

ENTOMOLOGY

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ABSTRACTS

Arbovirus Isolations from Delaware County Mosquitoes, 1978. R. R. PINGER, Ball State University, P. R. GRIMSTAD, University of Notre Dame, and M. J. Sinsko, Indiana State Board of Health.—During the summer of 1978, 1166 mosquitoes were collected from six sites in Delaware County, Indiana and processed for virus isolation. Four of the 66 pools that were assayed for virus by intracerebral inoculation into 1 to 2-day old suckling mice were positive. The virus isolates were identified by complement fixation and virus neutralization tests. The isolates were identified as follows: an isolate of LaCrosse virus from a pool of *Aedes triseriatus*, an isolate of trivittatus virus from a pool of *Aedes trivittatus*, and two isolates of Flanders virus from two pools of *Culex* mosquitoes. This is the first report of trivittatus and LaCrosse viruses from Indiana mosquitoes and the second report of a Flanders virus isolate.

Automated taxonomic procedures applied to a revision of *Geomydoecus* lice from pocket gophers of the *Thomomys bottae-umbrinus* complex. RONALD A. HELLENTHAL, Biology Department, University of Notre Dame, Notre Dame, Indiana, and ROGER D. PRICE, Department of Entomology, Fisheries and Wildlife, University of Minnesota, St. Paul, Minnesota 55108.—One of the greatest challenges in mammalian systematics is the *Thomomys bottae-umbrinus* complex, with its approximately 225 described subspecies. As part of a taxonomic investigation of the lice from these gophers we have accumulated and mounted over 31,000 adult lice from 2,000 hosts representing over 1,000 localities, and have quantified over 300,000 character observations from more than 11,000 of these lice. These character observations combined with their host and locality information form a computerized data base which is maintained at the University of Minnesota. Because of the quantity and complexity of these data we have automated our data handling and analysis and some portions of the taxonomic decision making process. We have developed an integrated group of computer programs called the BUG system which is used for the retrieval and analysis of stored louse data. This system provides for the definition of tentative taxonomic louse groups, the extraction of data for lice within these groups, and the analysis or comparison of these data within a group or between groups. Group definitions may be based on preliminary louse identification, host identification, host locality, specific host, or specific louse, or any combination of these criteria. The kinds of analyses built into the system include general data sum-

marization, character correlations, analysis of variance, principal components analysis, and agglomerative clustering. The system also has some graphics capabilities, including character distribution graphs, principal components scattergrams, and host geographic distribution maps. It can also select and format louse data for use with general statistical analysis computer program packages such as the BMD—Biomedical Computer Programs. The system is used to evaluate character homogeneity within groups of lice, make comparisons between groups and identify taxonomically useful characters for descriptions. Criteria for taxonomic groupings were developed from a comprehensive study of louse variation using a 5-level nested analysis of variance model. We have delineated 25 new louse taxa so far during this study and it is likely that more will be found.

Statistical Analysis of Insecticide Efficacy Data for Urban Cockroach Control—A Comparative Study. ERIK S. RUNSTROM, and GARY W. BENNETT, Department of Entomology, Purdue University, West Lafayette, Indiana.—Statistics have long been used to summarize and evaluate data in biological experiments; however, if misused, these analyses may be misleading and result in the formulation of unjustified conclusions. There are basically two approaches to analyzing field collected pesticide efficacy data, parametric and nonparametric statistics. Parametric tests are most commonly used; however, complications develop due to certain critical assumptions that must be satisfied prior to the use of these statistical tests. Nonparametric methods afford the benefit of being designed to avoid most of these assumptions and are easier to apply computationally. A comparison of both types of tests were made on pesticide efficacy data for the German cockroach, *Blattella germanica*, (L.) in low income apartments. The ease of use coupled with their overall efficiency make the nonparametric tests reliable methods of analysis.

Methods for Evaluating a Rodenticide Tracking Powder on Laboratory and Field Populations of Nuisance Bats. ROBERT M. CORRIGAN and GARY W. BENNETT, Department of Entomology, Purdue University, West Lafayette, Indiana.—Locating nuisance bat colonies for experimental studies is usually accomplished with the aid of county cooperative extension agents and pest control companies and through various advertising campaigns. Collecting bats from colonies for laboratory studies may be conducted during the daytime by collecting bats directly by hand, using nets, cheese cloth traps or various improvised cages. Evening collections involve using emergence funnel traps or by direct flight netting. In this study, wild-caught big brown bats, *Eptesicus fuscus*, were housed singularly in steel 28 cm x 20 cm x 22 cm small mammal cages. Bats were acclimated to laboratory conditions for 28 days prior to testing and trained to accept food in captivity using several methods. Diet consisted of a mealworm and bat "glop" diet. Rodenticide tracking powder was tested for efficacy against bats by treating three 20 cm x 10 cm x 2.5 cm rough red oak wood blocks with the tracking powder. Blocks were placed inside cages and

