

ECOLOGY

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ABSTRACTS

Mechanisms of Reproductive Isolation in Two Sympatric Stickleback Species. CHARLES L. BAUBE, Indiana University, Bloomington, Indiana 47405.—Throughout its range the Black-spotted Stickleback (*Gasterosteus wheatlandi*) is sympatric with the larger congeneric *G. aculeatus*. Though able to hybridize, reproductive isolation is maintained by a presumed behavioral mechanism that is, as yet, unclear. An experiment was undertaken to determine the extent to which male courtship maintains this isolation. Pairwise presentations to *G. wheatlandi* males of proportionally gravid female dummies of varying length shows that 1) males preferentially court the larger of the two dummies, and 2) preference strengths are related to the differences in length between the dummies.

These results indicate that *G. wheatlandi* male courtship preferences may be maladaptive because choice for the larger female often means the wrong species. Further discussion will focus on other factors that may be acting to achieve reproductive isolation between these species.

Notes on the Life History of the Intertidal Spider, *Paratheuma insulana* (Araneae; Desidae). JAMES W. BERRY, Department of Biological Sciences, Butler University, Indianapolis, Indiana 46208.—*Paratheuma insulana* is an intertidal spider previously found in the Caribbean region, and this is the first record of a member of the Family Desidae from the United States. This is also the first record of the male of the species. *Paratheuma insulana* inhabits broken coral rubble just below the highest tide mark. In the laboratory both males and females mature in about 6 months after passing through 6-8 instars. At about weekly intervals females produce cocoons containing an average of 20 eggs. Some females have produced as many as 25 cocoons. Adults have survived for as long as 14 months. They feed on an intertidal isopod found in decaying seaweed.

Bimodal Size Distributions of Even-aged Populations: Their Origins and Effects on Community Structure in Larval Salamanders. SPENCER A. CORTWRIGHT, Department of Biology, Indiana University, Bloomington, Indiana 47405.—Bimodal size distributions of even-aged populations can arise due to dominance and suppression (in plants) and cannibalism (in fish). Some larval Jefferson salamander (*Ambystoma jeffersonianum*) populations develop bimodal size distributions. Field evidence shows that bimodal distributions of Jefferson salamanders are only found in ponds or experimental enclosures which have sizeable wood frog (*Rana sylvatica*) populations. I propose the following mechanism for the origin of bimodality in Jefferson salamander larvae. The initial size distribution of salamanders is log-normal due to variation in hatchling size and chance early feeding opportunities. Later, individuals in the right tail of the distribution are able to exploit

wood frog tadpoles, a new and very profitable resource. These individuals subsequently grow much faster than those feeding mainly on zooplankton.

Early Root Development of Planted Red Oak Seedlings in Clearcut Forest Openings. L.D. FARLEE AND B.C. FISCHER, Purdue University, West Lafayette, Indiana 47907. — Northern red oak seedlings (1-0) planted spring 1986 in 3 clearcut forest openings on Yellowwood State Forest were excavated during the first growing season (early August) to evaluate root regeneration. Four seedlings per treatment block, stratified through three initial size classes, were randomly selected for excavation, giving a total of 36 seedlings sampled. Root regeneration characteristics were compared to seedling size, growth characteristics, chemical properties and quality of planting. Root regeneration capacity, and average length and weight of root regeneration were greatest in the largest seedling size class. The smallest seedlings had fewer primary lateral roots than the two larger size classes. Root initiation sites were found to be primarily where roots were injured during root pruning. Total above ground height and the number of growth flushes before excavation were greatest in the largest size class. The results of poor planting technique, air pockets around the root at the time of seedling excavation, were reduced shoot growth and root regeneration.

Aquatic Invertebrates and Phytoplankton of Miller Woods Ponds, Indiana Dunes National Lakeshore. ANGEL V. GOCHEE AND RICHARD L. WHITMAN, Department of Biology, Indiana University Northwest, Gary, Indiana 46408. — An organismal survey of the interdunal ponds of Miller Woods was made during 1984-85. These ponds exist in ridge and swale terrain, and may be classified as mature to presenescent. Study ponds were generally shallow and contained vernal, aestival and semipermanent water. Most of the ponds are natural; however, some ponds may have been created or deepened to supply fill for elevated railroad beds. Phytoplankton was dominated by diatoms (*Frustulia*, *Fragillaria* and *Tabellaria*) and *Pandorina*. Dominant zooplankton included cladocerans, *Ceriodaphnia* and *Daphnia*; copepods, *Eucyclops* and *Mesocyclops* and the sarcodine, *Arcella*. *Hyaella*, chironomids, *Sphaerium*, *Crangonyx*, *Lymnea*, caddisflies, *Asellus* and *Caenis* dominated lower trophic level benthos; while tabanids, dytids, odonates and phantom midges dominated higher trophic levels. No fish were observed in any of the ponds.

