PRELIMINARY ASSESSMENT OF THE OVIPOSITION COMPONENT OF AN EVOLVING COMPUTER SIMULATION (ECOSIM) OF MOSQUITOES

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Introduction.

Since 1987, Alameda County Mosquito Abatement District (ACMAD) has been using a computer simulation of mosquitoes called ECOSIM (Evolving Computer Simulation) to assist mosquito control technicians in timing their inspection and treatment of sources (Mead et al. 1990; Roberts et al. 1990; Conner and Roberts 1990). Initially, the simulation operated effectively on sources that were found to be positive for mosquitoes in their early stages of development by simply simulating the growth of larvae until they reached threshold. The date of threshold would then become the date of proposed reinspection and/or treatment. For those sources where no mosquito larvae were detected, however, an oviposition subroutine was necessary in order to generate an inspection date. Four species of multivoltine mosquitoes were chosen for the initial phase of this project: *Culex pipiens* L., *Culex tarsalis* Coquillett, *Culiseta incidens* (Thompson), and *Culiseta inornata* Williston.

Monitoring methods.

Monitoring oviposition traps, New Jersey light traps, and fixed station larval monitoring were used to determine if oviposition was taking place. Oviposition traps (also known as gravid female traps) were used for *Culex pipiens*. The traps used were modified from a design by Robert Cummings, Biologist/Engineer at the Los Angeles County West Mosquito Abatement District. His design is an improved version of Reiter's trap (Reiter 1983). The main improvement being the placement of the fan on the exit tube to avoid the mutilation of the specimens. A complete description of this trap design is soon to be published by Mr. Cummings. A fermented alfalfa infusion is used as the attractant for *Culex pipiens*. When the infusion has aged, lost its odor and turned red, it attracted *Culiseta incidens* females almost exclusively. Formulations that attract other mosquito species are being sought. Between three and six traps were put out overnight once a week. The traps were distributed throughout the county; three being in fixed locations where *Culex pipiens* is the dominant mosquito species.

The second means of detecting oviposition was through the use of adult light traps. The District operates eight New Jersey light traps in fixed locations throughout the county year round (since 1988; previously April-October). These traps run seven nights a week from 6 p.m. to 6 a.m. Adult mosquitoes are collected from the traps and identified weekly.

Fixed station larval monitoring is also being used to detect oviposition. Larvae are monitored at twelve locations throughout the county weekly. The monitoring is done by a single individual to standardize the sampling. The sources are treated when they reach threshold, and a new cycle of monitoring is begun.

Operation of the subroutine.

Operation of the subroutine currently uses a deterministic approach to predict oviposition. Initial values of the monitoring inputs have been established to trigger oviposition in the simulation. When input from any of the three methods of monitoring is greater than the established values, oviposition is assumed to be occurring and is triggered in the simulation. The initial values selected to trigger oviposition are five individuals in the adult light traps or ten percent of the fixed larval stations positive for larvae. When oviposition is triggered in the simulation, it occurs at a rate of 200 eggs per dip each day.

Results and discussion.

The oviposition subroutine, when operating properly, should provide us with information about the likelihood that oviposition is occurring by a particular species at a particular source. It should also indicate if the level of eggs being deposited will ultimately reach numbers of late instar larvae sufficient to trigger threshold. Our current level of knowledge, however, does not allow us to predict threshold by oviposition. For this reason, we have selected relatively low values for the inputs to trigger oviposition and high number of eggs to be oviposited. By using this approach, we expect to be able to provide fairly accurate, but conservative, information to the technicians. The threshold date would represent the minimum development time necessary for oviposition to trigger a threshold. We have adopted this conservative approach to use until we feel we can establish a correlation between the number of eggs being oviposited (in number per dip) and the various values of the monitoring inputs.

We currently feel that light trap data is not an accurate indicator of the oviposition, but that it may indicate when a species first becomes active at the start of a new breeding cycle. Light trap data indicating *Culiseta inornata* activity in the fall can be very useful when combined with rainfall information. If a technician inspects a source that has already been activated by the computer and finds no larvae at that source, the computer will start oviposition at that source on the following day unless the source was recorded as dry. If on a subsequent inspection the technician had found larvae, the computer would start the growth simulation from that point, since field numbers have priority. This is a self-correcting function of the program assuring that the most recent field data is used. Another conservative feature of the simulation occurs because there is currently no mortality or predation component in the simulation. The numbers of larvae in the simulation are likely, therefore, to be greater than what actually occurs in the field. The simulation is being validated by comparing larval numbers and threshold dates that are predicted with actual numbers from the field (as recorded on the technicians' daily reports). The values of the oviposition indices are changed as necessary during an on-going process of fine tuning.

Conclusions.

With continued study, we hope to more accurately predict the time intervals between successive generations of larvae as they progress through their breeding season. The generations become shorter in time as day length and temperature increase. We would like to move to a more stochastic approach to oviposition in the future. There are two goals we are aiming for: (1) To quantify oviposition in order to determine the number of eggs per dip. (2) To predict the probability that each source may be positive for larvae. The main reason for trying to improve the scheduling program is to save the technician time by only going to a source when it is necessary. This savings in time for the technicians also translates into savings for the District in fuel, insecticide and manpower costs.

References.

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