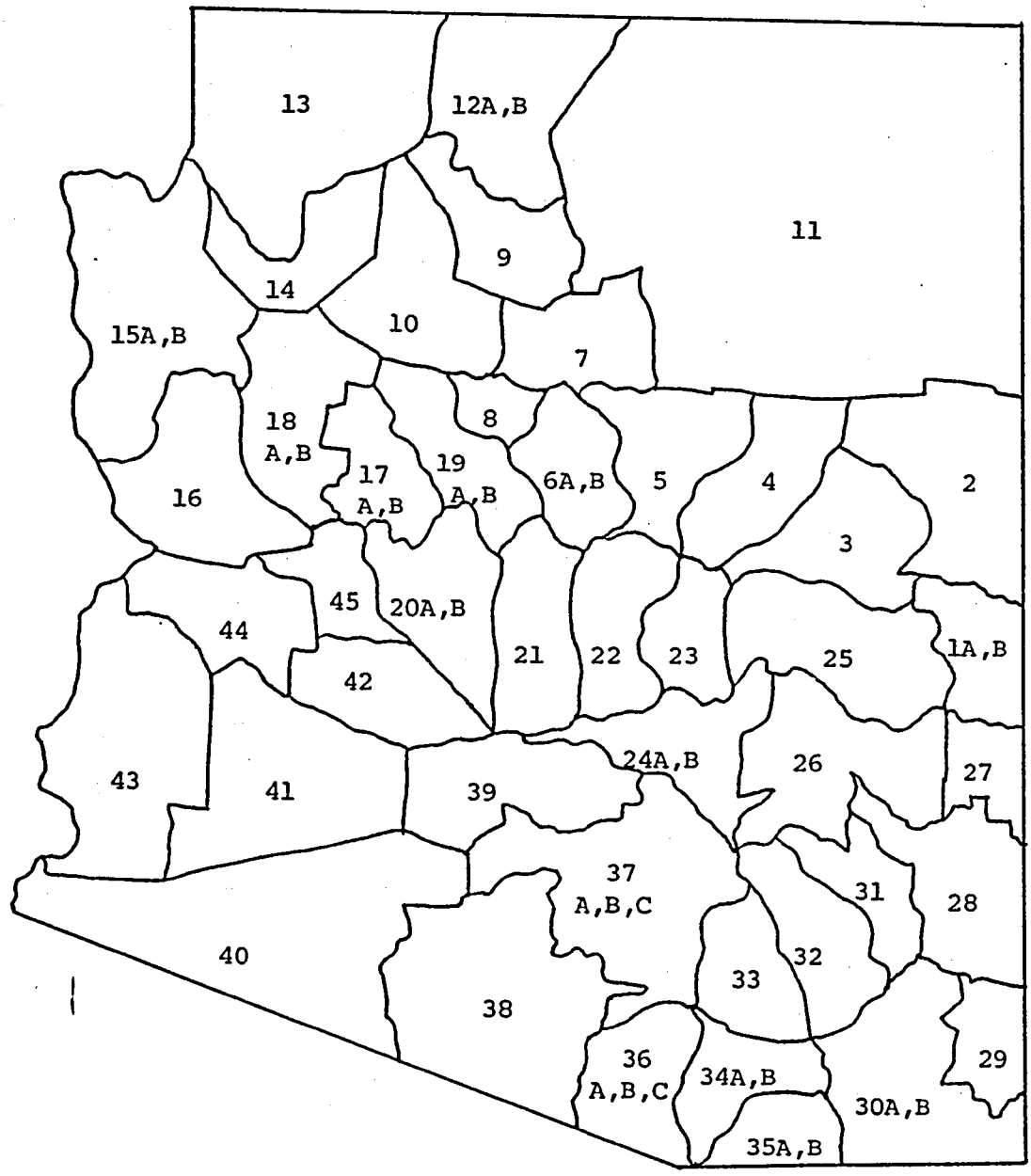

Figure 6. Arizona Game and Fish Management Units

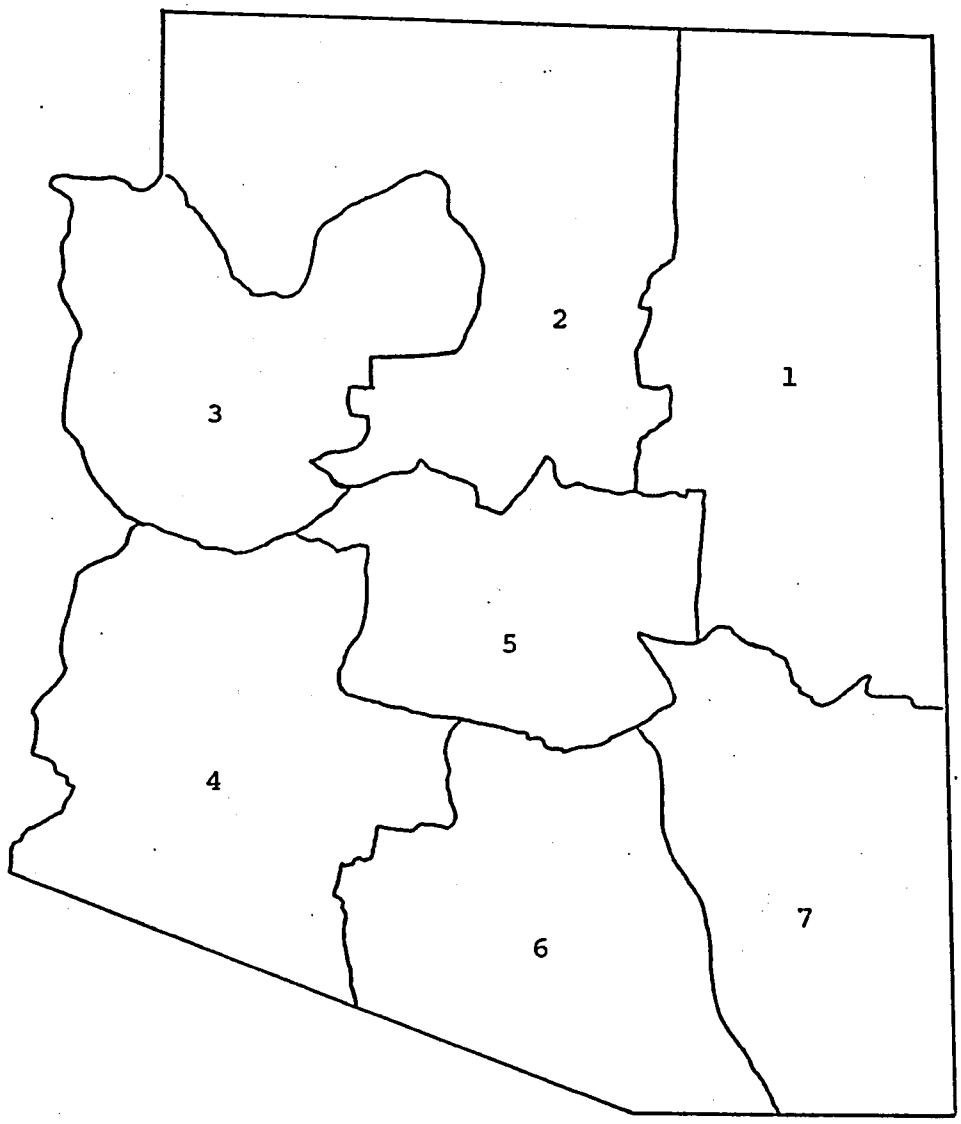

Figure 7. Arizona Game and Fish Management Regions

Figure 8. Map of the Counties in Arizona with the Population Center of the County

for all units, as recorded in Report 4, is larger than the total number of licensed hunters.

Also, since some of the hunters took more than one trip to the same game management unit, all of the hunts (one man for one hunt) were not recorded in the data surveys. It was necessary to develop a factor, when multiplied by the number of hunters as recorded in Report 4, that would yield an approximation of the total number of one-man hunts in each game management unit. This factor was developed by the following formula using an unpublished assumption provided by the experience of the Arizona Game and Fish Department (Carr, 1971). This assumption is that the average number of deer hunting trips per season is two trips per hunter.

Therefore:

$$\text{Multiplication Factor} = \frac{\text{(Number of deer hunters) (2.0 hunts/hunter)}}{\text{Total number of hunters as counted in Report 4}}$$

This factor, when multiplied by the number of "hunters" in a unit as counted in Report 4, yields an estimate of the total number of one-man hunts in the game management unit. By multiplying the total number of one-man hunts in each unit by the percentages given in Report 6, an approximation of the number of one-man hunts in unit j from county of origin i is found. Thus, Q_{ij} is the quantity of one-man hunts from county of origin i hunting deer in game management unit j.

The quantity (Q_{ij}) was divided by each 1,000 population of the county of origin i. Quantity was put on a per capita basis because of differences in population among counties. As will be demonstrated, this process will make estimation of the value of the site itself possible.

