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OBSERVATIONS ON THE NUMBER OF EGGS AND FEEDING HABITS
OF THE CISCO (LEUCICHTHYS ARTEDI) IN
SWAINS LAKE, JACKSON COUNTY, MICHIGAN

by

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While attempting to determine the abundance of Cisco in Swains Lake, the writers secured a number of specimens for stomach examinations and egg counts. The first collection and observations were made December 5, 1939. However, most of the fish included in this study were taken with gill nets between 7 and 9 P.M. December 14, 1939. Stomachs were examined from 84 fish and the ovaries were saved from 9 females - the only specimens which had their egg sacs still intact. All measurements were taken while the fish were in a fresh condition.

Swains Lake is somewhat representative of certain small southern Michigan lakes which consistently support a population of Cisco. It has a surface area of 70 acres and a maximum depth of 64 feet. Marked thermal and chemical stratification exists during the height of the summer period without a critical reduction in the dissolved oxygen in and immediately below the thermocline. This leaves a layer of water suitable for cold water fish as evidenced by the abundance and well being of Cisco.

The first Cisco spawning activity was reported about December 1 by conservation officials and test nets were set on December 5 at which time approximately 50 fish were taken. Most of these had not begun to spawn according

to reports. The final collection made December 14 included mostly "ripe" individuals. All of the males and all except 9 of the females had actually begun to spawn. The surface water temperature was practically at the freezing point and some thin ice crystals had begun to form near shore by late afternoon. Numerous Cisco were seen to break water during the early evening and as many as a dozen disturbances were seen at one time. There seemed to be no concentration of these fish. About as many were seen out over deep water as were observed over the shoals. By 9 P.M. of this date (at the time the gill nets were lifted) the lake had frozen completely over and the ice remained on the lake until the following spring "break-up".

Examination of the Cisco captured indicates that the spawning of these fish was about at its height. None of the specimens taken were completely spawned out and most of the females had just begun egg deposition. It would seem safe to assume, although no subsequent check was made, that spawning must continue for quite a period after the ice is formed.

There were 28 males and 56 females in the collection, or a ratio of 1:2. This ratio persists quite consistently through the different age classes (Table I).

Table I
The Age, Sex Ratio and Size of Cisco From Swains Lake.

| Age | Number males | Average total length in inches | Average weight in pounds | Number females | Average total length in inches | Average weight in pounds |
|-----|--------------|--------------------------------|--------------------------|----------------|--------------------------------|--------------------------|
| 4 | 4 | 15.53 | 1.32 | 1 | 15.00 | 1.38 |
| 5 | 8 | 15.75 | 1.40 | 14 | 15.65 | 1.52 |
| 6 | 7 | 15.82 | 1.43 | 17 | 15.74 | 1.59 |
| 7 | 9 | 16.05 | 1.34 | 19 | 15.77 | 1.54 |
| 8 | ... | ... | ... | 1 | 16.25 | 1.77 |
| 9 | ... | ... | ... | 3 | 16.25 | 1.58 |
| 10 | ... | ... | ... | 1 | 16.88 | 1.75 |

The collection of spawning fish have an age range of 4 - 10 years inclusive, with the age classes of five, six and seven accounting for 85.7 per cent of the entire sample. There was less than two inches difference in the standard lengths

of the smallest and largest fish and no great difference in the average weights of the youngest and oldest fish.

Actual egg counts made on 9 females is given in Table II. These fish

Table II
The Weight, Lengths, Size of Ovaries and
Number of Eggs for Nine "Cisco" Females.

| Standard length in inches | Total length in inches | Total weight in pounds | Weight of ovaries in grams | Number of eggs | |
|------------------------------|---------------------------|---------------------------|-------------------------------|----------------|--------|
| 12.50 | 15.25 | 1.48 | 128.2 | 23,272 | |
| 12.87 | 15.50 | 1.65 | 193.0 | 30,967 | |
| 13.00 | 15.37 | 1.62 | 152.8 | 28,243 | |
| 13.12 | 15.50 | 1.75 | 174.2 | 33,641 | |
| 13.25 | 15.67 | 1.72 | 178.5 | 32,505 | |
| 13.25 | 15.87 | 1.86 | 201.5 | 35,457 | |
| 13.37 | 15.87 | 1.80 | 181.7 | 37,272 | |
| 13.50 | 16.25 | 1.77 | 153.7 | 24,795 | |
| 13.50 | 16.25 | 1.79 | 182.9 | 26,804 | |
| Av- erage | 13.15 | 15.72 | 1.72 | 171.83 | 30,328 |

averaged 30,328 eggs each with the largest individual count being 37,272. There seems to be no correlation between the size or age of the fish and the number of eggs produced, although 9 fish is not an adequate number to give much significance to this point.

