

XXXI.—NOTES ON EXPERIMENTS IN PENNING SHAD AND  
TAKING EGGS AT BATTERY STATION, HAVRE DE GRACE, MD.,  
IN 1883.

---

By FRANK N. CLARK.

---

May 12, arrived at station at 12 noon. Found about 1,000,000 eggs and some fish in jars. Lieutenant Low had just sent seine out; it came in about 1 o'clock. The fish were transferred to the penning basin as usual and handled as carefully as the circumstances would permit. At 7 o'clock in the evening the fish in the basin were hauled in and examined. On opening some of the females most advanced and those that had been confined in the basin for several days, I found nothing but "slough" and blighted eggs, showing that the treatment of the fish had been unfavorable to a normal development of the eggs. Whether the trouble was caused by the fish being injured by handling or on account of being penned, I was unable to determine.

May 13, outside seine hauled at 6 p. m. All the fish in basin were handled again to-day. Found one good, ripe fish; the eggs came up well and were a prime lot. Think this fish was placed in basin yesterday. Eggs from another fish that was apparently ripe, looked clear, but on taking them and adding milt they did not come up, and were afterwards thrown away.

May 14, eggs taken from basin last evening look well. Net was laid out at 11 a. m. and landed at 2 p. m. Only 6 shad taken; not being such as I wanted to experiment with, I turned them over to the men's mess.

May 15, eggs in jar taken from fish in basin on the 13th are in good condition; are better eggs than those taken same night from gilliers' boat. Noticed that some fish hatched from eggs taken previous to my arrival are not doing well in glass aquarium; seemed to be very feeble; think the eggs were not allowed sufficient volume and current of water to give normal development to the embryos. Seine put out at noon and taken in at 3 p. m. Put 8 females, nearly ripe, and 7 males in crate just outside of basin. Crate made of strips nailed to frame-work; strips placed  $1\frac{1}{2}$  inches apart, to allow water to flow freely through it; size, 16 feet long by 6 wide and 4 deep. Placed in the basin 8 females and 7 males from same catch and in apparently same condition as those in crate. With a view to giving fish in crate a better current of water the crate was towed 5 rods out and anchored.

May 17, eggs taken from female from basin on the 13th still looking well. Haul seine came in at 7 a. m. Put 16 females, nearly ripe, in the basin. Seine laid out at 3.30 p. m. and hauled in at 6 p. m. Caught 100 shad; one ripe female. Put 16 males and 11 females in crate.

May 18, eggs from basin, taken the 13th, are in excellent shape, 90 per cent good. Examined fish in crate at noon; they are doing well. Examined them again at 6 p. m.; still looking well. Seine was not hauled to-day. Of a few eggs taken from a shad after it had been dressed, about 10 per cent came up and were in good condition.

May 19, eggs in jar from fish from basin have begun to hatch. These are the first from the penned fish. The form of the fish is visible in some of the eggs taken yesterday from a dressed shad. Temperature at 2 p. m. of water in basin at north end, 69° F.; near east gate, 67°; at end of west pier, 66°. At 2 p. m. seine was hauled in basin, the fish handled very carefully, and 11 females, hard, returned; 15 males and 2 females were found ripe—1 with rotten eggs and the other with a portion of her eggs blighted and some of them looking fairly well, but on adding milt or water they did not come up. Fish in crate were overhauled at 2.30 p. m. Found 7 dead females nearly eaten up by eels; 3 were alive, but quite badly laden with fungus; eels had been at them. Males looking fairly. The 3 females that were alive were brought ashore and cut open. In 2 the spawn looked normal; in the other it did not. The 2 that were apparently all right would not have spawned, probably, for a week or longer. In the evening a female shad brought in by the gillers, out of water one hour, was used with a male from the crate and a good percentage of impregnation obtained. Later in the evening 2 females that had been caught one and one-half hours were stripped and the eggs, fertilized with a live milter from the crate, looked very well.

May 20, 3 live males still in the crate. Eggs taken yesterday from fish caught one and one-half hours are looking well. No eggs taken to-day. Two degrees difference in temperature of water at warmest place in basin and west end pier, 69° and 67°.

May 21, males in crate still alive. Seine hauled; landed at 8 p. m. Placed 3 females, nearly ripe, and 8 males in a large tank and gave them a constant supply of fresh water from the pump. At 10 p. m. the females were all dead, but the males were doing well.

May 22, 2 of the males in tank in poor condition this morning. Took them all out at noon; experiment of holding them in tanks a failure. One male left in crate. Divided the basin into two sections by placing a net across from north side of east gate to north side of west gate.

May 23, seine hauled; taken through gate into basin without handling the fish. Do not know how many fish were caught.

May 25, seine was not put out to-day. At 6 p. m. a haul of 32 fish was made in basin; these were from the lot hauled into basin through

gate on the 23d. Of this lot 17 females; hard, and 5 males were returned to the basin. Six females were found ripe; from 1 of these 35,000 good eggs were taken; from the others nothing but rotten eggs.

