

DEPARTMENT OF COMMERCE

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THE FRESH-FISHERIES OF CADDO LAKE AND THE CYPRESS AND SULPHUR RIVERS OF TEXAS AND LOUISIANA.^a

The observations given in this report were made during the latter part of November and the early part of December, 1912. Effort was made not only to study the existing conditions but also to gather such facts in regard to previous conditions as could be substantiated by persons cognizant of the past history of the industry in this locality, and to consider the possibilities for better utilization of the shell resources. It is desired to express appreciation of the courtesies shown by the Progressive Club, of Jefferson, Tex., and thanks are also expressed to the Texas Commission of Fish and Oysters for the aid and information extended and furnished by its deputy warden located on Caddo Lake.

LOCATION AND DESCRIPTION OF THE WATERS INVESTIGATED.

Caddo Lake.—This body of water lies in Marion and Harrison Counties of eastern Texas and in Caddo County of western Louisiana. The lake proper, or Big Lake, as it is called, is about 14 miles long extending from a point about 2 miles below Wilsons Landing, Tex., to Mooringsport, La., with a maximum width of about 5 miles.

It is exceedingly shallow, with large areas only 4 to 8 inches in depth. The narrow boat channel has a depth of 4 to 15 feet, but elsewhere it is possible for one to wade throughout almost the entire lake. In low water a large portion of the lake is broken up by islands and ridges into numerous bayous and inlets, while in high water these more elevated areas are completely inundated. The whole lake is thickly dotted with cypress trees and stumps; and, the water being very low at the time the lake was visited, a great many grass hummocks of greater or less extent rose above the surface of the water. The bottom, generally, is composed of mud and clay, although in some places there are small sandy points or bars. The water at the time of this investigation was very muddy.

At Mooringsport the lake narrows; and from there to Shreveport, La., it is a continuous chain of flats and shallow inlets scarcely passable for rowboats in low water. About 3 miles below Mooringsport a Government dam is being constructed, the result of which will be to

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raise the lake level 4 feet and offer navigation from Mooringsport to Jefferson, Tex.

Cypress River.—The Cypress River proper is a small stream rising in Franklin County, Tex., flowing in a general southeasterly direction and emptying into Cypress Bayou, at the head of Caddo Lake. Near the mouth this stream is about 50 feet wide; but proceeding upward it narrows considerably, and in the vicinity of Jefferson it is only 10 to 12 feet in width. Its bed is composed of gravel and mud, with numerous small sand bars. The water at the time of this investigation was exceedingly clear.

Its two principal branches, the Black Cypress and the Little Cypress, rising in Morris and Wood Counties, Tex., respectively, are received, the first at a point 4 miles below Jefferson and the other near its mouth.

In high water the stream is navigable for motor boats as far as Jefferson; but in low water it is impassable except for rowboats, which can proceed only as far as the mouth of the Black Cypress.

Sulphur River.—This is a small stream rising in Fannin and Hunt Counties, Tex., flowing in a general eastern direction and emptying into the Red River. The bed is composed principally of soft and oozy mud, with some clay, and in some places it was impossible to approach the water's edge even with high rubber boots, on account of the very soft condition of the banks. Very little sand or gravel is encountered, except at places near the river source.

In the vicinity of Watson, Tex., the river is about 30 feet wide and quite deep; at Sulphur it is narrower but rather deep, averaging from 10 to 12 feet, while from Sulphur upward it becomes much smaller, until near Naples it is only about 6 feet wide.

CHARACTER, HISTORY, AND EXTENT OF THE FISHERY.

The mussel fishery in these waters is carried on solely for the yield of pearls, of which a great many, some of them of high value, are taken each year. A few small pearls have been found at times in the two rivers, but it is in the lake that the industry is centered.

This body of water contains too many stumps, logs, and snags to permit the use of bats with hooks, and, as the rake is used but little, the mussels are taken almost wholly by wading, and consequently pearling is carried on in the warmest months only, from April and May to September and October. When wading for mussels, some of the pearl seekers carry sacks suspended from their necks, and when these bags are filled go to the shore and cut the mussels open. Other pearlers pull boats around and throw the shells into them. A third method is to open the mussels one at a time as found and throw the discarded shells back into the water, with the result that the lake

contains a great many dead shells, making it more difficult to find the live ones. Again, other pearl seekers gather the mussels by leaning or lying over the stern of the boat and picking them up with their hands, at the same time propelling the boat along. As this does not necessitate being in the water for hours at a time, it is a very popular method. At the time of this investigation operations were entirely suspended; but in company with a "pearler" the writer visited many of the shallow places and mussels were taken where the water was scarcely deep enough to cover the shells. The mussels in the deeper water were collected by means of a rake.

