

## DIRECTIONS FOR COLLECTING, PRESERVING, AND SHIPPING FISHES

by Leonard P. Schultz

### COLLECTING FISHES

The usual methods of collecting fishes are baited hook and line, trolling, spearing, dredging, trawling, attracting them to the surface with a light at night, and using various nets and beach seines. Poisoning is the most important method for shallow water fishes of ocean reefs. Powdered cube or derris root with a five percentum of rotenone content or rotenone in concentrated form is best.

#### Collecting by Means of Fish Poisons on Coral Atolls\*

Thirty-five minutes before the tide reached its lowest point, the dry powdered root was placed in buckets or any suitable container and mixed with water to a thick chocolate malted milk consistency, allowing about 20 minutes for one man to mix 25 pounds. By squeezing and stirring with the hands, as water was gradually added the powder soon formed a thick mud. Ten minutes before low water, the distribution of the mixture began. The stupefying of a great variety of fishes with rotenone was most successful at the lowest stage of water.

The success of this operation depended on determining the strength of the currents and depth of water. A little of the mixture was tossed into the water, and the direction of movement of the small, light brownish cloud, watched. After several such tests, assistants, each with a bucket or two of the mud, were stationed in the water and the distribution began. In water 4 to 5 feet deep, with a slow current, the mud was thrown out permitting the little soft pellets to dissolve as they settled toward the bottom, forming a light brownish cloud. Twenty-five pounds of the dry powder formed a cloud about 100 to 150 feet long by 50 to 75 feet wide. It was highly effective if it took 10 minutes to pass any one point in water above 80° F. When used at lower temperatures the fishes must be exposed for a longer time. Usually a part of a bucket of the mud was reserved to strengthen the cloud after it had traveled a few hundred feet. This precaution was advisable, since the currents did not always behave as predicted.

Shallow Water Reef. -- It was learned through experience which shallow water habitats (to a depth of ten feet) were suitable for collecting fish with rotenone. An area with an abundant growth of coral heads in about 3 to 4 feet of water, down to ten feet in pools, with narrow to wide channels between the various kinds of corals, and a wind blowing the surface water more or less shoreward, was the most ideal situation.

Many kinds of fishes in the areas treated floated for a few minutes, then sank to the bottom. Some were picked up while they were violently swimming more or less in circles. A greater quantity of fish appeared at the surface than were recovered immediately. Those that drifted ashore were recovered but those that got over deep water were often lost.

---

\* Schultz, COPEIA, no. 2, pp. 94-98, 1948.

Immediately after introducing the rotenone, recovery of the fish started, but it was inadvisable to enter the area in which the treated water would flow, since that drove the unaffected fishes away. As soon as the water cleared, those fishes that settled to the bottom were collected. Two or three men continually wandered over the treated area, picking up the specimens in fine-meshed, bobbinet dipnets, 14 or 15 inches in diameter and 25 to 30 inches deep, with a 4 or 5-foot-long lightweight wooden handle.

As the water-laden cloud of rotenone drifted onward for a thousand feet or more, it spread out, gradually becoming so diluted that it lost its effectiveness. When the water appeared as a light, tan-colored cloud, it was most effective since it retained its stupefying properties yet was not so much concentrated as to be detectable by most fishes. Sharks, apparently able to detect small amounts of the rotenone in the water, left the area until the cloud had passed. They then returned to feed on the sick and dead fish, sometimes becoming troublesome. With only one or two 3 to 6-foot-long sharks feeding on the sick fish, the skin diver can keep watch of them. However, when two or three of these voracious creatures become too bold, as on one or two occasions, the ichthyologists left the water.

The searching for the demobilized fishes was done by means of a face mask covering eyes and nose, swim fins on the feet, and a dipnet. With a face mask, both hands were free to devote to picking up fishes, some of which were rather slippery. A canvas glove as an aid for holding slippery fish was used on one hand when necessary. Some of the fishes affected appeared lifeless, but when touched were found to be very much alive and quickly moved away unless caught in the dipnet. Those fishes too small to pick up with the fingers were, with a little practice, lifted from the bottom by inducing upward currents through rapid movement of the hands or feet. A fish, thus suspended for a few moments, was scooped up in the dipnet. Desirable fishes frequently swam into the crevices of the corals and erected their spines, making their removal difficult. With clear vision through the face mask, these, too, were collected.

A rubber boat, tied to one of the coral heads, served as a base from which to work and was an added safety in case someone ran into trouble under the rugged conditions. This boat held the preserving tank, and other gear. Three good swimmers picked up enough fish to keep one man busy preserving the specimens in the rubber boat.

Those fishes first to be affected by the rotenone were the damsel, cardinal butterfly, surgeon, and puffers; others such as needlefish, halfbeaks, goatfishes, gobies, jacks, threadfins, and mullets were a little slower in reacting to the treated water. The burrowing fishes, namely, eels, appeared last, probably because it took longer for the rotenone to diffuse into their habitats. Fish continued to appear for over 6 hours after treatment; eels were recovered that came out 8 hours after the cloud had passed their burrow.

