

Use fish mosquito control not new concept. Technique first investigated early 1900's after discovered malaria transmitted mosquitoes. Interest in larvivorous fish suffered fast-acting residual insecticides. Renewed attention given to fish. Two reasons change in attitude, pesticide contamination on the environment, insecticides costly, shorter-lasting <sup>life</sup> resistant mosquitoes.

Gambusia affinis synonymous biological control mosquitoes, mosquito fish offer great potential as an adjunct to chemicals for mosquito control.

### HISTORY

1854 First writings on Gambusia affinis. Early 1900's usefulness mosquito predators established. Long distance trans-plantation mosquito fish was made. 150 Gambusia Seabrook, Texas to Honolulu in 1905. Fish flourished 1907. In 1921 Gambusia from Augusta, Georgia to Spain. Italy 1922, Italy distribution was soon countries throughout Europe.

1921 In the United States, reported that the use of mosquito fish during 1920 malaria control, producing permanent results Southern states at a reduced cost. World War II, U.S. Army Malaria Control Units utilized Gambusia, Pacific. ~~control mosquito~~. California imported Gambusia Texas in 1922. Because of its use for mosquito control, Gambusia affinis probably has the widest range of any fresh water fish. Found nearly all the warmer regions of the world successfully established in areas where relatively severe cold weather occurs, such as Utah, Michigan, and Canada.

### BIOLOGY

Gambusia affinis 150 species of fish family Poeciliidae. This family. New World with Central America West Indies. Name



Gambusia "Gambusino", Cuban word "nothing". "To fish Gambusinos is to catch nothing". Affinis, means "neighboring" or "related". Well known appetite larvae, common name "mosquito fish". Also referred to a "top minnow".

OVER Head  
A relatively flat head, small body, protrusible mouth. Anal fin of both sexes is similar. <sup>unlike young</sup> Sexual dimorphis is later exhibited fin becomes small rounded in female, male modified elongated, rod-shaped copulatory the gonopodium. Gonopodium is normally carried backward and parallel body, quickly moved at any angle, forwards or sideways. Adult females 1 to 2- $\frac{1}{2}$  inches, males 1- $\frac{1}{4}$  inches. Female greater lengths than males grow until death. Males, grow very little gonopodium completely formed. Both sexes, body is pale grey with a blue metallic sheen. Belly silver, dorsum, brown or olive green. In many cases, dark, transverse bar across the eye.

U.S. divides Gambusia affinis between the two subspecies. Eastern subspecies, G. affinis holdbrooki, is Delaware to Florida and Alabama. Western subspecies, G. affinis affinis, Alabama to Illinois south to the Texas. Alabama, two subspecies meet and their distinctive features are lost. Likely that this occurs elsewhere in other states.

Gambusia found in sluggish, standing ~~water~~ waters. Thrives variety of water types fresh, brackish, clear, muddy, shallow, deep. Gambusia seldom found swift-flowing streams or water polluted chemical wastes acid in nature, tolerate moderately polluted sewage. Shows distinct preference shallow water where protected <sup>from</sup> predaceous fish, food vegetation more abundant. Large numbers mosquito fish water less than 1 inch in depth.

Essentially a warm water fish, tolerate wide range temperatures. 107.6°F. Cold water strains have been developed



successfully overwinter under ice in certain areas. Noted during winter, fish hibernate lower depths rarely seen spring water temperatures increasingly warmer.

#### FEEDING BEHAVIOR

Gambusia feed number of aquatic organisms including mosquitoes. Voracious feeders variety phytoplankton, zooplankton, larger aquatic insects. Insects constitute large part diet also consumed plant tissue consisting algae. Determining what taken food appear availability more important than choice. Studies in Alabama when mosquito populations increased, number eaten per fish, also increased. Analysis stomach peak feeding occurred soon after daylight decline later afternoon increase second lesser peak, evening.

Mosquito fish attracted prey movement. Range vision 4 to 5 inches, movement larger prey quickly noticed than small. Anopheles larvae will, in fact, remain motionless when fish are nearby. Protective instinct developed mosquito since "inactivity" protection against fish predators.

Voracious appetite Gambusia have mosquitoes. One large female eat 225 larvae pupae 1 hour. Pair of half grown Gambusia *ATC* 5,000 larvae in 11 weeks. All sizes readily feed larvae, fry few hours old attack young instars. Gambusia cannibalistic will prey on their own young if. *no other Food Available*

#### REPRODUCTION

Gambusia (live), give birth smaller numbers, newborn advanced stage development better adapted struggle for existence fish hatched from eggs.

After mating, female Gambusia store sperm deliver a number successive broods without contact male. Mating strictly promiscuous pairs not formed as egg layers. Fertilized eggs hatch within



body cavity young lie folded head tail. Delivered this form one two time. Straighten swim to nearest refuge. At birth, 3/8 inch in length, ratio males females 1:1. Fish grow older, ratio favors females hard live longer.

