A STUDY OF THE VALUE OF RECREATION AND IMPACT OF EUTROPHICATION ON RECREATIONAL ACTIVITY AT FLAMING GORGE RESERVOIR--1987

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INTRODUCTION

This paper presents the results of a second survey of the impact of eutrophication on recreational activity at Flaming Gorge Reservoir. The original survey was conducted during the months of April through September, 1986. The results of that survey have been presented in Oster et al (1987). The second survey was conducted during August and September, 1987.

The motivation for conducting another survey was that 1986 was not a typical year for eutrophication in Flaming Gorge Reservoir due to the draining of Fontenelle Reservoir. Fontenelle Reservoir, located approximately 60 miles upstream from Flaming Gorge, was drained during 1985 and has been kept at reduced levels since that time. The draining of Fontenelle increased the nutrient load of Flaming Gorge in 1986 which contributed to the largest algal bloom in the reservoir since 1978 (U.S. Bureau of Reclamation, 1987). Also, the added inflow from the draining resulted in the bloom appearing further south in the reservoir than normal. Eutrophication is generally concentrated in the Inflow area of the reservoir.

The purpose of a second survey was to determine if the abnormal algal bloom in 1986 affected the results of the earlier study. In particular, it is important to know whether there were significant changes between the 1986 and 1987 surveys in visitor use patterns and the responses of individuals to questions regarding the impact of algae on their recreational activity at Flaming Gorge. If the economic analysis performed in the original study should serve as a guideline for any decisions regarding control measures for eutrophication in Flaming Gorge, it is important that the benefit and loss estimates be as accurate as possible. Visitor use data and information on the impact of algae on recreational activity are key components in the calculation of the benefit and loss estimates.

The 1987 survey also included questions relating to various management issues of concern to agencies responsible for the operation of Flaming Gorge Reservoir. Questions regarding the Lake trout fishery, facilities on the reservoir, the impact of algae on catfish and bass fishing, and whether recreationists would favor control measures for eutrophication at the expense of decreased fishery productivity were asked. The questions were asked for the Utah Division of Wildlife Resources and the Wyoming Game and Fish Department, the U.S. Forest Service, and the U.S. Bureau of Reclamation respectively. The results of these questions will also be presented in this paper.

The reasons for measuring the impact of eutrophication on recreation at Flaming Gorge as well as the framework for the economic analysis have already been presented in Oster et al (1987) and will not be repeated here. This paper will only provide a brief summary and analysis of the results of the 1987 survey. However, the results of the questions regarding the various management issues for Flaming Gorge can only serve as an information base for agencies in any decision-making processes as it is beyond the scope of this study to suggest any implications of the responses to these questions.

METHODOLOGY

The survey procedure used for the 1987 study consisted of a personal interview with users of the reservoir as opposed to a personal interview and mail questionnaire procedure used in the 1986 survey. Since the primary concern of the second study was to assess whether the abnormal algal bloom had affected individuals' perceptions of the impact of algae on their recreational activity, it was determined that the personal interview, which focused on this aspect of the survey, was all that was necessary to meet this objective. Also, because respondents were asked their point of origin and the number of trips they make to the reservoir on the personal survey, the necessary

information to compare use patterns could also be acquired with the personal interview.

A total of 400 surveys were conducted in the 1987 survey as opposed to 820 in the 1986 survey. The smaller number in 1987 is attributable to the shorter time period available to conduct the survey. To account for the difference in sample size, the results of the surveys were tested for statistical differences at the 95% confidence level. As in the 1986 survey, the sample was stratified by the distribution of fishing pressure on the reservoir (Utah Division of Wildlife Resources, 1982). Approximately 17% of the surveys were randomly conducted at recreation sites in the Inflow area, 47% at recreation sites in the Open Hills area, and 35%, at recreation sites in the Canyon area. Because the second survey was conducted during the months of August and September, the results of the survey should be comparable to results of the 1986 survey since recreationists in 1987 were interviewed during the time period when eutrophication would normally occur.

In identifying problems with excessive algae at Flaming Gorge, recreationists were not restricted to the year in which they were surveyed. Respondents could indicate any year in assessing the impact of eutrophication on their recreational activities. Consequently, the difference between the results of the two surveys with regard to algae would not be strictly a reflection of differences between the individual years of 1986 and 1987. However, it is likely that the current level of algae in the reservoir has a strong influence on the response to the questions regarding eutrophication.