Determination of the Surrogate Price

The two components of the price variable (X_{ij}) are the variable costs of round trip transportation and on-site expenditures. Round-trip mileage was calculated from the population center of the county of origin (see Figure 8) to the geographic center of the game management unit (see Figure 6). A cost of ten cents per mile was assigned as the variable cost with an average of 2.3 hunters sharing these expenses (Carr, 1971). Determination of the variable transportation cost is shown in the following equation:

$$\text{Variable transportation costs} = \frac{\text{(Round trip mileage) (10¢)}}{\text{2.3 hunters per trip}}$$

The variable on-site costs were developed from the 1965 Arizona Game and Fish study by Davis (1967). To be consistent with the notion that the variable costs are the significant costs for demand studies of outdoor recreation, only additional food, lodging, and ammunition expenditures were used in developing the variable on-site costs. These costs were estimated by Davis to be $8.79 per hunter-day in 1965. That value was adjusted by the consumer price index in order to reflect changes in the relative purchasing power of the dollar from 1965 to 1970 ($8.79 x 123.1% = $10.82). Thus, variable on-site expenditures for 1970 were estimated at $10.82 per day.

A problem arose in allocating the on-site costs since only the total number of hunter-days per game management unit was known rather than days per trip. A decision was made to allocate the on-site costs in proportion to the distance traveled. By multiplying the total number of hunter-days times the on-site cost per hunter-day, an approximation

of the total on-site expenditures for each game management unit was found. These costs were then allocated in proportion to distance. This means, for example, that the hunter living very close to the hunting area would spend a smaller amount on variable on-site expenditures than would a hunter residing a long distance from the hunting area. This assumption indicates that the length of a deer hunting trip is functionally related to the distance traveled. The entire variable cost or surrogate price includes both transportation and on-site costs and is as follows:

X_{ij} = cost of taking a trip from county i to game management unit j

$$X_{ij} = \frac{\text{(round trip mileage) (10¢)}}{\text{2.3 hunters per trip}} + \text{weighted on-site variable costs}$$

The same values for transportation costs (10¢ per mile) and on-site costs ($10.82 per day) were used for the years 1960, 1965, and 1970 and in order to evaluate hunting demand in earlier years in terms of current (1970) prices.

Statistical Techniques for the Determination of Recreation Demand

Simple least squares linear regression was used to determine the relationship of the quantity of hunts to the variable cost involved in making the hunts. Regression analysis is a technique that fits a curve to a set of data points. The objective of least squares is to fit a line which minimizes the sum of errors squared where error is defined as the difference between the observed and predicted values of the dependent variable.

Several forms of equations were tested in order to find a single form that could be used for all estimates in this study. These forms are:

1. $Q_{ij}/1{,}000 \text{ pop.} = a + \frac{b}{X_{ij}}$
2. $\log(Q_{ij}/1{,}000 \text{ pop.}) = \log a + b \log X_{ij}$
3. $\log(Q_{ij}/1{,}000 \text{ pop.}) = a + b X_{ij}$
4. $Q_{ij}/1{,}000 \text{ pop.} = a + b \log X_{ij}$

These four forms were regressed on the same set of data and a comparison of the results was made. On the basis of consistently high coefficients of determination (R^2) combined with mathematical simplicity, the inverse form was selected as the "best" from of the equation to use with all data in the study. Therefore, the demand for the recreation experience is estimated in the following form.

$$Q_{ij}/1{,}000 \text{ pop.} = a + \frac{b}{X_{ij}}$$

where, $Q_{ij}/1{,}000$ = quantity of one-man hunts from county i to area j per 1,000 population of county i;

X_{ij} = variable transportation and on-site costs associated with the hunt;

a = regression constant;

b = regression coefficient.

Using this form, the data for each game management unit for the years 1960, 1965, and 1970, were subjected to regression analysis. The result is a demand curve for the total recreation experience for each game management unit for each of the years in terms of 1970 prices.

Resource Evaluation

The next step in the analysis is to develop predicted reactions that the hunters would have to added costs. This procedure leads to the development of a demand curve for the resource itself which may then be evaluated in terms of both the "consumers' surplus" and "nondiscriminating monopolist" methods. This procedure is as follows:

1. Incremental increases in price are added to the original observed prices. These prices are then entered into the statistical demand equation, and new visitation rates are found.
2. The new visitation rate for each county i to area j at a designated level of price is multiplied by the population of county i to derive the total predicted number of hunts from each origin at the new (higher) price.
3. The number of hunts from each county of origin, at a given level of increased cost, are summed to yield the total number of hunts at the given level of added cost.
4. The added costs are plotted against total number of hunts. These points approximate the demand curve for the resource itself.

The nondiscriminating monopolist values can be found by multiplying the added price times the corresponding quantity for each added price for each game management area. Since price times quantity equals total revenue, the nondiscriminating monopolist value corresponds to the point on the demand curve where total revenue is at a maximum; that is, where unitary price elasticity exists.

The total area under the demand curve for the resource represents the consumers' surplus value. This value was estimated through a two-step procedure. First, the equation of the demand curve was approximated by regressing added price on the total number of hunts. The equational form

$$Q = a + bP + cP^2$$

where, Q is total hunts and P is added price,

was selected as giving the best fit. Then, the area under the curve was found by integrating the curve from zero to that price where Q equals zero or where Q reaches a minimum without crossing the price axis. The following equation shows the integral of the demand curve for the resource.

$$\text{Consumer's Surplus Value} = \int_0^P QdP = aP + \frac{bP^2}{2} + \frac{cP^3}{3}$$

Assumptions

There are several assumptions implicit in the formulation and use of the model as described above. The model specifies that the quantity of deer hunting consumed is solely a function of variable transportation and on-site costs. It is assumed that other demand determinants such as income, leisure time, population, prices paid for other goods, and tastes and preferences are held constant at a given level. This does not imply that the other factors are not significant determinants of demand. However, the unavailability of data did not allow the use of these factors in the analysis.

In order to make interpersonal comparisons between hunters, it must be assumed that the marginal utility for money is held constant. This assumption allows the statement to be made that the hunters will react to price changes in the manner that is brought out by the statistical demand curve. This leads to the development of the demand for the resource and the resulting values for that resource.

The last assumption deals with the behavior of the hunters. It is assumed that each hunter behaves rationally and allocates his resources in a manner whereby the value of the marginal utility received from the hunting experience is at least equal to or greater than the variable costs of the experience. There are, however, two constraints that might restrict any attainment of maximum satisfaction for the individual deer hunter. Arizona hunting regulations stipulate that only one deer may be taken per year. Therefore, once a deer is taken, the hunting activity is stopped. There is also a time constraint. The Arizona Game and Fish Department designates a particular season during which deer hunting is a legal activity. In summary, institutional constraints limit the hunters' ability to extend their hunting experience so that their marginal utility gained from hunting would be equal to their marginal cost.

CHAPTER 4

RESULTS

Statistical Estimates of the Demand for the Whole Recreation Experience

Statistical demand estimates were developed for each game management unit. A detailed analysis for only one unit is presented in order to avoid redundancy. The results for the remainder of the game management units are presented in tabular form as a summary of the regression constants, regression coefficients, and results of the appropriate statistical tests.

The example is for game management unit 1A for 1970. Table 3 gives the data used in the least squares regression analysis where the quantity of one-man hunts from county i to unit j (Q_{ij} per 1,000 population as shown in column 4) is inversely related to the variable round-trip transportation and on-site costs of making the hunt (X_{ij} as shown in column 7). The result of the analysis are values for the regression constant and regression coefficient. For game management unit 1A in 1970, the equation for the demand for the whole recreation experience was found to be the following:

$$Q_{ij}/1{,}000 \text{ population} = -6.055 + \frac{418.626}{X_{ij}}$$

The regression coefficient (431.437) is statistically significant at the 1 per cent level. The coefficient of determination (R^2) equals .628 which indicates that 62.8 per cent in the variation of the dependent

Table 3. Determination of the Values for Quantity of One-Man Hunts and Total Cost per Hunt in Unit 1A, 1970

(1) County of Origin	(2) Population of County[a]	(3) Qij (Hunts)[b]	(4) Qij / 1,000	(5) Transportation Cost[b]	(6) On-Site Cost[b]	(7) Total Cost[c]
	number			dollars		
Apache	32,304	551	17.06	5.60	7.72	13.32
Cochise	61,918	64	1.03	25.86	35.31	61.17
Coconino	48,326	37	.77	19.13	26.11	45.24
Gila	29,255	206	7.04	14.78	20.17	34.95
Graham	16,578	128	7.72	10.87	14.84	25.71
Greenlee	10,330	358	34.66	6.96	9.49	16.45
Maricopa	968,487	1,125	1.16	22.39	30.56	52.95
Mohave	25,857	0	0			
Navajo	47,559	216	4.54	11.09	15.13	26.22
Pima	351,667	459	1.31	23.91	32.64	56.55
Pinal	58,579	101	1.47	22.39	30.56	52.95
Santa Cruz	13,966	14	1.00	29.35	40.07	69.42
Yavapai	36,837	14	.38	26.96	36.79	63.75
Yuma	60,827	51	.84	37.82	51.63	89.45

[a]Source: Number of Inhabitants-Arizona 1970 Census of Population, U. S. Department of Commerce.

[b]Derived as explained in Chapter 3.

