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Presented at Wildlife Damage Control Workshop, Kansas State University, Extension Service, December 11, 1975, Roy E. Schoonover, Kansas Forestry, F and Game Commission.

FISH POPULATION MANIPULATION

Fish population manipulation or control, as the term implies, may be defined as an operation or activity which results in the total removal of fish from a water area, the partial elimination of a fish population, or the selective removal of a species from a water area.

The purpose or objective for carrying out fish control projects may be grouped in two broad categories: (1) Fish Management; and (2) Other Applications.

The first category, Fish Management, is by far the most frequent reason for conducting fish population manipulation and control projects. Existing fish populations are removed or adjusted so that a population of fish can be established or developed which will better satisfy the demands of the public or the private user. Fish control or fish population manipulation is an important and widely used management tool in sport fisheries management.

In ponds that have contained fishlife for a number of years, sport fishing generally declines in quality as the result of highly competitive and prolific species becoming overabundant and suppressing the more desirable game fishes. In this condition, an improper predator-to-prey ratio exists and the fish populatio is considered to be out-of-balance. Bluegill and crappie are panfish species which often become overabundant in ponds and lakes; carp and other nongame fish may also become a problem.

To restore satisfactory fishing in such waters, removal of the entire fish population is generally recommended. However, if the unbalanced condition has not progressed too far, if the problem species concentrate in portions of the impoundment where alternate methods have a high probability of being successful, or if total removal of the fish population is impractical, then other approaches consisti of partial removal of the fish population or selective removal of a species or grou of species may be carried out.

The second category, Other Applications, may often have management implications; however, the main objective is normally to benefit some other interest or activity. Generally, fish control as carried out under this category is for the purpose of removing fishlife which may conflict with the primary or desired use of the water area. Some examples are as follows:

(1) removal of a particular species such as carp or the entire fish population from waterfowl marshes to promote growth of plant life beneficial to waterfowl;

(2) to clean out previously used hatchery or rearing ponds in preparation for a new crop of fish; and

(3) removal of contaminant species by fish culturists or commercial fish growers to eliminate predation and competition on the cultured fishes, or to reduce the consumption of fish food by unwanted species in the rearing ponds.

While there are several approaches to fish population manipulation and control, the most effective and widely used methods are: (1) complete drainage of the impoundment and the removal of the fishlife; or (2) application of fish toxicant to eliminate or reduce the fish population. These two methods are often used in combination as a means of reducing the cost or of increasing the effectiveness of the operation.

Other methods of population adjustment have been attempted in an effort to restore proper balance of fish populations in ponds and lakes. These methods or techniques have included: (1) seining and netting; (2) supplemental stocking of predator fishes; (3) aquatic vegetation control; (4) liberalized angling regulations designed to protect certain species and sizes, or to encourage the greater harvest of particular species or length groups of species; and (5) programs to encourage angling for, and to give greater utilization of "less sought after species" such as carp. While each is a step in the right direction, these methods alone have for the most part proven inadequate to accomplish the objective of restoring good fishing.

Complete pond or lake drainage has several advantages over reclamation by fish toxicant. Drainage of the impoundment gives greater assurance of total elimination of fishlife. It is generally possible to salvage some of the desirable species for restocking in other waters. Complete drainage of an impoundment permits the stabilization of soft mud bottom and establishment of vegetation in the basin to increase fertility and improve clarity of the water when the area is subsequently reflooded. There are limitations and disadvantages to complete drainage of an impoundment, however, and these include: (1) impoundments may not have drainage facilities; (2) in low rainfall regions there is a need to conserve water; (3) may interfere with the primary use of the impoundment; and (4) results in a delay in the restocking of fish until the impoundment receives adequate refilling.

Fish toxicants have been widely used for fish population manipulation and control, and this approach is most frequently the only practical method of achieving worthwhile results.

