

## ECOLOGY

Chairman: DAVID SPENCER

Department of Biology, Indiana University-Purdue  
University at Indianapolis, Indianapolis, Indiana 46205

Chairman-Elect: RICHARD WHITMAN

Department of Biology, Indiana University Northwest,  
Gary, Indiana 46408

### ABSTRACTS

**Size Distributions of Dune Pond Plankton: The Role of Herbivory.** ANN M. BERGQUIST and STEPHEN R. CARPENTER, Department of Biology, University of Notre Dame, Notre Dame, Indiana 46556. — We tested contrasting explanations for size shifts in limnetic phytoplankton and zooplankton. If the size structure of a phytoplankton assemblage influences the zooplankton size distribution, then as phytoplankton increase in size from spring to summer, the zooplankton size structure should shift from large to small, since larger zooplankton are more inhibited by large colonial and filamentous algae. Alternatively, if the zooplankton size distribution regulates the phytoplankton size structure, the opposite trend is expected. A shift to smaller zooplankton encourages smaller phytoplankton because smaller zooplankters have lower feeding rates and higher nutrient regeneration rates that favor small, rapidly growing algae. A shift to larger zooplankton favors larger phytoplankton that are not readily available to herbivores.

These contrasting hypotheses were tested using seasonal phytoplankton and zooplankton size distributions from two intradunal ponds at the Indiana Dunes National Lakeshore. Large cladocerans dominated the spring zooplankton sample in pond A, but by July the zooplankton assemblage consisted of much smaller herbivores. In pond B the opposite trend was observed. Phytoplankton size increased in pond B: small diatoms, *Scenedesmus* and Chlorococcales were succeeded by *Ceratium*, *Dinobryon*, *Fragillaria* and others. The phytoplankton genera in pond A did not change markedly, but the relative abundances of smaller individual and colonial forms increased. Our results do not support the hypothesis that phytoplankton influence zooplankton size distributions, but are consistent with the hypothesized effect of zooplankton on phytoplankton size distribution.

**Scale of Spatial Pattern: Four Methods Compared Using Simulations and Field Data.** JACK E. CHANEY, STEPHEN R. CARPENTER and NANCY J. McCREARY, Department of Biology, University of Notre Dame, Notre Dame, Indiana 46556. — Four methods of pattern analysis were compared: Nested ANOVA (Ann. Bot. 16: 293), two-term local variance (J. Ecol. 61: 225), random pairing (Vegetatio 29: 135) and spectral analysis (Ann. Rev. Ecol. Syst. 6: 189). Simulated patterns were: (1) fixed patches separated by gaps equal to patch length; (2) fixed patches with gaps 5X patch length; (3) patches of fixed length, gaps of random length; (4) patches and gaps of random length. The first peak of the variance-block size graph was used instead of the highest peak because it was more accurate in detecting correct patch size. Nest ANOVA and two-term local variance placed the patch size of patterns 2 - 4 between patch and gap size. Spectral analysis maximized variance at the mean full-cycle length. Even in the most variable simulations, random pairing showed a peak at the mean patch size.

Submersed vegetation was sampled using SCUBA along transects parallel to the depth contours. The random pairing method indicated a patch size of 40 cm. Fish nests of pumpkinseed sunfish, (*Lepomis gibbosus*) are approximately the proper size to generate this pattern.

**Algal Symbiosis in a Freshwater Flatworm, *Dalyellia viridis*.** RICHARD W. GREENE, Department of Biology, University of Notre Dame, Notre Dame, Indiana 46556. — The green color of the freshwater neorhabdocoel, *Dalyellia viridis*, results from the presence of large numbers of green unicellular algae distributed in its integument. Many other genera of freshwater organisms possess similar green symbionts (e.g. *Paramecium*, *Stentor*, *Ophrydium*, *Vorticella*, *Spongilla*), but *Dalyellia* differs in that the algae are situated intercellularly. Preliminary evidence suggests that the algae in all of the common associations mentioned may be the same, or at least very closely related. Thus, if the algae are functional, *Dalyellia* presents a unique opportunity to study the influence of the host on a symbiotic alga about which much is already known.

Oxygen exchange in *Dalyellia* has been investigated under light and dark conditions and with the photosynthesis inhibitor DCMU. Results show that oxygen is produced in the light in excess of the consortium's requirements. When DCMU is present, oxygen production ceases.

Studies of carbon-14 uptake show that *Dalyellia* incorporates several times more carbon in the light than in dark controls. Evidence, therefore, points to the algae as being functional endosymbionts. Photosynthetic products of the association are currently being analyzed by radio-chromatography, and nutritional relations of the partners also are being pursued.

