

cessfully reproduced using the program. Interactive features allow a user to alter site and population conditions as well as the basic characteristics of the species during the execution of the program. (Illus. 2x2 slides).

10:00 a.m. A Realistic Ecosystem Model and Its Response to Nutrient Enrichment, RICHARD G. WIEGERT, Department of Zoology, University of Georgia, Athens, Georgia 30601.

A stable coupled-compartment ecosystem model employs three rules to ensure realism in its behavioral response to perturbation: 1) maximum growth rates, 2) thresholds for limiting factors (a "limitation" coefficient), and 3) refuges for resource compartments. Computer studies of resource cycling in simple linear three and four trophic level models where all "species" have identical biological attributes showed some interesting system behavior. For certain combinations of growth rate, death rate and "limitation" coefficient, the systems exhibited "invariant" steady state behavior, that is, for a constant total amount of resource, no matter how the allocation of resource is changed among the compartments the same steady state proportional allocation is reestablished, and refuges are not needed. For other combinations, all compartments in the system persist only when refuges are present and a "variant" steady state is found. Perturbation of the system as above may now result in a new steady state with changed proportions of resource in each compartment.

The parallel of this phenomenon with the behavior of real ecosystems is examined and its significance discussed.

10:20 a.m. Land Use and Erosion Rates in Southern Michigan, MARGARET B. DAVIS, Department of Zoology and Great Lakes Research Division, University of Michigan, Ann Arbor 48104.

Erosion from the watershed during the last two centuries has been estimated from rates of sediment accumulation in a small lake. Inorganic sediment yield before settlement was about 20 tons km⁻² yr⁻¹. This estimate is based on sediment ash, and presumably includes most or all of the dissolved load as well as particulates. Sediment yield increased markedly after the forest was cut in 1830 A.D. In the years immediately following forest clearance, sediment yield peaked at about 500 tons km⁻² yr⁻¹, fluctuating widely over short intervals. These high rates are reminiscent of those that have been observed by other authors from construction sites in urban areas. After 1900, when the landscape was used for farms and houselots, erosion rates became more constant at 100-150 tons, a five-fold increase from the primeval rate when the landscape was still forested. (Illus. 2x2 slides).

10:40 a.m. Patterns of Inter-territorial habitat variation in Grassland Birds, JOHN A. WIENS, Department of Zoology, Oregon State University, Corvallis, Oregon.

I analyzed measures of 18 habitat variables (mostly vegetational features) from individual territories of breeding populations of three bird species occupying a southern Wisconsin grassland. This approach, in addition to providing information on individual variation in habitat occupancy, included consideration of habitat correlates with time of territory establishment, position in the breeding colony (central vs. peripheral), territory size, and the intensity of boundary competition (as gauged by the packing of territories). Ecological and evolutionary implications of these patterns will be discussed. (Illus. 2x2 slides).

11:00 a.m. Anthropogenic influences in the tropics, RIAD HALWAGY, Department of Botany, University of Kuwait, Kuwait.

Anthropogenic influences were studied in two vegetation types in semiarid Northern Sudan: (a) the islands and banks of the Nile and (b) the sandy desert plain.

Aspects of human interference are described and appear to favour *Acacietum* at the expense of *Tamaricetum* on the Nile islands and banks. Quantitative data on the desert plains reveal the total disappearance of annual grasses, reduction in number and size of perennial grasses and shrubs. The success of perennial grasses and herbs under these conditions is related to their desirability, palatability or growth form. Shrubs may develop a certain growth form under intensive grazing.

The effect of large scale attrition of the habitat resources, by removal of soil and vegetation, in creating desert conditions is described. The need for, and feasibility of, effective conservational measures are discussed. (Illus. 2x2 slides).

Session 4. Contributed Papers. Animal Behavior and Related Studies, Thomas F. Albert, Georgetown University, presiding. Social Science Building, A-201.

9:00 a.m. Ecological aspects of Peruvian treehopper behavior. DAVID B. EKKENS, Andrews University.

The term "social behavior" as applied to treehoppers (Homoptera: Membracidae) does not imply co-operation as in Hymenoptera but rather an attraction to a common place on a food plant. *Umbonia ataliba*, both adults and immatures, are found concentrated on the small twigs of *Calliandra angustifolia*. *Heteronotus nodosus* and *H. horridus* are also exclusively on *C. angustifolia*, but they are not gregarious. Other species having gregarious habits are *Enchenopa caruata*, *Tragopa luteimaculata*, *Aphetea affinis* and *Bolbonota pictipennis*.

Females of *Umbonia ataliba*, *Aphetea affinis* and *Tragopa luteimaculata* remain on the eggs after laying is completed as noted by other authors for various treehoppers. This is thought to protect the eggs from desiccation and predators.

Two genera of ants, *Pheidole* and *Crematogaster*, were observed attending Peruvian treehoppers for

their honeydew secretions. Both immatures and adults of *Bolbonota pictipennis* are attended. In other species (*Heteronotus nodosus*) the immatures are attended, but the adults seem to repel the ants by vigorous movements of the abdomen. (Illus. 2x2 slides).