[c]Sum of column 5 plus column 6.

variable (Q_{ij}/1,000 population) was explained by the variation of the independent variable (X_{ij}).

Statistical estimates for the demand for the whole recreation experience were derived for each of the game management units for 1970, 1965, and 1960. The regression constants and coefficients along with the coefficients of determination and F levels for 1970 are summarized in Table 4.[1]

Estimates of the Demand for the Resource

As discussed in Chapter 3, the statistical demand curve for the whole recreation experience cannot be used to evaluate the resource. The predicted recreation experience cannot be used to evaluate the resource. The predicted value of the total quantity of one-man hunts at incremental levels of added cost must be estimated for the resource itself. First, the original surrogate prices (Column 7, Table 3) are placed into the statistical estimate for the recreation experience. A value (Q_{ij}/1,000 population) is predicted for each surrogate price. This value is multiplied by the population per 1,000 of the county of origin to yield a total quantity of one-man hunts in the unit at zero added cost. Then, five dollar increments were added to the original costs, and the process was repeated at each increment. The result is a set of points in terms of added cost per hunt and total quantity of one-man hunts (see Table 5 for Unit 1A).

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1. Because demands in 1960 and 1965 were estimated using 1970 prices and since they are not useful for predictive purposes, the coefficients of the statistical demand equations for the recreation experience are not reported herein.

Table 4. Statistical Demand Estimates for the Whole Recreation Experience by Game and Fish Units for 1970[a]

Game and Fish Unit[b]	Statistical Results From Regression Analysis			
	Regression Constant(a)	Regression Coefficient(b)	R^2	F Level[c]
1A	- 6.055	418.626	.695	25.1
1B	- 5.556	409.113	.951	211.9
2	- 5.750	84.173	.974	149.2
3	- 2.185	140.423	.919	90.2
4	- 4.248	258.927	.890	56.6
5	- 5.752	419.261	.819	36.3
6A	- 4.178	469.687	.655	15.2
6B	- .042	63.900	.677	21.0
7	- 5.465	372.223	.972	381.8
8	- 3.656	242.718	.886	54.2
9	- 3.918	250.633	.857	41.8
10	- 4.975	308.046	.940	94.1
12B	- 6.667	456.589	.775	24.1
13	- 3.242	422.020	.435	7.7
15A,B	- 1.866	178.861	.693	20.3
16	-20.391	1,587.170	.937	118.6
17A	- 2.499	173.877	.999	7,317.9
17B	- 5.794	401.232	.981	308.5
18A,B	- 5.844	352.350	.591	18.8
19A	- .915	80.303	.902	73.8

Table 4.--Continued

Game and Fish Unit[b]	Statistical Results From Regression Analysis			
	Regression Constant(a)	Regression Coefficient(b)	R^2	F Level[c]
19B	- 6.418	338.953	.915	53.5
20A,B	- 7.286	510.431	.771	47.0
21	- 2.554	193.044	.930	66.5
22	- 9.301	487.899	.499	6.0
24A,B	- 4.454	93.221	.367	7.5
26	.446	13.115	.136	.6*
27	-19.797	957.967	.911	92.8
28	- 1.125	267.990	.335	3.5*
29	- 5.129	251.946	.740	17.1
30A	- 6.869	422.053	.954	103.8
30B	-12.024	769.544	.908	39.5
31	-16.649	797.219	.878	57.5
32	- 4.066	350.546	.509	8.3
33	1.037	92.580	.333	2.0*
34A,B	- 1.121	186.661	.268	3.7*
35A,B	- 2.668	264.079	.654	17.0
36A,B,C	- 1.680	136.834	.798	55.5
37B	-11.008	612.737	.386	2.4*
37C	.289	15.464	.964	27.1
38	.132	5.746	.115	.3*
39	.226	4.784	.349	1.6*

Table 4.--Continued

Game and Fish Unit[b]	Statistical Results From Regression Analysis			
	Regression Constant(a)	Regression Coefficient(b)	R^2	F Level[c]
41	- .780	70.310	.747	11.8
42	- .685	77.550	.782	10.8
43	-19.567	1,713.500	.954	41.7
44	.127	32.119	.062	.2*
45	- 2.428	169.727	.660	11.9

[a]All equations are of the form;

$$Qij/1{,}000 \text{ population} = a + \frac{b}{Xij}$$

Where Qij is the quantity of hunts from county i to area j and Xij is the variable cost of the hunt.

[b]Some units were combined (e.g., units 15A and 15B) to make units comparable with earlier years and/or because some individual units lacked an adequate number of observations for statistical analysis. Also, several units were completely deleted for lack of data.

[c]The asterisks adjacent to the F-levels indicate those regression coefficients which are not significant at the 5 per cent level of probability. Regression coefficients for all other equations are significant at at least the 5 per cent level of probability.

Table 5. Added Costs with Associated Total Hunts and Total Revenues for Unit 1A, 1970

(1) Added Cost($)	(2) Total Hunts(no.)	(3) Total Revenue($)
0	4,448	0
5	2,856	14,280
10	1,687	28,560
15	868	13,020
20	616	12,320
25	330	8,250
30	231	6,930
35	134	4,690
40	83	3,320
45	50	2,250
50	23	1,150

An estimate of the demand curve for the resource can be determined by regressing the points of added cost on the total quantity of one-man hunts in the form:

$$Q = a + bP + cP^2$$

where Q is total one-man hunts and P is added cost. The analysis for unit 1A yielded the following equation for the estimate of the demand for the resource:

$$Q = 3{,}597.2 - 190.21P + 2.38\ P^2$$

This process was repeated for all of the game management units. The result is an estimate of the demand curve for the resource for each of the game management units. These estimates are shown in Table 6 for the year 1970.

Value of the Resource by the Consumers' Surplus Method

The area under the demand curve for the resource represents the consumers' surplus value. This value can be found by taking the integral of the demand curve for the resource from zero added cost to the added cost where Q equals zero or where Q reaches a minimum value without crossing the added cost axis. For game management unit 1A in 1970, the integral of the curve and the resulting consumers' surplus value are shown below.

$$Q = 3{,}597.2 - 190.21P + 2.38\ P^2$$

$$\int_0^P Q\,dP = 3{,}597.2 - 95.10\ P^2 + .79\ P^3$$

$$\int_0^P Q\,dP = \$53{,}186 = \text{Consumers' Surplus Value}$$

Table 6. Statistical Demand Estimates for the Resource by Game and Fish Units for 1970[a]

Game and Fish Unit[b]	Statistical Results From Regression Analysis				
	Regression Constant(a)	Regression Coefficient(b)	Regression Coefficient(c)	R^2	F Level[c]
1A	3,597.2	- 190.21	2.38	.954	93.1
1B	2,769.4	- 136.84	1.60	.924	60.5
2	186.4	- 42.85	2.42	.999	1,834.1
3	2,036.8	- 129.21	1.94	.965	96.3
4	3,627.0	- 256.74	4.49	.990	252.4
5	7,288.4	- 399.58	5.52	.997	868.1
6A	15,359.0	- 655.66	6.86	.986	306.4
6B	3,174.8	- 97.13	.70	.969	264.4
7	2,941.0	- 161.92	2.19	.934	56.2
8	3,326.0	- 255.19	3.85	.997	741.4
9	2,278.9	- 171.49	3.19	.982	134.9
10	2,904.4	- 187.85	2.87	.962	89.0
12B	2,038.4	- 162.78	3.13	.965	69.9
13	3,308.7	- 121.98	1.05	.992	445.6
15A,B	1,831.4	- 89.77	1.09	.992	489.3
16	11,428.9	- 740.22	12.15	.999	2,370.9
17A	2,456.0	- 156.16	2.55	.995	390.0
17B	7,161.4	- 451.23	7.38	.990	199.3
18A,B	9,383.2	- 539.07	7.54	.988	284.2
19A	1,930.6	- 404.01	.90	.976	202.1

Table 6.--Continued

Game and Fish Unit[b]	Statistical Results From Regression Analysis: Regression Constant(a)	Regression Coefficient(b)	Regression Coefficient(c)	R^2	F Level[c]
19B	4,113.0	-1,373.80	9.71	.996	380.1
20A,B	27,355.6	- 373.09	17.49	.994	532.1
21	6,682.7	- 825.22	6.80	.999	1,313.7
22	12,191.2	- 32.56	13.97	.999	4,758.7
24A,B	331.1	- 32.08	.00	.957	22.4
26	888.6	- 32.08	.26	.744	24.7
27	2,708.6	- 216.54	4.39	.990	189.0
28	5,837.1	- 204.63	1.62	.860	52.1
29	1,539.6	- 122.50	2.47	.990	193.6
30A	4,021.4	- 229.75	3.14	.953	80.8
30B	6,236.8	- 382.05	5.65	.963	91.1
31	3,564.2	- 320.75	7.04	.972	69.3
32	10,388.8	- 556.83	7.16	.984	244.2
33	4,994.3	- 177.59	1.42	.826	40.5
34A,B	10,084.9	- 321.01	2.39	.923	102.1
35A,B	8,307.4	- 333.19	3.13	.939	100.6
36A,B,C	7,709.0	- 355.10	3.96	.960	119.4
37B	15,827.4	-1,545.62	38.05	.989	93.8
37C	869.9	- 15.07	.11	.743	24.6
38	312.3	- 11.42	.09	.725	22.4
39	620.2	- 22.03	.18	.828	41.0

Table 6.--Continued

Game and Fish Unit[b]	Statistical Results From Regression Analysis: Regression Constant(a)	Regression Coefficient(b)	Regression Coefficient(c)	R^2	F Level[c]
41	1,858.9	- 66.81	.63	.983	291.4
42	3,081.9	- 229.92	4.10	.937	37.1
43	7,273.9	- 837.45	27.34	.989	44.3
44	1,440.7	- 29.59	.20	.953	171.3
45	4,036.7	- 160.37	-1.72	.984	62.1

[a]All equations are of the form: $Q = a + bP + cP^2$

Where, Q is total number of one-man hunts and
P is added price.

