THE LARGE-MOUTHED BLACK BASS IN UTAH.

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This excellent fish was first introduced into Utah September 8, 1890, when a carload of black bass, red-eyed perch, crappies, and sunfish (many of them spawners) was received from the Illinois River. About a fourth of these were put into the Weber River at Ogden and the remainder into Utah Lake. Of the lot planted in Utah Lake, 2,000 were large-mouthed black bass. Of those planted in the Weber River at Ogden little has been said or heard, but the Utah Lake fish have developed very satisfactorily. They were not allowed to be taken in any manner for three years after their introduction, and at the expiration of the legislative period of protection it was evident that the large-mouthed bass had increased very rapidly and grown to a fairly good size. A few were taken in the fall of 1893, the largest weighing 3 pounds, the average being about 1 pound. In 1894 they began to be taken regularly for domestic use and commercial purposes—about 30,000 pounds per annum being reported by the commercial fishermen and dealers—and, including those taken by sportsmen and others for family use, I believe I would be within conservative bounds in saying that Utah Lake has produced annually 40,000 pounds of Oswego bass since 1894, without taking into consideration those taken for propagating purposes in this and neighboring States. I am told that they are increasing rapidly and that there are many millions in the lake.

The annual growth of the largest specimens taken seems to be about 1 pound. The largest fish taken in 1895 weighed 4½ pounds. In 1896 the largest weighed 5¾ pounds and was about 18 inches long. In 1897 the heaviest fish taken weighed 6½ pounds and was about 19 inches in length. Not having had any experience with this fish before its introduction here, the larger sizes seem to me to grow extremely stocky, their length not appearing to be more than about twice their depth. This is no doubt a marked characteristic of the species where favorable conditions exist for its perfect growth and development.

This Utah lake, which has proven to be such an excellent nursery for the Oswego bass, is situated near the center of the State and has an area of about 200 square miles, with an average depth of 10 to 15 feet, and lies at an altitude of 4,499 feet above mean sea level. The surface temperature of the water during the summer months I estimate will range from 60 to 65° F. I have not learned of any extended temperature tests of the water having been made to determine the average temperature.

The lake has an approximate length of 20 miles north and south, with an average width of about 10 miles east and west, and is fed by a number of springs and mountain streams of varying size, with one of considerable volume, the Provo or Timpanogos River. The water running into the lake comes from streams draining from the Wasatch

range of mountains immediately on the eastern side of the lake, and in consequence the lake bottom on that side is of a mud or silt character from deposits of inflowing streams.

The lake is abundantly supplied with native common fishes, chub, mullet, some mountain herring (Williamson's whitefish), three or four varieties of sucker, and minnows, with, unfortunately, an ever-increasing supply of carp, introduced here in 1886. It is also fairly well stocked with a large-growing native trout which frequents the inflowing and connecting streams in April, May, and June to spawn, and which I believe is classified as "*Salmo mykiss virginalis*." In the early settlement of the State this grand fish was almost phenomenally abundant in the lake and connecting streams. It is authentically reported that as much as 3,700 pounds of it have been taken at a single haul with a seine not exceeding 200 yards long, with many individual specimens weighing 25 pounds each. We do not now find any of these trout so large, but some are taken weighing 15 pounds, and since the taking of trout and bass is confined by law to the usual method of angling or trolling with hook and line only, I hope to again see some of these native Utah Lake trout attain to their old-time size.

The rapid increase and growth of the large-mouthed bass in this lake are no doubt due to the abundant supply of the native common fish together with a varied supply of fresh-water crustacea upon which they prey, with a depth of water and with water vegetation suitable to their requirements. I believe that all the conditions favorable to the perfect growth and development of the Oswego bass exist naturally in this lake, especially after they have attained the first year's growth. I have noticed, however, that the fry for the first year do not grow so rapidly in this lake as in some other smaller bodies of water to which they have been transplanted from this lake. Of four or five thousand fry which I had taken before the spawning season of 1897 for distribution in different parts of the State, the very large majority were from 2½ to 4 inches in length only. These were no doubt hatched the previous season and could not have been less than six to eight months old.

