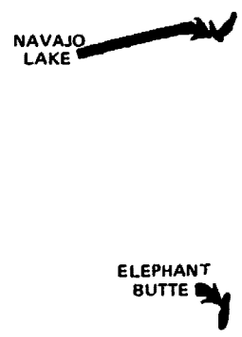

Fig. 1. Navajo and Elephant Butte reservoirs, population centers, and major highways

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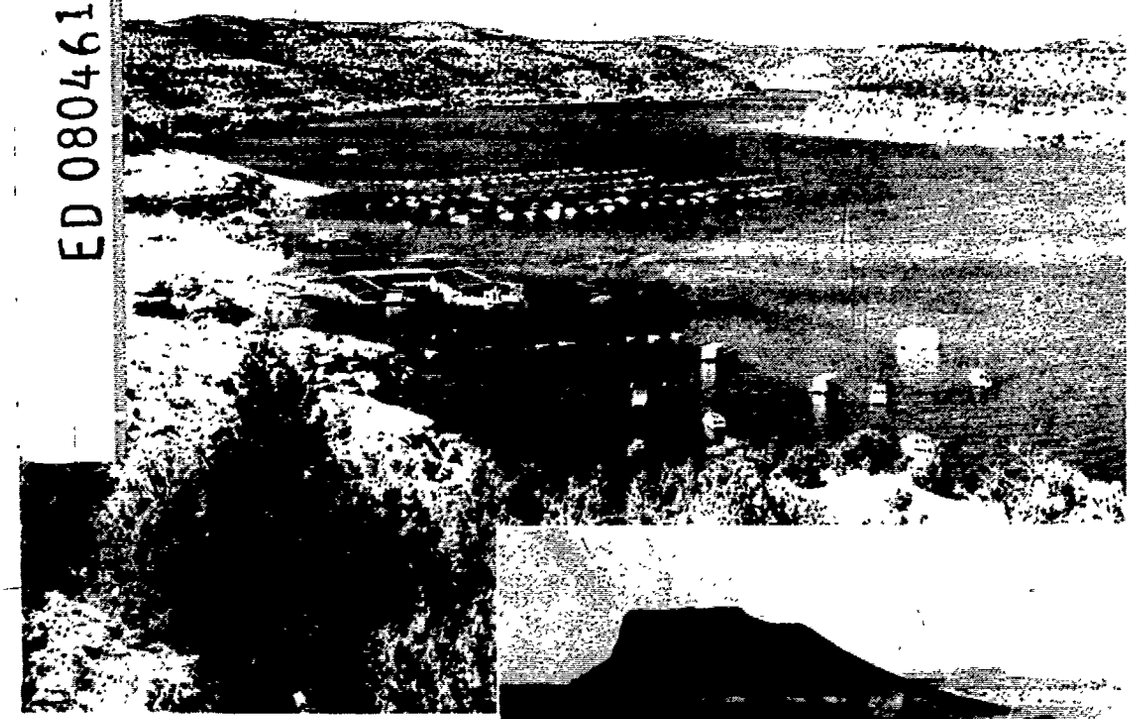
ABSTRACT

This document is a descriptive study of the recreational use and the value of water at Elephant Butte and Navajo Reservoirs. Previous research studies, as well as the study areas and recreational characteristics and procedures of investigation used in this study (sampling and data collection, data organization, analysis) are described. Discussions of water values (consumptive use, reaction to water levels, consumptive values of water) and the elasticities of demand are included. There are numerous tables and maps.

Recreational Use and Value of Water at Elephant Butte and Navajo Reservoirs



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October 1968 Las Cruces, New Mexico

Contents

Findings

Recreationists used as little as an estimated 4,000 acre feet of water in a five-month period at Navajo Reservoir in 1966 to as much as 26,796 acre feet in a seven-month period at Elephant Butte Reservoir. The value of the water used, when based on the estimated expenditures of recreationists, ranged from $394 per acre foot in the January through July period to $562 per acre foot in the August through December period at Elephant Butte Reservoir. At Navajo Reservoir, average values varied from $537 to $544 per acre foot.

Water skiing was the most popular activity at Elephant Butte Reservoir among the 518 parties surveyed there in 1966, while fishing was preferred by most of the 466 recreational parties interviewed at Navajo Reservoir. Boats, motors, and camp trailers contributed most to the average investments in recreational facilities and equipment at both reservoirs. The average investment was $1,970 per party at Elephant Butte Reservoir and $1,730 at Navajo Reservoir.

Average sizes of parties were approximately the same at the two reservoirs, and they spent about the same amount of time at the reservoirs. Expenses per person per day averaged $7.00 at Elephant Butte Reservoir and $7.97 at Navajo Reservoir. Travel costs and depreciation of equipment were the major cost items.

Although most recreationists at Elephant Butte indicated water level would not affect their decision to visit the reservoir, large majorities expressed approval of high water levels and disapproval of low water levels. More than half of the recreationists at Navajo Reservoir, which was filling during most of 1966, were indifferent to water levels.

Effective market demand for recreation is more elastic in the early than in the latter part of the year. The newer reservoir, Navajo Reservoir, has a more inelastic demand for recreation than Elephant Butte. However, a much larger portion of the demand curve for recreation at Elephant Butte is inelastic than at Navajo Reservoir.

Additional study is needed to separate the effects of water levels on recreational use in reservoirs in New Mexico from the seasonal effects.

Recreational Use and Value of Water at Elephant Butte and Navajo Reservoirs

Robert O. Coppedge and James R. Gray[1]

Recreational activities on the five major New Mexico reservoirs are increasing. These reservoirs are Elephant Butte, Navajo, Caballo, Abiquiu, and Conchas. The recreational activities include fishing, boating, water skiing, swimming, camping, picnicking, and sight-seeing. Originally, the reservoirs were constructed mainly for irrigation-water storage, flood control and, in some cases, hydroelectric power production. While many of the recreational uses have little effect on the main uses, the main uses do affect recreational activity. Large inflows of water in the early spring and large outflows in the late spring and summer cause reservoir levels to fluctuate widely during the year. Recreational developments and activities are handicapped by these fluctuations. Additionally, when water reaches the minimum pool necessary for fish survival, a legal or administrative decision, whether to continue to serve the main uses or to ensure fish survival, is necessary.

One major consideration in decisions about water allocations is the values that result. If water is to be used efficiently in New Mexico, the decision makers need to know the value of water used for recreational purposes. The objectives of this study are to describe recreationists' characteristics and attitudes at two of the state's largest reservoirs, devise a method for measuring the recreational demand for water, and estimate recreational water values at the two reservoirs.

Previous Studies

Wollman used a consumer surplus method to estimate the value of water when it was diverted to the Rio Grande Valley for fish habitat (1). If 18,600 acre feet were allocated for this purpose, the value added per acre foot was $214 at 1951 prices. If 37,000 acre feet were allocated, the value added was $148 per acre foot.

Kirkpatrick's study of gross expenditures of hunters and fishermen indicated resident sportsmen spent $13 per day for fishing, $29 per day for big game hunting, and $14 per day for bird hunting (2). With three million days being spent hunting and fishing

[1] Former Research Assistant and Professor, respectively, Department of Agricultural Economics and Agricultural Business.

in New Mexico in 1963, the gross annual expenditures of hunters and fishermen were estimated to be $53,400,000.

Gray and Anderson estimated that, in 1962, each acre of the Ruidoso Ranger District in south-central New Mexico generated an expenditure by recreationists of $61 (3).

