# The Relationship Of Mosquito Breeding To Aquatic Plant Production

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The animals and plants found on this earth are, for the most part, dependent upon one another for existence. There is no doubt that valid information is present to show that some plants could exist without the presence of animals. The facts still remain, however, that both must have certain fundamental prerequisites or combinations of these, such as air, light, temperature, humidity, water and nutrients to exist.

There is no philosophical argument against the fact that certain animals and plants are directly dependent on one another for survival. This is certainly true in the cross-pollination of many plants, and the phenomena can only be accomplished with certain species of insects. Without these insects the plants would perish from the face of the earth. Certain animals depend on other animals for their existence and the same thing can be said for plants.

All of these many factors have a direct bearing on the biotic potential of an animal or plant. Mother Nature has seen to it that organisms which live under adverse conditions must possess a high biotic potential in order that there may be survivors to maintain the population and perpetuate the species.

There are those who maintain that there is no such thing as a balance in nature, that nature is always out of balance. In the eyes of man this may be a true statement, but in the overall, long-range scheme of living animal and plant life, nature is always in balance. Man simply does not have the wisdom and knowledge to project his thinking to fathom and understand all of these many climatological, biological and physiological factors which are revolving around him, distorting the true picture.

Then it must be reasoned that nature in the overall is in balance and that there is a definite plan for all living matter, and without this celestial plan there would be no order of all living things. The classical example of what an unbalance of nature could mean is the theoretical hypothesis that a pair of flies beginning operations in April, might by August be the progenitors, if all were to live, of enough flies to cover the earth 47 feet deep! This never occurs because nature is one of the greatest controllers as well as one of the greatest perpetuators and maintainers of life.

In this connection we will discuss a small group of insects belonging to the family Culicide. This family includes all of the mosquitoes, strictly aquatic animals, which must have water in which to produce and develop certain stages of their metamorphosis.

An adult female mosquito, after her copulationary engagement, and in some species or physiological strains, after a blood meal, selects a certain aquatic habitat or ecological environment that is favorable to the perpetuation of that particular species. Practically all species of mosquitoes are most selective in the place or location which they seek out for oviposition. This, as well as many other ethiological phenomena, is not completely understood by man. The facts are that certain species oviposit only in water found in temporary receptacles, others in tree holes, leaf bases of plants, polluted water, damp soils in swales or depressions near the seacoast, in inland depressions, alkaline waters, acid waters, and waters of slow flowing streams. It therefore can be said that the selection of the breeding site has a direct bearing on the survival of the particular species.

The three species of Mansonia mosquitoes found in Florida cannot exist without the presence of aquatic plants, and two species are almost totally dependent on one aquatic plant — water lettuce Pistia stratiotes. The larval and pupal stage have specialized air tubes for penetration and attachment to plant roots and stems, from which they must derive their oxygen. Mansonia perturbans is found on many species of aquatic plants, preferably water lettuce, but also occurs in abundance on saw grass, cattail, lizard-tail, pickerel weed, arrowhead, spatterdock, water hyacinth, aquatic sedges, and other aquatic plants. This species is abundant all over Florida, but most especially in the shallow muck-bottom lakes and swamp regions. In North Florida there is one big brood each year; in South Florida there may be, in certain years, two broods.

It is a fact today that Mansonia mosquito breeding can only be controlled at the source by the elimination of all aquatic vegetation. This means that in order to control emergent vegetation the water must be maintained at least 25 inches deep. ([1]) It means also that all floating vegetation, and especially water lettuce, must be kept cleared from all water surfaces.

The heavy production of Mansonia mosquitoes is directly proportional to a uniform and constant depth of water under 25 inches, a loose muck or peat bottom, and an abundance of water lettuce and certain other preferred emergent types of vegetation. In nature this is rarely found, because the water fluctuates, and every few years most areas of vegetation are left high and dry, eliminating the breeding conditions. Since the animal has only one to two cycles in a year, it takes considerable time for the density to build up after an area has dried up, and about the time the density starts to increase, the breeding area goes dry again. A good example is the Everglades and many other similar small swamps in the state.

It can be seen that these species cannot exist without the presence of water and aquatic plants. Therefore, the control of these three species should be simple, because all you need to do is keep all the water drained from an area for four or five months out of the year, or control all the aquatic vegetation. But this is not always a simple job. We find that the control of aquatic vegetation, in the control of one group of mosquitoes, may during the fermentation process create another environment conducive to the heavy production of the Culex nigripalpus mosquito. It breeds in roadside ditches and other man-made ditches and excavations filled with grass infusion and aquatic vegetation.