In marked contrast to this apparently slow growth of the bass fry in Utah Lake the first year, in the Mount Nebo reservoir an almost phenomenal growth of the fry from the first planting was shown the first season. This reservoir is situated about 15 miles south of the lake, and was created by the construction of a masonry dam across Salt Creek at its exit from the Nephi Valley, through which it flows into Goshen Valley and thence finds its way into Utah Lake, or did so before being appropriated for irrigation purposes. This is a small sluggish stream of clear and slightly brackish water, averaging about 10 feet wide and well supplied with native minnows before the reservoir was created. This reservoir is about 5 miles long with an average width of ½ mile, and of varying depth from nothing to 15 feet in places, the water covering entirely new ground with the exception of the old creek channel. About the 1st of May, 1896, the parties controlling this reservoir made application for and received 90 large spawning bass and planted them here in this small body of water. These fish evidently began to spawn soon after being planted, for in about four months after the planting the place seemed to be alive with bass fry of very large size. It was estimated that there could not be less than 500,000 of these young fish. Having heard of this wonderful plant, I visited the site seven months after the plant was made, but unfortunately for my investigation a cold snap had partly frozen the pond over and driven the fish into the deep water so that I could not have an opportunity of making a personal estimate as to numbers. I was fortunate, however, in having a

close inspection of about 50,000 which had escaped through the dam gate and were penned in the channel immediately below. A dozen of the largest of these were taken with an improvised dip net. In contrast with the fry of the same or a greater age in Utah Lake, these had attained a superior growth of at least twice the length and ten times in weight. They would average 6 inches in length and weigh nearly ½ pound each, being very stocky. I can not account for this vast difference in the growth of the young bass the first year in these two places, unless it might be that in the new reservoir there are no large fish of other species to interfere with or disturb them; and the new ground perhaps furnished abundant food in the development of worms and other minute animal life exactly suited to their age and condition. I shall watch this reservoir plant with considerable interest to see how long the superior growth may continue.

Recognizing the superior adaptability of this splendid fish for the lakes and ponds of the lower valleys of this State, I recommended a legislative appropriation to stock these waters with large-mouthed bass, and the general assembly in March, 1897, appropriated a sum sufficient to stock all the suitable waters of the State. Arrangements were therefore made to catch the fish out of Utah Lake and place them in small ponds near the railway, preparatory to shipment to the various places of planting, and by May 4, 1897, enough had been taken to make a large carload, which was shipped on that date to Bear River and Bear Lake in the northern part of the State. This consignment consisted of 2,500 fish in all, 450 being large spawners averaging close to 2½ pounds each. Of this lot, 100 spawners and 600 yearling fry were deposited in Bear River at various points in Box Elder and Cache counties, and the remainder taken to Bear Lake and planted at a number of places on the eastern side of the lake embracing a range of about 25 miles in length. This beautiful sheet of water has approximately the same surface area and dimensions as Utah Lake, with the elongated axis north and south in a similar manner, and both lakes are flanked on three sides by majestic mountains. The southern and main part of Bear Lake has a beautiful sandy, gravelly, and rocky bottom and shores, with water as clear and limpid as glass, and attaining a depth of 250 feet in places, with the summer temperature on the surface ranging quite 10° F. below that of Utah Lake. It lies in the extreme northeast corner of the State, about 300 miles north of Utah Lake, and at an altitude of 5,911 feet above mean sea level, and is fed mostly by short cold streams flowing into it from the snow-clad mountains on the west. The common fishes are more numerous here than in Utah Lake, with two species of large growing trout, locally known as salmon trout (which frequent the inflowing streams to spawn) and the bluenose trout, which I am told spawns in the lake. Some of these trout in early times, before the use of seines and gill nets for commercial purposes, are reported to have attained the weight of 30 pounds.

This lake is about equally divided between Utah and Idaho, the east and west dividing line of the two States cutting the lake in about equal proportions, so that in stocking it with the black bass, Idaho receives as much benefit as Utah, which we do not at all begrudge. Theoretically this lake should produce a better quality of bass than Utah Lake. It apparently has equal if not superior food and spawning facilities, with a much purer quality of water that should impart a better flavor to the fish. The question of the considerably lower temperature of the water may and perhaps will prove to be an important factor for good or evil in the growth and development of this valuable food and game fish in this lake, which the next few years will no doubt

demonstrate. I feel quite sanguine, however, that this goodly plant of the Oswego black bass will prove successful, and of incalculable benefit to the northern part of Utah and the southern portion of Idaho.