Until four years ago very little was known of the value of the pearls or of the great number to be found in the vicinity, but since that time pearling has been prosecuted regularly. At first the pearls were taken to jewelers and sold for nominal sums, and it was not until the pearl buyers began to visit the lake that anything like fair prices were paid.

It was said that during the summer of 1911, at a point called Flat Lake, it was not uncommon to see two or three men wading their arms at the same time, each shouting that he had found a pearl.

Judging from the number of discarded shells heaped about on the shore and in the shallow water, pearl hunting must be carried on very extensively. Several reliable fishermen estimated that there were no less than 400 pearl hunters on the lake during the past summer; but, while this was a greater number than had been present during any previous season, it was stated that fewer pearls had been found. The summer of 1911 was a very profitable season. One pearl buyer stated that he paid out \$26,000 for pearls in less than two and a half months and that he knew three other buyers paid out fully as much and probably more during the same length of time. This period did not include the best part of the season, as the informant did not arrive at the lake until the latter part of August. The season of 1912 was considered a poor one as compared with previous years, but it was estimated by reliable persons that \$100,000 worth of pearls had been taken out of the lake.

Four pearl buyers had their headquarters on the lake all summer in 1912 and made daily trips among the camps of the pearl hunters. One of these buyers stated that some of the most valuable fresh-water pearls were found in this lake and that they had a color and luster unequalled in any other part of the country; some of them, it was said, displayed pink or greenish shades that were seldom seen elsewhere. Several small pearls that were seen by the writer had very fine luster. The colored pearls are found in the "white-eyes" (*Quadrula trapezoides*), while the white ones are confined principally to the "washboards" (*Quadrula lacos*) and the "back-horns" (*Tritogonia tuberculata*).

SPECIES OF MUSSELS FOUND AND THEIR DISTRIBUTION.

The mussels of Caddo Lake were first examined in the vicinity of Wilsons Landing, Tex. On looking over the many piles of discarded shells along the shore, a great preponderance in numbers of the species *Quadrula trapezoides*, commonly called the white-eye (in Arkansas known as "bank climber"), was noted, and on closer examination of the shells it was estimated that fully 80 per cent belonged to this one species. At some points these piles aggregated several tons, and in places near the shore the bottom of the lake was covered with masses of these waste shells. As the water had been higher in the spring, the mussels that were carried ashore then were opened on the more elevated portions of the land, but as the water receded the pearls kept within easy distance of its edge, as evidenced by the heaps of shells thus left.

A great many of the smaller piles, containing from 100 to 200 shells, were counted and the percentage of each species in each pile computed; then from these data and that obtained from estimates of the larger piles an approximate idea was obtained of the percentage in which each species occurred. These percentages are given in column 1 of the table on page 5, which shows that 87 per cent of the shells were white-eyes. Many piles were composed almost wholly of white-eyes and washboards, with here and there a few buck-horns, sand shells, or hickory-nut shells. Collections of live shells were also made in this vicinity, and the frequency with which the various species occurred is given in column 2 of the same table. Comparing these two columns, it is found that among the living mussels the percentage of white-eyes is reduced from 87 per cent to 56 per cent and the percentage of washboards from 10 per cent to 6 per cent. It was learned, however, that very few of the smaller warty-backs and the hickory-nut shells, and the thin shells, such as the floaters and paper shells, were opened, and this undoubtedly accounts for the large percentages of white-eyes and washboards making up the piles of discarded shells. Accepting this as an explanation, the disparity of the percentages in the two columns is readily understood.

In Alligator Bayou, above Wilsons Landing, the shells were not so plentiful. The white-eyes and washboards were not so numerous, although 63 per cent of the shells collected belonged to the former species. Quite a number of hickory-nut shells were taken, though they were small as compared with the examples of this species collected previously. The approximate percentages of the species collected at this point are given in column 3 of the table.

Farther up, through Cypress Bayou and into Cypress River, the quantity and quality of the shells decreased very perceptibly. The washboards became scarce. The warty-backs and sand-shells increased in numbers in proportion to the rest of the shells taken, making up 10 per cent and 12 per cent, respectively, of the total

number of shells collected. The percentages are given in column 4 of the table.

In the vicinity of Jefferson, Tex., there was a very marked decrease in the quantity of shells found. The number of warty-backs was proportionally large, but they were small, averaging about 1½ inches in length. They were, for the most part, completely buried in the sand, only a slight depression showing their location. A very marked increase of buttermilk shells was noted, 32 per cent of the mussels collected being of this species. A number of the mussels, principally the buttermilk and sand shells, contained many parasites (*Azar*) on the mantles. The percentages of the species found in this vicinity are given in column 5 of the table.

