Original: Fish Division
cc: Mr. Ruhl
Dr. Leonard

INSTITUTE FOR FISHERIES RESEARCH
DIVISION OF FISHERIES
MICHIGAN DEPARTMENT OF CONSERVATION
COOPERATING WITH THE
UNIVERSITY OF MICHIGAN

ALBERT S. HAZZARD, PH.D.
DIRECTOR

ADDRESS
UNIVERSITY MUSEUMS
ANN ARBOR, MICHIGAN

August 31, 1939

REPORT NO. 546

FURTHER OBSERVATIONS ON THE FEEDING HABITS OF THE BLUEGILL (LEPOMIS MACROCHIRUS) IN FORD LAKE, MICHIGAN

J. W. Leonard

During the afternoon of May 24, 1939, Dr. C. J. D. Brown and the writer took a large series of bluegills (Lepomis macrochirus) from Ford Lake, Otsego County, Michigan. The specimens were collected to afford further materials for a study of the feeding habits and growth rates of Montana grayling (Thymallus montanus) and unwelcome bluegills in Ford Lake.

General physical and chemical characteristics of this lake, observations on its immediate drainage basin, and accounts of periodic sampling of the fish populations since their introduction, have been recorded in reports and publications by the writer and others; hence it is unnecessary to allude to them in detail at this time.

The series of bluegills taken on May 24 comprised 121 individuals, all of which were taken by angling with artificial flies in the waters immediately adjacent to the beaver house and submerged beaver food pile on the north shore of the lake. Repeated observations have shown that the bluegill population tends to accumulate in this restricted area. It is probable that the shelter-seeking instincts of the bluegills are appealed to by the thick cover afforded by the submerged brush pile. It is likely, too, that desirable food organisms tend to concentrate there,

although very seldom have grayling been seen in this zone.

Lack of certain knowledge of the means by which bluegills were introduced, and of the sizes and numbers of the unauthorized stocking, renders difficult an accurate elucidation of the apparently mixed character of the bluegill population. For example, thirteen specimens, of which seven were female and six male, averaged 180.6 mm. in standard length. Of the remaining 108, the sixty-six males averaged 123.3, the females 113.7 mm. in standard length. Eight specimens of indeterminate sex averaged 114.0 mm. in standard length. Such widely disparate figures strongly suggest the presence of two age classes. In fact, there are very definitely three size classes, the 108 smaller examples being divisible into two groups not separable on the basis of sex but clearly different from that of size, weight, and intensity of coloration. During collection the superior vigor of the two larger size-classes was strikingly plain. Yet, if only one planting was made during the summer of 1937, as has been assumed, only one size and age class of bluegills should be present. It is generally assumed that bluegills do not spawn until their third year. If the entire planting was made up of fry, no natural fry should appear until the early summer of 1939; yet the population suggests the presence of three age classes exclusive of any fry that may appear during the current season.

In a collection previously reported on (Report No. 537), it was noted that the larger specimens (average standard length 117.8 mm.) taken October 28-29, 1938, fed preponderantly on odonate larvae, 82.4 per cent of the total diet being made up by members of this group. The species most frequently taken was Ladona julia, a large species. Plankton, midge larvae and aphids were also taken in significant quantities. Diet of the examples taken in May, 1939, consisted of various dragonfly nymphs to the

extent of 90.1 per cent, and, although a large variety of aquatic and terrestrial organisms were represented, none was present in any considerable amount. Only freshwater shrimp, midge larvae, caddis larvae, a "hair worm," and combined terrestrial Diptera adults bulked larger than 0.1 per cent, the arbitrary low limit set for percentage expression.

Repeated observations on the bottom fauna of Ford Lake have revealed the presence of a very large supply of mayfly nymphs, especially in the littoral zone. Mayfly nymphs are herbivorous; and it is only reasonable to assume that mayfly nymphs and other herbivorous forms must be much more numerous than the carnivorous Odonata, since the latter depend upon the former as does any predator upon its prey. Why, then, do Odonata nymphs continue to play such an important role in the diet of both grayling and bluegills, especially the latter? Moon[1] has shown that for a few days prior to emergence, many aquatic insects manifest an increased activity--a sort of nervousness and restlessness apparently stimulated by the nearing time for adult emergence. Yet there is no indication that any such increased activity exists to explain the consumption of dragonfly nymphs because large numbers were taken during the fall, and many of those taken in May showed, by the development of their wing pads, that emergence would not have taken place for several weeks. It has been customary to postulate that availability of food organisms largely determines the diet of fishes: that if, for example, two different groups of food organisms of comparable size are equally available, they will be fed upon impartially. Some doubt is cast upon the universal tenability of this view by the findings recorded in this study and in Report No. 537. In the latter report it was shown that dragonfly nymphs composed 82.4 per cent of the

---

[1] Moon, H. P. 1937. Journal of Animal Ecology.

diet of bluegills averaging 117.8 mm. in standard length. In the present instance 90.1 per cent of the bluegill diet was made up by these insects. Surely these figures must be construed as an indication of a preferential feeding habit governed by selectivity as well as by availability. Previous reports on Ford Lake show that Odonata nymphs formed a very significant and sometimes dominant element of the grayling diet until all invertebrate food organisms were crowded from favor by the large amounts of bluegill fry which were consumed.

