Rain Gardens and Mosquitoes

Fact Sheet FS1175

Fig. 1

Fig. 2

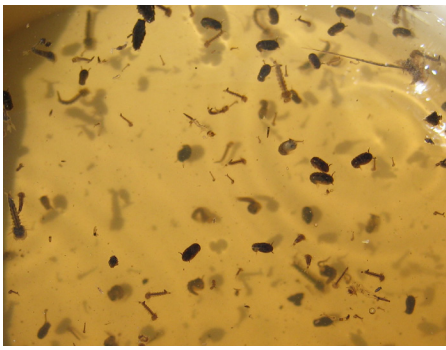

Fig. 3

Cooperative Extension

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Rain gardens are one of many sustainable or low impact development practices used to treat stormwater runoff, often referred to as "green infrastructure". Rain gardens treat stormwater as a resource; as opposed to the more conventional approach where stormwater treatment included removing stormwater as quickly as possible from the landscape and directing it to the nearest water body. By definition, a rain garden is a shallow, landscaped depression that facilitates the infiltration of stormwater runoff from impervious surfaces, confining it while it allows for slow percolation into the ground over 24-48 hours. This seepage of the stormwater runoff allows the physical settling out of sediment and adsorption of some nutrients such as phosphorus. Nutrient concentrations are reduced through biological and chemical processes as plants have the opportunity to uptake nutrients. The plants in this depression area are selected based on their ability to withstand being inundated with standing water for a period of time; however, it is also this ponding area which can cause concerns regarding mosquito production.

Because rain gardens are often a relatively inexpensive and easy-to-install solution to residential stormwater runoff, they have become a dominant form of "green infrastructure" in many areas of the nation. Rain gardens can help to reduce stormwater runoff by as much as 99 percent by redirecting the water into the garden. Some rain garden studies show stormwater runoff percolates even in cold and snowy situations.

Mosquito control agencies have been addressing serious health problems, real and potential, for more than a century and have raised concerns regarding the proliferation of intentional small bodies of standing water. Rain garden advocates and those performing mosquito control cross paths because rain gardens may temporarily hold water thereby creating potential mosquito larval habitat. A search of internet resources reveals varying guidance as to the safe amount of time a rain garden can take to drain before its benefits to the landscape create unwanted mosquito habitat.

Mosquito Facts

There are over 3000 mosquito species worldwide, 63 of which are found in New Jersey. Each mosquito species behaves differently and has a slightly different life cycle. The one common trait shared by all mosquito species is that their immature stages (larvae) start in water of some kind. Only female mosquitoes bite, males are incapable of biting. Females bite to acquire blood which is used to produce eggs. It is important to note that not all species of female mosquitoes bite as some can produce eggs without blood. For nutrition both male and female mosquitoes will feed on flower nectar, plant sap or other sugary substances; blood is not food for adult mosquitoes. Depending on the species, a mosquito can travel 20 miles or more for a blood meal. Humans are not the only source of blood for mosquitoes, some mosquito species seek out birds,

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reptiles, amphibians or various other mammals. While most of us think of mosquitoes as a nuisance, they also transmit diseases such as West Nile virus (WNV), dog heartworm, eastern equine encephalitis (EEE), malaria and many, many others.

Mosquitoes use a variety of habitats in which to lay their eggs. Some common mosquito habitats are swamps, water-filled tree holes, ornamental ponds, puddles, catch basins, stormwater facilities, gutters, and tires – literally any container that can catch and hold water. Mosquito larvae are generally not found in fast moving streams or in the open areas of ponds and lakes.

Mosquito control in New Jersey is based on the concept of Integrated Pest Management and is generally conducted at the county level with input from the Office of Mosquito Control Coordination and the State Mosquito Control Commission. Mosquito control programs utilize education, water management, biological control and regulated pesticides. Mosquito pesticides can be divided into two classes, those that kill larvae (larvicides) and those used to kill adults (adulticides). All individuals applying pesticides for professional mosquito control agencies in New Jersey are trained and licensed to perform these activities.

Mosquito Life Cycle

A mosquito goes through complete metamorphosis; egg, larva, pupa and adult (Fig. 4). The first three stages are spent in water. Some mosquito species deposit groups of eggs known as rafts, while others deposit eggs individually. Some must deposit their eggs directly on the water's surface while others can deposit them in moist areas where they may be inundated with water at a later time. Most eggs hatch in 24-48 hours but others can sit dormant for years before hatching. Once the eggs hatch, larvae go through four stages or 'instars', molting between each stage. In general mosquito larvae filter feed on suspended organic material but a few are actually predators and will eat other organisms in their environment. Larval mosquito growth is dependent on food availability and temperature. Generally the warmer the water the faster the mosquito proceeds through its growth cycle. The fourth larval stage molts into a pupa which contains the forming adult. The pupa does not feed but is mobile and has a characteristic 'C' shape. The pupal stage can be as short as two days. When the adult is formed in the pupa, the pupal skin splits at the water's surface and the adult slowly forces itself out, resting temporarily on the surface before taking flight. In the warmest weather a mosquito can proceed from egg to adult in 5-7 days.