A gravid sexually mature female recognized distended abdomen large blacktriangle area front anal fin known as the "gravid spot". Pigmented area also found immature females, reaches maximum size before female gives birth. Over Head

Gestation period 23 to 24 days. Time single brood to be born, 30 to 60 minutes. Three to four broods produced, number fry per brood 40 to 104, 300 occasionally be encountered. Female have broods throughout summer intervals of 3 to 6 weeks. Breeding season begins May ends in September or October.

Mosquito 4 to 5 years aquaria, seldom survive 2 years wild. General rule, both males femals die the same summer reached maturity.

Mosquitofish present unique problems safe transport.

Quantity can be transported safely dependent condition of the fish, physical handling, water quality. Fish aren't greatly stressed in their capture, loading movement, survival rates quite good. Conditions produce stress rough handling nets, seines; transfer fish seine truck; temerature shocks; enroute tank water sloushing.

With so many important elements involved, best way arrive safe hauling capacity test transport system starting small number slowly increase load each trip signs stress mortality observed. Male mosquitofish suffer first, keeping close watch male mortaility to gain some measure induced stress. Well-designed transportation systems capable handling fish loads 0.5 to 1.1 lbs of fish per gallon transport water.

Numerous types of containers can be used to transport mosquito



fish, crucial tank used rigid enough withstand water pressures involved, relatively nontoxic watertight. Tank configuration important maximize hauling capacities. Tank obtained, built great surface area to volume ratio as is practicable. A long, wide rectangular tank would support more fish oil drum equal volume. A tank filled to near capacity provide as much volume as possible minimize sloshing-surgeing. Interior baffles inserted reduce sloshing; but be removable facilitate fish access.

Tanks constructed of aluminum, steel, plywood, plastic or fiberglass. (SLIDE TRUCK & TANK #2)

STOCKING RATES - probably as many different stocking rates as are types of mosquito sources. Exact stocking rate impractical, if not impossible, rate works well one mosquito source may be low too high identical different California locale. When one takes into account variations weather conditions environmental factors, stocking rates may change same source one year to the next.

Technicians consider the species of mosquito intending control with fish. One source produces two species of mosquito may or may not same level of control both species. Usually necessary stock each mosquito species separately, even if this means overstocking with regard to the other species present. Another factor is whether not the stocking is for immediate eventual control. Immediate control rates much higher than rates required eventual control.

#### STOCKING

Selecting suitable stocking, several factors should be considered. The sites fail. Slides, 100, 101

Adequately CONTROL - Sites ARE Slides

After a site has been selected, approved, and properly



After stocking, populations reproduce at phenomenal rates, 30 days, 4,000 to 8,000 fish obtained rice fields initially stocked 200 mature females. Estimated 1.5 million removed 3 year period one pond initially stocked 2,000 Gambusia.

### INTEGRATED CONTROL

Management pest populations through use of integrated control techniques received increased past few years. "Integrated control" usually defined use of chemical, biological, physical control measures in sequence or simultaneously against, pest population. Mosquito fish program theme consists chemicals, larvicides herbicides to ~~augment & achieve~~ adequate mosquito control. Larvicides applied early control new mosquito broods, and may be discontinued, fish multiply become effective. Herbicides, serve to control dense vegetation, mosquitoes seek refuge from *predacious fish*

*Larvicides Kill* mosquitoes, spare the fish populations. *BPI B.sph read labels.*

Aquatic plants submerged leaves or dense network of roots near the water surface offer best protection immature mosquitoes from fish.

Whenever possible, it is recommended that the vegetation be removed mechanically. If, herbicide is required. *Looked at slides* factors plants growing shallow edges or margins or bank above the water line; water is free-flowing canal-static as in a pond, if the vegetation grass broad leaf, *if* submerged or immersed; will herbicide compatible with the aquatic, animal life; if treated water being used drinking livestock, wildlife humans. *RODEO LABEL.*

*Let's go Fishing*

*slides*

Effectiveness of Gambusia as mosquito predator documented period of 80 years. *on more*

Gambusia effectiveness will depend amount type vegetation debris present; density fish population; existence natural enemies as predaceous fish.



The effectiveness of Gambusia dependent on three factors *Just*  
*Mentioned*, may be necessary disturb change one or all of these  
to obtain adequate control. Can be accomplished removing the  
vegetation, increasing the fish by stocking, providing places  
of refuge, eliminating natural fish predators.

Michigan, Gambusia about 81% and 95% effective controlling  
anopheles ponds. Georgia's ponds swamps fish responsible for 50%  
and 80% reduction anopheline, culicine populations. Effective  
control both species in artificial ponds control much less heavily  
vegetated swamps. Observations been made absolute or 100% control  
cannot be expected in every situation. May be more effective  
some circumstances than others. But they do play a major role  
in today's mosquito program.