

Roveray, all these inconveniences disappear; kept in basins, protected against all danger, the young fish, abundantly fed on live food, develop as well if not better than under natural conditions, without involving any serious expense for their food; and when the suitable moment has arrived, they can easily be transferred to the waters for which they are intended, without running the risk of losing many.

It is therefore greatly to be desired that the administration should abandon the use of very young fish for stocking rivers (as they are nearly all doomed soon after they have been placed in the river) and give the preference to fish ten or twelve months old, which, as is stated above, have yielded the most satisfactory results in England and Scotland.

Messrs. Lugin and du Roveray, convinced of the advantages of their system, propose, at their own expense, to stock a water-course which, being subjected to special supervision, will enable them to make an absolutely convincing experiment.

**52.—REPORT ON THE PISCICULTURAL ESTABLISHMENT OF
PIEDRA, ARAGON, SPAIN.***

By F. MUNTADAS.

All persons who devote themselves to practical pisciculture will remember the change of opinion which took place some years ago, owing to the weakness of many persons whose experiments proved failures. Our Acclimatization Society, however, has never allowed itself to be influenced by the "piscicultural malaria;" it has always stood firm and preserved its faith in the future; it well understood that the discovery of two fishermen of the Vosges Mountains could not become merely a subject of curiosity or pleasure. It is true that a large number of amateurs have taken a wrong road, but many others have followed the right road, and have made marked progress in the successful method of raising salmon.

From the moment that the question of raising large quantities of young fry and young trout was agitated, it became necessary to pay attention to many different circumstances, and not to forget the cost of raising fish; for the problem is to derive some profit from the new industry, and, according to Mr. Larbaletrier's expression, "to make money by pisciculture, and not pisciculture by money."

All the methods of artificial feeding are expensive and, what is worse, do not entirely answer the purpose; it therefore became necessary to find and use natural elements. In short, it became necessary to give the young trout what it needed.

* *Rapport sur l'établissement de pisciculture de Piedra, Aragon (Espagne)*. From *Bulletin mensuel de la Société nationale d'Acclimatation de France*, 4th series, Vol. IV, No. 8, August, 1887. Translated from the French by HERMAN JACOBSON.

I had read in the Treatise on Pisciculture, by our late colaborer, Mr. Carbonnier, that in places where the fresh-water shrimp (*Gammarus pulex*) is produced the raising of salmonoids was easy. I ransacked my waters for these precious crustaceans, and, having found them in considerable quantities in the sources and along the course of the Devil Rock Brook (*Peña del Diablo*), I went to work and had my first rearing basin constructed. It was a complete success, and I had the honor to report it to the Acclimatization Society, which rewarded me by one of its medals. My young fish swallowed the little shrimps with the greatest delight, and seemed to care very little for the coagulated blood which was given to them in accordance with the instructions of the majority of treatises on pisciculture.

Ever since my first season I have used nothing but small shrimps for feeding my young trout, which grew amazingly fast. This method was followed during the first eight months. Later they found in the large basins (besides myriads of small shrimps) tadpoles, gudgeons, and craw-fish, of which they are very fond, especially during the shedding period of these crustaceans. In a special compartment I tried chopped meat (mutton, rabbit, etc.); but when I found that the carnivorous trout did not develop any quicker than the ichthyophagous ones I fed all of them on fish and crustaceans.

The enemies of the young fish (water-snakes, water-ousels, water-rats, etc.) committed great ravages in my open-air basins; and, with a view to prevent these ravages, I had a basin constructed of cut stones, 10 meters (32.8 feet) long, 1 meter (3.28 feet) broad, and 50 centimeters (1.64 feet) deep. The whole was covered by a small house with windows protected by gratings and a very close net-work of wire both down and up the stream.

The experiment had a twofold interest, viz: On the one hand to keep away the enemies of the young fish, and on the other to prove the success of my method of feeding the young fish after the umbilical sac had been absorbed. This twofold object was attained, and I am enabled to state that not only was the loss smaller, but the young fish kept in this basin developed more rapidly than the others. When, in September, I transferred the young trout to more extensive waters, those which had come from the stone basin gained on the others in every respect.