In 1952 Ximenes estimated that tourists spent from $50 million to $60 million yearly in New Mexico (1). Ximenes defined tourists as individuals considering New Mexico as their destinations for vacations. In a later study Hicks indicated the estimate by Ximenes should be raised by $25 million if the definition of tourist were expanded to include all persons touring in New Mexico (5).

Gray and Carruthers measured the present contribution of recreationists to a local economy and the estimated future effects of a planned reservoir in the Reserve Ranger District of southwestern New Mexico (6). Only six of the 12 industry groups were estimated to be materially affected by recreational activities. An increase of only 13 percent in water requirements for all 12 industries over the 1963 level was anticipated by the year 2000 even with a high level of recreational activity in the district.

Descriptions of Study Areas

Elephant Butte

Elephant Butte Reservoir is in south-central New Mexico, in Sierra and Socorro counties. The dam is four miles east of Truth or Consequences on State Highway 51, and the reservoir extends some 30 miles to the north from the dam, paralleling U.S. Highway 85. Location of the reservoir, population centers of the area, and major highways are shown in figure 1.

Access roads to the reservoir are plentiful near the damsite and, for the most part, are open to all kinds of traffic (figure 2). The eastern shoreline does not have any areas which are readily accessible by roads. Around the northern reaches of the reservoir, the roads become more primitive and often are not passable for passenger-type vehicles. Travel to and from the reservoir is along U.S. Highway 85, which connects El Paso, Texas, to the south with Albuquerque to the north, the two major population centers in the region.

Albuquerque is about a three-hour drive from the reservoir, or about 150 miles. Socorro is about 60 miles from the reservoir, Las Cruces about 80 miles, and El Paso, Texas, about 130 miles, or a two and one-half hour drive from the reservoir.

Construction of the Elephant Butte dam on the Rio Grande River was completed in 1916. At capacity, the reservoir will hold 2,195,000 acre-feet of water. Land area in the project is 44,089 acres, of which 21,900 acres are available for recreation. Total water surface area in the project is 17,000 acres, all of which is available for recreation. Shoreline length of Elephant Butte is 250 miles at normal capacity. The dam was originally constructed for the purposes of regulating the flow of the Rio Grande River and providing water storage for irrigation.

The shoreline of the reservoir is gently sloping and in many places has sandy beaches. Vegetation in the area is mostly mesquite and saltcedar, which provide little or no natural shade.

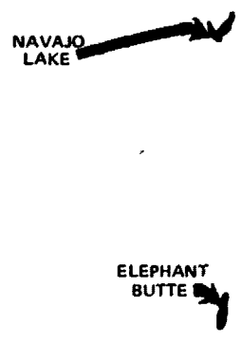

Fig. 1. Navajo and Elephant Butte reservoirs, population centers, and major highways

The climate is hot and dry, with an average July temperature of 80 degrees and daytime temperatures consistently well above this mark. Average annual temperature in 1965 was 60 degrees, with a low average of 43 degrees in December. In 1965, the annual precipitation was just under 8 inches, which is typical. The number of frost-free days is normally between 220 and 250. In 1965 the last recorded low of 32 degrees in the spring was on March 26, and the first recorded low of 32 degrees in the fall was November 27, or 246 total days. Spring winds and sandstorms are a recurring annoyance to recreationists at Elephant Butte Reservoir.

At the time of the survey, in the summer of 1966, there were two maintained boat docks and marinas. Numerous other places were utilized as

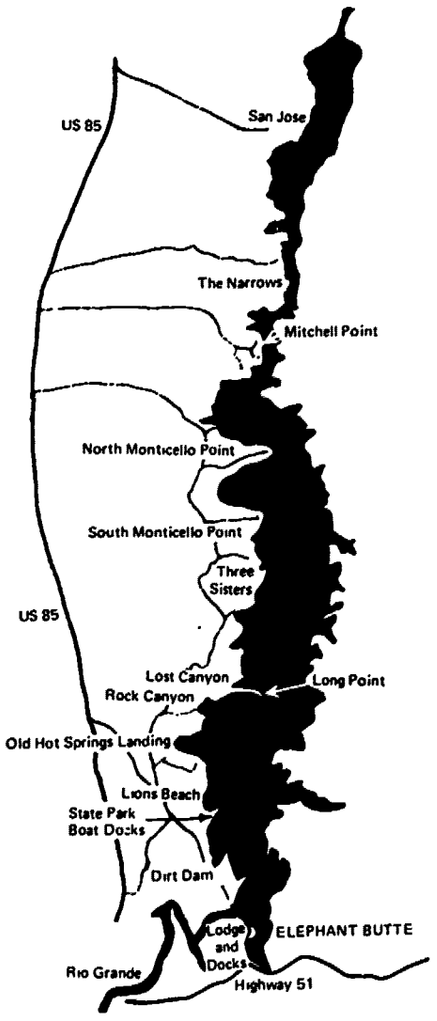

Fig. 2. Elephant Butte reservoir recreational areas

boat launching areas because of the gently sloping terrain. There was one developed campsite, near the site of the newest launching and docking facilities maintained by the New Mexico State Park and Recreation Commission. Comfort stations were available in the area, as were shelters, fireplaces, and tables. Water and electricity were also available. A Visitor Center was maintained for offices and tourist information.

The original area developed for recreational use is in the vicinity of the damsite. The facilities include a store and cafe, rental cabins, hotel, and trailer camp. Water, sewerage, and electricity are provided.

Major game fish in Elepl. nt Butte Reservoir are bass and catfish. In the winter, the reservoir is a favorite spot for duck hunters, particularly in the northern parts of the reservoir where waterfowl habitat is prevalent.

Navajo Reservoir

Navajo Reservoir, in northwestern New Mexico in San Juan County, extends into Archuleta County in Colorado. The eastern shore of the reservoir forms the boundary between San Juan and Rio Arriba counties. The major urban area in San Juan is Farmington, located about 35 miles west of the reservoir. Aztec, the county seat, is about 30 miles west of the reservoir. Location of the reservoir, population centers in the area, and access roads are shown in figure 1. Access roads to the area from the south are State Highway 44 from Albuquerque to Bloomfield, State Highway 17 from Bloomfield to Blanco, and Farm Road 511 to the damsite (figure 3).

Albuquerque is a four-to-five hour drive from the reservoir, or about 200 miles, as are both Santa Fe and Los Alamos, New Mexico. Within 50 miles of the reservoir are the towns of Farmington, Aztec, Bloomfield, and Blanco in New Mexico, and Durango, Ignacio, Allison, and Pagosa Springs in Colorado.

