



US Army Corps
of Engineers

Aquatic Plant Control Research Program

Vol A-00-1

December 2000

Economic Value of Aquatic Vegetation to Fisheries

by James P. Kirk and Jim E. Henderson

Aquatic vegetation is important, both in terms of positive and negative effects, to anglers, boaters, utilities, shorefront property owners, and waterfowl interests who utilize reservoirs. Multiple users of lakes and reservoirs complicate aquatic plant management decisions. Balancing limited funds for aquatic plant management is often difficult due to a lack of information about user preferences and the economic benefits of plant control. Such economic data are rare; previous studies of group preferences and economic values at Lake Gunterville, Alabama, while quite important, were costly in terms of time, labor, and resources (Bergstrom et al. 1993, Henderson 1996).

The need for more efficient approaches led to adapting the creel surveys, used for fishery analysis, to obtain preference and economic information from anglers (Hudgins and Malvestuto 1996). This article reports on the first year's progress of a study in South Carolina that evaluates the economic value of aquatic vegetation for fisheries. As time and funds become available, property owners, boaters, waterfowl hunters, utili-

ties, and other interests will be surveyed. These data, when combined, should provide information needed to optimize aquatic plant management decisions and to provide economic justification for future management efforts.

Approach and Progress to Date

Angler Creel Surveys

The economic value of aquatic vegetation to fisheries will be estimated by combining angler creel surveys and economic models of angler expenditures. An angler creel survey, henceforth called a creel, is a method of estimating attributes of a fishery by interviewing anglers. In such surveys, creel clerks count anglers in a given reservoir section and then conduct a series of interviews to assess their fishing effort, catch, attitudes, and financial expenditures. This sampling is done at different reservoir reaches and times in proportion to estimates of angling effort. By being statistically efficient, projections can be expanded to reliably

characterize the fishery in an entire reservoir.

Anglers can be creeled in boats, along the shoreline, or at access points. This study will use, for the most part, creel surveys of anglers in boats. In surveying anglers, it is important to use uniform methodologies and to ask clear, pertinent questions. Because of the expense, quality control issues, and data requirements, creel surveys are usually performed by state wildlife agencies.

Potentially three reservoirs (Lakes Murray, Moultrie, and Marion) in South Carolina will be studied in partnership with the South Carolina Department of Natural Resources. The South Carolina Department of Natural Resources, Freshwater Fisheries Division has years of experience in performing angler creels and uses similar proprietary software, at each lake, for analysis of creeling information. Therefore, because creeling methods and analysis are the same, creels are comparable from reservoir to reservoir and from year to year.





Figure 1. South Carolina Department of Natural Resources biologist interviewing a bank angler as part of an angler creel survey of Lake Moultrie, South Carolina

All three reservoirs have a history of varying levels of aquatic vegetation; therefore, anglers, as well as other reservoir users, have strong opinions about and experience with aquatic vegetation. Lake Murray is located adjacent to the state capital, Columbia, and receives heavy use. The 48,511-acre reservoir has been impounded for about 70 years and has had varying levels of hydrilla infestations since 1992. The reservoir supports excellent largemouth bass, striped bass, and redear sunfish fisheries. The shoreline is extensively developed, sailing and boating are popular, and South Carolina Electric and Gas Company operates the reservoir for power generation. Lakes Marion and Moultrie, 110,000 and 60,000 acres respectively, comprise the Santee Cooper reservoirs. The two lakes (which are connected by a canal) were impounded just prior to World War II for flood control and power. The reservoirs are renowned for their fisheries and support flourishing guiding busi-

nesses for striped bass and catfishes. Until recently, the world record blue catfish came from this system. The reservoirs have had a long history of aquatic plant problems and, during the 1980's and 1990's, hydrilla infestations reached about 36,000 acres before elimination by triploid grass carp. Stocking densities of triploid grass carp are now being monitored and manipulated with the goal of achieving 10 percent coverage, system-wide, of submersed aquatic vegetation.

Survey questions that targeted angler expenditures and perceptions were initiated in creels during May and July in Lakes Moultrie and Murray, respectively. At this time, only the May interviews at Lake Moultrie are available, so this discussion will focus primarily on how these data can be used.