In places where there is clear and cool water containing some lime, and where the fresh-water shrimp reproduces naturally, I have discovered the best method of raising salmonoids. It therefore gave me great pleasure to read that at the Gremaz establishment Messrs. Lugin and du Roveray had succeeded in solving the problem of raising young fish by the same means which I had employed here, and which I had described in the report which I had the honor to submit to the Acclimatization Society in July, 1872.

The closer we follow nature, the more certain we are of success. It may give an artificial pleasure to see a few young fish in a hatching-

basin and to watch the absorption of the umbilical bag; some of them may even be kept for some time on more or less expensive artificial food; but when it comes to pisciculture on a large scale, when the object in view is to stock large sheets of water, these means are insufficient.

I well remember a long conversation I had with Carbonnier. He told me in a firm and convincing manner that, as I had on my property at Piedra a water-course, which was always cool and limpid, and which had a considerable fall, I should abandon the Coste and all similar apparatus, and use the Jacobi box, placing it to half its height in the water (natural method), and, as I had large quantities of small shrimps, to give my fish small shrimps (natural food), and not think of any other food. I followed his advice, and my season of 1871-'72 was so remarkable that the Acclimatization Society rewarded me with the large gold medal at the public session of April, 1873.

From 1872 to 1874 I lived in France—two years lost to my pisciculture. On my return I had to begin over again; but as I felt sure of my method, I again set to work, and my establishment soon reached the high state of perfection which it had occupied prior to my visit to France.

The stone basin (mentioned already in my report for July, 1872) proved a great success. It produces on an average 1,200 trout every year, and the open-air basins contain young fish by the thousand, more or less, according to the zeal and the efforts of the various fishermen in whose charge they are. The food is always the same during the first two months, small shrimps assorted, furnished two or three times a day; later, small shrimps such as are gathered with small purse-net attached to the end of a stick, at the sources of brooks, and in the large basins; for these crustaceans multiply wherever the water of the Devil Rock Brook is found.

Although trout placed in rivers consume an enormous quantity of these small shrimps, a great many remain attached to cresses and other aquatic plants. The positively prodigious quantity of small shrimps in the lake, the sources of the brook, and the large basins has so far not allowed me to think of raising these crustaceans in the rivers, and saves the trouble of transferring the trout alternately from an exhausted river to one still containing many of these small shrimps.

Our young fish remain in one place from March till September, and they are fed two or three times a day, as their needs seem to require it; and it is a curious spectacle to see them in dense masses pursuing their living prey. The quantity of small shrimps given to the fish two or three times daily weighs 5 kilograms (about 11 pounds). Having carefully counted the number of shrimps contained in 5 grams (about one-sixth ounce), and found this number to be 672, the total quantity of shrimps fed to the fish in a single day is not less than 672,000, or 4,704,000 per week.

The importance of the fact that this food is furnished free of cost will easily be understood; and the circumstance that it is quickly distributed all over the basin renders it certain that all the young fish will get their share of food. One-third of the food is served to the trout in the stone-basin, where the trout of the season of 1886 may now be seen. Such is the result of confining the fish for sixteen months.

No sun, no vegetation, no hiding-places, no quiet retreats along the banks; and in spite of these conditions, which a theorist would consider disadvantageous, these trout measure 18 to 22 centimeters ($7\frac{1}{2}$ to $8\frac{1}{4}$ inches) in length. And to what is this owing? Simply to the abundance of food and the impossibility of finding hiding-places. The crustaceans are devoured as soon as they are put into the basin, as there is no place where they could hide. It would be hard to find yearling wild trout as strong and fat as those which have been confined in the basins ever since the umbilical bag has been consumed.