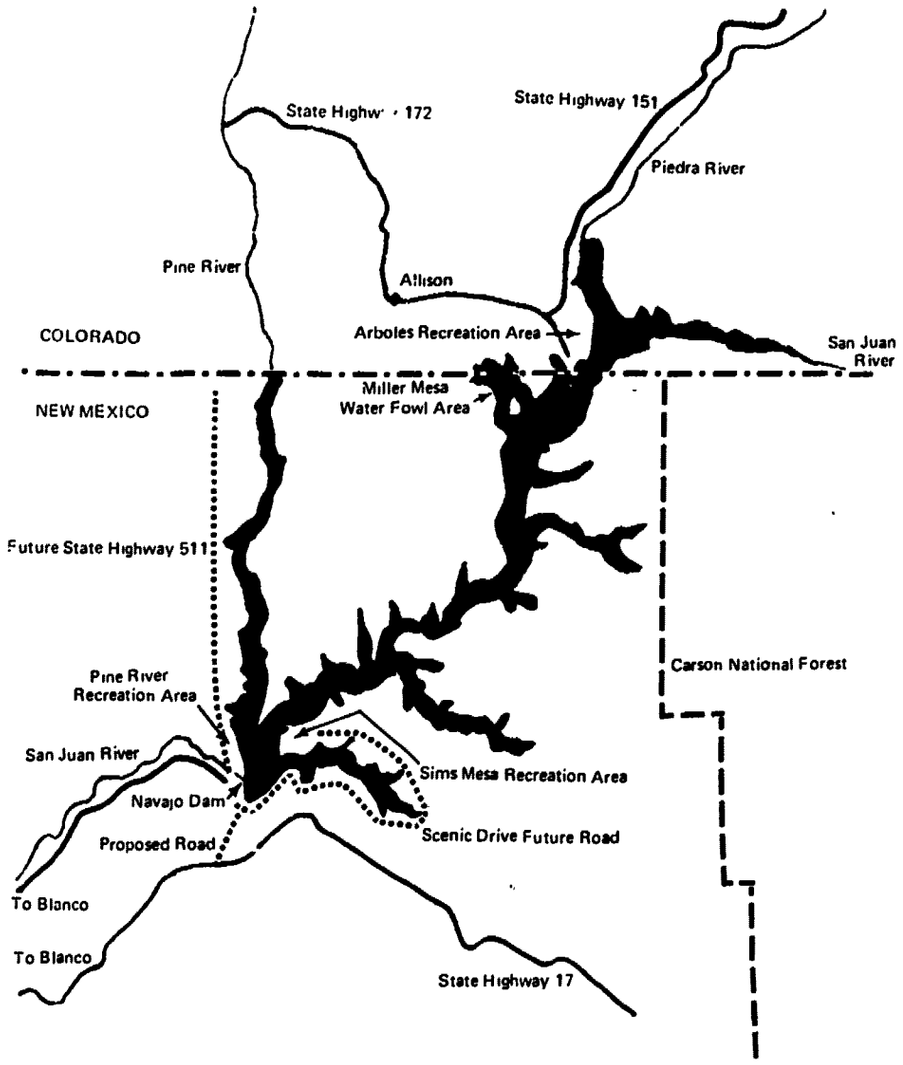

Fig. 3. Navajo reservoir recreational areas

The Navajo Dam is constructed on the San Juan River at its junction with the Pine River. At capacity, the reservoir will extend to within one-half mile of the Colorado border along its Pine River arm, and seven miles into Colorado along the San Juan River. The water surface will be approximately 17,800 acres at maximum capacity, and 15,600 surface acres at the anticipated normal level. Total land area in the project is 22,251 acres,

of which 21,090 acres are available for recreation. With 15,600 surface acres of water, the amount available for recreational use will be 15,450 surface acres. The shoreline of Navajo Reservoir at normal capacity will be approximately 150 miles. The dam was constructed for the purposes of regulating the flow of the San Juan River and providing water storage for irrigation. Storage of water was begun in June 1962. Downstream commitments, the rate of completion of construction projects, and fluctuating inflow combined to result in an unstable water level from the beginning storage date to the time of the study. The reservoir has never reached capacity.

The area is extremely rough and rocky, with steep canyon walls forming the bulk of the shoreline. Sandy beaches are few at Navajo Reservoir, and they will be virtually non-existent at normal capacity except for the upper portion of the reservoir and at the damsite.

Piñon pine and Rocky Mountain juniper constitute the major vegetation in the area, with a few ponderosa pine in the heights. Few large shade trees are found in the vicinity.

The climate is mild and semi-arid. The average temperature for 1965 was 51 degrees, ranging from a December average of 31 degrees to an average high of 75 degrees in July. For a few days, the temperature may be above 100 degrees in the summer and as low as 0 to 10 degrees during the winter, but these extremes are unusual. Precipitation at Navajo Dam totaled about 17 inches in 1965. This is considerably above previous years, when the rainfall averaged 8 to 9 inches annually. Over 70 percent of the days at Navajo Reservoir are recorded as sunny. The number of days between the last freezing temperature in the spring and first freezing temperature in the fall is generally 150 to 200 days. In 1965, the last recorded temperature of 32 degrees in the spring was May 22, and the first recorded temperature of 32 degrees in the fall was November 11, or an interval of 186 days.

At the time of the survey, in the summer of 1966, only the Pine River Recreation Area at the damsite was in use. A campground complex of two comfort stations and running cold water was in operation. The campsites in this campground offered a picnic table, shelter, and fireplace. A picnic ground was available for use, also with a comfort station. A Visitor Center had been constructed where park officials had offices and information about the reservoir was available. Another area was under development at the time of the survey, the Sims Mesa Recreation Area. Built from the same general pattern as the Pine River Recreation Area, it was to be opened in 1967. Further up the San Juan extension of the reservoir, the Arboles Recreation Area, just over the Colorado state line, is completed, waiting only upon the reservoir to back up into Colorado. A map of the area is shown in figure 3.

Rainbow trout is a major game fish in the reservoir. In July 1966, the New Mexico State Game and Fish Department began to stock the reservoir with bass. Several species of catfish inhabit the reservoir, especially in the upper reaches where the water is shallow and warmer, and the bottom is sandy. Navajo lies in the Pacific Flyway, and it is anticipated that waterfowl hunting will develop in the area. Miller Mesa Waterfowl Area will provide a resting place for waterfowl. This area is at the upper end of the San Juan portion of the reservoir, with its northern boundary being the Colorado border.

Procedures

Sampling and Data Collection

At Elephant Butte Reservoir, six major recreational-use areas lying mainly in the southern reaches of the reservoir were sampled. Sites were randomly assigned days in a six-day cycle. Weekend days and week days were randomly selected for interviews at the chosen sites. At the end of each interview period, the sites were rotated in the interviewing schedule.

At Navajo Reservoir two major recreational-use areas of Pine River and the San Juan River extensions of the reservoir were sampled. In a three-day cycle, the more heavily used site was sampled twice as frequently as the site with the lighter use. All recreationists at the sites were personally interviewed according to a prepared questionnaire. Interviewing began in early June and continued until early September at both reservoirs. Interviewing was also conducted in the fall and early winter. At Elephant Butte Reservoir, 518 parties were interviewed, and 466 parties were interviewed at Navajo Reservoir. A party consisted of one or more persons, with one person paying most of the costs of the recreational trip.

Data Organization

The questionnaires were stratified by zones from which the recreationists came. The zones used were: Zone 1, the county (s) containing the major portions of the reservoir; Zone 2, counties mostly adjacent to Zone 1; Zone 3, other counties in New Mexico; and Zone 4, states outside of New Mexico (figures 4 and 5).

Expenditures of recreationists were obtained on a per-trip basis except for fishing and hunting licenses, monthly or yearly fees on boat registrations, docking fees, and lake-use permits. The fishing and hunting license fees were allocated on the basis of an average of 10 trips per year. The other monthly or annual expenses were also converted to a per-trip basis with an average of seven trips per year (2). A depreciation rate of 10 percent of purchase price minus salvage value was applied to all equipment except cabins. A three percent rate was applied to the purchase value of cabins. Travel expenses per trip were computed according to the make and model of the recreationists' automobiles and the distances travelled. All automobile costs were included. Some recreationists visited more than one area during the trip to the reservoir. For these, a portion of the mileage was allocated to the reservoir visit by dividing the total number of miles driven by the number of places visited. When the distance thus computed was greater than twice the mileage from the home of the recreationist to the reservoir, the lesser distance was used.

Only expenditures for lodging, food, rentals, fees, and fuel, over and above what the recreationists estimated they would have spent at home, were recorded.

