REVIEWS AND ABSTRACTS

THREE-YEAR INVESTIGATIONS OF MOSQUITO BREEDING IN NATURAL AND IMPOUNDED TIDAL MARSHES IN DELAWARE. By R. F. Darsie, Jr. and P. F. Springer. Tech. Bull. 320, Univ. Del. Agric. Expt. Sta. 65 pp. 1957. An investigation of mosquito breeding in natural and impounded tidal marshes in Delaware was conducted from 1953 to 1955. Study areas included two natural marshes and two fresh-water impoundments, one completed in 1939 and the other after the first summer of study. The impoundments were designed to improve waterfowl habitat, and consisted largely of open expanses of water several feet in depth containing submerged plants with marginal stands of emergent vegetation.

In the tidal marsh, the mosquitoes dipped in greatest numbers were *Aedes sollicitans* and *Aedes cantator,* the two most important pests in the area. They were followed in abundance by *Culex salinarius* and *Anopheles bradleyi.* However, numbers varied considerably each year. *C. salinarius* was the species taken most commonly in 1953, *A. cantator* in 1954, and *A. sollicitans* in 1955. Breeding in the tidal marsh was not uniform, but occurred mainly at the upper edges near the mean high tide level, in sites characterized by growths of saltgrass, saltmeadow cordgrass, and mixtures of the two alone or with saltmarsh cordgrass.

Permanent impoundment of fresh water in the mosquito-breeding zone along the mainland reduced salinity and prevented frequently fluctuating water levels. As a result, the two important salt-marsh *Aedes* pests were almost entirely eliminated due to lack of suitable oviposition sites. *An. bradleyi* also was markedly reduced; however, *C. salinarius,* a broadly adapted species, continued to thrive. Impoundage favored breeding of certain fresh-water mosquitoes, including the permanent-water species, *Anopheles quadrimaculatus, Uranotaenia sapphirina,* and *Culex restuans,* and a flood-water species, *Aedes vexans,* which occurred only after rises in the pond level resulting from heavy rains. By reason of their daytime resting habits, generally limited flights, non-biting of humans, or the smaller numbers produced, these species, compared to the salt-marsh *Aedes,* were of less or no importance as pests. Most breeding occurred in woods edge, phragmites, cattail, switchgrass and, during the first year after flooding, swampdock.

In the impoundments, maintenance of a high, fairly stable water level, which flooded emergent vegetation, resulted in the production of large numbers of permanent-water mosquitoes (*Culex, Anopheles,* and *Uranotaenia*), but few *A. vexans.* High water also favored submerged pondweeds, which are heavily utilized by waterfowl. Recession of the water from the vegetated margin during the summer caused the growth of moist-soil annual and perennial plants attractive to waterfowl and muskrats. Under a drawdown condition, fewer permanent-water mosquitoes were produced, but subsequent reflooding before late fall resulted in larger numbers of *Aedes.* Lowering of the water level below the roots of host plants each summer for several weeks or more effectively prevented the successful breeding of *Mansonia perturbans.*

The principal mosquitoes taken in the light trap were *A. sollicitans, C. salinarius,* and *An. crucians* complex (probably mostly *bradleyi*). No one species was clearly dominant, *C. salinarius* being the most common in 1953, *An. bradleyi* in 1954, and *A. sollicitans* in 1955. However, *A. sollicitans* accounted for almost all of the daytime biting. In the *Mansonia* traps in Shearness Pond during 1955, the average emergence was 2.6 adults per square foot of cattail marsh, or 0.5 adult per cattail stalk.

Prior to impoundment, the principal wildlife utilization of the tidal marshes was by several species of surface-feeding ducks, shorebirds, rails, muskrats, fish, diamond-backed terrapins and blue crabs. Following fresh-water flooding, much larger numbers of waterfowl and certain other water birds utilized the ponds. Only a few birds showed considerable declines. Muskrat populations were restricted by the high water level in the impoundments, but many species of fish continued to thrive and several new species were noted. Fresh-water flooding eliminated diamond-backed terrapins and blue crabs, but bullfrogs and snapping turtles appeared.

