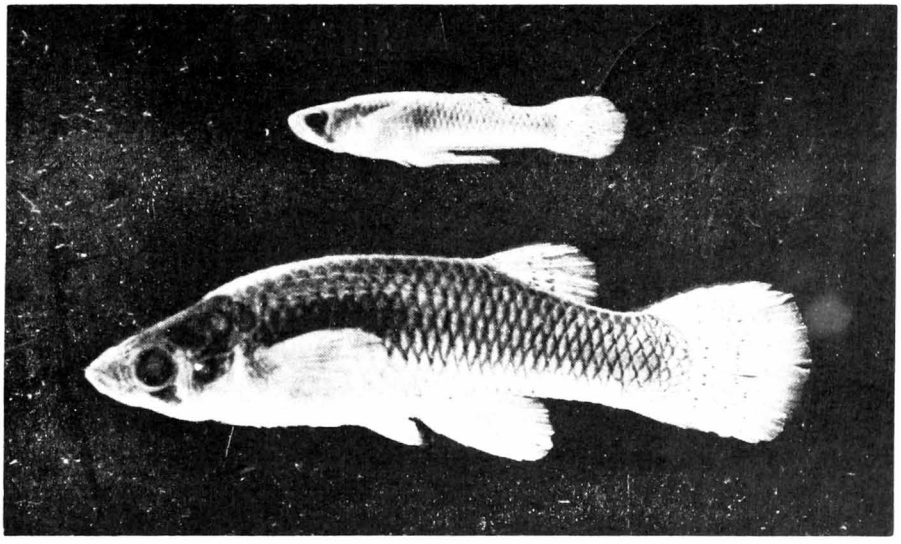
THE MOSQUITOFISH Gambusia affinis



Adult male (above) and adult female (below) *Gambusia affinis affinis*.
Courtesy of Dr. Louis A. Krumholz.

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF COMMERCIAL FISHERIES
Fishery Leaflet 525

THE MOSQUITOFISH, Gambusia affinis

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INTRODUCTION

An insignificant-looking little fish, *Gambusia affinis*, is largely responsible for making many parts of the world livable for man. In 1918 the great value of Gambusia as an eradicator of the aquatic stages of the mosquito was first clearly shown when these fish were used at Camp Hancock in Augusta, Georgia.

Gambusia eat aquatic larvae of mosquitoes, including the species that cause malaria and yellow fever. One female, 2 1/3 inches long, ate 225 large mosquito larvae within 1 hour, and a male, 1 1/4 inches long, ate 28 larvae during the same period. At birth Gambusia commence feeding on newly hatched mosquito larvae, which, when first hatched, are threadlike animals almost microscopic in size.

If there are no aquatic plants or debris (which furnish hiding places for mosquito larvae) or predators, Gambusia will control a mosquito population. Experiments extending over two summers in Michigan revealed that Gambusia reduced mosquito production 80 to 95 percent in ponds where natural conditions were simulated (Krumholz, 1948b). When introduced into a fish-free pond at the height of the mosquito breeding season, these mosquitofish brought about an 80 percent reduction in mosquito reproduction within a week.

Several species of Gambusia, of the order Cyprinodontes and the family Poeciliidae, occur in the warm or tropical areas of the United States, Mexico, and Central America. The species used to control mosquitoes is *Gambusia affinis* (Baird and Girard). This species has two subspecies: *Gambusia affinis affinis* and *Gambusia affinis holbrooki*. They are known also as mosquitofish, because they feed on mosquito larvae, and as topminnows, since they are shaped like a minnow and feed at the surface of the water.

RANGE

The natural range of *G. a. affinis* extends along the Gulf of Mexico coast from the mouth of the Rio Grande as far west as Bay St. Louis, Mississippi, and through the Mississippi River and its tributary waters as far north as central Illinois. Introductions have extended the range of *G. a. affinis* northward, even into Canada. They have been successfully introduced into Arizona, California, northern Illinois, Indiana, Kansas, Massachusetts, Michigan, Missouri, Nevada, New Jersey, New Mexico, New York, Ohio, Pennsylvania, Utah, Washington, Wisconsin, and probably other States.

The other subspecies, *G. a. holbrooki*, ranges from southern New Jersey along the Atlantic coast to the Florida Keys and along

the Gulf of Mexico coast as far as Apalachicola, Florida. It is not hardy enough to survive northern winters (Wascko, 1950).