Also determined were the number of persons per party and the number of days spent at the reservoir. The time spent at the reservoir was multiplied by the number of persons per party. The total expenses per party were divided by the product of time multiplied by number in party, yield-

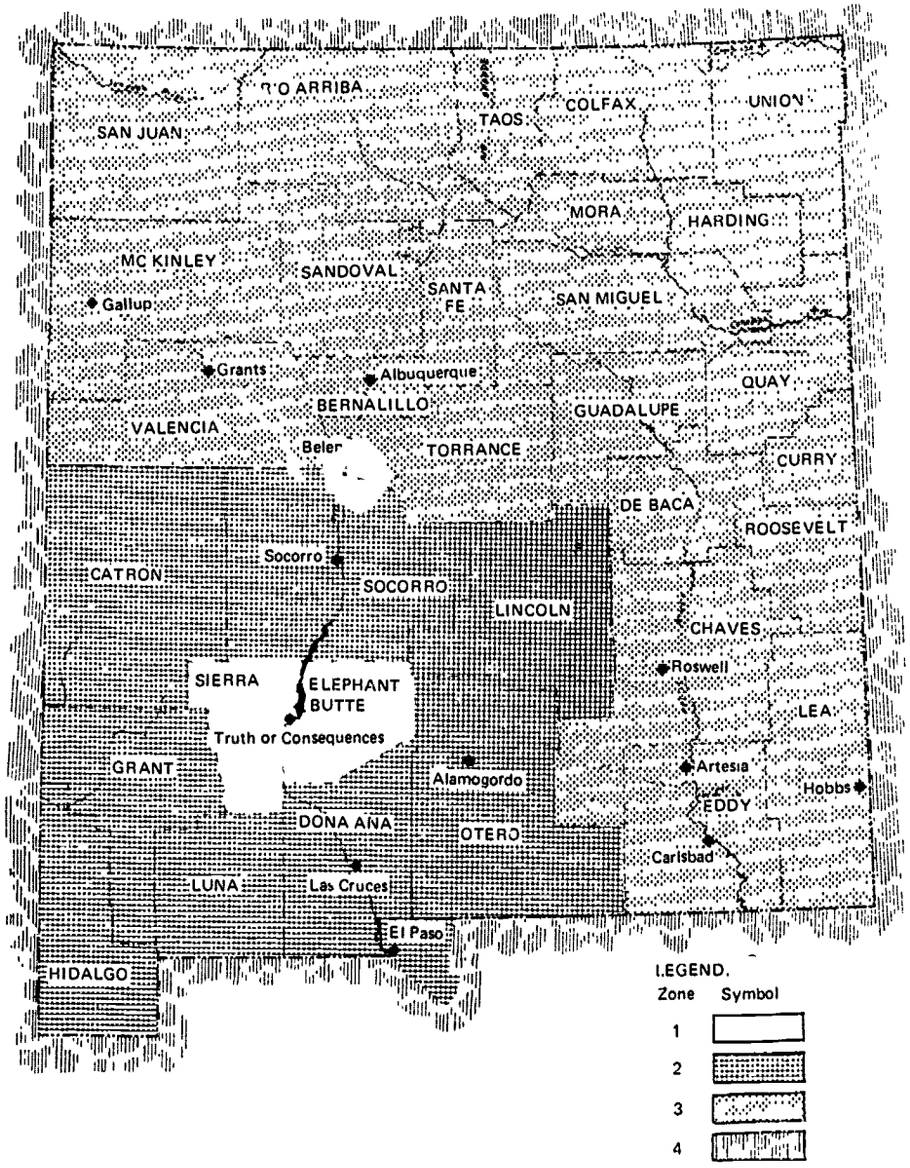

Fig. 4. Distance zones for Elephant Butte reservoir

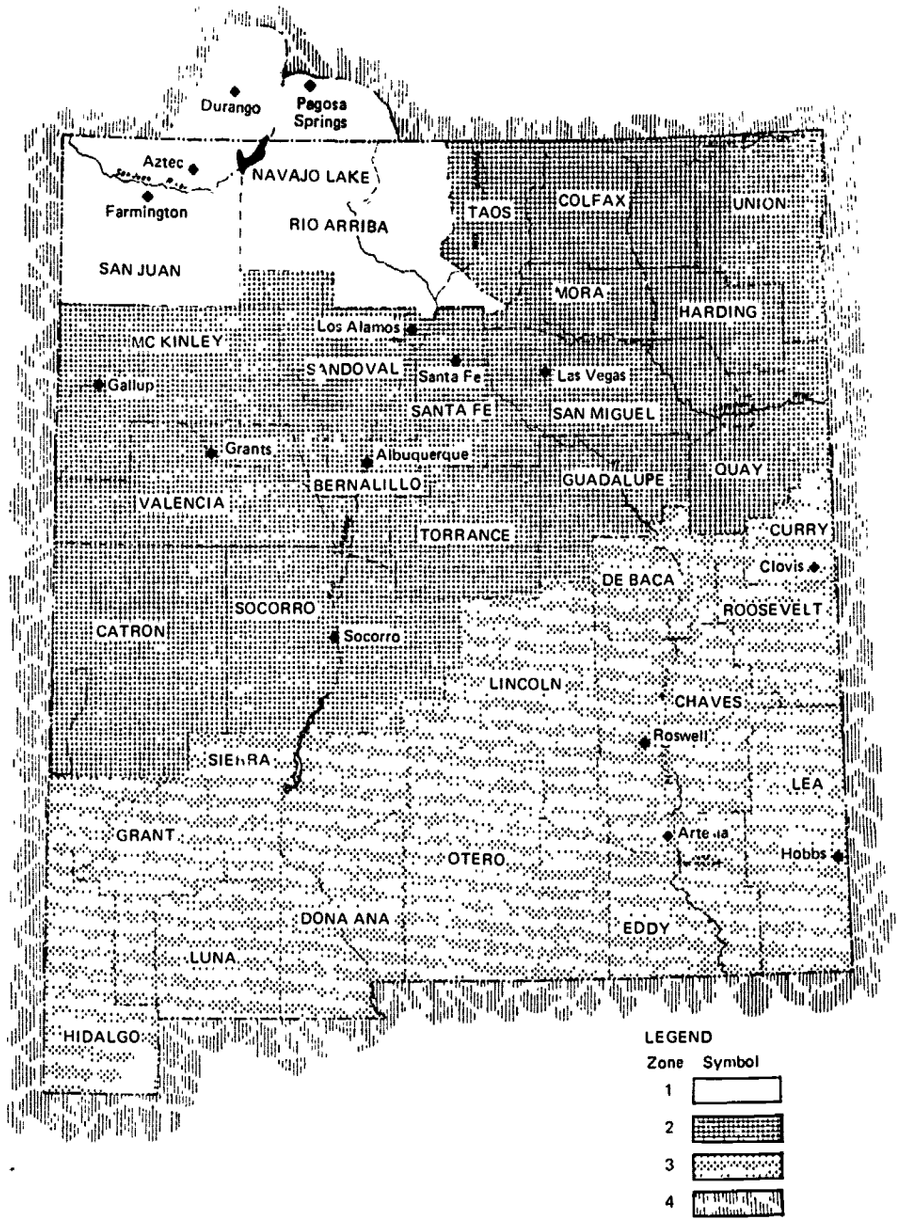

Fig. 5. Distance zones for Navajo reservoir

ing expenses per recreationist-day (commonly referred to as man-day).

Recreationists were also asked to specify their major recreational activity and to indicate their reaction to the water levels at the reservoirs.