**Patterns of Allocation in *Podophyllum peltatum* L. (Berberidaceae)** DEBORAH A. KEGEL, Indiana University, Bloomington, Indiana 47405. — Mayapples, summer-persistent perennial herbs of the eastern deciduous forests, exhibit both clonal growth and sexual reproduction. Ramet allocation patterns were examined through dry weight studies. Sexual shoots were associated with larger rhizomes. Seasonal changes in the dry weight of the old and new rhizome sections were found to differ between sexual and vegetative shoots. The relationship between fruit production and rhizome growth is examined. The role of the rhizome as a storage organ influencing growth patterns is discussed.

**A Technique for Measuring Ammonia Volatilization from Surface Application of Urea to *Dactylis glomerata* L. Pasture.** J. W. LIGHTNER, C. L. RHYKERD, D. B. MENGEL, L. E. SOMMERS and G. E. VAN SCOYOC, Department of Agronomy, Purdue University, West Lafayette, Indiana 47907. — A field study was conducted to determine  $\text{NH}_3$  losses of urea and urea-based fertilizers when surface applied to orchardgrass (*Dactylis glomerata* L.) pasture located on the Purdue Agronomy Farm, West Lafayette, Indiana. The  $\text{NH}_3$  collection system consisted of a vacuum pump, a chemical ( $0.5 \text{ H}_2\text{SO}_4$ ) trap to capture  $\text{NH}_3$ , and a volatilization chamber. (Hoff et al. 1981. J. Environ. Qual. 10:90-95). This technique was developed to measure ammonia volatilization in a conventionally tilled corn field.

The volatilization chamber, which provided the microplot, consisted of a PVC cylinder 30-cm I.D. by 25-cm long by 32.4-cm O.D. The cylinder was inserted into the soil leaving approximately 2-4 cm of the cylinder exposed above the soil surface. A plexiglass lid sealed the microplot off to the environment for short intervals during the day when  $\text{NH}_3$  loss was actually being measured. Between measurements the lid was removed to allow for normal environmental conditions.

On one side of the volatilization chamber there were five transfer ports con-

nected by tygon tubing to an  $\text{NH}_3$  trap, and on the other side of the cylinder there was an inlet port which opened to the ambient environment. The total  $\text{NH}_3$  loss was calculated by integrating the rate of loss over time.

A manifold system made of 2-cm CPVC water line with a regulator valve at each of 7 inlets permitted the simultaneous sampling of seven microplots. Air flow rate was in the range of 25-30 exchange volumes per minute per microplot. Volatilization studies on the orchardgrass pasture revealed that this technique has potential for measuring  $\text{NH}_3$  losses from surface applied urea and/or ureabased fertilizer to grass pastures.

**Competition and Coexistence in Submersed Freshwater Perennials.** NANCY J. McCREARY, STEPHEN R. CARPENTER and JACK E. CHANEY, Department of Biology, University of Notre Dame, Notre Dame, Indiana 46556. — Competition between two submersed perennials was studied *in situ* in Roach Lake (Gogebic Co., MI), using a de Wit replacement series. *Juncus pelocarpus* forma *submersus* Fassett and *Eleocharis acicularis* (L.) R. & S. were placed in the lake in pots subjected to two light levels, two sediment types, and two densities. The species were combined at five ratios and replicated four times for each treatment. The response variable was final yield on a dry weight basis.

Effects of light, density, and sediment on yield in pure culture were highly significant ( $P = 0.0003$ ). Full data set analysis showed differences in species' yield ( $P = 0.01$ ), and between environmental treatments ( $P < 0.0001$ ). Analyses of species and ratio within each environmental treatment showed no significant differences in the control, sediment, or shading treatments, however, the density treatment showed a significant ratio effect ( $P < 0.0001$ ). Relative Yield Totals approximated one in all treatments (0.84 to 1.0; SD = 0.29 to 0.4). Ratio diagrams for all four treatments indicate stable coexistence throughout the season. While *Eleocharis* grew more rapidly in these experiments, each species is limited more strongly by conspecifics than by neighbors of the other species.

