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THE USE OF ROTENONE AS A FISH POISON

Prepared in the  
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and  
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CAUTION:

The laws of all states prohibit the use of Derris, or other poisons toxic to fish, in public waters.

Prior to the introduction of a fish poison, the need for destroying the existing fish population should first be ascertained by a qualified person; after the need has been established, authorization to carry out such an operation should be obtained from the State Game and Fish Department.

Waters which have been treated with poison should not be allowed to drain into any other pond, lake or stream for at least 10 days after treatment. If the water is cold, two to three weeks should elapse.

Rotenone in Derris or Cube powders might cause nose and throat irritations if the powder is inhaled. The use of a mask or a damp cloth over the face during mixing operations will make the handling of the powders more comfortable.

The use of rotenone as a fish poison has been practiced for years by inhabitants of many tropical and subtropical countries. However, it is more commonly used as an animal and agricultural insecticide because its toxicity compares favorably with pyrethrum and nicotine sulfate. Rotenone has been found only in members of the family of plants to which the pea and bean are members (Leguminosae). The most common rotenone-producing plant of this family has been given the scientific name of Derris, which is also the common name used in this country. Derris is a native of Australia, Oceania and Southern Asia, whereas Cube, another form, is found in South America. The

commercial Derris or Cube powders are the ground roots of the rotenone-bearing plants.

Rotenone is lethal to most kinds of fish. Since 1934, it has been used as a tool in fishery management to renovate lakes and streams containing undesirable species of fish. Since 1940, fishery biologists have recommended that even larger numbers of lakes would be of greater value to sports fishermen if the undesirable species present were eliminated by poison. These undesirable fish may be predators such as gars or dogfish; they may be coarse fishes such as bullheads, buffaloes, drum, carp, goldfish, suckers or chubs, held to be of little value by anglers and known to be detrimental to game fish because they are competitors for food; or they may be game species such as bluegills, perch, rock bass, largemouth bass, and white bass, that are out of place ecologically as in certain northern trout lakes or in some warm-water lakes and ponds. These warm-water fishes generally make poor growth in cold waters and if present in large numbers, may harm the trout because of competition for food or by actual destruction of trout fry, fingerlings and even adults. Often these objectionable fish have been introduced, in well-meant but mistaken attempts to improve fishing. In other instances, newly-created bodies of water have been improperly stocked. This may have involved the planting of the wrong species, too many of one species and not enough of others, or too many of all species. There are other cases in which fishermen themselves, by selective fishing, have removed too many of the predatory species such as bass, which resulted in upsetting the balance between predator and prey. In such cases the "prey" species soon increase in size and numbers faster than the increase in their food supply. This condition usually produces a population of stunted fish. Sufficient food is present to maintain life with little or no increase in length or weight.

Once the harm is done, it is usually difficult to undo. If the body of water is small, it is sometimes feasible to destroy completely the existing population and to start over by restocking with desirable species. Where the size of the body of water or some other factors make complete destruction impossible, an effort may be made to eradicate or control the undesirable species without killing the more desirable ones. Methods such as spearing, netting and destruction of the young have all been tried without much success. However, partial or selective poisoning has been attempted with some success. Partial or selective poisoning has too frequently afforded only temporary relief and a great deal of caution must be exercised if this is attempted.

No matter what type of poisoning is attempted, it is essential that a preliminary survey be made by qualified persons of the waters to be treated. The trained man knows the habits and habitat preferences of each species of fish. He may also determine the cause or causes of the poor fishing.

Perhaps poisoning is not necessary to provide better fishing, in which case the biologist may recommend other management procedures. He may also recommend the species and numbers of each species to be stocked. Therefore, our advice is to obtain expert advice before poisoning is attempted.

If not properly applied, derris may effect only an incomplete kill. Because of a high reproductive potential, the new fish which survive may soon overpopulate the lake or pond because the factor or factors which produced the undesirable situation in the first place are still present. It is therefore necessary to remove the entire population of fish.