The sample data from each reservoir were analyzed separately. Further, both of the two samples were subdivided by zones. Also, an analysis was made with the two samples subdivided into two seasonal groups. On the basis of the 1965 monthly count at Elephant Butte Reservoir, approximately half of the recreationists visited the reservoir in the January-through-July period. Therefore, the samples at each reservoir were divided according to date of visit, January through July or August through December.

Reservoir levels at both Elephant Butte and Navajo reservoirs were determined from Bureau of Reclamation records. Evaporation and seepage data were also obtained from this agency. The minimum pool necessary for fish survival at Elephant Butte Reservoir was estimated by Jester.[2] This estimate was approximately the same as the average minimum pool in the reservoir over the past 15 years. The minimum pool at Navajo Reservoir was the amount planned as being the minimum operational level when the reservoir was constructed.

Consumptive use of water was based on total evaporation from the reservoirs in 1966, plus total seepage. These sums were multiplied by the portions that the minimum pools represented of the average amounts of water in the reservoirs from January through December 1966. The result is the loss of water from the reservoirs allocated to the minimum pool. In this procedure, it is assumed that recreational use of a reservoir is competitive with other uses in the proportion that the minimum pool is of the average pool in the reservoir. That is, none of the recreational activities "consume" water from the reservoir as do irrigation and power-production. However, a minimum pool is necessary for continued recreational use, so evaporation and seepage loss from the minimum pool can reasonably be charged as a consumption loss due to recreationists.

[2] Personal communication with Douglas B. Jester, Assistant Professor of Animal, Range, and Wildlife Sciences, NMSU.

Analysis

The expenses computed on a man-day basis were arrayed from highest to lowest, with the "y" value being expense per man-day and the "x" value being the accumulated number of man-days in the sample. The total expenses of the sample for each time period at each reservoir were determined. The sample expenses were multiplied by a factor representing the number of recreationists at each reservoir in 1966 (the population divided by the sample being the factor used). Values per acre foot of water "consumed" by recreationists were computed on the basis of the total estimated expenditures of recreationists in each period divided by the consumptive use of water in each period. Additionally, the change in the estimated value of recreation per acre foot of water in the reservoirs from one time period to the other was estimated by dividing the changes in values by the changes in the quantities of water in the reservoirs.

Effective market demand price elasticities were determined according to arc elasticity computational procedures. Three areas on the demand curves common to both reservoirs and to both seasonal periods were selected. Also, unitary elasticity points were determined.

Recreational Characteristics

Elephant Butte Reservoir

Water skiing was the most popular activity at Elephant Butte Reservoir among the parties interviewed, with 15 percent of all parties choosing this activity as the main purpose for visiting the reservoir (table 1). Local recreationists (those in Zone 1 or residents of the county in which the reservoir is located) preferred fishing to water skiing.

The most frequently mentioned reason for visiting Elephant Butte Reservoir rather than another reservoir was its location (table 2). Apparently recreationists using the reservoir do so on a regular basis. Only eight percent of the parties in the sample were visiting the reservoir for the first time.

Fifteen percent of the parties reported the number of visits to Elephant Butte Reservoir in 1966 was not typical of other years. Among the reasons reported, the two most frequently mentioned were new purchase of boat and newly moved to area.

Few parties reported making Elephant Butte Reservoir only one of two or more stopping places during a tour of recreational areas. Over half those visiting other places planned tours in New Mexico.

Boats and motors were the most common type of recreational equipment owned by recreational parties visiting Elephant Butte Reservoir in 1966 (table 3). The investment in boats and motors exceeded the investment in other kinds of recreational equipment in both Zones 1 and 4. In Zones 2 and 3, or counties adjacent to the reservoir and other counties in New Mexico, the few recreationists owning cabins at Elephant Butte Reservoir averaged an investment of $3,741 for this item. Camp trailers were the third most costly item of recreation equipment of all recreational parties in the sample.

The average investment in recreational equipment and facilities of all parties in the sample visiting Elephant Butte Reservoir in 1966 was $1,970 (table 3). Residents of Zones 2 and 3

Table 1. Number of Parties in Sample, by Activity and Zones, Elephant Butte Reservoir, 1966

Activity	Parties in Sample					Proportions of Parties Participating [1]
	Zone 1	Zone 2	Zone 3	Zone 4	Total	
	No.	No.	No.	No.	No.	Percent
Fishing	55	90	42	5	192	37
Water Skiing	7	107	108	9	231	45
Boating	0	3	5	2	10	2
Sightseeing	2	3	3	4	12	2
Camping	1	3	6	1	11	2
Picnicking	4	3	1	0	8	2
Swimming	3	10	10	3	26	5
Hunting	1	3	10	0	14	3
Other	2	5	7	0	14	3
Total	75	227	192	24	518	100[1]

1 Total does not add to 100 percent because of rounding error.

Table 2. Number of Parties in Sample Reporting, Major Reasons for Selecting Reservoir, Reasons the Number of Visits Reported for the Year are Not Typical of Past Years, and Other Places Visited, Elephant Butte Reservoir, 1966

Item	Parties Visiting the Reservoir	
	Number	Percent
Major Reasons for Selecting Reservoir:[1]		
First Trip to Reservoir	34	8
Close to Home	173	40
Good Fishing	57	13
Climate	48	11
Beaches	89	21
Good Facilities	20	5
Size of Reservoir	10	2
Total	431	100
Major Reasons for Number of Visits Reported Not Being Typical of Past Years:		
First Time at Reservoir	17	22
Newly Purchased Boat	23	29
Newly Moved to Area	20	26
More Leisure Time	12	15
No Reason	6	8
Total	78	100
Other Places Visited on Trip:		
In New Mexico	41	59
In Texas	24	34
Other States	5	7
Total	70	100

1 Some parties indicated two or more major reasons. Others indicated no major reason.

Table 3. Investments of Recreational Parties at Elephant Butte Reservoir, 1966

Item	Recreational Investment					Percentages of Parties Reporting Values
	Zone 1	Zone 2	Zone 3	Zone 4	Average of All Zones	
	Dol.	Dol.	Dol.	Dol.	Dol.	Percent
	Average Values of Parties Reporting Values[1]					
Tents	15	43	44	50	43	16
Camp Trailers	906	1368	1414	1010	1357	43
Sleeping Equipment[2]	27	37	41	29	38	41
Cooking Equipment[3]	20	31	29	28	30	53
Special Clothing	31	42	44	0	41	4
Boats and Motors	1011	1661	1823	1367	1661	68
Boating Equipment[4]	22	52	61	29	53	65
Fishing Tackle	74	80	103	72	85	44
Rifles, Hunting Equipment	165	253	602	0	419	4
Other	11	10	150	15	57	4
Cabins	0	3953	2150	0	3741	3
	Values of All Parties					
Total Investment	49846	530694	429614	10154		
Average Investment	665	2338	2238	423	1970	

1 Average only of those reporting values, rounded to nearest dollar.
2 Sleeping bags and related equipment.
3 Cooking utensils, stoves, lanterns, iceboxes, etc.
4 Life jackets, skis, etc.

had much larger investments than local residents and out-of-state visitors.

Expenditures per party differed materially by zones. In Zone 1, the local zone, equipment rental was the largest average expense (table 4). In Zone 2, depreciation was the largest expense. As the distance increased from home to Elephant Butte Reservoir, as for recreationists from Zones 3 and 4, travel expenses and lodging became the largest expenses. The two categories of travel cost and depreciation together accounted for 74.6 percent of the total average expenditures of all parties.