used by bats for roosting activity. Bats were subjected to the toxicant for a period of 20 days, and were then held for a post-treatment observation period of 15 days. Observations on behavior, sickness and mortality were recorded on a daily basis. Rodenticide tracking powder was also used experimentally on field populations of nuisance bats. Population sizes of bat colonies were estimated using an evening flight emergence count method. The rodenticide was applied to bats and roosts directly within infested structures using hand and power dusters. Two control populations were used; one treated with a non-toxic clay carrier to measure disturbance, the second untreated and undisturbed. Control and treated populations were counted at 24 hrs., 3 days, 1 week, 2 week and 1 month intervals following rodenticide application.

Possible insect-plant coevolution in the Late Paleozoic. GENE R. KRITSKY, Department of Biology, Tri-State University, Angola, Indiana.—This paper will present evidence that the Palaeodictyoptera (U. Carboniferous-Permian) may have acted as pollinators of the Pteridospermales. The Palaeodictyoptera possessed two pair of large membranous wings, a small pair of lobes on the pronotum, and sucking mouthparts which consisted of five stylets that superficially resembled the Hemiptera feeding apparatus. The presence of the sucking mouthparts has been cited as evidence that the Palaeodictyoptera fed on plant juices. The primary host plant is unknown but the giant lycopods and the Pteridospermales have been suggested. Evidence from pollen studies indicate the pteridosperms required an insect pollinator and a review of the insect orders found in the U. Carboniferous indicates that the Palaeodictyoptera and its relatives were the most likely candidates. A survey of Palaeodictyoptera prothoracic lobes and wings revealed a similarity between certain species' lobes and wings with various pteridosperm pinnules. This similarity included the size, shape, placement, and even venation of the lobes and certain wings to seed fern pinnules. Even some highly modified paranotal lobes resembled specialized seed fern pinnules suggesting a close association between the Palaeodictyoptera and pteridosperms. Other Palaeodictyoptera wings had irregular spot patterns that may have aided in cryptic coloration. The evidence for the hypothesis presented is circumstantial, and the type of evidence needed for possible verification is explored.

A New Beginning for Heat Units and the Alfalfa Weevil. A. K. NELSON¹ and R. T. HUBER, Department of Entomology, University of Arizona, Tucson, Arizona 85721.—The affects of different thresholds and starting dates in a heat unit accumulation system are investigated. A system with a lower threshold will accumulate heat units faster than a system with a higher threshold. A system with a later starting date will always be a constant value less than a system with an earlier starting date.

A heat unit accumulation system using a 45° F threshold and beginning at last frost is shown to accurately predict spring alfalfa

weevil population peaks in areas where a system beginning on March 1 does not.

It is noted that identification of the conditions leading to the termination of diapause and the beginning of adult activity in the spring would improve any phenological model of the alfalfa weevil.

How Midges Swarm: A spatial temporal analysis of *Chironmus riparius* flight by computer. MARK JANSEN and H. DAVID VAIL, Purdue University, West Lafayette, Indiana.—A laboratory colony of *C. riparius* was established to study the swarming behavior of the primitive flies. Life cycle parameters in the colony were found to agree with literature values for both field and laboratory populations. Initial analysis of swarming demonstrates that duration of swarming depends on swarm marker size. For large markers, the duration of swarming was independent of the number of midges in the cage. Initial results indicate that midges are functionally identical and that special reconstruction from stereoscopic movie cameras will yield results interpretable in terms of classical mechanics.

Examination of the Generalized Root Model RHIZOS in its ability to Simulate Corn Root Growth. E. L. PANG and H. D. VAIL, Department of Entomology, Purdue University, West Lafayette, Indiana.—RHIZOS is a two-dimensional root model simulating root growth in a vertical soil slab. The purpose of this study was to adapt RHIZOS for the simulation of corn root growth. The original linear growth rate found in RHIZOS had to be modified as simulated root mass far exceeded expected values for corn growth and was not sensitive to growth at low temperatures. Thus, the slope was changed from 0.0215 to 0.0182 and the y-intercept was changed from 0.212 to 0.0425. The model was then calibrated with corn root data. As a first approximation, the total root mass alone was considered. A comparison of root weight for corn growth at constant temperatures of 10° and 15° C with simulated values, for root growth under similar conditions, showed that root mass and rate of root growth were very similar for the first 15 days, after which, the simulated values lagged behind the actual data. Comparisons of the actual data with simulated values for growth at 25° C proved the linear growth equation inadequate as the simulated values were far below the actual root mass values. The study was supported by Grant #R805429-01-0 from the U.S. Environmental Protection Agency.