FOREIGN INTRODUCTIONS

Both subspecies have been introduced into many foreign lands (Hildebrand, 1931; Krumholz, 1948b). In about 1920 the International Red Cross asked the United States Bureau of Fisheries for brood stocks of Gambusia for Italy and Spain. The shipment of *G. a. holbrooki* from Augusta, Georgia, to Italy failed. However, the fish of the same species sent to Spain arrived in fairly good condition and multiplied rapidly. Within a year or so Italy obtained a brood stock from Spain but the fish were unable to withstand the winters in northern Italy. In 1927, *G. a. affinis*, hardier than *G. a. holbrooki*, were shipped from Carbondale, Illinois, to Trieste, Italy. These fish survived and multiplied.

From the original introductions into Spain and Italy, Gambusia have been distributed to nearly all south European countries and to Germany and Austria. They were introduced also into Palestine, the Philippine Islands (from thence to China and Japan), Russia, Thailand, Union of South Africa, Hawaiian Islands, the West Indies, and Argentina. From these places of introduction, Gambusia spread far and wide until they have become almost cosmopolitan in the warmer sections of the world.

HABITAT

The two subspecies are found in many types of water whose temperature may range from 40° to 100° F. They flourish in sluggish and standing water, fresh, brackish or marine, clear or muddy, deep or shallow, open or overgrown, but prefer clear shallow water. They probably seek shallows to escape large predacious fish, such as largemouth black bass, and to feed on mosquito larvae, which are more numerous there than elsewhere.

Mosquitofish occur in ditches and pools containing either hard or brackish water. Common characteristics of these environments are a relatively high mineral content in the form of dissolved solids and an abundant supply of plant and animal food. They thrive too in artesian well discharges, cisterns, water tanks, potholes, and rain barrels. They have been known to live also in an open municipal septic tank containing sewage. In this environment they stayed at the surface at all times and appeared to be respiring at the airwater interface.

LIFE HISTORY

Description

The two subspecies are almost identical in color, form, and size. While the color is usually olive or dull silvery, darkest on the head and lightest on the belly, it varies according to the character of the habitat. Individuals living in ditches and drains are usually pale, and those in dark-colored water of swamps are dark green, with a distinct purple bar below the eye. There is frequently a fine dark line along the sides, sometimes a dark blotch below the eye; a dark purplish blotch is usually present on the side above the vent in the female. The dorsal fin has 2 or 3 transverse rows of fine black spots. The anal fin in the female is dark-edged; the caudal fin has 3 or 4 irregular transverse rows of dark spots; the other fins are dusky. The fins are small, and the scales large in proportion to the size of the fish. Dark pigment outlines each scale.

There are a few differences between the two subspecies. *G. a. holbrooki*, has 8 rays in the dorsal fin, and the third ray of the gonopodium (sexual organ) shows a deep split when examined under the microscope (Innes, 1956). *G. a. affinis* has only 7 rays in the dorsal fin, and the split in the third ray of the gonopodium is lacking.

The sexes of the same species differ in form and structure. The female has a deeper body than the male. Females, whose maximum size depends on the fertility of the water in which they live, grow throughout life and may reach a length of 2 1/2 inches. Males grow little after the gonopodium is formed (Turner, 1941) and do not exceed 1 1/2 inches. The female has a small, rounded anal fin with the rays connected by a membrane, and the male has the third, fourth, and fifth anal fin rays united and lengthened to form the gonopodium (picture on cover).

Generally mosquitofish, which are relatively free from disease, die during the summer in which they mature. Some females mature in their first summer of life; others do not mature until their second summer and die when about 15 months old. Less hardy than females, males die at an earlier age.

Food

While adult Gambusia eat principally larvae and nymphs of aquatic insects, they also eat plant food such as diatoms, desmids, and filamentous algae. The young feed mostly on plankton (the passively floating or weakly swimming animal and plant life).

Reproduction

Gambusia are ovoviviparous; that is, a female produces eggs that hatch within her body. The male fertilizes the eggs in the female by using the gonopodium to deposit sperm in her genital tract. A female is able to produce several broods of young after being fertilized once.

Studies of 30,093 specimens of *G. a. affinis* collected during 1938, 1939, and 1940 from eight ponds in northeastern and central Illinois reveal much about their breeding habits (Krumholz, 1948b). Males matured at smaller sizes and at slightly earlier ages than females. Some females in two ponds became sexually mature for the first time early in their second summer of life when 8 to 10 months old and 1 to 2 inches long. They reproduced for 10 to 15 weeks, usually bearing 3 to 4 broods. The offspring of their first and possibly their second brood became sexually mature during their first summer of life when 4 to 6 weeks old and about 1 inch long. They reproduced for 4 to 10 weeks, generally bearing only 1 or 2 broods.