In the vicinity of Mooringsport, La., the conditions were just about the same as those encountered in other portions of the lake, piles of shells being found along the shore and in the shallow water. As above, the shells in some of the smaller piles were counted and estimates made of the larger heaps. The percentages of the species thus found among discarded shells and among those collected alive in the same region are given in columns 6 and 7, respectively, of the following table:

SPECIES OF MUSSELS COLLECTED IN CADDO LAKE AND THE CYPRESS RIVER.

Local name.	Scientific name.	1		2		3		4		5		6		7	
		Dis- carded shells on shore of Caddo Lake below Wilson's Land- ing, Tex.	Per cent. 87	Shells collected alive in Caddo Lake below Wilson's Land- ing, Tex.	Per cent. 56	Shells collected alive in Alli- gator Bayou above Wilson's Land- ing, Tex.	Per cent. 63	Shells collected alive in Cypress Bayou River above Wilson's Land- ing, Tex.	Per cent. 64	Shells collected alive in the Cypress River above Wilson's Land- ing, Tex.	Per cent. 3	Dis- carded shells collected on the shore of Caddo Lake near Moor- ings- port, La.	Per cent. 81	Dis- carded shells collected on the shore of Caddo Lake near Moor- ings- port, La.	Per cent. 81
White-eye.....	<i>Quadrula trapezoides</i>	10	6	8	34	3	17	100							
Washboard.....	<i>Quadrula hexo-</i> <i>Quadrula fragosa</i> ..	X	11	3	2	17	17	8							
Hickory-nut shell.....	<i>Lampsilis folia-</i> <i>foliosa</i>	X	3	6	12	6	12	3							
Sand shell.....	<i>Tribosonia tuber-</i> <i>culata</i>	X	4	X	9	0	0	5							
Buck-horn.....	<i>Quadrula pustu-</i> <i>losa</i>	X	X	X	X	X	10	32							
Warty-back.....	<i>Lampsilis purpu-</i> <i>rata</i>	X	X	X	X	X	X	32							
Buttermilk shell.....	<i>Quadrula pustu-</i> <i>losa</i>	X	X	X	X	X	X	X							
Warty-back.....	<i>Lampsilis rapells</i>	X	X	X	X	X	X	X							
Paper shell.....	<i>Quadrula reflexa</i>	X	X	X	X	X	X	X							
Three-horned warty-back.	<i>Arctiois confra-</i> <i>cosa</i>	X	X	X	X	X	X	X							
Mucket.....	<i>Lampsilis pule-</i> <i>ola</i>	X	X	X	X	X	X	X							
Floater.....	<i>Arctiois corpa-</i> <i>lenta</i>	X	X	X	X	X	X	X							
	<i>Lampsilis elabera-</i> <i>ta</i>	X	X	X	X	X	X	X							
	<i>Plicatula elegans</i>	X	X	X	X	X	X	X							
	<i>Plicatula tomah-</i> <i>wensis</i>	X	X	X	X	X	X	X							
	<i>Quadrula undaria</i>	X	X	X	X	X	X	X							

It was stated by a number of "pearlers" that the washboards were most numerous at Porters Point, and, acting on this information, some collecting was done at that place. It was found that of the shells collected 52 per cent were white-eyes and 16 per cent were washboards.

The mussels do not seem to lie in beds, but are scattered promiscuously over the lake, and can be gathered at almost any place where they have not been fished out entirely. The white-eyes seemed to be quite plentiful close to the stumps and sometimes as many as four or five could be taken in the vicinity of one small stump. Around the grass hummocks also the shells were particularly plentiful, because, according to the guide, the pearl hunters do not work close to the grass in the warm weather for fear of snakes. The washboards appeared to be more plentiful where the bottom was composed of clay, in which they were three-fourths buried.

Not many mussels were found on the Sulphur River and those occurring were of noncommercial species. Those collected in the vicinity of Watson, Tex., were the paper-shell (*Lampsilis gracilis*), the buttermilk-shell (*Lampsilis purpurata*), the floater (*Anodonta copulata*), the sand-shell (*Lampsilis fallaciosus*), and the white-eye (*Quadrula trappeoides*). The same species were found at Sulphur, and at Naples paper-shells, sand-shells, and floaters were taken.

MEASURES FOR THE PERPETUATION AND IMPROVEMENT OF THE FISHERY.

