

ECOLOGY

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ABSTRACTS

An Application of Techniques to Assess the Spatial Distribution of Land Cover or Habitat Types. STEVEN E. BACKS, Indiana Department of Natural Resources, R.R. #2, Box 477, Mitchell, IN 47446.—Procedures to evaluate wildlife habitat often incorporate an assessment of the spatial distribution of cover types or habitat components important to a particular species. Ten “Missouri interspersed patterns” depicting a range of forest: openland distributions were used to determine if analytical techniques to quantify spatial variables of “interspersed,” “juxtaposition,” and “spatial proximity” could differentiate between patterns and rank them in relative order of heterogeneity. A 3-level, systematic sampling grid was used to simulate a grid cell approach applicable to geographic information systems. Mean ranking values for spatial variables were used to order interspersed patterns by decreasing spatial heterogeneity. An index of similarity based on the coefficient of variability was used to differentiate mean values.

Seasonal Phenology of Chironomids in a Northern Indiana Stream. MARTIN B. BERG and RONALD A. HELLENTHAL, Department of Biological Sciences, University of Notre Dame, Notre Dame, IN 46556.—Although chironomids (Diptera: Chironomidae) are often the numerically dominant insects in streams, they are commonly ignored in aquatic insect life history studies. Since chironomids represent a species rich group in many stream habitats, seasonal phenologies provide insight into how members of this diverse assemblage coexist in a given stream reach. Fifteen 56.25 cm² Ekman grab samples were collected biweekly for one year in Juday Creek, a third-order northern Indiana stream, to examine seasonal phenologies. Forty-two co-occurring species of chironomids dominated by *Diamesa nivoriunda*, *Pagastia*, *Cricotopus bicinctus*, *Eukiefferiella* sp. (*claripennis* group), *Eukiefferiella* sp. (*devonica* group), *Parametriocnemus lundbecki*, and *Tvetenia* sp. (*bavarica* group) were collected. Many taxa showed temporally coordinated life cycles ranging from univoltine to asynchronous.

Breeding Status of the Loggerhead Shrike in Indiana. KENNETH M. BURTON and DONALD R. WHITEHEAD, Department of Biology, Indiana University, Bloomington, IN 47405, and Chris Iverson, Indiana Department of Natural Resources, Division of Fish and Wildlife, 3900 Soldiers Home Road, West Lafayette, IN 47906.—The loggerhead shrike (*Lanius ludovicianus*) has experienced a serious decline throughout the northeastern portion of its range in recent decades. The reasons for this decline are unclear, but habitat alteration is probably the main factor. Incidental records from Indiana suggest a similar decline, and the species

is now classed as endangered here. A study sponsored by the Department of Natural Resources' Nongame and Endangered Wildlife Program was begun this year to determine the shrike's status and distribution in the State, assess reproductive success, and analyze nest-site and territory characteristics. Results so far indicate that the breeding population is larger than was believed and concentrated in the southwestern portion of the State. The highest numbers of birds were found in Daviess, Dubois, Spencer, and Pike Counties. Thirty nests were monitored; 60% were successful.

The Effects of Oxygen Concentration on Embryonic Development, Post-hatching Characteristics and Sex Ratio in the Red-eared Turtle, *Pseudemys scripta*. CORY R. ETCHBERGER, JOHN B. PHILLIPS, MICHAEL A. EWERT, HENRY PRANGE, and CRAIG E. NELSON, Department of Biology, Indiana University, Bloomington, IN 47405.—This study examined the effects of oxygen concentration during embryonic development in *Pseudemys scripta*. The characteristics studied included: 1) the number of days to pipping; 2) the number of days following hatching to yolk absorption (umbilical scar formation); 3) the ratio of egg mass converted into hatchling mass; 4) the amount of yolk assimilated by the hatchling; and 5) the determination of sex. Sex in this species is determined by temperature. Above the pivotal temperature (estimated from previous studies to be 29 C) predominantly females are produced (>30 C produces all females), while at incubation temperatures >29 C males predominate (>27 C produces all males). One hundred eggs were equally divided among four oxygen treatments: High (30% O₂); Atmospheric (21%); Low (15%); and Low-Low (11%). All eggs were incubated at 29 C in small incubation containers enclosed in environmental chambers where oxygen concentration, temperature, and humidity were controlled: Eggs incubated in the Low-Low treatment pipped significantly later and absorbed their yolk slower than those in the other three treatments. Oxygen concentration did not affect hatchling size. In addition, when a clutch effect was accounted for, the Low-Low group converted significantly less of the egg into hatchling. Determination of sex as a function of oxygen concentration will be discussed.