The commercial derris or cube powders usually sold for poisoning fish have a guaranteed 5 percent rotenone content. Although powders have been used almost exclusively in the past for poisoning fish, rotenone is now extracted and sold in liquid and paste form. While more expensive, they are much more comfortably and easily handled, and the time saved in applying them undoubtedly compensates for the increased cost. Rotenone emulsions have been applied successfully by airplanes to large bodies of water. The emulsions are also formulated to contain 5 percent of rotenone while the pastes have a 2.5 to 3.0 percent rotenone content.

Acetone is the common solvent used to remove traces of rotenone, and all containers which may be used later to transport live fish should be cleansed with this chemical.

Current prices of rotenone poisons vary somewhat according to season, locality and availability. Derris and cube powders will cost between 30 and 60 cents per pound and emulsifiable rotenone about 75 cents.

When properly applied, a concentration of one-half (0.5) part of rotenone per million parts of water is the maximum amount generally required to kill fish. However, experience has shown that some fish occasionally survive because uniform concentration is not obtained in all parts of the body of water being treated. This usually results from inexperience or use of improper methods of applying the poison. If any doubt exists about obtaining a complete kill, it probably is best to use one part of derris to each million parts of water. The concentration of one-half part per million is obtained by distributing 1.4 pounds of the powders or emulsions (5 percent rotenone content) to each acre-foot of water.

To calculate the amount of poison required to treat a body of water, the area should be fairly accurately measured. To determine the volume in acre-feet it is necessary to multiply the acreage by the average depth in feet. The best method would be to have a surveyor make a regular survey. However, a much simpler method will suit our purposes. For example, a pond 165 feet wide at one end and 115 feet at the other and 265 feet long at one side and 245 feet at the other would average 140 feet wide by 255 feet long. By multiplying the average length by the average width the

surface area is found to be 35,700 square feet. By dividing the number of square feet (35,700) by the number of square feet in an acre (43,560) you find that this pond has surface area of 0.82 acres. To determine the average depth, frequent soundings at regular intervals, across the pond should be taken. Suppose it is decided to take soundings across the pond on five cross sections equally distant from each other and at five points on each cross section equal distances apart. The readings in inches, may be as follows:

19	19	17	20	17
24	36	36	40	42
38	42	48	52	58
24	32	38	42	48
18	16	19	25	30

These 25 soundings total 800 inches; the average depth, therefore, is 32 inches, or 2.67 feet. We would now multiply the area in acres (0.82) by the average depth in feet (2.67) to obtain the figure of 2.19 acre feet of water in the pond. To determine the amount of derris required to treat the pond multiply 2.19 by 1.4. Therefore, 3.1 pounds of derris is required for one-half part per million or 6.2 pounds if the stronger dosage of one part per million is believed to be needed.

Rotenone in the form of powders is much easier handled if made into a thick paste by the addition of water. The paste can then be thinned further by the addition of more water. This may be applied in several ways. That most commonly used consists of pouring the solution in the wake of a moving outboard motor. If the area of the body of water is small, a boat can be tied or anchored in one place, with the motor driving the water towards the farthest shoreline. The motor should be operated until the fish begin to die. If outboard motors are not available the solution can be scattered over the surface of the water with a small pan or dipper (Figures 1 and 2). If there is excessive feather-edge along the shoreline, or if there are muskrat runs, it is advisable to pour or spray small quantities of the liquid solution around these areas before or during the time the rest of the pond is being treated. If this is not done, some fish which may be in the shallow edges or in the holes in the pond bank may avoid being killed.

Another common method of application is to place the powder, or a thick paste in open-meshed burlap sacks which are towed behind a boat.

Emulsifiable rotenone is a concentrated form of rotenone in liquid form which may be readily mixed with water. This material is designed in such a way that when applied to the surface of a body of water, it settles and disperses throughout all parts of the water with the excess finally settling on the bottom. Wettable rotenone paste is much more rapid in its action than straight powdered rotenone. It is also much more convenient to use because there is no dust problem when mixing with water. Rotenone paste may be mixed with any quantity of water before being applied.

In applying any type of rotenone it is a good practice to disperse the drug in a criss-cross pattern over the entire surface of the body of water being treated. In so doing there is little opportunity for the fish to escape contact with the poison.