[b]Some units were combined (e.g., units 15A and 15B) to make comparable units with earlier years and/or because some individual units lacked an adequate number of observations for statistical analysis. Also, several units were completely deleted for lack of data.

[c]All F-levels for the regression coefficients are at the 5 per cent level of probability or above.

The consumers' surplus value for game management unit 1A in 1970 was $53,186. This value represents the value of the resource (Unit 1A) to the state over and above the costs paid for participating in deer hunting. Consumers' surplus values are derived for all of the Game and Fish management units for 1970 (Table 7). These values are later aggregated to yield regional and statewide estimates of the value of the resource by the consumers' surplus method.

Value of the Resource by the Nondiscriminating Monopolist Method

The nondiscriminating monopolist value is also found from the schedule of added cost per hunt and total number of one-man hunts as shown in Table 5. By multiplying added cost by one-man hunts, the total revenues at alternative added costs are found. The nondiscriminating monopolist value equals the maximum total revenue that could be extracted by an all powerful monopolist by charging a single additional price. The estimate of the nondiscriminating monopolist value for unit 1A in 1970 equals $28,560 when an additional $10.00 is assessed per hunt. The nondiscriminating monopolist values by game management units for 1970 are summarized in Table 8. Estimates of resource values at alternative added costs by Game and Fish units are given in Appendix.

These monopolist values represent the amount of surplus satisfaction that could be extracted by an all powerful monopolist charging a single price to all consumers. However, even a monopolist could not extract an amount equal to the total value of consumers' surplus. To do so, one would have to charge each consumer the maximum price that

Table 7. Consumers' Surplus Values for 1970 by Game and Fish Units

Game and Fish Unit[a]	Consumers' Surplus Value ($)
1A	53,186
1B	36,056
2	533
3	20,680
4	33,858
5	89,268
6A	92,544
6B	66,683
7	35,099
8	33,087
9	20,025
10	30,816
12B	16,585
13	57,264
15A,B	24,761
16	119,191
17A	26,398
17B	78,409
18A,B	106,753
19A	28,872
19B	27,458

Table 7.--Continued

Game and Fish Unit[a]	Consumers' Surplus Value ($)
20A,B	368,027
21	83,064
22	117,003
24A,B	1,683
26	15,475
27	22,863
28	104,761
29	13,077
30A	45,541
30B	66,285
31	25,888
32	125,587
33	88,320
34A,B	202,239
35A,B	148,179
36A,B,C	108,566
37B	108,927
37C	35,768
38	5,343
39	10,997
41	35,948
42	26,708

Table 7.--Continued

Game and Fish Unit[a]	Consumers' Surplus Value ($)
43	45,924
44	52,597
45	54,200

[a]Some units were combined (e.g., units 15A and 15B) to make comparable units with earlier years and/or because some individual units lacked an adequate number of observations for statistical analysis. Also, several units were completely deleted for lack of data.

Table 8. Nondiscriminating Monopolist Values for 1970 by Game and Fish Units

Game and Fish Unit[a]	Added Cost Per Hunt ($)	Total Quantity of Hunts (no.)	Nondiscriminating Monopolist Value ($)
1A	10	1,639	16,390
1B	10	1,146	11,460
2	3	78	234
3	10	762	7,620
4	10	1,372	13,720
5	15	2,536	38,040
6A	25	4,501	112,525
6B	30	1,123	33,690
7	15	773	11,595
8	10	1,341	13,410
9	10	754	7,540
10	10	1,051	10,510
12B	5	1,218	6,090
13	15	1,742	26,130
15A,B	15	725	10,875
16	10	5,163	51,630
17A	15	698	10,470
17B	15	2,056	30,840
18A,B	15	2,769	41,535
19A	20	579	11,580
19B	5	2,445	12,225

Table 8.--Continued

Game and Fish Unit[a]	Added Cost Per Hunt ($)	Total Quantity of Hunts (no.)	Nondiscriminating Monopolist Value ($)
20A,B	15	11,085	166,275
21	20	2,030	40,600
22	10	5,297	52,970
24A,B	5	128	640
26	10	838	8,380
27	10	919	9,190
28	15	3,240	48,600
29	10	501	5,010
30A	10	1,912	19,120
30B	10	3,210	32,100
31	5	1,967	9,835
32	15	4,264	63,960
33	10	4,179	41,790
34A,B	10	7,496	74,960
35A,B	10	5,394	53,940
36A,B,C	10	4,360	43,600
37B	5	9,794	48,970
37C			
38	10	235	2,350
39	15	380	5,700
41	20	709	14,180
42	10	1,695	16,950

Table 8.--Continued

Game and Fish Unit[a]	Added Cost Per Hunt ($)	Total Quantity of Hunts (no.)	Nondiscriminating Monopolist Value ($)
43	10	1,987	19,870
44			
45	10	1,546	15,460

[a]Some units were combined (e.g., units 15A and 15B) to make comparable units with earlier years and/or because some individual units lacked an adequate number of observations for statistical analysis. Also, several units were completely deleted for lack of data.

he would be willing to pay. Therefore, nondiscriminating monopolist values are lower than consumers' surplus value.

Regional and Statewide Results

The Arizona Game and Fish Department combines the game management units into seven Game and Fish regions for management purposes. An analysis by regions is presented in this section along with statewide results. Figures 6 to 8 in Chapter 3 show the geographic boundaries of game management units, game management regions, and counties for the State of Arizona. Since regions are for the most part simply combinations of game management units, a separate economic analysis was not attempted.[2]

The nondiscriminating monopolist values by Game and Fish regions were determined by horizontally summing the quantity of one-man hunts at each five-dollar increment of added cost for all of the game management units that are contained within a game management region. A total revenue function for each game management region was found by multiplying added cost times the corresponding quantity of one-man hunts in the region. The maximum total revenue in each region represents the nondiscriminating monopolist value for that region. Estimates of the resource values at alternative levels of added cost are given for each region in Table 9. The nondiscriminating monopolist value for each region is lower than the sum of the nondiscriminating monopolist values for all units contained within a region. The reason is that if

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2. Whenever a unit was contained in two regions, the unit was assigned to the region containing the majority of the land area.

Table 9. Estimates of Resource Values at Alternative Added Costs for 1970 by Game and Fish Regions

Game and Fish Region[a]	Added Cost Per Hunt ($)	Quantity of Hunts (no.)	Total Revenue ($)[b]
Region 1	0	13,800	
	5	8,450	42,250
	10	5,021	50,210*
	15	3,046	45,960
	20	2,043	40,860
	25	953	23,825
	30	494	14,820
	35	296	10,360
	40	140	5,600
	45	114	5,130
	50	68	3,400
	55	34	1,870
	60	24	1,440
	65	15	975
	70	8	560
	75	1	75
Region 2	0	67,513	
	5	46,966	234,830
	10	31,458	314,580
	15	21,971	329,565*
	20	14,811	296,220

Table 9.--Continued, Estimates of Resource Values, 1970

Game and Fish Region[a]	Added Cost Per Hunt ($)	Quantity of Hunts (no.)	Total Revenue ($)[b]
	25	8,317	207,925
	30	4,864	145,920
	35	1,743	61,005
	40	639	25,560
	45	107	4,815
	50	56	2,800
Region 3	0	28,635	
	5	19,997	99,985
	10	14,165	141,650*
	15	9,166	137,490
	20	6,724	134,480
	25	1,444	36,100
	30	540	16,200
	35	249	9,065
	40	193	7,720
Region 4	0	6,669	
	5	5,075	25,375
	10	3,982	39,820
	15	2,928	43,920*
	20	43	860
	25	35	875
	30	30	900

Table 9.--Continued, Estimates of Resource Values, 1970

Game and Fish Region[a]	Added Cost Per Hunt ($)	Quantity of Hunts (no.)	Total Revenue ($)[b]
	35	26	910
Region 5	0	30,254	
	5	19,246	96,230
	10	11,534	115,340*
	15	7,558	113,370
	20	4,328	86,480
	25	1,412	35,300
	30	703	21,090
	35	137	4,795
	40	114	4,560
Region 6	0	36,773	
	5	28,050	140,250
	10	22,034	220,340*
	15	12,937	194,055
	20	6,278	125,560
	25	4,375	109,375
	30	2,854	85,620
	35	2,352	82,320
	40	1,802	72,080
	45	1,430	64,350
	50	863	43,150
	55	675	37,125

Table 9.--Continued, Estimates of Resource Values, 1970

Game and Fish Region[a]	Added Cost Per Hunt ($)	Quantity of Hunts (no.)	Total Revenue ($)[b]
	60	446	26,760
	65	189	12,285
Region 7	0	43,861	
	5	30,014	150,070
	10	19,958	199,580*
	15	10,088	151,320
	20	4,720	94,400
	25	3,448	86,200
	30	1,205	36,150
	35	822	28,770
	40	566	22,640
	45	421	18,945
	50	334	16,700
	55	270	14,850
	60	214	12,840
	65	165	10,750
	70	141	9,870
	75	130	9,750

[a]See Figure 7, Chapter 3 for regional boundaries.