Thirty-four Years of Tree Growth Data at the Southern Indiana Purdue Agricultural Center. BURNELL C. FISCHER and RICHARD K. MYERS, Department of Forestry and Natural Resources, Purdue University, West Lafayette, IN 47907.—In 1953, 69 - 1/5 acre continuous forest inventory (CFI) plots were established at the Southern Indiana Purdue Agricultural Center (SIPAC). The 69 CFI plots were remeasured in 1956, 1962, 1966, 1980, and 1987. Despite some timber stand improvement activities, including timber harvesting, stocking continues to increase. The initial per acre stocking in trees 9.0" DBH and greater of 35.3 trees, 36.8 square feet of basal area, and 1197 board feet (Doyle) has increased to 63.8 trees, 73.6 square feet, and 3643 board feet. Average annual growth (net growth and ingrowth) has increased from 56 board feet/acre in the first measurement period to 145 in the 1980-87 measurement period. Increased stocking and increased numbers of trees entering the sawtimber classes over time has resulted in a decreased average DBH growth increment in the most recent measurement period. DBH growth trends follow those for other southern Indiana CFI data bases with yellow-poplar and the red oaks greatest and hickories the slowest. Pictorial changes in stand structure will be presented.

Quantitative Analysis of Four Nature Preserves in Indianapolis, Indiana. RONALD P. HELLMICH, Ball State University, Indiana Department of Natural Re-

sources, 605B State Office Building, Indianapolis, IN 46204, and Arthur L. Spingarn, Indiana Department of Natural Resources, 605B State Office Building, Indianapolis, IN 46204.—Four wooded tracts ranging in size from 8 to 18 hectares in Indianapolis were dedicated in the summer of 1987 as Indiana State Nature Preserves. A quadrat sampling method was used to tally trees from approximately 20 regularly spaced 100 m² plots at Woollen's Gardens, Marott Park, Spring Pond, and Eagles Crest. *Acer saccharum* was dominant among sapling (2.5 to 10 cm dbh) and trees (>10 cm dbh) and was first or second among canopy trees (>30 cm dbh). The second dominant tree species (>10 cm dbh) was different at three out of four sites, being *Fagus grandifolia* at two, and *Liriodendron tulipifera* and *Platanus occidentalis* at the remaining sites. Tree density at the four sites ranged from 339 to 500 trees (>10 cm dbh) per hectare while the mean tree diameter ranged from 14 cm at Marott Park to almost 19 cm at Eagles Crest. Quantitative sampling at Woollen's Gardens and Marott Park led to substantially different characterizations of the vegetation than previous subjective descriptions. Eagle Crest Woods was considered the best example of the classic beech-maple forest among the four. Differences in topography, water regime, visitor use, and disturbance history help explain the individualistic nature of the plant communities at these four preserves.

Summer Drought Response of an Old-Growth Woods. ELLEN M. JACQUART, Holcomb Research Institute, Butler University, 4600 Sunset Avenue, Indianapolis, IN 46208 and Arthur L. Spingarn, Indiana Department of Natural Resources, 605B State Office Building, Indianapolis, IN 46204.—Moisture stress was monitored in two canopy and two understory tree species at Hemmer Woods Nature Preserve during the 1987 and 1988 growing seasons. Measurements were taken on white oak (*Quercus alba*) and flowering dogwood (*Cornus florida*) on upland soils, and yellow poplar (*Liriodendron tulipifera*) and pawpaw (*Asimina triloba*) on bottomland soils. Radial expansion in oaks and poplars was measured using aluminum band dendrometers. Growth from June-August, 1988 was greatly reduced compared to the same period in 1987. Average pre-dawn xylem water potentials in flowering dogwood dropped to minus 20 bars in September, 1987. In June, 1988, the potentials fell to minus 14 bars, compared to minus 2 bars in June, 1987. Less extreme stress levels were observed in pawpaws. The physiological responses were closely linked to the late summer drought in 1987 and early summer drought in 1988.

