FISHERIES RESEARCH BOARD

OF CANADA

MANUSCRIPT REPORTS OF THE BIOLOGICAL STATIONS

No. 283

Title

RHEOTROPISM EXPERIMENTS IN FRESH-WATER FISHES

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1933

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by

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Introduction:-

The history of rheotropism is a very interesting one. The phenomenon appears to have been "discovered" by Schleicher and to have been first carefully investigated by Stahl in 1884. It was then considered to be a peculiarity belonging to certain organisms by which they take toward flowing water a direction of motion opposed to that of the current. Orientation was supposed to be based upon pressure, the animals turning toward a pressure stimulus. For this reason rheotropism was long considered to be a special form of barotaxis. Verworn in his General Physiology classes rheotropism, stereotropism and geotropism under the collective heading of barotaxis. His reason appears to have been that he believed all three forms of behaviour to be responses to pressure. In this connection he says in part "a second form of barotaxis in which the stimulus is produced not as thigmotaxis by contact with a solid body but by a gentle current of slowly moving water is rheotaxis..."

Lyon (1905) did not think it reasonable that pressure could be the method of stimulation responsible for the orientation of fish in currents of water. The current, he argued, would only serve to carry organisms down stream. No pressure would result unless the animals became oriented and actually swam against the current. It was, he thought, because the animals opposed the current that the current came to exert any pressure. This led him to think of visible objects of the environment (e.g. stream bottom, stream bank etc.) as important sources of stimulation. With this idea in mind he tried a series of experiments from which he concluded that "by far the largest element in securing

orientation of the fishes experimented with is an optical reflex of such kind that the animal tends to retain the same visual field." However, it is important to note that Lyon also at that time found that blind fishes or fishes in the dark were able to orient themselves to the current. Orientation seemed in such cases to be dependent upon contact with the bottom. Blind fishes did not orient themselves in a uniform current unless they were able to touch stationary objects. Cases of genuine reaction to pressure do, however, seem to be known. For example fish in a small tank into which a rapid stream of water is flowing through a small aperture will orient themselves to the current. It is not necessary that such fish be in contact with any solid object. (Washburn 1926). Here the different parts of the stream have different velocities. There must also be a pressure factor when fish swim upstream against the current as salmon do when they go upstream to spawn.

One of Lyon's most interesting experiments was one in which the fish were placed in a revolving glass cylinder. The fish were found to follow the revolution of the vessel despite the fact that there was a slight current in the opposite direction. Had the response been to pressure the fish should have gone in the opposite direction.

Another important experiment conducted by Lyon was one in which some young fish were placed in a corked bottle, the bottle being full of water. The bottle was submerged close to a wall having a covering of algae. Under these conditions it was found that a movement of the bottle in either direction caused a movement of the fish in the opposite direction. Pressure could not, of course, have been a factor here.

Garrey (1905) observed that when a swarm of sticklebacks was kept in an aquarium all the fish oriented themselves with the long axis parallel and that

the whole school swam in a parallel course, but in a direction opposite to that of the moving observer. When the observer remained stationary in a position near the aquarium and moved a white object the fish immediately responded by moving slowly and oppositely to the moving object.*

Jordan (1917) has made the interesting observation that the small fish Epinephrus striatus Block reacts to current such that its head remains downstream. Jordan considers this a negative reaction to a stimulus produced upon the lips of the fish by the current. However, the fish does maintain itself in the current and is not swept downstream so that a positive rheotropism must exist despite the peculiar orientation of this fish.

* It has been suggested by Garrey that possibly the motion of a near object causes an apparent movement of the whole horizon in the opposite direction and that it is to this that the fish react.

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