May Creel Surveys from Lake Moultrie

In the May creel, a total of 251 individuals were surveyed in the

104 angling parties. Of the boat anglers, 71 percent (65 interviews) had fished during the period of high aquatic plant density and had perceptions on aquatic plants, while 83 percent of the bank fishers (5 out of 6 interviews) had fished during this period. However, based on only this sample, definite or confident economic estimates cannot be made.

Perceptions of Aquatic Plants and Fishing

Much of the public support for aquatic plant management comes from anglers' perceptions about how aquatic plants affect their angling. Different users (fishing versus water skiing), and different types of use (bank versus boat fishing) have different perceptions (Bergstrom et al. 1993, Henderson 1996). At Lake Moultrie, respondents were asked directly about plant management, i.e., "removal of submersed vegetation" and fishing success, to obtain perceptions of aquatic plant management efforts. Figure 2 shows responses to the following question:

"How has the removal of submersed vegetation affected your fishing success?"

Hurt	Helped
No effect	No opinion

The majority of boat anglers perceive plant removal to hurt fishing. For bank angler responses, one respondent said "help" and the remainder said "no effect" or "no opinion." These preliminary perceptions are consistent with Lake Guntersville results that asked about "impact of aquatic plants on recreational activity." At Lake Murray, the question being used is "How do the aquatic plants affect your fishing success?" After Lake Murray surveys are completed, responses of the two perception questions will be compared.

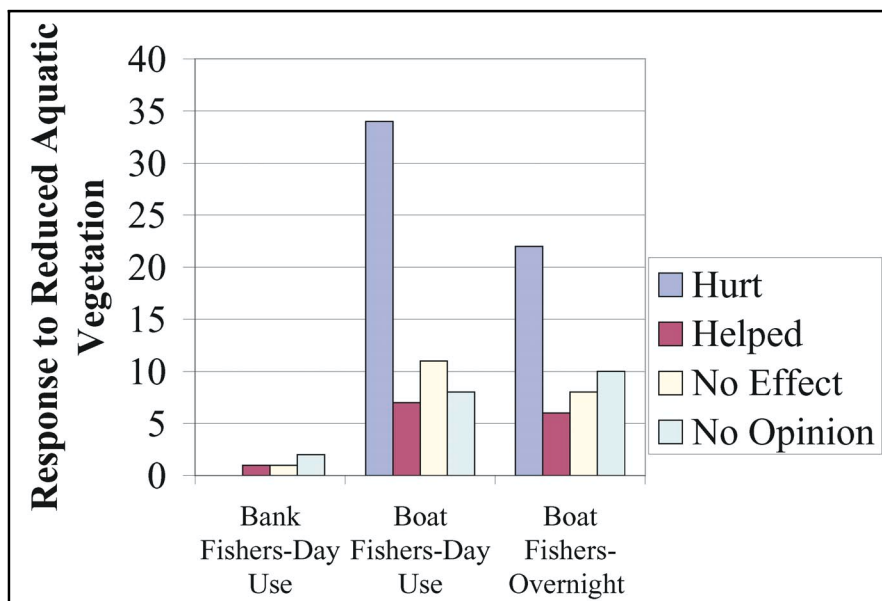


Figure 2. Angler responses to reduced levels of aquatic vegetation in Lake Moultrie, South Carolina

Response to Increased Aquatic Plants

Respondents were asked how their fishing behavior would change under different levels of aquatic plant coverage. Questions were asked about two levels of cov-

erage; first when plant “levels were at their highest (full plants)” and then “half those levels (half plants).” Based on those responses, numbers of fishing days were calculated for user groups (see Figures 2, 3, and 4).