If the pearling industry be continued at the present intensity and no measures taken to protect the fishery, or no conditions interfere to lessen this wholesale destruction of the mussels, it will be a matter of a few years only until the supply is practically exhausted. The State of Texas has adopted one measure of improvement by requiring each person to take out a permit before being allowed to gather mussels. There is no charge made for this permit, but each recipient is expected to carry the discarded shells to the bank instead of throwing them back into the water, and to report the number of shells taken from the lake, the number of pearls found, and their value. A list of the latest reports turned in, numbering 61, was made available by the deputy game warden, and out of 793,392 mussels opened 53 pearls, with an aggregate value of \$1,404.50, were found. A great quantity of salt water and waste from the many oil and gas wells in the vicinity runs into the lake and, as a result, it is said that many fishes and mussels are destroyed. It has been proposed to induce the oil companies to make some other disposition of their waste, but as yet nothing has been done.

If the Government dam, in process of construction below Mooringsport, is completed by next summer, it is not expected that very

much pearling will be done in that year, as the consequent rise of 4 feet in the water level will make it difficult to secure the mussels until they have had time to work out into the shallow water. This dam will put several thousand acres of additional land under water and should ultimately prove of great aid in increasing the production of mussels. Yet, while the dam will thus produce more favorable conditions in Caddo Lake proper, or Big Lake, it will have a tendency to decrease the supply of mussels below its full, where the water, not very deep at the present time, must become still more shallow. Consequently the shells will become easy prey for the pearlers, and it will be only a matter of a short time until this portion of the lake will be practically depleted of mussels. It is expected that the loss here, however, will be more than recompensed by the gain in Big Lake.

With a little cooperation between the States of Louisiana and Texas an arrangement for putting a close season on the pearl fishing, or providing for a small license fee, might be agreed upon. It seems advisable that some such means should be undertaken to further protect the industry by preventing the present wholesale destruction of the mussels.

POSSIBILITY OF UTILIZING SHELLS NOW WASTED.

Button factories have written from time to time to Mooringsport and Jefferson, inquiring about the mussel fishery and requesting samples of the shells to be tested as to the qualities for button manufacture. It was learned that a factory located at Erie, Pa., with a branch at Memphis, Tenn., had sent to the lake to see about buying up the shells, but had found transportation too expensive for the shells to be handled profitably by shipping them to the factories. It was stated by Mr. Wallis, a pearl buyer with interests in a button factory, that a project to establish a blank-cutting factory on the lake to offset the effect of the high freight rates had been seriously considered at Mooringsport, but after figuring the cost of production the plan was dropped mainly because of the high wage demanded for labor, \$3 per day being the regular rate paid in the oil fields in that vicinity. It was also said that in order to hold the laborers it would be necessary to work the year round, which was not thought possible for a very large factory with the existing resources of shells.

The high cost of labor can not be conclusively accepted as an obstacle to the establishment of a blank factory in the vicinity of Mooringsport, however. At Wilsons Landing efficient men were working in a sawmill for a wage of \$1.50 per day. Labor is plentiful at Jefferson, where a small factory might be established, the higher stage of water making it possible to transport the shells to that town on barges at a minimum cost.

Although the majority of the shells found in Caddo Lake are white-eyes, belonging to the species *Quadrula trapezoides*, which has no commercial value, there are a number of fairly good commercial shells found here that would amount to several tons during a season, the principal species being the washboard, hickory-nut shell, warty-back, and buck-horn. It is thought that enough marketable shells are found in the lake each season to supply a small blank factory the year round, but if such is not the case it might be possible to hire men who hunt pearls in the summer as button cutters during the winter months.

The pearlery were told that it might be to their advantage to save the good shells for future use and a number of them signified their intention of doing so. One fisherman had a pile of several tons consisting of washboards which he had collected during the past summer.

COMMERCIAL APPRAISAL OF THE MUSSELS.

Generally speaking, the shells found in these waters are not of high value for commercial purposes. The washboards, on the whole, were of large size with fair luster, but a great majority of them were badly stained, materially decreasing their value. The sand-shells (*Lampsilis fallaciosus*) found in the lake were comparatively heavy, but usually the inside of each valve had a pink or salmon color, especially in the cavities of the umbones. The examples found in the Cypress River in the vicinity of Jefferson were extremely thin, but those in the Sulphur River compare favorably with those collected in Caddo Lake. It was the only shell having any commercial value that was found in this river. The buck-horns found in the lake were of good luster, and a majority of the shells were white, though some had rosy hues and others were badly stained. The hickory-nut shells and warty-backs were small, but of good quality. The floaters (*Anodonta carpulenta*), buttermilk-shells (*Lampsilis purpurata*), paper-shells (*Lampsilis gracilis*), and the species *Plagiola danielsonis* have no commercial value. The pig-toes (*Quadrula webbia*) found in the Cypress River near Jefferson have no commercial value on account of their very small size.

