

HOW TO USE THE STATE BIO-CONTROL (MOSQUITOFISH) PROGRAM FOR MOSQUITO CONTROL IN NEW JERSEY

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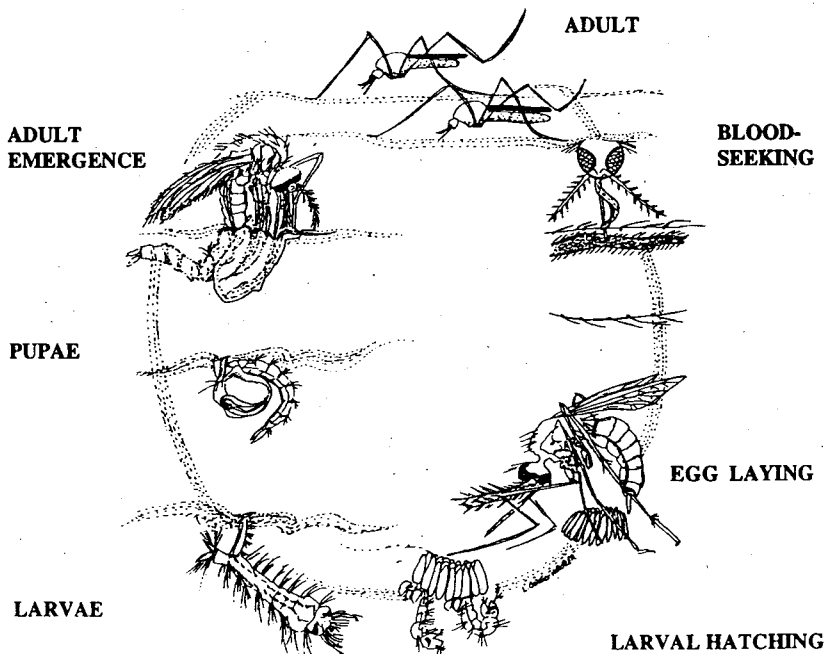
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Introduction

In an effort to control mosquitoes with less reliance on the use of pesticides, the New Jersey mosquito control community utilizes several approaches. In an integrated approach to pest control, one aspect is the use of biological control agents. An example of a biological agent for mosquito control is the mosquitofish, *Gambusia affinis*. When used correctly it is an efficient, cost-effective, and environmentally sound method for the control of mosquito populations. This document describes the use of these fish for mosquito control in New Jersey.

Mosquito Biology

There are over sixty different species of mosquitoes in New Jersey, and they may be found in almost as many varieties of habitat. All have one point in common. They all require, as part of their life cycle, standing water in which to develop. It is in water where, as larvae and pupae, they spend a major part of their life cycle. During these aquatic stages of their development mosquitoes are most susceptible to control. It is at this point that mosquitofish, once introduced, will opportunistically consume mosquitoes.



Role of Control Agencies

Often the most visible method of mosquito control is the application of an insecticide. Such applications for the control of larvae and adults are only temporary. It is the responsibility of New Jersey's network of county mosquito control agencies to continually survey and manage those sites which are documented as mosquito breeding habitat.

Another control strategy is water management within the habitat. By eliminating stagnant, polluted or otherwise degraded conditions to restore a healthy ecosystem, mosquito control can be achieved.

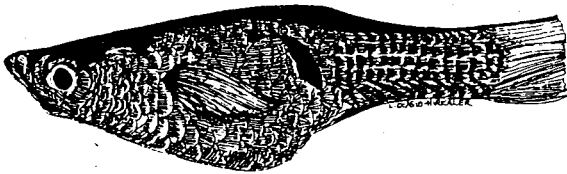
In addition to the two aforementioned strategies (insecticides and water management), biological-control agents are also employed as part of the state's integrated control efforts. If mosquitofish are determined to be an appropriate biological control response to a mosquito problem, it is only as a result of an inspection and survey by the county mosquito control agency.

Mosquitofish Biology

Gambusia affinis, a member of the live-bearer family *Poeciliidae*, is one of the most widely distributed freshwater fish. This is due to its worldwide introduction for mosquito control.

The species thrives in a wide variety of water types, being very tolerant of high water temperatures as well as very low dissolved oxygen levels. *Gambusia affinis* give birth to an average of 40-100 live fry, each of which is approximately 3/8" in length. On average, 3 to 4 broods are produced each year, depending on the size of the female and the length of the breeding season. Females can attain a maximum length of two inches; males one inch. Both sexes seldom survive for more than two years.

