
A METHOD OF STUDYING THE LIFE HISTORY OF FISHES



By Charles F. Holder



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The owners of the island of Santa Catalina, Cal., latitude 33°, at my suggestion established a small zoological station, which was thrown open free to students who would come with letters from teachers. The aquarium cost about \$10,000. The tanks were placed out in the room so that they could be examined from all sides and the light reach all parts. For all purposes this plan is the most satisfactory, though it does lose the glamor of the "dark, unfathomed caves," which, as often seen in aquariums, are unnatural. Nearly all fishes that live near the surface like the sunlight as it sifts down through the water, so in the zoological station the tanks are bright and clear, and the fishes can be seen, slightly magnified, from all sides, and studied or admired.

No better opportunity to study the life history of fishes can be imagined, and as the fauna resembles that of the Bay of Naples, or, if possible, is richer, the field is an interesting one and almost totally missed by zoologists who take tables at Naples, paying for them, when they could have a greater opportunity here for nothing. Through the courtesy of the owners I have had the entrée to this aquarium and have made many interesting observations.

In observing the habits of fishes I have taken, for example, the shiner, a surf fish, keeping it before me constantly. During the breeding season I observed the birth, which was tail first, of the remarkably large young, and had them before me until they reached the adult stage. The development of the Garibaldi was more interesting, as it is at first a beautiful metallic blue, iridescent, and gradually, as it grows, assumes an orange-red tint, until when nearly 2 years old it is almost entirely orange. I watched the changes, kept the fish in different tanks, and tried them with different foods and colors. I had a tank built about 3 feet long, 8 inches wide, and 2 feet high, which I used in photographing fishes at different ages and stages of their development. The tank could be arranged with the weed in which the fish live in a state of nature, and was placed on the roof of the aquarium in the sun. It was so narrow that the prisoners could not get away from the camera, hence were easily photo-

graphed. I have a series of nearly all the fishes of this region, and I commend this method of individual tanks for old and young fish and eggs, and the photographing of them at intervals, as a simple yet conclusive method of examination and study.

From the side of the tank every motion of a fish could be observed, while in an adjoining room were specimens of the same fish in alcohol or formalin for study. Here I saw the swell shark and the California Port Jackson shark deposit their eggs; later I saw the young making their way out of the corkscrew eggs, then had them photographed as they were hatched, the entire history of the fish being observed and recorded.

I paid particular attention to the protective resemblances. I arranged tanks with colored bottoms and watched and timed the adaptation of color in sculpins and the beautiful kelpfish. In the latter is found one of the most beautiful of all fishes that depend upon protective resemblance. It not only imitates the kelp perfectly in tone, shade, and color, but hangs in it, head down, imitating the leaf in shape and position. I followed the fish from birth to the laying of eggs; found that the female was nearly twice as large as the male, and I think I had the first opportunity to notice the building of the nest, which I reported to the *American Naturalist*. The male had glorious nuptial colors. I watched the female carefully, and the moment she sank to the bottom, exhausted from an effort of twining a silken egg cord about the weed, the male sprang ahead, poised over the eggs, his body violently quivering as he showered over them a cloud of spermatozoa. The following is an account I published in the *American Naturalist*:

One of the most interesting fishes found in the great kelp beds along the shores of Southern California is the so-called kelpfish, *Heterostichus rostrata* Girard. In color it closely resembles the seaweed in which it habitually lives. During the past year two adult kelpfishes and a smaller fish of another kind occupied one of the tanks in the Santa Catalina Island Aquarium. The larger kelpfish, a female, was about 9 inches in length; the male measured about 5 inches. I was attracted to them by the savage attacks of the male on a stranger, and investigation showed that he was in nuptial colors and was attending the female. The offending fish was removed, giving the kelpfish the entire tank.

All the colors of the male kelpfish were highly accentuated and brilliant. What had been white was now lavender and silver; the dark angles of the zigzag barring took on darker tints and were emphasized by countless lines of lavender, yellow, blue, and gold; patches of silver, old rose, lavender, and white appeared here and there the entire length of the fish, making it a most gorgeous creature. The long vibrating dorsal fin was erect, and the fish was unusually alert as if sensible of the importance of the situation and its responsibilities.

In the tank were several small bunches of a deep maroon seaweed 4 or 5 inches high; and as I watched the female, large and heavy with spawn, she approached the weed and appeared to examine it, passing around it several times. Then I saw that her ventral surface was pressed against the weed and that its branches were being caught together by a viscid pure white cord having the diameter of a thick thread. It

clung tenaciously to every branch it touched. Along the cord were large numbers of small eggs. When 4 or 5 inches of the cord had been attached, the fish would rest, the male taking her place and hovering over the eggs, which he guarded with a viciousness altogether unexpected in so small a fish. He withdrew when his mate resumed egg laying. She frequently pushed her way through the clump of weed, but more often passed around it, the silken tenacious cord binding it together in a globular or oval mass about the size of a hen's egg. The entire nest * * * was formed in about two hours, the fish dropping to the bottom of the tank after each effort and lying there for ten or twenty minutes.

I had taken a series of photographs of the nest, and by removing the eggs to a glass globe, in turn placing them in the interior of the large tank so that they would not be disturbed, I soon had the young for examination.

This seems to me the simplest method of observation, namely, open, free, well-lighted tanks, with large skylight, so that the natural conditions of the ocean are more or less obtained; aeration from above, so arranged that it can be increased in the case of surf fishes, or decreased for deep-water forms; special tank for photographing fish at various stages of development, etc., at once simple and productive of results of value to students or laymen.