The Biology of the Zimmerman Pine Moth (*Dioryctria zimmermani*) in Indiana Landscapes with Reference to it's Control. JAMES W. YONKER and DONALD L. SCHUDER, Department of Entomology, Purdue University, West Lafayette, Indiana.—The Zimmerman pine moth, a phloem and cambium borer, has become an increasingly important pest of ornamental pines over the last 25 years. Since it's discovery in Indiana in 1956, it has spread from 9 northern counties to at least 48 counties in northern and central Indiana. Within this area, Scotch pine, a European species used extensively as an ornamental and Christmas tree, seems to be attacked most frequently and destructively. Ex-

ternal evidence of Zimmerman attack is a resin mass that accumulates on the trunk, at the point of insect entry. Studies completed in 1978 and 1979 on this insect/host/damage association indicates that hand removal of the resin masses could be an easy, effective and economical alternative for controlling this insect.

The Influence of Organic Substrates Upon Oviposition Site-Selection in the Mosquito *Culex restuans*. BRIDGET HOBAN, DURLAND FISH and GEORGE B. CRAIG, JR., St. Joseph County Mosquito Abatement Program, Department of Biology, University of Notre Dame, Notre Dame, Indiana. —Monitoring the egg production of adult mosquitoes affords many advantages over light trapping or man baiting in determining the presence of, or changes in, populations of blood-feeding mosquitoes. Many important species of *Culex* mosquitoes are known to oviposit in water with high organic content that provides a microbial infusion for the developing larvae. In an attempt to determine how to solicit the maximum oviposition response in *Culex* mosquitoes in northern Indiana, an array of oviposition monitoring stations containing different organic substrates at various concentrations was offered to a natural field population of mosquitoes in a series of 2 experiments. Over 1,100 egg rafts of *Culex restuans* were collected during the 8 week study period and their numerical distribution among the experimental stations was the criterion used for evaluating the effectiveness of each replicated treatment. In the first experiment, stations provided with fresh cow manure as the organic substrate yielded over 3X as many egg rafts as did commercially prepared, dehydrated cow manure or fresh horse manure. A concentration of 250 ml per 5 L of water was found to be superior or equal to higher concentrations of 500 ml and 1,000 ml per 5 L of water for all substrates tested. In the second experiment, fresh cow manure yielded over 4X as many egg rafts as did either goat, buffalo, or llama manures and 100x as many as alfalfa pellets at the same concentration. These results indicate that infusions generated with fresh cow manure are superior to other animal manures or plant substrates in their ability to attract ovipositing *Culex restuans* mosquitoes and that cow manure might be the substrate of choice in oviposition monitoring stations used in routine surveillance for other *Culex* mosquitoes that utilize similar aquatic habitats.

The Use of an Ovitrap Grid for Measuring Adult Movement and Population Density of the Tree-Hole Mosquito *Aedes triseriatus*. WILLIAM J. BERRY, DURLAND FISH and GEORGE B. CRAIG, JR., St. Joseph County Mosquito Abatement Program, Department of Biology, University of Notre Dame, Notre Dame, Indiana. —A modified ovitrap was used in a grid system in 6 northern Indiana woodlots to measure the movements of ovipositing mosquitoes within woodlots and to estimate adult population densities among woodlots. Black beverage cans were fitted with over-sized lids fixed at a slight angle to prevent contamination by rain and forest litter. Fresh oak stemflow (200 ml) served as an oviposition attractant and 4X12 cm balsa-wood strips served as oviposition substrates. A standard grid consisted of 50 ovitrap cans attached to

trees $\frac{1}{2}$ m above ground at regular intervals over a 2.3 ha area. A grid was placed in each woodlot and the balsa-wood strips were examined for eggs each week. Differences in the number of eggs recovered from each ovitrap within a woodlot were interpreted as horizontal movement of ovipositing mosquitoes. The horizontal pattern of oviposition showed aggregated distribution indicating preference for certain areas within the grids. These aggregations were not correlated with the size or density of trees, or the distribution of naturally occurring tree holes. Differences in the total number of eggs per woodlot were interpreted as differences in adult mosquito densities. In order to determine the relationship between egg numbers and population density, oviposition rates were compared between 2 woodlots where absolute population densities were known. One woodlot supported an adult population of 1,700 females and yielded an average of 1,000 eggs/day. The second woodlot supported a population of 3,600 adult females but only yielded an average of 850 eggs/day. These results indicate that an increase in the oviposition rate is not necessarily indicative of an increase in population density.