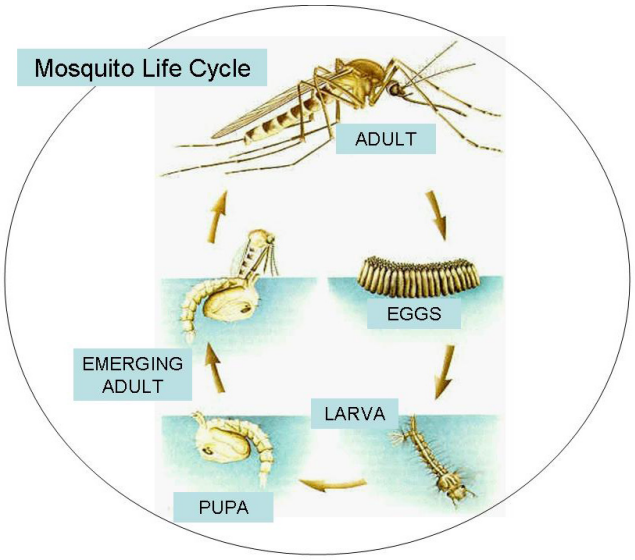

Fig. 4

Locating Larvae

If water remains after 72 hours, the rain garden should be checked for mosquito larvae. In the early stages of development mosquito larvae are difficult to spot with an untrained eye. As the larvae grow larger and begin transforming into pupae, it is usually possible to spot them with the naked eye. The small vertical larvae will come to the surface of the water to breathe. The larvae can also be seen "wriggling" in the water while the 'C' shaped pupae is usually found "bouncing" along just beneath the surface of the water (Fig 3.). To check for larvae use a white cup or container to scoop some of the water out of the rain garden to provide a clear background while checking the water for mosquitoes (Fig. 1). If requested, the local mosquito control agency may be able to come and inspect your rain garden for mosquito larvae as well.

Keeping Your Rain Garden Mosquito Free

The best way to keep a rain garden mosquito-free is to accept the potential for it becoming a mosquito habitat and design, build, and maintain the rain garden accordingly. A problem can occur when rain gardens are sited improperly, poorly constructed, or not maintained properly. Rain gardens should be designed and constructed to drain completely within 72 hours to avoid standing water and potential mosquito larval habitat. As with any stormwater feature, if water does not drain away completely within 72 hours, mosquitoes may have time to complete their life cycle. Rutgers Water Resources Program suggests 48 hours to maintain a margin of safety.

A rain garden that is sited, installed and maintained in the recommended manner will most likely not become mosquito habitat. Rutgers Water Resources Program (WRP) Fact Sheets, guidance and training offer

detailed information on site selection, installation, and maintenance. Selecting a site with good drainage and an acceptable percolation test is one key to a successful mosquito free garden. United States Environmental Protection Agency (US E.P.A.) studies have found that a rain garden's ability to drain or lack thereof is more heavily impacted by poorly draining soils, than the size of drainage area the rain garden is designed to treat. If the soil texture test indicates high clay content the depth of the garden can be decreased to three (3) inches to allow evaporation to complement infiltration as a method to assure complete drainage. Soil amendments that increase the sand component to fill the volume of the garden should also be used. In some gardens additional holes are filled with sand to increase infiltration (Fig. 2) in excavated gardens with higher clay content. Remember not all sites are appropriate for rain gardens.

In addition to following the guidelines set by the Rutgers Water Resources Program (see FS513) on location and maintenance practices is also important to ask the following questions:

- If it is built on public or commercial property, is training required on maintenance?
- Will it be a volunteer group that may have experts on rain gardens, but may need coordination when it comes to putting in the hours to keep the rain garden healthy?
- Has a maintenance manual and agreement been developed and provided to all parties?
- If routine maintenance fails, does everyone know who to contact for further assistance?

Consider contacting the local mosquito control agency when installing a rain garden. Rain garden locations my be useful to mosquito control agencies, especially if a standing water problem does occur. Mosquito control personnel may be able to provide information on mosquito biology and provide inspection services to you. Each mosquito control agency is unique and may provide different services based on your location.

Contacting your local mosquito control agency

The NJDEP Office of Mosquito Control Coordination has set up a hot line for the public to reach their local mosquito agency. Dial 1-888-666-5968 or 1-888-NO-NJ-WNV. In addition, complete NJ state information on mosquitoes, including a list of county mosquito control agencies throughout NJ, is available online at nj.gov/dep/mosquito/index.html.

Resource List

Frequently Asked Questions About Mosquitoes. Wayne J. Crans. Rutgers Cooperative Extension. New Jersey Agricultural Experiment Station. NJAES Publication No. H-40400-01-98.

Dietz, M. and J.C. Clausen. 2005. A field evaluation of rain garden flow and pollutant treatment. Water, Air and Soil Pollution. 167:123-138.

Controlling Mosquitoes Around the Home. Wayne J. Crans and Farida Mahmood. Rutgers Cooperative Research and Extension. NJ Agricultural Experiment Station. Published October 1994. NJAES Publication No. H-40101-01-94.

New Jersey Mosquito Control Association website. njmca.org

Stander, E.K., M. Borst, T.P. O'Connor and A.A. Rowe. 2009. The Effects of Rain Garden Size on Hydrological Performance. Conference proceedings of International Erosion Control Association Northeast Chapter's Annual Conference. Hartford, CT. October 27-29, 2009.

Acknowledgements: Dr. Peter Bosak at Cape May County Department of Mosquito Control provided extensive comments on the mosquito life cycle.

Photos:
Fig. 1. To check for mosquito larvae a white cup can be used to make the larvae more visible. Photo courtesy Bill Karlak. 2011.
Fig. 2. In areas where the soil has a higher clay content additional holes can be dug and filled with bank run sand to increase the infiltration capacity of the rain garden. This can only provide better infiltration and should not be utilized to compensate for a site where a failed percolation test indicates the site should not have a rain garden. Photo courtesy Pat Rector, 2010.
Fig. 3. Mosquito larvae may be seen by a wriggling movement in the water with the naked eye. Photo courtesy of Bill Karlak, 2011.

Fig. 4. Mosquito Life cycle.

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