MOSQUITOES IN BROMELIADS - What's the Real Story?



The Zika scare has added an element of hysteria to a problem that has been with Florida since people first inhabited the state. Face it; mosquitoes are a fact of life in Florida (and most inhabited areas of the Earth). Historically there have been few mosquito vectored diseases affecting humans in Florida with some outstanding exceptions: Yellow Fever, Malaria, Dengue to name some, with Yellow Fever having been eradicated from our hemisphere and Malaria and Dengue very rare in Florida. Enter Zika with its associated birth defects in humans, add sensational publicity and you have a wave of hysteria that leads to many irrational decisions on the part of the public as well as our political leaders.

A complex problem rarely has simple causes or solutions. The fact that mosquitoes breed in standing water and that many bromeliads retain water between their leaves has led to a over simplistic 1+1=2 logic. To make any sense of the issue, one must have some facts. The facts are that only some mosquitoes breed in bromeliads and only some of these can potentially vector human diseases. The incident of success of these disease vectoring mosquitoes in completing their lifecycle in a bromeliad is a big factor. Knowing how mosquitoes breed and their requirements to survive is all important to understanding the potential role that bromeliads might play in the spread of mosquito borne diseases.

The article below, written by Dr. J Howard Frank, Professor Emeritus, University of Florida, one of the world's leading experts in the biology of mosquitoes in bromeliads and author of many papers on the mosquito-bromeliad connection, is a short but concise overview of the Zika (and other mosquito borne diseases) scare related to bromeliads. Understanding the life cycle of the types of mosquitoes that inhabit bromeliads in Florida and those that can carry diseases is of critical importance and concern for making decisions in this hot-button issue. (Dennis Cathcart, Tropiflora, LLC, Sarasota, FL)

An Ecology-Based View of Mosquitoes in Bromeliads

Dr. J Howard Frank, Professor Emeritus, University of Florida

In nature in Florida: A few native epiphytic bromeliad species impound rainwater in their leaf axils. The northern limit of their distribution is a line roughly between Volusia County and Hillsborough County. Immature stages of two species of the mosquito genus *Wyeomyia* often inhabit these water-filled leaf axils. The life cycle of all mosquitoes is ADULT-EGG-LARVA (4 larval growth stages [sizes])-PUPA-ADULT. Adult females of these mosquitoes will bite people and rabbits, but do not transmit any disease to people. They bite in daylight hours, peaking in late afternoon, not at night. You may encounter *Wyeomyia* mosquitoes in many state parks, and perhaps also in your own yard. Occasionally an interloping mosquito, *Toxorhynchites rutilus*, lays eggs into these leaf axils, but it normally inhabits dark water-filled rot-holes in trees. Unlike other mosquitoes, its adult females do not bite; instead its larvae gain their protein by feeding on pest mosquito larvae!

How do *Wyeomyia* mosquitoes live? Adult females take blood; males and females drink plant nectars. Eggs and pupae do not feed. Dead leaves and twigs and seeds from the tree above fall into the leaf axils, especially during hard rain which adds leachates from the tree canopy and, on breakdown by minute bacteria and fungi, provides food to the bromeliad and to mosquito larvae. Larvae filter-feed on these resources. Typically the water is very clear because the *Wyeomyia* larvae and bromeliad remove nutrients – so clear that it was used for drinking water by early explorers (it would hurt nobody to drink water with some mosquito larvae). Very many *Wyeomyia* mosquito larvae die due to competition with each other for food (shown by University of Florida laboratory experiments).

Now we grow exotic bromeliads in Florida, so what is the difference? In 1978-1979, a University of Florida survey was conducted in four urban areas of Florida, of mosquito immatures in exotic bromeliads planted in the ground. The reason was the spread of Dengue fever types II, III, and IV, transmitted by the mosquito *Aedes aegypti* in the Caribbean, a threat to Florida. The question was: what is the prevalence of *Aedes aegypti* in exotic bromeliads? To answer the question, the apparently commonest bromeliad in urban areas, *Billbergia pyramidalis*, was surveyed. Cities surveyed included the Daytona Beach area, Tampa, Vero Beach, and Miami, in collaboration with local Mosquito Control Districts. The result was that 98.8% of all the mosquito immatures were *Wyeomyia,* which do not transmit any diseases to humans; less than half of 1% were *Aedes aegypti* , and about 0.7 % *Culex quinquefasciatus*, both of which were interlopers in a bromeliad habitat that had been taken

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over by native Wye*omyia* mosquitoes. This suggested that *Aedes aegypti* were but a trivial component of mosquitoes in *Billbergia pyramidalis* bromeliads. Furthermore, the numbers of immature mosquitoes present do not show the **outcome** of extreme competition among mosquito larvae – which is shown only by numbers of mosquito pupae (or emergent adults). The numbers of *Aedes aegypti* surviving to the pupal and adult stage in bromeliad leaf axils is effectively zero (0%).