In the first brood, males and females were in almost equal numbers, but in succeeding broods the females gradually outnumbered the males. The average number of young in a brood decreased as the length of the mother increased. Some metabolic factor, coincident with the approaching end of the reproductive season, may control the number of young.

The young

Fertilized eggs hatch in 21 to 28 days. Within several hours a female expels from a few to several hundred live young (figs. 1 and 2). About three-eighths of an inch long at birth, they are well developed and completely formed. They have prominent black eyes and are often uniformly yellowish. The fins are dusky, and the caudal fin usually has a cross series of dots. At birth they are able to swim.

Growth of mosquitofish is rapid, depending on the food supply and to a lesser extent on the water temperature.

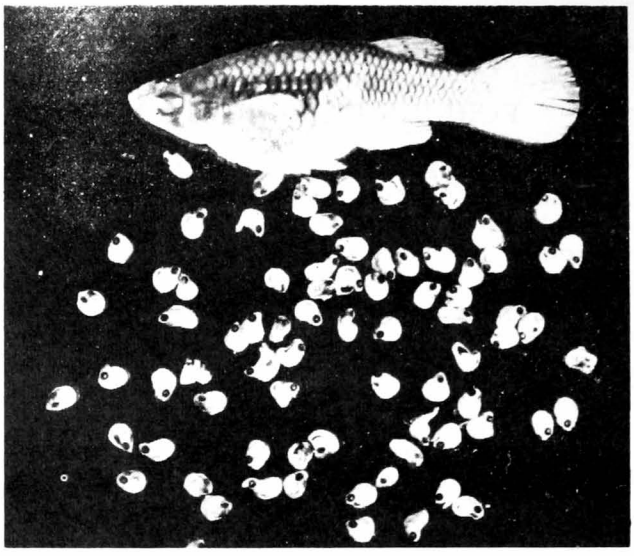

Figure 1.--Pregnant female *Gambusia affinis affinis*. The brood of 79 embryos were removed later. The yolk sac has been completely absorbed, and the embryos are nearly fully developed and about ready for birth.

Courtesy of Dr. Louis A. Krumholz.

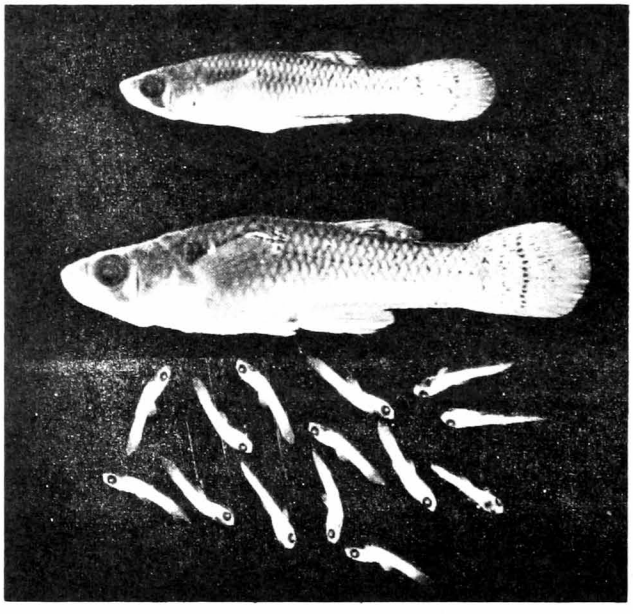

Figure 2.--Adult male (above) and adult female (below) *Gambusia affinis affinis* and young. The young are about 4 hours old.

Courtesy of Dr. Louis A. Krumholz.

ENEMIES

Birds, frogs, large fish, and water snakes devour Gambusia.

CULTURE

Gambusia can be easily bred in aquariums at water temperatures of about 75° F. While they prefer live foods, they will eat prepared foods.

They should not be mixed with other species in aquariums, because Gambusia will often attack other fish by nipping pieces from the fins and tails.

In nature, female Gambusia seldom eat their young because a good supply of natural food is usually available. In aquariums, however, the young must hide among the plants to escape the mother. For protection, the young should be separated from the adults. There are two methods to accomplish this. One is to provide the young with hiding places, such as dense growths of plants, and the other is to use a partition to separate the mother from her offspring (Innes, 1956).

DEALERS

Most tropical fish dealers either have Gambusia in stock or can order them.

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