As a mosquito predator, *G. affinis*'s effectiveness can be attributed to several characteristics:



1. Flattened head with a protrusible, dorsally oriented mouth which enable the fish to feed at, or near, the water surface, and small size which enables them to inhabit shallow waters and penetrate dense vegetative growth where mosquito larvae and pupae hide.

2. Ovoviviparous (live-bearing) reproduction which does not require specialized substrates for oviposition (egg-laying) as is the case with many fish species.

3. High fecundity, short life cycle and broad tolerances for temperature and organic pollution.

Throughout its development *G. affinis* has a voracious appetite, feeding on a wide variety of plankton as well as larger aquatic insects. It is a random feeder, with the availability of food being more important than type.

Being opportunistic feeders, other invertebrates and fish fry are readily consumed by *G. affinis*. In consideration of indigenous non-target species, the Bureau of Freshwater Fisheries' policy limits the stocking of these fish only into certain state waters for the purpose of mosquito control (see policy). The species has a number of natural enemies including wading birds and various piscivorous (fish-eating) fish such as bass, pickerel and sunfish.

Habitat Types

There are, in general, two types of aquatic mosquito habitat: floodwater and permanent water.

Not all bodies of water require introduction of mosquitofish (such as lakes, ponds and streams as these sites generally do not offer mosquito breeding habitat). Some examples of mosquito habitats where fish may be introduced include:

- Stormwater management facilities.
- Woodland, or snowmelt created pools, and areas containing sheetwater.
- Ditches and swales.
- Freshwater marshes.
- Dredge-spoil impoundments.
- Wildlife production impoundments.

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- Artificial containers - i.e. ornamental ponds, abandoned swimming pools, foundations.
 - Excavated sites.
 - Trash sites.
 - Sewage lagoons and/or waste-water facilities.

Potential stocking sites of an environmentally sensitive nature should be reviewed by state biologists from the Division of Fish, Game and Wildlife's Bureau of Freshwater Fisheries, and from the N.J. Office of Mosquito Control Coordination.

Approval Process

While the use and distribution of mosquitofish is not recommended to the general public, they may gain the benefit of this biological control agent by way of their county mosquito control agency. Following a request to, and approval by, the N.J. Office of Mosquito Control Coordination, deliveries or stockings of *G. affinis* are made via the New Jersey Division of Fish, Game and Wildlife's Charles O. Hayford Fish Hatchery in Hackettstown.

How to Determine a Good Site for Mosquitofish

Not all bodies of water are suitable habitat for mosquito production, and not all mosquitoes are pestiferous to man, or will transmit disease.

Mosquitofish stocking shall not take place without first performing an important program of surveillance. Before any insecticide application or water management project is undertaken one must be assured of the presence, density and species of mosquitoes there. This need applies no less significantly with regard to the stocking of mosquitofish.

*Not all bodies of water capable of supporting *G. affinis* are necessarily mosquito breeding habitat.*

Sites that qualify must satisfy the protocol described at the end of this document. All sites must be surveyed for pest species of mosquitoes, and the size of the area determined and recorded.

Sites that have been documented as mosquito producers and are considered to be favorable for stocking with mosquitofish may include:

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- areas that are environmentally sensitive to, or inaccessible for, pesticide applications
 - sites that are unable to be managed via Best Management Practices, or Open Marsh Water Management.
 - sites that do not support native or resident fish populations.

When to Stock

As part of an ongoing program, a mosquito control agency should index sites and periodically record mosquito breeding. Early spring fish stocking will be most efficient for season-long control. However, mid-season stocking may be appropriate for areas which periodically dry back and re-flood as a result of seasonal weather.

Which Mosquito Species/ Which Not?

In general terms, *G. affinis* is attracted to moving, active prey. The feeding and respiratory habits of the various mosquito species will determine *G. affinis*' feeding behavior. For this reason, mosquitofish may not be appropriate for the control of some *Anopheles* or *Coquillettidia* species .

In general, the use and application of *G. affinis* should be by professional mosquito control agencies only. These agencies should become accustomed to treating the use of these fish with the same amount of caution as they would a pesticide. No stocking should take place without first performing an adequate mosquito survey and an investigation of the natural history of each site. All stockings should be made with discrimination, and not randomly.

Evaluate Efficiency

The continued presence of adequate numbers of mosquitofish should result in the reduction of the mosquito population and any associated pesticide applications. Mosquito control inspectors and biologists should continue to periodically survey sites after stocking in order to evaluate the overall efficiency of mosquitofish as control agents. Methods for seining or trapping of mosquitofish to determine their populations are described in articles found in the bibliography of this document.