Hysteria due to the presence of Zika virus in Florida. Belatedly in 2016, some people have realized that mosquito larvae occur in bromeliad leaf axils in Miami. Apparently they do not realize that studies on the subject were performed in 1978-1979, much less the results of that study. Their whistle-blowing is inappropriate except in the special circumstance that people have allowed the pollution of the water in bromeliad leaf axils. What pollution?

A) do not allow grass clippings from a lawnmower to get into the bromeliads. These clippings rot and enrich the water, making it appropriate for *Aedes* and *Culex* mosquitoes.

B) do not allow the flowers of *Neoregelia* bromeliads to decompose in the water for the same reason. For ease of maintenance, it is best not to grow masses of close-packed *Neoregelia*.

C) do not use the insect growth regulator methoprene (sold as brand name Altosid) nor the bacterium *Bacillus thuringiensis* **serovar** *israelensis* (sold under at least two brand names) because it kills all mosquito larvae, including the beneficial *Wyeomyia* as well as the bad ones such as *Aedes* and *Culex* mosquitoes and the dead bodies of the mosquito larvae they kill will rot and eventually will provide nutrient to living *Aedes* and *Culex* mosquitoes.

Summary: ***Wyeomyia* mosquito females prefer to lay their eggs in pale green bromeliads and their immature stages represent 98.8% of all mosquitoes in a typical bromeliad in urban habitats in southern Florida. *Aedes aegypti* females (vectors of dengue, Chikungunya, Zika, and yellow fever) prefer to lay their eggs in black containers of water (think scrap tires and saucers under plant pots). *Wyeomyia* are highly adapted to life in water in bromeliad axils: under conditions of intense competition with *Wyeomyia* in bromeliads, *Aedes aegypti* larvae die. If you think you need to reduce numbers of mosquito larvae in your bromeliads, prefer to use pressure from a garden hose with a suitable nozzle to wash out nutrients (thus starving the mosquito larvae even more) and maybe wash out some of the mosquitoes themselves. Keep the water in your bromeliad leaf axils so clean that you would be prepared to drink it.**

A short selection of pertinent publications on mosquitoes by Dr. J.H. Frank:

Frank, J.H., Curtis, G.A. 1977. On the bionomics of bromeliad-inhabiting mosquitoes. III. The probably strategy of larval feeding in Wyeomyia vanduzeei and Wy. medioalbipes. Mosquito News 37:200-206.

Frank, J.H., Curtis, G.A. 1982. Bionomics of the bromeliad-inhabiting mosquito Wyeomyia vanduzeei and its nursery plant Tillandsia utriculata. Florida Entomologist 64: 291-506

Frank, J.H., Lynn, H.C., Goff, J.M. 1985. Diurnal oviposition by Wyeomyia mitchellii and W. vanduzeei (Diptera: Culicidae). Florida entomologist 68: 493-496.

Frank, J.H. 1986. Bromeliads as ovipositional sites for Wyeomyia mosquitoes: form and color influence behavior. Florida Entomologist 69: 728-742.

Frank, J.H., Stewart, J.P., Watson, D.A. 1988. Mosquito larvae in axils of the imported bromeliad Billbergia pyramidalis in southern Florida. Florida Entomologist 71: 33-43.

Gettman, A.D., Frank, J.H. 1989. A method to reduce Wyeomyia michellii eggs in Billbergia pyramidalis bromeliads. J. Florida Anti-Mosquito Assoc. 60:7-8

Electronic (WWW)publications. Note that all those on University of Florida servers have been updated since their original publication (and some of the updates have been considerable) so that they may be thought of as works in progress.

Frank,J.H. 1996. A bibliography of the aquatic biota in bromeliads phytotelmata. Published on WWW at http://entnem.ifas.ufl.edu/frank/BromeliadBiota/bromfit.htm

Frank, J.H. 1996. Bromeliad-inhabiting mosquitoes in Florida. Published on WWW at http://entnem.ifas.ufl.edu/frank/BromeliadBiota/mosbrom.htm

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