Presettlement and Modern Vegetation Patterns in Wabash County, IN. DOUGLAS C. KELLER and DAVID J. HICKS, Biology Department, Manchester College, North Manchester, IN 46962.—The presettlement vegetation of Wabash County was established by study of early land survey records. The dominant vegetation types were oak-hickory, beech-maple, and floodplain forest. Oak-hickory forest tended to be associated with the better drained soils in the northwestern part of the county. Small areas of barrens, bog, and wetland also occurred. Modern forest vegetation consists of over 1200 individual patches of forest, most of them less than 5 ha.

Yellow Perch Fecundity in Indiana Waters of Lake Michigan, 1985-86. THOMAS S. MCCOMISH, Department of Biology, Ball State University, Muncie, IN 47306 and STEVEN M. SHROYER, Department of Fisheries and Wildlife, University of Minnesota, St. Paul, MN 55108.—Fecundity of yellow perch (*Perca flavescens*) was evaluated for fish from Lake Michigan near Michigan City, Indiana, in 1985

and 1986. Fish ($n = 83$) used for fecundity models ranged from 172-290 mm and age 3-6. Fecundity was estimated using both volumetric and gravimetric methods. Comparison of estimated fecundities to total egg counts revealed volumetric estimates more closely approximated the actual (mean error -3.4% , SD 8.2%) than gravimetric estimates (mean error $+8.8\%$, SD 6.5%). Equations describing fecundity (F) as a function of total length (L) were developed as least squares regression models. Models utilized means for fish in 10 mm intervals transformed to base 10 logarithms. The 1985 and 1986 data were combined since no difference in models was found between years ($P > 0.05$). The 1985-86 model based on volumetric estimates was $\log F = -4.0396 + (3.5834) \log L$ ($r = 0.982$) while the 1985-86 model based on gravimetric estimates was $\log F = -3.8258 + (3.5097) \log L$ ($r = 0.986$). The volumetric model was used to predict fecundity based on length and age and to compare to yellow perch fecundity models from other Lake Michigan locations.

Chemically Mediated Discrimination Against Blue-green Algae by Suspension-feeding Copepods. FELIX MOXTER and WILLIAM R. DEMOTT, Department of Biological Sciences, Indiana-Purdue University, Fort Wayne, IN 46805.—Toxicity, low food value, and/or unmanageable size often make blue-green algae poor food for zooplankton. We used dual label radiotracer experiments to examine selection between high quality *Chlamydomonas* and a variety of blue-green algae by zooplankton. In contrast with nonselective *Daphnia*, the copepod *Diaptomus birgei* exhibited three patterns of selectivity: 1) several taxa, including *Aphanizomenon*, toxic *Microcystis*, and toxic *Anabaena* were ingested at low rates under all conditions; 2) *Chroococcus*, nontoxic *Anabaena*, and nontoxic *Microcystis* were strongly rejected only when high quality *Chlamydomonas* was abundant; and 3) *Glaucocystis* was ingested at high rates under all conditions. These results are in good agreement with the predictions of an optimal diet model.

