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ABSTRACTS

Pipewort Pond, a Unique Wetland with Atlantic Coastal Plain Elements in Elkhart County, Indiana. James R. Aldrich, Division of Nature Preserves, Indiana Department of Natural Resources, Indianapolis, Indiana 46204.——This remarkable wetland supports a unique assemblage of native vascular plants many of which are commonly referred to as "Atlantic Coastal Plain disjuncts." Many of the species that occur at Pipewort Pond such as *Fuirena pumila, Psilocarya scirpoides, Rhynchospora macrostachya, Eriocaulon septangulare, Juncus pelocarpus* and *Utricularia purpurea* are rare or otherwise noteworthy species for the Indiana flora. The vegetation and ecology of the wetland is discussed and a species list is presented.

Competition for Ownership of Webs in the Semi-social Spider *Cyrtophora moluccensis* of Yap (Caroline Islands, Micronesia). James W. Berry, Department of Zoology, Butler University, Indianapolis, Indiana 46208.——In a colonial web each spider builds its own orb, but wandering individuals frequently challenge the original inhabitant of the orb. When a spider is introduced into the orb of another spider, one of the individuals eventually is chased from the orb. Two important factors in deciding possession of the orb are prior occupancy of the orb and body weight. Disregarding weight differences, the owner retained possession of the orb about 70% of the time. The heavier spider, whether the intruder or the owner, was the winner 60% of the time. In 53 experiments, the time elapsing between the intruder being introduced into the orb and one of the individuals leaving the orb varied from 30 seconds to more than four hours.

Regional Low Density and Extinction in Populations of *Peromyscus leucopus*. Alex Burgin and David T. Krohne Department of Biology, Wabash College, Crawfordsville, Indiana 47933.——In the spring and summer of 1984 unusually low densities of populations of the white-footed deer mouse, *Peromyscus leucopus* were, encountered throughout the Sugar Creek drainage in west-central Indiana. Extensive trapping at seven sites on both sides of the creek indicated that this phenomenon extended for at least 60 km and included local extinction in at least three sites. Age structures were biased toward adults in all sites during the low density periods. Sex ratio was heavily biased toward males on all sites but one during this period. On the one site in which males did not predominate, recovery from the low density situation began earlier and continued more rapidly than on other sites. By the end of the summer of 1984, the

sites had begun to diverge in density with some recovering at different rates while others remained extinct.

Predator-determined Structure in Amphibian Pond Communities. SPENCER A. CORTWRIGHT, Indiana University, Bloomington, Indiana 47405.——Community structure encompasses the number and relative abundances of interacting species. The mechanisms producing community structure are interactions among the species and their relations to the physical environment. Patterns in pond-breeding amphibians suggested that moderate or high densities of a fall-breeding *Ambystoma* (a salamander predator on spring-breeders) were associated with low populations of one spring-breeding salamander and higher populations of a second. A factorial pen experiment was done using two densities each of the three salamanders (plus constant numbers of other common amphibians).

The results showed a strong predator effect on the fall-breeding *Ambystoma opacum* on two early-hatching species, *Ambystoma jeffersonianum* and *Rana sylvatica*, in both the pen experiment and the pond itself. Two later-hatching species, *Ambystoma maculatum* and *Notophthalmus viridescens*, experienced much higher survivorship in the presence of predators. *Rana clamitans* breeds even later, has low palatibility, and is too large to be consumed the following spring. Thus, timing of prey hatching and possibly prey behavior may strongly affect prey susceptibility and, hence, community structure.

In more temporary pools without *A. opacum, A. jeffersonianum* survives in higher numbers and appears to depress the survivorship of *A. maculatum*. Thus *A. opacum* appears to cause a reversal in the relative abundances of these two prey species.

The Complex Relationship of Embryonic Development to Incubation Temperature in Turtles. MICHAEL A. EWERT AND CRAIG E. NELSON, Indiana University, Bloomington, Indiana 47405.——In birds, the incubation period within a species deviates little from the mean. In turtles, however, the incubation period within a species varies greatly and healthy turtles hatch following a broad range of durations. Only part of this variation is attributable to acceleration of development by increased temperature. At a single temperature, eggs from higher latitudes develop up to 30% faster than conspecifics from lower latitudes, a difference expressed throughout embryonic differentiation. Other species have a variably prolonged arrest of development in early stages and, sometimes, at term, when otherwise they are ready to hatch.

