The Value of Mosquito Taxonomy to Pest Mosquito Control

Andrew J. Rogers
West Florida Arthropod Research Laboratory
Panama City, Florida

Until recently *Culex nigripalpus* was regarded as a mosquito of no medical significance and was thought not to be an important pest species (King et al., 1939). In 1962 this species was shown to be a principal vector of St. Louis encephalitis (Chamberlain et al., 1962). Vector studies in the lower Rio Grande Valley of Texas during the 1971 Venezuelan Equine Encephalitis epidemic resulted in virus isolations from 11 species of mosquitoes of five genera (Sudia et al., 1971). The species having the highest infection rates were *Psorophora confinnis, Aedes sollicitans* and *Psorophora discolor;* all generally regarded as pest mosquitoes. Others on that list that are best known as "pest" species were *Aedes taeniorhynchus, Psorophora ciliata, Culex salinarius,* and a species each of *Deinocerites* and *C. Melaniconion).*

These are only examples of the rapidly changing status of many species that once were regarded only as pest mosquitoes. Therefore, based on current knowledge it is difficult to completely separate pest species and disease vectors. This statement is made to justify using an example involving a disease vector to make a point, thus encroaching slightly on the subject of another panelist.

The example is recorded in Cushing's History of Entomology in World War II (Cushing, 1957). This reference states that there was a high malaria rate at an American military base on the Island of Trinidad during World War II. Army medical personnel not trained in entomology spent millions of dollars draining swamps adjacent to this base, but the malaria rate was not reduced by the drainage. Finally, an entomologist was asked to study the problem and he found that the mosquito that was transmitting the malaria was a species of *Anopheles* that was breeding in the air plants that were growing on the trees surrounding the base. A program to control the air plants quickly brought the malaria rate down. The point to be made by this example is that millions of dollars and perhaps a number of lives could have been saved if the malaria vector in this case had been identified before control methods were selected. This brings into focus the basic point of this presentation; namely, that effective control measures against any mosquito must be based on the biology of that particular species, and the biology cannot be known until the identification of the target species is known. Since biological control will be discussed by another speaker, this paper will only consider control by water management and insecticides.

Control by Water Management - How and where a mosquito deposits its eggs might be regarded by some as an academic question that only should be of interest to the scientist. Actually, this information is of vital concern to mosquito control workers. Some of the more important pest species are the floodwater mosquitoes of the genera *Aedes* and *Psorophora*, so called because of their habit of depositing eggs on soils subject to flooding. control the breeding of these species by water management, there are two exactly opposite alternatives: 1. drainage, which will control any mosquito, and 2. permanent flooding. However, some floodwater species deposit eggs on soils of such low elevation that effective drainage without pumping is not feasible. The two salt-marsh species, *Aedes taeniorhynchus* and *Ae. sollicitans*, are examples. Many of the Florida East Coast salt marshes, for example, average approximately 0.4 feet above sea level; therefore, wind tides and normally heavy rains in the summer and fall frequently flood drainage ditches and marshes alike for a week or more--ample time for a brood of salt-marsh mosquitoes to develop and emerge. Most of these vast marshes were ditched, first by hand and later by dragline, over the past 40 years, but never with completely satisfactory control. In recent years, many of these same marshes have been diked and flooded. This procedure eliminates the breeding of these two species and is based entirely on the simple fact that neither of these mosquitoes will deposit their eggs on water.

There are many variations in the egg-laying habits of mosquitoes that must be considered by control personnel. For instance, the vicious pest species *Mansonia perturbans* lays its eggs in rafts on the surface of the water among aquatic plants of many kinds; whereas, *M. titillans* glues its eggs to the under-surface of the leaves of water lettuce. Some *Aedes* choose grass covered depressions in open pastures to deposit eggs and others place their eggs above the water line inside containers or tree holes. Other *Aedes* and some *Psorophora* seek out moist, shaded soil of swamps and dense woods to deposit their eggs. These are known collectively as "woods" species, and some of these are among the more important pest mosquitoes, e.g., *Ae. infirmatus* and *P. ferox*.