Two Decades of Change in the Forest Structure of Virgin Coast Redwoods (*Sequoia sempervirens*) D. Don (Endl.) in Stout Grove, Del Norte County, California. MARION T. JACKSON, Department of Life Sciences, Indiana State University, Terre Haute, Indiana 47809 and D. BRIAN ABRELL, Division of Nature Preserves, Indiana Department of Natural Resources, Indianapolis, Indiana 46204. — In 1966 the trees of a 3.2 hectare section of Stout Grove, a virgin stand of coast redwoods located along the Smith River in Del Norte County, California, were mapped at a 1:33 scale. In August 1986 all trees ≥ 10 cm dbh were remeasured to determine growth, in growths and mortality of individual trees. Ten tree species comprise the stand with redwood (the only canopy tree) contributing nearly 90% of stand density and over 99% of stand basal area. This excellent high quality first growth redwood stand appears to be near equilibrium with growth and ingrowth basal area closely approximating that lost due to mortality.

Evolution of Reproductive Isolation in Two Species of Toad. JANE F. KOSKA, Department of Biology, Indiana University, Bloomington, Indiana 47405. — The American toad (*Bufo americanus*) and Fowler's toad (*B. fowleri*) are sympatric throughout much of eastern North America and often hybridize. Blair (1941) found that Bloomington,

IN area populations were hybridizing in 1940. Jones (1973) suggested that following some initial introgression, hybridization had ceased by 1970. In 1986, males were collected from three sites, including those used by Blair and Jones. Seventeen morphological characters were recorded. A discriminant analysis distinguished two groups corresponding to the two species. The analysis accounted for all variance using 8 characters. No intermediates were detected. These results suggest that no effective hybridization is occurring. Further research will incorporate call parameters and more extensive sampling.

Ginn Woods: An Undisturbed Virgin Forest in East-central Indiana. MARK S. McCLAIN, Ball State University, Muncie, Indiana 47306. —The edaphic and pedologic factors of forest soils and their influence on the naturally occurring climax vegetation in an old-growth forest in east-central Indiana, known as Ginn Woods, were examined. The tree species composition on the respective soils in the woods was studied. The extent of disturbance and history of the woods was examined. It was found that the soils were undisturbed and it appears that there has never been any fire, grazing, or timber taken from the northern portion of the woods. It was concluded that the northern portion of Ginn Woods is an undisturbed, virgin forest and is best classified as a sugar maple-American beech-slippery elm association.

Microcosm Acid Rain Experiments with Water from Oriole Pond, Perry County, Indiana. THOMAS S. McCOMISH, Ball State University, Muncie, Indiana 47306. —The potential impacts of acid rain on the alkalinity, conductivity, and pH of surface waters in Perry County of southern Indiana were investigated in microcosm experiments with water from Oriole Pond. Microcosm models simulated systems with one-third annual volume replaced with simulated acid rain (SAR) at pH 5.6, 4.5, 4.0, and 3.5.

Microcosms with water only after treatment with SAR showed significant declines in alkalinity (15-33 ppm) and conductivity (29-38 umhos). A significant pH decrease of 0.2 units occurred with SAR at pH 4.0 and 3.5. Other microcosms with water and substrate material had greatly lowered initial values for alkalinity and pH compared to those with water only due to substrate influence. Addition of SAR resulted in a significant decrease in conductivity (22-35 umhos) in all SAR tests. A significant pH decrease of 0.4 units occurred at pH 3.5. Alkalinity was so low in the microcosms at the initiation of experiments (0.6-1.2 ppm), due to the low pH levels (5.5-5.9), that no changes were measurable with addition of SAR regardless of pH level.

These results reveal Oriole Pond water is vulnerable to change with addition of acid rain. Since the pH of rain in this area is about 4.5, models indicate a likely negative impact of acid rain on surface waters with low alkalinity in this area of Indiana.