[b]Asterisks indicate the nondiscriminating monopolist value for the region.

different "added costs" were changed for each unit, a larger could be extracted than if only a single price were charged at the regional level. Obviously, a larger total return can be obtained if one discriminated between units rather than charge a single price for the whole region.

A similar process was used in arriving at the statewide values. The results are given in Table 10. For the same reasoning as outlined above, a single nondiscriminating price at the state level would give a lower return than would the sum of the revenues at seven discriminatory prices at the regional level.

Consumers' surplus values for Game and Fish regions and the state were found by adding consumers' surplus values for each of the individual units contained within a region. Regional consumers' surplus value ranged from a low of $81,872 for region 4 to a high value of $697,342 in region 6 (see Table 11). The total consumers' surplus value for the state was estimated to be $2,910,496 for 1970. These values, along with state and regional nondiscriminating monopolist values are given in Table 11. The problem of nonadditivity does not arise with consumers' surplus values.

Estimates for 1960 and 1965

Nondiscriminating monopolist values and consumers' surplus values were also estimated for the deer hunting resource in Arizona for 1960 and 1965. The costs, including both transportation and on-site expenditures that were used as the surrogate price, were held at the 1970 price level. This was done so that the values of the resource in

Table 10. Estimates of Resource Values at Alternative Added Costs for the State of Arizona in 1970

Added Cost Per Hunt ($)	Quantity of Hunts (no.)	Total Revenue ($)[a]
0	227,505	0
5	157,798	788,990
10	108,152	1,081,520*
15	67,694	1,015,410*
20	38,947	778,940
25	19,984	499,600
30	10,690	320,700
35	5,625	196,875
40	3,454	138,160
45	2,072	93,240
50	1,321	66,050
55	979	53,845
60	684	41,040
65	369	23,985
70	149	10,430
75	131	9,825

[a]Maximum total revenue for a single statewide nondiscriminating price would be between the two starred values since regional added costs were either 10 or 15 dollars.

Table 11. Consumers' Surplus and Nondiscriminating Monopolist Values for 1970 by Game and Fish Regions

Game and Fish Region[a]	Regional Nondiscriminating Monopolist Value ($)	Consumers' Surplus Value ($)
1	50,210	144,313
2	329,565	970,535
3	141,650	250,705
4	43,920	134,469
5	115,340	291,972
6	220,340	697,342
7	199,580	421,160
State Total	1,257,000[b]	2,910,496

[a]See Figure 7, Chapter 3, for regional boundaries.

[b]The nondiscriminating monopolist value for the state is less than the total for all regions. See discussion in the text.

1960 and 1965 could be compared to 1970 values in terms of the current (1970) price level. Table 12 shows a summary of the statewide values of 1960, 1965, and 1970.

Both nondiscriminating monopolist and consumers' surplus values are shown as remaining fairly constant for 1960, 1965, and 1970. These results seem somewhat inconsistent with the fact that the actual number of resident deer hunters steadily increased during this time period. If correct, the results indicate that in the past, hunters participated at a higher per capita rate for a given cost than they do at the current time, even though total participation has risen because of increased total population. A comparison of population data with number of deer hunters indicate that population increased by 36 per cent from 1960 to 1970 while the number of deer hunters increased by only 15 per cent during this same time period. These facts support the hypothesis that the per capita rate of participation in deer hunting is decreasing over time.

However, further study of the method used in estimating the values for 1960 and 1965 indicates that these values may be somewhat overestimated. This is because of the use of the 1970 price level for 1960 and 1965 in determining the statistical recreational demand curve. Using this method, participation in the deer hunting experience was overestimated because the hunters actually paid less for the quantity of hunts than was assigned. A more correct procedure would have been to use unadjusted actual prices for the study years and derive the values for the particular study year at the year's prices. These values could

Table 12. Summary of Nondiscriminating Monopolist and Consumers' Surplus Values for the State of Arizona for 1960, 1965, and 1970

Year	Consumers' Surplus Value ($)	Nondiscriminating Monopolist Value ($)	Approximate Number of Licensed Deer Hunters[a]
1960	3,100,000	1,200,000	84,000
1965	2,800,000	1,100,000	88,000
1970	2,910,496	1,257,000	97,000

[a]Derived from data in the Arizona Game Management Data Summary, Arizona Game and Fish Department (1960, 1966, and 1971).

then be adjusted to the 1970 price level by using the consumer price index. Thus, while the population data supports the hypothesis of static total value of the hunting resource, the estimates for 1960 and 1965 are tentative.

Comparability of the Results With the Utah Study

The values of the Arizona deer hunting resource obtained in this study may be compared with the values estimated in a similar study of Utah by Wennergren (1967). Arizona and Utah are not homogeneous with respect to the various demand determining characteristics, but they are sufficiently similar to warrant comparison. Table 13 compares the factors in Utah and Arizona which might influence the demand for deer hunting and displays the total estimates of values for the two states.

The Utah study found that the value of the resident firearms deer hunting resource by the consumers' surplus method to be $2,308,020 in 1965. The consumer price index (123.1) was applied to that figure to yield a value of $2,838,000 for 1970 to compare to the Arizona value for 1970 of $2,910,496. The nondiscriminating monopolist value for Utah, adjusted to the 1970 price level, equals $1,186,000 while the 1970 Arizona value is $1,257,000.

Total state values by both methods of evaluation for Utah and Arizona are nearly identical. Table 13 shows that per capita income, population, and land area are larger in Arizona. However, participation in Utah (in 1965) was two times as large as participation in Arizona.

Table 13. Comparison of the Estimated Values of Resident Deer Hunting and Characteristics Influencing Values in Utah and Arizona

Value of Characteristic	Utah	Arizona
Consumer Surplus Value ($)	$2,838,000	$2,910,496
Nondiscriminating Monopolist Value ($)	$1,186,000	$1,257,000
Population, 1970 (no.)[a]	1,047,000	1,737,000
Land Area (square miles)[a]	82,381	113,563
Per Capita Income, 1970 ($)[a]	$ 3,210	$ 3,542
Deer License Holders - 1965 (number)	179,000[b]	98,000

[a]Source: Statistical Abstract of the United States 1971, U. S. Department of Commerce, Bureau of Census, Washington, D. C., 1971.

[b]Source: Estimated from Wennergren, Demand Estimates and Resource Values for Resident Deer Hunting in Utah (1965).

The Wennergren study excluded "additional food cost" as a variable expense. Additional food was 45.4 per cent of the nontransportation variable cost and 31.4 per cent of the total variable cost including transportation in the Arizona study.[3]

The 1965 Wennergren Study assumed transportation cost was five cents per mile. The 1970 Arizona study assumed ten cents per mile. Adjustment of the 1965 five cents per mile assumption by the consumers' price index (123.1) only raises the Utah mileage assumption to 6.155 cents. The ten cent assumption used in the Arizona study is still 75 per cent larger than the adjusted Utah assumption.

One might argue that the variable cost assumptions for the Arizona study are too high, thus over estimating the value of the resource. Many researchers have questioned whether the value of additional food can be estimated, or whether hunters really have additional food costs to what they would have spent had they stayed home. Wennergren assumed that they did not. The Arizona study used estimates developed by Davis (1967) in his 1965 total expenditure study for the Arizona Game and Fish Department. Davis' estimates may well have been too large.

Also, the assumption of ten cents per mile may be too high to use as a transportation cost. While ten cents per mile is often used as a rule of thumb for automobile costs, the ten cents includes the

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3. Expenditures for transportation at 10¢/mile was $1,832,216
Expenditures for lodging, ammunition, etc. was 2,241,207
Expenditures for additional food was 1,863,567

estimated cost of repairs and depreciation costs which are not really considered when an individual makes a decision whether or not to take a trip. For example, if gasoline costs 30¢ per gallon and a car averages 15 miles per gallon, gasoline costs alone are only two cents per mile.

An alternative interpretation of the results for Arizona and Utah would be that Wennergren somewhat under estimated the value of deer hunting in Utah by excluding additional food expenditures and using low transportation costs. In addition, it is unlikely that using higher costs would explain the very large difference in total participation between Arizona and Utah. The fact that the total value of the hunting resource is relatively low in Utah, while participation is quite high (compared to Arizona), can be interpreted as showing that the quality and nearness of Utah deer hunting is very good. People do not have to travel far distances or make high expenditures to enjoy a hunting experience in Utah. Therefore, the value of the hunting resource, as estimated by the surrogate price method would be under estimated in terms of the expenditures that hunters would actually make if they really had to.