Although at least sixteen different families of terrestrial insects were represented in the diet, no one family was encountered in more than eight stomachs, and their combined volume accounted for less than 0.5 per cent of the total volume of food consumed. It is likely that, although the day was warm and sunny, terrestrial insects were not available in very large numbers, or their showing would have been more significant. Willingness of the bluegills to feed on surface food was indicated not only by the wide variety of terrestrial insects taken but also by the fact that the entire series of specimens was collected by means of artificial flies taken "dry" or just as they sank. Many fish could be seen resting in the water only a short distance--three to ten inches-- below the surface of the lake, and appeared to manifest immediate interest in any fly, natural or artificial, which struck the water.

Continued observations on the diet of the Ford Lake bluegill population may be expected to yield interesting data on the future fate of the dragonfly fauna of the lake. Because of the prolific nature of the bluegills, their numbers may be expected to increase sharply; and it will be of interest to note whether or not their feeding will result in a diminution of the numbers of dragonflies normally present.

Stomach Contents of 108 Bluegills From Ford Lake, Michigan.

Taken on Flies, May 24, 1939, 2:30 - 5:30 P.M. Clear, Warm.

Organism	Number Stomachs Containing Organism	Average No. Organisms in Stomachs Containing Them	Total Volume	Per Cent of Total Volume
CRUSTACEA (Freshwater shrimp)				
Hyalella knickerbockeri	32	3.5	0.200	0.2
Gammarus sp.	6	9.1	0.125	0.1
EPHEMEROPTERA (Mayfly nymphs)				
Ephemera cf. simulans	9	2.5	0.800	0.7
Stenonema sp.	10	1.0	0.125	0.1
Blasturus sp.	3	1.0	0.025	trace
Baetidae Gen. et sp.	7	1.0	0.025	trace
Caenis sp.	38	3.0	0.575	0.5
ODONATA (Damselfly and Dragonfly nymphs)				
Zygoptera - Gen. et sp.	12	1.3	0.075	trace
Ischnura verticalis	3	1.3	0.050	trace
Enallagma spp.	15	3.4	0.650	0.6
Gomphus spp.	67	2.9	29.400	27.4
Aeshna sp.	19	1.2	4.100	3.8
Anax junius	13	1.1	3.200	3.0
Tetragoneuria cynosura simulans	59	2.0	31.075	29.0
Celithemis elisa	7	1.4	0.825	0.8
Ladona julia	1	1.0	0.275	0.3
Libellula spp.	98	2.0	22.575	21.0
Sympetrum sp.	12	1.7	2.150	2.0
Leucorrhinia sp.	2	2.0	0.625	0.6
Odonate debris	...	...	1.675	1.6
HEMIPTERA (Water bugs)				
Corixidae Gen. et sp.	3	1.0	0.050	trace
Plea striola	1	2.0	trace	trace
COLEOPTERA (Water beetles)				
Dytiscidae Gen. et. sp.	1	1.0	trace	trace
Bidessus sp.	4	2.2	0.025	trace
Hydrophilidae Gen. et sp.	1	1.0	0.025	trace
Haliplus sp., Larva	1	1.0	trace	trace
Family, Gen. et sp.	1	1.0	trace	trace
TRICHOPTERA (Caddisfly larvae)				
Hydroptilidae Gen. et sp.	1	1.0	trace	trace
Leptoceridae (Oecetis et al.)	45	3.4	3.225	3.0
Limnephilidae Gen. et sp.	1	1.0	0.100	trace
DIPTERA (Crangeflies, midges and deerflies)				
Tipulidae, Gen. et sp., larva	1	1.0	0.025	trace
Chironomidae " " " "	72	17.3	1.275	1.2
Chironomidae," " " , pupae	39	1.8	0.075	trace
Chironomidae, adult	1	1.0	trace	trace
Ceratopogonidae, Gen. et sp., larvae	40	2.4	0.150	0.1
Chrysops sp., larva	1	1.0	trace	trace

Stomach Contents of 108 Bluegills From Ford Lake, Michigan.

Taken on Flies, May 24, 1939, 2:30 - 5:30 P.M. Clear, Warm.

(Continued)

Organism	Number Stomachs Containing Organism	Average No. Organisms in Stomachs Containing Them	Total Volume	Per Cent of Total Volume
GORDIOIDEA				
Gordius sp.	1	1.0	0.200	0.2
Homoptera				
Cicadellidae	1	1.0	trace	trace
Fulgoridae	1	1.0	trace	trace
COLEOPTERA				
Carabidae	2	1.5	0.025	trace
Histeridae	2	1.0	trace	trace
Sphindidae	1	1.0	trace	trace
Chrysomelidae	1	1.0	trace	trace
Aphodius sp.	1	1.0	0.050	trace
Family	3	1.6	trace	trace
LEPIDOPTERA				
Family, larva	1	1.0	trace	trace
DIPTERA				
Mycetophilidae	2	1.0	trace	trace
Empididae	2	1.0	trace	trace
Bibionidae	8	1.5	0.275	0.3
Family	3	1.0	trace	trace
HYMENOPTERA				
Family	1	1.0	0.025	trace
Tenthredinidae	1	1.0	trace	trace
Formicidae	3	1.3	trace	trace
ALGAE				
Cladophora sp.	1	1.0	0.025	trace
PISCES				
Fish scales	2	...	trace	trace
ANIMAL DEBRIS	13	...	1.225	1.1
PLANT DEBRIS	33	...	1.975	1.8
			107.300 cc.	100.0%

Per cent total volume, aquatic organisms	96.8
" " " " , terrestrial organisms	3.2
" " " " , all recorded as "trace" combined (0.600 cc.)	0.6
	100.0%