Medical and Veterinary Entomology
Livestock and Poultry Integrated Pest Management

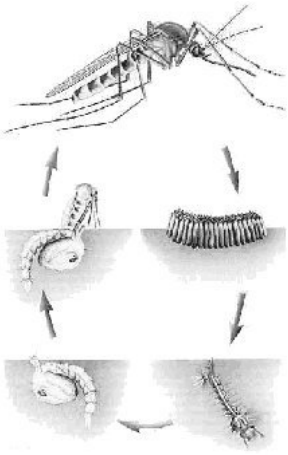
N. C. State University - Department of Entomology

Insect Note ENT/mv-2 (Rev. 2002)

Managing Lagoons To Control Mosquito Breeding

Mike Stringham, Extension Specialist and Wes Watson, Veterinary Entomologist
N. C. State University, Raleigh, NC

Female *Cx. quinquefasciatus* lay their eggs in the water along the shoreline of a lagoon. The eggs are glued together to form small rafts that float on the water's surface. The larvae, often called "wrigglers", that hatch are filter feeders that eat small bits of organic matter, bacteria and other microscopic organisms. The larvae feed and develop and eventually molt into pupae commonly called "tumblers". This is a non-feeding stage of development. The adult mosquito emerges from the pupa and completes the life cycle. Two factors, vegetation and the characteristics of the effluent in the lagoon, make the difference between a lagoon that produces few mosquitoes and one with a teeming population of *Cx. quinquefaciatus*. Leading work done at N. C. State University (Rutz and Axtell, 1978) demonstrated that mosquitoes can be all but eliminated from animal waste lagoons with good vegetative control and reduction of floating debris. The nitrogen, organic matter and oxygen content of lagoon water also discourage mosquito breeding when they are above or below a specific range. Effluent characteristics cannot be easily manipulated, but will reduce mosquito populations under the right conditions. They can also be used as a monitoring tool to predict the likelihood of mosquito problems.



The life cycle of a *Culex* mosquito.

Vegetation Management. Mats of floating plant material and other debris provides both hiding places and food for the developing larvae. Heavy, unmowed vegetation that hangs into the water along a lagoon's shoreline provides additional cover for mosquito larvae. It also serves to trap floating plant material, manure and trash that further enhances the habitat for mosquito breeding. Management practices that eliminate floating debris will discourage mosquito breeding. Efforts to do so are particularly critical from mid-July through late October when the transmission of encephalitis viruses is most likely. Do the following to discourage mosquito breeding:

1. Eliminate weedy growth along lagoon shorelines. A well maintained grass groundcover is preferable to a mixed stand of broadleaf weeds. Grasses are easier to maintain and less prone to hang into the water.

Tall fescue, bermuda, centipede and carpetgrass are examples of grasses that may be used to stabilize lagoon banks.

2. Mow bank vegetation frequently. Weekly or biweekly mowing will eliminate rank growth and reduce the volume of clipped plant material left floating in the water after mowing.
3. Clear floating debris from the lagoon surface regularly.

Effluent Characteristics. The amount of total Kjeldahl nitrogen (TKN), the chemical oxygen demand (COD) and total organic carbon (TOC) will dramatically affect the suitability of a waste lagoon for the larvae of *Cx. quinquefasciatus*. Total Kjeldahl nitrogen values for lagoon water of less than 50 mg/liter or greater than 500 mg/liter (4.2 lbs/1,000 gal) won't support early stage mosquito larvae. TOC values that fall outside the range of 100 to 1,000 mg/liter are also effective, as are COD values of less than 400 mg/liter and greater than 2,000 mg/liter. There is a catch, however. Effluent values that are in the appropriate range for mosquito control may not be effective if bank vegetation and floating debris are neglected.

Total nitrogen appears to be the most important characteristic of lagoon water when it comes to controlling mosquitoes. High TKN values alone will dramatically reduce larval survival even when TOC and COD values are ideal for mosquito production. Average nitrogen values for animal waste lagoon water found in the North Carolina Extension publication AG-439-18, *Nutrient Content of Fertilizer and Organic Materials* (Zublena, et. al., 1991), are listed as pounds of total nitrogen (TN)[1/] per acre-inch, but are easily converted to a pounds per 1,000 gallons equivalent. Although these averages suggest North Carolina lagoons are mosquito free, keep in mind that there is a considerable amount of variation between lagoons. Also keep in mind that drought or heavy rains will affect lagoon water's nitrogen content. Such changes are often temporary, but may last long enough to allow at least one generation of mosquitoes to emerge. Testing is the only way to be sure a lagoon's nitrogen values are high or low enough to discourage mosquito breeding. It is advisable to test lagoon water in June or July to evaluate its suitability for mosquito production.

Control Of Existing Mosquito Problems. Populations of mosquito larvae and pupae in lagoons may become high from time to time in spite of the best prevention efforts. The appropriate use of insecticides will bring an infestation under control within 1 to 3 days. Temophos (Abate® 43EC and Abate® 1, 2 or 5G) is an organophosphate compound that is an effective mosquito larvicide. VectoLex® CG is a biological larvicide containing the bacteria *Bacillus sphearicus* is effective for use in lagoons and other impoundments. Methoprene (Altosid®) is an insect growth regulator that kills mosquito larvae by disrupting their development. This product comes in a variety of formulations, but pellets are perhaps the best suited for farm lagoons. Specially formulated mineral oils (Bonide Mosquito Larvicide® and BVA Chrysalin®), napthenic oil (Mosquito Larvicide GB 1111®), distilled petroleum oil (BVA Larvicide2®), and monomolecular surface films such as Aqnique MMF 5996® may be applied to lagoon surfaces to smother mosquito larvae and pupae.

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Because mosquito breeding occurs in a zone about 10 feet wide from the shoreline outward, it is not necessary to treat the entire surface area of the lagoon. In addition, Altosid® products are not effective in water much over 2 feet in depth. Calculate treatment needs based on a 10 foot wide band around the circumference of the lagoon.

Animal facilities may be treated for adult mosquitoes using either pyrethrin fogs or permethrin surface sprays. Fogging should be done at dusk and requires that the building be closed for 15 to 30 minutes for effective knockdown. Surface sprays should be applied to mosquito resting sites. These generally include interior wall surfaces (especially corners), under building eaves and other surfaces in locations protected from the wind or high volume air movement.

Further Reading:

Rutz, D. A. and R. C. Axtell. 1978. Factors affecting production of the mosquito *Culex quinquefasciatus* (=*fatigans*) from anaerobic animal waste lagoons. North Carolina Agricultural Experiment Station Technical Bulletin, no. 256; pp. 32.

Zublena, J. P., J. V. Baird, and J. P. Lilly. 1991 (rev. 1997). Nutrient content of fertilizer and organic materials. North Carolina Extension Service Publication, AG-439-18. Available at:
http://www.soil.ncsu.edu/publications/Soilfacts/AG-439-18/

Florida Mosquito Control. An excellent overview of mosquito management (control, monitoring, etc.). **Note that not all recommendations are approved for use in North Carolina.** This document may be found on the web at:
http://gnv2.ifas.ufl.edu:7100/~veroweb/whitep/whitep.htm

The *2001 North Carolina Agricultural Chemical Manual* provides the latest chemical control recommendations for mosquitoes and other pests, as well as useful information about applicator safety, application equipment and calibration, and waste water analysis at:
http://ipm.ncsu.edu/agchem/agchem.html

[1/] Current lagoon water analysis in North Carolina is expressed as total nitrogen (TN) and accounts for both TKN (organic nitrogen + ammonia) and nitrate nitrogen.