Lopinot (1975) made a survey of fish toxicant usage in the midwest and he found that in the 12 states, including Kansas, and two Canadian provinces, more than 22,000 gallons of 2½% rotenone were used in 1972 to rehabilitate fish populations. Lopinot, as a result of summarizing reports and data from Stroud and Martin, Sport Fishing Institute, estimated that more than 1,000,000 acres of water were treated with fish toxicants in the United States in the period, 1954-1973. It was estimated that during the 10-year period, 1963-1972, that more than 121,000 acres of water and about 4,200 miles of streams were treated with toxicants of various kinds in the midwest region, (including Illinois, Iowa, Indiana, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin, Ontario, and Manitoba).

Fish toxicant is generally applied with one of three objectives in mind:

(1) Complete treatment for the eradication of the total fish population of the water area;

(2) Partial treatment to eradicate only a part of the fish population;

(3) Selective treatment for the eradication of certain species of fish in the water area.

The Federal Insecticide, Fungicide, and Rodenticide Act of 1947 requires registration of all economic poisons entering interstate commerce. Registration of fish toxicants is included in that act and is now handled by the U.S. Evironmental Protection Agency.

Only two fish toxicants are currently registered for use in general fish management: Rotenone and Fintrol. These toxicants are registered for nonfood use application. Formulations of these two toxicants have been used quite widely in the United States.

Of these, rotenone is the most extensively used fish toxicant in fishery management. There are three basic formulations of rotenone in use, namely a 5% wettable powder, a 5% emulsifiable concentrate, and a 2.5% emulsifiable concentrate plus synergist. There are indications that the liquid formulations of rotenone repel fish, therefore causing them to make a special effort to avoid it by moving into any available source of fresh water. The effects of rotenone are to a certain extent reversible, and there is the possibility for fish to recover if they find fresh untreated water or are placed in fresh water. Rotenone formulations are best adapted to be used for complete treatments of water areas, and for partial treatment projects where the objective is to produce a general reduction of all fish species in the treated section. Rotenone is most commonly used at concentrations ranging from 1.0 milligram/liter (ppm) to 5.0 mg/1 (ppm).

In the treatment of a water area, powdered rotenone can be mixed with water to form a slurry and then be placed in weighted burlap sacks and dispensed by towing behind a boat powered by an outboard motor. Emulsified rotenone and slurries of powdered rotenone are most commonly dispersed from boats by means of gasoline-engine driven pumps or sprayers, or by pouring the mixtures into the propeller wash of the outboard motor. Weighted hoses used in conjunction with engine-driven pumps are effective in discharging rotenone solutions in treating areas of deep water.

Powdered rotenone is not so frequently used as it once was prior to the development of the liquid formulations. Considerable labor was involved in mixing the wettable powder with water to form a slurry which could be readily distributed. Also, personnel who mixed and handled large quantities of the wettable powder often suffered temporarily from headache, sore throat, and other cold symptoms as a result of contact with the dust.

Antimycin is an antibiotic produced as a by-product in cultures of Streptomyces. Antimycin is not currently available, but hopefully its manufacture and marketing will be resumed soon. Prior to discontinuance of its production, this fish toxicant was manufactured and marketed as Fintrol by Ayerst Laboratories, Inc. When available in the past, the formulations most frequently used included (1) Fintrol-5, coated on grains of sand, which released its toxicant within 5 feet of water depth; (2) Fintrol-15, coated on sand grains, which released its toxicant within 15 feet of the water surface; and (3) Fintrol-Concentrate which is a liquid formulation.

Antimycin does not repel fish, so that they are most likely to incur a lethal dose before beginning to seek fresh water. Antimycin acts irreversibly, so that if a fish gets a toxic dose of this chemical, it will not survive even if placed in fresh water. In this region, antimycin is used most frequently as a selective toxicant to eradicate scale fish while not being harmful to catfish species. For this use, antimycin is commonly applied at concentrations ranging from 1.0 to 8.0 parts per billion (ppb). Sand-formulated antimycin can be readily applied to the water by a hand or powered seed spreader or may be poured slowly into the propeller wash of an outboard motor and boat. Solutions of antimycin are quite frequently distributed in the water by a venturi attachment to an outboard motor, by pumps, sprayers, or by spilling into the propeller wash of a boat. The sand formulations have an advantage in treating marshes and water areas that contain extensive growths of emergent and submerged aquatic vegetation, because the sand grains have a tendency to bounce off vegetation and penetrate weed-choked water where circulation and mixing is restricted. Under these conditions, liquid toxicants may give poor results because the fine spray or droplets adhere to or dry out on the leaves and stems of vegetation above the water surface and fail to reach the water to disperse and toxify where fishlife will be affected.