This being the largest and most important individual plant to be made in the State, it received the first attention; and after its successful accomplishment, it was deemed advisable to defer the plantings in the southern part of the State till the cool weather in the fall, and for the further reason that the spawning time was dangerously near for successful catching and transportation. Further stocking of the State waters was therefore postponed until the 30th of October, when I took a shipment of 130 large spawners, ranging from 1 to 5 pounds weight, and 1,100 yearling fry to Richfield on the Sevier River in the central-southern part of the State and planted them in a clear, sluggish stream of spring water tributary to the Sevier River. This spring stream is 15 to 20 feet wide and has its source in a succession of connected spring ponds and lakelets of varying moderate depth, fringed and interspersed with tules, flags, water-cress, moss, and other vegetation, and covering an area of probably 200 to 300 acres. It is an ideal small place for the bass, and the whole shipment was planted here and designed as a stocking plant for this section. Most of the water to be stocked is of a pond character, with generally small and slowly flowing streams, the Sevier River being perhaps an exception.

This stream, although the main drainage avenue of this part of the State, can hardly aspire to the dignity of a river, its channel being from 30 to 50 yards wide only. For one or two months in the spring of the year, however, the melting snows from the mountains along its course and the mountain streams tributary to it swell its volume to the dimensions and character of a torrent or a small river, but in the summer months the channel is drained almost dry in places for irrigating purposes. Nevertheless the water drains and seeps back again into the channel, giving long stretches of water with hardly a perceptible current. The bass might do fairly well here, as the common fish abound everywhere in these waters, and the upper portion of the stream has a goodly supply of the same species of trout found in Utah Lake, and all the streams tributary to it and where its source originates are thronged with mountain trout.

Sevier River has its source in the mountains forming the rim of the Great Salt Lake Basin, near the southern boundary line of the State, and flows thence 200 miles in a northeasterly course to a point at Gunnison in Sanpete County, where the course changes to northwesterly for about 40 miles, and again to westerly and southwesterly for about 50 miles; then, after flowing through the entire length of the Sevier Valley and passing through six counties, it finally discharges into Sevier Lake in Millard County. This lake has no outlet and contains too much saline matter for the existence of fish life; but there are a number of square miles of connected lagoon lakelets near the mouth of the river on either side before reaching the main saline lake, where the water is fairly good, with an abundant supply of all the native common fishes, and carp innumerable. Here I have high hopes that the bass will do well; and these waters, together with a few other smaller patches in this locality, were the next and last to claim our stocking attention for this season.

On the 12th of November our last carload, consisting of 200 large spawners and 1,800 yearling fry, was started over the Oregon Short Line Railway from Utah Lake at Provo. At Juab station, 60 miles south from Provo, 45 large spawners were taken out and sent by wagon to Scipio Lake, 20 miles southwesterly from this point. The

lake has an area of 1,000 to 1,500 acres, well supplied with native common fish and carp. Chicken Creek Lake, 3 miles south of Juab station, is a patch of clear spring water covering an area of 500 acres or more, with every indication of being an ideal small place for bass, with excellent spawning conditions and plenty of food. The railway passing close to the shore of this lake at one point, I had the train stopped a few minutes in passing and set 16 large spawners at liberty here. Passing on about 6 miles farther, to where the Sevier River is first encountered on this line, a plant of 400 yearling fry was made, after which the bulk of the shipment was taken on to Deseret and planted in the lagoon lakelets, near the mouth of the Sevier River. Forty-five large spawners were planted in Clear Lake, about 15 miles south of this point. This lake contains only about 2,000 to 3,000 acres of water suitable for bass culture, but I expect to see larger bass produced here than at any other place in the State. The water, issuing from large springs bordering the lake, is very slightly brackish and clear as crystal, with a fairly uniform temperature of 55° to 60° F. throughout the year. Minnows and common fish are superabundant here, and carp planted here six or seven years ago have grown very large, some of them, I am told, weighing 30 to 40 pounds.

