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A FURUNCULOSIS EPIZOOTIC IN CLEAR LAKE YELLOW BASS [1]

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Abstract

A furunculosis epizootic during May 1968 decimated the yellow bass population in Clear Lake, Iowa. Loss in body weight during the previous year and reduced fecundity suggested that inadequate nutrition resulting from over-population was a causal factor.

Introduction

Furunculosis caused by *Aeromonas salmonicida* is a common disease of freshwater fishes and has been investigated intensively for several decades (Herman, 1968). The disease wreaked havoc in salmon and trout hatcheries throughout the United States in the early 1930's and was originally thought to be an infection of salmonids found only in the hatchery. Outbreaks of the disease in wild populations are common today, and the list of affected species continues to grow. This paper reports a major furunculosis epizootic of yellow bass, *Morone mississippiensis,* which occurred at Clear Lake, Iowa, in May 1968. An earlier outbreak at Clear Lake in 1965 appeared to be the first record of furunculosis in yellow bass (Atchison, 1967).

Clear Lake is a natural eutrophic lake of 1,474 hectares located in north-central Iowa in western Cerro Gordo County. Bailey and Harrison (1945) listed 23 species of warm-water fish in the lake. The yellow bass was introduced about 1932 and has fluctuated widely in abundance since that time. Frequently, it has been the most abundant species of fish present.

Methods

From April 1967 to September 1968, adult yellow bass were gillnetted weekly from Clear Lake in the spring and at monthly intervals for the rest of the year. Young-of-the-year fish were obtained by seining shoreline areas during July and August for evidence of reproduction success. Methods of body measurements and fecundity estimates were described by Bulkley (1969).

Water-temperature data were obtained from the City of Clear Lake water-treatment plant where water is withdrawn from the lake at a depth of 3 meters.

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Results

On May 21, 1968, numerous moribund yellow bass were observed near the surface of Clear Lake. The bass made only feeble attempts to avoid capture. Within 2 days after onset of the epizootic, mortality was extensive and reached a peak within 7 days. By May 29, a major portion of the bass population had succumbed.

Examination of the fish revealed a generalized fungal growth on the epidermis. Internal organs appeared normal, although the lining of the lower intestine was slightly inflamed on occasional specimens.

Presumptive tests conducted by biologists of the U.S. Fish and Wildlife Service at the Genoa, Wisc., National Fish Hatchery indicated the presence of *Aeromonas salmonicida*. Growth of the bacterium was abundant on Difco's "Bacto" furunculosis agar. The colonies developed purple-black pigment after the addition of 1-percent aqueous para phenylenediamine. Brown pigment developed after prolonged incubation. Bacteria isolated from the culture were gram-negative, nonmotile rods. Lack of symptoms, such as obvious furuncles, and rapid mortality suggested that most bass were afflicted with the acute form of furunculosis (Herman, 1968).

McCraw (1952) reported that optimum growth of *Aeromonas s.* occurs between 10 and 22 C, and temperatures normally must be within 13 to 19 C (55-56 F) before a major epizootic will occur in nature. Examination of Clear Lake water temperatures during May 1968 supported this observation (Fig. 1). Water temperature reached 13 C on May 2 and remained above this level for 5 days before dropping to 10.5 C on May 11. On May 13, temperatures again