**An Analysis of Dispersal in an Unmanipulated Population of *Peromyscus leucopus*.** MARK MINER and DAVID T. KROHNE, Department of Biology, Wabash College, Crawfordsville, Indiana 47933. — The demographic characteristics and the consequences of dispersal were studied in a population of *Peromyscus leucopus* with an extensive live-trapping system. Dispersal events up to 1 km (minimum straight line distance) could be detected with this system. Although the absolute number of dispersers increased with density, relative indices showed no correlation with density. Dispersers were a random sample of residents with respect to age structure but the sex ratio was significantly more male-biased than that of residents. Dispersers appeared to suffer high mortality associated with the move and the establishment of residency in the new area. Once residency was established however, there was no difference in mortality rate between residents and newly arrived dispersers. Dispersal was not preferentially directed to regions of lower density. It is suggested that dispersal in this species is more intimately related to social interactions and the avoidance of inbreeding than to demography.

**Replacement of *Ulmus americana* L. in an Old-Growth Central Indiana Woods.** G.R. PARKER and D.J. LEOPOLD, Department of Forestry and Natural Resources, Purdue University, West Lafayette, Indiana 47907. — In 1926 all trees ( $\geq 10$  cm dbh) were permanently tagged and mapped in a 20.6 hectare, old-growth tract of timber in Randolph County, Indiana. The central 8.5 hectares were resurveyed in 1976. The relative basal area and relative density of *Ulmus americana*, American elm, at this time was 4.2% and 12.9%, respectively. By 1976, 94.5% (172 individuals) of the tagged

*U. americana* were dead. Species which grew into the gaps created by dead American elm were (out of 451 ingrowth trees  $\geq 10$  cm dbh) *Ulmus americana* (23%), *Acer saccharum* (14%), *Celtis occidentalis* (9%), *Carya ovata* (8%), *Fraxinus americana* (6%), *Fagus grandifolia* (4%), and other species (36%). Though Dutch elm disease and phloem necrosis has killed most American elms that existed in the initial survey, the density had increased three-fold by 1976. Precocious reproductive maturity and shade tolerance has allowed *U. americana* to exist in this old-growth forest, its presence generally restricted to smaller diameter individuals.

**An Analysis of the Community Gradient Between an Aspen-Maple Upland Forest and an Alder-Cedar Swamp Forest in Northern Lower Michigan.** CHRIS PETERSON and EDWIN R. SQUIERS, Departments of Biology and Environmental Science, Taylor University, Upland, Indiana 46989. — The structure of the plant community in the ecotone between an aspen-maple upland forest and an alder-cedar swamp forest was studied at the Grass River Natural Area, Antrim County, Michigan. Basal area, density, and frequency data were collected by taxonomic species from circular quadrats of 100 square meters each, spaced at 30 meter intervals along six parallel transects between the two community types. Elevation and depth to ground water was also recorded at each quadrat. The ecological distance between quadrats was assessed using a variety of indices of diversity and community similarity, Bray-Curtis ordination, and principle component analysis. The results indicate that the changes along the ecocline are complex and species specific with dominant species such as large-toothed aspen, northern white cedar, and bracken fern displaying relatively sharp distributional boundaries while the abundance of many of subdominants changes very gradually.

**An Eco-Inventory of the Grass River Natural Area, Antrim County, Michigan.** EDWIN R. SQUIERS, MARTHA SITLER, MARK BREEDERLAND and CHRIS PETERSON, Departments of Biology and Environmental Science, Taylor University, Upland Indiana 46989. — This presentation reviews the findings of a three-year ecological inventory of the Grass River Natural Area. The 1000 acre preserve surrounds the Grass River, a part of the watershed that drains east central Antrim County, Michigan. The river flows south then west across an outwash plain of Wisconsin glacial till between Lake Bellaire and Clam Lake. Several cold water trout streams enter the river as it meanders through sedge meadows, northern white cedar swamps and a variety of other northern plant associations. The area displays a flora of more than 400 species highlighted by the presence of sundew, pitcher plants, and a variety of orchids, ferns and mosses. Bald eagle, osprey, mink, and otter fish the river while bear, bobcat and coyote roam the surrounding swamp forest.

Summary data will be presented from each of the six major components of the study: 1) Ecosystem Descriptions, an evaluation of the terrestrial, wetland and aquatic habitats; 2) Ecosystem Mapping, vegetation, hydrology, soils, etc.; 3) Floristic Inventory, vascular and nonvascular species; 4) Faunistic Inventory; 5) Water Quality, a chemical and biological evaluation of the major aquatic systems; and 6) Identification and Documentation of Ecologically Sensitive or Otherwise Noteworthy Areas. The segments of the study dealing with trophic dynamics in the sedge meadow and the aquatic ecosystems will be reviewed in detail.

