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LEUCICHTHYS HUBBSI, A NEW CISCO, FROM IVES LAKE, MARQUETTE COUNTY, MICHIGAN

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THE data recorded in this paper were obtained, for the most part, during a survey of the coregonid fauna of the eight lakes of the Huron Mountain Club in Marquette County, Michigan, made between August 23 and September 2, 1924, with the coöperation of the Huron Mountain Club and the U. S. Bureau of Fisheries. Doctor Carl L. Hubbs carried on more extensive explorations in these lakes during June and July of 1927 and his specimens have also been examined for the purposes of the description here given. These investigations disclosed in one of the eight lakes a coregonid form belonging to the lake-herring group that is sufficiently different from those known from the Great Lakes Basin to warrant a name. It is here designated as *Leucichthys hubbsi.*

The type is a female specimen, 207 mm. in length to the base of the caudal, collected in Ives Lake on July 3, 1927. It is catalogued in the Division of Fishes of the Museum of

Zoology as number 81678. Fifty-one additional specimens were obtained from the same lake on August 29, 1924, and forty-five on July 2–4, 1927. These fish are catalogued in the same collection as paratypes.

The body is fusiform, considerably compressed and rather deep. The greatest depth, through a point just in front of the dorsal, is contained 3.5 [(3.5) 3.8–4.2 (5.1)] times in the total length. The anterior dorsal profile of the body rises in a smooth curve from the occiput to the dorsal insertion, but the line is slightly steeper over its cranial half. The contour from the dorsal insertion curves faintly and evenly into the caudal peduncle. The ventral curves run approximately like the opposite dorsal ones. The head, which is relatively long and of medium depth, is contained 3.7 [(3.5) 3.7–4.0 (4.2)][1] times in the total length. In side view it is about equilaterally triangular. Its dorsal profile is usually straight to faintly convex and often forms a smooth arc with the predorsal contour. The premaxillaries are always heavily pigmented and are directed forward, ordinarily making an angle of 45° to 55° with the horizontal axis of the head. The snout, seen from the side, is short and rather blunt. It is contained 4.0 [(3.4) 3.7–3.9 (4.3)] times in the head. The maxillary is always much pigmented, a line of black often running along its cutting edge, and is contained 2.7 [(2.4) 2.6–2.8 (3.0)] times in the head length. The eye is large, contained 4.0 [(3.5) 3.8–4.0 (4.3)] times in the head length. The mandible, usually black-tipped, is rather frail with a more or less pronounced symphysial knob, and is usually longer than the upper jaw.

The lateral line scales number 75 [(63) 67–75 (79)].

The gillrakers on the first branchial arch number 20 + 34 [(16) 18–20 (21)] + [(30) 32–35 (36)] = 54 [(47) 51–54 (57)].

[1] These and succeeding figures in brackets are based on an examination of 96 paratypes ranging in length from 136 to 213 mm. The usual as well as the extreme range in variation is given, the latter in parentheses.

The dorsal edge of the pectoral is slightly decurved at its distal end. The paired fins are relatively long. The pectorals are contained 1.3 [(1.2) 1.3–1.5 (1.8)] times in the distance from their insertion to that of the ventrals; the ventrals are contained 1.2 [(1.1) 1.3–1.5] times in the distance from their origin to that of the anal. The dorsal rays number 9–10 (11); the anal (9) 10–12 (13); the ventral (10) 11–12; the pectoral (14) 15–16 (17).

In life the fish is silvery in color, like all Great Lakes species of *Leucichthys,* with the underlying tones of pea-green and blue green and the superficial iridescence. Preserved specimens that have lost the silvery tone show heavy pigment over the entire dorsal surface, heaviest in front of the dorsal and so concentrated in the cranial cartilages as to make them almost black. The pigment extends onto the sides but diminishes ventrad and is usually absent on the belly. The fins are always much pigmented. The dorsal and caudal are decidedly dusky; the cranial border of the former and the lateral borders of the latter are usually black; the other rays of both are darkest on their distal ends. The lower fins are not smoky, as the pigment dots there are coarser. The dots are scattered rather evenly over the ventrals and the anal, except that near the bases and the extreme tips of the rays and on the last two or three of the shortest rays of each (often on more in those specimens that are least pigmented), there is less pigment or even none. The dorsal margin of the pectorals is black and there is abundant pigment on the other long rays. As in the case of the ventrals and anal, the bases and the etxreme tips of these fins have least pigment and it is usually absent on the four or five shortest rays.

