

1/20/48  
C.W. Creaser

### INTRODUCTION

by John F. Lyell - Sept 17, 1948

The purpose of this paper is a study of the life history, habitat, distribution, and ecology of the Gasterosteidae in northern Lake Michigan. It was conducted under the supervision of Dr. Charles W. Creaser.

Much help and advice were received from Dr. <sup>Lyell</sup>~~Ely~~ J. Thomas and Mr. Norman J. Wilimovsky. To these persons I wish to express my appreciation, and to the Biological Station of the University of Michigan for making this study possible.

### AREA UNDER INVESTIGATION

The area examined was that approximate to Lake Michigan in Emmet and Charlevoix Counties.

In Charlevoix County, the Beaver Island Group was examined. The following islands of this group were investigated: Beaver Island (St. James Bay), Garden Island (Indian Bay), Hat Island, Hog Island, Pismire Island, Shoe Island, and an unnamed island just southeast of Garden Island.

In Emmet County the following areas were investigated: In and about Wilderness Park (Trout Creek, Big Stone Bay Creek, and Big Stone Bay), and Waugoshance Point.

### Field Observations:

Eucalia inconstans was collected in the following places:

- 1) Tributary to Big Stone Bay in Emmet County. Time: 3:15-3:45 P.M.
- 2) Trout Creek (a tributary to Carp lake) June 24, 1948
- 3) Beaver Island (St. James Bay) July 26, 1948
- 4) Trout Creek July 21, 1948

5) C C C Pond (Wilderness Park) July 21, 1948

6) Big Stone Bay Creek July 21, 1948

7) Cheboygan River July 7, 1948

Water: Brown and clear Drainage: Lake Michigan

Vegetation: Sagittaria, Eleocharis Smallii, Anacharis canadensis

Bottom: Mud and debris Air Temp. 60 - 65° C

Shore: Sandy with some grass Current: not noticeable

Depth of capture: 3 feet

Date: 7/17/1948 Time: 3:15 - 3:45 P. M.

Common Associatife Fish in relative order of occurrence were:

Salvelinus fontinalis

Umbra limi

Chrosomus eos

Margariscus margarita

Rhynichthys atratulus

#### METHODS OF STUDY:

The procedure of study was divided into two separate fields. Eucalia inconstans, the brook stickleback, was studied in the small streams and tributaries in the Wilderness Park area. Pungitius pungitius, the nine spined stickleback, was studied in the Big Stone Bay, Waugoshance Point, and the Beaver Island Group.

#### I. Eucalia inconstans

The mating and spawning of Eucalia inconstans has been recorded in many sources. (Gill 1907, Forbes and Richardson

1920, Norman 1931, Boardman 1944).

The male is the central figure, being the nest builder and nest protector. The nest is made from aquatic flora, usually rigid substance, such as reeds, sticks, grasses, etc. The female is forced to enter this construction and deposit her eggs. The male then enters, spreads milt over these, and guards the nest until the fry emerge. He also aerates the eggs daily, takes them from the nests and turns them, and generally keeps the nest and environment clean. These duties continue until the fry are old enough to care for themselves. (Gill 1907, Norman 1931). The above facts are well established.

A trip was made to Trout Creek for the purpose of observing spawning. The method used was to locate nests, breeding males, etc. by means of a glass bottomed bucket. Due to the limited amount of light, silt in the stream, and limited field of vision of the bucket, not to mention the smallness of the nest, etc. searched for, no such nest or activity were observed. *Eucalia* apparently were not breeding, for they were observed swimming side by side with small *Salvelinus fontinalis*, a procedure not common in breeding activities, where associations with other fish are rare or unheard of (Norman 1931). Of course there is the possibility that these may have been female fish, for it is almost impossible to differentiate sexes from external colors, and the variance in color in *Eucalia* is tremendous.