RESULTS

USE PATTERNS

Results from the 1987 survey indicated that the use patterns of recreationists were consistent with the results of the 1986 survey. Table 1

displays a comparison of data between the 1986 and 1987 surveys for the percent of recreationists coming from the four states that made up the market area for Flaming Gorge. The market area is the geographical region from which trips to a recreation site are consistently generated.

Table 1. State of Origin of Surveyed Population

	1986	1987
Utah	54.0	58.1
Wyoming	37.4	32.1
Colorado	6.0	6.3
Idaho	.8	1.0
	98.2	97.5

Thus, both years' surveys show that over 97% of those interviewed came from the four state area of Utah, Wyoming, Colorado, and Idaho.

The data on county use data also compared favorably between the two surveys. The 1987 data showed that 9U of the respondents came from counties within the market area. The 1986 survey indicated that 93% of the respondents came from the counties within the market area. Also, the data showed similar use patterns between the two surveys for the counties that generated the most use for Flaming Gorge. Table 2 shows a comparison between the 1986 and 1987 survey data of the percent of recreationists coming from the four counties with the highest use of the reservoir.

Table 2. County of Origin of Surveyed Population

	1986	1987
Salt Lake (UT)	28.8	29.0
Sweetwater (WY)	26.6	21.0
Davis (UT)	7.5	9.0
Weber (UT)	7.4	11.0
	70.3	70.0

The data indicate that approximately 70% of those surveyed originate from only four counties in Utah and Wyoming. The entire market area for Flaming Gorge consisted of 27 counties among the four states of Utah, Wyoming, Colorado, and Idaho.

Results from the two surveys also showed there was not a significant discrepancy between the number of trips recreationists make to Flaming Gorge. The 1986 survey indicated that the mean number of trips made to the reservoir was 13. The mean number of trips for the 1987 survey was 10. These numbers were not statistically different at the 95%, confidence level.

Comparison of use patterns between the two surveys indicate that there were no significant discrepancies between the 1986 and 1987 survey data. This is important since benefit estimates are, in part, dependent on the size of the market area and the number of trips made by recreationists to the reservoir. If use patterns between the two surveys had been significantly different, it would have been necessary to redefine the market area for Flaming Gorge and in turn, reestimate the values derived for recreation at the reservoir. Since this is not the case, however, the estimates of the benefits of recreation at Flaming Gorge from the 1986 study are still appropriate measures of value.

IMPACT OF EUTROPHICATION ON RECREATION

Table 3 displays a comparison between the 1986 and 1987 survey data of

Table 3. Percent of Recreationists Aware of or Adversely Affected by Algae

	1986	1987
Aware of Excessive Algae	26.0	19.8*
Adversely Affected by Excessive Algae	13.0	8.5*

*Significantly different at the 95% confidence level.

the percent of recreationists indicating they had either been aware of, or been adversely affected by, excessive algae in their recreational activity at Flaming Gorge. The data indicate that, of the 400 people surveyed in 1987, a smaller percentage were aware of, or had been adversely affected by, excessive algae in their recreational activity than the 820 people surveyed in 1986. Statistical testing did indicate that these numbers were significantly different at the 95%, confidence level.

As was noted in Oster et al (1987), there was a large discrepancy between the percent of people identifying a certain year as a problem year for algae and the physical amounts of algae in the reservoir as measured by U.S. Bureau of Reclamation studies. In particular, results of the 1986 survey indicated that the highest percentage of recreationists identified 1986 as a problem year for algae while water quality studies showed that algal blooms in 1978 were far greater in concentration and areal extent than during any other year documented. The 1986 survey data indicated the lowest percentage of people identified 1978 as a problem year for algae. Because the data also indicated that 78%, of the people who were interviewed had used the reservoir prior to 1978, it seems reasonable to suggest that individual's overall perceptions of the impact of algae on recreational activity are, in part. Influenced by the current year's water quality conditions. Thus, a higher percentage of recreationists indicating they had either been aware of or adversely affected by algae in the 1986 survey is probably some reflection of the increase in eutrophication for that year.

Results of the 1987 survey showed that 44.3% of the recreationists that has either noticed or been adversely affected by eutrophication were impacted in 1987 compared to 76%, of recreationists being impacted in 1986. Results of

the 1986 survey showed that 69% of recreationists indicated 1986 as the year they had been impacted. Thus, in both surveys, 1986 was identified most often as the year when algae was encountered. While there are no physical measurements of the amount of eutrophication in Flaming Gorge for 1987 to compare to 1986, the 1987 survey responses indicate that eutrophication was not as prevalent in 1987 as in the previous year.

