XVI.—REPORT ON OVERLAND TRIP TO CALIFORNIA WITH LIVING FISHES, 1879.

By Livingston Stone.

Hon. Spencer F. Baird,

United States Commissioner of Fish and Fisheries:

Sir: I have the honor to report as follows:

In compliance with the request of the California fish commissioners to bring lobsters, striped bass, eels, and black bass to California, I began preparations on the 27th of March, 1879, for an overland trip with the above-mentioned varieties of fish.

It will be observed that two of these fishes are salt-water species. Now, a double difficulty attends the transportation of fishes inhabiting salt water. In the first place, ocean water becomes foul when confined in tanks, and in the second place it is incapable of being kept cold *en route* by the introduction of ice, which, of course, would freshen the water to a fatal degree. I will take up by itself the first difficulty, viz, that of the ocean water becoming foul *en route*.

It is well known that ocean water contains an infinite number of microscopic insects commonly called by the general term animalculæ. It is equally true, though not so well known, that these animalculæ are the cause of the fouling of ocean water when confined in tanks.

I have found but two ways of getting rid of this insect life in the water without spoiling the water. One way is to boil the water. This effectually destroys the animal life in it, but it also initiates a series of chemical changes, the result of which is that it precipitates a reddish-brown substance and daily loses more and more of its natural saltness, either of which circumstances would unfit it for sustaining the life of salt-water fishes. This puts boiled ocean water out of the question altogether.

The other way to get rid of the animalculæ in the water is to let it stand two or three weeks, covered and perfectly still. At the end of that time the microscopic creatures will be found at the bottom of the tanks in the form of a deposit of slime. The water above will be perfectly sweet and clear, and will remain so indefinitely.

After trying both ways of clarifying the ocean water I adopted the latter method of letting it stand, and put nearly a thousand gallons in process of preparation. Much of this was spoiled from having been put in casks not absolutely clean, and from other causes, but there was

enough left of good water when the expedition started to furnish an abundant supply for the journey.

The necessary supply of ocean water having been arranged for, I next proceeded to secure the striped bass, and with this end in view I wrote to Mr. Eugene Blackford on the subject, and was met by him with a spirit of cordial co-operation. At his suggestion I engaged Mr. Fred. Mather to take charge of getting the bass. I went to New York and saw Mr. Mather, and was informed by him that six-inch bass could be obtained, but none smaller. I told Mr. Mather to go on and get a supply of that size to take to California, and he made arrangements for doing so; but about a week after I received a letter from Mr. Throckmorton containing explicit directions to take only very small bass, and to go in search of them myself. I immediately went to New York a second time, and from there to the Neversink River, New Jersey, and found the place where the young bass could be procured. After making such preliminary arrangements as could be made at that time, I returned to Boston to give my attention to procuring the lobsters and eels. For the remainder of the work of getting the striped bass I refer you to the very excellent report, herewith appended, of Mr. H. W. Mason, who afterwards procured the bass from the Neversink River and accompanied the expedition to California.

I must add here that it being the close season for striped bass in New Jersey, I applied to the fish commission of that State for permission to catch bass in the Neversink, and immediately received the following permit, accompanied by a very cordial personal letter from Mr. Anderson, expressing great interest in the expedition and conveying his best wishes for its success.

[Commissioners: Benj. P. Howell, Woodbury; E. J. Anderson, Trenton; Theo. Morford, Newton.]

STATE OF NEW JERSEY COMMISSIONERS OF FISHERIES,
Trenton, May 21, 1879.

Mr. Livingston Stone, United States deputy fish commissioner, is hereby granted permission to take striped bass from the Neversink River for the purpose of transferring them to the Pacific coast. This authority extends to any of the accredited agents of Mr. Stone, and includes fishing in any manner that he or they may see fit, notwithstanding anything to the contrary in the laws of this State regulating the times and modes of taking fish.

E. J. ANDERSON,
Commissioner of Fisheries of New Jersey.

On arriving at Boston, I at once applied to Mr. S. M. Johnson and Mr. J. R. Johnson of the firm of Johnson & Young, lobster dealers, Warren Bridge, Boston, whose co-operation I had found on several similar occasions of the greatest value, and I take this opportunity to say that from first to last these gentlemen were untiring in their efforts to assist

in making this enterprise a success, and they are entitled to a large share of whatever credit there may be in introducing lobsters for the first time into the Pacific Ocean.

