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THE CONTROL OF FISH PREDATORS AT HATCHERIES AND REARING STATIONS[1]

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At various times during the past eight years, studies of vertebrate predation on fishes have been carried on in Michigan. An important phase of the work has been an investigation into methods and effects of controlling fish predators at hatcheries and rearing stations, and an evaluation of the effects of such control. One aim has been to find means of reducing expensive losses of fish, and of man hours required for the most commonly practiced forms of control--shooting and trapping. The work has been conducted in the hope that it might lead to greater economy and efficiency in fish culture, by methods which will conserve the lives of countless fish-eating animals. Attempts have been made to find effective and practicable means of control which, wherever possible, do not involve killing.

In order to augment my experimental data and observations obtained during the past two years in Michigan, 390 questionnaires were sent to hatcheries throughout the United States. These sheets were designed to

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[1] Contribution from the Co-operative Fish Management Unit, sponsored by the American Wildlife Institute with support from the Associated Fishing Tackle Manufacturers, the Institute for Fisheries Research of the Michigan Department of Conservation, and the University of Michigan.

bring together recent developments in methods of control of predation on fishes, to gather information on the present status of predator control at fish hatcheries and rearing stations, to enumerate the kill, and to summarize the views of hatchery officials on the predator problem. The questionnaires were sent out under the direct auspices of the Institute for Fisheries Research at the suggestion of A. S. Hazzard. The American Wildlife Institute and the University of Michigan co-operated.

Richard H. Pough of the National Association of Audubon Societies assisted in drafting the questions and contributed information which he had gathered on this problem in 1936. The U. S. Bureau of Fisheries, through the kindness of M. C. James, assumed the task of mailing the blanks to federal hatcheries. The invaluable counsel and guidance of Carl L. Hubbs were continually available, and Milton B. Trautman gave important technical advice. The kind co-operation of these and all other coactive agencies and individuals is hereby gratefully acknowledged.

Of the questionnaires sent out, eighty went to federal, three hundred to state, and ten to private hatcheries. Returns number 241, including thirteen which are not treated in the following summary because they represent stations which are entirely under roof or for some other reason have no problems directly dealing with fish-eating animals.

In the 228 hatchery units of thirty-eight states whose replies are analyzed, there are according to the reports approximately 135,714 linear feet of raceways, and 2,861 ponds with a total area of 2,223 acres. In this water more than thirty[2] kinds of fish are cultured. At 110 stations predation is regarded as involving significant losses and as a menace to

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2/ Swepson, Earle. "Fish culture is big business in the United States," The Progressive Fish Culturist, No. 41, 1937:16.

the economical operation of the plant, whereas at 112 establishments predation is not considered a problem. Whether or not predation is regarded as a serious problem, the men in charge of many stations consider current control methods (mostly trapping and shooting) inadequate, from either the point of view of holding down losses of fish or of convenience.

The experience of these fish culturists is presented since it may contribute to the understanding and solution of the problem of predator control at fish hatcheries and rearing establishments. Details of experiments on predator control in Michigan will be reported in other papers. No data are here included on the analyses of the feeding habits of predatory animals at fish stations, or on the interpretations of the complex effects of predation in these environments of concentrated prey.

CONTROL METHODS WHICH FRIGHTEN AWAY OR EXCLUDE PREDATORY ANIMALS

Summarized under this heading are all practices reported as used to exclude or frighten away animals which may prey upon fish.

Screens

Covering screens. Covering screens are recorded as used for the exclusion of fish-eating birds and other animals at twenty-four stations. Included in the variety of screening devices in current use are: tar paper and wood slat covers for raceways; rotary screens driven by water power on circular ponds; cloth screens claimed to reduce algal growth and to exclude not only fish-eating birds but also other fish-eating animals from raceways and small circular ponds; and poultry-wire screens on frames or in large rolls for covering raceways or small ponds.

In all installations reported, covering screens are stated to be effective in the exclusion of fish-eating birds and frequently of certain mammals, snakes, and turtles.

A disadvantage in the use of screening is its interference with the handling of the fish, as in feeding or cleaning operations. Since this type of protection is limited in its application to small ponds, raceways, and rearing troughs, the interference with routine duties should be reduced to insignificance if convenience along with effectiveness is kept in mind when the construction is planned. Ultimately, fewer hours will be spent in the control of predators when such a contrivance is in operation than are necessary for the shotgun patrol or for staking out and tending steel traps.

