

Chief, Section of Marine Fisheries
Washington, D. C.

February 26, 1957

Chief, North Atlantic Fishery Investigations, Woods Hole, Massachusetts

Manuscript: The Maintenance of Immature Sea Herring in Captivity,
by Farrin, Scattergood and Sindermann

Enclosed is subject manuscript which Scattergood sent in for publication
in Progressive Fish Culturist. He sent only one print of each photo, but we
presume you can get by with these.

Herbert W. Graham

cc: Mr. Scattergood

Orig. + 1 sent to Wash.

Woods Hole Laboratory
Manuscript Report Number

55 - 1

February 28, 1957

Dr. Graham:

Manuscript "The maintenance of immature sea herring in captivity" received and scheduled for review.

L. A. Walford
L. A. Walford, Chief
Branch of Fishery Biology

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Office Memorandum • UNITED STATES GOVERNMENT

TO Chief, North Atlantic Fishery Investigations
Woods Hole, Massachusetts

DATE: March 12, 1957

FROM Editor, The Progressive Fish-Culturist

SUBJECT: Manuscript, "The Maintenance of Immature Sea Herring in Captivity"
by A. E. Farrin, L. W. Scattergood, and C. J. Sindermann

We have examined with much interest this description of
of the technique used for holding immature sea herring. We are
placing the material in line for publication when other commitments
permit.

W. F. Carbine

Original sent to Mr. Scattergood

Office Memorandum • UNITED STATES GOVERNMENT

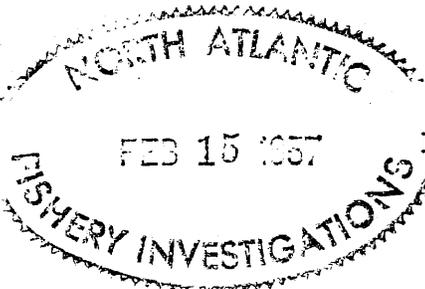
TO : Chief, North Atlantic Fishery Investigations
Woods Hole, Massachusetts

DATE: February 14, 1957

FROM : Project Leader, Atlantic Herring Investigations
Boothbay Harbor, Maine

SUBJECT: Ms. The Maintenance of Immature Sea Herring in Captivity

Enclosed are the original and three copies of the above manuscript by Farrin, Scattergood, and Sindermann. We have written it for Progressive Fish Culturist. Two photographs are to accompany it; these will be sent down soon.



L.W.S.

Leslie W. Scattergood

Encs.

Project Leader, Atlantic Herring Investigations
Boothbay Harbor, Maine

February 18, 1957

Chief, North Atlantic Fishery Investigations, Woods Hole, Massachusetts

Manuscript: The Maintenance of Immature Sea Herring in Captivity, by Farrin,
Scattergood and Sindermann

This will acknowledge receipt of subject manuscript. We will forward this
to Washington when we receive the photographs you are sending.

Herbert W. Graham

THE MAINTENANCE OF IMMATURE SEA HERRING IN CAPTIVITY

Alva E. Farrin, Leslie W. Scatbergood, and Carl J. Sindermann
U. S. Fish and Wildlife Service
Boothbay Harbor, Maine

Many marine fishes are notoriously difficult to maintain for long periods of time under aquarium conditions, even when running sea water is available. In this category has been the sea herring--an extremely fragile fish for experimental purposes. In the course of several years work with certain diseases and parasites of immature fish of this species, experiments with live herring in the sea water tanks of the Boothbay Harbor (Maine) Laboratory of the U. S. Fish and Wildlife Service have proved necessary and instructive. To carry on this work it has been vital to evolve a successful technique for holding fish for extended periods. We feel that some of the information gained may be of use to other marine fisheries investigations.

