

wharf in this city 226,721 shad, while in 1868 Mr. John Gibson sent alone from Stony Point and High Point 219,205, nearly as many shad as all the fishermen on the Potomac sent to the wharf the present season.

At that time all the following shores were fished: On the Maryland side: Tent Landing, Moxley's Point, Bryan's Point, Greenway, Gut Landing, Pamunkey Point, Chapman's Point, Stump Neck, Budd's Ferry, and Goose Bay. On the Virginia side: Ferry Landing, White House, Stony Point, High Point, Marshall Hall, Freestone Point, Cock-Pit Point, Opossum Nose, Mr. Hoes', The Clifton, Arkendale, The Gums, Tumps, Windmill Point, and Caywood's, besides a host of smaller shores not mentioned. Some of the large fisheries were leased and rented for large sums annually, as the following will show. The shores on the Maryland side, ranged in price per annum from \$500 to \$1,000, while those on the Virginia side ranged still higher, Stony Point renting annually for a number of years for \$2,500, Freestone Point from \$1,300 to \$3,500, White House from \$1,000 to \$2,000, and other shores in proportion. At present but few of the large shores are fished, owing to the scarcity of fish.

No one cares to assume the risk incurred, while those which are fished are at very low rents, and many of them conditionally, the owners not caring to have their shores remain idle.

NANTICOKE RIVER.—E. L. Martin writes:

"We are just feeling the beneficial effects of the shad deposited by you in the Nanticoke. I am informed by old fishermen that notwithstanding the backward and unfavorable spring, there have been more shad taken from the Nanticoke than for many years. I have never seen larger or better ones.

SEAFORD, DEL., May 1, 1884.

SACRAMENTO RIVER.—The Havre de Grace Republican says:

"We learn from Commander Frederick Rodgers, U. S. N., now stationed at Mare Island, California, that shad are now being caught in large quantities in San Francisco Bay and other waters of California. There were no shad there until they were introduced by the United States Fish Commission several years ago, thus proving beyond a doubt the good results of their labors."

170.—MEMORANDA ON LANDLOCKED SALMON.

By CHARLES G. ATKINS.

A.—SYSTEMATIC POSITION.—There have been thought to be several distinct species, or at least several naturalists finding landlocked salmon in this or that district have thought them new species and have called them *Salmo sebago*, *S. gloveri*, &c. Within a few years Dr. Bean and others in Washington have carefully compared them with *S. salar*, and find no specific difference.

The difference in size is commonly very great, landlocked salmon in

general being but one-fourth or one-fifth the size of the river or sea salmon. There are also differences in color. Landlocked salmon never in the breeding season assume so bright colors as male river or sea salmon. Aside from these unimportant differences may be mentioned as more important the difference in habits, landlocked salmon not going to the sea, as a rule, though it is likely that it sometimes has occurred to stray individuals to descend the Saint Croix or Presumpscot to the sea. They find their normal sea in the lakes. Also it may be noted that though in maturity the landlocked salmon are smaller, in embryonic stages they are larger, the eggs being perhaps 10 per cent greater in diameter.

Another interesting point of comparison is the retention of the embryonic markings to a much greater age by landlocked salmon than by river salmon. I have seen a Sebago salmon 13 inches long with the dark bars on the sides still very distinct, and in removing the skin of adult landlocked salmon, I have found the marks still distinct on the under side of the skin and on the membrane that still covered the flesh, as though the restriction of the landlocked salmon to fresh water had stopped its development, keeping it still in a somewhat embryonic stage.

B.—RANGE.—FOUR DISTRICTS IN MAINE, viz.:

1. Basin of Presumpscot River (Lake Sebago, &c.).
2. Basin of Sebec River, a branch of the Penobscot. These salmon are not known to be found in other parts of the Penobscot Basin. It is singular that they have not spread all through the Penobscot, as it has many lakes seemingly well suited to them.
3. Basin of Union River, Hancock County.
4. Basin of Saint Croix River.

The fish of the Presumpscot and Saint Croix had earlier a wider range than the others, and in both rivers were occasionally caught almost down to tide-water. Within twelve years I have seen two that were taken at Cumberland Mills on the Presumpscot.

C.—SIZE OF ADULTS.—This varies much. The Sebago fish often reach 8 and 10 pounds, and sometimes 15. Saint Croix (or Schoodic, as we commonly call them) salmon rarely exceed 6 pounds, and average 2½. They are larger in some parts of the Schoodic Lakes than others, but these differences are not constant. For instance, in 1875, those caught at Dobsis were nearly twice as large as those of Grand Lake Stream, but the latter have increased in size year after year, until now they are about the same size as the Dobsis fish. The Union River fish are large, about like the Sebago salmon; the Sebec fish are about like the Schoodic in size.