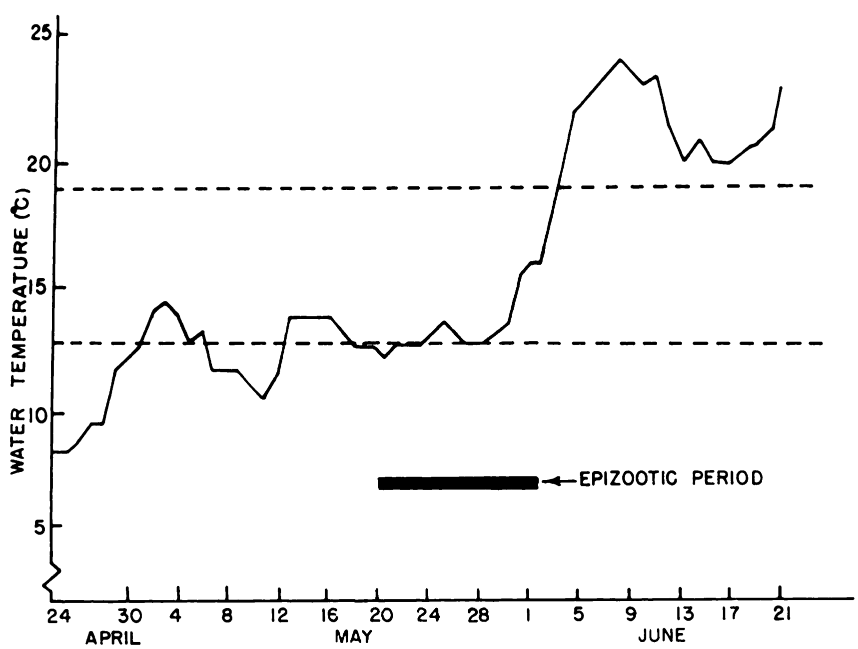

FIGURE 1. *Clear Lake water temperatures in relation to furunculosis epizootic, May 1968. Broken lines encompass the optimum temperature range for epizootic outbreak; the broad horizontal line represents the epizootic period.*

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climbed above 13 C and remained at or above this level for the 7-day period preceding the epizootic. Mean water temperature during the epizootic was 13.4 C.

An epizootic temperature threshold of 13 C coincides with spring spawning temperatures of yellow bass. Clear lake yellow bass initiate spawning activity on rising water temperatures at ca 13 C (Bulkley, 1969). Peak spawning cccurs at 15-16 C. In 1968, spawning commenced around April 30. From April 30 to May 21, an increasing percentage of female bass examined contained ovaries in a state of complete atresia. The atresia might have been caused by a 4-C drop in water temperature that occurred between May 3 and 11 (Fig. 1). However, furunculosis, which reached epizootic levels by May 21, was a more likely cause.

All age classes of yellow bass were affected by the disease. A random sample of 23 dead bass collected along the shoreline on May 21 contained 7 fish of Age II, 5 fish of Age III, 4 fish of Age IV, 5 fish of Age V, and 1 fish each of Ages VI and VIII. The epizootic did not result in observed mortality of other fish species, although black bullheads, *Ictalurus melas*, were exceedingly abundant in the lake.

Accurate mortality estimates were not feasible because of the lake size and duration of the epizootic. Fish were floating into shore over a 2-week period. Counts of fish at approximately 2-kilometer intervals along the shoreline on May 29 provided an estimate of 380,000 dead yellow bass (31.2 metric tons). Confidence intervals exceeded the estimate, however, due to wide variation in numbers of fish found within individual sampling sites. This estimate, although thought to be well below actual loss, did indicate that the mortality was considerable.