Our sea water tanks are of pine construction and of both circular and rectangular designs. The first tanks we used were rectangular, but a trial with circular ones clearly demonstrated that the latter were to be preferred, because they were about half as expensive, much tighter, more easily moved, and provided a better water circulation. We have four large rectangular tanks of approximately equal dimensions, about 11 feet in length, 3 feet in width, and $2\frac{1}{2}$ feet in depth. The water capacities range between 470 and 490 gallons. We have 16 small circular tanks, each with approximate diameters of $3\frac{1}{2}$ feet and depths of $2\frac{1}{2}$ feet. The capacities of the small tanks are between 100 and 110 gallons. There is also a large circular tank, $9\frac{1}{2}$ feet in diameter, 4 feet deep, and with a capacity of 1,590 gallons. Each rectangular tank has an upright drainpipe near one end; each circular tank has a drainpipe in the center.

Each tank is cleaned several times a year, at which time the fish are transferred to another tank, the inside tank surfaces are scrubbed and washed thoroughly with formalin and then given a coat of black asphalt paint. In this manner, marine borer damage is kept at a minimum.

In the initial efforts to hold live herring, we felt that perhaps freshly caught herring would adjust themselves more readily to captivity if they were kept in semi-darkness for several days; consequently, we equipped each tank with a hinged cover. However, these were later removed when we could see no noticeable difference in survival in covered or uncovered tanks. Since the tanks are inside the main laboratory building, they are never exposed to direct sunlight.

Salt water is supplied by a direct flow system utilizing a centrifugal pump. The rectangular and large circular tanks are each furnished with about ten gallons of water per minute, while the small circular tanks each have about five gallons per minute. All tanks are equipped with air stones connected to either 110-volt AC or 6-volt D.C. air pumps. The 110-volt system is of value when the laboratory's water-pumping system fails, and the 6-volt pump, which operates from a storage battery, is used during periods of complete electrical failure. With these air systems, we have kept herring alive for several days when the supply of salt water has failed.

Usually the herring are caught within several miles of the station. These fish, of either age groups 0 or 1, ranging in size from two to eight inches, are dipped with a bucket from a seine net into ten-gallon steel milk cans, which are equipped with an air supply in warmer weather. The fish are transported immediately to the laboratory by boat or car. About 20 to 50 fish are put into each can. Great care must be taken to avoid rough handling during capture and transport, or heavy mortalities will result. The herring are put into the large rectangular tanks which serve to hold the fish prior to their being used in experiments. Normally, about 200 to 500 fish, depending upon their sizes, are kept in these holding tanks. In the small circular tanks in which we maintain experiments, about 25 fish are held.

After experimenting with various foods, such as ground liver, live mysids, and cat food, we have selected ground sea mussels as the principal diet for herring. The raw mussel meats are removed from the shell, macerated in a Waring Blendor, then allowed to cool to near the freezing point before being fed. The resultant product is buoyant, palatable to the fish, and little is lost in solution. Not all the food is eaten by the herring, for they consume only floating particles; food dropping to the bottom is ignored. During the summer when the water temperature ranges ^{from} 16 to 18 degrees Centigrade, about 15 grams of food per fish is put in the tanks daily. In winter when the water temperature may drop to a level of 1 to 3 degrees Centigrade, the food is reduced about one-third. Satisfactory results have been obtained by feeding three times a day. An addition of yeast extract is included in the diet at present.

Certain ectoparasites have been noted on herring in the experimental tanks--the parasitic copepod Caligus rapax on the body surface, and the monogenetic trematode Gyrodactylus sp. on the gill bars/ and mucous membranes of the oral cavity, but these have not been definitely associated with increased mortality.

Bacteremias, with tail rot and sloughing of the skin as external symptoms, have been responsible for mortalities of experimental fish in the past. Terramycin, made available to us through the courtesy of Charles Pfizer and Company, has proven to be effective in reducing such bacterial infections. A dosage of 1.5 milligrams per gram of herring is added to one feeding daily immediately before it is made available to the fish. Other antibiotics and sulfas have been tested, and some, with the exception of sulfamethazine, have been found to be effective.

The methods described above provide survival and growth of immature herring under artificial conditions--so that after an initial transfer loss, the tank population is relatively stable for periods up to two years.