Because of the small acreage of the impoundments in relation to the surrounding tidal marsh, the decline in certain wildlife was of little importance. The net effect of fresh-water flooding was a significant reduction of nuisance mosquitoes in an important breeding zone and greatly enhanced conditions for waterfowl and certain other marsh birds.

To minimize the mosquito nuisance and to provide conditions favorable for waterfowl in impoundments, it is recommended that, where possible, a combination of the flooding and drawdown management be practiced.—Authors' abstract.

THE BEHAVIOUR OF LARVAE AND PUPAE OF *Aedes aegypti* (L.) IN LIGHT AND TEMPERATURE GRADIENTS. By T. A. Omardeen. Bull. Ent. Res. 48 (2):349–357. 1957. This paper reveals the interesting fact that while second and third stage *aegypti* larvae initially move away from light, they actually have no light preference and will gradually move back towards light, whereas fourth stage larvae and pupae, especially the latter, exhibit definite photophobia. While third and fourth stage larvae and pupae of *aegypti* prefer zones of 28–32° C., it is a curiously interesting observation that more second stage larvae congregate in the

23–27° than in the 28–32° C. zone.—Jack Colvard Jones, National Institutes of Health, Bethesda, Md.

THE INFLUENCE OF TEMPERATURE AND HUMIDITY UPON THE ACTION OF INSECTICIDES. I. DURING THE POST-TREATMENT PERIOD. II. TEMPERATURE DURING THE PRE-TREATMENT PERIOD. By A. B. Hadaway and F. Barlow. Ann. trop. Med. and Parasitol. 51(2):187–193; 194–200. 1957. Two to three day old, blood-fed, adult female *Aedes aegypti* and *Anopheles stephensi* were treated with DDT, gamma-BHC, dieldrin, and diazinon using 2 different methods (by application to dorsal thorax with Kerr microburette or by placing adults on filter papers containing deposits of insecticides). As expected, fewer mosquitoes were killed at a given dosage of DDT when the post-treatment temperature was increased from 25 to 30° C. (i.e., there is a large negative temperature coefficient). With dieldrin and diazinon, kills tended to increase with post-treatment temperatures (i.e., there is a small positive temperature coefficient). With BHC there was no change in kill with post-treatment temperature increase. The really striking new fact in the first article is that great humidity differences (20 to 95 percent) apparently have no effect whatever on kill with any of the insecticides. The second article shows that where age and nutritional status are controlled pre-treatment temperatures (25 or 30° C) have no effect on susceptibility of *Aedes* to DDT, dieldrin or BHC.—Jack Colvard Jones, National Institutes of Health, Bethesda, Md.

WORLD HEALTH ORGANIZATION. 1956. Malaria. World Health Organ. Bul. 15(3/5):361–862. Price $6.00. One should not miss this outstanding compilation on malaria. The ideas of some of the most active students of malaria are woven together to cover the disease from a global viewpoint. Such broad phases as control, eradication, resistance, vectors, epidemiology, distribution and antimalarials are among the subjects included.

Some of the papers of particular interest to mosquito workers are as follows: G. MacDonald was concerned with the theory of malaria eradication. He analyzed the process of elimination of malaria, the detection of residual foci and the reintroduction of the disease. Surveillance in Ceylon, Thailand and in Taiwan was discussed by L. F. Gunaratna, L. Ayurakitkosol and M. E. Griffith, and C. T. Ch'en and K. C. Liang, respectively.

Several authors contributed on the problem of resistance of anophelines to insecticides. J. R. Busvine dealt with the meaning of insecticide resistance and with measurements of the susceptibility of different mosquitoes to insecticides. In Greece, G. A. Livadas and K. Thymakis indicated that the tendency for anophelines to acquire resistance to DDT appeared to be continuing. G. Belios and G. Fameliaris found *Anopheles sacharovi* Favr. larvae to be resistant to chlordane and dieldrin in parts of Greece, but, although DDT was more generally used no appreciable resistance to DDT was noted. *A. sundaicus* (Roden.) resistance to DDT in Java was reported by C. Y. Chow and H. T. Soeparmo.

G. Giglioli compared the biological variations of *A. gambiae* Giles with those of *A. darlingi* Root. Studies on the ecology of *A. claviger* (Meig.) in the Middle East were described by G. Gramiccia.