Then there are the pest species of the genus *Wyeomyia* that lay their eggs only in air plants or in pitcher plants (*Saracenia* sp.). One can imagine what might happen if untrained, inexperienced people were given a large budget of public funds and a dozen draglines to control these pest species in a vast wetland. Let us hope that that era of environmental and economic waste in the name of mosquito control is all in the past.

Water management is an effective but expensive method of mosquito control. Some variations in oviposition habits have been cited only as one aspect of the biology of mosquitoes that is important in the proper use of this method of control.

<u>Chemical Control</u> - Like water management, effective and economical mosquito control by insecticides also requires detailed knowledge of species biology, which in turn requires accurate species identification.

Generally, larviciding is the preferred method of mosquito control by chemicals. If one is to effectively control a target species by this method, he first must know where the larvae are. If this sounds too elementary, consider that the larvae of individual species, like the eggs from which they hatch, have specific habitats. They range from tree holes and air plants to tin cans, and from pot-holes to vast swamps and marshes. If the target species is a *Mansonia,* the informed control operator will know that he cannot kill these larvae with oils, for he will know that the larvae are on the submerged roots of aquatic plants.

A knowledge of the time required for larval development also is important in larviciding effectively. For instance, *Psorophora confinnis,* an important pest species, can, and often must complete larval development in four days in order to survive the rapid drying of its temporary floodwater breeding sites. On the other hand, timing is not that critical when larviciding certain *Anopheles* and *Culex* that are found in permanent water and require up to two weeks for larval development. The newer larvicides such as the juvenile hormone mimics generally are more effective against the late instars. A knowledge of larval biology of the target species obviously is important in the use of these materials.

Effective control of adult mosquitoes by insecticides also depends on accurate identification and knowledge of species biology. For instance, a thermal aerosol operation can be successful or it can fail, based on the behavior of the target mosquito and the timing of the application. *Aedes taeniorhynchus* adults rest in leaf litter at ground level during daylight hours. Thermal aerosol droplets are of a size that do not deposit on the ground in sufficient quantity to kill mosquitoes at that level. Therefore, use of this method against this species during daylight hours is a waste of funds and chemicals.

Presumably, the best time to apply space sprays is during the flight activity of the target species, because flying mosquitoes are known to collect more small droplets than mosquitoes at rest, and they are not as likely to be in protected areas at this time. But there is a two fold problem here: 1. the activity period of many species is too short to permit wide area coverage when the mosquitoes are most active, and 2. our knowledge of resting habits and behavior of adult mosquitoes at night is very inadequate. Perhaps those who study mosquito biology will soon start to fill this gap in our knowledge.

Abatement personnel also should know that some mosquitoes rest inside hollow trees and logs, culverts, and other structures; therefore, neither ground space sprays or aerial spraying are as likely to control these species as effectively as those that are in less protected places at the time of application.

Species susceptibility to various insecticides also is an important factor in adulticiding. In some ground ULV tests conducted in Florida in recent months, where two species were exposed side by side in separate cages in the same tests, differences in susceptibility up to 20 times have been recorded for the two species.

As with water management, we could go on and on with examples of the importance of species biology to effective mosquito control by chemicals, but perhaps those cited will be adequate to emphasize the main point of this paper, which is, that taxonomy is the basic science, the starting point, on which all effective abatement procedures must be based, for without accurate identification there can be no logical planning and selection of the best methods of abatement. As applied scientists and operational personnel, let us resolve to support in every way possible this basic aspect of the science and art of mosquito control.

References Cited

Chamberlain, R. W., W. D. Sudia, P. H. Coleman and L. D. Beadle. 1962. Vector studies in St. Louis encephalitis epidemic, Tampa Bay Area, Florida. Amer. J. Trop. Med. and Hyg. 13:456-461.

Cushing, Emory C. 1957. History of entomology in World War II. Pub. No. 4294, Smithsonian Inst., Wash., D. C., p. 45.

King, W. V., G. H. Bradley and T. E. McNeel. 1939. The mosquitoes of the Southeastern States. Misc. Pub. No. 336. U. S. Dept. Agri., Wash. D. C.

Sudia, W. D., V. F. Newhouse and L. D. Beadle. 1971. Special report, Venezuelan encephalitis. Vector Control Briefs. HEW-CDC, Atlanta, Ga., 3 pp.