

Alabama's Surface Waters: A Treasure Taken for Granted

by

David R. Bayne

Professor

Department of Fisheries and Allied Aquacultures
Auburn University

Introduction

Few Alabamians are aware that their state ranks near the top in terms of abundance and diversity of aquatic resources. About one-twelfth of all the water that flows into the oceans from the lower 48 United States flows through Alabama. There are about 77,000 miles of rivers and streams traversing the state, most (61%) of which have year-round flow. Many streams have been impounded to form ponds and reservoirs that, along with a relatively few natural lakes, make up more than 500,000 acres of standing water. Alabama has more navigable channels (1,438 miles) than any other state (Mettee et al., 1996).

The abundant waters flow across a landscape broken often by geologic transitions from mountain streams in the Appalachian Plateau to coastal rivers entering the Gulf of Mexico. Such physical diversity results in diverse habitats available for colonization by aquatic organisms. These varied habitats are home to an extraordinary array of plants and animals. Relative to North America, Alabama fresh waters support 43% of all known species of gill-breathing snails, 52% of known aquatic and semi-aquatic turtles, 60% of known mussels and 38% of known fish (Lydeard and Mayden, 1995). Such biodiversity is a showcase for North

American aquatic ecosystems and rivals the biodiversity of some tropical rain forests that receive much more media attention.

The news is not all good, however. Extensive damming of flowing streams, water pollution and introduction of exotic species has taken a toll on the diverse aquatic communities of our state. For example, 10% (31 species) of Alabama fishes, 69% (119 species) of Alabama mussels, 65% (97 species) of Alabama gill-breathing snails and 43% (10 species) of Alabama freshwater turtles are recognized by biologists as being either extinct, endangered, threatened, or of special concern (Lydeard and Mayden, 1995). Action taken under the Endangered Species Act (1973) has been slow in developing and critical habitats of many species continue to be lost (Lydeard and Mayden, 1995).

Historically, the economic value of Alabama's abundant and diverse aquatic resources has been difficult to assess. There are so many uses of our surface waters and so many and varied users demanding a share of these finite resources. While it might be relatively easy to assign an economic value to a hydroelectric generating facility, it is considerably more difficult to assess the value of a clean, healthy drinking water

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supply for a city or the worth of a day spent fishing on an Alabama lake or stream. Also the economic benefits derived from recreational uses of Alabama surface waters are spread throughout the state's economy, making it even more difficult to track and document.

Fortunately, economists have recently begun to turn their attention to this complex problem. Weiss Lake is a 30,200 surface acre impoundment of the Coosa River in northeast Alabama near the towns of Cedar Bluff and Centre. Weiss Lake is but one of 39 publicly owned lakes in the state which have a total surface area of about 490,000 acres (ADEM, 1996). A study released in 1995 revealed that tourism associated with Weiss Lake generated an annual economic impact of \$200 million to Cherokee County (Bell et al., 1995). Of course, there are economic benefits of Weiss Lake in addition to tourism, such as flood control, potable water supply, hydroelectric power generation, and enhanced property values. Proximity to Weiss Lake influences land value. For example, in 1994 the average value of lakefront property was \$10,646/acre; three miles from the lakeshore the value was \$879/acre; and five miles from the lakeshore the value was \$697/acre (EARPDC, 1997). If other public lakes in Alabama had a per acre tourism value similar to Weiss Lake, lake tourism would

generate \$3.2 billion annually for the state's economy. In comparison, all cash receipts from farm and forestry commodities produced in Alabama in 1996 totaled \$4.2 billion (Alabama Agricultural Statistics Service, 1997).

Another recent economic study involved six Alabama reservoirs (Weiss, Logan Martin, Lay, Harris, Martin and Lewis Smith) representing about one-fourth of the surface area of all Alabama lakes. The annual expenditures by recreational users for trip expenses and equipment in 1994-95 were over \$500 million. The total annual economic value of these six lakes based on user, landowner and lakeside business surveys was estimated to be \$1.47 billion (Fishery Information Management Systems, 1997).

Sport fishing is a major tourist activity on Alabama waters. Both salt and freshwater fishing are popular and attract out-of-state dollars. In one recent economic study conducted in 1994, anglers expended over \$1.1 billion on equipment, food, lodging and transportation to fish in Alabama waters. The total estimated economic impact of sport fishing in the state in 1994 was over \$2.0 billion (Travnichek and Clonts, 1996). According to the American Sportfishing Association, the economic impact of sportfishing in the United States increased 36% from 1991 to 1996, to \$108 billion.

The limited economic data cited above are sufficient to demonstrate that Alabama surface waters generate billions of dollars in revenue each year from sources other than industrial development. If water quality and quantity can be adequately maintained, the economic value of our surface waters will

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increase in the future as greater demands are placed on limited resources by an expanding human population. The question raised here is whether Alabama leaders are sufficiently committed to the long-term conservation and protection of aquatic resources.