More on: Do Tadpoles Die for Their Siblings? CRAIG E. NELSON, SCOTT J. BARTON AND DAVID F. PARKHURST, Indiana University, Bloomington, Indiana 47405. —If same-age, conspecific tadpoles are grown together, the largest tadpole usually grows rapidly but the growth of the smaller tadpoles is retarded. The extent of this disparity increases with increased crowding. At the extreme, smaller tadpoles die and are eaten by the others. To assess the evolutionary significance of this pattern, we examined tadpoles of four species for differences in growth between groups of siblings and non-siblings. There were significant differences in each species but the pattern differed among species. In wood frogs siblings are smaller, in bullfrogs siblings are larger, in the other two species the pattern changes with density. In American toads, the growth of the largest tadpole was disproportionately accelerated. Toads and wood frogs were tested for differences in degree of association between sibling groups and non-sibling groups. Sibling toads spend more time together. These differences in growth and behavior are concordant with ecological differences among the species.

Pollination, Nutrient and Energy-limited Female Reproductive Success in *Catasetum ochraceum* Lindl. (Orchidaceae). GUSTAVO A. ROMERO, Department of Biology, Indiana University, Bloomington, Indiana 47405. — *Catasetum* L.C. Rich. is one of about 4 known orchid genera with separate staminate (“male”) and pistillate (“female”) flowers. Evidence indicates that female reproductive success is pollination, nutrient and energy-limited. First, hand pollinated flowers set more fruits than undisturbed flowers and only a third of the undisturbed inflorescences set fruits. Second, fruits contain a considerable proportion of the plant nutrient reserves, and most plants bearing fruits one year bear male flowers or no flowers at all the next. Finally, only plants exposed to sunlight bear pistillate flowers, suggesting that only those plants able to sustain high photosynthetic rates can bear fruits.

Aspects of the Biology of *Carex woodii* Dew. (Cyperaceae). Paul E. Rothrock, Taylor University, Upland, Indiana 46989. — *Carex woodii*, a sedge of rich, dry woodlands, is endangered with extirpation in Illinois, Indiana, and Ohio. In much of its range, this species is associated with moraine deposits of the Wisconsin glaciation; however, eastern populations also occur in unglaciated regions of diverse geologic history. In N-central Indiana, *C. woodii* blooms over a 14 to 20 day period in early April. According to field observations, female flowers expand 1 or more days before male flowers of the same culm. Unpollinated stigmas can remain receptive for approximately 7 days. Filaments of mature anthers elongate at night. Pollen release begins from ca. 9 AM to early afternoon depending upon temperature and humidity and is completed within 4 hours. *C. woodii* produces well-formed, abundant pollen (> 30,000:1 = pollen:ovule ratio) which is easily carried by wind. Bagged inflorescences were self-compatible and non-apomictic. In the 1986 season, fruiting was sparse with only 8 of 30 sample plots bearing fruiting culms.

Aggression versus Courtship in Sticklebacks: The Role of Habituation. WILLIAM J. ROWLAND, Department of Biology, Indiana University, Bloomington, Indiana 47405. — Interaction of courtship and territorial aggression in male threespine sticklebacks (*Gasterosteus aculeatus*) was investigated by presenting dummy females to subjects nesting alone (Solitary Situation) and in view of males in adjacent tanks (Rival Situation). During dummy presentation subjects engaged in more courtship and nest activity when solitary than when in the rival situation. Subjects in the latter situation instead spent most time during dummy presentation threatening and biting rivals. Thus, the presence of a rival can interfere with another male's courtship, by distracting the latter's attention from the dummy female or by eliciting in him an aggressive state that interferes with the expression of sexual tendencies. With prolonged, constant view of rivals, subjects spend less and less time with them but increasingly more time courting the dummy during presentations. This decrease in aggression is presumed to result from habituation to the neighboring males. Thus, habitation can play an important role in mitigating aggressive response to familiar rivals, thereby allowing males to devote more time to courtship and nesting activities. This study was supported, in part, by an Indiana Academy of Science Research Grant to the author.

Analysis of Playback-record Responses in the Male Cricket Frog, *Acris crepitans*. WILLIAM J. SHEPHERD AND STEPHEN A. PERRILL, Department of Biological Sciences, Butler University, Indianapolis, Indiana 46208. — A series of playback-record experiments were performed with male cricket frogs. An unsolicited call was recorded for each subject. Immediately following, a conspecific mating call was broadcasted while the subject's response call was simultaneously recorded. The response to the broadcasted call differed from

the unsolicited call in structure and sound pressure level. When *Hyla versicolor* calls were broadcasted as controls, one of 12 *Acris* responded.

