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

1 ppm; chromium, 96-hour TL_m, 110 ppm as dichromate, 170 ppm as chromate, 0.2 ppm as hexavalent chromium under conditions of continuous exposure; ammonia, 2.5 ppm, with toxicity dependent upon pH and extent of ionization.

The 96-hour TL_m's of bluegills in soft water to some of the organic insecticides most widely used in the south are as follows: DDT, 0.016 ppm; BHC, 0.790 ppm; toxaphene, 0.0035 ppm; parathion, 0.700 ppm.

TOLERANCE OF THE FRY OF COMMON WARM-WATER FISHES TO SOME CHEMICALS EMPLOYED IN FISH CULTURE

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ABSTRACT

The toxicity of fifteen chemicals used in vegetation control or disease treatment was studied. The fry of largemouth black bass, *Micropterus salmoides*, bluegill, *Lepomis macrochirus*, and channel catfish, *Ictalurus punctatus* were used as test animals. Chemicals included were three forms of silvex, three formulations of endothal, simazine, atrazine, diquat, two forms of benzenehexachloride, roccal, acriflavine, malachite green and methylene blue. Results of toxicity tests were used to arrive at a safe concentration of the various chemicals for the species of fry used as test animals.

Several of the chemicals showed evidence of species specificity and one herbicide was sufficiently toxic to these species of fishes to warrant consideration as a fish toxicant.

INTRODUCTION

The purpose of this series of tests was to obtain information concerning the effects of some of the newer herbicides upon young fry; such information to serve as a guide for estimating safe concentrations of untried chemicals for the treatment of ponds containing fry. Other chemicals occasionally used in fish production techniques were included. The tolerance of three species of fry to fifteen chemicals was tested. All of the tests were conducted at the National Fish Hatchery at Marion, Alabama.

MATERIALS AND METHODS

TEST ANIMALS

The black bass (*Micropterus salmoides*) fry used throughout this series of tests ranged in size from 9 to 21 millimeters in total length and had an overall mean total length of 18 millimeters. They were removed from a brood pond on the day before the tests and were held for one hour in a two parts per million solution of pyridylmercuric acetate. They were then kept overnight in a holding house tank.

The bluegill (*Lepomis macrochirus*) fry had maximum and minimum total lengths of 25 and 15 millimeters, respectively, with a mean total length of 17.8 millimeters. They were handled in the same manner as the bass fry as to treatment and acclimatization period.

Channel catfish (*Ictalurus punctatus*) fry ranged in size from 10 to 16 mm and were in the yolk-sac or post absorptive stage.

The acclimatization period varied from one group to another, but was never less than 16 hours. As the water flowing through the holding house and used as diluent for the test solutions was also used to hatch the channel catfish eggs, no acclimatization period was required. These fry were transferred directly from hatching troughs to test solutions. The good survival of those placed in control units demonstrated that the prophylactic treatment wih P.M.A. was not needed.

CHEMICALS

The chemicals used in the tests are listed in Table Number I.