Marginal fences. The federal hatchery at Saratoga, Wyoming, and some New Hampshire hatcheries employ a poultry-wire fence about twenty-four-inches high at the water's edge about raceways and ponds. Since wading birds do not ordinarily alight in water, this fence, it is thought, materially retards such birds from destroying fish.

Double-end box traps or ground pits installed at intervals along such a fence will capture turtles and snakes.

At another station similar advantage in the exclusion of wading birds is claimed for a two-strand wire fence placed in the same way as the poultry fence just cited.

Field observations indicate that such fences may not entirely exclude wading birds. Great blue herons have often been seen to alight directly on water several feet deep and while floating there to capture injured fish liberated from fishermen's hooks. Somewhat rarely, they have been observed to catch fish by diving, kingfisher fashion, from a height of

about twenty feet. Might not these adaptable habits enable the birds at least occasionally to obtain fish from fenced fish-rearing waters?

Wires

Wires strung above the water to exclude fish-eating birds or to frighten them away have been reported as tried at seventeen stations. Experience has indicated that the proper type of wiring to be used depends on the size and location of the body of water to be protected and on the bird species to be excluded.

Cross-wiring near ground level. For raceways, nine- to sixteen-gauge wires strung in eight-inch squares on wooden frames and placed about two feet above the water were found by Guy Lincoln at Oden, Michigan, to eliminate predation by such birds as kingfishers, mergansers, and herons. A disadvantage of such a covering is that it tends to become unsightly and malodorous when feeding operations are carried on without the removal of the frames. The use of light-gauge wire will partially obviate this difficulty. To permit cleaning operations or removal of fish, the frames can be readily propped up at one side.

For small ponds, a half acre or less in area, wires strung to form twenty-four-inch squares about two feet above the water are regarded as likely to exclude birds which alight upon the water, but the maximum effective size of mesh still needs to be determined by extensive trials. It may be expected that herons will feed about the margins of a pond so treated and that occasionally a kingfisher will fish through the mesh. Since kingfishers have been observed to perch on nine-gauge wire, it is recommended that lighter wire be used where possible. Whether more time would be consumed in removing and reinstalling the wires each time a pond

so covered is cleaned or seined than would be required in the usual shotgun patrol, is difficult to predict. It is certain that to save fish lives and bird lives simultaneously is good conservation.

For larger ponds, of one or several acres in surface area, wiring is generally deemed impracticable. The construction and maintenance of this type of protective measure over large areas would seem to be too costly and inconvenient to be justified by the losses in fish which might be prevented. Howard S. Doyle of Nevada, however, records having tested and found effective light-weight telephone wire strung in twenty-four-inch parallels about two feet above the water on a two-acre pond. According to observations made at this Nevada station, great blue herons are usually frightened by the wires. An occasional over-bold individual is killed while attempting to rise under the wires.

Overhead wiring. Where predation by birds is extremely severe, overhead wiring[3] may be practicable, especially in raceways and small ponds of northern trout-rearing establishments where losses of fish to birds continue throughout the year. Arches of iron pipe or other types of frames erected to support the wires should be made sufficiently strong to withstand extreme conditions of ice and snow. Sixteen-gauge wire of a non-rusting material, preferably steel-core copper wire, is suggested. From a preliminary experiment,[4] it is believed that the wires will need be six inches apart and parallel to the length of the raceways to afford protection. The use of second-hand piping and Civilian Conservation Corps

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[3] McAtee, W. L. and S. E. Piper. "Excluding birds from reservoirs and fish ponds," U. S. Dept. Agric., Leaflet, 120, Sept. 1936, 6 pp.

[4] Conducted during 1937 in co-operation with Donald V. Gray of the U. S. Forest Service at East Tawas, Michigan.

labor considerably reduces the cost for this type of protection. There are advantages of overhead wiring: once erected there is no need to move parts to enable handling of fish, and maintenance costs are negligible.

Wind-operated scares

The sole wind-scare on which the questionnaires give definite information consists of tin cans bunched and tied to wires and exposed to wind for noise making. The federal station at Dexter, New Mexico, which tested this contraption, reports it to be unsuccessful.