What is the adaptive significance of variable incubation periods? In particular, what do slower developers gain? In species with environmental sex determination, prolonged development may match temperature sensitive phases of development with seasonal arrays of temperatures more favorable for gonadal development. Alternatively, some species may be "bet-hedging" to assure that some eggs hatch when environmental conditions are favorable. We are using calorimetry and respirometry to explore the energetic implications of these options.

A Competitive Ecotone between Hardwood and Relict Hemlock Communities. SCOTT FERSON, Department of Ecology and Evolution, State University of New York, Stony Brook, New York 11794 and DANIEL D. STOCKTON, Department of Biology, Wabash College, Crawfordsville, Indiana 47933.——Apparently relict stands of Eastern Hemlock (*Tsuga canadensis*) occur along Sugar Creek bluffs at the Allee Memorial Woods Nature Preserve in Parke County, Indiana, in sites usually occupied by beech-maple hardwoods. If, despite their complexity and variability, these communities behave integrally in interaction with each other, the boundary between them is expected to

be very sharp and display a constant width when measured objectively across perpendicular transects. In this case, local floristic configurations will form a bimodal distribution in vegetation space lacking intermediate states. All hardwood trees (larger than 7.5 cm dbh) and all hemlock stems (taller than 10 cm) were measured for diameter and mapped in a 1.8 hectare area which included an extremely sharp ecotone between communities with and without hemlock. Qualitative estimates of understory and herbaceous layer composition were also made. Analysis of these data may give weak-inferential evidence that this ecotone is the result of mutual competitive exclusion by the two communities along an environmental gradient.

Development and Analysis of a CFI Data Base for Indiana. BURNELL C. FISCHER AND JOHN A. KERSHAW, JR., Department of Forestry and Natural Resources, Purdue University, West Lafayette, Indiana 47907.——Continuous Forest Inventory (CFI) plots were established throughout Indiana during the late 1940s through the mid 1960s. Many of these plots were maintained and periodically remeasured. However, few summaries of the data were attempted and the data, if not lost, was simply put in the file cabinet. This type of data is essential if forest researchers are to develop models of forest development and growth which can be used by forest managers.

The relocation and remeasurement of the Purdue portion of Indiana's CFI plots is nearing completion. This will result in a data base of over 400 CFI plots (many originating in the early 1950s) on either Purdue Agricultural Centers and Purdue Department of Forestry and Natural Resources woodlands. The initial effort was concentrated on these woodlands because the existing data was most accessible and these plots were considered to be in the "best" condition. Work has begun to assess the condition of plots and accompanying data bases on State Forests and other woodlands.

Initial analysis of the data has concentrated on the development, and growth and yield of forest stands and the response of individual trees by species and size class. Stand growth is summarized by growth component. Gross growth, ingrowth, mortality and cut for basal area and board foot volume are utilized. Although, individual tree growth has primarily been an analysis of diameter growth by size class and species, we are also looking at ingrowth and mortality rates.

Obviously, tree and plot growth rates are quite variable depending on both forest and site conditions. The summarization of a large data set, such as is available in Indiana, should allow researchers to test a number of hypotheses on the growth and management of Indiana forests.

Biofiltration in Intensive Culture Systems: Design Considerations. GEORGE S. LIBEY AND GARY E. MILLER, Purdue University, West Lafayette, Indiana 47907.——The growth of the human population is accompanied by a need to increase food production. Aquaculture, the cultivation of aquatic organisms, offers the potential for expanding the human food base. Reconditioning systems for fish culture increase the use of limited water supplies and maintain necessary water quality parameters. Characteristics or reconditioning systems include:

Removal/detoxification of metabolic wastes
Solid waste removal
Reoxygenation
Temperature control
Disease control

Design constraints are:

Soluable organics concentration

Soluable inorganics concentration
Temperature
Dissolved oxygen
Alkalinity
pH

Devices available include:

Packed tower (trickling filter)
Rotating biological contractor
Fluidized bed-reactor
Tube/plate clarifier