There are local differences recognizable to one acquainted with the different varieties, but hardly to be described. One interesting point of difference between Schoodic and Sebec fish is this: Sebec fish mature at a smaller size than the Schoodic,* and, while still small, frequent the

* Later researches indicate that this is true only in comparison with the fish of Grand Lake. In some of the other Schoodic lakes we find fish that mature when of small size.

same grounds with the large fish. Sebec salmon, apparently mature, having lost the red spots and dark bars, may be taken on the same day, all the way from 8 inches up to 2 feet in length, but of Schoodic salmon, as taken at Grand Lake Stream, I have never seen a mature fish which was less than 12 inches long, very few are less than 15, and never one that had lost bars and red spots was less than 11; and these small fish, as well as the smaller ones with bars and spots (8 or 9 inches long), are rarely found with the larger fish.

D.—GRAND LAKE STREAM.—This is the headquarters of the variety of the Schoodic Lakes. That is, to no other stream do so many salmon resort to spawn; and in no other lake do so many find their home as in Grand Lake. After the prevailing backwoods system of nomenclature, the stream that flows out of Grand Lake is called Grand Lake Stream. Here, as in many other instances that I know of, the salmon move down from the lake into its outlet at the spawning season instead of up into the tributaries. It follows that the young fish, instead of dropping down with the current as young sea salmon do, are in the habit of ascending their native streams till they reach deep water above.

Grand Lake is one of the finest sheets of water in Maine, with clean, wooded shores, and very clear water. Grand Lake Stream is a bright, dancing stream, 3 miles long, with quick water almost every rod, and abundant spawning grounds.

E.—THE BREEDING OPERATIONS.—For eight years we have been conducting almost the entire business of spawning for the fish. Our traps span the stream at the outlet of the lake. No fish now get past us except by accident. With fine-meshed nets we build a series of inclosures. Those which the fish first enter are on the principle of a weir or pound, and few fish ever get out against our will. They come in mostly by night. Every morning we count our catch and sort them, taking spawn from all that are ready. The earliest fish begin to spawn in the stream before the end of October; we begin to take eggs a few days later, from the 4th to the 8th of November. Many of the females have to be kept some days before they are ripe. (Not so with the Penobscot fish—sea salmon—which are generally all ripe together, and some days earlier than the Schoodic.) The yield averages 1,600 eggs per female. We commonly catch four females to three males. The males come in earlier in the season. The first run is nearly all males; the last, nearly all females. The ripe fish continue to come in until November 20; sometimes not all are manipulated till December. Often there is severely cold weather during the spawning season. We operate under cover of a roof. Sometimes ice shuts us off from communication with the lake; but if not, we take the fish we have manipulated in cars and tow them 1 or 2 miles up the lake, where they are set free. One-fourth of the spawn taken is hatched here and the fry let loose in Grand Lake, to avoid exhausting the supply. There has been no falling off as yet. The fry are planted along the shore scatteringly where there are loose, rough rocks for them to hide under.

We have three spawn houses, or rather one developing house (exclusively so) and two hatching houses. The developing house is fed with lake water. Its location compels us to vacate it in March, but the long stay of the eggs in the cold lake water keeps development back, so that none are hatched and grown enough for planting until June, when their natural food has become abundant.

Our best hatching house stands on the lake shore and is a very substantial structure, partly under ground, with massive stone walls; it has capacity for developing 4,000,000 eggs or hatching 1,000,000. Troughs are arranged on six floors, and water runs through the series, so that it can be used at least three times, with ample facilities for aeration. We pass water from one trough to another by letting it fall in a broad, thin sheet over the side of the trough. This is very effectual, and young hatched in this house are exceedingly vigorous. The above hatching house covers 1,500 square feet of ground. We have also a neat little cottage for the superintendent, a lodge for the foreman, an ice-house, and a wood-house, all in convenient proximity.

Our method of manipulating fish is perhaps common. We use the "dry method" wholly. Ten-quart tin milk-pans receive the spawn and milt. The fish are used just as the "dipper" hands them up, male or female first, as may chance. After the eggs of four or five fish are taken and well milted another hand takes them, agitates them diligently for a few minutes, and then washes them off at once, after which they stand in pans on shelves till it is convenient to carry them to the hatching house. Careful observation has shown that impregnation is instantaneous upon contact of milt, and all agitation and waiting is merely to secure contact. Milt in pure water loses spawn in a few seconds, retaining scarcely any power after one minute. Eggs likewise soon lose their capacity for impregnation if put into water; but a little water does no appreciable harm within a few minutes. Either eggs or milt can be exposed to air for hours without losing power. The mucus that comes with the eggs from the fish does not act on milt or eggs like pure water; milt in it retains its power for hours. If males are scarce we strain out the milted liquid from a spawn pan and use it again. In a can standing in water I have kept it forty-eight hours and then used this mixed mucus and milt effectively.

Three-quarters of our eggs are shipped away. The owners are Maine, Massachusetts, Connecticut, and the United States. We pack in sphagnum moss, wet to imbed the eggs, and dry to surround this mass. Surrounded by 3-inches dry moss they go on a sled, in the morning, with the temperature 10 to 15 degrees below zero, 28 miles (taking the whole forenoon), without the frost penetrating to them. The eggs are ready to pack as soon as the eyes become black. We send all off from January to March. What we keep hatch in May and are set free in June.

BUCKSPORT, ME., *February 15, 1883.*