### Aquaria Observations.

Specimens were collected and were brought back and kept in various aquaria. Four methods were tried: (1) A small amount of water in a glass aquarium 12 x 9 x 6½ inches, in which an ample amount of sand, small rocks and Elodea had been placed. Into this tank air was pumped from a Marco pump. (2) The same setup as above, except in place of pumped air, running water was allowed to enter and leave the aquarium. (3) The above setup was used, without pumped air or running H<sub>2</sub>O, only it was placed in a refrigerator at about 2½° C. (4) The original setup was used without pumped air or running H<sub>2</sub>O, only the water was changed about three times a week. The last method seemed to give the best results. The fish in the running water seemed to be readily killed by Saprolegnia parasitica. The brook stickleback also preferred a more slow running, shallow stream than that which could be obtained in the aquarium. Those placed in the refrigerator survived in a satisfactory manner, but were so lethargic that no deductive observations could be made. One interesting observation was made in connection with the temperature change undergone when the fish were put into, and at a later date removed from the refrigerator. This was the color change undergone by the fish. A similar phenomenon was observed, especially the males, in a paper by Merriman and Schedl (1941) where it was pointed out that this color change accompanies gametogenesis. The fish, when returned to normal

temperatures, were seen to regain their breeding colors, and eggs were observed, though no nest building or fertilization occurred.

Another strange observation was the hyperactivity noted in these fish which lived in the tank, into which air was pumped. Those in the aquarium with running water were active, but not to the degree of these other fish. There is a possibility that the high oxygen concentration of the water was the etiological factor, but this remains to be proven.

The fish were fed zooplankton, and seemed to survive on it. Oddly enough, the smaller forms seemed to survive better than the more mature forms, the susceptibility to fungus of whom was quite marked.

Field Observations.

Specimens of Pungitius pungitius were collected in the following places: Number of specimens collected per trip:

- 1) Big Stone Bay, Emmet County, Michigan -- 24 -- 20 -- 16 -- 14 -- 8 -- 2
- 2) Waugoshance Point, Emmet County -- 4 -- 2 --
- 3) St. James Bay, Charlevoix County -- 6
- 4) Unnamed Island southeast of Garden Island, Charlevoix County... 7 (from terns)

The typical biological conditions were as follows:

Water: White, Clear

Vegetation: None; small amount of algae on rocks.

Bottom: Sand, boulders, occasional debris

Water temperature: 18° C                      Air temperature: 22° C

Distance from shore: to 30 yards              Tide: None

Depth of capture: to 4 feet                      Depth of water: to 5 feet

Common Associative Fish in order of relative occurrence:

Notropis hudsonius

Rhinichthys cataractae

Catostomus commersonnii

Boleosoma nigrum

Percina caprodes

Notropis athernooides

II Pungitius pungitius

Only one mention of the spawning and breeding has been found in the library of the Biological Station of the University of Michigan (Gill 1907). This report was neither conclusive nor applicable to the prevailing situation.

The problems that arise when one studies the life history of Pungitius are quite complex when contrasted with Eucalia. Nowhere within my investigations has any information been cited that suggests habitat preference of these fish. This, then, was the first study undertaken.

Fish were taken in Big Stone Bay and Waugoshance Point in Emmet County and in St. James Bay, Beaver Island in Charlevoix County

Fish had been taken regularly by the Ichthyology class of the Biological Station of the University of Michigan in Big Stone Bay in Emmet County. Pungitius was collected here on four trips this year, but not in sufficient numbers to consider this as habitat preference for the fish. Other areas

-7-

were seined in the Beaver Island Group, and although no great number of Pungitius were actually seined, numerous ones were found in regurgitated specimens from gulls and terns to indicate the presence of the fish in rather large numbers somewhere in this area. This led to two postulations: (1) That the fish must inhabit the Pelagic region (or Limnetic in fresh water terms) of Lake Michigan. This was upheld by watching terns feed in this area, and secondly because other areas (littoral, sublittoral, etc.) were seined with no results in areas where fish are known to be present. (For habitat preference and ecology, see table above.) (2) That these fish are found in this Pelagic region in rather large schools. This is verified by the fact that the majority of fish preferred for food by these terns was found to be this fish, and in order for this to be true the fish must be present in fairly large numbers. Further work at Waugoshance Point has indicated the sporadic appearance and disappearance of these fish in ample numbers to uphold the original theory. The fish were reported to be on a sand bar on the Point, but when the area was completely covered the next day, no specimens of Pungitius were collected. On a later date another group of these fish was found by the author in a pool in the center of another bar in this same locality. I think that the particular school of Pungitius that these individuals belonged to, was forced inland by a prevailing wind, and this group of fish were washed ashore. All indications point to this situation being true, for the habitat is exactly similar to that of the Beaver Island Group, as is the area in Big Stone Bay where the fish are taken regularly in small numbers.