Care was exercised in picking up supposedly dead spiny fishes, and especially moray eels, since they may inflict serious wounds. Scorpion fishes, siganids, and other venomous species, even the stinging corals and jelly fishes, were treated with respect.

The snake eels often appeared with about 6 to 12 inches of their head section above the bottom. They were grabbed firmly and quickly, then the remaining 2 or 3 feet of their bodies were pulled out. A light touch or a miss when grabbed usually caused the eel to withdraw into its burrow and the specimen was lost.

The rotenone appeared to affect the fishes by constricting the capillaries of the gills, depriving them of an adequate oxygen supply. They leave their hiding places for more oxygen, thus exposing themselves under a weakened condition and simplifying their capture.

Shallow tidal pools that trap fish at low tide are simple to work, but the use of rotenone in the ocean surf on the ocean reef of a coral atoll requires special technique.

Lithothamnium Ridge: -- The outer margin of an atoll rim on the ocean side usually consists of the slightly raised pink to red colored lithothamnium ridge contrasting beautifully with the deep blue ocean beyond. It is dissected by rugged surge-channels, and deep pools often 20 feet deep directly connected with the ocean. This ridge, creviced and pitted with holes, is about a foot or two higher than the flat part of the reef farther inward. At extremely low tides it is exposed except as the surf crashes over it, then some of the water is forced back over the flat part of the reef, flowing seaward again through the surge-channels.

Some of the surge-channels, extending for a hundred feet or more back into the solid reef, are more or less roofed over or with perforations large and small through which the water may pour or spurt on the incoming surge of a wave. They are lined with rich green and red algae, blue, red, yellow and green corals, and a host of brilliantly colored fishes live in these clear waters.

Rotenone was used successfully along the lithothamnium ridge in the ocean surf. The "mud" was administered a few minutes after the low point of the tidal cycle. An area was selected where pools occurred but which were not completely connected with the surge-channels. These pools were desirable as settling basins for the sick and dying fishes. The area between two or three surge-channels, where the waves flow inward across the ridge was the place where we placed the rotenone mixture. Big handfuls of the thick mud were thrown out as far as possible into the backwash of a wave. The next moment the oncoming breaker churned the water into foam and carried the water-laden cloud of rotenone inward, spreading it over the area and into the numerous crevices, then it flowed out the surge-channels. Soon the rotenone cloud was distributed along the ocean edge of the reef, and some was brought back again over the lithothamnium ridge. The continual surging inward of the water brought in the sick fish. Men were stationed along the surge-channels to take fishes that were being swept out to sea and perhaps lost. After the pools and channels cleared, the bottoms were searched for fishes by the skin divers.

Deep-water Use of Rotenone: -- Two ichthyologists who were excellent swimmers and skin divers, successfully carried on several deep-water poisonings of fishes with the powdered root. They mixed in the usual manner about 35 pounds of the substance, then placed 5 to 10 pounds of the "mud" in desert water bags. Equipped with standard United States Navy shallow water

diving outfits they took the rotenone to the bottom, distributing it around coral growths. Down below with the usual dipnets, they recovered fishes, bringing them to a man at the surface, who preserved the specimens. This deep-water work was necessary to obtain a more complete picture of the fish fauna of Bikini and the change in kinds of fishes at various depths in the lagoon. Several fish species occurring over the shallower parts of the reefs normally are not found at depths below 10 or 20 feet, whereas some kinds below that depth are not taken near the surface.

#### Collecting With a Light at Night

A bright light suspended from a small ship at night at the surface of the sea attracts to it myriads of nocturnal organisms -- crustaceans, worms, squid, octopi, and numerous species of fishes. Silversides, small wrasse, round herring, the pelagic stages of goatfishes, surgeon fishes, puffers, lizard and file fishes dart in and out of the field of illumination. Large flying fishes, a foot or two long, come swimming or flying toward the light at night. Down below a few feet, larger predaceous fishes can be seen rushing about feeding on the abundant animal life. Eager collectors gathered above this light on a platform, with fine-meshed dipnets scooped up the animals, and preserved them for future study.

#### PRESERVATION OF FISHES

In general, the following rule should be applied: Preserve all fish that come into the net or are taken by other means. Do not throw away small specimens because there are many species of fish of which the adults do not reach an inch in total length. Large numbers of specimens of each kind are very desirable. One hundred specimens of a single species are often not too many and in some cases are not enough.

