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## The Biological Action of Rotenone on the Lake Fauna

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it seem probable that while dark antennal color and extra sensoria, characteristic of winged aphid, are determined after wings, ocelli, and wing muscle, they complete their segregation before that of the latter group.

COE COLLEGE,  
CEDAR RAPIDS, IOWA.

## THE BIOLOGICAL ACTION OF ROTENONE ON LAKE FAUNA

HOWARD L. HAMILTON

The powdered root of *Derris elliptica*, which contains the alkaloid, rotenone, has long been used by the natives of tropical countries as a fish and arrow poison. Recently it has been introduced in this country as an insecticide, and is being used by conservation workers to remove rough fish from waters which are to be stocked with game fish. Little or no consideration has been given to the possibility that the poison might kill other members of a lake fauna (thus breaking the food chain) and seriously affect the survival of any fish with which the waters might be restocked. The purpose of the present investigation was to determine the effect of rotenone on various aquatic animals.

The paralyzing action of rotenone on the respiratory center in mammals is well known. Fish respond to the drug by swimming to the surface and gasping for air; the amount of air swallowed is soon sufficient to float them ventral side uppermost, and the animals writhe on the surface of the water in this position until death results from suffocation. The lethal concentration (that which produced death in at least twenty-four hours) for various animals is given below:

Animal	Lethal	Concentration
Buffalo ( <i>Ictiobus</i> sp.)	1	6,000,000
Carp ( <i>Cyprinus carpis</i> )	1	5,000,000
Leptodora kindti	1	2,000,000
Diaptomus	1	2,000,000
Daphnia	1	2,000,000
Bullheads ( <i>Ameiurus melas</i> )	1	2,000,000
Argulus	1	2,000,000
Estheria	1	1,000,000
Rana pipiens	1	500,000
Ambystoma tigrinum	1	500,000
Leeches	1	500,000
Amphipods	1	100,000
Planaria	1	100,000

Other animals which showed little or no sensitivity to rotenone were: *Cambarus inununis*, the water snails (*Physa halei* and *Limnia stagnalis*), aquatic insects of the families Corixidae and Notonectidae, and water mites (Hydrachnidae). Gill breathing animals were more sensitive to rotenone than air breathers. A concentration of 1:500,000 was lethal to tadpoles of *Rana pipiens* within eight hours, but metamorphosed animals could tolerate the same concentration for 24 hours. In general, the more exacting the oxygen requirements of the fish, the more sensitive it was to rotenone. It was found that rotenone was rapidly decomposed in water from West Okoboji and that a solution as strong as 1:100,000 was apparently harmless after 48 hours.

A gross examination of the gills of normal and derristreated fish showed a marked difference in blood supply. The gills of poisoned fish were pale pink instead of bright red, and this indicates that suffocation was due to decreased circulation of blood through the gill filaments. The beat of the heart remained strong, and it is probable that death was due to a vaso-constrictor action of the alkaloid.

The concentrations of the drug which killed fish were too dilute to affect other animals, except for the microcrustacea. These plankton animals were killed within one to four hours by concentrations that were lethal to bullheads in 24 hours. It is concluded that derris root, if carefully used, may be useful in removing undesirable fish from a lake, provided that the fish with which the waters are to be restocked do not depend upon the microcrustacea of the plankton for their food.

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## ABSORPTION OF LIGHT IN THE OKOBOJI LAKES

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In August 1938 the absorption of light was measured at various depths in the Okoboji Lakes by means of a photronic cell and a tungsten filament lamp which were mounted behind glass windows in separate metal housings so that a parallel beam of light passed through one half meter of water before striking the photronic cell. This apparatus could be lowered to any desired depth, and the