This being our last stocking shipment for the season of 1897, a recapitulation will show that nearly 800 large spawners, averaging nearly 2½ pounds each, and 5,000 yearling fry were distributed by the State fish and game department in the public waters, covering a longitudinal area of about 450 miles, giving a long, if not a wide, distribution throughout the State to this superior food and game fish. In addition to the State plantings, 750 large spawners were furnished to applicants for private pond cultivation throughout the State during the season, and 5,000 yearling fry to the State of Colorado for distribution in public waters of that State, making a total of over 11,000 bass distributed for propagating purposes from Utah Lake during the season of 1897.

A few words as to the method of transportation and care in transit may not be out of place. As we had no specially constructed tank car for the purpose, barrel receptacles had to be resorted to; 50 barrels of 40 to 50 gallon capacity each were placed in a large baggage car, kindly furnished by the Short Line Railway Company. The fish were taken with small nets from the ponds close by, put into barrels of fresh water in wagons waiting to receive and convey them a short distance to the car, where they were again transferred from the barrels in the wagons to the barrels in the car, which also contained fresh water to about four-fifths of their capacity. From 10 to 15 of the large spawners were all that was deemed advisable to put in a barrel, and 300 to 400 fry in barrels of the same capacity. Everything was timed to make as close connection as possible with the north-bound express train. This was our first experience in transporting the fish in carload lots such a long distance; the undertaking was therefore largely experimental, and at this season of the year (May 4) was attended with considerable hazard.

Air-pumps and hand-bellows with rubber tube attachments to reach the bottom of barrels for aerating the water had been provided, together with buckets for the same purpose. We soon learned that the buckets were of far greater practical utility than all the other contrivances. When the fish showed signs of discomfort by coming to the top of the water, a few applications of the bucket would send them down again. This was done by dipping the water out of the barrels and pouring it back again from as great a height as possible by the attendants, and I observed that a quick and violent return of the whole bucketful had a much better effect than a slow and gentle

pouring. Sometimes if a barrel chanced to be overlooked a little too long and the fish were particularly uncomfortable, it would take from 8 to 12 bucketfuls dipped out and poured back as rapidly and violently as possible to make them easy again. I found that this performance had to be repeated with each barrel once every 30 minutes to be safe, showing that these large fish especially consume the air out of the water very rapidly.

After an all-night run of fifteen hours in the car, the nearest station to Bear Lake was reached, and here eight wagons were waiting to take the cargo to the lake, the nearest point being about 12 miles south of the railway. The barrels containing the fish were soon transferred to the wagons and the lake was reached about noon, and some of the fish planted at the first favorable place and opportunity. Three-fourths of the lot, however, was taken to the extreme southern end of the lake and planted there at 9 o'clock p. m., after a 40-mile wagon-haul and thirty hours in the barrels. The only change of water was during the first four hours of the trip, at Salt Lake City and Ogden, where less than half the water was taken out and replaced with a fresh supply. The lack of fresh water, therefore, had to be compensated by the vigorous application of the water-buckets to supply sufficient aeration. An observation made during the long wagon-haul should not be omitted. Wagons with springs and some without springs were used, and I noticed that the fish in the wagons without springs seemed to be in a better condition than those in the spring wagons; and in going over rough places in the road the water showed less tendency to slop over and spill out.

After getting the last of this consignment of bass into the waters of Bear Lake with a loss of not to exceed 7 per cent in transit, and all in good lively condition, I felt very greatly relieved, for I expected to lose a much larger percentage. The shipments to the southern part of the State in the cool months of autumn were made with less than 1 per cent loss, thus showing that the cool weather in the fall of the year is the best time to transplant and distribute this fish in Utah. From the high parental instinct and other good qualities of this great fish, I am strongly of the opinion that it is the coming fish for pond cultivation in this State.

I wish to express the highest appreciation of the conduct of our local railroads, the Oregon Short Line and the Rio Grande Western railways, in furnishing cars and free transportation for this State distribution of the black bass, and also to acknowledge the important service rendered by the United States Commission of Fish and Fisheries at Washington in first introducing the large-mouthed black bass in Utah.

SALT LAKE CITY, UTAH.