May 26, seine hauled; landed at 10.30. Found one spent shad, the first of the season. Did not put any fish in the basin.

June 1, seine hauled at 5 p. m. Put 40 females in basin and 8 males in crate. Fish apparently in better condition than any hitherto reserved for penning. In the evening, took 35,000 eggs from female brought in from gillers' boat, dead one hour, and fertilized them with male from crate. Eggs very good, better than any of the 153,000 brought in same evening from gillers' boats.

June 2, seine hauled; landed at 5 p. m.; very poor haul; did not put any fish in basin, but placed 4 males in crate. In the evening, hauled seine in basin and caught 35 fish; found 6 ripe females, but no good eggs; transferred remainder of fish to boat filled with water, and then taken across line of net extending from gate to gate and overturned, releasing fish in channel.

June 5, seine laid out early this morning; landed at 7.30 a. m. Caught 31 shad; put 7 males in crate and turned remainder of fish over to the men's mess. Lieutenant Low left the station to-day. Seine hauled at 8.30 p. m.; caught 51 shad, 8 ripe; took 200,000 eggs. Sent four men out to work the gillers' boats; they took 160,000 eggs; also brought in 4 female shad, from which 100,000 good eggs were obtained after fish had been dead one hour, using live males from the crate.

June 6, seine laid out at 7 p. m.; landed at 10 p. m. Caught 15 shad, 7 ripe; took 100,000 eggs from five, in the usual manner; took eggs from the other two, and fertilized by cutting open two males and emptying contents of milt sac into a pan, diluting with water, and pouring the mixture over the eggs. About 50 per cent of the eggs came up nicely. The males had been stripped in the usual manner a short time before being opened. Caught about 1,000 catfish in the seine. Had a boat fitted up for the purpose of carrying live fish to and from gillers' grounds; more especially for towing males out to the men working the gillers' boats, a great scarcity of milts being reported. Boat arranged with holes through sides, covered with netting; top of boat covered partly with boards and remaining portion with pieces of seine. In the evening 5 fish were placed in the boat and towed to the gillers near Havre de Grace light. These fish were supposed to be males, but three proved to be female shad. Seventy-five thousand eggs were taken from 3 ripe shad, using the 2 males towed out; these eggs were the best taken to-day. There were 20,000 taken this evening from other sources, making 195,000 for the day. Making arrangements for putting in a pound-net. Went out this afternoon to drive stakes, but tide was so low could not work launch.

June 7, wind blowing too hard this morning to drive stakes for

pound-net. Seine laid out at 7 a. m.; landed at 9.30. Caught 7 shad, none ripe, and great numbers of catfish. Put 2 male shad in crate and 5 females in basin. Eggs impregnated yesterday by cutting open the milters, all dead. Heavy storm about 4.30 p. m.; water very turbid. Did not lay out large seine this afternoon. Hauled seine in basin; caught 7 shad, 1 ripe; used male out of crate and got 30,000 good eggs. The female from which these eggs were obtained was one of the lot of 5 placed in the basin this morning. The 6 hard fish were returned to the basin. In the evening sent launch up towards Havre de Grace to see if gillers were out; only two out; one caught 1 shad and the other none. Wind blowing strong all day; muddy water first appeared outside of basin at 1 p. m.; inside of basin, seven hours later, 8 p. m., showing very conclusively that there is not a good change of water inside.

June 8, laid out large seine at 8.30; hauled in at 11 a. m.; caught 3 large rock, 600 pounds catfish, and 12 shad. Catfish turned over to men's mess; 1 spent shad salted; 10 female shad placed in the basin and 1 male in the crate. Drove some pound-net stakes to-day. Did not haul large seine in the evening, as men did not get back from gillers in time; there were 50,000 eggs taken from gillers' boats. Two men sent out with gill-net; caught 1 female shad.

June 9, laid out large seine at 9 a. m.; returned at 11.30 a. m. Caught 9 female shad, 2 of them spent; placed the 7 hard shad in basin; caught 400 pounds catfish and 1 bass; turned over to men's mess. No gillers out. No eggs taken to-day. Had 4 men at work setting pound stakes.

June 10, warmest day of season; temperature 87°; of water in jars 83°; water in basin, near inlet pipe to pump, 85°. Heavy shower at 9 p. m.

June 11, seine laid out at 9.45 a. m.; landed at noon. Caught a few catfish and 6 female shad; 1 was ripe, 1 spent, and 4 turned into the basin. About noon a strong breeze sprang up from WNW. and by 3 p. m. was blowing a gale. No gillers out and no eggs taken.

June 12, sent men out to lift pound-net and straighten stakes. Caught some fish offal, but no shad. Hauled in large seine at 1 p. m. Caught 2 unripe female shad, and 1 male shad; placed the former in basin and the latter in crate. At 7 p. m. hauled seine in basin and caught 30 shad; 9 females ripe, but eggs were rotten.