Leucichthys hubbsi is associated in Ives Lake with a representative of the common lake-herring *Leucichthys artedi,* but it is distinguishable from that species almost at a glance. It has more gillrakers, fewer lateral line scales and longer paired fins than the *artedi* of that lake. The comparative figures follow:

Comparison of *Leucichthys hubbsi* and *Leucichthys artedi* from Ives Lake, Michigan

	L. *hubbsi*			*L. artedi*		
Gillrakers on first branchial arch	(47)	51–54	(57)	(44)	45–49	(52)
Lateral line scales	(63)	67–75	(79)	(67)	73–82	(85)
Pv/P	(1.2)	1.3–1.5	(1.8)	(1.3)	1.5–1.8	(2.0)
Av/V	(1.1)	1.3–1.5		(1.2)	1.4–1.6	(1.7)

The gillrakers in *hubbsi* are much longer than in the associated form of *artedi,* those of the latter being usually very much reduced in length (probably abnormally). The *artedi* representative regularly grows much larger and has, on the average, a more slender body, shorter and less hooked mandible, a somewhat shorter head and maxillary, and possibly a smaller eye. The spawning season of the two forms is also different, *hubbsi* spawning probably in May and *artedi* probably in November, as is usual with the species in the Great Lakes. Certainly it does not spawn before October. Though males taken in late August often exhibited faint traces of pearls, the females showed no close approach to ripeness.

Ives Lake is about one and one-quarter miles long and has a maximum width of about a mile. I made only a few soundings in the lake, but the data indicate that the northern half is deepest. A depth of 60 feet is recorded a few rods off the northeast shore and a depth of 102 feet was found near the center. According to Doctor Hubbs' soundings, this depth continues to near the northwest shore. Toward the south the bottom slopes gently upward and there is a broad expanse over which the water is about 50 feet deep. The bottom appears to be of decomposed brownish sandstone and is very soft. The lake has several small feeders and drains through a small stream that drops more than one hundred feet into Pine Lake. The steepness of this descent prevents the accession of fishes from the lower lakes and it is likely that faunal interchange with lower waters has long been interrupted, probably since the Algonquin stage of the Great Lakes.

Apparently ciscoes are very common in the deeper waters of this lake. A piece of $2\frac{3}{4}$ inch gillnet lifted from about 80

feet after having been set one night had, together with 110 redsided suckers (*Catostomus catostomus*) and 19 trout (*Cristivomer namaycush*), 37 herring, chiefly *artedi*. A piece of 2½ inch net lifted with it had along with 15 suckers and 16 trout 132 specimens of *Leucichthys*, chiefly *hubbsi*. Each net was about 650 feet long. Doctor Hubbs in his more intensive collecting in the lake found only three additional species of fish: the perch (*Perca flavescens*), the chub (*Couesius plumbeus*) and the brooktrout (*Salvelinus fontinalis*), the last certainly introduced. Considering the abundance of individuals of the few species it harbors and the much richer fish fauna of Lake Superior two miles away, the scanty fauna of Ives Lake is remarkable.