Sexual Selection and Alternative Mating Strategies in *Hyla crucifer* and *Hyla chrysoscelis*. MOLLY MORRIS, Department of Biology, Indiana University, Bloomington, Indiana 47405.——Observations and field experiments were conducted on a population of *Hyla crucifer* (spring peeper) and a population of *Hyla chrysoscelis* (gray treefrog) during their respective mating seasons. Data was taken to determine behavioral and/or morphological characteristics that could influence a male's reproductive success. Close attention was also given to the location and distinguishing characteristics of the call sites. In both species, large males did not have a higher probability of mating than smaller males, nor did I find positive assortative mating of large males with large females and smaller males with smaller females. Factors that seem to affect mating success in gray treefrogs include the number of nights spent calling and a male's close association with another calling male. Males that spent more evenings calling had a higher probability of mating. These and other results will be discussed in terms of mating systems, alternative male mating strategies and game theory.

Do Tadpoles Die for their Siblings? CRAIG E. NELSON, Department of Biology, Indiana University, Bloomington, Indiana 47405.——When same-age conspecific tadpoles are grown together, it has frequently been observed that one or a few of the tadpoles grow well and that the growth of the other tadpoles is severely inhibited. Indeed the inhibited tadpoles often fail to feed and consequently die. Inhibitability appears to be selectively disadvantageous and might be expected to evolve out of the population. Kin-selection could maintain inhibitability if its net effect was an increase in the growth and/or survivorship of favored siblings. These experiments ask whether the growth disparity within sibling groups is greater than that within groups of non-siblings. Such a disparity would strongly implicate kin-selection.

Tree Species Dynamics in an Old-growth Deciduous Forest since 1926. GEORGE R. PARKER AND DONALD J. LEOPOLD, Purdue University, West Lafayette, Indiana 47907.——All trees ($\geq$ cm dbh) in a 20.5 ha mature deciduous forest on the Tipton Till Plain of central Indiana were tagged and mapped in 1926. Trees within the central 8.5 ha were remeasured and mapped in 1976. Thirty-two species were recorded in 1976 and 28 in 1926. There was a shift in relative abundance among species due to ingrowth and mortality. The majority of ingrowth trees within a 5-m radius gap of dead dominant trees were *Ulmus americana* (30% of total) and *Acer saccharum* (20%). Low mortality species ($\leq$25%) included *A. saccharum, Aesculus glabra,* most *Carya* spp., *Celtis occidentalis* and most *Quercus* spp. High mortality species ($\geq$75%) included *Fagus grandifolia, Ulmus* spp., and *Fraxinus nigra.* Nearly half (46.9%) of those trees measured in 1926 were dead by 1976. Stand density and basal area increased 93.9 and 30.8%, respectively, to 320 stems/ha and 31.0 m/ha by 1976. Mortality has average 2.9 stems/ha since 1976 with *U. americana* accounting for about 30% of those dying.

Male Mating Behavior in *Hyla cinerea*. STEPHEN A. PERRILL, Department of Zoology, Butler University, Indianapolis, Indiana 46208.——*Hyla cinerea* males in two ponds on Wilmington Island, Georgia, were toe-clipped and freeze-branded for individual identification. Their activities and rates of mating success were observed over three breeding seasons, 1979-81. The goal of these observations was to relate their behavior, location, and physical characteristics to their rates of mating success. Three categories of behavior were considered (calling, satellite and non-calling) and more than 80% were found to be either calling or adopting the satellite strategy for most of the observation period. The least site-specific, least mobile males showed the highest rate of mating success; the most site-specific, the least successful. In each year, there was a significant positive correlation between calling activity and mating success. Also, there were consistent positive relationships between the number of nights the frogs frequented the study site and their rates of mating success; but mean body size did not appear to influence the mating success rates.