Liquid toxicants, if they contain volatile solvents, should not be sprayed from aircraft because of the possibility for these volatile components to be lost in the air, with only the insoluble toxicant reaching the surface of the water where it does not disperse into solution.

Antimycin degrades rather rapidly when applied to water having a pH of 8.5 or higher; therefore, less toxicant is required in water with a low pH than in water having a high pH. The effectiveness of antimycin also varies with temperature of the water; less toxicant is required in warm water than in cold water.

Some species of fish are more susceptible to antimycin than are other species. Studies have shown that 10 parts per billion (ppb) or less in waters below pH 8.5 satisfactorily eliminated pest species such as green sunfish, carp and suckers. However, higher concentrations were necessary to kill goldfish, gar and catfish, with as much as 200 parts per billion (ppb) required to kill black bullheads.

A number of recommendations can be made to assist in achieving a successful reclamation project for ponds and lakes. These factors as mentioned can contribute to the success or failure of the fish control project and are discussed as follows:

1. In reaching a decision as to whether a fish control project is justified, test netting studies should be carried out to obtain information on the species and dominant sizes of fish in the impoundment, as well as the ratio of desirable to undesirable species.

2. Water analyses are beneficial for larger lakes and also for smaller impoundments where unusual chemical conditions are expected. Temperature, pH, and alkalinity are parameters of particular importance, since these conditions can influence the effectiveness of the fish toxicant.

3. A careful estimate should be made of the volume of water in the impound-

ment to be treated. This is necessary since the quantity of fish toxicant required to provide the proper concentration in the water for a satisfactory fish kill is based on water volume being treated. The area of the water impoundment should be measured and computed or estimated carefully. Adequate depth measurements should be made in order to determine the volume of water present. For larger lakes, it is advisable to prepare a depth contour map so that the impoundment can be divided into sections for computation and allocation of toxicant, in order to get proper distribution when the application is being made.

4. When a choice of treatment time is possible, it is advantageous to make the application as near the time of restocking as possible in order to reduce the opportunity for wild fish to re-enter, or for any surviving fish to reproduce. For this same reason, it is preferable not to apply toxicant to a pond during the primary spawning season, because of the possibility of eggs hatching after the water has lost its toxicity. We have found that late summer, about September 1, is a satisfactory time for conducting reclamation projects with fish toxicant. At this season, extremely high water temperatures and the cold temperatures of late fall and winter are avoided, since these conditions can reduce the effectiveness of the toxicant, or result in the necessity of using a higher concentration.

5. If a complete kill or nearly a complete kill of fish is to be achieved, it is necessary to apply a great deal of effort to the application of the fish toxicant in order to get thorough coverage and to get uniform dispersion at the proper concentration. Thorough distribution of the fish toxicant must be made in both deep and shallow areas, including inlets and outlets, with special care taken to get proper coverage along weedy and marshy edges and in beds of vegetation within the lake. If extensive areas of water vegetation exist, it may be impractical to get thorough coverage with fish toxicant unless the lake is drawed down out of the vegetation. Areas in the lake known to contain spring s and seeps should be given special attention, with the toxicant dispensed near the bottom. If the lake is stratified (thermocline present), it will be necessary to dispense

the toxicant in the lower depths in order to get adequate distribution and the proper concentration of the toxicant. Isolated potholes and inflowing streams would need to be thoroughly treated in conjunction with the pond or lake if a conscious effort is being made to achieve a complete kill and to postpone the re-introduction of fishlife which may contain undesirable species. Care should be taken to schedule the application during a period of settled weather conditions so as to avoid having rainfall causing inflow and dilution of the toxicant before the fishlife has been eliminated from the impoundment.