Table 4 displays recreation sites identified by recreationists from the 1987 survey who had either been aware of or adversely affected by algae in 1985, 1986, and 1987. Data from the 1987 survey are used to display the difference between the years with regard to recreationists' identification of where eutrophication was encountered on the reservoir. Again, the percentage amounts do not add up to 100% since recreationists were allowed to identify more than one site. Also, only sites that were most consistently identified are included in the Table.

Table 4. Sites Where Algae was Encountered on Flaming Gorge Reservoir

	1985	1986	1987
Confluence	0	0	22.9
Firehole-Buckboard Area	77.7	43.3	60.2
Squaw Hollow	3.7	17.7	0
Pipeline	3.0	13.3	0
Lucerne	0	15.0	2.9

The data indicate that a greater percentage of recreationists encountered eutrophication at more southern points in the reservoir in 1986 than in 1985 and 1987. As was noted in Oster et al (1987), it is probably a reflection of the anomaly in water flow from Fontenelle in 1985-1986 that more southern sites such as the Pipeline and Lucerne were designated as areas for excessive algae in 1986.

The data on locations where recreationists encountered excessive algae in 1985 and 1987 seem to corroborate U.S. Bureau of Reclamation studies in identifying the Inflow area as the region the reservoir where eutrophication is normally concentrated. Consequently, the assumption made in Oster et al (1987), that the northern end of the reservoir would be unusable during the time eutrophication normally occurs, is still a valid base for estimation of the loss in benefits to recreationists from eutrophication. As was stated in Oster et al (1987), making this assumption will result in calculation of the maximum loss in recreation benefits from eutrophication. The 1987 survey data did not show any increase in the percentage of recreationists indicating they had been impacted by eutrophication and thus, the original calculation of the maximum loss in benefits would still represent an upper bound for the impact of eutrophication on recreational users of Flaming Gorge Reservoir.

Table 5 compares the percentage of recreationists indicating a particular activity that had been adversely affected by algae. Data on fishing and boating activities compare favorably; however, the percentage amounts for waterskiing and swimming activities are significantly higher for the 1987 survey than for the 1986 survey. This is most likely explained by the fact

Table 5. Percent of Recreationists Indicating Activity Affected by Eutrophicatlon

	1986	1987
Fishing	73.0	65.5
Boating	67.0	66.0
Waterskling	23.0	48.3*
Swimming	24.0	62.0*

*Significantly different at the 95%7, confidence level

that the area of concentration for eutrophication in 1987, as indicated by recreationists, was the Firehole-Buckboard area where waterskiing and swimming activities are more popular. This is particularly true in the Firehole area. Data from the 1987 survey showed that the majority of those people indicating 1987 as the year when algae had adversely affected their recreational activities identified waterskiing and swimming as the activities affected.

MANAGEMENT ISSUES

Utah Division of Wildlife Resources and Wyoming Game and Fish

Of the 400 people surveyed in 1987 55.0% indicated they do regularly fish for Lake trout in Flaming Gorge Reservoir. Forty-five percent said they do not regularly fish for Lake trout. These numbers reflect the response of recreationists surveyed during the months of August and September and thus, there may be some bias upward since these are the months when Lake trout fishing is most intensive.

Table 6 indicates the size of Lake trout recreationists who regularly fish for Lake trout would like Fish and Game agencies to manage for in Flaming Gorge Reservoir (See Question 12, Appendix A). The data indicate that 86.8% of those people who regularly fish for Lake trout would like to see the reservoir managed for Lake trout of 20 pounds or more.

Table 6. Percent of Recreationists Identifying Size of Lake Trout to be Managed for in Flaming Gorge Reservoir

Pounds	Percent Response
0 - 10	3.7
10 - 20	9.6
20 - 30	51.4
30 - 40	31.7
40 plus	3.7

In response to the question of whether they would support stricter regulations on Lake trout fishing in Flaming Gorge, 78.9% of recreationists who regularly fish for Lake trout indicated they would support stricter regulations. 21.1%, said they would not support stricter regulations (See Question 13, Appendix A).

U.S. Forest Service

Table 7 provides the percentage of recreationists indicating whether they found the facilities at the three marinas on the reservoir (Buckboard, Lucerne, Cedar Springs) to be sufficient for their boating needs (See Question 8, Appendix A). The percentage amounts represent the response of all 400 recreationists surveyed.

Table 7. Percent of Recreationists Indicating Whether Facilities at Marinas are Sufficient for Boating Needs.