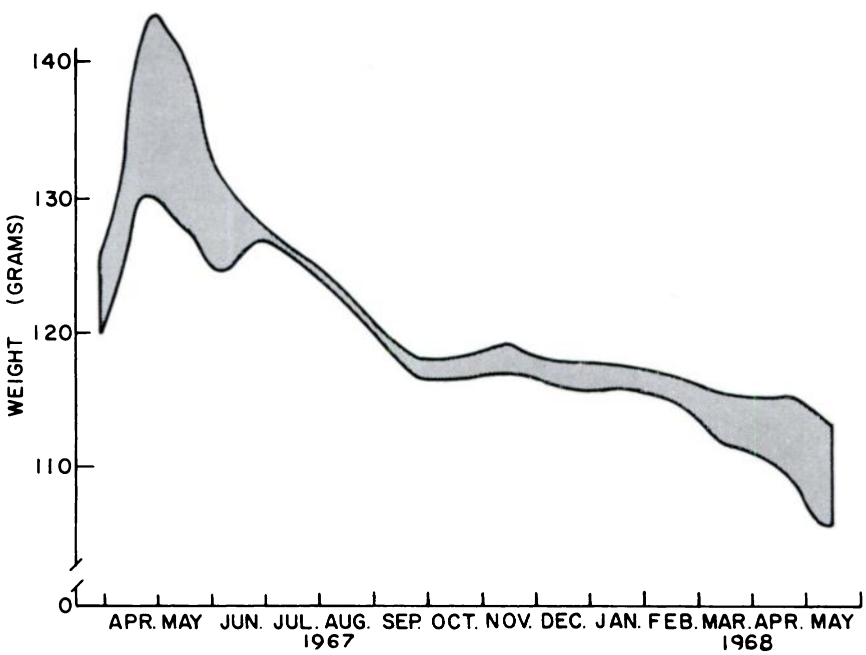

FIGURE 2. *Seasonal changes in computed body weight of 200 mm female yellow bass with and without ovaries. The solid black represents ovary weight; the upper edge of the black represents total body weight, and the lower edge the body weight minus ovaries.*

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More precise data on change in relative abundance of yellow bass were obtained from gillnet catches taken April 29 to July 29, 1968 (Table 1). On June 11, 1 adult and 2 yearling bass were captured with 119 hours of gillnetting effort. Previous catches exceeded 1 bass per gillnet hour. The decrease in catch was not related to any change in fish distribution with the onset of warmer weather, as indicated by comparison of summer gillnet catches from 1965 to 1968. Weekly gillnet sampling is conducted on a systematic basis at Clear Lake during July and August each year to obtain an index of relative fish abundance. Catches per gillnet hour of yellow bass during the 4-year pericd were: 1965, 2.633; 1966, 1.032; 1967, 2.009; and 1968, 0.029. With similar effort, 703 yellow bass were netted in 1967 in contrast to 8 fish in 1968.

During the year before the epizootic, a distinct decrease in mean body weight of adult bass occurred (Bulkley, 1969). The change in weight was evident by plotting computed weights of fish at a selected body length of 200 mm for each collection date (Figs. 2 and 3). The upper line in the figure represents the mean body weight; the lower line represents body minus gonad weight.

TABLE 1. *Catch per hour of Clear Lake yellow bass by 125-foot experimental gillnet April to July, 1968*

Date	Hours of effort	Catch per gillnet hour
April 29	45	0.967
May 6	64	1.219
May 13	73	2.158
May 20	67	0.735
May 28	73	0.108
June 11	119	0.025
July 29	36	0.000

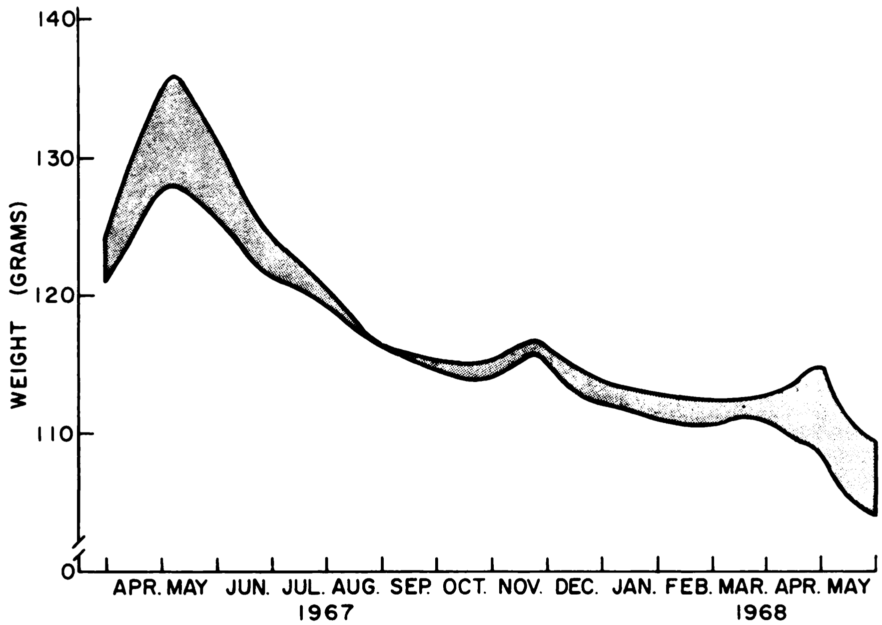

FIGURE 3. *Seasonal changes in computed body weight of 200 mm male yellow bass with and without testes. The solid black represents testes weight; upper edge of the black represents total body weight and the lower edge the body weight minus testes.*