The usual method of estimating the number of eggs by weighing and counting small samples was tried on three fish along with actual counts of all the eggs for these same specimens. Samples were taken at random after the ovary had been broken up and the eggs well mixed. The results appear below.

| Specimen number | Total weight of ovary in grams | Weight of sample in grams | Estimated number of eggs | Actual number of eggs | Per cent error |
|-----------------|--------------------------------|---------------------------|--------------------------|-----------------------|----------------|
| 1 | 154.65 | 5 | 31,023 | 28,243 | 9.8+ |
| | | 5 | 28,425 | 28,243 | 0.6+ |
| | | 5 | 28,138 | 28,243 | 0.4- |
| | | 70 | 29,663 | 28,243 | 5.0+ |
| | | 70 | 26,617 | 28,243 | 5.7- |
| 2 | 193.52 | 10 | 34,358 | 30,967 | 10.9+ |
| | | 10 | 29,848 | 30,967 | 3.6- |
| | | 50 | 30,643 | 30,967 | 1.0- |
| 3 | 173.0 | 5 | 39,341 | 32,505 | 21.0+ |
| | | 5 | 31,451 | 32,505 | 3.2- |
| | | 5 | 34,254 | 32,505 | 5.3+ |
| | | 70 | 30,658 | 32,505 | 5.7- |

According to these few data the 5 gram samples were about as accurate (average per cent error 6.7) as the 70 gram samples (average per cent of error 5.4).

The stomachs were examined from 87 Cisco from Swains Lake and four from Browns Lake. While most of the fish in Swains Lake were feeding to some degree, only 8 fish actually had full stomachs. This may be explained by the fact that most of these fish were actually in the act of spawning. The four from Browns Lake on the other hand had completed spawning and all had full stomachs.

A summary of the analysis of the stomach examinations is given in Table III.

The numbers of organisms present are estimates based on partial counts.

Table III
Summary of Stomach Analysis

| | | |
|-----------------------------|---------------------------|----|
| Number of stomachs examined | | 91 |
| Number of stomachs empty | | 5 |
| Number of stomachs with | 1 - 10 plankters | 47 |
| Number of stomachs with | 11 - 100 plankters | 22 |
| Number of stomachs with | 101 - 1000 plankters | 5 |
| Number of stomachs with | 1001 - 5000 plankters | 2 |
| Number of stomachs with | 5001 - 10,000 plankters | 3 |
| Number of stomachs with | 10,001 - 20,000 plankters | 7 |

An analysis of the contents of the 12 full stomachs is shown in

Table IV.

Table IV
Analysis of 12 Full Cisco Stomachs
Swains Lake

| Total volume of water displacement | Organisms | | | Total number of organisms |
|---------------------------------------|-----------|-----------|---------------|------------------------------|
| | Daphnia | Diaptomus | Miscellaneous | |
| 34.2 | 13,954 | 205 | Cisco eggs | 14,159 |
| 27.6 | 19,278 | 980 | ... | 20,258 |
| 27.3 | 11,630 | 600 | ... | 12,230 |
| 26.2 | 15,144 | 550 | ... | 15,694 |
| 25.1 | 15,831 | 627 | ... | 16,458 |
| 25.8 | 10,036 | 387 | ... | 10,423 |
| 18.3 | 3,650 | 64 | ... | 3,714 |
| 18.0 | 2,412 | 180 | ... | 2,592 |

Browns Lake

| Total volume of water displacement | Organisms | | | Total number of organisms |
|---------------------------------------|-----------|-----------|----------|------------------------------|
| | Daphnia | Diaptomus | Rotifera | |
| 16.9 | 6,160 | 110 | 135 | 6,405 |
| 32.0 | 11,776 | 112 | 128 | 12,016 |
| 34.6 | 8,685 | 484 | 242 | 9,411 |
| 14.8 | 6,949 | 22 | 37 | 7,008 |

As can be seen, Daphnia, Diaptomus, and Rotifera made up the great bulk of the stomach contents. Such miscellaneous items as Cisco eggs, corethra and dragonfly nymphs were found in the stomachs of 6 fish. Tapeworms of an unknown species were present in the stomachs of 44.4 per cent of the fish studied.

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