Problems

The passage of the Clean Water Act in 1972 marked the beginning of dramatic improvement in water quality across the nation. The purpose of this federal law was "to restore and maintain the chemical, physical and biological integrity of the nation's waters." The federal government, working cooperatively with state and local governments, virtually eliminated the discharge of untreated municipal and industrial waste into surface waters. The waters deemed safe for fishing and swimming have doubled since 1972. In spite of the success of the Clean Water Act, Alabama waters continue to suffer from excessive quantities of plant nutrients, sediment and toxic contaminants. If Alabama is to realize the economic potential that exists with clean, healthy aquatic environments, these problems must be resolved.

Excessive Plant Nutrients

The word, eutrophic, means well-nourished and therefore eutrophication refers to the natural and artificial addition of plant

nutrients (e.g. nitrogen and phosphorus) to aquatic ecosystems and to the effects of the nutrients (e.g. plant growth) on these systems (National Academy of Sciences, 1970). Natural eutrophication usually proceeds relatively slowly in concert with the aging process of lakes. Lake trophic status refers to the nutrient content and biological expression of nutrients within a lake. Trophic categories in common use include: oligotrophic (few nutrients, low productivity); mesotrophic (moderate nutrients, medium productivity); eutrophic (abundant nutrients, high productivity); and hypereutrophic (excessive nutrients, excessive productivity).

Man's activities can greatly accelerate eutrophication. The term used to describe this is cultural eutrophication. Cultural eutrophication is a type of water pollution that has increased with population growth, industrialization, intensive agricultural (e.g. animal waste) and forestry production, recreational activities and development of shoreline properties. Cultural eutrophication causes changes in aquatic plant and animal life that can interfere with water uses, detract from natural beauty and reduce the economic value of the resource. In extreme cases, lakes can be virtually lost (National Academy of Sciences, 1970).

Accelerated eutrophication can cause the following problems:

- 1) growth of excessive amounts of aquatic plants (higher plants and algae);
- 2) increased quantities of decaying plants that may interfere with drinking water supplies;

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- 3) greater oxygen demand that can rob waters of oxygen needed by fish and other aquatic life;
- 4) decreased water clarity and;
- 5) wide fluctuations in pH (e.g., acidity), elevated surface water temperatures, and decreased light penetration.

Alabama does not have water quality standards that directly address cultural eutrophication. Existing standards for inland waters apply to both streams and lakes and contain no criteria that set limits on plant nutrients (e.g. total phosphorus or total nitrogen) or quantity of plant life (e.g. phytoplankton chlorophyll *a* or algal growth potential). Current standards will not prevent Alabama waters from becoming choked with plant life because of nutrient loading from both point and non-point sources. For example, secondary treatment of municipal wastewater removes only 12% of the total phosphorus and 58% of the total nitrogen (EPA, 1990). Not all waste treatment in Alabama removes nutrients that efficiently. It is not surprising that most Alabama lakes are increasing in trophic status, some to dangerously high levels. There are no uses of Alabama lakes, other than waste assimilation, that are enhanced by nutrient enrichment beyond moderately eutrophic levels. Fish growth, biomass and

sport fishing likely benefit from increases in chlorophyll *a* (indicator of plant abundance) up to certain levels, but beyond that, water quality worsens and fish habitat shrinks (Bayne et al., 1994, Maceina et al., 1996). Oxygen depletion and accumulation of toxic products in deeper waters of highly eutrophic reservoirs greatly increases the risk of fish (and other aquatic animal) kills in waters downstream from the dam or in the lake itself, if the water column is suddenly mixed. Mixing of lake waters during severe summer storms is not uncommon (Davies et al., 1979). Increases in trophic status beyond moderately eutrophic levels degrades the quality of the resource for virtually all recreational users. Even processed water for municipal and industrial use is negatively affected by excessive eutrophication.

To prevent further cultural eutrophication of Alabama waters the state should adopt numerical water quality standards related directly to nutrient pollution and its biological effects. These lake standards should be set on an individual lake basis following studies to determine measures required to reduce nutrient enrichment (AFA, 1996). Immediate attention should be given to those lakes classified as use-threatened or use-impaired because of cultural eutrophication (ADEM, 1996).

Excessive Sedimentation

Soil erosion, transport and sedimentation of eroded particles is a natural process affecting aquatic ecosystems. If watersheds are undisturbed and vegetated, the movement of soil particles into streams and lakes is minimal, causing little or no problem. However, if vegetation, particularly stream-side vegetation, is removed and watershed soils are disrupted, large quantities of soil moved by rainfall runoff can enter our

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surface waters. Man's activities that remove vegetation and disturb soil are the primary causes of excessive sedimentation. The adverse effects of sediment loading of surface waters include the following:

- 1) stream channels and lake basins are filled with sediment, displacing valuable aquatic resources;
- 2) high concentrations of suspended soil particles clog the gills and smother the eggs of many aquatic organisms including fishes;
- 3) hard substrates (e.g. rocks and gravel) required by many aquatic organisms are covered with silt and clay resulting in a loss of this important habitat and;
- 4) as filling proceeds, aquatic plants invade shallow waters creating weed management problems.