The vectors of malaria are of particular interest. M. Farid noted the involvement of *A. sergenti* (Theo.) in malaria eradication programs east of the Mediterranean and Botha de Meillon discussed malaria vectors in Africa. Distribution of the vectors in Africa and Madagascar was discussed by J. Hamon, J. P. Adam and A. Grjebine.

The next series of papers concerns the epidemiology and control of the disease in different areas. G. Macdonald reviewed the subject of malaria in equatorial Africa, P. M. Bernard in tropical Africa, D. Metselaar in New Guinea, J. de Zulueta in Sarawak, Brunei and Borneo (one paper in collaboration with F. Lachance), H. M. Archibald in northern Nigeria. G. Joncour describes control in Madagascar, M. Ciuca in Romania and C. Simic in Yugoslavia.

Malaria control by drugs was discussed by G. Houel who described the use of different drugs for mass treatment in Morocco. H. M. Archibald and L. J. Bruce-Chwatt described the suppression of malaria in Nigerian school children.—Helen Sollers, Plant Pest Control Div., ARS, U. S. Department of Agriculture.

DAYTIME RESTING PLACES OF *Anopheles minimus* IN RURAL HOUSES OF TAIWAN (FORMOSA), CHINA. By Po-Taun Tseng, Hsi-Hauan Chen, and D. J. Pletsch. J. Formosa med. Assoc. 55 (12):22–28. 1956. (In English, with English and Chinese summaries.) A total of 14,466 specimens of female *A. minimus* collected in 757 rural houses throughout various parts of Taiwan were analyzed to study their daytime resting places in human dwellings. Of the 7 types of rooms or house areas classified, bedrooms are preferred as anopheline shelter, followed by store rooms, sitting rooms, kitchens, bathrooms, toilet rooms, and under eaves, in the order named.

Of the 16 types of microhabitats classified, the areas listed as "underneath bed," "roof, inside," "underneath furniture," and "wall below 1 meter" are the 4 most preferred resting places.

It is estimated that of the total number of the mosquitoes found in a house 14.68 percent rest on the surfaces of objects which are not treated with ordinary applications of residual insecticides. It is suggested that in Taiwan, the examination of areas "underneath beds" will suffice for sampling of an *A. minimus* population in human habitations.—Authors' summary.

THE SUSCEPTIBILITY OF *Aedes aegypti* LARVAE OF DIFFERENT AGES TO DDT AND DIELDRIN, AND THE RELEVANCE OF THE RESULTS TO THE FORMU-

LATION OF STANDARDIZED SUSCEPTIBILITY TESTS FOR MOSQUITO LARVAE. By A. H. Parker. Ann. trop. Med. and Parasitol. 51(2):201–215. 1957. In this important study, uniformly reared *Aedes aegypti* larvae of all stages and known ages were exposed as batches of 20 within 100 cc of 5 different concentrations of DDT and dieldrin (acetone suspensions in distilled water) at 24° C for either one hour or for 24 hours, both followed by tap rinses and 24-hour recovery periods with food and water. The short exposure requires this recovery period, the long one does not. Determinations of mortally affected larvae were made with a slightly modified Burchfield-Hilchey-Storrs apparatus (when affected, larvae do not initially move away from the light). According to the author of this paper 24-hour mortality readings with either long or short exposures give a reliable index of eventual mortality to both DDT and dieldrin. The long exposure method could not be used for first and second stage larvae due to high control mortality with distilled water.

The data show, somewhat unexpectedly, the intriguing fact that with both insecticides, second day old first instars were the most susceptible of all stages. As expected, those about to pupate were the least susceptible of larval stages.

With both short and long exposures it was found that the median lethal concentration significantly increased with each day of development. The total variation with long exposures was less than with short ones. Third stage larvae were significantly less variable than the fourth stage with either exposure. Inherent variation was found to be greater with DDT than with dieldrin.

Parker found no evidence of changes in *Aedes* susceptibility at larval molts (a fact true also for *Anopheles quadrimaculatus* when these larvae are exposed to dilute formulation DDT—unpublished data of the reviewer). A significant change in susceptibility at the molt apparently occurs only with relatively higher concentrations of toxicants.

Parker suggests for bioassay studies with *aegypti* the use of third stage larvae and 24-hour exposures.—Jack Colvard Jones.