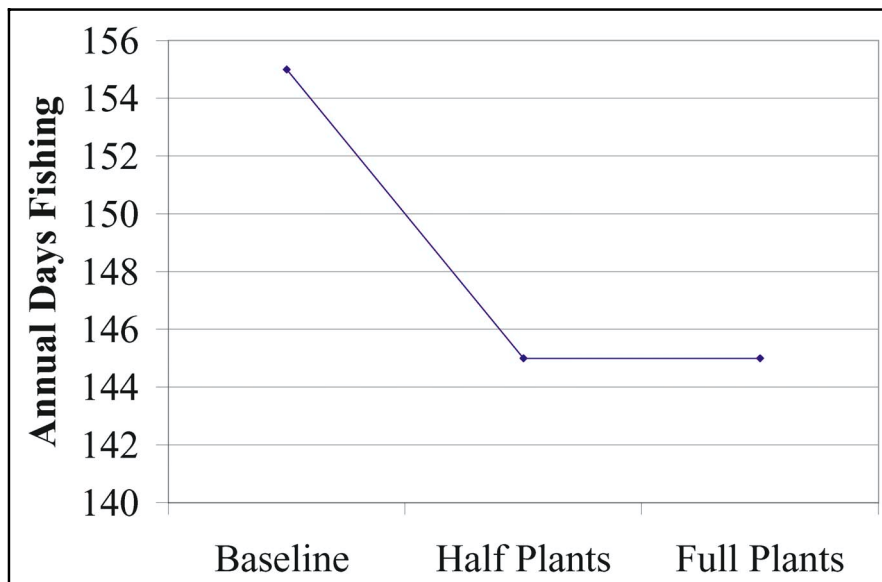


Figure 3. Response of bank anglers to differing levels of aquatic vegetation and future fishing efforts in Lake Moultrie, South Carolina

Effects of Aquatic Plants on Angling Expenditures

Creel surveys have been used to collect expenditure data that can be used to estimate the importance of recreation to local economies. Economic impacts are significant—in 1994, recreation expenditures for the 4 million trips to Corps reservoirs in South Carolina resulted in estimated total sales of \$252 M, income of \$136 M, and 6,600 jobs (Jackson et al. 1996).

The Corps has streamlined methods to evaluate the economic impacts of recreation trips on local economies (Propst et al. 1998). These methods are based on surveys of Corps visitors and development of “spending profiles” for user groups. These groups include day users versus overnights, boaters versus non-boaters, residents versus non-residents, and development of economic input-output models to estimate impacts of spending on regional economies (i.e., within 30 miles of the reservoir, about a one-county distance). Average trip expenditures for the May creel interviews are shown below.

Mean Trip Expenditures

Shore Fishing	\$ 11.29
Boaters—Day Use	\$ 78.39
Boaters—Overnight	\$352.47

The creel surveys at Lakes Moultrie and Murray provide the opportunity to see if the expenditure data can be used to estimate the economic impacts of recreation to local economies. The “full plants” and “half plants” trip information (Figures 2 and 3) was used in an existing model that estimates economic impacts for Corps recreation users (Propst et al. 1998). The model bridges the direct expenditures made by anglers to the economic sectors, by tracing material

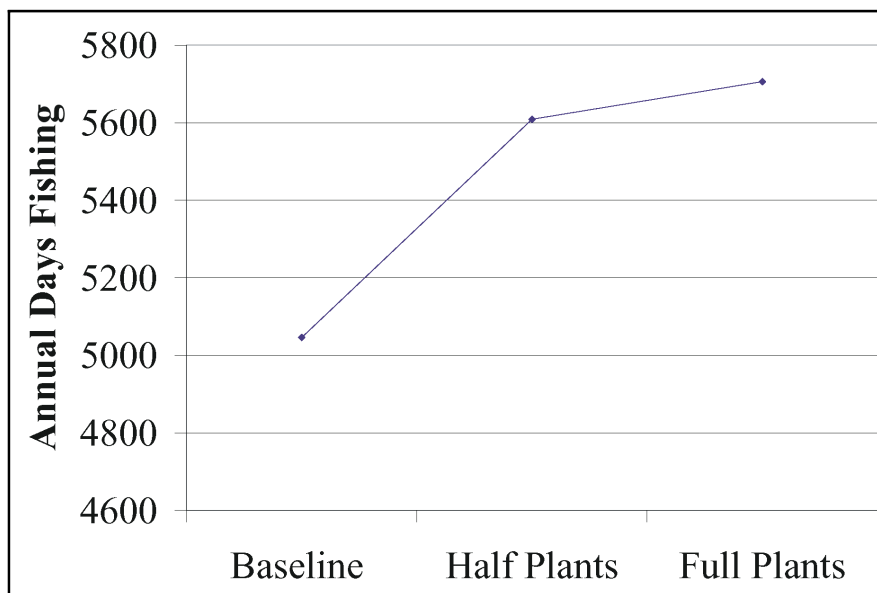


Figure 4. Response of boat anglers to differing levels of aquatic vegetation and future fishing efforts in Lake Moultrie, South Carolina

and labor expenditures through the economy (Propst et al. 1998). Because the creel interviews had not been expanded to total monthly or annual use, model results are only illustrative.