In summary, this author feels that the Arizona estimates are probably too high, and the Utah estimates are probably too low.

CHAPTER 5

USEFULNESS OF RESULTS

Resource Values in Alternative Uses

The analysis revealed that in Arizona, 98,000 resident deer hunters generated $2,910,469 of consumers' surplus value in 1970. This value represents the total net benefits of the resident deer hunting resource to the State of Arizona.

The nondiscriminating monopolist method provides the maximum total revenue that could be extracted at a single price as set by an agency such as the Arizona Game and Fish Department. The monopolist price for 1970 was found to be about $10.00 in additional costs per one-man hunt with $1,257,000 of revenue generated at that level of added cost. It is not suggested that the administrative agencies should raise fees to the point where revenue is maximized. There are serious equity considerations that should be made before major increases in fees could be justified. However, the nondiscrimination monopolist value gives a resource value to be compared to values of alternative products of the land resource if decisions relative to competing uses must be made.

The significance of this study is the role it can play in developing public land policies. Deer hunting represents only one of the possible uses of the forest and range land resources in Arizona. Other alternatives include such uses as timber production, water production, cattle grazing, and other forms of outdoor recreation. This

analysis will compare the value of the same land resource in cattle grazing and deer hunting. Table 14 shows estimated values per square mile (one square mile equals one section) of cattle and deer hunting for different areas in Arizona. The cattle grazing values were computed as the estimated average animal unit months per section in each area (Dickerman and Martin, 1967), times the weighted average price per animal unit month. Prices of public lands, classified by public agencies (i.e., State lands, Forest Service land and Bureau of Land Management lands) were obtained from Martin and Jefferies (1966). Prices were weighted by the percentages of each type of land in the area (Dickerman and Martin, 1967). These data are summarized in Table 15.

Figure 9 shows a map of the state divided into six ranching areas selected on the basis of similar land characteristics for grazing. The differences in values between areas given for grazing in Table 14 reflect the value of the land resource in cattle production; in the areas where grazing conditions are poorer, returns are lower than in areas which have prime grazing conditions.

The values for deer hunting are the total values of the game management units within a particular grazing area divided by the total number of sections within that area. Since all sections of land within an area are not deer habitat and do not contribute to deer hunting activity, these estimates of value per section are minimum value estimates. Thus, they cannot be directly compared to the value of a section of cattle grazing unless one can estimate what proportion of the total land area is in fact deer habitat. For example, if in the Southeastern

Table 14. Comparison of Cattle Grazing and Deer Hunting Values for a Section of Land in Six Different Cattle Producing Areas in Arizona

Ranching Area[a]	Value of Cattle Grazing	Value of Deer Hunting - Consumers' Surplus	Value of Deer Hunting - Nondiscriminating Monopolist Method
	----------dollars per section----------		
Western Desert	48.35	21.87	9.16
Arizona Strip	105.34	12.23	5.34
Central Mountain	135.48	58.26	25.59
Southern Desert	153.47	73.32	32.31
Southeastern Desert	185.44	39.54	18.53
Central Plateau	209.15	31.58	11.54

[a] See Figure 9.

Table 15. Average Animal Unit Months per Section on Arizona Cattle Ranches and Weighted Average Prices per Animal Unit Month

Ranching Area[a]	AUM's per Section per Year	Weighed Average Price per AUM[b]
Southern Desert	142	$1.08
Western Desert	45	$1.08
Southeastern Desert	124	$1.50
Central Mountain	77	$1.75
Central Plateau	120	$1.76
Arizona Strip	81	$1.30

[a]See Figure 9.

[b]Assumes: $1.75 per AUM for forest lands,
$1.08 per AUM for BLM lands,
$1.91 per AUM for state lands;
see Martin and Jefferies (1966).

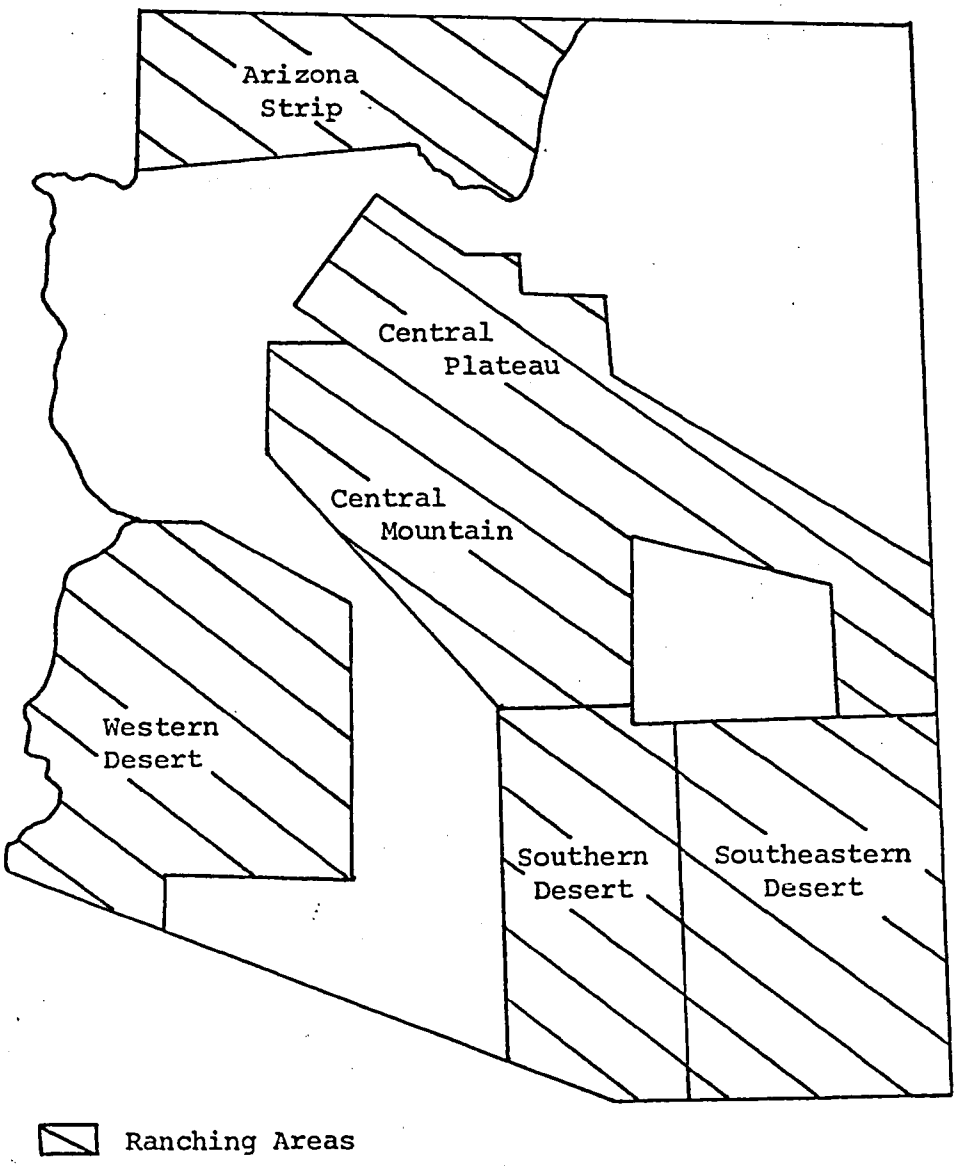

Figure 9. Ranching Areas in Arizona

Source: Dickerman and Martin (1967)

desert area, only one fifth of the land was deer habitat, one would multiply the value given in Table 14 by a factor of five. This would make the nondiscriminating monopolist value for the Southeastern desert equal to $92.65, which could then be compared to the value of $185.44 per section for cattle ranching. Data on the proportion of each area that is deer habitat is being sought but is not presently available.

The deer hunting values do not reflect the value of the land in terms of the capacity of the land to produce deer. Rather, the values reflect the magnitude of the demand determinants which in turn affects the degree of hunting participation. It is the distribution of hunters and total participation that ultimately affects the value of the resource. For this reason, the Southern desert near Tucson has the highest value for deer hunting and the Arizona strip in the northwest corner of the state has the lowest value. But, the Arizona strip is widely considered superior deer hunting territory.

In a similar fashion, the high values per section for grazing do not really reflect the productivity of the areas for producing cattle, but rather more closely reflect the demand for cattle ranches; that is, the demand for participation in ranching activity. (Differences in values between areas particularly reflect productivity.) As discussed by Martin and Jefferies (1966), land values created by the demand for ranches by the public far exceeds that value that would reflect the productivity of the land in producing beef for markets. If the land were evaluated relative to its productivity for beef production for market, and the deer hunting values were adjusted upward to adjust

for actual deer habitat area, the values for deer hunting per section might well exceed those for cattle grazing.

The comparison between cattle ranching and deer hunting was made in order to show that it is possible to compare benefits received from a recreational experience against another use of the resource area. In this case, cattle production was arbitrarily chosen for illustrative purposes only. Although cattle grazing and deer hunting are two alternative uses for the land resources, this study makes no attempt to determine whether this product relationship is competitive, complementary, or unrelated in terms of use. If the relationship is unrelated or complementary, the values per section for the two uses are additive rather than expressing the value of a trade-off as would be the case with competing use.

