Valuing Resources and Uses in the Central Winter Ecosystem Management Area North Kaibab Ranger District

Report prepared for the North Kaibab Ranger District
Kaibab National Forest
Fredonia, AZ.

By

Dr. Jon A. Souder
College of Ecosystem Science and Management
School of Forestry
Northern Arizona University,
Flagstaff, AZ 86001

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EXECUTIVE SUMMARY

The purpose of this study is to initiate the incorporation of considerations of the benefits that society receives from wildlands into decisions that are made about their management. Too often, resource managers have been resistant to using economic valuation information, often because they feel that determining societal benefits is too complex for individual allotments or ecosystem management areas, that the quality of the information limits its effectiveness, or that decisions should not be made on the basis of economics, or a combination of these reasons. It is my intent in this study to show that readily available information can provide an indication of the relative values associated with various uses of wildlands, and that this information—while not perfect—is at least comparable in quality to the quality of other types of data relied upon to make decisions. The process used for the valuation in this study is based on a systems approach that looks at the quantity and quality of resources that provide public benefits, attempts to place a value on the yield of these resources, and by implication, provides evidence of effective ways to gain additional benefits. Through the process of constructing this valuation, the limitations of available data became apparent, which has an additional benefit of indicating what information could be collected to improve the economic justification for resource management decisions.

This valuation analysis is for the Central Winter Ecosystem Management Area (CWEMA) of the North Kaibab Ranger District, Kaibab National Forest. The Kaibab Plateau, where the CWEMA is located, is unique in serving as the northern gateway to the North Rim of the Grand Canyon National Park, of having one of the best—if not the premier—mule deer population in Arizona and the southwest, having traditionally provided support to surrounding local communities resulting from recreation (including hunting), forage for livestock, and fuelwood for personal use. As times have changed, society's demands for services from the Central Winter EMA have also changed. This report illustrates how the relative balances of uses of the CWEMA have changed from the traditional focus on commodities to greater recent benefits from non-consumptive uses. The following table provides a summary of the estimates of the benefits received from the CWEMA.

Summary of estimated values received annually in the Central Winter EMA.

Resource	Analysis Area	Estimated Benefits	Fee Receipts Distribution				Benefit Distribution	
			County	State	Treasury	N.K.R.D.	Local	Region
Dispersed Recreation	W. of S.R. 67	$6,400,000	$0	$0	$0	$0	$6,400,000	
Hunting								
Mule Deer	CWEMA	$922,604	$0	$51,649	$0	$14,757	$470,528	$452,076
Turkey	CWEMA	$401,655	$0	$20,375	$0	$0	$248,864	$132,416
Livestock Grazing	CWEMA	$45,988	$676	$0	$1,353	$676	$43,283	unknown
Fuelwood	NKRD	$48,984	$839	$0	$2,517	$0	$45,492	$0

Sources: Information discussed in report.

INTRODUCTION

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Two broad categories of human uses occur in the Central Winter EMA and will be analyzed. The first are called "non-consumptive" uses, which mean that the object of enjoyment is not consumed by the user, but remain available to others. Dispersed recreational use is considered non-consumptive in this discussion. Typical examples of these non-consumptive uses are auto touring, sightseeing from viewpoints, nature study and viewing wildlife. Non-consumptive uses, while generally jointly available to others, can be adversely affected by crowding and resource degradation may be caused by overuse.

The second category of human use are those activities that "consume" resources. In these activities, one person's use generally precludes another person from obtaining the same benefit. For example, if a deer is harvested by one hunter, that deer is not available to another hunter; or if livestock eat forage, that plant material is not available for other species' use. Examples of consumptive uses in the CWEMA that will be evaluated are hunting, livestock grazing, and fuelwood gathering.

METHODS

A variety of mechanisms are available to determine the values that people place on the various human uses in the Central Winter EMA. If uses are sold in the open market, the price that people are willing to pay for a use provides the surest indication of the demand for, and the value placed, on that use. However, most uses on public lands are not sold competitively in the open market. As a result, other methods of determining demand and value are needed. One way to indirectly estimate values is to determine how much people spend to partake in an activity. Expenditures are commonly divided into fixed costs—such as the costs to purchase necessary equipment and travel to the location—and variable costs, such as food, etc., that reflect the amount of time spent in an activity. A third way to determine value is to ask people what they are willing-to-pay to have specific uses available, or conversely willing-to-accept to allow removal. This mechanism—called contingent valuation—is commonly used to determine non-market values.

The principal valuation mechanism used for the analyses in this section is transactions evidence of user expenditures as determined by surveys. Two primary surveys provide the source material for the non-consumptive uses and hunting values. The 1991 National Survey of Fishing, Hunting, and Wildlife Related Recreation (U.S.D.I., U.S.D.C., 1993) contains Arizona-specific participation and expenditure information. The results from this survey are used to characterize state-wide recreational uses and per-day state-wide expenditure information for non-consumptive recreation and hunting. The second survey was conducted by Dr. Martha Lee and others in 1992 for two Districts in the Kaibab National Forest (Lee et al., 1993, 1994). In this survey, visitors to the North Kaibab Ranger District were interviewed about the size of their group, where they were from, and the number of days they stayed in the area. Interviewees were provided with a mail-back written survey that requested information on the various types of activities that they participated in, where—and for how long—in the North Kaibab they visited, and how much they spent in the local area. In addition, Lee et al. specifically targeted deer hunters in a supplementary survey to determine how they used the North Kaibab Ranger District.

The demand for the various uses is an important component of the valuation process. One way to characterize demand is to look at the level of past uses in an area to project future uses. So if use of an area or resource has increased at an annual rate of 3% over the past ten years, it is not too extreme to expect that in the near-term equivalent increases will occur. However, the accuracy of projecting future uses from past trends is lower as the time horizon increases, or as the carrying capacity is reached. Future demand for non-consumptive recreational uses will use a trend projection technique (Rowlands, 1993) in combination with the visitor use information in Lee et al. (1993, 1994). For commodities that are marketed, demand is also indicated by the relative

profitability of the enterprise. This technique will be used to characterize the demand for the products of livestock grazing.

A second way is to think that demand is an indicator of the uniqueness of a specific use in the CWEMA, compared to the availability of that use elsewhere. Uniqueness can be determined by examining the origin of visitors (i.e., how many are from out-of-state or from foreign countries), using the assumption that the further that someone travels indicates the uniqueness of a specific use or site. Uniqueness can also be determined—where the supply or availability is limited—by identifying the number of people who desire to use a resource compared to the amount available. Economists call this "excess demand", and it is again an indicator of the uniqueness of the resource if there are more people desiring it than can be accommodated. In a number of cases, there is an excess demand for resources throughout the region, state or nation. If the available quantity is fixed (so that prices do not rise to reduce demand), then the level of excess demand in one location relative to others is an indication of uniqueness. This characterization of uniqueness will be used for hunting opportunities in the CWEMA compared to other areas of the state, with the ratio of demand versus supply for the various hunts throughout the state ranked. Those hunts where excess demand is greatest are necessarily more unique than those where demand is less.

The data used for the valuation is from pre-existing studies; no original material was collected for this study. The data quality reflects the original purposes for which it was collected, but its accuracy is generally within the range of acceptability for the purposes of the CWEMA. The geographic area covered by a number of studies is larger than the CWEMA; in these cases the studies' results have been interpreted and adjusted to reflect the conditions in the CWEMA. This has been done through consultation with the originators of the studies and the CWEMA Interdisciplinary Team. All monetary values are adjusted for inflation, and reported in 1996 dollars.

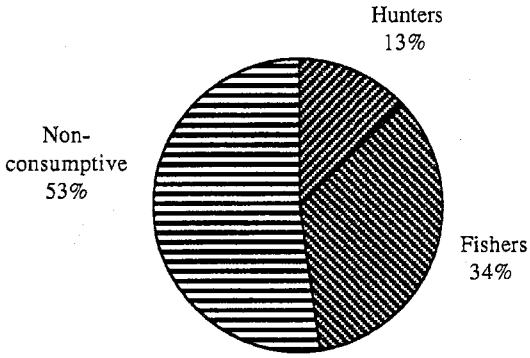
The valuation section is organized by major resource use, and within each resource part existing uses, the demand and uniqueness of the resource, and estimated values are discussed. First, non-consumptive recreation will be discussed. The second part discusses hunting use in the CWEMA, focusing on mule deer and Merriam's turkey. The third part evaluates the benefits of livestock grazing in the Central Winter EMA. This discussion is followed by an estimate of the economic values resulting from fuelwood gathering and timber harvests in the CWEMA. A final, concluding section summarizes the valuation information to provide the framework for discussing potential trade-offs and joint benefits among the various resources valued by humans in the Central Winter EMA.

RESULTS

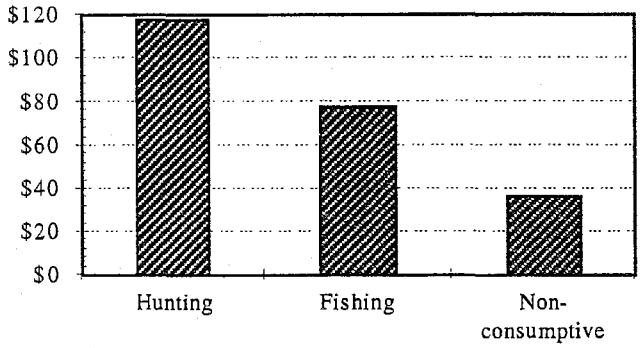
I. Non-consumptive Recreation

Because of its location adjacent to the North Rim of the Grand Canyon National Park, its close proximity to other National Parks and Monuments in southern Utah—the "Golden Circle"—and its comparatively pristine nature, the North Kaibab Ranger District receives high visitor use,

Wildlife-related Recreation in Arizona



Arizona Recreational Expenditures
(1996 Dollars Per Day of Activity)



both from state residents, from across the nation, and from throughout the world. The characteristics of this visitation can first be ascertained by looking at recreational uses, and values, in the state of Arizona. The analysis will then proceed by examining patterns in the recreational use of the North Kaibab Ranger District, and finally estimate values for an area that contains the Central Winter EMA.