Boating and water skiing parties spent more per trip than parties engaged in other kinds of recreational activities at Elephant Butte Reservoir in 1966 (table 5). However, most parties visited the reservoir to water ski or fish. These recreationists stayed the longest at the reservoir. Water skiing, picnicking, and swimming parties averaged four persons or more per party in 1966.

With an average of 2.9 days per trip and 3.4 persons per party, the average party represented 9.86 man-days of recreation. With average expenditures of $69.04 per party, weighted average expenditures of recreationists visiting Elephant Butte Reservoir in 1966 average $7.00 per man-day. Fishing and water skiing expenses per man-day were about average or below average. The few hunters had the highest expense per man-day.

Navajo Reservoir

Fishing was more popular among the parties interviewed at Navajo Reservoir than the combination of all other activities (table 6). Only among visitors from Zone 4 was fishing less popular than the combination of all other activities. Camping was a popular activity for out-of-state recreationists at Navajo Reservoir.

The newness of Navajo Reservoir was the reason a large percentage of

Table 4. Average Expenses per Party in Sample Visiting Elephant Butte Reservoir, 1966

Type of Expense	Recreational Expenditure of Parties Reporting Expenditures				Average of All Zones	Proportions of Parties Reporting Values	Average Expenditures per Party
	Zone 1	Zone 2	Zone 3	Zone 4			
	Dol.	Dol.	Dol.	Dol.	Dol.	Percent	Dol.
Travel Cost[1]	3	22	33	37	24	98	23.52
Boat Fuel	5	10	11	11	10	66	6.60
Food and Refreshments[2]	6	7	8	11	8	31	2.48
Lodging	0	12	17	21	16	16	2.56
Rental of Equipment	12	9	14	16	13	5	.65
Fees	1	4	4	2	4	75	3.00
Licenses	1	2	2	5	2	48	.96
Bait	2	4	3	4	3	33	.99
Ammunition	3	4	9	0	7	4	.28
Depreciation[3]	9	33	32	6	28	100	28.00
Total							69.04

1 Travel cost per mile ranged from $0.06 to $0.12, averaging $0.098.
2 Additional cost over food cost at home.
3 Ten percent of value reported divided by typical number of trips (7) taken per year.

Table 5. Expenses, Duration of Trip and Size of Party, by Type of Activity, Elephant Butte Reservoir, 1966

Activity	Total Expense[1]	Parties Visiting the Reservoir		Average Expenses per Party[2]	Average Time Spent at Reservoir per Party	Average Number of Persons per Party	Average Expenses per Man-Day
	Dol.	No.	Percent	Dol.	Days	No.	Dol.
Fishing	10,143	192	37	53	3 3	2.6	6.18
Water Skiing	20,687	231	44	90	3.1	4.1	7 08
Boating	947	10	2	95	2 4	3.4	11 64
Sightseeing	610	12	2	51	1 8	2 6	10.90
Camping	397	11	2	36	2 0	3.4	5.29
Picnicking	109	8	2	14	1 0	4 5	3 11
Swimming	815	26	5	31	1.7	4 0	4.56
Hunting	660	14	3	47	1.4	1 5	22.38
Other	838	14	3	60	1 6	3 5	10 71
Total	35,206	518	100				
Average					2.9	3.4	9.09[3]

1 Including depreciation, rounded to nearest dollar.
2 Average only of those reporting values.
3 Unweighted average of all activity groups.

Table 6. Number of Parties in Sample, by Activity and Zones, Navajo Reservoir, 1966

Activity	Parties in Sample					Proportions of Parties Participating
	Zone 1	Zone 2	Zone 3	Zone 4	Total	
	No.	No.	No.	No.	No.	Percent
Fishing	71	197	20	30	318	68
Water Skiing	24	29	1	0	54	12
Boating	10	16	1	3	30	6
Sightseeing	0	2	0	5	7	2
Camping	2	20	1	18	41	9
Picnicking	1	1	0	1	3	1
Swimming	0	2	0	7	9	2
Hunting	1	0	1	0	2	*
Other	0	1	0	1	2	*
Total	109	268	24	65	466	100

* Less than 0.5 percent.

parties chose to visit the reservoir in 1966 (table 7). Only eight percent of the parties at Elephant Butte Reservoir stated their first trip to the reservoir was their reason for the visit, but 26 percent selected this reason for their trip to Navajo Reservoir. Good fishing was the most popular reason given for visiting Navajo Reservoir in 1966.

The newness of the reservoir also accounted for the difference between the reservoirs in the stated reasons why the number of trips reported were not typical of past years. At Elephant Butte Reservoir only 14 percent of the parties reported the number of trips were not typical, and various reasons were given. At Navajo Reservoir, 36 percent of the parties indicated the

Table 7. Number of Parties in Sample Reporting, Major Reasons for Selecting Reservoir, Reasons the Number of Visits Reported for the Year are Not Typical of Past Years, and Other Places Visited, Navajo Reservoir, 1966

Item	Parties Visiting the Reservoir	
	Number	Percent
Major Reasons for Selecting Reservoir:[1]		
First Trip to Reservoir	144	26
Close to Home	106	19
Good Fishing	159	29
Climate	53	10
Good Facilities	38	7
Size of Reservoir	48	9
Total	548	100
Major Reasons for Number of Visits Reported Not Being Typical of Past Years:		
First Time at Reservoir	170	86
Newly Purchased Boat	11	6
More Leisure Time	3	2
No Reason	12	6
Total	196	100
Other Places Visited on Trip:		
In New Mexico	67	35
In Colorado	87	47
In Arizona	9	5
Other States	24	12
Total	187	100

1 Some parties indicated two or more major reasons. Others indicated no major reason.

number of trips reported was not typical. A large portion of the parties indicated the number of trips was not typical because this was their first trip to the reservoir.

The location of Navajo Reservoir apparently influenced recreationists to visit other places as well as Navajo. More than a third of the parties indicated they planned visits during the current trip to other places in Colorado, New Mexico, Arizona, and other states.

With fishing as the most popular activity, the largest percentage of parties in the sample reported investment in fishing equipment at Navajo Reservoir (table 8). However, the average investment of the few having cabins was the largest single investment. Boats and motors and camp trailers were owned by 40 to 50 percent of the recreationists, and these items contributed materially to the average investment reported by all recreational parties. The investments by zones at Navajo Reservoir varied in the same way as those at Elephant Butte Reservoir except cabin ownership at the newer reservoir seemed to be concentrated in Zones 1 and 2 rather than Zones 2 and 3. Also, cabins apparently were newer and larger at Navajo Reservoir because the average investment per cabin was almost twice the investment at Elephant Butte Reservoir.

Travel costs were the largest single expense of almost all recreational parties at Navajo Reservoir (table 9). Depreciation and lodging were the next

Table 8. Investments of Recreational Parties at Navajo Reservoir, 1966

Item	Recreational Investment					
	Zone 1	Zone 2	Zone 3	Zone 4	Average of All Zones	Percentages of Parties Reporting Values
	Dol.	Dol.	Dol.	Dol.	Dol.	Percent
	Average Values of Parties Reporting Values[1]					
Tents	75	56	61	71	61	25
Camp Trailers	1252	1308	1491	1554	1349	40
Sleeping Equipment[2]	72	74	108	75	76	52
Cooking Equipment[3]	56	62	50	68	61	54
Special Clothing	28	40	0	54	41	6
Boats and Motors	2547	1902	2617	1466	2100	44
Boating Equipment[4]	131	111	94	99	115	43
Fishing Tackle	98	106	122	97	104	81
Rifles, Hunting Equipment	115	110	645	0	179	2
Other	0	138	90	71	86	2
Cabins	8000	5000	0	0	6500	*
	Values of All Parties					
Total Investment	213818	467490	52025	72973		
Average Investment	1962	1744	2168	1123	1730	

1 Average only of those reporting values, rounded to nearest dollar.
2 Sleeping bags and related equipment.
3 Cooking utensils, stoves, lanterns, iceboxes, etc.
4 Life jackets, skiis, etc.
* Less than 0.5 percent.