June 13, landed seine at 1.30 a. m.; caught 3 shad; 1 ripe but eggs rotten, 1 hard, and 1 male. Seine laid out again at 11 a. m., and landed at 1.45 p. m.; caught some catfish, perch, and 1 spent shad.

June 14, very low tide; could not lay seine in consequence.

June 15, laid seine at 12.30 a. m., landed at 4 a. m. Caught 3 shad and a number of rockfish. Two of the shad were males and 1 a female, with worthless eggs. Hauled in seine again at 3.30 p. m. Caught some

catfish and rockfish but no shad. Current down river so strong had to lay seine in NE. direction from battery on flood tide.

June 16, landed seine at 4.30 p. m. Some rock and catfish but no shad. Had to lay seine in NE. direction from battery, on high tide, on account of strong current. Wind SE. veering to SW. later, with slight rain.

June 18, seine hauled in at 6 p. m. Some rock and catfish, and 2 shad, 1 spent and 1 hard. Took up pound-net to day.

June 19, seine brought in at 10 a. m. Seine badly rolled on account of grass and no fish caught. Spread seine out on grass to dry. Ropes and quarter-chains stretched on buildings for same purpose. Woodram's men working on apron in basin. Pound-net placed in store-room.

June 20, temporary force discharged.

June 21, seine stored in SW. room of men's quarters in hatching house.

In all, several hundred shad were placed in the basin. Good eggs were taken from only 3 fish, and these had been held not more than forty-eight hours, being so far advanced when caught that the conditions of confinement could have had little or no effect on the eggs, even if such conditions were adverse to a normal development of immature spawn. The results of the experiments, though negative, should not, however, be regarded as decisive, as the circumstances were not such as to insure a healthy condition of the fish, on which the normal development of the eggs must largely depend. It is very evident that there was an insufficient current or change of water throughout the basin, except between the gates. The fact that turbid water outside the basin did not find its way inside for nearly eight hours leaves no room for doubt on this point. This difficulty, however, can be largely overcome by providing additional openings, through the north pier, thus allowing free entrance and exit to the tide currents, both ebb and flow. An arm extending from each opening will divert to the basin the currents deflected by the apex of the pier. It would also be well to divide the basin into four sections, by laying seines between the east and west pier; one for the males and three for females of different stages of advancement. The apron extending from the southwest gate to the north pier provides an easy landing for the seine hauls from each section. By this arrangement unnecessary handling or disturbance of the fish least advanced can be avoided.

The experiments show very conclusively that female shad are extremely sensitive to the least interference with nature's methods of reproduction; and that under certain circumstances such interference results in impairment of that function. Very different results, however, may be obtained under more favorable circumstances. There is still considerable room for experiment in this direction. But should all efforts to hold female shad in confinement with a view to saving their

eggs prove futile, thousands of eggs that would otherwise be lost can be saved from the gilliers' boats and the haul seine, simply by holding a reserve stock of males in the basin and towing them in a crate or car to the gilliers' grounds, or by bringing the females to the basin, either of which methods is entirely practicable. The location and facilities of the station are all that could be desired for this purpose, and there is invariably a scarcity of male fish from about the 25th of May to the close of the season.

*Record of shad-hatching operations conducted by Frank N. Clark, at Havre de Grace, Md., under the direction of the United States Fish Commission, from June 4 to June 11, 1883.*

Date of receiving eggs.	Date of hatching eggs.	Number of eggs obtained.	Condition of eggs obtained.	Number of fish hatched.	Per cent of eggs hatched.	Disposition of the fry.
1883.	1883.					
June 4, 11 p. m.	June 7	100,000	Poor	47,000	47	To H. E. Quinn.
June 4, 11 p. m.	June 7	100,000	Good	85,000	85	Do.
June 4, 11 p. m.	June 7	90,500	Good	70,000	77½	To H. E. Quinn.
June 4, 11 p. m.	June 7	85,000	Good	68,000	80	Planted in bay.
June 4, 11 p. m.	June 7	30,000	All died			
June 5, 9 p. m.	June 8	95,000	Good	80,000	84½	Planted in bay.
June 5, 11 p. m.	June 8	86,000	Good	65,000	75½	
June 5, 11 p. m.	June 8	95,000	Good	77,000	81½	Planted in bay.
June 5, 11 p. m.	June 8	42,000	Fair	25,000	59½	To H. E. Quinn.
June 5, 11 p. m.	June 8	26,000	Good	20,000	76½	Do.
June 5, 9 p. m.	June 8	92,000	Good	80,000	86½	Planted in bay.
June 6, 10 p. m.	June 8	93,500	Fair	55,500	59½	
June 6, 10.30 p. m.	June 8	101,000	Poor	60,000	59½	
June 7, 8 p. m.	June 8	30,000	Good	20,000	66½	
June 8, 10.30 p. m.	June 11	30,000	Poor	16,000	53½	Planted in bay.