Improving Arizona Game and Fish Department Data So As To Improve Hunting Demand Estimates

A complete study of demand for hunting and fishing in Arizona is currently in progress by the Department of Agricultural Economics at the University of Arizona. This project (funded by the Arizona Game and Fish Department) will estimate demand functions for all types of hunting and fishing activities in the state for 1970 using primary data gathered specifically for the purpose.

The values for deer hunting found by the study using primary data will be compared with the values obtained by this study which uses secondary data and imputed costs. If the values from the two studies are of equal reliability, the method using secondary data would be

preferred for future studies since it is the least expensive. Of course, the primary data study will include other demand determinants and socio-economic variables such as age, ethnic background, education, and preference for leisure. The study described herein was limited to a simple bi-variate demand analysis of price and quantity. Nevertheless, the simpler, secondary-data model may prove to give adequate estimates.

Table 16 shows the deer report questionnaire that the Arizona Game and Fish Department has used in the past few years. The data derived from this questionnaire gives the hunter distribution in a game management unit by county of origin, total hunters, and total number of deer hunter days in the unit. A sample of the current data is given in Table 17, for one game management unit.

Although these data were sufficient to complete a demand analysis, several problems existed. First, if a hunter only hunted in one game management unit, he was counted only once without recording the number of trips. Second, if a hunter hunted in several units, he was recorded once for each unit but the total number of trips was still unknown. What is needed is a breakdown of the number of deer hunting trips per hunter to each game management unit along with the average number of hunter days per trip by area of origin. By having these data, the assumptions regarding the average number of trips per season (2.0 trips per hunter per season) and the number of days per trip (distributed according to distance traveled) could be eliminated.

This new information could be used to examine the differences between the number of trips per season and hunter days per trip that

Table 16. Questions on Current Arizona Game and Fish Department Questionnaire (1969 Deer Report)

1. Residence: State _____ County _____

FIREARMS DEER

2. Did you buy a 1969 Firearms Deer Tag? Yes ____ No ____

3. Did you hunt for deer in Arizona in 1969? Yes ____ No ____

4. Write in ALL units by number in which you hunted deer. (Refer to map) Unit Number ____ ____ ____ ____

   Write in the number of days hunted in each unit (Count part of a day as a whole day) (Do not count pre-season scouting as hunting). Days Hunted ____ ____ ____ ____

5. Did you kill a deer during the 1969 firearms hunt in Arizona?

   Yes ____ No ____

6. In what unit did you kill a deer? _____ (Unit Number)

   Date of kill _____ (Month - Day)

7. Was it a white-tail deer ____ or mule deer ____?

8. Was it a buck* ____ or other ____?

9. Did you wound a deer that could not be recovered?

   Yes ____ No ____ How many ____

*Do not mark buck unless antlers exceed 3" in length.

Table 17. Sample of Current Data Collected by Arizona Game and Fish Department for Unit 1A in 1970

County of Origin	Distribution of Hunters (%)
Apache	16.3
Cochise	1.9
Coconino	1.1
Gila	6.1
Graham	3.8
Greenlee	10.6
Maricopa	33.3
Navajo	6.4
Pima	13.6
Pinal	3.0
Santa Cruz	.4
Yavapai	.4
Yuma	1.5
Non-resident	1.5

Total number of hunters in unit 1A equals 2,540.

Total number of hunter days in unit 1A equals 7,186.

hunters living close to the hunting area would take, as opposed to those residing a relatively longer distance from the area. It is hypothesized that the hunters living close to the area would take more trips per season with a small number of days per trip, whereby the individuals living farther from the hunting area would take fewer trips but for longer lengths of time. These added data could influence the estimate of the value for the resource.

Also, cost data could be added to the current information gathered by the Arizona Game and Fish. A careful distinction should be made between fixed and variable costs as discussed in Chapter 2 of this thesis. A cost-related question might attempt to extract the following information:

1. Food expenditures made by the individual for a single hunting trip which is in excess of what is normally spent at home.
2. Any additional lodging expenditures.
3. Any expenses for guides, equipment rentals, and ammunition.
4. Travel expenses.

The additional information regarding costs could be used to develop the independent variable (surrogate price). This would eliminate the need to impute values for the costs involved with making a deer hunting trip. At a minimum, one would need to know how many hunters shared the transportation costs.

One problem in reporting has been eliminated by new Arizona Game and Fish regulations. A deer hunter no longer can hunt in more than one

game management unit in a single year. Therefore, questions 4, 5, and 6 could be replaced by the following set of questions:

a. Write in the number of the game management unit in which you hunted deer. _____

b. How many trips did you take to the game management unit to hunt deer in the past season? _____

c. Write in the number of days per deer hunting trip for each trip taken to the area. Count each partial day as a full day.

	1st trip	2nd trip	3rd trip	4th trip	5th trip	6th trip
Days per trip	_____	_____	_____	_____	_____	_____

d. Did you kill a deer during the (year) firearms hunt in Arizona?

Yes _____ No _____ Date of Kill _____
Month-Day

Should the regulations again be relaxed so that hunters could hunt in more than one unit, the above information would be needed for each unit hunted.

If cost information were also to be gathered, additional questions could be as follows:

For the following questions, please estimate the expenditures that you and your family made specifically in relation to your most recent visit to this recreation area. Include only costs that you and your family incurred specifically in preparation for this one trip. (Make a rough guess if necessary)

(a) 1. Total food and refreshment expenditures made on this trip, including liquor. (This includes food and drink traveling to and from the site as well as at the site. Include the value of food and drink taken along from home.) $_____

2. Is this more, less, or the same as you would have made if you had stayed at home?

	(Circle One)	more	less	same
(b)	Lodging cost to and from the site as well as at the site, camp fees included.	$_____		
(c)	Ammunition	$_____		
(d)	Vehicle and equipment rental	$_____		
(e)	Additional miles that the car was driven for recreational purposes at or near the recreational site other than traveling to the site and returning home from the site	_____miles		
(f)	If transportation charges were shared, what proportion did you pay? (For example, 1/2, 1/4, etc.)	_____		

Summary Observations

Several conclusive statements can be made regarding the analysis and the results of the study. Primarily, the analysis showed that the secondary data gathered by the Arizona Game and Fish Department could be used to evaluate the deer hunting resource by accepted economic methods. It is shown that economic theory and statistical tools are applicable to both the data and this unique form of consumer good.

It was also determined that the surrogate price, which contains variable transportation and on-site expenditures, was the principle determinant of the number of hunts in a resource from origins of varying distances. The relatively high coefficients of determination (average R^2 = .70) indicated that the surrogate price did in fact explain a significant portion of the variation between the two variables.

The derived demand estimates from simple least squares regression analysis gave estimates of the willingness of the hunters to pay.

By assuming that the hunters will react to increases in cost as are described by the slope of the demand estimates of the recreation experience, the value of the resource can be determined. In addition, the final value of a game management unit is a function of the location of the resource area relative to the distance from large population centers, distribution of hunters, number of hunters, and the costs incurred for the deer hunting trip.

APPENDIX

SUPPLEMENTARY TABULATIONS: ESTIMATES OF RESOURCE VALUES AT ALTERNATIVE ADDED COSTS BY GAME AND FISH UNITS FOR 1970

	Added Cost Per Hunt ($)	Quantity of Hunts	Total Revenue ($)
Unit 1A	0	4,046	
	5	2,665	13,325
	10	1,639	16,390
	15	843	12,645
	20	524	10,480
	25	363	9,075
	30	183	5,490
	35	120	4,200
	40	63	2,520
	45	36	1,620
	50	18	900
	55	2	110
Unit 1B	0	3,318	
	5	2,042	10,210
	10	1,146	11,460
	15	693	10,395
	20	502	10,040
	25	361	9,025
	30	180	5,400
	35	120	4,200
	40	79	3,160

	Added Cost Per Hunt ($)	Quantity of Hunts	Total Revenue ($)
	45	56	2,520
	50	36	1,800
	55	21	1,155
	60	6	360
Unit 2	0	187	
	3	78	234
	5	34	170
	7	4	28
Unit 3	0	2,260	
	5	1,321	6,605
	10	762	7,620
	15	395	5,925
	20	258	5,160
	25	72	1,800
	30	43	1,290
	35	17	595
	40	10	400
	45	3	135
Unit 4	0	3,795	
	5	2,305	11,525
	10	1,372	13,720
	15	727	10,905

	Added Cost Per Hunt ($)	Quantity of Hunts	Total Revenue ($)
	20	410	8,200
	25	108	2,700
	30	64	1,920
	35	7	245
Unit 5	0	7,496	
	5	5,247	26,235
	10	3,635	36,350
	15	2,536	38,040
	20	1,699	33,980
	25	746	18,650
	30	250	7,500
	35	179	6,265
	40	13	520
Unit 6A	0	15,379	
	5	12,010	60,050
	10	9,189	91,890
	15	9,308	109,620
	20	5,599	111,980
	25	4,501	112,525
	30	410	12,300
	35	331	11,585
	40	24	960