Marina	Yes	No	Never Used
Buckboard	28.4	7.0	64.6
Lucerne	67.1	8.8	24.1
Cedar Springs	39.4	7.5	53.1

Table 8 displays the response of recreationists to the question of how important various types of reservoir camping are to their recreational experience at Flaming Gorge (See Question 9, Appendix A). In this context reservoir camping refers to camping on the reservoir with a boat. The data indicate that 51.9% of recreationists rated a boat access camping experience as either important or very important; 52.9% designated undeveloped area boat camping as important or very important; and 52.3% said that boat camping was important or very important to their recreational experience at Flaming Gorge.

Table 8. Percent of Recreationists Indicating Importance of Boat Camping on Reservoir.

Type of Camping	Very Important	Important	Not Important	Don't Camp
Boat Access Campground	17.4	34.5	1.5	46.6
Undeveloped Area	19.1	33.8	1.3	45.8
Boat Camping[a]	19.1	33.2	1.3	46.3

[a] This type of camping refers to recreationists who stay on their boat on the reservoir but not at a boat access campground or undeveloped beach area.

When asked if they currently camp on the reservoir 30.5% of recreationists surveyed said yes, 49.1% said no, and 20.4% indicated they planned to camp in the future. Of those people who said they did not currently camp on the reservoir 6.1% indicated they did not due to lack of facilities for boat camping. 93.9% said they did not camp due to personal preference.

U.S. Bureau of Reclamation

In response to the question of whether they thought there was a need for additional recreational sites on the eastern side of the reservoir 24.9% of those surveyed indicated yes, 17.1% said no, and 57.9% had no opinion (See Question 10, Appendix A). Table 9 displays the number of recreationists identifying a reason for their response. The data show that the majority of recreationists did not have an opinion as to whether there should be additional facilities on the eastern side of the reservoir and that this is attributable to the fact they do not use that side.

When asked whether excessive algae on the water surface would be a deterrent to catfish or smallmouth bass fishing even if creel rates on these species were high, 12.3% of those surveyed said yes, 87.0% said no, and .7% had no opinion (See Question 14, Appendix A). The reasons for these responses and the number of recreationists identifying a particular reason are displayed in Table 10.

Table 9. Reasons for Whether Additional Recreational Sites are Needed on Eastern Side of Flaming Gorge Reservoir.

Reason	Number of Recreationists
Yes	
Other recreation sites too crowded	61
Closer to Rock Springs and other Wyoming origins	16
Would like to see a marina on that side	11
Would provide variety to recreational experience	4
Would like to fish more on that side	3
No	
Should improve existing facilities	34
Too far to travel	9
Wouldn't get used	8
Would like to see more sites on west side	6
Don't want more people on that side	4
Too windy	3
No Opinion	
Don't use that side	241
TOTAL	400

Table 10. Reasons Why Excessive Algae Would Not Be a Deterrent to Catfish and Smallmouth Bass Fishing Given High Creel Rates

Reason	Number of Recreationists
Yes	
Not aesthetically pleasing	25
Messes up equipment	18
Fish would not taste good	6
No	
Not bothered by algae	150
Don't fish for those species	149
Don't fish	26
Don't use the area - too far to travel	20
Algae is good for bass fishing	6
TOTAL	400

Finally, in response to the question of whether algae control measures would be favored even if it resulted in a lower fishery productivity at the southern end of the reservoir, 33.9%, of recreationists surveyed indicated yes 41.2% said no, and 24.9% had no opinion (See Question 15, Appendix A). Of those people indicating yes to the question, 37%, voluntarily indicated they would favor the control measures only if the eutrophication situation was determined to be a problem for the reservoir.

SUMMARY AND CONCLUSIONS

The results of the 1987 survey displayed a strong consistency with data collected in 1986 on use patterns of recreationists and individuals' perceptions of the impact of algae on their recreational activity at Flaming Gorge Reservoir. This outcome indicates that the abnormal algae bloom of 1986 did not affect the results of the original study. Consequently, the total and net benefit amounts calculated from the 1986 data are still appropriate estimates of the annual value of recreation at Flaming Gorge Reservoir. The loss estimates due to eutrophication would also remain the same.

Results of the 1987 survey also showed that 44.3% of the recreationists that had either noticed or been adversely affected by eutrophication were impacted in 1987 compared to 76%, of recreationists being impacted in 1986. While there are no physical measurements of the amount of eutrophication in Flaming Gorge for 1987 to compare to 1986, the later survey responses indicate that eutrophication was not as prevalent in 1987 as in the previous year. The abnormality of the 1986 bloom also seemed to be corroborated by the fact that 77.7% of those people who encountered excessive algae in 1985, and 83.1% who encountered it in 1987, indicated Buckboard and sites north as points where they encountered algae. This is in contrast to 43.3% of recreationists indicating this area for excessive algae in 1986. If 1985 and 1987 are representative of normal years for eutrophication, the 1987 survey suggests that eutrophication is typically concentrated in the Inflow area of the reservoir.