By using pendent shiny squares of tin and rotating beams of light F. M. Uhler and S. Creech of the Bureau of Biological Survey have been successful in frightening ducks and geese from a grain field near Unionville, Michigan. "In the approximate center of the field they placed an iron pole in the ground. At the top [about four feet above the ground] they set an ordinary bicycle wheel, atop which they placed two electric lanterns. On the underside they attached six curved tins so that the slightest stir of wind would revolve the wheel and lanterns."[5] As the wheel rotates, the beams of light are reflected from squares of tin suspended from cross arms of stakes placed at intervals over the whole field. "Apparently terrified by the flickering tins, not a duck has set foot in the field since the ... [device] was set up."[6] Although this system has not been tested for its effect on the behavior of fish-eating birds, its apparent possibilities for frightening these birds warrants its mention here.

Specific information is lacking on noisy windmills, wind-animated scarecrows, and "scarebirds"[7] as suggested by Cottam and Uhler.

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[5] Wood, Robert B. "Strange gadget frightens ducks," Ann Arbor News (Ann Arbor, Michigan), Saturday, October 29, 1938:9.

[6] Ibid.

[7] Cottam, Clarence, and F. M. Uhler. "Birds in relation to fishes," U. S. Dept. Agric., Wildlife Research and Management Leaflet, BS-83, May, 1937, 16 pp.

Mechanical noise-making devices

Automatic acetylene detonator. Brief tests were conducted during the past summer on the automatic acetylene detonator sold by the Salt Lake Stamp Company, Salt Lake City, Utah. This detonator generates acetylene gas as water drips on calcium carbide through an adjustable valve from a reservoir tank. At controlled intervals a report occurs, which resembles that of a twelve-gauge shotgun. Simultaneously with the explosion the gun takes on a sudden movement and a blue-white flame about two feet in length is emitted from the firing chamber. The machine operates continuously and automatically by reason of a pilot light. A single filling of calcium carbide will last as long as twenty-four hours, exploding at intervals of two minutes. A twenty-four-hour charge of carbide costs about ten cents, and about ten minutes of time is required for a man to clean and refill the gun each day.

During five days and nights of full-time operation of the detonator suspended above a quarter-acre group of trout raceways and small rearing ponds, two kingfishers, two American bitterns, and one great blue heron were seen to fish in close range of the exploding gun. It cannot be stated how many birds were prevented from feeding on the fish during the period of the test. Judging from the behavior of this "mechanical scarecrow" at night, it has definite possibilities in the control of night herons, and others of the heron tribe. A combination of this gun with pendent, shiny squares of tin is doubtless worth testing. (The detonator has proved effective in the control of blackbirds, robins, and starlings about cherry orchards in southern Michigan.[8])

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[8] Cardinell, H. A. "Protecting cherries from birds," Mich. St. Coll., Agric. Exp. Sta., Circ. Bull. 160, May, 1937, 22 pp.

Firearms. Two stations report successful use of firearms as frightening devices.

Other noise-making devices. Marine sirens and loud gongs electrically timed and operated are not known to have been examined for their possibilities.

Miscellaneous methods

At Marion, Alabama, it has been found that since one martin will drive any osprey off the grounds, boxes put up on poles for martin nests are a distinct asset.

Scarecrows on pond walls are reported as effective at the Springville, Utah, federal hatchery, but as useless at the Leetown, West Virginia, station. A floating scarecrow, however, was estimated to be 80 per cent effective on circular ponds at the Bear Lake federal hatchery, Utah. "Kingfishers became more bold and less afraid of this scarecrow than any other predator."

Interest in live trapping, banding, and removing birds to other territories was expressed by C. L. Edmundson, a federal fish culturist of Smokemont, North Carolina. "Verbail" live pole-traps for kingfishers were tried at a few stations in Michigan during the past summer. Despite all possible care taken to set traps so that the lightest contact (by a bird) would release the mechanism, no birds were caught during a trial period of three months, although birds were caught in adjacent steel pole-traps. A successful program of live trapping would be welcomed.

A rather novel live trap for great blue herons and American bitterns is suggested by A. F. Fleury of Hollis, Maine, who writes:

"I found a very successful way in trapping Blue Herons [Ardea herodias] and Marsh hens [Botaurus lentiginosus]. It is as follows: take a flour barrel and break out both top and bottom; cut barrel so it stands out of

the water about one and one half feet and paint this portion a dull gray or black.