	Added Cost Per Hunt ($)	Quantity of Hunts	Total Revenue ($)
	45	16	720
	50	9	450
	55	2	110
Unit 6B	0	3,384	
	5	2,683	13,415
	10	2,215	22,150
	15	1,892	28,380
	20	1,443	28,860
	25	1,251	31,275
	30	1,123	33,690
	35	150	5,250
	40	133	5,320
	45	107	4,815
	50	45	2,250
	55	19	1,045
Unit 7	0	3,445	
	5	1,935	9,675
	10	1,136	11,360
	15	773	11,595
	20	543	10,860
	25	381	9,525
	30	231	6,930

	Added Cost Per Hunt ($)	Quantity of Hunts	Total Revenue ($)
	35	171	5,985
	40	124	4,960
	45	87	3,915
	50	55	2,750
Unit 8	0	3,385	
	5	2,287	11,435
	10	1,341	13,410
	15	809	12,135
	20	383	7,660
	25	164	4,100
	30	112	3,360
	35	80	2,800
Unit 9	0	2,362	
	5	1,498	7,490
	10	754	7,540
	15	298	4,470
	20	202	4,040
	25	132	3,300
	30	94	2,820
	35	64	2,240
Unit 10	0	3,139	
	5	2,046	10,230

	Added Cost Per Hunt ($)	Quantity of Hunts	Total Revenue ($)
	10	1,051	10,510
	15	461	6,915
	20	230	4,060
	25	134	3,350
	30	82	2,460
	35	51	1,785
	40	25	1,000
	45	3	135
Unit 12B	0	2,193	
	5	1,218	6,090
	10	525	5,250
	15	227	3,405
	20	135	2,700
	25	92	2,300
	30	57	1,710
	35	27	945
Unit 13	0	3,308	
	5	2,702	13,510
	10	2,179	21,790
	15	1,742	26,130
	20	1,291	25,820
	25	986	24,650

	Added Cost Per Hunt ($)	Quantity of Hunts	Total Revenue ($)
	30	716	21,480
	35	82	2,870
	40	64	2,560
	45	49	2,205
Unit 15A	0	1,930	
	5	1,344	6,720
	10	986	9,860
	15	725	10,875
	20	424	8,480
	25	271	6,775
	30	138	4,140
	35	86	3,010
	40	55	2,200
	45	8	360
	50	2	100
Unit 16	0	11,517	
	5	7,901	39,505
	10	5,163	51,630
	15	3,196	47,940
	20	1,527	30,540
	25	458	11,450
Unit 17A	0	2,493	

	Added Cost Per Hunt ($)	Quantity of Hunts	Total Revenue ($)
	5	1,742	8,710
	10	1,036	10,360
	15	698	10,470
	20	418	8,360
	25	197	4,925
	30	9	270
Unit 17B	0	7,320	
	5	5,075	25,375
	10	2,971	29,710
	15	2,056	30,840
	20	1,350	27,000
	25	760	19,000
	30	19	570
Unit 18A,B	0	9,992	
	5	6,536	32,680
	10	4,146	41,460
	15	2,769	41,535
	20	1,763	35,260
	25	866	21,650
	30	114	3,420
	35	39	1,365
	40	21	840

	Added Cost Per Hunt ($)	Quantity of Hunts	Total Revenue ($)
	45	6	270
Unit 19A	0	2,120	
	5	1,504	7,520
	10	928	9,820
	15	740	11,100
	20	579	11,580
	25	441	11,025
	30	332	9,960
	35	23	805
	40	18	720
	45	13	585
	50	9	450
	55	6	330
	60	3	180
Unit 19B	0	4,088	
	5	2,445	12,225
	10	923	9,230
	15	191	2,865
	20	60	1,200
	25	22	550
Unit 20A,B	0	27,722	
	5	20,316	101,580

	Added Cost Per Hunt ($)	Quantity of Hunts	Total Revenue ($)
	10	15,007	150,070
	15	11,085	166,275
	20	8,174	163,480
	25	2,682	67,050
	30	1,764	52,920
	35	1,000	35,000
	40	366	14,640
Unit 21	0	6,731	
	5	4,929	24,645
	10	3,575	35,750
	15	2,652	39,780
	20	2,030	40,600
	25	1,545	38,625
Unit 22	0	12,288	
	5	8,254	41,270
	10	5,297	52,970
	15	3,077	46,155
	20	1,300	26,000
	25	263	6,575
Unit 24A	0	351	
	5	128	640
	10	25	250

	Added Cost Per Hunt ($)	Quantity of Hunts	Total Revenue ($)
Unit 26	0	1,086	
	5	934	4,670
	10	838	8,380
	15	68	1,020
	20	56	1,120
	25	29	725
Unit 27	0	2,817	
	5	1,607	8,035
	10	919	9,190
	15	428	6,420
	20	239	4,780
	25	140	3,500
	30	64	1,920
Unit 28	0	7,045	
	5	5,780	28,900
	10	3,744	37,440
	15	3,240	48,600
	20	588	11,760
	25	452	11,300
	30	298	8,940
	35	182	6,370
	40	128	5,120

	Added Cost Per Hunt ($)	Quantity of Hunts	Total Revenue ($)
Unit 29	0	1,592	
	5	944	4,720
	10	501	5,010
	15	242	3,630
	20	151	3,020
	25	75	1,875
	30	31	930
Unit 30A	0	4,533	
	5	2,859	14,295
	10	1,912	19,120
	15	683	10,245
	20	488	9,760
	25	328	8,200
	30	233	6,990
	35	159	5,565
	40	100	4,000
	45	52	2,340
	50	12	600
Unit 30B	0	6,447	
	5	4,524	22,620
	10	3,210	32,100
	15	824	12,360

	Added Cost Per Hunt ($)	Quantity of Hunts	Total Revenue ($)
	20	597	11,940
	25	431	10,775
	30	302	9,060
	35	198	6,930
	40	114	4,560
	45	43	1,935
Unit 31	0	3,777	
	5	1,967	9,835
	10	742	7,420
	15	389	5,835
	20	215	4,300
	25	124	3,100
	30	64	1,920
Unit 32	0	10,386	
	5	7,673	38,365
	10	5,821	58,210
	15	4,264	63,960
	20	1,291	25,820
	25	287	7,175
	30	201	6,030
	35	105	3,675
	40	38	1,520

	Added Cost Per Hunt ($)	Quantity of Hunts	Total Revenue ($)
	45	20	900
	50	4	200
Unit 33	0	5,876	
	5	4,893	24,465
	10	4,179	41,790
	15	2,241	33,615
	20	205	4,100
	25	130	3,250
	30	126	3,780
	35	123	4,305
	40	120	4,800
	45	118	5,310
	50	115	5,750
Unit 34A	0	11,912	
	5	9,353	46,765
	10	7,496	74,960
	15	4,470	67,050
	20	2,529	50,580
	25	2,049	51,225
	30	1,781	53,540
	35	1,551	54,285
	40	1,332	53,280

	Added Cost Per Hunt ($)	Quantity of Hunts	Total Revenue ($)
	45	1,108	49,860
	50	409	20,450
	55	36	1,980
	60	32	1,920
	65	27	1,755
	70	24	1,680
Unit 35A	0	9,446	
	5	7,055	35,275
	10	5,394	53,940
	15	2,711	40,665
	20	1,657	33,140
	25	1,235	30,875
	30	885	26,550
	35	688	24,080
	40	534	21,360
	45	85	3,825
	50	68	3,400
	55	52	2,860
	60	39	2,340
	65	27	1,755
	70	16	1,120
	75	6	450

	Added Cost Per Hunt ($)	Quantity of Hunts	Total Revenue ($)
Unit 36A,B,C	0	8,507	
	5	6,068	30,340
	10	4,360	43,600
	15	2,264	33,960
	20	1,536	23,040
	25	1,109	27,725
	30	834	25,020
	35	604	21,140
	40	436	17,440
	45	175	7,875
	50	117	5,850
	55	67	3,685
	60	24	1,440
Unit 37B	0	15,613	
	5	9,794	48,970
	10	3,229	32,290
	15	1,723	25,845
	20	33	660
Unit 38	0	406	
	5	355	1,775
	10	235	2,350
	15	11	165

	Added Cost Per Hunt ($)	Quantity of Hunts	Total Revenue ($)
Unit 39	0	695	
	5	596	2,980
	10	518	5,180
	15	380	5,700
	20	9	180
Unit 41	0	2,018	
	5	1,500	7,500
	10	1,167	11,670
	15	893	13,395
	20	709	14,180
	25	567	14,175
	30	450	13,500
	35	352	12,320
	40	269	10,760
	45	197	8,865
	50	135	6,750
	55	80	4,400
	60	32	1,920
Unit 42	0	2,892	
	5	2,196	10,980
	10	1,695	16,950
	15	20	300

	Added Cost Per Hunt ($)	Quantity of Hunts	Total Revenue ($)
	20	7	140
	25	5	125
	30	3	90
	35	1	35
Unit 45	0	4,130	
	5	3,044	15,220
	10	2,144	21,440
	15	1,546	23,190
	20	8	160

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