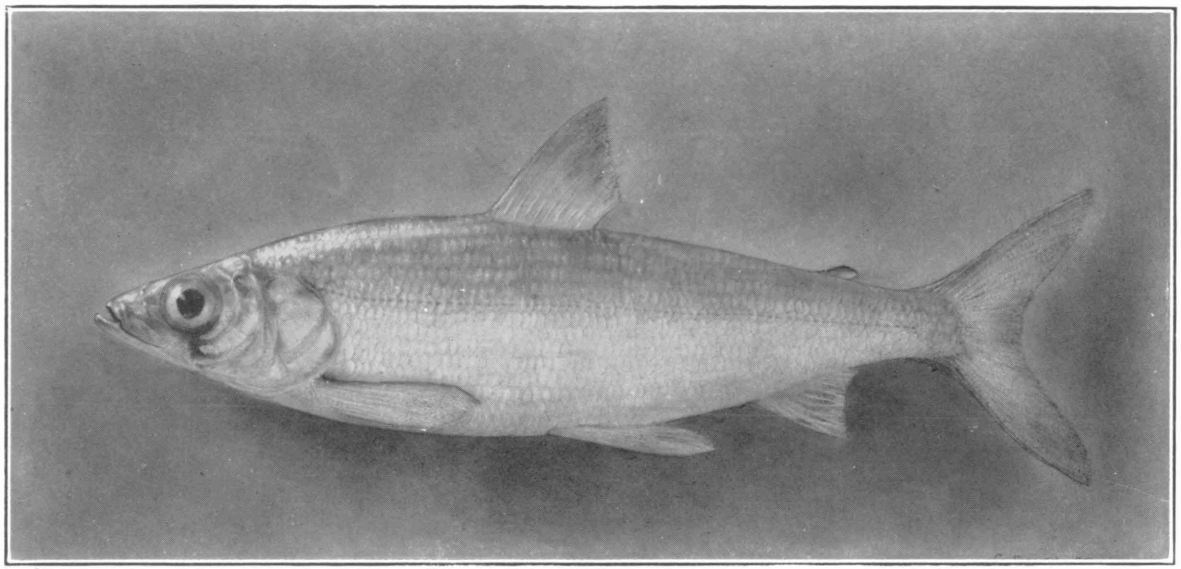
Little is known about the habits of *Leucichthys hubbsi* except that the time of spawning has been established. Specimens collected by me in late summer had small ova, indicating that spawning could not take place for several months. Doctor Hubbs' female specimens of early July show mostly spent ovaries and an occasional individual still has ripe eggs. The collection of eyed *Leucichthys* eggs from the stomach of the other species of *Leucichthys* caught at that time proves that *hubbsi* had recently spawned (the *artedi* form does not spawn until fall), so the time of spawning probably is in May when the ice breaks. Specimens under 150 mm. in length have been found generally to be sexually immature.

Doctor Hubbs examined the food of his specimens of *Leucichthys*, taken in early July, 1927, and has permitted me to give his data here. His specimens of *hubbsi* were found to be feeding chiefly on plankton crustaceans and *Pontoporeia*. The immature *artedi* taken at the same time from shallow water had also been feeding on the plankton, but the adults from the deep water were feeding almost wholly on larval midges. A few had ingested *Pisidium*, *Pontoporeia* and fish eggs. My specimens taken late in August, 1924, showed different food. Of 51 *hubbsi* examined, 20 had had no food recently and all the rest had fed sparingly, chiefly on plankton crustaceans. Two had found midge pupae and in three there

was a trace of some large crustacean, probably *Mysis*. One had found only a burrowing mayfly larva and two small flies. Of 42 *artedi,* 11 had empty stomachs and the rest had fed more or less heavily on *Mysis* or *Pontoporeia,* or both, with an occasional midge larva, *Pisidium* and tiny ball (4 to 6 mm.) of earth. Two had remains of adult insects, which of course they may have found along the bottom, and several had traces of plankton crustaceans.

It is thus possible that the two forms of *Leucichthys,* though occurring in the same habitat, do not compete strongly for food. *L. hubbsi,* with numerous and fine gillrakers and protruding mandible, has been found to feed chiefly on the plankton, and *artedi* with its fewer and coarser gillrakers and shorter jaw to subsist chiefly on larger forms that live on or near the bottom. The relation between the character of the food, the number and character of gillrakers, and the shape of the mandible has been found in Great Lakes *Leucichthys* to be very loose and it is not intended here to indicate more than the possibility that a close relation may exist in these two species in Ives Lake.

PLATE I



Leucichthys hubbsi, new species