"This barrel is stood up on end in the center of ponds or pools. Cover top with wrapping paper and take a razor blade and cut slits the whole width of the barrel top. Herons and marsh hens take this for a stump or something to light upon .... and break through the paper that is already weakened by cutting. After the bird goes through the paper it is in the water and since it has no room for its wings to open, it is unable to rise from the barrel trap."

Fleury also reports that a well-trained hunting dog frightens animals away from his trout raceways and rearing ponds.

Table-like covers placed in small rearing ponds to afford shade for fish, may also be made to furnish protection from predators according to Russell Lord of Pittsford, Vermont. Since ordinarily these covers provide excellent places upon which wading birds may alight and from which they may successfully fish, Lord is placing poultry netting screen about the edges of his covers in order that birds cannot stand at the edge and strike.

The hanging of dead fish-eating birds on poles about ponds, suggested in the replies on one questionnaire, is undoubtedly ineffective and gruesome.

The electric fence as a means of controlling wading birds and electrified shocking perches for kingfishers, grackles, and other birds, are apparently untested.

Carl L. Hubbs reports that he has seen pendent shiny squares of tin successfully used to protect Japanese rice fields from bird depredations. The squares are suspended from ropes which radiate from a control stand in the center of the field. Impulses from the control house cause all the squares to move and reflect the sun in many flashes.

Environmental control

It is well known that great concentrations of available prey result in a "baiting" of predators. Fish hatcheries and rearing stations with their high concentrations of fish are of this nature. Since the concentrating of the fish prey is unavoidable in ~~artificial~~ fish culture, all environmental features which aid predators should be eliminated if possible.

Location of hatcheries. Severe predation may often be prevented by locating fish-cultural establishments outside the usual limits of the major flyways of fish-eating birds and beyond the flight range of large nesting colonies. In Michigan it has been found that stations located on or near the shores of the upper Great Lakes are visited by many more kingfishers than comparable stations located farther inland.

Pond construction. In the construction of rearing ponds, the shoreline should be as regular as possible, since irregularity often aids predation.

In ponds and raceways with concrete or rip-rap vertical walls, and with the water level two feet below the top of the wall, the fish are much less vulnerable to predation than in ponds with gradually sloping sides. It seems desirable to have at least eighteen inches of water at the margins of ponds and raceways. A. H. Dinsmore of Berlin, New Hampshire, reports this type of construction effective.

Fish concentrations. The more concentrated the fish in a body of water or in a part of it, the greater is their vulnerability to predation. Any device or practice which will ensure even distribution of fishes in rearing enclosures rather than encourage concentrations, at such points as water inlets, for example, lowers their vulnerability to predation (and to disease).

Marginal vegetation. Frequent trimming of weeds about the margins of ponds and raceways creates a less favorable environment for snakes and other predatory animals.

Removal of fishing perches. Elimination of perches for kingfishers may reduce predation to a certain extent, but cannot be expected to eliminate it entirely. Kingfishers can successfully fish without the aid of perches.

Buffer populations. In 1935, Indiana conservationists, recognizing the important position of frogs and toads in the diet of fish-eating birds and other piscivorous animals, mentioned the possibility of creating amphibian buffer populations.[9] The proposal was to surround fish ponds with several pools and to stock these with breeder frogs and toads. Although this plan is not without merit, it has apparently never been tested. An abundance of forage fish might also serve to lessen the loss of game fish.

Several buffer organisms ordinarily occur in most rearing ponds, particularly those in use for pond-fish culture. Many of these organisms are either enemies of fish or harm the pond structure. Moles, snakes, tiger salamanders, crawfish, and giant water bugs, diving beetles, and other predacious insects are among them. Most of these forms often appear in the stomachs of larger fish-eating animals.

CONTROL METHODS WHICH INVOLVE KILLING

Pole-traps

Ninety hatcheries report the use of at least 514 pole-traps; the number in use at any particular station ranges from one to fifty. Ordinarily a unit consisting of a No. 0 steel trap mounted on top of a pole or post

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[9] From the unpublished data of Richard H. Pough gathered during 1936.

five feet above ground or water level is used. In Michigan, a pole-trap is generally fastened by its chain and sliding ring to a wire which slants from the top of the pole to an under-water position where it is made fast. When a bird is captured, the trap is knocked from the pole and both bird and trap slide under the water, thereby achieving a speedy and humane end. Moreover, the dead or dying bird is rendered inconspicuous to the visiting public.