Fish control or fish population manipulation in streams will be discussed briefly; however, a minimum of this activity has been carried out in Kansas. There are many more and complex factors which must be taken into consideration in planning and conducting a stream reclamation project than are involved with a pond or lake reclamation project.

Streams flow across land under many individual ownerships, thus creating special problems of acquiring access and of developing public relations. Where a considerable mileage of stream reclamation is undertaken, the success of the project depends on getting the fish toxicant dispensed in such a way as to have a linear section of the stream carrying a thoroughly distributed and adequate concentration of chemical to be lethal to the species of fish intended to be removed. Furthermore, this "treated" section of the stream must carry a sufficient concentration of toxicant so as to be effective even with the diluting effects of any small tributaries and other sources of fresh water not themselves being treated. The stream section carrying the toxicant must be of sufficient length so that as this volume of water moves downstream with the flow, an effective concentration of the chemical will be maintained in an uninterrupted dose for a long enough time period to eliminate the target species of fish at all points along the stream. If all of the factors involved in such a project are carefully considered, the magnitude of the problems involved in such an undertaking will be readily realized.

The success of a stream reclamation project is generally in direct relationship to the length of the stream treated. Projects to eliminate or drastically reduce nongame fish in the feeder stream to a newly-constructed impoundment are generally reasonably successful if a relatively short mileage of stream is involved. However, in projects involving considerable mileages of streams where treatment has the objective of suppressing rough fish, the recovery of the undesirable species has generally been rapid and benefits have been questionable and temporary.

With respect to future activities in this field, environmental concern and the current emphasis on preservation of rare and endangered, or unique species will in all probability greatly limit stream reclamation projects.

In closing, I should emphasize that pond and lake owners who may be considering the use of fish toxicant in impoundments on their property should first check on legal implications. This can be accomplished by contacting the fish and game agency in their respective states with regard to laws and regulations which may be applicable.

In Kansas, we advise individuals and organizations interested in using fish toxicant in ponds and lakes under their ownership to contact the Kansas Forestry, Fish and Game Commission concerning applicable laws and regulations, and we can also provide them with technical advice and recommendations on carrying out the reclamation project.

In signing their fish application forms, owners of private water fishing impoundments that have been stocked with fish obtained from the Kansas Forestry, Fish and Game Commission agreed that for a period of 10 years, they would operate such impoundments in compliance with all State laws and Commission regulations relative to fishing methods and creel limits. This statute, therefore, prohibits the treatment with fish toxicant of a pond or lake in this category until after the expiration of the 10-year period.

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We have effective results in controlling crayfish in our ponds usihg Baytex. Baytex is a highly toxic compound that effects the nervous system af many organisms. Used in small concentrations it will kill crayfish without hurting fish. We uxe Baytex at 40 ppb. We normally dilute the required amount of chemical with water and then mix it thoroughly in the pond.

Leeches can be controlled using Dylox. Masoten is another trade name for dylox. The recommended rate of application is 1/2 ppm. This should be applied in a manner so it is thoroughly mixed in the pond.

Recomended treatment for snails is 5 ppm copper sulfate. This too should be applied in a manner which thoroughly mixes the chemical in the pond.

Predaceous insects can be controlled using 1.5 gallons of diesel fuel/ acre of water. This may be dumped in on the leeward side of the pond and allowed to drift across the pond forming a thin film. Dylox at the rate of 1 ppm is recommended for insect control.also.

I know of only one treatment for tadpoles and have never tried it myself. The compound is called tad-tox and is made by combining 2 lbs. Copper Arsenic with 4 lbs. flour and 8 lbs. cottonseed meal. Then add water to form a paste dnd scatter in the shallow areas around the pond. It often takes 3 weeks to kill the tadpoles and reported results are variable.

I hope this is the information you needed. If you still have some questions I will try and answer them.

Bruce Taggart