Disturbance Effects in Oak Dominated Forests of Central Indiana. PAUL T. SHERWOOD AND GEORGE R. PARKER, Purdue University, West Lafayette, Indiana 47907.——Gap phase tree replacement patterns were studied in an old-growth deciduous forest located in east central Indiana and in a second-growth deciduous forest in west central Indiana. Both forests are dominated by *Quercus* species with understories comprised most of late seral, shade tolerant species such as *Acer saccharum*. Diameter distributions by species for individuals within the five gaps sampled suggest that the midtolerant *Quercus* species are not replacing themselves in the small canopy openings created by the fall of one or two canopy dominants. The effects of agricultural abandonment on secondary forest edge succession were studied in another *Quercus* species dominated old-growth forest located in west central Indiana. Thirty-five percent of all stems sampled on this site are *Fraxinus* spp. while sixteen percent are *Quercus palustris*. The effect of strip clearcutting on forest tree regeneration pattern was also studied in a fourth *Quercus* species dominated forest in west central Indiana. Five year results indicate that while greater than 700 stems per hectare of *Quercus* spp. individuals were found in the clearcut, these stems are in a subordinate position to *Acer saccharum* and *Ulmus* species.

The Relationship between Weed Community Development and Tillage Type in Grant County, Indiana. EDWIN R. SQUIERS AND LEONARD H. ROBBINS, Departments of Biology and Environmental Science, Taylor University, Upland, Indiana 46989.——The relationship between tillage type and weed community development was investigated on the experimental fields of the Miller Purdue Agricultural Center 2 miles east of Upland, Indiana. Beginning in 1985, the conservation tillage techniques of paraplow and no-till were compared with traditional moldboard plowing on a pair of 360 ft. × 1200 ft. fields. A randomized complete block design was established with four replicates of each of the three tillage types. The fields were planted in corn in 1985 and rotated to soybeans in 1986. The weed community was assessed each year using four strip samples of ten plots each within each of the replicates yielding 480 plots across the experimental design. Analysis of variance was used to compare weed species frequency data within and between tillage types. The results indicate that some differences in the weed community do develop in response to each tillage type. These differences, though significant, were not reflected in lowered yields. This study suggests that, in terms of crop production, the weed control problems often associated with conservation tillage methods may be more a matter of perception than reality.

The Assessment of Interactions among Ovipositing Goldenrod Gall Flies, *Eurosta solidaginis*, Fitch. ROD WALTON, Department of Biology, Indiana University, Bloomington, Indiana 47405.——The interaction assessment method of estimating density-dependent interactions between conspecifics and between members of different species is outlined and applied to a population of goldenrod gall flies, *Eurosta solidaginis*. The method is based on ideal free distribution and answers two questions: What is the effect of *Eurosta* oviposition behavior on conspecifics? and How does *Eurosta* respond to varying *Solidago* (host plant) density? Results of the analysis suggest that adult females avoid ovipositing in areas in which other flies have oviposited. Analysis of the effect of host plant density on the growth of fly populations shows a minimal but negative effect. The effect of spatial scale at which data is collected can be critical for this analysis. The entire procedure was repeated for five scales of measurement (1,4,9,16,25 m²) and results were similar for each scale.

Gap Structure in a Mature Till Plain Forest. JEFFREY S. WARD AND GEORGE R. PARKER, Purdue University, West Lafayette, Indiana 47907.——Canopy type was determined on a five-meter grid for a 8.0 ha study area in the Davis-Purdue Research Forest. At each point the canopy was described as: 1) Primary canopy—the top of the canopy was at least twenty meters above ground, 2) Secondary canopy—the top of the canopy was between five and twenty meters, 3) Gap—top of the canopy was less than five meters. Woody vegetation between two and ten cm dbh were inventoried on a ten-meter grid. Sixty-two percent of the stand had primary canopy, thirty percent had secondary canopy and eight percent of the stand was in gaps. Gap sizes ranged from 25 m² to 375 m² with a mean of 52 m²; gap size distribution was lognormal. Using Clark-Evan's nearest neighbor index gaps were found to be randomly dispersed in the study area. Relationships between vegetation and gap sizes are discussed.