A. Overview of Recreation in Arizona

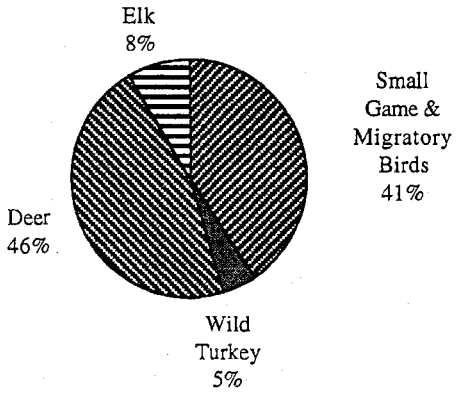
Recreation is immensely important for both residents and visitors to Arizona. Popular activities include not only hunting and fishing, but also a variety of non-consumptive recreation uses. Recreational usage on a state-wide basis can be described in terms of the number of people participating, what they do, how long and how much money they spend on their trips, and whether or not they are residents or visitors. State-wide information on wildlife-related recreation is available in the 1991 *National Survey of Fishing, Hunting, and Wildlife-Associated Recreation* (U.S.D.I., U.S.D.C., 1993).

Fifty-three percent of Arizona residents and visitors reported in the *1991 Survey* that they primarily engaged in non-consumptive wildlife-related recreation: feeding, photographing, and/or observing wildlife in their trips outside of their home community (defined as greater than 1 mile from their residence). Consumptive wildlife-related recreation was primarily fishing (34% of respondents), with hunting being a distant third (13% of respondents).

However, the amount that people expend to engage in recreation is related to the type of activity. Hunters tend to spend proportionately greater amounts per day of activity than either anglers or non-consumptive recreationists. Expenditures are generally the amount paid to travel and stay at an activity site, and oftentimes also include equipment costs and fees. Nonresidents not only have the added expense of more travel costs in order to reach their destination, but also the higher charges for permits if they hunt or fish.

Hunting opportunities in Arizona exist for a number of different species. By far the most hunting occurs for deer (46% of hunters hunt deer). Small game and migratory birds provide another forty percent of hunting in the state. Elk (8%) and wild turkey (5%) provide the remainder of hunting recreational use.

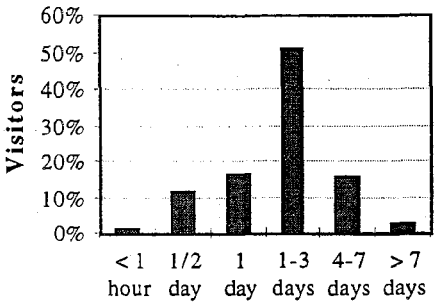
Hunting in Arizona
(Proportion by Number of Hunters)



1. North Kaibab Ranger District Recreational Use

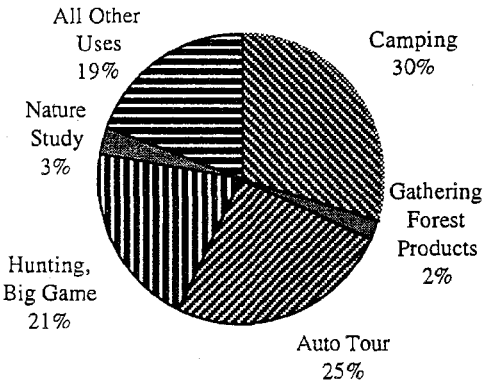
Use. Lee et al.'s (1994) study estimated that there were 533,525 visitors to the North Kaibab/North Rim GCNP in 1992. Of these visitors, 70% visit both the National Park and the National Forest, while 12% visit only the Forest. The majority of visitors spend from 1 - 3 days in the area.

Length of Visit to N.K.R.D.



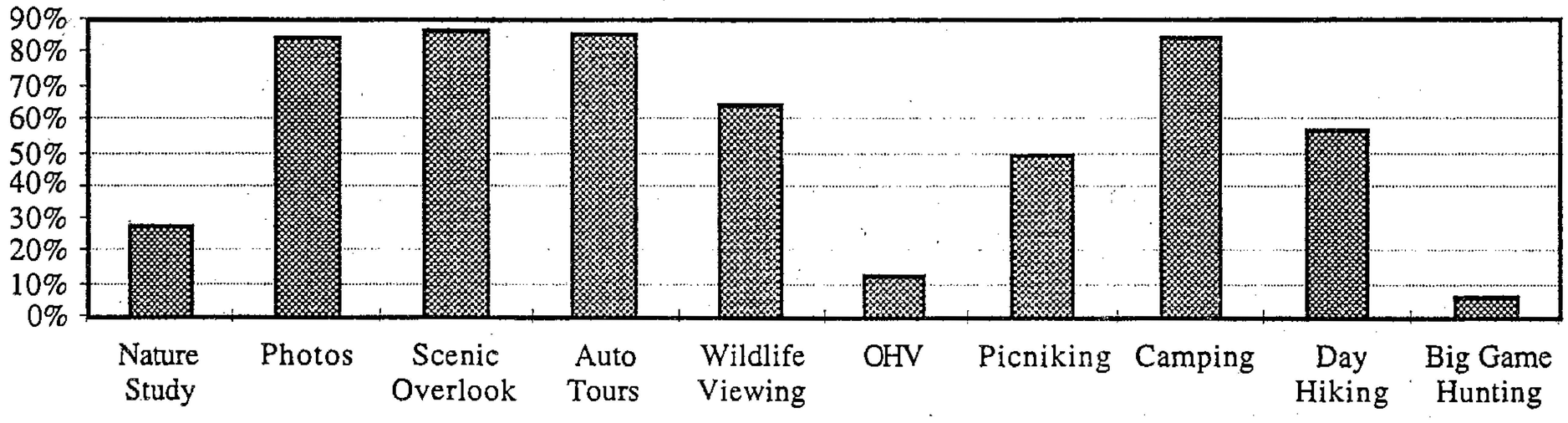
Two sources of information are available on recreational uses in the North Kaibab Ranger District. The first is the statistics collected by the Forest Service, called the RIM database. It is apparent from examining the database that consistency in data collection makes comparing year-to-year recreational use difficult, if not impossible. Nonetheless, the figure at right takes the median of reported recreational uses for the period 1988 - 1996 (excluding 1992), to provide an indication of the various types of recreational activities occurring in the North Kaibab Ranger District. Auto touring, camping and big game hunting are the three most common recreational activities, comprising over 75% of use in the District.

Major Recreational Uses on the North Kaibab Ranger District
(Median % of RVD's, 1988–1996)



The second source of information on recreational uses of the North Kaibab Ranger District comes from the Lee et al. (1993) survey and accompanying reports. Lee et al.'s use categories differ from those contained in the RIM database. Additionally, rather than apportioning visitation to various uses, as the RIM reports do, Lee et al. (1993) asked survey respondents to check from a list which activities they participated in. The survey results indicate that most visitors to the North Kaibab Ranger District camp—either in dispersed (19%), tents (39%) or in RV's (26%), and most

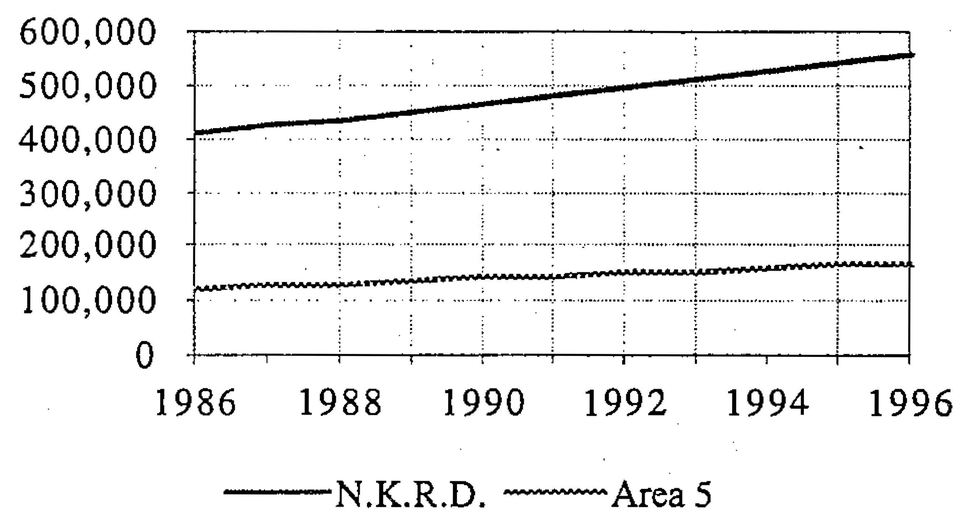
Visitor Activities in N.K.R.D. (Lee et. al., 1993a)



drive through the Forest to scenic overlooks where they take pictures and watch wildlife. Compared to the RIM's data, the 1992 Survey showed higher rates of participation in nature study (28% compared to 3%) and lower rates of big game hunting (6.5% compared to 21%).

Demand. Rowlands (1993) projects increased visitation to the North Rim of the Grand Canyon National Park of just over 3% per year based on visitation over the period 1986 - 1996.

Visitation to NKRD and Area 5.



The uniqueness of the North Kaibab Ranger District and the North Rim of the Grand Canyon National Park is indicated by the percentage of visitors from foreign countries, 10%, and the percentage of visitors from states other than Arizona and Utah, 70% (Lee et al., 1993). Only 11% of the visitors were from within 150 miles of Jacob Lake (Lee et al., 1993).