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Hence, the blackened area represents mean gonadal weight. The figure is somewhat diagrammatic in that the curves were plotted from the rolling averages of three sample values. Body weight as well as gonadal weight increased in both sexes before spawning in May 1967. Upon spawning, the fish commenced losing weight and continued to do so until the following May when the epizootic occurred. The average female measuring 200 mm weighed 137 grams at spawning time in 1967 but only 115 grams in 1968, a 16-percent decrease. The average male was approximately 13 percent lighter in body weight at spawning in 1968 than in the previous year. Gonads at spawning time were similarly reduced in size in 1968.

The change in mean ovarian weight reflected a large difference in potential fecundity for the two years. Estimates of mature ova in ovaries just before spawning in 1967 ranged from 51,300 ova in a 182-mm female to 282,400 ova in a fish 197 mm total length. The 1968 estimates ranged from 82,400 ova in a fish 196 mm long to 156,000 ova in a female 202 mm long. On the basis of ova production per unit of body length, a female measuring 200 mm produced an average of 1,041 ova per mm body length in 1967 and 598 ova per mm body length in 1968. Hence, potential fecundity was approximately 40 percent lower in 1968.

Ovaries of females examined during May indicated few fish actually spawned to any extent before the epizootic. The resulting low abundance of offspring supported conclusions drawn from gonadal observation. Reproduction success of Clear Lake fishes has been monitored annually since 1946. Nine stations around the lake, representing different habitat types, are seined at dusk once weekly during July and August. Because of sampling variation, the method reflects only gross differences in the young-of-the-year population, but it does provide evidence of successful or unsuccessful reproduction. During the 6-week period ending August 31, 1967, 7,015 young-of-the-year yellow bass were captured. In 1968, with similar seining effort by the same personnel, 77 young bass were collected. Yellow bass reproduction in 1968 was the lowest recorded for the 13-year period from 1956 to 1968 (Bulkley, 1969) and reflected the impact of the epizootic on the population.

Discussion

Loss of body weight in yellow bass for a 12-month period during 1967 and 1968 and reduced fecundity suggested that nutritional deficiency because of over-population precipitated the 1968 epizootic. Inadequate nutrition has been shown to depress resistance to bacterial infection (Lopez-Toca, 1955). Timing of the epizootic agreed with reports that natural resistance of fish is at its lowest ebb toward the end of the winter fast, when lack of plasma proteins may inhibit antibody production (Snieszko, 1958).

It is postulated that the large 1967 year class of yellow bass created sufficient additional competition for available food that the population suffered severe nutritional deficiency and resistance to disease was lowered. When spring arrived, stress from fluctuating water temperatures and spawning activity further weakened the fish. The population was sufficiently high that, as temperatures warmed to levels suitable for optimum growth of *Aeromonas s.*, the infection rapidly spread and assumed epizootic proportions.

It is not known how long *Aeromonas s.* has existed in Clear Lake, but a smaller mortality of yellow bass in June 1965 was also attributed to furunculosis (Atchison, 1967). Other dieoffs occurred in earlier years, but the cause of mortality was not determined. The yellow bass has been noted for its slow growth and stunting tendencies in Clear Lake, presumably because of overpopulation and lack of food (Buchholz and Carlander, 1963). It appears likely that many of the fluctuations in abundance of this species

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have resulted from disease induced by a high population density and inadequate nutrition.

Further investigation will be made to determine the carrier rate of furunculosis in the yellow bass population as well as incidence of the disease among other fish species in the lake.

Acknowledgements

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