Although efficacious in the capture of kingfishers, pole-traps also take an unfortunate toll of small land birds. For this reason the method which ensures the immediate plunge of a sprung trap and the quick death of its occupant hardly permits the liberation of song birds. Land birds of the size of the English sparrow have been observed to alight upon the pan of a delicately set No. 0 trap without tripping the mechanism; but bluejays and birds of similar size fare less well. However, one or both of the birds' legs are often broken and consequently there are few occasions to liberate such unfortunates.

Under-water and blind-set steel traps

Two hundred ninety-seven under-water or blind-set steel traps are reported as used at thirty-three stations. The size employed is No. 1½. Under-water traps are set in shallow water near the margins of ponds frequented by wading birds. Blind sets, consisting of steel traps covered with a few leaves or some loose sand, are made on the banks of ponds or pools where predatory birds habitually alight. In brood-stock ponds the under-water traps frequently catch the fish they should protect. Large fish feeding on the bottom are often caught; more frequently, however, they spring the traps without injury to themselves.

The efficiency of under-water traps has been increased at the Santa Rosa, New Mexico, federal hatchery by concentrating traps about stakes on which carp or other coarse fish have been impaled to function as lures.

Turtle traps

Turtles are considered fish predators at twenty-seven stations. Control has been demonstrated as possible by several methods. Traps, trot lines, basking logs liberally equipped with large, barbed hooks, mass removal of turtles from their hibernation sites, and shooting with a small caliber rifle have been successfully used.

Snake control

Fifty-five fish-cultural establishments require some form of control against snakes. Generally water snakes of the genus Natrix have been found to be the principal offenders, but in Michigan garter snakes (Thamnophis sirtalis) have also been found to be destructive to fish under hatchery conditions.

As previously mentioned, pits dug in the ground along marginal fences about rearing waters may be effective snake traps. Robert Smith of East Killingly, Connecticut, advertises for sale a water snake trap which he claims is very effective. I do not know, however, whether this trap has been tested at any fish hatchery.

Intensive and prolonged campaigns to eradicate snakes from hatcheries have shown that local populations of troublesome species may be reduced to very low levels. Since the movements of snakes are much more restricted than are those of fish-eating birds, for example, intensive local campaigns for a year or two apparently reduce snake populations for several years. During two summers at a rearing station in central Michigan, all of the many snakes seen were killed, with the result that but few snakes were

observed throughout the succeeding three seasons.

Shooting

Of 213 fish-cultural establishments where shooting is employed as a means for reducing losses caused by fish-eating animals, nineteen report regular patrols while 183 shoot as occasion seemingly demands. Several stations consider this form of control the only effective and practicable means of protection for their particular set of conditions.

A few hatcheries estimate that the value of fish annually taken by vertebrate predators may be as much as one thousand dollars.[10] Percentages of fish lost from single ponds have been as great as one hundred per cent.

In the questionnaire, an attempt was made to learn the annual number of animals destroyed in protecting hatchery fish (Table I). Unfortunately, the lack of uniformity in the use of common animal names, especially those of birds, and the inability of the average hatchery employee to identify correctly the animals killed, result in unavoidable uncertainty. Thomas Hinshaw, Division of Birds, Museum of Zoology, University of Michigan, was called upon to assist in the interpretation of the vernacular names applied to birds.

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[10] From the unpublished data of Richard H. Pough gathered during 1936.

Table I

The kinds of animals and number of individuals of each kind reported killed in the control of fish predators during 1937

Animals	Hatcheries reporting kills		Number killed
	By kind only	By number of individuals and kind	
REPTILES			
Snakes ..... Species of water, garter, and pine snakes are included.	9	46	1,776
Turtles ..... Known to be included are musk, snapping, painted, geographic, and soft-shelled turtles.	8	19	698
BIRDS			
Grebes ..... Listed are horned and pied-billed grebes. Other species are doubtless represented.	2	10	178
Great blue heron ..... Represents various subspecies of great blue heron.	3	73	512
Blue herons, cranes, and herons ..... Apparently subspecies of the great blue heron but also may include little blue heron and other heron species.	6	63	619

White herons†	2	9	246
This name may be interpreted as referring to American or snowy egrets and immature little blue heron.			
Green heron	....	20	207
Includes subspecies.			
American bittern	....	16	282
Includes subspecies, and perhaps a few least bittern which are sometimes taken for young of the American bittern.			
Bitterns† and shitepokes†	3	37	1,858
Where doubt existed regarding the application of "bittern" or "shitepoke" to mean American bittern, least bittern, or green heron, the numbers given were placed in this category.			
Black-crowned night heron	2	13	281
Night herons†	1	4	346
When reports made no distinction between black-crowned and yellow-crowned night herons and when specific distinctness could not be determined on the basis of known range, the numbers recorded were placed under this heading.			