Hardwood Tree and Ground Cover Establishment on Reclaimed Mineland and Unmined Reference Sites in Indiana. PHILLIP E. POPE, WILLIAM R. CHANEY AND WILLIAM R. BYRNES, Department of Forestry and Natural Resources, Purdue University, West Lafayette, Indiana 47907.——Establishment success, productivity, and compatibility of ground cover and hardwood tree seedlings planted concurrently and maintained under the same level of management were evaluated on reclaimed, surface-mined, coal land and unmined reference sites in southwestern Indiana. Topography, soils, and vegetation were similar on both sites prior to mining. The mined land was reclaimed for forest land use under provisions of Public Law 95-87, The Surface Mining Control and Reclamation Act of 1977. The reference area was cleared of all vegetation and both sites were disced, limed, and fertilized before planting. Soil physical and chemical properties were analyzed and compared between sites. One-year-old black walnut (*Juglans nigra* L.) and red oak (*Quercus rubra L.*) seedlings were planted at 2 x 2 meter spacing concurrently with a mixture of K-31 fescue (*Festuca arundinacea* Schreb.) and red clover (*Trifolium pratense* L.) in spring 1981. Tree rows in one-half of each experimental unit were treated with amizine (simazine + amitrole) and dalapon to control ground cover plants and to assess the competitive effects of ground cover on hardwood tree establishment and growth. After three growing seasons, black walnut and red oak seedling survival was significantly greater on the reference site (88 and 77%, respectively) than on the reclaimed mineland (50 and 42%, respectively). Chemical control of ground cover was essential to meet stocking levels of 450 trees/acre specified in Federal and Indiana reclamation laws. Percent ground cover exceeded 70% of the cover present on the unmined reference site for three growing seasons, and hence met the initial requirement of Public Law 95-87. Ground cover biomass was similar on the minesite and reference areas in 1981, however, it was about twice as great on the reference site than on the minesite in the 1982 and 1983 growing seasons.

Interactions among Mast, Small Mammals, and Insects, and their Implications for Oak Management. BRAD SEMEL AND DOUGLAS C. ANDERSEN, Purdue University West Lafayette, Indiana 47907.——Interactions among acorn weevils (Circulionidae), short-tailed shrews (*Blarina brevicauda*), white-footed mice (*Peromyscus*), and acorns were examined to assess the net impact of these animals on acorn germination and survival. Only 5% of acorns collected in traps within replicate plots at Martell Forest, near Lafayette, Indiana were found to be undamaged. Sixty-two percent of the 1983 acorn crop was damaged as a result of Curculionid infestation; arboreal vertebrates damaged another 29%.

Feeding trials indicated *P. leucopus* will consume both infested acorns and weevil larvae; a preference for non-infested acorns over infested acorns was detected in laboratory food choice experiments. *Blarina* consumed weevil larvae but did not extract them from acorns. *Peromyscus* detected and excavated larvae that had exited host acorns and entered the soil only from the upper 5 cm of the soil profile in contrast to *Blarina brevicauda*, which consumed larvae from within the upper 16 cm of the soil profile. Field experiments indicated that about 50% of larvae overwinter in the upper 5 cm of the soil profile; no larvae were noted to overwinter below 21 cm. Other field experiments indicated that rates of acorn removal by mice decreased as the proportion of weevil infestation increased. An attempt to document a negative impact by *Blarina* on *Peromyscus* populations was inconclusive.

Taken together, our studies suggest that precaution is necessary in designing oak management programs based largely upon chemical insect control to increase acorn production; enhancement of the beneficial activities of *Blarina* may provide an alternative strategy.

Density-dependent Mortality on Galls of the Goldenrod Gall Fly, ***Eurosta solidaginis.*** ROD WALTON, Department of Biology, Indiana University, Bloomington, Indiana 47405.——The dependence of predator foraging on both local and overall prey density can have broad implications for the dynamics and stability of a predator-prey system. Recent discussions of the effects on predator efficiency of predator aggregation in areas of high prey density, transit times between prey patches and predator handling times, together with the distribution of prey among patches of a heterogeneous habitat suggest that different prey distributions should result in different foraging rates by predators. Prey faced with a strongly aggregating predator, for instance, will benefit from an underdispersed rather than a clumped distribution. This is especially critical for sedentary prey. *Eurosta solidaginis* (Tephritidae) females oviposit in the stems of *Solidago* spp. during early spring. Third instar larvae overwinter within spherical stem galls. During development and over the winter, larvae are vulnerable to several predators: two species of parasitoid (*Eurytoma* spp.) a predatory beetle larva (*Mordellistena* spp.) and avian predators (e.g. Downy Woodpeckers). This study was undertaken to determine the distribution pattern of *Eurosta* galls in a natural habitat, the degree of density-dependence for each predator, and the theoretical "optimal" gall distribution that would minimize predation losses under the constraints of a specific suite of predators.