Value. Lee et al.'s (1994) study determined that visitors spent an average of $276.84 in the local area during visits to the North Kaibab/North Rim GCNP. In 1996 dollars, this would be about $313 per trip.

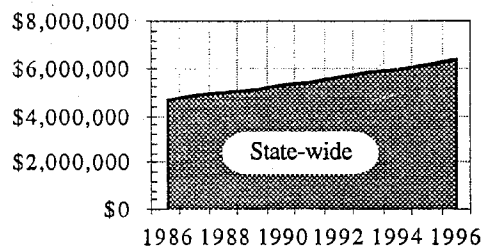
2. Central Winter EMA Recreational Use

Visitor use statistics are not collected separately for the Central Winter EMA. The closest proxy for this information is data reported in Lee et al. (1992) surveys for the North Kaibab Ranger District. Lee et al.'s Area 5 corresponds to the portion of the North Kaibab Ranger District lying to the west and outside the travel zone of State Highway 67, from Jacob Lake to Grand Canyon National Park, and south, and outside the travel zone, of U.S. Highway 89A from Jacob Lake to Fredonia.

Uses. Of those visiting the Forest or Park, 69% never went west of State Rt. 67 or U.S. 89A into Area 5. The 31% who did go into Area 5 spent an average of 26 hours there. Converting this to recreation days, this would approximate 179,800 visitor days, with the vast majority of this being non-consumptive (wildlife viewing, auto tours, etc.).

Value. Lee et al.'s (1994) study concluded that visitors spent an average of $276.84 in the local area during visits to the North Kaibab/North Rim GCNP. The value of this from the 1991 National Fish, Wildlife and Non-consumptive Wildlife Use is $36.77 per day (1996 dollars), which translates to about $6.4 million in 1996. The figure at right shows estimated expenditures for the period from 1986 to 1996.

Area 5 Estimated Expenditures
(1996 Dollars)



II. Hunting

Hunting opportunities exist for mule deer, Merriam's turkey, blue grouse, Rocky Mountain bighorn sheep, and a number of other game birds and small mammals. In this valuation, the focus will be on mule deer and turkey, because that is where the bulk of the demand and value exists. The basic data source for the use and demand sections is the Arizona Game and Fish Department's "Hunt Statistics" database for the years 1986 - 1996. Use statistics were derived from the number of hunters and hunt-days in Game Unit 12A for turkey and archery mule deer hunts, and Unit 12A West for firearm mule deer hunts.

With the exception of archery hunts, big game hunt tags are allocated through a lottery system. Applicants submit their first, second, etc. choices for particular hunts (i.e., geographic area and time within the season), which are then randomly drawn in a lottery. Hunting demand, and the uniqueness of the Central Winter EMA, was determined in two ways. First, the number of first and second requests for a particular hunt where added and then divided by the number of available permits for that particular hunt. This provides an indication of the demand for that hunt relative to the supply of available permits. An excess demand for that hunt exists if the ratio of choices to permits is greater than one; while there is a surplus of permits if the ratio is less than one. The higher the ratio the greater the excess demand.

Hunter value information is derived from two sources: (1) the *1991 National Survey of Fishing, Hunting, and Non-consumptive Wildlife* (NSFHW, U.S.D.I.-U.S.D.C., 1993), and (2) Lee et al.'s 1992 survey of deer hunters on the North Kaibab Ranger District (Lee et al., 1993, 1994). The 1991 National Survey of Fishing, Hunting, and Wildlife Associated Recreation reports expenditures on a per-person, per-day basis state-wide. In contrast, the *1992 Lee Survey* asked respondents how much they spent in the local area on a per-trip basis. In both the following sections, regional expenditures are calculated by multiplying the number of hunters by Lee et al.'s per-trip figure ($297.64/trip in 1996 dollars). State-wide expenditures are calculated by taking the 1991 NSFHW per day value ($117.61/day in 1996 dollars), multiplying by the number of hunter days, and then subtracting the amount determined to be the regional expenditures.

A. Mule Deer Hunting in the CWEMA

Significance of the Kaibab mule deer population has been recognized since the 1900s, culminating with the establishment of the Grand Canyon Game Preserve in 1906. This mule deer population has been one of the most intensely studied, certainly in Arizona if not in the Colorado Plateau as a whole (Russo, 1964, Haywood et al., 1987; McCullock and Smith, 1991). Because of these studies, it is possible to provide comparatively detailed information on the herd's population dynamics, mule deer use of the Central Winter EMA, and hunting use and values.

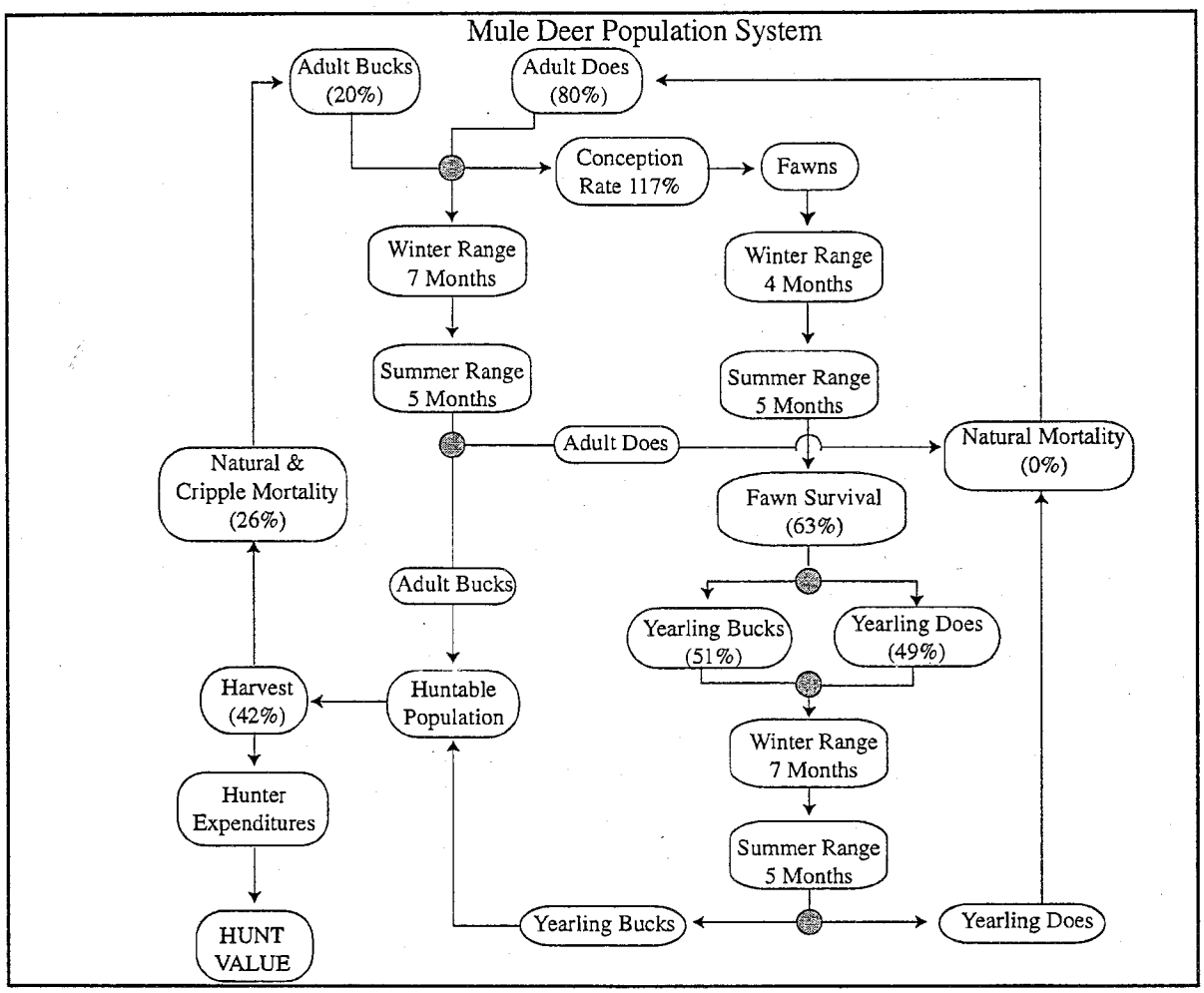
1. Mule Deer Populations on the Central Winter EMA.

The figure below shows a systems diagram representing how the inter-relationships among the components of the mule deer herd. The following two tables provide the data used to describe the population characteristics of the mule deer herd in the Central Winter EMA. The herd is comprised of bucks (males) and does (females), both adults (over two years of age) and yearlings (between one and two years old), and fawns (the young less than one year old. Due to hunting pressure, the ratio of bucks to does is relatively small, on average there are four adult does for every adult buck. This imbalance in sex ratios is not evident in the yearling animals, where bucks and does are relatively balanced. Adult does (usually reproductive at about two and a half years) generally have an average of more than one fawn, hence the conception rate is greater than one. Natural mortality is high for fawns, with only about 63% surviving to be one year old. Survival rates for yearlings are difficult to easily determine from available statistics, because the surviving yearlings go into the adult population comprised of multi-age classes. Because most yearling bucks have antlers, they are susceptible to hunting pressure the same as the adult bucks. Hunting mortality for these bucks averages about

Population dynamics of the Unit 12A WEST mule deer herd.

Component	Median	Low Range	High Range
Adult Buck:Doe Ratio	0.25	0.22	0.40
Yearling Buck:Doe Ratio	1.03	0.94	1.05
Fawns:Doe	1.17	1.03	1.70
Buck Harvest Percentage	42%	39%	49%
Doe Natural Mortality	-1%	-2%	7%
Buck Mortality (Natural + Cripple)	26%	15%	46%

Source: Population data from the table below, using techniques in Russo (1964).



