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SCIENTISTS STUDY BEHAVIOR OF TUNA--THE BETTER TO CATCH IT

The fishermen often stand shoulder to shoulder at the stern of the ship, from which live bait has been tossed (chummed) into a school of tuna in the Pacific. When the tuna approach closely enough, the fisherman start catching them on barbless hooks. Sometimes a fisherman needs the help of several of his colleagues, and their poles, to land a large fish.

Because science has a prior claim, some of these tuna are not destined for early canning. They are inspected for damage and, if all right, are lowered into a portable tank aboard the ship. The line holding each fish is slackened, allowing the tuna to "throw off" the hook. When the tank has its quota, the ship heads for its home port of Honolulu. There, the portable tank is moved by crane from ship to shoreside tanks. The portable tank is lowered into the larger tank and the tuna allowed to swim out of the smaller one.

In the shoreside tank, they are trained and studied. Tuna that may naturally swim counterclockwise around the tanks can be trained to alter this pattern at the sound of a buzzer and make sharp turns through an opening in a barrier net.

They can also be trained to respond to vertical and horizontal patterns of light: When one pattern is shown to the tuna and it makes a correct move, it is rewarded with food; when it makes a wrong move, it receives an electric shock.

Hundreds of miles to the east of the fishing vessel's operation, a nylon net reaches across a half-mile of the Pacific and is a couple of hundred feet deep. It has no bottom. Yet, when it is hauled in, its openwork pattern becomes a large purse, entrapping many tuna within its mesh. The frenzied attempts of tuna to escape are mostly futile.

This continuing research on the behavior of tuna, in captivity and in the sea, is being conducted by the Bureau of Commercial Fisheries (BCF), Fish and Wildlife Service, U. S. Department of the Interior. The search for knowledge about the tuna is being pressed with the persistence--but with more rational methods--of Captain Ahab pursuing Moby Dick.

The study seeks to find out what the tuna can see, hear, and smell, what bait will entice it, and what net or line will best catch and hold it. Beyond all this, scientists hope to learn how to predict the tuna's response to both natural and artificial stimuli in the ocean. The information acquired will be passed on to the American tuna fleet to help it catch the fish most efficiently.

The information is needed. The tuna industry, second only to the shrimp industry in dollar value, faces stiff competition from Japan, the leader in tuna fishing. The United States fleet in the tropical Pacific fishes primarily for skipjack and yellowfin tuna and is concentrated in the eastern Pacific, from southern California to northern Chile, several hundred miles offshore.

The Bureau of Commercial Fisheries research on tuna behavior is being conducted at the Kewalo Basin Laboratory in Honolulu and at the Tuan Resources Laboratory in La Jolla, Calif. At La Jolla, where there are no facilities for holding captive tuna, research is being done from BCF or chartered vessels. Here the research focuses on the response of the fish to fishing gear, its behavior during the entire fishing operation, and its attempts to escape a net.

To Catch a Tuna

Already, practical information of much value to the fishing fleet has come out of the research--information that helps answer two important questions: Where in the vast ocean is one most likely to find tuna? How far down should one drop his nets?

Tuna live in the warm upper layers of the ocean, and they are sensitive to temperature changes. Their distribution and movements vary from month to month because features in their environment change as they follow their food sources.

In the eastern Pacific, the upper 500 feet of the ocean is not as uniform in temperature as the atmosphere above the sea. The ocean contains a layer or zone of water called the thermocline, where there is a rapid change in temperature with depth. BCF scientists have learned that where these sandwiched cold-water layers occur less than 50 feet from the surface, and where the temperature change is very rapid, the chances of catching tuna with a purse seine are improved by 65 per cent.

The depth of the thermocline is located with a bathythermograph, a device that also records temperature. Based on BCF's success with the instrument, more and more commercial tuna vessels are being equipped with it.

The Bureau already has achieved what it calls "fair reliability" in predicting the whereabouts and abundance of skipjack in the waters off Hawaii, and of albacore and bluefin along the West Coast. The scientists base their predictions on the time in early spring when the ocean begins to warm and on changes in the movement of the different types of water. They then can predict when the fish are likely to show up, in what abundance, and whether they will be early or late in reaching the area. As the researchers learn more about the interrelations between tuna and the ocean, their predictions will become more precise.

Research in the Ocean

Work in the Pacific is being carried on by the BCF research vessels, Charles H. Gilbert and Townsend Cromwell, which are equipped with observation chambers below the waterline.

To the fishery scientists, the tuna's world is made up of schools, each composed of several tons of fish, usually the same species and size. If a school is not feeding, it may swim along at six to eight knots for hours, with bursts of speed up to 20 knots for short periods.

Most of the time, tuna swim with their mouths open. This allows water containing oxygen to flush over their gills. Should a tuna stop swimming, it would suffocate.

Scientists study the response of tuna to different types of bait and the behavior of the bait. Bait that is silvery and fast moving, such as sardines and anchovies, is good. Live bait is better than dead, and the research vessel is equipped with tanks to keep bait alive.

Although skipjack are a schooling species, they break ranks when food stimuli appear and pursue the prey as individuals. Superimposed over the four or five dark stripes running from tail to head of the skipjack are alternating, vertical, dark and light bars. These bars fade slowly when the stimuli disappear and reappear when new food stimuli appear. The excitement of skipjack going after their food is described as a "feeding frenzy."

Scientists also are interested in the reaction of tuna to specific sounds, particularly those associated with fishing operations. The sounds are transmitted to schools of tuna and their reactions are carefully observed.

Research in the Tank

Much research on tuna cannot be done at sea. Tuna are fast and do not stay long enough in one spot to satisfy the scientists' need for close and continual study. The big problem, however, was how to keep tuna alive in tanks so that experiments could be conducted.

In 1960 the BCF achieved this when it found a way to eliminate manual handling of skipjack from the time of capture until they were placed in shoreside experimental pools. With this technique the fish now live up to six months in captivity.

Research at BCF's Biological Laboratory in Honolulu emphasizes studies regarding tuna hearing and sight. When this knowledge is gained it may be useful in designing fishing gear less visibile to fish.

Though the Bureau of Commercial Fisheries believes some of its findings are tentative and cannot be applied over too broad a base, researchers are confident they have gathered much information that will pay off in greater fishing success for United States fishermen.

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