It is relatively easy to document the adverse effects of sedimentation in smaller streams

where stream bottoms are accessible, if not visible. In larger streams, lakes (reservoirs) and estuaries, it is difficult and costly to estimate sediment accumulation rates and measure adverse effects. Existing water quality data show that many Alabama streams transport large quantities of suspended solids, particularly during the rainy months.

Two actions are necessary now.

- 1) Determine the distribution and extent of sedimentation damage in larger aquatic systems in Alabama. This will identify lakes requiring special attention.
- 2) Concurrently, more vigorously apply "best management practices" designed to reduce non-point sources of sediment pollution.

Toxic Contaminants

Toxic contamination of Alabama waters usually falls into two rather broad categories:

- 1) persistent organic compounds (e.g., chlorinated hydrocarbons) and metals (e.g., mercury) that bioaccumulate in tissues of aquatic animals and,
- 2) short-lived organic compounds (e.g., organophosphate and pyrethroid insecticides) that are very toxic to aquatic organisms but degrade rapidly and do not bioaccumulate.

Persistent materials (e.g. chlordane, DDT, PCBs and mercury) pose two problems. They are toxic to aquatic organisms and they tend to accumulate in the fatty tissues of organisms exposed to sublethal concentrations. The accumulation of these toxic materials in fish can be passed on to

humans who eat the fish. State agencies monitor the concentration of toxins in fish and issue fish consumption advisories to protect the public health. There are currently advisories in effect for over 60,000 acres of reservoirs and 42 miles of streams in Alabama (ADEM, 1996). The sources of these contaminants have been identified and contained, and the U.S. Environmental Protection Agency has banned all uses of PCBs, DDT and chlordane. Environmental concentrations of these chemicals will slowly decrease to safe levels, but until they do, monitoring of fish tissue residues will be necessary.

The less persistent but more toxic pesticides in use today can be devastating to aquatic systems if accidentally introduced. Two recent incidents, both involving insecticides, serve to illustrate the problem. In August 1995, an insecticide applied to crops on the watershed of Big Nance Creek in Lawrence County, Alabama, was washed into the creek during heavy rains. Over 244,000 fish were killed (ADEM, 1996). In October 1997, a warehouse fire in Birmingham, Alabama resulted in the release of a pesticide that flowed with the water used to extinguish the blaze into Village Creek and Bayview Lake killing virtually all fish and many other aquatic animals in over 30 miles of stream channel. A total of about 166,000 fish were killed. Clearly there is room for improvement in the safe storage, transport and use of pesticides in Alabama.

Water Quantity

This year Alabama will be negotiating with Georgia and Florida over water use in the Coosa, Tallapoosa and Chattahoochee rivers. The interstate compacts that have been

formed will deal with many issues related to management of water resources, but the most important issue will be the amount of water that can be withdrawn from these rivers to support continued growth in the Atlanta, Georgia metropolitan area. The quantitative effects of upstream water withdrawals should be fairly easy to predict with existing hydrologic models. A more difficult task, and one that must not be overlooked, is to predict the impact of diminished flows on water quality in Alabama rivers and reservoirs. Water quantity and water quality are interrelated. A reduction in Coosa River discharge caused by upstream consumptive use of water will decrease the flushing rate of downstream reservoirs, increase the concentration of industrial and municipal waste, and dramatically increase biomass of plankton algae. In a study of Weiss Lake conducted during the growing seasons of 1989 and 1990, algae production almost doubled during the relatively dry 1990 season compared to the unusually wet 1989 season (Bayne et al., 1994).

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Conclusions

Alabama is the nation's fourth richest state in terms of number of plant and animal species; only Florida can match it in number of species per square mile. At the same time, Alabama leads the nation in number of extinct species with 98 (Stolzenburg, 1997). Weiss Lake generated over \$200 million from tourism for Cherokee County, Alabama in 1994 and yet this lake is, arguably, the most polluted large public lake in the state (ADEM, 1996). Is the glass half full or half empty? I would argue that the glass is more than half full given the potential economic benefits that exist if we adequately protect and conserve our aquatic resources. Imagine what tourism would bring to Cherokee County if nutrient pollution and toxic contamination were under control.

If Alabama addresses existing water quality problems (nutrients, sediment and toxins) and commits to conserve and protect our remaining aquatic resources, the state can reap the economic rewards for generations to

come. Recreational fishing and tourism that depend on clean, fishable waters, have the potential to make a substantial positive impact on the state's economy. Moreover, maintaining quantity and enhancing quality of aquatic environments is in the best, long-term interest of all Alabama citizens. In addition to economic rewards, benefits would include improved public health and the satisfaction of knowing that Alabama's rich natural heritage will be enjoyed for generations to come.

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