Table 9. Average Expenses per Party in Sample Visiting Navajo Reservoir, 1966

Type of Expense	Recreational Expenditure of Parties Reporting Expenditures					Proportions of Parties Reporting Values	Average Expenditures per Party
	Zone 1	Zone 2	Zone 3	Zone 4	Average of All Zones		
	Dol.	Dol.	Dol.	Dol.	Dol.	Percent	Dol.
Travel cost[1]	9	37	63	53	34	94	31.96
Boat Fuel	10	12	18	14	12	44	5.28
Food and Refreshments[2]	10	11	11	15	11	40	4.40
Lodging	40	24	29	9	25	4	1.00
Rental of Equipment	4	8	6	17	9	9	.81
Fees	3	4	8	3	4	79	3.16
Licenses	2	1	1	6	2	80	1.60
Bait	3	4	9	8	5	61	3.05
Ammunition	3	1	10	0	3	1	.03
Depreciation[3]	28	25	31	16	25	100	25.00
Total							76.29

1 Average only of those reporting values, rounded to nearest dollar.
2 Additional cost over food cost at home.
3 Ten percent of value reported divided by typical number of trips (7) taken per year.

two largest expenses, but only four percent of the parties paid for lodging. Because of the location of Navajo Reservoir, many out-of-state parties travelled shorter distances than many in-state parties. Consequently, travel costs of parties in Zone 3 were larger than average costs of parties in Zone 4. Navajo Reservoir is farther from population centers than Elephant Butte Reservoir, so the average travel costs per party at Navajo was higher. Also, with fishing being a major activity at Navajo Reservoir, expenditures for licenses and bait were much higher at this reservoir than at Elephant Butte.

As at Elephant Butte Reservoir, the parties at Navajo Reservoir engaging in boating and water skiing spent the highest average amount (table 10). Parties engaged in fishing, water skiing, and hunting spent an average of three days or more at the reservoir, and the water skiing and picnicking parties were the largest. The average time spent at Navajo Reservoir by the 466 parties in the sample was the same as the average time spent at Elephant Butte Reservoir by the 518 parties in the latter sample. Further, the average number of persons per party at the two reservoirs was approximately the same.

With an average of 2.9 days per party and 3.3 persons per party, each visit at Navajo Reservoir represented an average of 9.57 man-days of recreation. With an average expenditure of $76.29 per party, expenditures at Navajo Reservoir in 1966 averaged $7.97 per man-day, or $0.97 more per man-day than at Elephant Butte Reservoir. Fishing and water skiing expenses per man-day were about average while the few sightseeing, hunting, and other parties had high expenses per man-day.

Table 10. Expenses, Duration of Trip and Size of Party, by Type of Activity, Navajo Reservoir, 1966

Activity	Total Expense[1]	Parties Visiting the Reservoir		Average Expenses per Party[2]	Average Time Spent at Reservoir per Party	Average Number of Persons per Party	Average Expenses per Man-Day
	Dol.	No.	Percent	Dol.	Days	No.	Dol.
Fishing	23,109	318	68	73	3.1	3.0	7.85
Water Skiing	5,361	54	12	99	3.0	4.2	7.86
Boating	2,521	30	6	84	2.5	3.8	8.84
Sightseeing	520	7	2	74	1.4	2.9	18.23
Camping	2,683	41	9	65	2.0	3.6	9.03
Picnicking	124	3	1	41	1.0	4.3	9.53
Swimming	544	9	2	60	2.2	3.7	7.37
Hunting	134	2	.4	67	3.0	1.0	22.33
Other	137	2	.4	68	1.5	2.0	22.67
Total	35,133	466	100.0				
Average					2.9	3.3	12.63[3]

1 Including depreciation, rounded to nearest dollar.
2 Average only of those reporting values.
3 Unweighted average of all activity groups.

Water Values

Consumptive Use

The consumptive use of water for recreational purposes was based on the minimum amounts of water necessary for fish survival at the two reservoirs. At Elephant Butte Reservoir, 26,796 acre feet of water was allocated to recreational uses for the January 1 through July 31, 1966 period (table 11). For the later period of August 1 through December 31, 1966, 11,447 acre feet were allocated.

At Navajo Reservoir, net seepage loss was considered by Bureau of Reclamation personnel to be negligible. Since the average pool in 1966 for both seasonal periods was less than the planned minimum operational level, all evaporation losses were charged to recreation.

Reaction to Water Levels

The awareness of recreational parties and their reaction to water levels at Elephant Butte Reservoir are shown in tables 12 and 13. Those living closest to the reservoir were the most aware of the level. Although an overwhelming majority expressed no reaction to the water level, large majorities liked high water levels and disliked low water levels.

At Navajo Reservoir, approximately the same pattern of awareness was recorded as at Elephant Butte Reservoir (table 14). However, more than a half of the parties indicated no reactions to either high or low water levels (table 15). Since Navajo Reservoir is new and it was still filling during most of 1966, the basis for reactions at Navajo

Table 11. Seasonal Consumptive Use of Water for Recreational Purposes at Elephant Butte and Navajo Reservoirs, 1966

Item	Units	Elephant Butte Reservoir	Navajo Reservoir
For Period January 1-July 31, 1966:			
Total Evaporation	Ac.Ft.	47,740	5,700
Net Seepage	Ac.Ft	15,382	0
Gross Loss	Ac.Ft.	63,122	5,700
Factor Calculation			
Minimum Pool	Ac Ft.	200,000	344,286
Average Pool	Ac.Ft.	471,128	344,286
Percent Minimum of Average	Pct.	42.451	100.000
Consumptive Use[1]	Ac.Ft.	26,796	5,700
For Period August 1-December 31, 1966:			
Total Evaporation	Ac Ft.	19,062	4,000
Net Seepage	Ac.Ft.	-3,003	0
Gross Loss	Ac.Ft.	16,059	4,000
Factor Calculation			
Minimum Pool	Ac.Ft.	200,000	456,640
Average Pool	Ac.Ft.	280,580	456,640
Percent Minimum of Average	Pct.	71.281	100.000
Consumptive Use[1]	Ac.Ft.	11,447	4,000

1 Consumptive use is the product of gross loss multiplied by the percentage the minimum pool is of the average pool.

Table 12. Number of Parties Aware of Water Level before Visit, by Zone, Elephant Butte Reservoir, 1966

Item	Zone 1	Zone 2	Zone 3	Zone 4	Total
	No.	No.	No.	No.	
Aware	70	127	97	1	295
Not Aware	5	100	95	23	223

Reservoir are not considered to be comparable to those at Elephant Butte Reservoir. The water levels at Elephant Butte Reservoir were considered to be typical of established reservoirs in New Mexico—high levels in spring and declines in levels throughout most of the year.

Consumptive Values of Water

Using the Anderson-Gray procedure (3), a demand equation was fitted to the "x" variable of cost per man-day, and the "y" variable of accumulated man-days. At Elephant Butte Reservoir, the effective market demand functions achieved satisfactory fits based on the values of the coefficients of determination (table 16). The integral of the equation (the area under the demand curve) was determined, representing the recreational expenditures of the sample. Recreational expenditures were considered to be the recreational value of the reservoir. Sample values were expanded to represent the population. The population numbers are based on Bureau of Reclamation traffic counts of the total numbers of recreationists visiting the reservoirs during the two time periods.