A possible third indication of the preference of Pelagic habitat may be postulated from the general external characteristics of the fish. The coloration, that of countershading — silver below and rather dark or stippled above, is indicative when compared to a known Pelagic fish such as Notropis atherinoides. Secondly, the position and construction of the mouth points to the same conclusion. This factor is further upheld by watching terns feeding, and observing that this feeding is accomplished only in very shallow depths and consequently they must capture these fish when the sticklebacks are at the surface. Another indication of this Pelagic form is found in the keeled caudal peduncle of Pungitius and also the caudal fin. This is analogous to such salt water forms as the mackerel, yellow jack, and albacore.

No attempt was made to observe the breeding adults of Pungitius, for the general consensus is that the breeding occurs in the late spring. This theory was upheld by the concave appearance of the abdomen of the living forms believed to be female, indicating a possible loss of roe. Secondly, breeding observations were always hampered by the weather and location of the fish. One attempt was made to capture fry in the Big Stone Bay area, by means of an oceanographic half-meter trawl, but none <sup>were</sup> ~~was~~ found.



## Aquaria Studies.

As in the five spined cousin, different methods were tried for the rearing of this fish. One previous attempt having failed, that of keeping the fish in deep water in a cylindrical glass tank,  $10\frac{1}{2}$  inches high, and 10 inches in diameter, the fish were next placed in an aquarium 6 x 8 x 8 inches. As in the case of the brook stickleback, these fish were placed in the refrigerator, rocks, sand, and Elodea being added. Here fish survived, but they were too sluggish to note any specific activity. When the aquarium was removed from the frigid temperature, a marked increase in activity was observed, and feeding could be observed. The predominant manner in which the specimens are now living is at room temperature, the H<sub>2</sub>O being changed twice a week. The fish seem to prefer rather shallow water, and do their feeding at the surface. Their diet is chiefly zooplankton, insect larvae, and any phytoplankton they obtain from the Elodea.

## CONCLUSION

### I Eucalia inconstans

- 1) The life history of Eucalia inconstans has been observed, and can be found in the literature from many sources.
- 2) Eucalia inconstans may be collected in any stream having the specified characteristic, but the main prerequisites seem to be fairly dense aquatic vegetation, a rather muddy

bottom, and a slow-moving current.

- 3) Eucalia inconstans may be kept in aquaria and possibly made to breed. The optimum conditions seem to be sand, rocks, aquatic vegetation, and water which is changed once or twice a week.
- 4) When Eucalia are submitted to low temperatures (around  $2\frac{1}{2}^{\circ}$  C) there is a marked color change, and also a pronounced decrease in activity.

## II. Pungitius pungitius

- 1) Few records have been made of the activities of this fish. One such account was found in the literature (Gill 1931), but the evidence cited was not conclusive.
- 2) From all indications, Pungitius pungitius is a Pelagic fish. The general external characteristics, as well as general habitat preference, point to this conclusion.
- 3) There are indications that the fish travel in rather large schools. This is postulated from the sporadic appearance and disappearance of these fish in the Emmet County area.
- 4) These fish were kept in aquaria with fairly good success. The situation that seemed to be most compatible was that similar to the method used in Eucalia inconstans, small rectangular aquaria, with the water at room temperature. Sand, small rocks, and Elodea being added.
- 5) A marked increase in activity was also observed when these fish were taken from a frigid environment ( $2\frac{1}{2}^{\circ}$  C).