The first difficulty to be encountered, viz, the tendency of the ocean water to become foul in the tanks *en route*, was overcome, as above mentioned, by letting the water stand long enough to clear itself of animal life.

The second difficulty of keeping the water cold in the tanks without introducing ice into it, I resolved to meet by using a variety of coolers formed by the mixture of melting ice and salt. I tried three methods of using the freezing mixtures: (1.) Putting the ice and salt in large stone jugs and hanging the jugs in the tanks; (2.) The regular ice-cream-freezer plan of putting the freezing mixture in a vessel surrounding another vessel containing the water to be cooled; (3.) Filling a large earthen drain-tile with the freezing mixture and keeping it in a reserve tank of water from which the water, when cool enough, could be exchanged with the warmer water in the lobster tanks.

All three varieties worked very well, and were employed for nearly the whole trip, the ice-cream-freezer method, however, being found to work the best in actual practice.

After completing my preparatory arrangements for the care of the lobsters in transit, I procured some lobsters of Messrs. Johnson, and in order to test the efficacy of my plans I subjected the lobsters for a fortnight, as nearly as practicable, to the very conditions which they would encounter on the journey, and for this purpose I kept men watching them and dipping the water in the tanks every fifteen minutes, night and day, for fourteen days. The result was very encouraging, and gave strong hopes that the lobsters would reach the Pacific Ocean alive.

For the eels I am indebted to the courtesy of Mr. Seth Green, who procured 3,000 from the Hudson River and delivered them at the Albany depot, charging for them only the cost of getting them and delivering them. They were brought to the depot by Mr. E. L. Marks, to whom our acknowledgments are due for the valuable assistance rendered by him in loading our freight into the New York Central train on the night of the 12th of June. Besides these eels, we took five or six hundred which Mr. Mason brought with him from New Jersey.

I ought here to mention that Captain Vinal Edwards, of Wood's Holl, Mass., very kindly consented at my request to furnish eels for the expedition or to assist in any way he could, but owing to the eels being otherwise provided for, Captain Edwards was not called upon to supply them.

The black bass were furnished by Messrs. Stone & Hooper, of the Cold Spring trout-ponds, Charlestown, N. H.

It was intended to also take scallops and carp, but scallops were out of season and could not be found, and Professor Baird, who was to furnish the carp, concluded to send them at a more convenient time of the year.

All the preparations having been completed, the railroad companies *en route* having been informed of the expedition, and all the parties in charge of fish having been notified by telegraph when to rendezvous at Albany, the expedition started on the 12th of June.

Mr. Mason left Red Bank, N. J., with the striped bass and eels at noon. Mr. Finnigan left Charlestown, N. H., with the black bass at 2 p. m. The writer left Boston, Mass., with lobsters, at 6 p. m., and Mr. Marks left Troy, N. Y., with the eels in season to meet the others at midnight at Albany. After leaving Albany the expedition consisted of Mr. H. W. Mason, of Newton, Mass., Mr. James Finnigan, of Charlestown, N. H., and myself.

On the way from Boston to Springfield with the lobsters I was very materially assisted by Mr. Marshall L. Perrin, of Cambridge, Mass., who voluntarily accompanied me as far as Springfield, and worked with great diligence over the lobsters, which required special attention owing to the fact that 40,000 young lobsters had hatched out in one of the tanks on the way to the Boston and Albany depot in Boston.

The start from Albany was very favorable. The tanks, though very heavy, were loaded on the train all right, the fish were in excellent order, the railroad men were courteous and everything was propitious.

I had, however, no hope of getting all four varieties of fish to California alive. It is obvious to any one that it must be almost impossible to keep fish alive for seven days and nights crowded together in small tanks. Even with the best of care and luck the task is made doubly hazardous on account of the thousand chances of accidental injury which may befall them during a week's journey in the cars. The difficulty becomes more apparent when it is remembered that the aeration of the water must be incessant from the time the fish leave one ocean till they reach the other. If the aeration is forgotten or neglected, though only for a moment or two beyond the limit of safety, the fish are certain to die. With all these contingencies in my mind, I think no one will be surprised that I did not expect to get all the kinds of fish through alive. I thought there was a fair chance of getting two varieties, a very small chance of accomplishing the journey with three varieties, and not one chance in a hundred of getting all four kinds safely over.