Analysis of economic impact of recreation expenditures was broken down into the following categories:

- Total sales of goods and services
- Income resulting from the total sales
- Jobs resulting from expenditures, reported on an annual basis (e.g. two part-time jobs reported annually as one job)

For the economic models (Propst et al. 1998), the number of annual fishing days for the three plant levels or conditions and the average trip expenditures for each angler group were evaluated. The three user groups had a total of 5,046 annual days of angling for baseline conditions, 5,706 annual days for “full plant” conditions, and 5,609 for “half plant” conditions. The total annual days were allocated to the three user groups to

evaluate total spending and are presented below.

Economic Impacts of May Creel Interviews (Unexpanded Sample)

	Total Sales (\$M)	Income (\$M)	Annual Jobs
Baseline/ Annual	\$0.29	\$0.15	8
Half Plants	\$0.33	\$0.17	9
Full Plants	\$0.34	\$0.18	9

This tabulation shows that the economic impact of an increased number of fishing trips by the boaters offsets reduced trips by the shore anglers, shown in Figures 3 and 4.

How To Use This Information

Economic impacts and angler perceptions can be compared among other user groups. Increased fishing trips by boaters under the “half plant” and “full plant” scenarios show that total sales in the local

economy increased by 14 percent when plants are increased to the “half plant” levels (half the historic high level). Management of plants up to the “half plant” levels will result in increasing economic benefits for local and regional businesses. Under the “full plant” levels, economic impacts are increased by only 1 percent. Costs of aquatic plant control for different levels can thus be compared directly to the economic impacts resulting from the control.

This information tells the manager that highest use by anglers and highest economic impacts occur when plants are at the historic high plant levels, but that the “half plant” levels provide nearly as much angler use and economic effects. While the “full plant” levels may be desirable to the boat anglers, use of the lake by water skiers, jet skiers, pleasure boaters, and shore anglers may be adversely affected if not prevented altogether. Hence, preferred plant levels for some groups may be inversely related to the anglers’ preferences.

Evaluation of Economic Questions in the Creel Survey

May creel surveys from Lake Moultrie have shown the following:

- Anglers are able to estimate the number of trips that they would take as a result of increased aquatic plant coverage. The complexity and length of the questions appears acceptable to anglers. The information on expenditures collected in the creels does not completely match the format and data requirements for the economic impact analyses.
- Information on where the purchases take place (at home, on the way, or at the site) is needed to allocate the economic impacts to the area

around the lake versus at the visitor's home.

- Using the May creel surveys, all overnight expenditures were combined in the single overnight category. Information as to where the visitor is staying is needed because expenditure patterns and response to aquatic plants may be significantly different for campers, second home residents, or those lodging in a motel.
- The ability to recall plant conditions from years past should be questioned.
- To minimize the burden on creel clerks, a mailback survey that respondents could take home after their trip should be considered. In this way, more detailed and complete information on expenditures and preferences for alternative plant levels could be obtained. Alternatively, creel respondents could be contacted by phone.

Summary

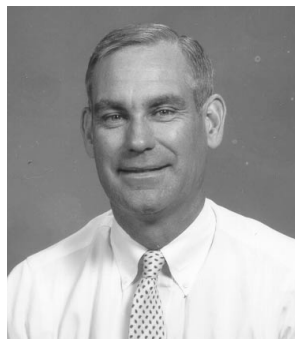
Studies have begun, in partnership with the South Carolina Department of Natural Resources, to survey angler expenditures and

perceptions in relation to aquatic vegetation coverage in two South Carolina reservoirs. Economic models using expenditure data gathered from creels will be used to estimate the value of aquatic vegetation to anglers. The quality of questions in the surveys has been improved to provide better information for economic models. Future efforts will involve further creeling, perhaps the addition of another reservoir (Lake Marion), and surveys of other user groups. Information and techniques derived from this study will be used to assist in making aquatic plant management decisions and to provide economic justification for control efforts not just in South Carolina, but potentially other reservoirs and waterways.