42%, ranging from 39% to 49% depending upon the year. In addition to hunting mortality, bucks also suffer from cripple mortality (Russo, 1964) when they are wounded (or left as unsuitable), as well as natural mortality from severe winters and predation. For bucks, non-hunting mortality averages about 26% of their population, but can range from a low of 15% to a high of 46%. Doe mortality is basically from natural sources: birthing, predation, and winter stress. It averages less than 1% (the negative figure in the table probably represents survey error), to a high of about 7%. Because in recent years (since 1991), only antlered hunts have been permitted, the population available for harvest is represented by bucks and yearling bucks, although periodically the Game & Fish Commission authorizes antlerless hunts to reduce population levels and bring the buck:doe sex ratios up.

Population estimates for the Unit 12A West mule deer herd were provided by the Arizona Game and Fish Department. These are displayed below for the period 1986 – 1996. The entire mule deer population shown in the above table ultimately produces the huntable animals through the process described in the flowchart. It is these huntable animals that draw hunters to the North Kaibab and the Central Winter EMA. Both the mule deer population, and hunting activities, occur

in an area greater than the CWEMA, but because the mule deer herd uses the CWEMA for its wintering grounds, and the late-season hunts typically occur within the CWEMA, it is reasonable to apportion the hunting benefits received according to the proportion of time that the herd spends on the winter range.

Estimates of mule deer populations and harvests, Unit 12A West, 1986–1996.

	Pre-hunt Population						Post-hunt Population			
Year	Yearling Bucks	Bucks	Does	Yearling Does	Total	Harvest	Bucks	Does	Fawns	Total
1986	2,206	1,383	6,054	2,206	11,848	3,135	1,352	7,510	5,557	14,418
1987	1,662	1,986	5,626	1,662	10,936	2,792	1,612	6,449	4,321	12,382
1988	1,529	1,863	5,427	1,631	10,450	2,164	2,038	6,175	3,952	12,165
1989	1,136	1,963	4,946	1,136	9,181	3,226	1,682	6,008	3,064	10,754
1990	912	1,819	4,559	897	8,188	3,581	749	4,407	2,688	7,845
1991	837	1,126	3,364	813	6,140	764	1,014	4,225	2,704	7,944
1992	999	972	3,337	973	6,281	804	961	4,368	2,883	8,211
1993	1,075	943	3,402	1,019	6,439	928	643	4,504	2,896	8,043
1994	1,018	871	3,483	966	6,338	856	677	4,514	2,663	7,854
1995	832	781	3,505	856	5,974	698	768	4,042	3,395	8,204
1996	1,066	867	3,685	1,066	6,683	797	757	4,453	3,073	8,283

Source: Population estimates provided by Mr. Todd Buck, Arizona Game & Fish Department, Fredonia, AZ., 8/1/97.
Harvest data provided by Arizona Game & Fish Department, Game Management Branch, Phoenix, AZ.

The mule deer population requires forage for its food. A commonly accepted way to measure forage use by mule deer is to convert their consumption to Animal Unit Months (AUMs). Because AUMs are also used to account for livestock forage use, it is possible to compare—and allocate—forage use between mule deer and livestock. Five mule deer are considered to be the equivalent of one Animal Unit (AU). It is possible to determine the mule deer's forage consumption by using the population figures in the above table. The following assumptions are required to estimate mule deer forage use in the CWEMA:

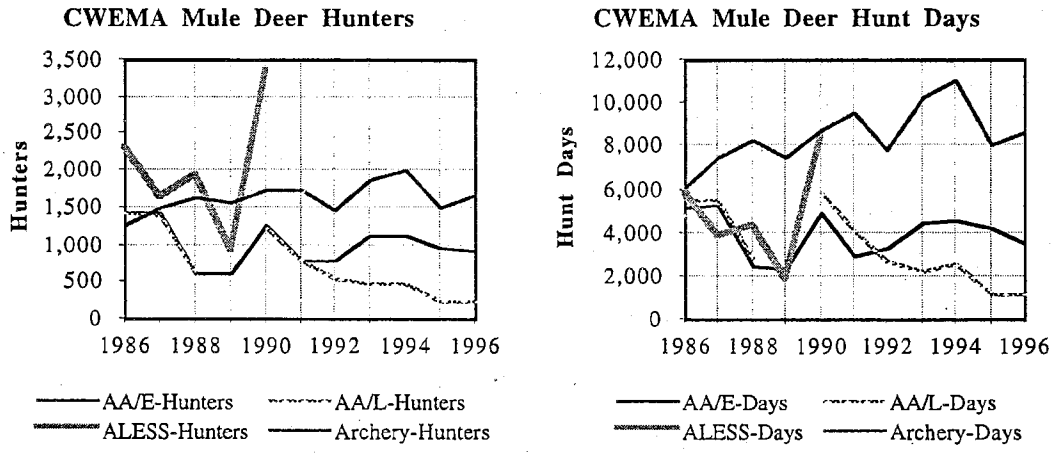
(1) Five adult or yearling mule deer comprise one Animal Unit (i.e., fawns are treated like calves in the calculation of forage use);
(2) The Unit 12A WEST herd spends 6 months from May to October on its summer range (including migration time), and 6 months from November through April on its winter range (including migration time) (Haywood et al., 1987);
(3) The average date of hunts is November 1;
(4) Thus, the "Pre-hunt" population is on the CWEMA for 4 months (January through April), and the "Post-hunt" population is on the CWEMA for 2 months (November and December).

Using the assumptions described above, over the last five years the Unit 12A WEST mule deer herd is estimated to have consumed an average of 13,777 AUMs of forage, of which 7,130

AUMs were located on the Central Winter EMA. The bulk of the remaining forage for this herd is provided by the Central Summer Allotment. These 7,130 AUMs of forage are considered to provide the sustenance that the Unit 12A WEST herd requires to produce the mule deer that are sought by hunters in the CWEMA.

2. Deer Hunter Use and Values in the CWEMA

Hunter Use. Four different mule deer hunts occur in Game Unit 12A WEST. Depending upon the weather, hunters during the late season hunts are likely to be physically present in the CWEMA, while those hunting earlier will be at higher elevations, but are seeking mule deer that require winter range in the CWEMA. Firearm hunts are divided into early (AA/E) and late season



(AA/L) for antlered deer. Periodically, there are also antlerless (does and fawn) hunts (ALESS) to reduce herd numbers. The anterless hunts typically occurred in late October when the herd was on its summer range. However, two of the antlerless hunts during the last time they were offered (1990) occurred during the first half of November when the herd was probably migrating from it summer to wintering grounds.

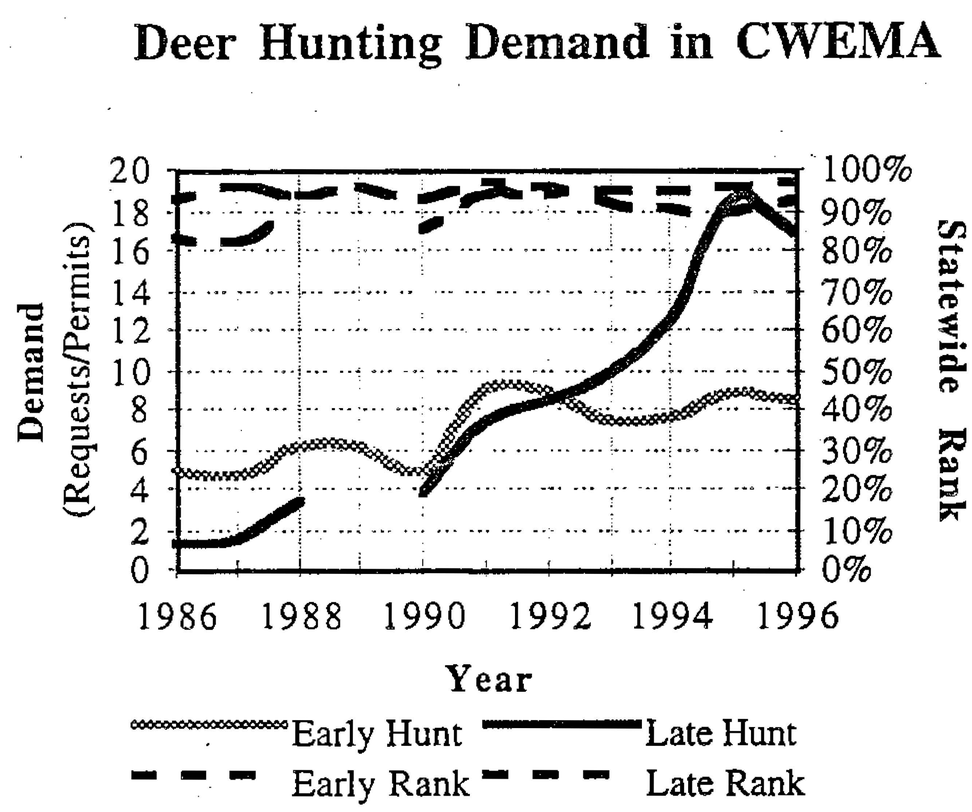
With the exception of archery hunts, mule deer tag numbers are set by the Arizona Game Commission based on recommendations from the Arizona Game and Fish Department (AG&FD). The AG&FD bases their hunt tag recommendations on the population size and hunter success. The Department also recommends antlerless hunts when population levels exceed what they consider to be the habitat's carrying capacity.