Mergansers ‡/	5	25	408
Included here are American, hooded, and red-breasted mergansers, for the most part inseparable in the reports given.			
Osprey	6	31	278
Sometimes called "fish hawks."			
Gulls ‡/	....	10	117
Recorded in questionnaires as gulls, and sea, Franklin, and herring gulls.			
Terns ‡/	....	7	662
In some reports specified as common, black, and least terns.			
Gulls and terns ‡/	....	21	136
No separation of gulls and terns killed is made for purposes of record by stations in Michigan or by a few of the stations in other states.			
Kingfisher	8	166	5,568
Water ouzel	....	13	306
MAMMALS ‡/			
Muskrat	....	8	101
Mink	....	15	64

"Rats" ‡ ..... Some of these are probably Norway rat, others, muskrat.	....	7	133

* A few alligators were taken at Lake Park, Georgia.

† Other species of birds and number of individuals reported killed are 1 water turkey, 4 least bitterns, 7 mallards, 2 wood ducks, 37 least sandpipers (?), 46 great horned owls, 40 magpies, 5 ravens, 33 crows, 5 robins, and 70 grackles. Additional unspecific groups of birds and numbers reported killed are 17 loons, 3 pelicans, 10 ducks, 20 snipes, 8 owls, 5 canaries, and 125 blackbirds. Four "sand-cranes" (possibly sandhill cranes) were killed at the Delafield, Wisconsin, State Fish Hatchery.

‡ Colloquial, or unspecific animal name quoted from the replies to the questionnaires.

‡ Five raccoons and four domestic cats are also reported taken.

Discussion of the records of kill

Since the kill records when first considered seem neither amazingly nor alarmingly high, it should be remarked that they probably are by no means complete. Many private fish rearing establishments and over 60 per cent of state operated hatcheries and rearing stations are unrepresented in the questionnaire returns from which these data are drawn. Some stations were not provided with forms, and many others failed to reply.

There is a possibility that certain kill records are higher than actual kills, for some hatchery men feel that such records are a form of employment insurance or a matter of personal pride. Such exaggerations are probably more than compensated for by the unrecorded deaths of animals which, ~~through wounds~~ though wounded by shotguns or traps, escape immediate death.

Fish culture during 1937 in the United States entailed an unestimated total sacrifice of animals and a recorded extermination of 2,474 reptiles, 12,442 birds, and 307 mammals. It is a matter for consideration whether the reproductive capacity of ~~any~~ each species is or is not sufficient to counterbalance the effects of the kill about fish hatcheries and rearing stations. It is regretted that much of the data on the questionnaires regarding the numbers and kinds of animals killed must lose much specific value from lack of uniformity of reports or failure to keep records. If accurate identifications of animals killed and complete records of take at hatcheries were available, the annual figures for each species might be employed as an index to abundance. A comparison of such figures from year to year might disclose important trends of population density and interesting cyclic phenomena.

Summary and Conclusions

This report contains data and observations on the fish-predator problem in thirty-eight states.

Since too many predators and non-piscivorous animals are killed (15,223 reported for 1937) and too many fish are annually destroyed by predators, a need exists for the wider and wiser use of control methods which exclude or frighten away predatory animals.

Preliminary suggestions are given for the control of vertebrate predators of fishes at hatcheries and rearing stations. The possibilities of the many methods discussed should stimulate experiments.

The most successful methods of control in use are varieties of screening, wiring, shooting, and trapping. Less successful according to reports are wind-operated and mechanical "scares." Environmental control is largely unexplored but has evident potentialities.

Because of their extremely diverse nature, all hatcheries do not have the same problems of predation. Consequently a uniform policy of predator control is doubtless impracticable, at least in respect to detailed methods.

INSTITUTE FOR FISHERIES RESEARCH

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