

THE POTENTIAL OF TWO NATIVE CALIFORNIA FISH IN THE BIOLOGICAL CONTROL OF CHIRONOMID MIDGES (DIPTERA:CHIRONOMIDAE)

S. F. COOK, JR.

Lake County Mosquito Abatement District, Lakeport, California

During investigations into the trophic relationships between the midges and fish of Clear Lake, Lake County, California, it was observed that at least two species of fish native to this body of water feed extensively upon the larvae of chironomid midges. Although the impact of these fish in the maintenance of population levels of chironomids in Clear Lake is partially negated by other factors, results from this work indicate a real potential in these fish as biological control agents for these midges under certain conditions.

The fish of concern here are the prickly sculpin, *Cottus asper* Richardson (Cottidae), and the freshwater viviparous perch, or tule perch, *Hysteroecarpus traskii* Gibbons (Embiotocidae). Both are native California fish that are little known or appreciated except by the ichthyologist. Neither are game species, nor are they generally considered detrimental to a sport fishery. Both species occur in moderate abundance in Clear Lake where most of the present observations were made. Because the emphasis in this study was directed towards the chaoborid midge, *Chaoborus astictopus* Dyar and Shannon, no attempt was made to identify the chironomids found in the fish stomachs below the family level.

Both the prickly sculpin and tule perch are apparently adaptable to a wide variety of habitats and conditions. In Clear Lake they survive temperatures ranging between 40-80° F. From all indications they spawn after one year. Both species have been taken in Clear Lake from the high littoral shoreline zone and from the limnetic and profundal zones well out toward the middle of this large lake. They are relatively small, generally compatible with other fish, and have been observed to attain high densities under suit-

able conditions and in the absence of predatory species.

The stomach contents of 64 sculpins were examined from Clear Lake. Of these 64 stomachs, 47 (73.3%) contained chironomid midge remains. This amounted to 73.5 percent by volume of all the food consumed by these fish. The latter value was by far the highest of the 18 fish species examined during this study. A seasonal breakdown of the food consumption indicated that the sculpins feed heavily upon midge larvae throughout the year.

C. asper is one of two common freshwater sculpins in interior central California. It is, however, the only species that frequents lakes, although it is found commonly in some of the larger drainages. As are most representatives of this family, *C. asper* is typically a littoral bottom species, usually found under rocks or other cover. In Clear Lake, however, it frequently has been taken 2 miles offshore in minnow traps set on the bottom where no cover exists; it has also been the most frequent fish taken at night in plankton nets near the surface in the same area of the lake. This indicates that *C. asper*, at least in Clear Lake, will utilize the offshore area where the majority of the chironomid midges develop.

Eddy (1957) indicates that *C. asper* attains a length of 12 inches and ranges in coastal streams from Ventura County in southern California to Alaska. Of the several hundred individuals observed from Clear Lake, however, the largest was about 3¼ inches. The average length was approximately 1½ inches. Why this species does not attain larger size in this area is not known. There is, however, a taxonomic problem concerning this highly variable group that is beyond the scope of this report.

Although the prickly sculpin in Clear Lake is relatively common, it appears to be held down by heavy predation from the introduced game species. The smaller largemouth blackbass, for example, feed upon them extensively even though other forage fish are considerably more abundant.

Little is known of the ability of this sculpin to withstand polluted waters, or conditions otherwise unfavorable for most fish. Other related species, however, are noted for this ability. The staghorn sculpin, *Leptocottus armatus* Girard, an euryhaline species associated with many coastal bays, sloughs, and estuaries, is frequently found in polluted waters where few other fish can survive. *Cottus asper* has been found to be one of the more tolerant species of fish in Clear Lake to conditions of low dissolved oxygen concentrations.

H. traskii, the tule perch, is also a representative of a large family that is almost exclusive marine, this species being the only freshwater representative in the United States. Of 143 stomachs from Clear Lake specimens, 57 (40.6%) contained chironomid larvae or pupae; this represented 23.1% by volume of the total food consumed by these fish. Unlike the sculpin, the perch was observed to feed most heavily upon the chironomids during the summer months, at which time the percent by volume of midges in the stomachs approached 50 percent. In winter and early spring it feeds to a larger extent upon the zooplankton which is very abundant in this eutrophic lake. The perch feeds less from the bottom than the sculpin and probably consumes more of those midge larvae present in the open water.

The range of *H. traskii* as given by Eddy (1957) is central California, mostly

in the Sacramento River drainage. Although this fish is not generally noticed by the sportsman, it is moderately abundant in some of the larger streams and in a few lakes and reservoirs. The maximum length is about 6 inches; the average length in Clear Lake is about 4 inches. In this lake, the tule perch is generally dispersed throughout the major zones. In the late spring or early summer they tend to concentrate along the shoreline where spawning takes place. The average female gives birth to perhaps 2 dozen fully developed young about 1 inch in length.

Although the freshwater perch is difficult to maintain in aquaria, it is nevertheless very hardy and will also withstand conditions of low dissolved oxygen concentrations. This species has been taken in moderate numbers in the polluted Napa River below the effluent of a major sewage treatment plant. Detergent foam at times covers the water in this stretch of river.

Increasing numbers of sewage, industrial, and domestic water impoundments in urban and suburban areas are creating serious midge problems. The use of fish to alleviate some of these problems is a very practical solution if the proper fish can be found to effect control under the environmental conditions imposed in any particular case. Although the potential of *C. asper* and *H. traskii* as chironomid controls has not been put to test under controlled conditions, on the basis of the limited biological data available, it would appear that these species have real potential in this regard under conditions that would favor their optimum development.

References Cited

- EDDY, S. 1957. How to Know the Freshwater Fishes. W. C. Brown Co., Dubuque, 253 pp.