Official N.J. Mosquitofish Policy

It is the policy of the New Jersey Bureau of Freshwater Fisheries to permit the stocking of the mosquitofish, *G. affinis*, in certain state waters for the purpose of mosquito control. Permission will be granted only for those waters in which no indigenous fish population exists and from where the mosquitofish can be reasonably expected not to escape. Additionally, the above mentioned waters must harbor sufficient numbers of mosquito larvae/pupae which may result in a nuisance or health concern for the surrounding human or animal population as determined by the state or a county mosquito commission or agency. Stocking of mosquitofish will not be permitted in areas identified as endangered or threatened (plant or animal) species sites, exceptional resource wetlands, or adjacent to such sites or in areas identified by law as state "Natural Areas."

Protocol for Use

1. Site selection is dependent upon evidence of mosquito larval habitat, including species identification.
2. Site history should include frequency of mosquito breeding, by species and pesticide application.
3. Site survey should include:
 - a. description of area (woodland pool, stormwater facility, freshwater marsh, etc.)
 - b. size (surface area, depth)
 - c. source of inflow (stream, sheetwater, run-off precipitation)
 - d. destination of outflow (if any)
 - e. determination of water retention (y/n?)
 - f. non-target species present
 - g. other fish species supportable/ present
4. Appropriate sites should be indexed, reviewed and scheduled for stocking with the Office of Mosquito Control Coordination. Acquisition methods are described later in this protocol.
5. County mosquito control biologists and/or N.J. state biologists will supervise site specific stocking procedures.

6. Records should be kept on stocking date, and then at periodic intervals thereafter dealing with the following:

- a. stocking rate per acre
- b. age of fish, and fecundity
- c. mortality
- d. health
- e. water temperature
- f. non-target predation
- g. larvicide efficiency
- h. amount of pesticide saved

7. Stocking/restocking and preseason/midseason procedures will be continually evaluated and adjusted by all involved agencies in order to best serve the mosquito control community, the public and the environment.

Acquisition Procedure

All requests for mosquitofish should be made to the Office of Mosquito Control Coordination at (609) 292-3649 in Trenton. Upon approval, the hatchery superintendent will be notified and contact will be established between the county mosquito control agency and the hatchery prior to delivery.

Transport and Stocking Procedures

Fish will be shipped by one of three methods depending on the number of fish needed and the urgency of the request:

Mail

Small numbers of fish can be shipped via Overnight Express. This method will be used if several hundred to a thousand fish are needed. All fish will be shipped in an insulated container outfitted with double plastic bags containing a small quantity of oxygenated water. Containers should be returned to the hatchery for reuse.

Tank

County agencies may choose to pick up fish at the hatchery. This method is preferred if between 1,000 and 25,000 fish are needed. The N.J. State Mosquito Commission has purchased three oxygen-bottle equipped transport tanks for this purpose. The Office of Mosquito Control Coordination should be contacted for information regarding the location and pickup arrangements for one of these tanks.



Truck

If more than 25,000 fish are requested, the hatchery will deliver the fish to a central point in a county or region. The county agency(ies) will then transfer the fish directly to the site or into one of the transport tanks where the fish can then be distributed as needed. This method works best if several counties coordinate delivery of large numbers of fish. Requests for mosquitofish by this method and subsequent deliveries will be coordinated with other county agencies.



Stocking

Fish should be tempered if the temperature difference between the receiving water and the transport tank water is greater than 5°C. Temperature differences between the hatchery truck and the transport tanks should also be checked before transferring fish. Tempering can be accomplished by adding water to the transport tank by pump or bucket until the desired temperature is reached. The fish can be transferred by net into the receiving water. During times of extreme temperatures, caution should be exercised with regard to the ambient temperature of the receiving water.

The numbers and methods listed above should be used as a guide. The purpose of this program is to get the fish to the places where they are needed, when they are needed. Cooperation by all parties involved is necessary to accomplish this task.

Technical Assistance

Technical assistance can be obtained by calling the Hackettstown Hatchery at (908) 852-3676 between 8 a.m. and 3:30 p.m. Monday through Friday. Assistance will be given for transport, stocking, harvesting, or holding problems.

Additional fish species are presently being considered by staff biologists and by the N.J. State Mosquito Control Commission as future candidates for the Bio-Control (mosquitofish) Program.