The start from Albany was nevertheless propitious and encouraging. We had with us three tanks of lobsters, three tanks of striped bass, two tanks of black bass, and two tanks of eels. The lobster tanks contained 22 female lobsters with over a million eggs nearly ready to hatch out. The striped-bass tanks contained 132 small bass, 3 or 4 inches long, and 30 larger bass, about 6 or 8 inches long. The eel tanks had between 3,000 and 4,000 eels in them. The black bass tanks contained 22 large bass. The tanks were heavy and difficult to lift, weighing about 300 pounds apiece.

Besides the tanks containing fish, there were two large freezing tanks, in which were kept the reserve of ocean water and a constantly renewed

freezing mixture to maintain the reserve at as low a temperature as possible. These weighed nearly 300 pounds apiece when full. We also had two five-gallon stone jugs, containing the freezing mixture, and a large supply of ice and salt, an assortment of dippers, hatchets, thermometers, and other small articles indispensable to a journey of this kind.

The main points about the care of the fish were: (1) to keep the temperature of the tanks just right all the time; (2) to keep the water constantly aerated; (3) at every change of cars to make the transfer from one train to another without injury to the fish and in season to take the connecting train.

We left Albany about midnight. The tanks having been put in place for the run to Buffalo, the freezing mixture having been renewed, and the temperature of each tank regulated, Mr. Mason and the writer, about 3 a. m., found a chance for some rest, while Mr. Finnigan took care of the fish till morning. From that time till the end of the journey we arranged the different watches as well as we could to have the burden of the work fall as evenly on all as possible.

The next day we were all very diligently employed in taking care of the fish. Indeed the work of an expedition of this sort is unremitting. It took the whole waking time of all of us to keep the water aerated, the freezing mixture renewed, and the temperature of the various tanks at the proper point. When night came we were all in arrears in the matter of sleep, and I accordingly hired a passenger for $10 to help us through the night, one of our party remaining with him while the other two took some sleep.

I aimed to keep the lobsters at a temperature of between 46° and 55°, the striped bass between 55° and 65°, the eels between 55° and 62°, and the black bass between 40° and 50°. (See table of actual temperatures at close of report.)

It was easy enough to manage the temperatures of all the tanks except those containing the lobsters; but these gave us a good deal of trouble, because they could only be cooled by exchanging the water on the lobsters with the water in the coolers, and by using the stone jugs containing the freezing mixture. On very warm days it was extremely difficult to reduce the temperature in the lobster tanks as fast as the heat of the day raised it. With great pains, however, we succeeded in preventing it from rising high enough to do any mischief.

To keep the temperature of the black bass right it was only necessary to introduce ice as fast as the water became too warm. The temperature of the eel tanks required somewhat more attention, because they both became too warm in warm days and too cold on cold nights. To keep them right we had sometimes to introduce ice and sometimes warm water, which we heated with alcohol lamps, or, when there was one on the car, on the stove. The striped bass tanks were more like the eels in re-

gard to regulating the temperature, it being necessary at times to warm the water and at others to cool it.

I would here call attention to the fact mentioned in Mr. Mason's appended report that the striped bass seemed to do as well in artificial salt water made from sea salt and fresh water as in the salt or brackish water of their natural habitat. This fact very much simplified the carrying of the striped bass, as no reserve of natural salt water was needed for them, and in cooling the water in the freezers when the water in their tanks became too warm, it became only necessary in that emergency to introduce a sufficient quantity of ice water mixed with the proper proportion of sea salt.

On Saturday morning at eight o'clock we reached Chicago. Here we transferred to the Chicago, Burlington and Quincy Road, making the change of cars without accident and leaving Chicago at 10.15 a. m.

On examining the fish after leaving Chicago, we found twenty-five dead striped bass. I find it difficult to account for this disaster, although it was probably the result either of the temperature of their tanks getting too low the preceding night or of insufficient aeration, or both.

We crossed the Missisippi River at seven o'clock Saturday, throwing into the river, as I always have done before, a few fish for luck.