The common malaria-carrying mosquito, Anopheles quadrimaculatus, will never be found breeding in waters more acid than pH 5.1, and its optimum range will be found in sunlit waters where the pH is from 7.0 to 8.4. The breeding will be scarce in dense gum swamps, but will be found heavy in sunlit ponds and lakes, where there is a moderate density of emergent and floating vegetation, consisting of wild pepper weed, cecum grass, duck weed, and other aquatics which afford protection to the larvae and pupae from predacious insects and fish. All of the small Culex are found in similar habitats.

The common Anopheles crucians will be found in acid bogs and swamps which have a predominance of emergent and floating vegetation. Where there is heavy pollution in ditches, swamps and ponds, thre will probably also be found a heavy density of aquatic vegetation. In these types of habitats we can expect heavy production of Culex quinquefaciatus mosquitoes. It can be said that the density of these mosquitoes is increasing each year in direct proportion to the construction of sewage treatment plants.

The floodwater mosquitoes, which are some of the worst biters and produce the greatest densities, are not dependent upon vegetation for their survival to the extent that are the Mansonia, Anopheles, Culex, Culiseta and other minor species.

As you know, man is a real smart creature. He is trying to conquer space to get away from the many problems which he has created on this earth. He has not conquered the animals, including himself, nor the plants which live on the earth.

In order to conserve fresh water, to control floods, and produce environments for fish and wildlife, it is felt necessary to dam off river courses and to construct dikes to hold back water, in order to accomplish the above aims. This in itself is unnatural and will in the long run lead to unbalanced conditions which may bring about problems in mosquito and midge production in the state.

A man-made environment of water areas where the aquatic vegetation is not controlled, could lead to encephalitis epidemics which might paralyze the state's economy, and could take years to recover. Changed environments can bring about an abundance of wildlife, and also an abundance of mosquitoes, interwoven with an increased viremia in the wildlife population, which would place these conditions in juxtaposition and could very well bring about epidemics of encephalitis in the human population living near and adjacent to the impoundments, as well as establishing endemic encephalitis in the segment of the population utilizing the areas for fishing and hunting.

The old saying that you are shot if you run and cut if you stand, must also be considered. The killed fermenting plants, as stated before, can produce favorable conditions for the production of Culex nigripalpus, a vector of arboviruses.

Our present wisdom has not been developed to the point that we are able to figure out ways and means of properly disposing of our waste waters. Our present plans call for depositing it in the ocean, rivers, streams, lakes, ponds, swamps, and ditches. There is no question that our waters are naturally rich in organic matter and other nutrient materials, which produces an outstanding and vigorous crop of all types of aquatic and terrestial plants. The addition of waste water increases these nutrients, causing a heavy production of plankton, which in turn produces a heavy population of midges and of the mosquito Culex quinquefaciatus, a known carrier of St. Louis encephalitis.

Here, man is busy unbalancing nature in the hope of producing a better environment for the Homo sapiens. Just how far can man go or dare to go in these unnatural episodes is difficult to say. It can probably be said, however, that only time will tell, but time waits for no man and he who will not take heed of nature's warnings may do for himself and his fellow man irreparable damage.

It is my belief that today Florida stands at the crossroads. She has come a long way in the difficult struggle to eliminate the historical mosquito-borne diseases, and to eliminate tremendous environments of floodwater mosquitoes. This has made it possible for Florida's beaches and coastlines to develop.

Unless caution, wisdom and good judgment are used in the creating of impoundments and the pollution of water courses, the day may soon come when the yoke that once hung around the necks of the citizens of Florida of yesteryear may again come on the wings of the Culicidae to wreak havoc once again to its citizenry.

The one thing that may deter such a catastrophe is the diligent and proper control of aquatic vegetation. Four genera of great vectoring mosquitoes can be almost completely controlled at the source by controlling aquatic vegetation. Under these conditions, nature will have a chance to bring about a balance which must be maintained in all man-made endeavors if we are to keep Florida the crown jewel of the North American continent.

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(1) Steenis, J. H., Smith, L. S., and Cafer, H. P. Studies on cattail management in the northeast. N. E. Wildlife Conf., 1:149-155, 1958 (1959).

# The Effects Of Aquatic Vegetation On Fish

**By C. L. Phillippy**

Fassett (1940) stated that the relations of plants to fish are complex and most statements in the literature are very general. He further stated that aquatic plants may serve as food, shade, protection to fish, support algae and small animals which are directly or indirectly food for game fish, form habitats for the deposition of eggs, and may aid animal life by oxygenating the water.

Lager (1956) said vegetation is of the greatest importance not only in providing food for the organism upon which stream fish live, but also in providing shelter for these organisms and for young fish as well.