The difference in the estimated expenditures of recreationists at Elephant Butte visiting the reservoir from January 1 to July 31, 1966 and from August 1 to December 31, 1966 was $1,128,511. Meanwhile, the reservoir level decreased 190,548 acre feet. On the average, for each acre-foot decrease in reservoir level, recreational expenditures decreased $21.67.

When the total estimated expenditure of all recreationists is divided by the consumptive use of water in the corresponding time periods, the result is the amount of expenditure for each acre foot of water lost from the reservoir because of recreational activity. The recreational value per acre foot of water used by recreationists was $394.16 in the early season period and $562.03 in the late season period.

At Navajo Reservoir the total recreational expenditures decreased by $950,088 from the January 1 to July 31, 1966 period to the August 1 to December 31, 1966 period (table 17). However, reservoir levels *increased* 112,351 acre feet. The failure of expenditures by recreationists to increase when reservoir level increased might indicate that the seasonal effect at Navajo Reservoir was more important than the water level effect. Additional study is needed to separate these two effects on recreational expenditures.

The value of water based on recreational expenditures and the amount of water lost from the reservoir because of recreational uses at Navajo Reservoir in the forepart of 1966 was $543.70 per acre foot. The value in the latter part of the year was $537.26.

Table 13. Reactions of Sample to the Water Level, Elephant Butte Reservoir, 1966

Item	Parties Visiting the Reservoir
	Number
Response to How Water Level Affects Decision to Visit Reservoir:	
No Reaction	430
Like High Water Level	29
Like Constant Water Level	6
Like Low Water Level	8
If Water Level Low, Don't Come	45
Reaction to High Water Level upon Arrival at Reservoir:	
No Reaction	129
Like High Water Level	374
Dislike High Water Level	15
Reaction to Low Water Level upon Arrival at Reservoir:	
No Reaction	130
Like Low Water Level	20
Dislike Low Water Level	368

Table 14. Number of Parties Aware of Water Level before Visit, by Zone, Navajo Reservoir, 1966

Item	Zone 1	Zone 2	Zone 3	Zone 4	Total
	No.	No.	No.	No.	
Aware	83	79	4	4	170
Not Aware	26	189	20	61	296

Table 15. Reactions of Sample to the Water Level, Navajo Reservoir, 1966

Item	Parties Visiting the Reservoir
	Number
Response to How Water Level Affects Decision to Visit Reservoir:	
No Reaction	378
Like High Water Level	23
Like Constant Water Level	13
Like Low Water Level	0
If Water Level Low, Don't Come	52
Reaction to High Water Level upon Arrival at Reservoir:	
No Reaction	254
Like High Water Level	195
Dislike High Water Level	16
Reaction to Low Water Level upon Arrival at Reservoir:	
No Reaction	244
Like Low Water Level	10
Dislike Low Water Level	212

Table 16. Value of Water for Two Seasonal Periods, Elephant Butte Reservoir, 19[illegible][1]

Item	Units	January 1-July 31, 1966	August 1-December 31, 1966	Change
Regression Equation	...	y=40.96 —11.22 log x	y=42.49 —12.54 log x	
Coefficient of Determination	percent	91	95	
Integral of the Regression Equation (Recreational Expenditure by the Sample)	dollars	21,794.65	13,343.05	—8,451.60
Recreational Expenditure by the Population	dollars	10,562,036.10	6,433,525.02	—4,128,511.08
Average Pool[2]	acre-feet	471,128	280,580	—190,548
Decrease in Value of Water per Acre-Foot Decrease in Water Storage	dollars			21.67
Total Consumptive Use of Water for Recreation[3]	acre-feet	26,796	11,447	
Value of Water per Acre-Foot	dollars	394.16	[illegible]2.03	

1 Anderson-Gray procedure.
2 Based on Bureau of Reclamation records of water levels.
3 Based on Bureau of Reclamation records of recreational pool, water levels, evaporation, and seepage.

Table 17. Value of Water for Two Seasonal Periods, Navajo Reservoir, 1966[1]

Item	Units	January 1-July 31, 1966	August 1-December 31, 1966	Change
Regression Equation	....	y=62.86 —18.79 log x	y=68.67 —21.33 log x	
Coefficient of Determination	percent	93	96	
Integral of the Regression Equation (Recreational Expenditure by the Sample)	dollars	18,069.89	15,348.53	—2,721 36
Recreational Expenditure by the Population	dollars	3,099,112.62	2,149,024.43	—950,088.19
Average Pool[2]	acre-feet	344,286	456,640	+112,354
Decrease in Value of Water per Acre-Foot Increase in Water Storage	dollars			8 46
Total Consumptive Use of Water for Recreation[3]	acre-feet	5,700	4,000	
Value of Water per Acre-Foot	dollars	543.70	537.26	

1 Anderson-Gray procedure.
2 Based on Bureau of Reclamation records of water levels.
3 Based on Bureau of Reclamation records of recreational pool, water levels, evaporation, and seepage.

Elasticities of Demand

Elasticities were computed for each reservoir for both periods with the effective market demand equations based on the Anderson-Gray variables and integral. The demand curves exhibited both inelastic and elastic segments. Consequently, arc elasticities were determined at three arbitrary levels — when expenditures ranged from $2.00 to $1.00 per man-day, from $10.00 to $20.00, and from $20.00 to $30.00. Also, the unitary point was determined.

Elasticity of demand is a measure of the response of the quantity demanded to a given change in price. If price changes one percent and the quantity demanded also changes one percent, then the elasticity is said to be unitary. At unitary elasticity, a price change will have no effect on the total expenditures because a price change will be exactly offset by a reverse change in the quantity of man-days of recreation demanded. When demand is inelastic, a price increase will only partially be offset by a decrease in quantity demanded and total expenditures will increase. Price *decreases* in the inelastic range of the demand curve will result in a *decrease* in total expenditures. The opposite situations occur when demand is elastic. Demand is inelastic if the elasticity value ranges from 0 to —1. Demand is elastic if the value ranges from —1 or lower.

Effective market demand price elasticities are shown in table 18. Effective market demand for recreation at both reservoirs is more elastic in the early than the late season. The newer reservoir, Navajo Reservoir, has a more inelastic demand for recreation than the older reservoir. The unitary point (or the point at which price does not affect total expenditures) is at a much lower price at Elephant Butte Reservoir and a much larger portion of the effective market demand curve for recreation is in the inelastic range at this reservoir.

Table 18. Effective Market Demand Elasticities at Elephant Butte and Navajo Reservoirs, 1966

Reservoir	Season	Unitary Elasticity Point		Elasticities at Prices of: $2-$4 Per Man-Day	$10-$20 Per Man-Day	$20-$30 Per Man-Day
		Pct.[1]	Dol.			
Elephant Butte	Jan 1-July 31	50.4	4.93	—.6073	—2.3174	—3.8615
	Aug. 1-Dec 31	50.9	5.30	—.5452	—2.0537	—3.6250
Navajo	Jan 1-July 31	34.6	8.06	—.3655	—1.6382	—2.7305
	Aug. 1-Dec 31	31.0	9.27	—.3228	—1.4714	—2.4639

1 Percentages of total recreationists with inelastic demand characteristics.

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About the cover

At Navajo Lake (larger picture) fishing was found to be the most popular sport. Elephant Butte recreationists (small picture) favor water skiing. Photos: Navajo Lake, courtesy Farmington Industrial Development Service; Elephant Butte, courtesy New Mexico Department of Development.