The number of mule deer tags available for firearm hunts for antlered deer has been between 1,250 and 1,650 for the early and late hunts over the past six years. Tags in recent years have been reduced from levels of about 3,000 per year for antlered deer that were seen in the late 1980's. Deer populations were also reduced in the late 1980's and in 1990 through high levels of antlerless deer tags: 11,100 were sold over the period 1986 - 1990, ranging from 1,000 in 1989 to 3,700 in 1990. Since 1990 no antlerless deer tags have been sold. In contrast to the recent

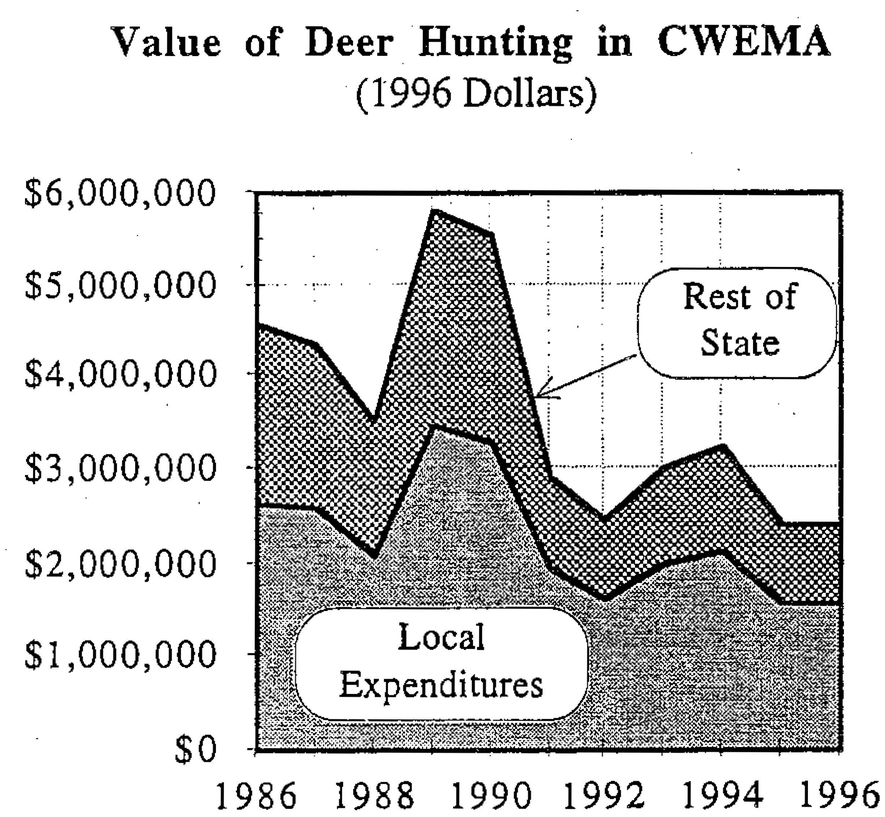
reduction in firearm mule deer tags, the number of archery hunters has increased on the Kaibab Plateau.

The AG&FD only reports archery hunters and hunt days on a Unit 12A basis, but McCulloch and Smith's (1991) research that shows that 60% of the Kaibab Deer Herd winters in the CWEMA. Thus the AG&FD's archery hunt data has been adjusted to account for this 60%: this means that an additional 1,500 to 2,000 archery hunters are afield annually in Unit 12A WEST. And the trend in archery hunting use of the CWEMA's mule deer herd is increasing as the number of tags for firearm mule deer have decreased.

Demand. The reduction in mule deer firearm tags has coincided with increased demand for these tags statewide. Demand for the early hunt tags has been around eight times the available supply over the past five years, while demand for the late hunt—which takes place in the pinyon-juniper and typically produces higher numbers of trophy deer—has exceeded the number of available permits by over sixteen times in the last three years. On a state-wide basis, these two hunts rank in the top 10% of demand, with the late one generally being in the top three most demanded hunts in the state. And the Unit 12A WEST firearm hunts allow at least as many tags as the total number of higher-ranked hunts, testifying both to the uniqueness and the productivity of the Kaibab mule deer herd.



Value. The value of hunting in the CWEMA can be determined from the number of hunters, and the number of days that they spend hunting the Unit 12A WEST mule deer herd. We know from statistics compiled by the Arizona Game & Fish Department that over the last five years an average of 3,150 tags for all hunts on Unit 12A WEST (including pro-rated archery tags). These hunters generated an annual average of 3,079 trips for an average of 15,145 days for each year.

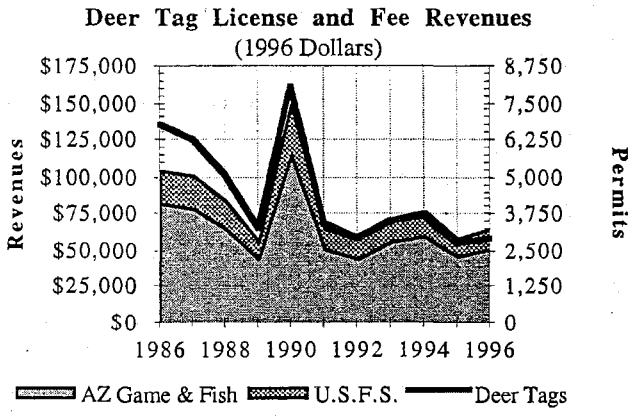


The figure at right shows the values received from this hunting, both for expenditures in the local area ($297.64/trip; Lee et al., 1993, 1994), and statewide ($117.61/day; NSFHW,

1993). The five year average value for the Unit 12A WEST mule deer hunts is estimated to be $1,783,000 (1996 dollars), divided 51% for expenditures in the local, North Kaibab area, and 49% for the rest of the state (or nation).

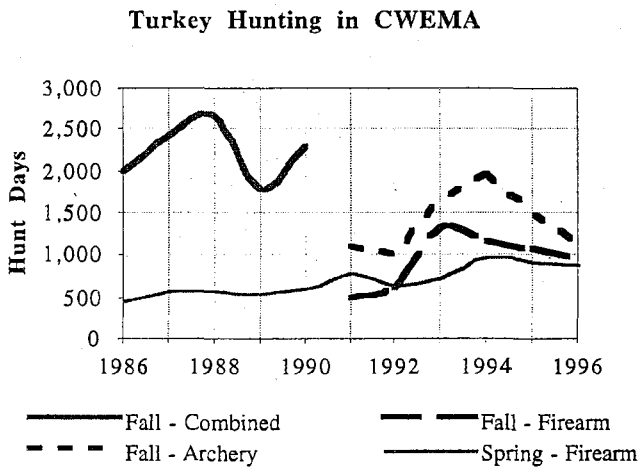
The value of the forage consumed by the Unit 12A WEST mule deer herd can be imputed by combining the valuation information from above with the forage consumption information provided earlier. Assume that the average mule deer hunting value is about $1,800,000 per year, and the deer herd is estimated to consume about 14,000 AUMs of forage annually to produce this benefit. The value of this forage is estimated to be $129.41 per AUM. The hunting benefit produced by the forage consumed by mule deer on the CWEMA is estimated to average $922,604 per year.

The mule deer hunts also provide direct revenues to both the Arizona Game and Fish Department through their license fees, and to the North Kaibab Ranger District through the $5.00/tag surcharge for hunting in the Grand Canyon Game Preserve. On a last five-year average basis, the Game and Fish Department received about $52,000 per year (inflation adjusted to 1996) in license fees for hunting in Unit 12A WEST. The Department and the North Kaibab Ranger District received in addition almost $15,000 per year for habitat improvements funded by the $5.00/tag surcharge.



B. Merriam Turkey Hunting in the CWEMA

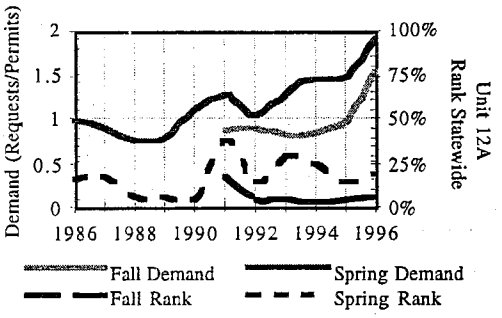
Turkey hunting data and values were determined similarly to mule deer. First, turkey hunt data for the period 1986 - 1996 for Unit 12A was extracted from the Arizona Game & Fish Department's turkey hunt database. The AG&F estimate that 75% - 80% of the turkey habitat, populations, and hunting occurs in the Central Winter EMA. For our purposes, the 75% estimate was used. Hunting values, and local and state-wide economic values used the same day- and trip- expenditure information that was used for mule deer.



Use. Between 750 to 1,400 turkey hunters annually use the Central Winter EMA for 3,000 to 5,000 hunter days. Firearm hunts occur in the spring and fall, and archery hunts in the fall. The majority of use is in the fall (75%), while the number of hunt days is divided almost equally between firearm (55%) and archery (45%).

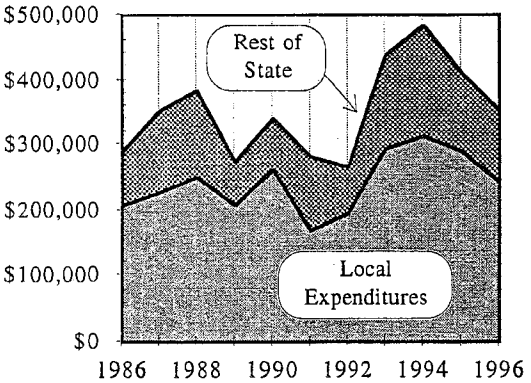
Demand. Estimates of demand for turkey hunting, and the relative attractiveness of the Central Winter in contrast to the remainder of the state were determined using the same procedures as for mule deer. In contrast to mule deer in the Central Winter, the demand for turkey hunting tags was much less than that for mule deer. The comparative rank that the turkey hunts rated statewide was almost the opposite of the mule deer: turkey hunting in the Central Winter is in much less demand, and is considered much less unique, than is mule deer hunting. The Unit 12A turkey hunts were often ranked near the bottom of demand state-wide. This is shown by the dashed lines in the figure below. Spring turkey hunts are in more demand than fall firearm hunts (archery turkey tags are sold over-the-counter outside the lottery system). The demand for spring firearm turkey tags has recently ranged from 1.5 to 2 times the number available, and the Unit 12A hunts rank at about the bottom 25% statewide. In contrast, there is little excess demand for fall firearm turkey tags: until 1995 the number of requests for tags in the lottery was less than the number available. This can be seen from the solid, light-colored line in the figure above.