It has been found that derris does not readily penetrate the deeper parts of a lake (20 to 25 feet or more) when applied at the surface. Several methods have been employed to introduce the poison into the deeper parts. A centrifugal pump is probably the most efficient. Satisfactory results have also resulted from using an inverted funnel attached to a piece of garden hose. It is necessary to weight one end of the hose so that it will sink. The funnel causes sufficient suction to pull the derris suspension from a tank in a moving boat to reach depths of 30 feet or more. Some workers have towed weighted burlap bags of paste through deep water (50 to 60 feet or more) with satisfactory results.

For best results, surface water temperatures should be above 70 to 75 degrees. However, lakes have been successfully treated when the surface water temperature was only 44°F.

Within a few minutes after treatment starts, fish will be noted coming to the surface and darting about as though having lost their sense of balance. There may also be some gasping and gulping of air. The fish do not remain on the surface for long. After death, most fish sink to the bottom until bloating causes them to rise to the surface again. A complete kill will usually be obtained in from 24 to 36 hours.

The fish die of suffocation caused when the capillaries in the gills of the fish shrink to a diameter which does not permit the passage of the oxygen-bearing red blood cells. In other words, the circulation in the region of the gills is cut off and the blood stream is no longer able to supply the organs of the body with oxygen necessary for certain body functions. It has been ascertained that poisoned fish will recover if rescued from the treated water at the first signs of distress and placed in untreated water.

Because large numbers of fish may be killed during poisoning of a lake, methods of disposal must be taken into consideration. The burial of dead fish near the lake is generally the best procedure. However, the fish may be fed to poultry or hogs or may be placed on the land as fertilizer. Poisoning with derris does not render the fish unfit for human consumption. If collected while still fresh, fish may be eaten or placed in cold storage for consumption at a later date.

Generally speaking aquatic insects, crustacea and other types of invertebrates are less sensitive to the action of rotenone than are fish. People, cows, horses, sheep, pigs, chickens, cats, dogs, snakes, frogs,

and other vertebrates are not affected when they swim in or drink water treated with rotenone. Continued inhalation of the dust when mixing the powder with water sometimes causes headaches and irritation to the membranes of the nose and throat. Such irritations usually pass off shortly after exposure has been discontinued. However, it is suggested that as a protection a nose mask be used when mixing the powder.

Before the pond, lake or stream is restocked with desirable species of fish, a water test should be made. This is done by placing a minnow bucket containing a few fish in the pond, lake or stream which has been poisoned. The test should be made in the deep end of the pond or lake where the water temperature is likely to be lowest and most toxic. If the fish are not dead at the end of 24 hours, the chances are that the lake is ready for restocking. Before making this toxicity test however, it is recommended that oxygen analyses be conducted. There may be some areas in the lakes or ponds with insufficient oxygen to maintain fish life. This is especially true in the water right next to the lake or pond bottom.

In conclusion we wish to stress the following: Before poisoning is attempted the need for destroying the existing fish population must be ascertained by a qualified person. Rotenone is expensive. Therefore it is necessary to have a fairly accurate estimate of the area of the body of water to be treated. If the rotenone is not properly applied, a complete kill might not occur. If adequate toxicity tests are not conducted before restocking, all newly planted fish may die. It is therefore recommended that before poisoning is attempted, a qualified person should make a biological and chemical survey of the pond, lake or stream to be treated. If possible, this person should also carry out the poisoning and subsequent restocking.

The Fish and Wildlife Service does not have the personnel available to carry on surveys, poisoning and restocking. These duties should be performed or supervised either by the various State Fish and Game Departments or by qualified biologists who have received permission from the states to perform this type of work. The states and not the Fish and Wildlife Service have complete authority and jurisdiction over state waters.

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Figure 1. Two simple methods of applying derris in small ponds. A dipper is used in applying derris from a tub (canoe in rear). In canoe in foreground a hand pump with rubber tubing weighted so that derris is being distributed in deeper layers of water.



Figure 2. Method of applying derris with dipper and tub.