9:20 a.m. Twenty-four Hour Fecal Outputs for *Sylvilagus floridanus* on Natural Diets Under Field Conditions, ARTHUR JOHANNINGSMEIER, Dept. of Biology, Boston University, Boston, Mass.

Total 24 hour above ground fecal outputs were obtained from individual *S. floridanus* during February and March of 1970 and 1971. These animals were live trapped and released on the Plum Island National Wildlife Refuge at Newburyport, Mass. Fast green dye and colored glass beads were used to identify the fecal outputs of individual animals and to measure the fecal output rates. Each sample was analyzed for dry matter, nitrogen, cellulose and kilocalories. Quantitative and qualitative comparisons between field and laboratory fecal outputs of this species on natural and simulated natural diets were also carried out to determine the feasibility of using these techniques for food intake estimation in terrestrial ecosystems. (Illus. 2x2 slides).

9:40 a.m. Water Balance and Bladder Function in a Field Population of the Desert Tortoise, *Gopherus agassizii*. JOHN E. MINNICH, Zoology Department, University of Wisconsin, Milwaukee, Wisconsin.

Rates of water turnover in a Mojave Desert population of desert tortoises (*Gopherus agassizii*) during most of the summer of 1970 were exceedingly low (0.36 ml/100 g body wt. x day), only slightly greater than rates of metabolic water production (0.31 ml/100 g x day). The low water turnover rates are related to the abundance of dry items in the diet (dried grass, dried stems of woody plants, stones). Bladder fluid osmolalities increased steadily until they became equal to plasma osmolalities; this suggests water reabsorption from the bladder. After a rainfall of 0.48 inch, most tortoises gained weight and exhibited an increase in water turnover rate and a decline in bladder fluid osmolality. These data suggest that tortoises drank an average of 14.4 ml/100 g of rainwater (range 0 to 27.1 ml/100 g) and stored most of it in their bladders. (Illus. 2x2 slides). (Supported by a grant from the Wisconsin Alumni Research Foundation.)

10:00 a.m. Seasonal Trends in Body Fat of White-tailed Ptarmigan, CLAIT E. BRAUN, Colorado Division Game, Fish and Parks, Fort Collins, Colorado.

Seasonal trends in fat levels of white-tailed Ptarmigan (*Lagopus leucurus*) in Colorado were determined from 125 whole carcasses collected between 1966-69. Samples were available from every month of the year representing 39 adult males, 61 adult females, and 25 chicks. Chicks were found to have highest fat reserves immediately upon hatching, with levels decreasing rapidly during the initial month of life. Adult males gained fat during winter and had highest levels prior to breeding. Levels decreased markedly during the breeding period but increased upon termination of breeding. Female ptarmigan had highest fat reserves prior to leaving wintering areas in April and prior to egg deposition in June. Percent fat decreased rapidly following both periods and decreased again during autumn movements to wintering locations. Low levels of depot fat found suggest there is little need for fat buildup in this species, and that foods available contain sufficient energy throughout the year. (Illus. 2x2 slides).

10:20 a.m. Apparent Failure of Woodchucks, *Marmota monax*, to Minimize Exposed Surface Area During Hibernation, THOMAS F. ALBERT and J.A. PANUSKA, Department of Biology, Georgetown University, Washington, D.C. 20007.

Fourteen hibernating woodchucks, *Marmota monax*, (ambient temperature, $6^{\circ} \pm 1^{\circ}\text{C}$) were observed every 4 hours during two 24 hour periods and every 12 hours during a 15 day period. The typical "curled up" posture of a hibernator was seen less than half the time. The animals assumed a variety of postures. Most commonly, however, they lay somewhat uncurled on their sides. Occasionally they lay on their backs. The body temperature of two of these animals, continuously monitored, was usually equal to or less than their maximum cage temperature. Hibernating *Marmota monax*, therefore, appeared to be making little effort to reduce the surface area exposed to cold. (Illus. 2x2 slides).

10:35 a.m. Vocalization and Its Ontogeny in the Blue Jay (*Cyanocitta cristata*), ROBERT F. EDWARDS and GEORGE H. WARING, Department of Zoology, Southern Illinois University, Carbondale, Illinois.

Sounds of adult, wild and cage-reared Blue Jays were tape recorded and analyzed using the sound spectrograph. The adult vocal repertoire included: High-low Pumphandle, Monotone Pumphandle, Quiet Pumphandle, Jeer Cry, Monotone Cry, Kueu Cry, Chucking, Growling, Rattle, Whirring, Peeping, Chirping, and Random Jabber. The ontogeny of vocalization was studied in young Blue Jays, cage-reared in the presence of adults. Development was observed from the time of hatching until an adult-like vocal repertoire developed. Sounds of developing birds were recorded regularly and spectrographically analyzed. The entire vocal repertoire developed within seven months. Chirping, Growling, and Chucking appeared early and were adult-like at first appearance. Some calls occurred early, then were absent, only to reappear in somewhat modified form at onset of sexual maturity, e.g., Kueu Cry and Peeping. The pumphandle calls developed gradually from precursor sounds. (Illus. 2x2 slides).