Since the month of October last, the piscicultural establishment of Piedra has been rented by the Government. At this time there may be seen in the raising-basin thousands of this year's trout which have already reached an average length of 7 centimeters ($2\frac{1}{4}$ inches). These basins swarm with crustaceans, and nevertheless the three daily rations are never omitted. If one asks the fishermen as to the harvest of small shrimps, they invariably answer: "The more we take, the more there seem to be."

If the Government will construct inclosed basins on the existing model, it might try to acclimatize exotic species without fear of hybridization, which is an important point.

Mr. Raveret-Wattel points out the way to restock the rivers, not only with young fish, but also with trout 8, 10, and 14 months old, as is done in Scotland with those called "yearlings." I entirely agree with Mr. Raveret-Wattel and the Scotch pisciculturists. If there is war, soldiers should be sent out, not babies; it is not the number which assures success, but the age and valor of the soldiers. Leaving this figure, which, however, shows the reason for employing "yearlings," I venture to assert that if this system gains ground, the old system of stocking rivers should also be abandoned at Piedra, and the new system introduced. There will be no lack of food for the "yearlings," for in digging out new ponds fed by the Devil Rock Brook it will be found that after two months they will be filled with cresses and other aquatic plants; and underneath these plants large numbers of small shrimps will be found, as has been the case in all the ponds which have been dug, where many millions of these small crustaceans are caught every year.

In some places where the water freezes, the reproduction of the crustaceans is possibly suspended for some time. I can not state this with absolute certainty, for I have not had occasion to make the necessary observations; but it seems to me that ice would not favor reproduction. In the lake and in the Devil Rock Brook the temperature, even

during the severest winter weather, never falls below 50°. This is really a spring temperature, and I have with my own eyes seen small shrimps reproducing in winter as well as during the other seasons of the year. I doubt whether there is any other place as highly favored by nature for raising salmonoids, and also cyprinoids (tench, barbel), and crawfish.

Where the small shrimp is not found and the water contains particles of lime, attempts should be made to introduce it and favor its reproduction.

53.—AMERICAN SILVER PERCH, OR CALICO BASS.

By GILBERT DUCLOS.*

M. Emile Bertrand has recently sent to the Fish Culture Establishment of the Zoological Garden of Acclimatization a number of American silver perch, or calico bass (*Pomoxys sparoides*), born in a pond belonging to him in the vicinity of Versailles.

The reproduction of this species in 1888 was very considerable, for not only the three-year-old fishes, but even those born in 1887 have yielded an enormous number of eggs from which young calico bass were developed. The three-year-old fish living in M. Bertrand's pond are now about $7\frac{1}{2}$ inches long and $2\frac{3}{4}$ inches deep. The first spawning fish were imported directly from America. M. Bertrand had 25 of them. On account of the fatigue of the voyage only two males and a number of females survived.

The spawning of the first year, 1887, yielded M. Bertrand more than 500 fry, some of which were given to various members of the Acclimatization Society; others were sold. The flesh of the calico bass strongly resembles that of our European perch (*Perca fluviatilis*). After the spawning of 1888 M. Bertrand estimated that he had many thousands of calico bass. At the time of spawning, more than a hundred nests have been observed which have been placed in water about 8 inches deep. Evidently this species loves heat. The spawning places most sought after for the nests were the stone steps descending into the pond. The water being shallow the steps receive the sun's rays, retaining the heat to the advantage of the fishes.

The adult fish does not fear the cold. M. Bertrand, desirous to learn whether the calico bass would thrive in impure waters, placed a number of the young in a little pool which received waters full of impurities, and of which the temperature rose to above 77 degrees Fahrenheit. In spite of these unfavorable conditions the calico bass have prospered and have increased rapidly. Individuals which were $\frac{1}{4}$ of an inch long in April, when they were placed in this pool, measured $3\frac{1}{4}$ inches in the following August.

*La Perche Argentée d'Amérique ou Calico Bass. From *Revue des Sciences Naturelles Appliquées* No. 1, January 5, 1889, p. 12. Translated by Dr. T. H. Bean.