Specimens of the shells collected were sent to the United States biological station at Fairport, Iowa, to be identified and examined as to the qualities for button manufacture. The following descriptions were compiled from the notes furnished by the shell expert of that station.

Washboard (*Quadrula lutes*). This shell is large and has a fair luster, though the inside is badly spotted. The material is brittle, thus causing difficulty in manufacturing it into buttons and, more-

over, the spotted buttons have to be colored or smoked, thereby lessening the value of the product from this shell.

Hickory-nut shell (*Quadrula fragosa*). The luster and texture of this shell are first grade. It is rather small, but when large it can be cut into 16 to 24-line buttons.

Warty-back (*Quadrula pustulosa*) and (*Quadrula pustulata*). These shells are small and it is possible to cut but one or two 16 to 20-line buttons from each. When large they are classed second to the nigger-head (*Quadrula ebena*) in luster and texture.

White-eye (*Quadrula trapezoides*). This species has no value as a button shell on account of its purple color, though a few can be used in the manufacture of novelties.

Sand-shell (*Lampsilis fallaciosus*). These specimens are fair sized. When large, the species is classed with the yellow sand-shell (*Lampsilis anodontoides*), making first-grade 16 to 20-line buttons. Knife handles and novelties are also manufactured from it.

Mucket (*Lampsilis luteolus*). The luster and texture of this shell are first grade. It is of uniform thickness and the whole shell can be cut into buttons. It is classed with the river mucket (*Lampsilis ligamentina*).

Buck-horn (*Fritogonia tuberculata*). This shell, when not spotted, is classed as first grade in luster and texture.

Three-horned warty-back (*Obliguaria reflecta*). The texture and luster of this shell are second grade. It is a good button shell when large, being cut into 16 to 20 line buttons.

Deer-toe (*Plagiola leagans*). The luster and texture of this shell are fair, but, being very small, it is not regarded as a button shell. When it is large it can be cut into small line-buttons.

Black pocketbook (*Arcidens confragosa*). These shells, on account of their thinness, are not suitable for buttons. The species is never valuable, although it is sometimes possible to use the larger individuals for small-line buttons.

In general, each species varied but little in the different places where found, and the samples used for the above appraisal may be considered to be average specimens of the commercial shells found in the lake.

FISHES EXAMINED FOR NATURAL INFECTIONS OF MUSSEL LARVÆ.

A number of fishes were obtained by means of a small seine, and these were sent to the United States biological station at Fairport, Iowa, to be examined for glochidia, or attached mussel larvae, with the results given in the table following. In addition to these fishes, the spoonbill cat, alligator gar, and common gar are found in large numbers in the lake.

FISHES TAKEN IN CADDO LAKE, MOORINGSPORT, LA., DEC. 2, 1912 AND DETERMINED FOR ATTACHED MUSSEL LARVAE.

Species.	Num-ber of Specimens.	Infected.		Remarks.
		Gills.	Fins.	
Blue cat, <i>Ictalurus furcatus</i>	16	0	0	Gills badly decayed.
Minnow, <i>Nannostomus bleekeri</i> (?).....	28	0	0	
Synbranch, <i>Pseudorasbora</i>	10	0	0	Two fish with Myxosporidia.
Killifish, <i>Fundulus notatus</i>	4	1	0	Glochidia above of L. cavity but smaller (0.050 by 0.110 mm.), well-developed; developed.
Labidochelys, <i>Labidochelys</i>	10	0	0	
Strawberry bass, <i>Pomoxis sparoides</i>	4	0	0	Four of these fish infested with a parasite resembling a glochidium but smaller than any species (circular type) known; probably Protozoa (Sporozoa).
Crappie, <i>Pomoxis annularis</i>	4	0	0	A few Myxosporidia present.
Chamaeleon, <i>Chamaeleon</i>	2	0	0	
Sunfish, <i>Lepomis gibbosus</i>	48	0	0	A few minute parasites.
Largemouth black bass, <i>Micropterus salmoides</i>	4	0	0	
Darter, <i>Baleonoma nigricum</i>	1	0	0	
Cotton-tail, <i>Cottus bairdii</i>	1	0	0	
Darter, <i>Percina caprodes</i>	3	0	0	
Darter, <i>Etheostoma caeruleum</i>	1	0	0	
White bass, <i>Ameiurus chrysops</i>	1	1	0	Three glochidia of a species resembling <i>Q. heros</i> but with shorter hinge line (0.283 by 0.330 mm.); not encysted and probably accidentally introduced.
Total.....	137	2	0	