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APPENDIX

Physical Description, Fish Population and Creel Census Statistics, Allatoona Reservoir, Georgia.

Physical Data

Location: Etowah River, Northwest Georgia
Latitude: 34.1°, Longitude 85.3°
Date Reservoir Filled: 1950
Length of Reservoir: 20 miles
Length of Shoreline: 180 miles
Area: 10,550 acres
Maximum Depth: 120 feet
Normal Fluctuation: Approximately 25 feet

Biological Data

Rotenone Samples of Fish Population, two, 2-acre cove samples.

Block off net ⅜" mesh, May 15-18, 1962, 1 ppm 5% Rotenone. Temperature 70°. Data according to Surber (1959) given as mean number and pounds per acre.

Group A. Predatory Game Fish

	Fingerling		*Intermediate*		*Harvestable*		*Total*	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Largemouth Bass	0	0	6	.75	1	2.05	7	2.80
Spotted Bass	21	.15	17	1.05	7	3.13	45	4.33

CREEL CENSUS SUMMARY

Survey by boat of complete and incomplete bank and boat fishing trips.

$$\text{Catch hr.} \mp \frac{\text{catch of any species}}{\text{total hours fished for all species}}$$

2,408 fishermen checks Mar. 1-Nov. 30, 1961

Annual average catch per hour of Bass* = .088 fish/hour

* *Micropterus punctulatus* 98%, *Micropterus salmoides* 2%.

PANEL DISCUSSION ON COOPERATIVE PROGRAMS IN WATER POLLUTION

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INTRODUCTION

During the last 16 annual meetings of the American Fisheries Society 149 resolutions have been adopted. Of these 69 resolutions have dealt with multiple use developments and pollution (Amer. Fish. Soc. Newsletter, Dec., 1961). While this demonstrates an acute interest in pollution and the problems of multiple water usage, it is, nevertheless, a passivle approach to the solution of the problem.

Modern technology, which is creating turmoil among the crafts and trades, is also making severe demands on the regulatory agencies charged with protecting the public's interests and future welfare. Under these compelling forces of change, it is only fair to expect each discipline to do its fair share in solving the problems related to pollution and multiple water usage. The time honored practice of hiding behind an accusing finger is a luxury of the past.

The need for a common understanding between the two principal disciplines concerned with the modification, management and protection of aquatic and fishery resources has been with us for much longer than many of us choose to remember. A significant portion of this misunderstanding lies in the approach necessary for each discipline to achieve its ultimate goals.

The engineer works in an environment of tangibles which can be reduced to a numerical expression. These values are well known because they can be weighed, measured and visually inspected without harm. He can specify what is needed and be assured of receiving material that will suit the requirements of the function it is to perform. The biologist, however, works with a complex of intangibles where many of the requirements of life are unknown, even for man. It is a world of variables inherited from their ancestors and a world in which the same capacity will be passed on to their progeny. This innate capacity for variation is one of the many reasons why only part of a fish population may succumb to a particular waste and why the response will vary in various parts of the country to the same waste.

The problem of evaluating the effects of treated or untreated wastes on native fish populations has been ignored, to a large extent, except when fish kills occur. The effects of wastes on population dynamics, alteration of food chains to favor coarse fish, reproduction and various other essentials are rarely considered. Preoccupation with methods and techniques that fit the rather confined needs of the particular discipline involved have received a great deal more attention than the problem itself. A certain amount of confusion and misunderstanding has its origin in the lack of communication between the waste-treatment engineer and the biologist. Some progress has been made in this regard since engineering agencies have engaged the services of biologists, but much still needs to be done if we are to meet the needs of the immediate future.

With the promise of increasing abundance in the South, we must evaluate our programs and reconsider the priority of our various tasks. To many factions the rate of economic growth is *the* measurement of success of our area. The proponents of this concept fail to consider the inevitable concomitants—the replacement of old and valued traditions and systems by newer and often less controllable systems.

Where economic growth is employed as the ultimate criterion of achievement in our society we must realign our thinking to control or reduce the harmful side effects of such a philosophy. If we are to meet the challenge of the immediate future and our obligation to the public we serve, we must consider the importance of ponds and pollution, waste disposal and water quality and immediate gains against long term losses. The advantages we receive and enjoy in a free competitive economy are accompanied by a responsibility to that system. This responsibility can be met, in part, by not making unnecessary demands for waste treatment. It seems that it may be desirable to direct at least part of our energies toward determining areas where reduced waste treatment will provide satisfactory results where fisheries are concerned. The monies thus saved can be applied to the treatment of wastes which are known to affect fish populations. Additionally, funds saved in this manner can be used in research or paid to stockholders in the form of dividends without increasing the cost of the product to the consumer. If we fail to trim the unnecessary costs from waste treatment, we will be placing an additional and unnecessary burden on the people we serve by increasing the cost to the consumer and contribute to the problem of inflation at the same time.

When waste treatment to a desired level is thwarted by the absence of technical knowledge, including both the ability to attain that which is known to be desirable or a lack of sufficient knowledge of what is necessary to maintain desired water quality, we find ourselves in an unenviable position. We are, indeed, in the midst of an expanding economic revolution which is and will be further complicated by the European Common Market. The necessity of maintaining our position in the production of consumer goods at a competitive price requires little explanation or imagination. As a result of this we find fisheries considered as a peripreral problem and regarded generally as a desirable but unnecessary toy.