Turkey Hunting Demand in CWEMA
(Firearm Tags Only)



Value. Three general categories of value are received from turkey hunting in the Central Winter EMA. First, there are the tag and license sales revenues that the Arizona Game & Fish Department receives. Second, the hunters using the Central Winter purchase goods and services in the local area. And third, these hunters make purchases in the remainder of the state for equipment and supplies. These latter two categories are shown in the figure below for the period 1986 - 1996.

Value of Turkey Hunting in CWEMA (1996 Dollars)



The values generated from turkey hunting are directly related to the number of hunters and the length of time that they spend hunting. Local expenditures were calculated using

Lee et al. (1993) per trip expenditures in the local area of the Kaibab Plateau. In constant 1996 dollars, these expenditures are estimated to average about $250,000 per year in the local area, and another $125,000 in the remainder of the state. The Arizona Game and Fish Department collects about $32,000 per year in turkey license tags for hunters in the Central Winter EMA.

III. Livestock Grazing

Most grazing on public lands in the southwest are cow:calf operations. In cow:calf operations, the marketable crop is the calves that are produced by mother's grazing, and who typically spend their first nine months on the range. A schematic of a typical cow:calf operation is shown in the figure below. In this section, values associated with the various components of a

Cow:calf Grazing System

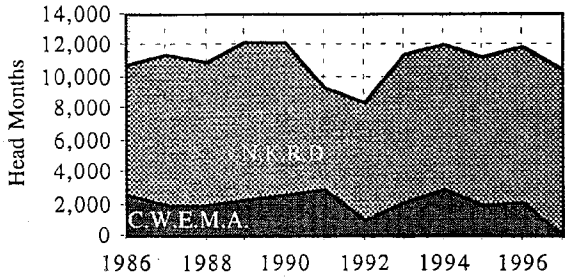
typical cow:calf operation will be explained, and placed in the context of livestock grazing occurring both within the Central Winter EMA as well as the North Kaibab Ranger District. Following the scheme for the other resources, livestock grazing values will be divided between those occurring locally—within the Arizona Strip—and those that occur regionally or state-wide.

Three factors typically go into determining the value of an AUM of forage in an operation where the primary product is calves. First, there is the size of the mother cow herd which is producing calves. These mother cows initially comprise the principle consumer of forage. After calves are born, they too consume forage but their consumption is combined with the mother's for the purposes of AUM calculation. Second, only between 80% and 85% of the mother cows successfully produce calves that live until market (due to infertility and death loss). During any given grazing year, generally about 10% of the mother cows are culled from the herd and sold. Third, each calf gains between 50 and 60 pounds per month on the range, rising from its birth weight of approximately 85 pounds. Thus, the ultimate value of an AUM of forage can be derived from the value resulting from this 50 to 60 pound per month weight gain. Values can be apportioned based on (1) the total number of AUMs for the livestock herd using the Central Winter EMA; (2) the grazing receipts received by the Forest Service (and divided among the District,

County and U.S. Treasury); (3) benefits that the rancher receives from public forage above and beyond the fees paid; and the local and regional benefits

Use. Cattle use the Central Winter allotment from October 1 to May 31. The total AUMs permitted corresponds to about 295 head during the majority of the grazing season, from December through May. The number of animal unit months (AUMs) of forage allocated to domestic livestock in the Central Winter mule deer winter range decreased from about 8,600 AUMs in 1964 to about 2,204 today (McCullock and Smith, 1991). The figure at right shows head months (see discussion of conversion to AUMs) used from 1986 – 1997. No grazing has been allowed on the Central Winter EMA since July, 1996 because the Bridger Knoll Complex Fire destroyed many of the improvements required to control livestock. As the table below shows, the Central Winter and Central Summer allotments combined provide between 55% and 75% of the total livestock use on the North Kaibab Ranger District.

Livestock grazing on the District and Allotment



Livestock grazing use in Head Months on the North Kaibab Ranger District allotments.*									
Fiscal Year	Central Winter	Central Summer	Kane	Kanab Creek	Ryan	Burro	Willis Canyon	House Rock	N.K.R.D. TOTAL
1986	2,604	4,779	1,060	246	No Data	715	Inc. Data	1,387	10,791
1987	2,004	4,779	648	60	1,704	240	1,406	548	11,389
1988	2,004	4,779	No Data	120	1,704	510	1,208	548	10,873
1989	2,316	4,779	289	174	1,704	650	1,674	717	12,303
1990	2,628	4,776	852	138	1,704	390	1,033	676	12,197
1991	2,873	2,291	852	120	1,819	510	835	No data	9,300
1992	886	4,779	367	120	1,200	42	742	184	8,320
1993	2,028	4,824	863	120	1,690	519	1,033	282	11,359
1994	2,874	5,213	569	156	1,289	414	2,047	354	12,916
1995	1,973	4,818	566	207	1,757	444	1,157	360	11,282
1996	2,037	4,818	948	208	1,643	516	1,280	492	11,942
1997	0	4,912	863	207	1,738	601	1,744	423	10,488

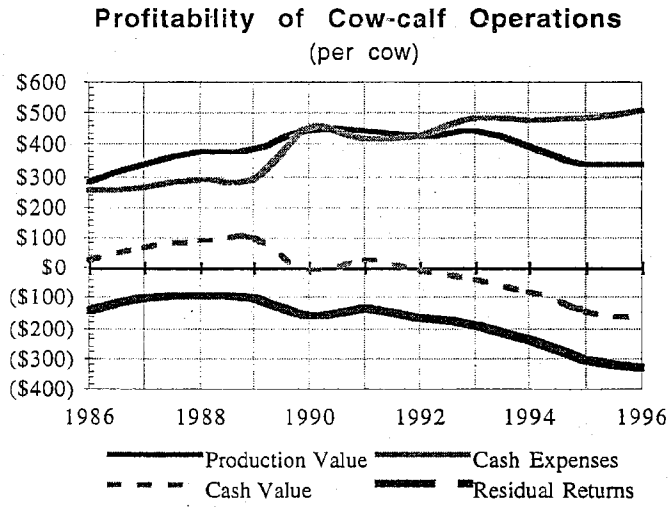
* Source: Grazing receipt files in the Kaibab National Forest Supervisor's Office, Williams, AZ.

Demand. As can be seen in the figure above, the Central Winter EMA provides between ten to twenty-five percent of the permitted livestock use on the District, with the average being about 17% in the years prior to the Bridger Complex fire. However—at present—the same cattle move between the Central Winter and Central Summer allotments. Because of this, the absence of

available forage in one allotment potentially affects the permittee's use of the other allotment. In other words, because of this linkage the two allotments can be considered as a single production unit.

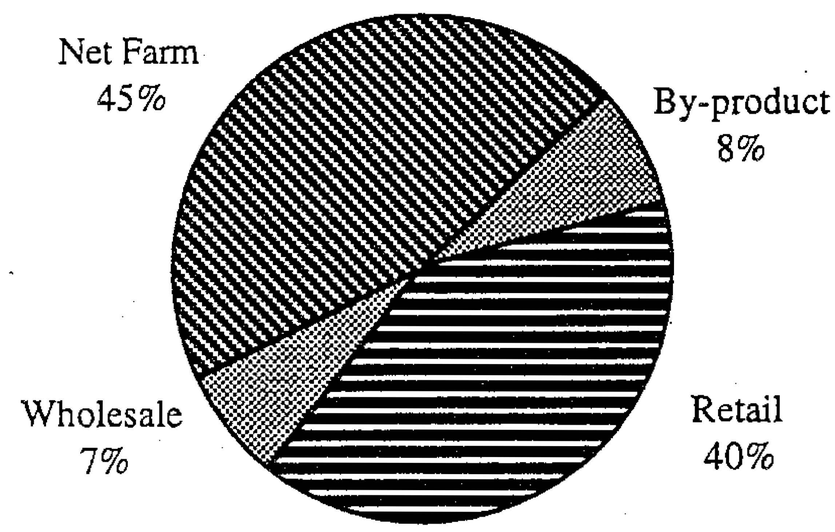
Another way to characterize the demand for livestock forage is to consider the demand for the products produced from this forage. For cow-calf operations, this corresponds to calves. But the market for calves is regionally—if not nationally—determined based on the overlying demand for beef and calves and yearlings for the feedlot market. One proxy for this demand is the profitability of cow-calf operations. The profitability of cow-calf operations in the west also reflects, in addition to overall market conditions, the comparative advantage—or disadvantage—of western cow-calf operations relative to other regions of the country.

Information on the profitability of cow-calf enterprises on a regional basis is provided by the U.S.D.A. Economics Research Service in their "Costs of Production – Livestock and Dairy" annual reports (USDA-ERS, 1996b). The chart at right reports the profitability per cow for the western region over the period 1986 - 1996. First, the cash value of products produced, including calves, heifers, steers, and cull cows, are apportioned. This cash production value is compared to the cash costs involved in production. Over the last 11 years, net cash returns have been positive in five years, and negative in the other six years. Beyond simply cash returns, profitability is also reported when the operator's risk (involving return on capital investment) and management effort (including unpaid labor) are included (called "Residual Returns" on the chart). When this is done, the state of western cow-calf operations are even more tenuous: they have, on average, never been profitable over the past eleven years, and recent trends are becoming even more unfavorable.