References

- Bergstrom, J. C., Cordell, H. K., Teasley, R. J., Souter, R., Messonnier, M. L., Betz, C. J., Smith, M. M., and Barber, L. R. (1993). "Aquatic plant coverage and outdoor recreation at Lake Guntersville, Alabama: A study of user preferences, economic values, and economic impacts," Environmental Resources Assessment Group, Athens, GA.
- Henderson, J. E. (1996). "Management of nonnative aquatic vegetation in large impoundments: Balancing preferences and economic values of angling and non-angling groups." *Proceedings of Multidimensional Approaches to Reservoir Fisheries Management*. L.E. Miranda and D.R. DeVries, eds. American Fisheries Society, Vol 16, 373-381.
- Hudgins, M. D., and Malvestuto, S. P. (1996). "Minimum sociocultural and economic data requirements for optimum yield management of reservoir fisheries." *Proceedings of Multidimensional Approaches to Reservoir Fisheries Management*. L.E. Miranda and D.R. DeVries, eds. American Fisheries Society, Vol 16, 223-235.
- Jackson, R. S., Stynes, D. J., Propst, D. B., and Carlson, B. D. (1996). "A summary of the national and state economic effects of the 1994 Recreation Program," Technical Report R-96-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.
- Propst, D. B., Stynes, D. J., Chang, W-H., and Jackson, R. S. (1998). "Estimating the local economic impacts of recreation at Corps of Engineers projects—1996," Technical Report R-98-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

About the Authors:



Dr. James P. (Phil) Kirk is a fisheries biologist in the Environmental Laboratory, U.S. Army Engineer Research and Development Center. His interests include reservoir fisheries management, use of triploid grass carp in large systems, and endangered species assessment. Dr. Kirk holds bachelor's and Master of Science degrees in Wildlife Biology and a Ph.D. in Fisheries from Auburn University. He can be reached at (601) 634-3060 or e-mail James.P.Kirk@erdc.usace.army.mil.

As an environmental planner in the Environmental Laboratory, U.S. Army Engineer Research and Development Center, **Jim Henderson** has been involved in numerous studies to assess environmental programs. These projects include economic valuation of the Corps' aquatic plant control program, development of the Corps' Regional Recreation Demand Model, documenting environmental features for streambank protection projects, and developing procedures for visual impact assessment for environmental planning and evaluation. He holds a bachelor's degree in Biology and a master's degree in Environmental Planning, both from Texas Tech University. He can be reached at (601) 634-3305 or e-mail Jim.E.Henderson@erdc.usace.army.mil.



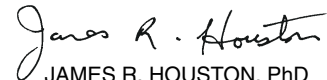


**US Army Corps
of Engineers**
Engineer Research and
Development Center



Aquatic Plant Control Research Program

This bulletin is published in accordance with AR 25-30 as one of the information dissemination functions of the Environmental Laboratory of the Engineer Research and Development Center at the Waterways Experiment Station. It is principally intended to be a forum whereby information pertaining to and resulting from the Corps of Engineers' nationwide Aquatic Plant Control Research Program (APCRP) can be rapidly and widely disseminated to Corps District and Division offices and other Federal and State agencies, universities, research institutes, corporations, and individuals. Contributions are solicited, but should be relevant to the management of aquatic plants, providing tools and techniques for the control of problem aquatic plant infestations in the Nation's waterways. These management methods must be effective, economical, and environmentally compatible. The contents of this bulletin are not to be used for advertising, publication, or promotional purposes. Citation of trade names does not constitute an official endorsement or approval of the use of such commercial products. This bulletin will be issued on an irregular basis as dictated by the quantity and importance of information to be disseminated. Communications are welcomed and should be addressed to the Environmental Laboratory, ATTN: Dr. John W. Barko, U.S. Army Engineer Research and Development Center (CEERD-EV-E), 3909 Halls Ferry Road, Vicksburg, MS 39180-6199, or call (601) 634-3654.


JAMES R. HOUSTON, PhD
Director

CEERD-EV-E
OFFICIAL BUSINESS

DEPARTMENT OF THE ARMY
ENGINEER RESEARCH AND DEVELOPMENT CENTER
CORPS OF ENGINEERS
WATERWAYS EXPERIMENT STATION, 3909 HALLS FERRY ROAD
VICKSBURG, MISSISSIPPI 39180-6199

BULK RATE
U.S. POSTAGE PAID
Vicksburg, MS
Permit No. 85