Formalin Preservation: -- Formalin preservation is recommended instead of alcoholic preservation. The fish should be dropped alive (if possible) into a solution of formalin made up by mixing one part of commercial formalin with nine parts of water [fresh or salt--Ed.] This solution is of sufficient strength to preserve small fish up to five inches in length, in about three days, but larger specimens should be left in it for a greater length of time, depending upon their size. Fish which are allowed to die before being preserved are paled and distorted and hence are of less value. All specimens over three inches in length should be slit in the belly with a sharp knife or scissors or they should be injected with formalin. This allows the preservative to enter the body cavity and keep the contents from spoiling. In addition to this, very large fish, a foot or more in length, should be injected about every two inches into the muscle tissue and left in formalin from five to seven days, or more. After that time, if it is desired, they can be transferred to water for one or two days, and the formalin washed out, and then placed in seventy-five percent alcohol. One should never crowd the fish in the containers like sardines in a can. If it is desired to leave the specimens in formalin indefinitely, they may be transferred to a weaker solution, made up as follows: One part formalin to fifteen or eighteen parts of water, to which has been added two teaspoonsful of

borax to each gallon of preservative. This weaker formalin solution is usually of sufficient strength to preserve the fish indefinitely if the container is closed tightly. Always fill the containers full of liquid.

Alcoholic Preservation: -- Drop the fish alive (if possible) into thirty-five percent alcohol and in about six hours they should be placed in seventy-five percent alcohol. If the specimens are at all crowded, the alcohol should be poured off and fresh seventy-five percent alcohol added the next day. If they become soft, then another change of alcohol should be made, using seventy-five percent again. In general, formalin preservation is best at the start and should be used instead of alcoholic preservation because formalin hardens the specimens. However, after the fish have been in formalin about a week, they should be transferred to seventy-five percent alcohol, after thoroughly washing the formalin out, because the acid in the formalin has a tendency to soften the bones, unless it is neutralized (as by adding borax - see above).

Salt Preservation: -- If neither formalin nor alcohol is available, fishes may be preserved in salt. The fish should first be soaked in a saturated brine solution and when thoroughly impregnated, they should then be packed in dry salt for shipment. As with the other methods of preservation, the abdominal cavity should be opened to allow the salt solution to enter freely. It may be necessary to open the intestinal tract of those fishes that feed heavily on vegetation and remove the vegetable matter accumulated therein.

Skinning Large Fish: -- Fish too large for preservation in available containers should not be thrown away but should be skinned as one would skin a rabbit. Make a slit along the abdomen and remove the skin and flesh from the body, but leave all of the fins in place and the head attached to the skin. This skin can then be placed in formalin or alcohol, or it may be salted. It is best to remove most of the fat and all flesh from the skin. For moderately large fish, it might be well to leave the vertebral column intact.

Labels: -- Labels, giving all essential data, should be placed in the jar with the fish when collected. Accurate information about the locality is as valuable as the fish, for specimens without proper data are of little scientific value. These labels should have the following data: Exact locality, with reference to a town or island commonly appearing on maps; date; collector; and any other information that seems pertinent, such as depth of water, method of capture, ecological data, etc.

The labels should be written with a soft lead pencil on a special type of paper furnished by the U. S. National Museum, or on any pure linen ledger paper. Do not use ordinary paper, because it will disintegrate in the liquid. Do not use ink or indelible pencil, as these wash off the label. Large fish may have tags tied onto them, preferably through the lower jaw, with all essential data written on the tag, or a number may be used and the data recorded under the identical number in a notebook.

Wrapping Fish for Shipment: -- After thorough preservation, fish may be wrapped for shipment in the following manner: Place the small fish in a stack (as cordwood is piled), with their heads outward, so that the tails are

protected, and then wrap them in cloth, with the ends secured firmly, tied up with string, or sewed. Be sure to protect all the fins. Tie each package firmly but not so tightly that the strings will cut into the fish. All containers should be completely filled with packages of fish, or the excess space filled with excelsior or dry grass. Do not use paper as it softens and dissolves in the liquid and does not fill the spaces. After the container is completely filled, then nearly all of the excess liquid may be poured off, leaving the contents of the container wet. Be sure the container is sealed to prevent evaporation. If a metal can is used, the top should be soldered on. Shipment may be made by mail or express or other means. If the material is to be sent "Collect", please let us know prior to shipment, so that arrangements can be made to take care of the transportation charges.

Precautions: -- 1. During preservation, fill all containers completely full of preservative so that there is a minimum of air-space in the container. If the fish are allowed to shake around in the jar, their fins will be frayed out and the rays and scales will become worn off, thus greatly reducing the value of the specimens.

2. Never overcrowd the fish in the containers, because overcrowding causes the fish to be hardened in distorted shapes and also they are very likely to spoil for lack of enough preservative (this is particularly true of soft-bodied fish such as suckers and of fish collected in the tropics).

3. All fish over three inches in length, especially soft-bodied fish, should have a small slit made in the belly. The slit should penetrate into the abdominal cavity. It is best to inject all fish over one foot in length, filling the body cavity with preservative.

4. As a rule, fish should be left in the preservative for at least one week, depending on their size, before being wrapped for shipment.

5. Always place a label, with the essential data, in each jar or package of fish. Be certain that you have linen ledger paper for labels as this does not go to pieces in liquid preservatives. Do not use a label covered with starch, as this comes off in water.