Value. The economic values associated with grazing on the Central Winter EMA can be apportioned among those directly received by the U.S. Government in the form of grazing fees, the benefit to the permittee rancher from using forage in the EMA, and benefits received by others after calves and cattle are sold until the meat is purchased by the consumer at retail. A first place to start is to apportion the value of a retail pound of beef among these various parties. This apportionment is shown in the figure at right. The average retail Choice grade of beef sold for $2.80 per pound in the third quarter of 1996 (US.D.A.-E.R.S., 1996a). This value reflects a weighted average price for all cuts sold by retail markets. This beef was purchased from a wholesaler, who received an average of $1.59 per pound from the retail store. But one pound of beef to the consumer is equivalent to 2.4 pounds of cattle weight "on the hoof" to the rancher or feedlot. Not all of the 1.4 pounds that is not cut into retail beef is waste: these "by-products" are sold, or used in the production of cattle, and have a value of $0.24. Thus the gross farm or ranch value from a pound of beef averages $1.61, with the net beef value equaling $1.37 after the value of the by-products is subtracted. However, this value reflects selling the beef carcass to the wholesaler or meat processor, and does not include the weight gain and value received when cattle are fattened in feedlots (this value is included in the gross farm value in the previous discussion).

Apportionment of the Value of a Pound of Beef at Retail Sale



The values for a pound of beef in the retail market can be converted to values per pound for the complete animal by dividing by 2.4. By doing so, the average retail value becomes $1.67 per, value to the wholesaler is $0.663, value of the by-products is $0.10, and value to the producer is $0.57 per pound. This conversion—and the values represented in it—allow the value of an AUM of forage to be apportioned among the various parties in a manner similar to that used for the other resources in the CWEMA.

Calculation of Weight Gain Resulting From an AUM of Forage

- One cow (1,000 lb.) is assumed to consume 26 lbs. of dry forage per day.
- One month (30 days) is assumed to require 780 lbs. of dry forage.
- Marketing weights for weaner calves are 450 lbs. for steers and 425 lbs. for heifers 200 days after birth.
- Birth weight is assumed to be 70 lbs.
- Net weight gain averages 367.5 lbs./200 days (50%:50% ratio steers to heifers).
- Thus a calf is assumed to gain 1.8375 lbs. per day from this forage.
- Total weight gain for calves is 55.125 per AUM.

The U.S.D.A. Economic Research Service provides information on cattle prices in markets throughout the western United States. Its information on prices in Arizona and Utah provide an indication of what the rancher is receiving for the calves and cull cows raised and marketed on the CWEMA. Because prices received by ranchers for both calves and cull cows fluctuate for year-to-year, an average of the last five years of U.S.D.A. prices received information was used to

estimate values. The annual price data was adjusted for inflation using the Consumer Price Index (CPI-U), and then the individual 5-year averages for each state were averaged to obtain the prices per hundredweight (cwt.) used in the table at right. This procedure yielded an average price per hundredweight for calves of $86.95 (much higher than the $58.25 2-state average ranchers received in 1996). For cull cows, the 2-state, 5-year average price is $43.72/cwt.

Calculation of CWEMA Grazing Value	
Herd size	**296**
Cow proportion of herd	* 94%
Number of cows in herd	= 278
Calving success & death loss	* 85%
Number of calves produced	= 237
Deduction for 10% cow replacement	- 28
Calves marketed	= 209
Average weaner calf weight (425 lb. heifer/450 lb. steer)	* 438
Total weaner calf weight (90 heifers; 118 steers)	91,571
Average price per hundredweight (cwt.)	* $86.95
Value of calves marketed	**$79,617**
Number of cull cows	28
Average weight of cull cows (lbs.)	* 1,000
Total weight of cull cows	28,000
Average price per hundredweight (cwt.)	* $43.72
Market value of cull cows	$12,242
Number of cow replacement heifers	28
Average weight of replacement heifers	* 425
Total weight of replacement heifers	11,900
Imputed replacement heifer price (cwt)	* $86.95
Imputed value of replacement heifers	= $10,347
Net market value from cull cows	**$1,896**
Total annual value of herd	**$81,512**
Annual AUMs for Herd	÷ 3,552
Value per AUM	**$22.95**
Permitted AUMs on CWEMA	* 2,004
Annual value of CWEMA grazing	**$45,988**

The flow chart for a cow-calf livestock operation shown previously was used to estimate the value of livestock grazing—and consequently the value of an AUM of forage—on the CWEMA. Starting with the 296 animal herd permitted on the CWEMA, deductions were made for (1) the number of bulls servicing the herd (6%); (2) the yield of calves to market weight from the cow herd (85%, including death loss); and finally the number of heifers from the calf crop that are commonly used to replace unproductive cows that are culled from the herd (10%).

Calf crops are generally equally distributed by sex; however, the replacements for the cull cows come only from the heifers (no replacement for the bulls is assumed). Steer calves are generally average about 25 lbs. heavier than heifer calves at market weight (450 lbs. versus 425 lbs.). This weight difference is taken into account in calculating the estimated total weight gain for the calf crop. Prices reported by the U.S.D.A. do not differentiate between steer and heifer calves, so the average price of $86.95/cwt. was multiplied by the number of cwt.'s produced (about 916). The marketed calf crop is then estimated to be worth about $80,000 annually for the 296 animal herd.

Again following the cow:calf operation flow-chart, the net value of the cull cows—after the imputed market value of the replacement heifers— can be determined. The annual replacement of 10% of the cows in the herd represents 28 animals. If each cull cow weighs about 1,000 lbs., then the gross value of the 28,000 lbs. is $12,242 at $43.72/cwt. However, the value of the replacement heifers (whether from within the herd or purchased outside) must be deducted from the price received for the cull cows. Because calves are twice as expensive per hundredweight as cull cows, there is little net monetary gain—approximately $2,000—received. The value of the

calves is added to the net value of the cull cows to obtain an estimate of the total annual production value received from the 296 animal livestock herd: $81,512.

The value of an AUM of forage can be imputed by dividing the net benefits, $81,152, by the 3,552 AUMs required to support the 296 animal herd for a year. The value of an AUM of forage for this herd is estimated to be $22.95. But the total value of the herd is received as a result of the herd grazing on both the Central Winter and Central Summer allotments. Based on the existing schedule for the Central Winter allotment, 2,004 AUMs of livestock grazing are authorized in the CWEMA. This 2,004 AUMs multiplied by the benefit of $22.95/AUM provides an estimate of the value of livestock grazing on the CWEMA: about $46,000 per year.

The distribution of this $46,000/year benefit is important for comparative purposes. Under the Public Rangelands Improvement Act, the U.S. Forest Service charges the livestock permittee $1.35 per AUM. This equals $2,705 per year for the 2,000 AUMs authorized for the CWEMA. This $2,700 is divided among three parties: (1) the counties receive 25%, or about $676/year as revenue sharing to support roads and schools; (2) the Forest Service receives 50%, or $1,353 in its Range Betterment Fund to rehabilitate rangelands and construct fences and water developments; and (3) the U.S. Treasury receives the remaining $675/year. Once the Federal grazing fee is subtracted, the permittee receives the remaining $43,000 in benefits, from which he has to pay his expenses and obtain any available profits.

Summary of Annual Livestock Benefits	
Herd size	**296**
Calves Marketed	209
AUMs of Livestock Forage	2,004
Estimated Total Benefits	$45,988
Grazing Permit Receipts	$2,705
County Revenue Sharing	$676
Range Betterment Fund	$1,353
U.S. Treasury	$676
Rancher Benefits	$43,283
Value per AUM of Livestock Forage	$22.95

IV. Fuelwood

Use. The fourth major resource in the Central Winter EMA for which economic values can be inferred is fuelwood, principally pinyon and juniper. Pinyon-juniper woodlands cover approximately 78% of the Central Winter EMA (Draft MSR, 1997). The Management Situation Report provides data about fuelwood permits for the period 1987 - 1996, however, only in 1993 were the permits likely to represent fuelwood harvested in the CWEMA.

Demand. The demand for fuelwood, as expressed in the number of permits sold, has decreased by over half in the last ten years. The Management Situation Report states that

Fuelwood permits and values, N. K. R. D.

Year	Permits	Fees	Receipts ('96$)	Benefits
1987	1,004	$5,020	$7,009	$70,280
1988	997	$4,985	$6,683	$69,790
1989	965	$4,825	$6,171	$67,550
1990	846	$4,230	$5,133	$59,220
1991	900	$4,500	$5,240	$63,000
1992	972	$4,860	$5,494	$68,040
1993	685	$3,425	$3,759	$47,950
1994	524	$2,620	$2,804	$36,680
1995	669	$3,345	$3,481	$46,830
1996	478	$2,390	$2,390	$33,460
5-yr. Avg.	666	$3,328	$3,356	$45,592

Source: N.K.R.D., Draft Management Situation Report, August, 1997.

demand for fuelwood permits has been reduced as a consequence of the reduction in timber harvesting in the North Kaibab Ranger District. Timber harvest operations leave unsuitable logs and slash from their operations that are easily accessible to fuelwood gatherers. The underlying demand for fuelwood has probably not changed, but this demand has shifted to other locations as the difficulty in obtaining fuelwood on the North Kaibab Ranger District has increased.