Survey of Distribution of Freshwater Snails in the St. Joseph and Kankakee River Basins (St. Joseph and Marshall Counties, Indiana). T. MARK OLSEN, DAVID M. LODGE, GARY W. KOHLHEPP, and LOUISE M. WEBER, Department of Biological Sciences, University of Notre Dame, Notre Dame, IN 46556.—We determined the distribution of state-threatened and other freshwater snail species in two drainage basins (St. Joseph and Kankakee) in two northern Indiana counties (St. Joseph and Marshall). In each basin, 36 sites were randomly chosen: 18 were lentic and the remainder were either streams or ditches. Depending on substrate present, each site was sampled with a kick net and/or quadrat. ANOVA was performed to test differences in species abundance among habitats and basins. Twenty-two species of snails, including three threatened species (*Campeloma decisum*, *Goniobasis livescens*, *Lymnaea stagnalis*) were found. *Pleurocera acuta* and *P. canaliculatum* were most abundant ($p < 0.05$) in ditches and *Gyraulus parvus* was most abundant ($p < 0.05$) in lentic habitats. *Valvata lewisi* was more abundant ($p < 0.05$) in the Kankakee river basin. Habitat appeared to be more important than biogeographic history in determining snail distribution.

Does the Female Northern Cricket Frog (*Acris crepitans*) Discriminate Male Advertisement Calls Based on Frequency (Pitch) Differences? STEPHEN A. PERRILL, Department of Biology, Butler University, Indianapolis, IN 46208.—Two choice discrimination experiments were conducted on female cricket frogs that had recently been removed from amplexus. Speakers for broadcasting the male advertisement call were placed 2 m apart and the female was released at

the center position, 1 m from each speaker. Sound intensity was equalized at the center release spot with a Bruel and Kjaer integrating sound level meter (model 2230) before each trial. Two experiments were conducted: 1) a note from a natural call from a population in east Texas with a dominant frequency of 3800 Hz was dubbed on one track of a tape and paired with a note from a natural call from a population in central Indiana with a dominant frequency of 3500 Hz on the other tape track; and 2) a synthetic call with a dominant frequency of 3500 Hz was paired against a synthetic call with a dominant frequency of 3800 Hz. These two tests were performed on 14 frogs at a sound pressure level of 75 dB. Fifteen frogs were given the same tests at a sound pressure level of 89 dB. The female frogs discriminated between some of the choices but results remain unclear for others.

The Effects of Temperature on Sex Development in the Iguanid Lizard *Sceloporus undulatus*. BRIAN E. VIETS, Department of Biology, Indiana University, Bloomington, IN 47405.—Sex-determining patterns in lizards are poorly understood. Presently, only five of some 3300 species have been examined. Two lizards are known to have genetic sex determination (GSD), and three are known to have temperature-dependent sex determination (TSD). Due to the small number of lizards investigated thus far, a survey of additional species may be useful before any adaptive benefits of either sex-determining pattern can be determined. *Sceloporus undulatus* was examined for its sex-determining pattern as part of larger study on the sex-determining patterns of lizards. Although *S. undulatus* lacks heteromorphic sex chromosomes, its sex was found to be determined genetically. This species represents a third documented case of GSD in lizards. Eggs were incubated at 24°, 25°, 27°, 28°, 30°, 32°, and 34° C. The sex ratio at each temperature was not significantly different from 1:1. Days to hatching was inversely proportional to incubation temperature, and was significantly different at each temperature. The effects of temperature, sex, and clutch on hatchling size also were examined. Abnormalities occurred in 44% of the hatchlings. Defects were independent of temperature, but clutch specific.

The Role of Perceptual Biases in Food Selection by Suspension-feeding Copepods. M. DESIREE WATSON and WILLIAM R. DEMOTT, Department of Biological Sciences, Indiana-Purdue University, Fort Wayne, IN 46805.—We used radiotracer experiments to test the effects of algal size, motility, and extracts on food selection by planktonic copepods. Several co-occurring copepod species exhibited similar preferences for larger high quality algae over smaller high quality algae. *Tropocyclops prasins* exhibited a strong preference for motile flagellates, whereas *Diaptomus birgei* did not discriminate between motile and nonmotile forms. The addition of algal extracts did not influence patterns of selectivity or feeding rates. Preferences for large or motile cells are probably due to differential detection rather than decision-based selection. The results of experiments with algal exudates suggest that copepods detect algae by mechanoreception rather than distance chemoreception.