References

Oster, Jeanette M., Taylor, David T., Jacobs, James J., and Edward B. Bradley, "Reservoir Eutrophication and the Value of Recreational Activities: A Case Study of Flaming Gorge Reservoir," Department of Agricultural Economics and Wyoming Water Research Center, Laramie, Wyoming, June, 1987.

U.S. Department of Interior, Bureau of Reclamation, Salt Lake City, UT, Personal Communication with Jerry Miller, 1987.

Appendix A

Effects of Water Quality on
Flaming Gorge Recreation

ID# ____________
SITE ____________
INTERVIEWER ____________
DATE ____________

Q-1) Where do you live?

____________________ City _________________ COUNTY ________________ STATE

Q-2) Have you noticed any of the following water quality problems during your recreational activities at the reservoir in the past 5 years?

1) Not very clear; murky
2) Strange odors or tastes
3) Algae growth or plant scum
4) Dead fish
5) Irritation to eyes or skin
6) Floating Objects
7) Other ________________________________
8) No objection

Q-3) Has the presence of algae affected your enjoyment of recreation on Flaming Gorge?

Yes No

Q-4) When and where has algae affected your recreation on the reservoir?

YEAR	MONTH												WHERE	TYPE
19____	1	2	3	4	5	6	7	8	9	10	11	12	______	______
19____	1	2	3	4	5	6	7	8	9	10	11	12	______	______
19____	1	2	3	4	5	6	7	8	9	10	11	12	______	______
19____	1	2	3	4	5	6	7	8	9	10	11	12	______	______
19____	1	2	3	4	5	6	7	8	9	10	11	12	______	______

Q-5) What recreational activities have been affected by algae?

1) Fishing 2) Boating 3) Waierskling 4) Swimming 5) Other ___________

Effect on Recreational Activity	Activity
1) Switch to a different site on Flaming Gorge Reservoir?	_________________
2) Change recreational activities at Flaming Gorge?	_________________
3) Go to a different reservoir?	_________________
4) Change to other forms of recreation?	_________________

Q-6) What specific location on the reservoir was the primary destination of this trip to Flaming Gorge?

LOCATION ____
MILES FROM HOME (ONE-WAY) _________________________________
HOURS OF TRAVEL TIME _____________________________________

Q-7) What is the total number of trips you make to Flaming Gorge in a year?
_____

Q-8) Do the three marinas (Buckboard, Lucerne, Cedar Springs) provide sufficient facilities for your boating needs?

	YES	NO	NEVER USED	FACILITIES LACKING
Buckboard				
Lucerne				
Cedar Sprines				

IF NO, what facilities are lacking?

Q-9) How important are each of the following types of reservoir camping to your recreation experience at Flaming Gorge Reservoir?

	Very Important	Important	Not Important	Don't Camp
1) Boat access campground				
2) Camp on hoat				
3) Undeveloped area				

Do you currently camp on the reservoir?

Yes No Plan to camp in future

IF NO, Is this due to a lack of facilities for reservoir campings

Yes No (Prefer not to camp on reservoir)

Q-1O) Do you feel there is a need for additional developed recreation sites on the ease side of the reservoir?

Yes No No opinion

Why? _____
_____
_____

Q-ll) Do you regularly fish for Lake Trout at Flaming Gorge Reservoir?
Yes No

Q-12) What size trophy Lake Trout would you like the Fish and Game to manage for in Flaming Gorge?

a) 0 - 10 pounds
b) 10 - 20 pounds
c) 20 - 30 pounds
d) 30 - 40 pounds
e) 40 plus pounds

Q-13) The regulations imposed by the Fish and Game are, in part,determined by the desired size of harvested Lake Trout. Given this, would you support more restrictive regulations, if necessary, to maintain Lake Trout of the desired record size stated above?

Yes No

Q-14) In recent years the Game and Fish have stocked Smallmouth Bass and Catfish in the northern end of the reservoir (i.e. Inflow area). If the catch rate for these species became comparable to overall catch rates in the Canyon area, would excessive algae on the water surface be a deterrent to your fishing activities in this area?

Yes No

Why? _____
_____
_____

Q-15) If a decrease in algae in the northern end of the reservoir resulted in decreased fishery productivity in the remainder of the reservoir; would you favor algae control in the northern end of the reservoir?

Yes No No opinion