Value. Fuelwood cutting and gathering permits are sold for $5.00 per cord. The fees collected have ranged from a low of about $2,300 per year to a high of slightly over $5,000 per year, averaging about $3,300 in nominal and real terms over the last five years. The fees that the Federal government receives are divided with 25% going to the County as revenue-sharing, and the remaining 75% going to the U.S. Treasury. Inflation-adjusted receipts, expressed in 1996 dollars, show a real reduction in the value of receipts over the last 10 years of from about $7,000 per year in 1987 down to about $2,400 per year in 1996. Using a net imputed value of $70 per cord in 1996 (assuming that the replacement price for a cord of pinyon-juniper firewood would be $75 in the Fredonia-Kanab area), the social benefits of fuelwood from the North Kaibab Ranger District have averaged about $46,000 per year over the last 5 years, but have decreased from about $70,000 per year to about $33,500 per year, or a drop of over half.

DISCUSSION

The purpose of this study is to incorporate considerations of the benefits that society receives from wildlands into decisions that are made about their management. Readily available information can provide an indication of the relative values associated with various uses of wildlands, and that this information—while not perfect—is at least comparable in quality to the quality of other types of data relied upon to make decisions. The systems approach process used in this study looks at the quantity and quality of resources that provide public benefits, attempts to place a value on the yield of these resources, and by implication, provides evidence of effective ways to gain additional benefits. The following table provides a summary of the estimates of the values received from four uses in the CWEMA.

Summary of estimated values received annually in the Central Winter EMA.

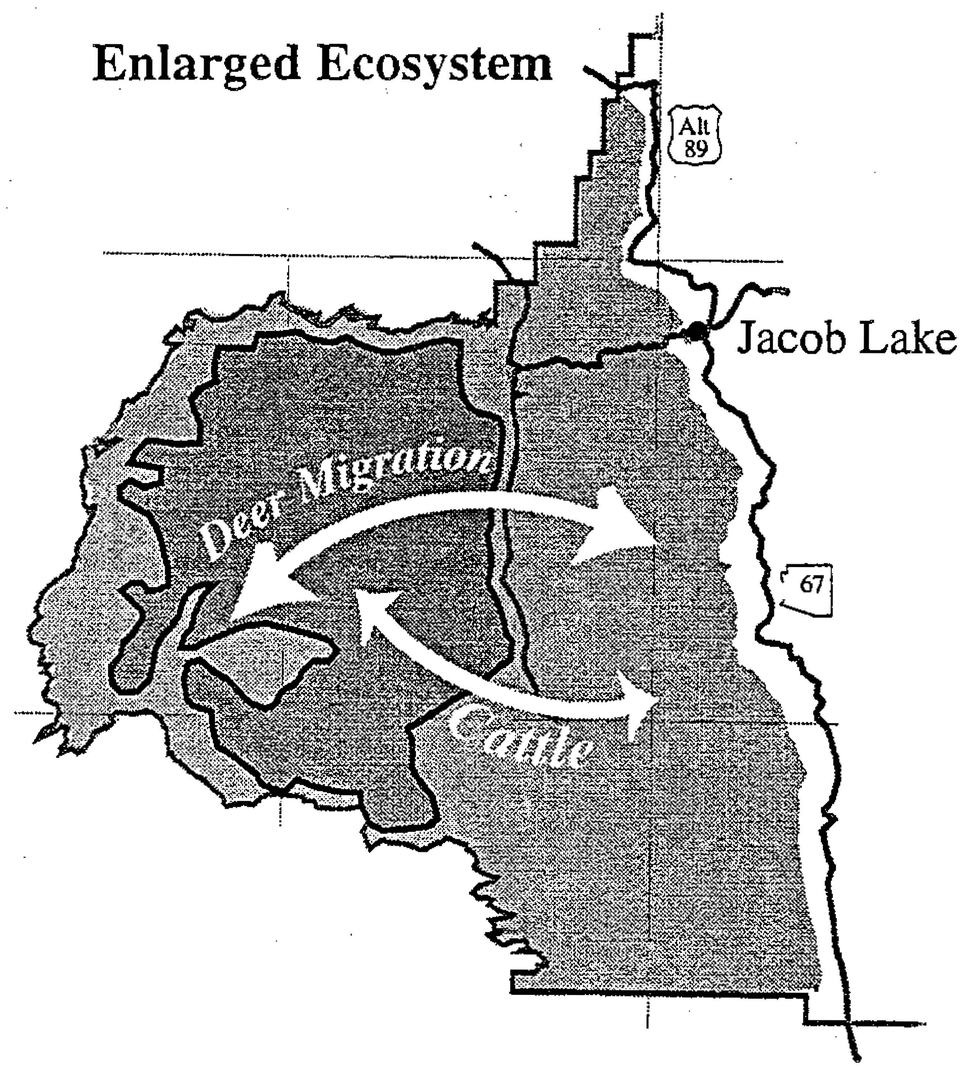
Resource	Analysis Area	Estimated Benefits	Fee Receipts Distribution				Benefit Distribution	
			County	State	Treasury	N.K.R.D.	Local	Region
Dispersed Recreation	W. of S.R. 67	$6,400,000	$0	$0	$0	$0	$6,400,000	
Hunting								
Mule Deer	CWEMA	$922,604	$0	$51,649	$0	$14,757	$470,528	$452,076
Turkey	CWEMA	$401,655	$0	$20,375	$0	$0	$248,864	$132,416
Livestock Grazing	CWEMA	$45,988	$676	$0	$1,353	$676	$43,283	
Fuelwood	NKRD	$48,984	$839	$0	$2,517	$0	$45,492	$0

Sources: Information discussed in report.

It should be apparent from the information in the table above that the vast majority of public benefits, whether locally or regionally, result from recreation-related uses of the Central Winter EMA. While the area for the estimation of dispersed recreation benefits is greater than the CWEMA—and while the bulk of recreation use occurs outside the CWEMA—if only 3% of the dispersed recreation occurred in the area its value to the public would be almost $200,000 per year. Similarly, while the bulk of mule deer hunting in Unit 12A West occurs at elevations higher than the CWEMA, trophy hunting in the late seasons occurs within the CWEMA, and the herd is dependent upon the area for critical winter habitat.

In contrast, the benefits in terms of livestock forage from traditional grazing in the CWEMA represent about 5% of the value that forage in the CWEMA provides for mule deer. A value of an AUM of forage for livestock compared to mule deer was derived for this study. The benefit received from an AUM of forage on the CWEMA for livestock was calculated to be $22.95; a similar calculation for the value of an AUM of forage for mule deer showed it to be worth $129.41, or approximately five times more valuable.

Economists frequently criticize agency managers because they do not balance benefits and costs of various management possibilities. Often, managers are not provided with effective "signals" to indicate where society desires management emphasis to be placed. One signal that if often used are funds that return to the agency based on its decisions. While necessarily an imperfect mechanism, examination of the summary valuation table includes columns representing receipts to various governmental entities, including the North Kaibab Ranger District. The relative lack of management emphasis on dispersed recreation may result from the lack of direct returns to the agency from these uses. However, this cannot explain differences in management intensity between hunting and livestock grazing. The North Kaibab Ranger District receives greater amounts of funding from the tag surcharge on hunting in the Grand Canyon Game Preserve than it does from the Range Betterment Fund generated from a portion of the grazing receipts.



It became apparent through the course of this study that the Central Winter Ecosystem Management Area is a sub-unit of a larger ecosystem, both biological and economic (see map at right). The boundaries of the CWEMA were based on a grazing allotment that provides winter range. The corresponding Central Summer allotment provides livestock forage for the remainder of the year, i.e., the same cattle move back and forth between the two areas. So from a livestock perspective, the two allotments are integrally united. A similar situation exists for the mule deer: the herd largely summers in the

higher elevation areas in the Central Summer allotment and migrates to lower elevations in the CWEMA to winter. So for the deer the ecosystem is a combination of both areas. For dispersed recreational use, a case can be made that the types of use (visiting overlooks, auto tours, wildlife watching, wilderness access) are compatible with combining the two areas. This certainly makes sense when the available information is reported on the basis of the larger area.

The valuation approach used in this study certainly has limitations. Of particular concern is that the uses which can be easily valued are restricted, both conceptually and as a result of available information. A whole host of other values—such as the publics' desires for pleasing landscapes, the value that they place on intact ecosystems, and the value that ecosystems play in maintaining biological diversity, and cleansing air and water—are not easily picked up from the survey information used for this study. Additionally, conflicts among uses—for instance, the competition for forage between mule deer and livestock, any effects (and whether they are positive or negative) between the presence of cattle and the enjoyment of the area by recreationists—have not been determined for this area.

Through the process of constructing this valuation, the limitations of available data became apparent. First, much of the information used to develop this study came from disparate sources, both within the Forest Service, and other cooperating agencies, such as the Arizona Game and Fish Department and Agricultural Extension. This highlights both the problem and the opportunity for studies of this type: there may be problems pulling data from agency sources, but also opportunities because a wealth of data exists that can be brought to bear on management decisions. Starting with studies of this type shows where information does not exist, and this knowledge can then be used to determine priorities for acquisition of additional data. For this study, additional site-specific information on dispersed recreation use, and visitors' perceptions of conflicts among uses would be valuable. For example, are visitors' enjoyment of wildlife viewing adversely or positively affected by the presence of livestock. Do they prefer dense, open or a mosaic of tree densities in pinyon-juniper vegetation? The information gained from asking these questions can be directly used to make management decisions.

Even with the limitations discussed above, the valuation study used as an example shows that considerable benefits are being received from uses other than livestock grazing on wildlands. Dispersed recreation and hunting provide orders of magnitude more societal benefits. Before decisions are made to continue investments in managing livestock, it would seem to make sense to determine whether the benefits received from this use outweighs its costs, both financially and in terms of the management effort required. Other uses, such as fuelwood gathering, generate comparable receipts and values compared to livestock grazing, but these uses inexplicably receive less management emphasis. If the purpose of public wildlands is to provide benefits to society, studies of this type can show where management emphasis and decisions can provide greater benefits.

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