This day's experience was very much like that of the day before, except that the eels from the Hudson showed signs of languishing. Upon noticing the condition of the eels, I resolved to try an experiment with them which has often come to my mind, and which was also suggested by Mr. Marks at Albany.

The experiment consisted in placing a few hundred eels in a bucket containing a piece of grass sod. *It proved to be a perfect success, and undoubtedly solves the problem of carrying eels over long distances.* The eels which were placed in a bucket containing the sod required no attention whatever, and arrived at their destination in perfect order. I venture to say that any number of eels could be safely sent in this manner from Albany to Sacramento by express without a messenger and without any care *en route* except that required to keep them right side up. If my conclusions are correct, the State of California can be abundantly stocked with eels in this way at a very small expense.

We arrived at Omaha on Sunday morning with all the fishes in excellent order. Owing to a telegram going astray, the Union Pacific Railroad authorities were not ready for us on the arrival of the Chicago, Burlington and Quincy train, and in the consequent confusion and difficulty of making the transfer, the black bass tanks must have been overlooked a few minutes too long, for on examining them after leaving Omaha we found seven dead ones. We also found one dead lobster. The lobster proved to be the one that had hatched its brood at Boston, and was undoubtedly not in condition to survive the journey.

We were also obliged to throw away the Hudson River tank of eels

to-day, there being no hope of their surviving the journey. Now that the new method of carrying eels has been discovered, I will not attempt to explain why these all died. I will only say that a large number of eels cannot be carried over four days in a tank containing pure, clear water.

No further mishap occurred during the journey. We passed the Laramie plains into the Rocky Mountains in safety, and on the morning of Tuesday, June 17, descended into the valley of Great Salt Lake, at Ogden, with lobsters, striped bass, black bass, and the remaining eels in splendid order.

We made the transfer to the Central Pacific Railroad at Ogden successfully, and renewed our anxious journey with lighter hearts and more hope of favorable results than we had dared to entertain in all the previous part of the journey. Cheered by the hope of getting the fish through alive, we redoubled our exertions and kept at work with the dippers *every minute aerating the water in the tanks night and day* till we reached Sacramento, June 12, at 10.30 a. m. Here we were met by Hon. B. B. Redding, secretary of the California fish commission, and many friends of the enterprise, and it was with great gratification that we showed them the lobsters, striped bass, eels, and black bass in perfect condition. No more trouble was encountered after this, and the fishes reached their various destinations safely. Some of the eels were placed in the Sacramento River and the remainder were left in Alameda Creek. The striped bass were placed in brackish water, in the Sacramento, near Martinez. The black bass were taken to San Mateo by Mr. Mason, and put into the Crystal Spring reservoir, in San Mateo County. The lobsters were carried to Oakland wharf by the writer, where they were met by a steamer chartered for the purpose, which took them to the Bonito light-house, under the shadow of which, in a sheltered bay a few miles outside the Golden Gate, I had the pleasure of placing them with my own hands—the first lobsters ever introduced into the Pacific Ocean. They were all in splendid order except one, and had with them over a million eggs nearly ready to hatch.

Thus terminated one of the most important and difficult expeditions ever attempted with living fishes. The dangers they had to encounter were innumerable. It seemed as if only a miracle could save them, but they escaped all their dangers, and the result was as gratifying as it was unexpected.

Before closing this report I wish to make my grateful acknowledgments to the railroad companies over whose roads we passed, viz, Boston and Albany, New York Central, Lake Shore and Michigan Southern, Chicago, Burlington and Quincy, Union Pacific, and Central Pacific, from all of whom the expedition received the utmost courtesy and the most thorough co-operation. Below will be found a table of the temperatures at which the fish were kept during the journey.

Table of temperatures.

	June 13.	June 14.		June 15.		June 16.		June 17.		June 18.
	12 p. m.	12 m.	12 p. m.	12 m.	12 p. m.	12 m.	12 p. m.	12 m.	12 p. m.	12 m.
	°	°	°	°	°	°	°	°	°	°
Lobsters	54	56	53	57	50	49	47	46	46	45
Striped bass	55	60	66	64	62	62	60	58	57	58
Black bass	44	45	43	50	42	40	42	43	40	43
Eels	56	58	55	59	60	60	58	56	57	57