The potential of each fishery as a source of high protein food, which will ultimately be used to fulfill the needs of an expanding population, has escaped the attention of the nation as a whole. It appears likely that the importance of this phase of fisheries will go unnoticed until at least some of the present burdensome and phenomenal surpluses of agriculture are reduced by the needs of our population.

In order to meet these obligations to the public, we must devote part of our efforts to define water quality that will meet the needs of fish and we must develop management techniques that will produce an adequate fishery where the desired water quality is either unattainable or unavailable. The first will be solved, at least partially, by the increased demands for domestic consumption. The need for more water for domestic uses will be followed by reservoirs which solves one problem, in part, while creating another. The development of management techniques will have to follow water management modifications. The success we enjoy here will be directly dependent on how well we define the needs of fisheries before these modifications are made.

Essentially, the problem involved here requires a change in attitude from, "What are you (industry or state agency) going to do about pollution or water management?" to a more appropriate one which, in substance, would be, "How can we help solve the problem?" The problems we now face as a nation with regard to water usage are of staggering complexity. We must contribute to the ultimate solution of the problem instead of waiting for someone else, for the problems involved greatly exceed the abilities of any single discipline to solve to the satisfaction of the varied interests of a complex modern society.

The success of our nation as a world power has its origin in an industrial economy with a vast quantity of raw materials. There are many problems in a rapidly expanding population and a diminishing supply of natural resources. Many of these problems are the result of what we have left undone. We must increase our knowledge of waste treatment, both domestic and industrial, but what is more important in our immediate future is a knowledge of what is required insofar as water quality is concerned.

It is also essential that we realize that we will not be able to satisfy all of the minority groups where multiple water usage in concerned. It is necessary to bear in mind that compromise will be the foundation of a well rounded program of multiple water usage. To achieve optimum conditions for one interest at the expense of other worthy interests and objectives cannot be defined as successful water management. If we use past experience as a basis of predicting future events, it seems likely that the administrators who incorporate studies in their programs to define the needs for water quality will enjoy a greater success than those who choose to leave the development of such criteria to others.

I am aware that many administrators will disagree with the suggestion that the service agency should become more active in research that would give us some of the basic and fudamental knowledge. Aldrich (1960) and Phelps (1960) dwell at length on why it cannot be done. I am also aware that it was not originally intended that our service agencies should become involved in research. The need for such endeavours, however, is evident in many areas at this time. Our complete dependance upon universities for needed research should be examined in the light of our present and future needs. This is not and should not be interpreted as an attempt to belittle or detract from the many achievements of our universities. If we are able to keep abreast with the rapid developments and demands of our immediate future, we must either embrace research at the service agency level or strip our universities of their academic freedom and prescribe what is needed to meet the needs of a rapidly expanding and complex society. I feel confident that none of us would indulge in the folly of the latter.

The time required for change in administrative philosophy and governmental policy before the necessary research can be incorporated into various programs will take much more time than our aquatic resources will be able to tolerate. It seems that our best interim approach lies in an active information exchange program. These programs could be in the form of panel discussions, newsletters of the various technical societies and exchange between individuals. We must learn the limitations of the other disciplines and make others aqually aware of ours.

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WATER QUALITY CRITERIA FOR FRESHWATER FISHES

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ABSTRACT

Good productivity of fish and aquatic life are dependent upon clear, clean water at favorable temperatures and with sufficient concentrations of needed dissolved gases and solids. The number of individuals and species of bottom animals or plankton present in streams and lakes are important criteria of water quality. Siltation is one of the most damaging and widespread pollutants; it causes reduction of light penetration, destruction of shelter, and smothering effects on eggs. For short periods fishes tolerate turbidities up to 100,000 parts per million, but under long-term exposure, concentrations of 100-200 ppm can be directly harmful. Fishes may tolerate dissolved solids up to 3,000 ppm or more if they are nontoxic earth metals and physiologically balanced. Bass and bluegill eggs and fry can survive in salt water up to about 10 percent sea strength.

Temperatures of 93° to 96° F. represent the critical level for most species of warmwater fishes. Trout require a maximum summer water temperature of about 68° F. for good production. The effects of cooling waters from steam electric plants and towers of industrial plants may be detrimental to fish, imposing temperature blocks on spawning runs or reducing desirable food organisms. They may, however, provide places where anglers can harvest fishes or (in the south) places where threadfin shad, a desirable forage fish, can winter north of their normal range.

Oxygen levels should be high enough to permit growth and reproduction. This level is about 5 ppm for warmwater fishes and 6 ppm for salmonoid fishes. Oxygen requirements of fishes may be affected by the presence of carbon dioxide.

The pH of streams of the United States generally ranges between pH 7.4 and 8.5. The acid death point for pond fishes is pH 4.0 and the alkaline death point pH 11.0. Levels of pH from 6.5 to 9.0 are most suitable for culturing pond fish. Organic wastes from domestic sewage and paper mills deplete oxygen supplies. Five-day BOD's above 10 ppm in streams and 3.5 ppm in lakes indicate pollutional effects.

For bluegills, the toxic levels of some of the important industrial wastes are as follows: phenols, 48-hour median tolerance limit (TL_m), 22 ppm; cyanide, 96-hour TL_m, 0.15 ppm; copper, 30-day TL_m, 0.46 ppm in soft water—safe level, about 0.1 ppm; zinc, lethal level, 4 to 5 ppm as Zn^{++} in waters with pH's from 7.1 to 8.0 and hardnesses from 20 to 150 ppm—safe level, about