Level 3: Mosquitos in Two Different Pool Habitats

Aedes albopictus. Credit: Public Health Image Library.

- **Background Information:** Belonging to the family Culicidae, mosquitoes play an integral role in the spread of diseases such as malaria, dengue fever, West Nile fever, and encephalitis. When female mosquitoes bite their victims in order to obtain blood to use as food, they sometimes exchange their saliva with us as well. While the saliva might only cause a small rash, the bacteria, viruses, or parasites that live inside that saliva can cause terrible damage to humans. This makes mosquitoes one of the leading vectors of disease, or organisms that transmit infectious pathogens to other organisms. According to data from the Center for Disease Control (CDC) and the World Health Organization (WHO), mosquitoes can be considered the most dangerous animal in the world.

  Considering the amount of damage mosquitoes can inflict upon humans, it is important to understand their life cycle so that we can control their populations. Mosquitoes go through four stages in their life cycle: egg, larva, pupa, and adult. Eggs are laid in or near water surfaces. Once hatched, the mosquito larvae live in the water but need to come to the surface to breathe. The mosquito larvae feed on microorganisms and organic matter found in the water. Between one and three weeks, larvae molt into their pupal stage, which is their non-feeding stage when they change into an adult mosquito. The adult mosquitoes then emerge from the water to carry out the rest of their lives as terrestrial flying insects.

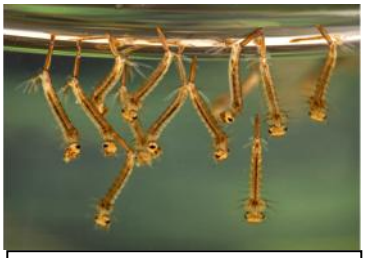
As you can see, bodies of water play a vital role in mosquito development. Dr. Shannon LaDeau and her team were interested in better understanding how these different types of water bodies affected that development. She and her team chose to look at semi-permanent versus ephemeral pools of water to see if they affected the large outbreak of adult mosquitoes that usually occurs following a spring thaw or periodic rain events. Semi-permanent pools have rainwater in them for most of the mosquito development season. Ephemeral pools go through wet/dry cycles every 1-2 weeks.

When looked at through this simple lens, the answer might seem obvious. Mosquito population density and diversity would surely be largest in the semi-permanent pools, where the developing mosquitoes would not be affected by sudden dry periods that would hinder their ability to develop. However, many organisms feed off of mosquito larvae, and those organisms would be more likely to gather in semi-permanent pools of water. Would these organisms be able to more effectively control mosquito populations in the semi-permanent pools or would the boom-bust cycle of ephemeral pools make mosquito development unfeasible? Would certain species of mosquito be able to develop more rapidly in the ephemeral pools? Dr. LaDeau and her team decided to find out.

Lithobates clamitans; Green frog

- **Dataset Timeframe:** Spring/summer 2013

- **Data Collection Methods:** Ephemeral and semi-permanent pools on the Cary Institute of Ecosystem Studies property in Millbrook, NY. Ephemeral pools are wet for 1-2 weeks at a time. Semi-permanent pools generally persist most of the season. Pools change in size over the season, reflecting precipitation patterns.



Culex mosquito larvae in water

Larvae sampling: Mosquitoes spend their larval and pupal stages underwater. Mosquito larvae were sampled from each pool using a standard 500ml dipper. Each dip was a random sample of a square meter area of water. Each pool was sampled on four dates, two to three weeks apart, during the summer.

Adult sampling: Mosquitoes emerge from the water as adults. Floating pyramid traps were used to sample emerging insects (aquatic larvae that emerge as terrestrial – often flying - adult stages). Pyramid traps sample one square meter surface area. Three traps were used at semi-permanent pools. One to two traps were used at each ephemeral pool (for instance, pool 712 was large and had two emergence traps). Traps were placed out at each pool for 1 week at a time. This was repeated three times at each pool during the summer.

Emergence trap.

❖ **Dataset Variables:**

➢ **Larvae Data**

- Total area of pool sampled = 1 square meter * number of dips
    - Total area sampled is roughly a constant proportion of the total pool size.
- The column list from J to R includes individual mosquito species sampled.
- Week.Number: Week number (of 52 in year)

- Wetness: YES = water in pool; DRY = no water in pool
- larv.effor larvae sampled/# dips = larvae per m^2 of pool
- Amphibians present: Yes (observed), No (not observed) including adult or larvae/tadpoles
- Richness (# genera): # of Mosquito genera

➢ **Emergence Data**

- All species were identified to lowest taxonomic level possible
    - Mosquito species are all under Culicidae
- Trap: Trap number (1-3 per pool)
- Taxa: All species were identified to lowest taxonomic level possible
- Common Name: All taxa were identified by their common name
- Count: Number of indivduals for each taxonomic group

➢ **Pool Characteristics Data**

- Hydrologic category and maximum (at wettest) size of each pool.
- Multiplier: number of dips. Since each dip represents a m^2 sample area, you can find the sampled area by multiplying by the multiplier.

❖ **Information about Site:**

These data represent comprehensive sampling of a set of forested pools on Cary Institute property during spring/summer 2013.

❖ **Source of Datasets:** Shannon LaDeau (Cary Institute of Ecosystem Studies)

❖ **Inquiry Idea Starters:**

➢ *Does pool type affect mosquito population density?*

➢ *Does pool type affect mosquito diversity?*

➢ *Is there a mosquito development stage that is drastically reduced in either the semi-permanent or ephemeral pools? What might account for this?*

❖ **Extension Ideas:**

➢ How can Cary Institute control its mosquito population through the monitoring of semi-permanent and ephemeral pools?

- What does this data tells us about the role mosquito predators play in mosquito development?

- **References:**

Center for Disease Control. *Mosquito-borne diseases map*: https://wwwnd.cdc.gov/arbonet/Maps/ADB_Diseases_Map/index.html

World Health Organization. *Mosquito-borne diseases.*: http://www.who.int/neglected_diseases/vector_ecology/mosquito-borne-diseases/en/