Eddy (1957) stated that an abundance of organic matter, such as a heavy weed crop or even domestic sewage through the oxidation processes of decomposition causes a great oxygen consumption and often results in depletion of the oxygen. Eddy also said that minnows, bullheads, and other rough fishes consume large quantities of plant food. The game fishes are mostly predaceous, feeding on smaller fishes and on all sorts of other aquatic animal life such as are found in the root systems of certain floating aquatic plants and living on the leaves of some emergent plants. Eddy explains that we are just beginning to learn about the daily movements of many of our common fishes. Pike move into shallow waters during the day to feed and at evening pass into deeper waters outside of the weed bed to spend the night. On the other hand, the pikeperch move inshore at sundown and spend the night in shallow water moving outside the weed beds during the early morning to spend the day. Perch and sunfishes also exhibit similar daily movements.

Borgerson (1957) writing on home aquariums said no aquarium really needs plants. Their often-touted virtues as oxygen producers have been overrated, and people with the most know-how, tropical fish breeders and dealers, often make little use of plants, except for show, or for actual breeding.

He later states that plants do have functions. They do produce oxygen to a limited degree and they consume carbon dioxide, the fishes waste gas. They use organic refuse or fertilizer. Many fish instinctively deposit their eggs on plants and without plants they won't spawn. And plants provide hiding places for shy species, help all fishes feel at home.

Eipper and Brumsted stated some farm pond owners think that their ponds should be kept completely free of all plant growths. There is generally a definite advantage in controlling the amount of some plant life, but complete eradication of all forms is rarely necessary or practical.

In farm ponds, as in all waters, the microscopic, bloom-forming algae are important food for tiny animals which, in turn, may be eaten by fishes. High yields from bass-bluegill ponds and bait ponds require a heavy growth of these algae. Ponds used for growing bait minnows and other warm water fish are usually fertilized to encourage algae growth.

Even filaments algae and higher plants (especially submerged forms) increase fish production, particularly in trout ponds. They sometimes aid trout survival by keeping the water cool by shading. These plants may also improve trout growth by increasing the population of water insects, the chief food of farm pond trout.

In ponds used to raise bait minnows that lay their eggs on vegetation, small amounts of these plants are necessary for good minnow reproduction unless artificial spawning devices are used.

Aquatic plants are interesting forms of vegetation. They help to make a pond look natural and attractive to more varied groups of wildlife.

Stockdale (1960) stated that plants which grow under, on or out of the water may be undesirable in your pond from a variety of reasons. They may interfere directly with fishing and fish production. They may protect little fish, reducing the effectiveness of the bass as predators and hastening the day when the fish population will become unbalanced. Some plants may give the water an unpleasant smell. A mat of thread-like or filamentous algae floating on the pond's surface greatly increases the rate of water loss through evaporation.

Large plants, which have visible stems or leaves, are not needed for fish life. The microscopic plants in your pond will provide the necessary oxygen and plant food.

Klingman (1961) stated that aquatic weeds choke lakes, irrigation and drainage ditches, interfere with swimming and fishing, foul electric and outboard motors, and may cause undesirable odors and flavors in the water.

On the plus side, they may reduce erosion along shore lines, and some plant species provide food and protection for fish, fowl, and game. Algae are the original source of food for nearly all fish and marine animals; and swamp smartweed, wild rice, wild millet, and bull rushes provide food and protection for waterfowl, especially ducks.

Controlling aquatic weeds sometimes causes problems other than those of the chemical itself. For example, rapid killing of dense, weedy growth may kill the fish. This may happen even though the chemical is non-toxic to the fish.

During photosynthesis living plants release oxygen and fish depend on this oxygen for respiration. When plants are killed, they produce no more oxygen. Worse yet, dead plants are decomposed by microorganisms which require oxygen for respiration. These two actions may reduce oxygen content in the water so the fish suffocate. The answer is to treat part of very heavily infested areas at one time; fish will move to the untreated part.

Fassett in his book "Manual of Aquatic Plants", lists many plants compiled by Leopold and Huff which have a relationship to fish. A part of the list is as follows: Water plantain — shade and shelter for fish; Water shield — shade and shelter; Fanwort — cover and valuable food producer; Coontail — good shelter for young fish and supports insects valuable as fish food; Chara — fair shelter and excellent producer of fish food especially for largemouth bass, has a softening effect on water; Needle rush — forms spawning ground for largemouth bass; Mud plantain — food and shelter; Rush — forms spawning grounds for rock bass, bluegills and other sunfish; Duck weed — poor food producer and excessively shady; Water meal — good food and cover; Najas — good food producer and shelter; Amencan lotus — good shade and shelter; Spatterdock — shade and shelter some species leaves harbor insects; Pondweed — food and shelter, leaves eaten by bluegill, softens water removing lime and carbon dioxide; Bulrush — used for nesting by blue-