SUMMARY

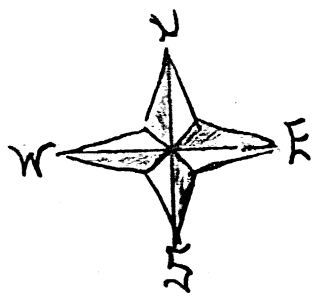
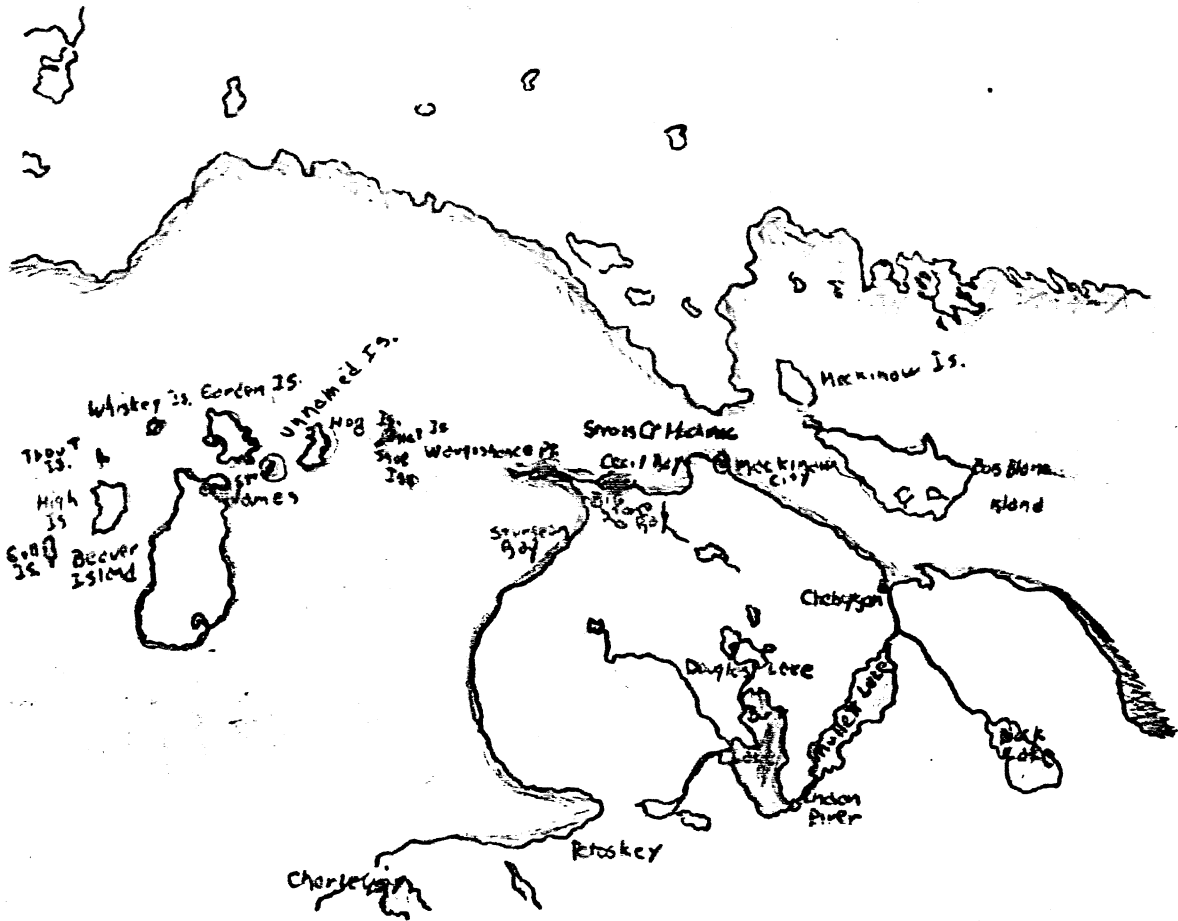
- 1) Eucalia inconstans, the brook stickleback, was taken in the small streams in Emmet County, Michigan.
- 2) The typical environment of this fish seemed to be a shallow, slow-running stream, in which ample vegetation was present.
- 3) Fish may be kept with success in an aquarium at room temperature.
- 4) Fish will also survive in a frigid temperature, but their activity is greatly reduced.
- 5) Pungitius pungitius, the nine spined stickleback, was taken in the Littoral area of Big Stone Bay, Waugoshance Point, and St. James Bay in the Beaver Island Group, Emmet and Charlevoix Counties, respectively.
- 6) These fish were not taken in ample number to indicate any typical habitat, therefore the fish were concluded to be Pelagic fish.
- 7) The strange manner in which the fish were caught in cycles seems to indicate a schooling character in these fish.
- 8) The general external characteristics of these fish are indicative of a Pelagic or deep water form.




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LOCALITY MAP



-  area where Pungitius was taken
-  " " " " reported
-  " seized in search of Pungitius.