**Use of *Aeromonas hydrophila* as an Indicator of Trophic State in Indiana Lakes.** CARL E. WARNES, Department of Biology, Ball State University, Muncie, Indiana 47306. — Lakes and reservoirs throughout Indiana were sampled for densities of *A. hydrophila* to determine if their numbers could be used to indicate lake

trophic status. Reservoirs sampled included Bass and Holiday (Porter Co), Brookville, Eagle Creek, Lemon, Morse, Prairie Creek, and Salamonie. Cedar (Lake Co), Crooked (Whitely Co), Maxinkuckie, Syracuse, Waubee, Wawasee, and Lake of the Woods (Marshall Co) were the natural lakes sampled. Comparisons of trophy were made on the basis of Carlson's Trophic State Indices (TSI) and that of the Indiana State Board of Health (ISBH). Correlation with *A. hydrophila* numbers to these calculated values were used to indicate the validity of the hypothesis. Correlations to various physical-chemical parameters, season and lake sites were also performed.

**Rats and Mice Transmit More than 200 Zoonotic Pathogenic Organisms.** WALTER WEBER, Indianapolis, Indiana. — A review of medical literature (human and veterinary) has indicated more than 200 documented zoonotic pathogenic organisms affecting man and domesticated animals have been identified with rats and mice. These include 105 bacterial, 8 rickettsial, 10 mycotic, 22 viral, 14 protozoal, 14 cestodes, 18 nematodes, and 29 trematodes. Although hundreds of arthropods have been found on rodents, forty two ectoparasites have been identified with the zoonotic organisms. These include 8 species of mites, 19 ticks, 11 fleas, and 5 other insects. Part of the life cycle of these organisms may be spent in the blood stream, internal organs, saliva or excretions. The disease organisms may be spread by bites, ectoparasites, urine, feces, oral, ocular, or nasal secretions. Since the pathogens are often in the blood and vital organs of the rodent, an animal eating them may acquire the disease. The significance of rats and mice in transmission of pathogenic organisms is considerable and complex. Many of these facts have been and others are being investigated by scientists throughout the world.

**Limnological Characteristics of a Southern Indianan Lake During Manual Removal of Macrophytes Followed by Addition of a Photosynthetic Inhibiting Dye.** RICHARD L. WHITMAN, Department of Biology, Indiana University-Northwest, Gary, Indiana 46408. — During summer 1979 a limnological investigation was conducted on Reflection Lake located on the campus of Indiana State University-Evansville. Intensive manual removal of submerged aquatic macrophytes occurred between June 10 and July 16. Twelve liters of Aqua Shade® (a photosynthetic inhibiting dye) was added to the lake between July 17 and July 23 and an equivalent amount on Aug. 1. Both manual removal and Aqua Shade addition were successful in removing unwanted vegetation, but the former technique may require excessive use of manpower.

Phosphates, nitrates, nitrites, chlorides, silicates, pH, hardness, dissolved oxygen, temperature, chlorophylls, phytoplankton and fish population were analyzed during lake treatment. Following the cessation of macrophyte removal and initiation of dye treatment: epilimnetic oxygen levels rose, as did filamentous blue greens, chlorophyll b, pH, and littoral nitrites. Temporary increases in phosphates, nitrates, and turbidity occurred with dye application, while total hardness generally decreased. Fish population analyses did not indicate an adverse effect on bluegill and largemouth bass from the above described treatments.

**The Use of Sediment Oxygen Demand in Stream Sediment and Water Quality Assessment of Salt Creek, Porter County, Indiana.** RICHARD L. WHITMAN and EUGENE J. FARON. Department of Biology, Indiana University-Northwest, Gary, Indiana. 46408 — Oxygen uptake of stream sediments and its relationship to bottom fauna, developing fish eggs, and chemical interactions has received increasing attention. In this study we measured oxygen uptake rates of Salt Creek

sediments using Gilson Respirometry during July, Aug., and Sept. 1980 and April 1981. Two locations were selected upstream of the Sewage Treatment Plant and six below it. The technique described is relatively simple and uses conventional equipment and methodology. Replication is somewhat higher than reported for other more traditional oxygen demand indices (BOD, COD, etc.), although station transects showed considerable variation due to heterogeneous sediment composition. Sediment organic content, stream water temperature and nitrates were positively correlated with oxygen uptake rates, while surface water velocity, turbidity, total suspended solids, pH, and alkalinity correlated in a negative manner ( $p = 0.05$ ). Oxygen uptake is significantly higher in sediments just below the treatment plant ( $p = 0.05$ ). Sediment oxygen uptake rates in conjunction with 48 hours diurnal oxygen monitoring give a reasonably good description of dissolved oxygen relationships in a stream subjected to perturbations from organic loading.

