

YELLOWSTONE LAKE:
AN EVALUATION OF PATTERNS IN PRODUCTIVITY

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Objectives

This study was initiated in 1982 to critically evaluate the evidence (Varley 1974, Shero and Parker 1977) that primary productivity in Yellowstone Lake has decreased during the last 1500 years with an accelerated decline in the last century. Our specific objectives were the following:

- (1) Assemble, summarize, and evaluate existing data and observations related to the past and present trophic status of Yellowstone Lake.
- (2) Identify all possible explanations for the observed pattern in lake productivity, both long-term (last 1500 years) and recent (last 100 years), and summarize and evaluate existing evidence to support or refute each proposed explanation.
- (3) Collect new data to test one attractive hypothesis that has been mentioned frequently but never examined closely, namely that changes in the nutrient status and productivity of the lake are related, at least in part, to the effects of large fires in the watershed (Varley 1974, Romme and Knight 1982).

Methods

For our first objective, we examined all available documents and data in the Yellowstone Park library and in the files of the U. S. Fish and Wildlife Service in Mammoth Hot Springs. The staff of the U. S. Fish and Wildlife Service also assisted us by compiling and providing us with summaries of water chemistry data that they have been collecting since 1976. We obtained additional data on precipitation chemistry in Yellowstone Park from the National Atmospheric Deposition Program.

For our second objective, we first conducted a computerized

bibliographic search which uncovered a large number of publications pertaining to the subject of lake productivity. We have now collected and reviewed most of these documents, and have supplemented this information by talking with several limnologists and paleo-ecologists about the subject.

For our third objective, we collected field data in 1982 on fire history and present stand age and successional stage (Arno and Sneck 1977, Romme 1982) in the forests of the watershed of the South Arm of Yellowstone Lake. In 1984, 1985, 1986, and 1987 we gathered additional data from the forests in the watershed of the West Thumb, the Flat Mountain Arm, and the north end of the lake, as part of a new study of fire and landscape dynamics on the subalpine plateaus of Yellowstone Park, supported by the National Science Foundation (NSF Grant No. BSR-8408181 to W. H. Romme and D. G. Despain). Using our data from the 1982 field season and from our NSF-supported work, we are now reconstructing fire history and changes in the vegetation mosaic of the entire western portion of the lake watershed for the period 1735 - 1985, using methods described in Romme (1982). We will then examine available records of past lake productivity, in the form of diatoms preserved in lake sediments (Shero and Parker 1977) and chemical changes in the sediments (J. Kaster, personal communication), to see if changes in productivity have coincided with major fires or other changes in the vegetation of the watershed.

Results

We have nearly completed our analyses related to objectives (1) and (2), but are not yet ready to make any conclusions about historical patterns in lake productivity. We are still analyzing the data for objective (3) as part of our NSF project. We reported preliminary fire history results in our progress report for the 1982 Annual Report of the UW-NPS Research Center. Our study of fire history and its possible relation to lake productivity will be considerably more expansive than we originally proposed and is taking longer than we first expected, but we think that incorporation of the results of our NSF-supported data collection and of J. Kaster's related research on the lake sediments will eventually lead to a better documented and more useful final report. We plan to submit our final report in 1987, after completion of our NSF-supported work in the watershed of Yellowstone Lake.

Conclusions

No conclusions are possible at this time.

Literature Cited

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