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Chairman: THOMAS S. MCCOMISH, Department of Biology Ball State University, Muncie, Indiana 47306

Chairman-Elect: ROBERT B. PRIDDY, Department of Natural Resources Huntington College, Huntington, Indiana 46750

Abstracts

Growth of Andropogon gerardi as Affected by Seed Source, Heavy metals, and Nutrients in two Northwestern Indiana Soils. LOUIS H. EHINGER and GOERGE R. PARKER, Department of Forestry and Natural Resources, Purdue University, West Lafayette, Indiana 47907.____A greenhouse pot study was conducted to test the effects of seed source, heavy metals, and nutrients on the growth of Andropogon gerardii. Soil and seed were collected from two sites in northwestern Indiana. One site is an urban, heavy metal contaminated site; the other is a rural uncontaminated site.

The growth variables considered were germination, height growth, tiller production and biomass. Germination of seed from the urban site was less than that of rural site seed. The urban site soil reduced height growth within four weeks of germination. Added nutrients promoted height growth by the eighth week although they did not alleviate completedly the height reduction in the urban soil. Plant height appeared also to slow down in correlation with an increase in tiller production.

After seven weeks, the urban site soil had significantly reduced the number of tillers produced per plant. After nine weeks it became apparent that this was affected by the seed source. The urban site plants produced significantly fewer tillers than the rural site plants on the rural site soil while neither seed source produced tillers on the urban soil.

Top biomass reacted essentially the same as plant height. Both added nutrients and the rural site soil resulted in more top biomass. Again nutrients increased biomass on the urban site soil but did not alleviate completely the biomass reduction due to the urban soil. Root biomass reacted differently. Nutrients increased root biomass in the urban site soil but decreased root biomass in the rural site soil.

Although ecotypic (site) variation in tolerance to the urban site soil could not be shown, the urban site plants did exhibit some characters common to metal tolerant ecotypes.

Adult plants were suggested to be better suited than seed material to population tolerance studies on the urban site due to suspected low selection pressures and high gene flow.

Effects of Zinc addition to two northwestern Indiana soils on growth of Andropogon scoparius and availability of Cd, Pb and Cu. LARRY J. MILES and GEORGE R. PARKER, Department of Forestry and Natural Resources, Purdue University, West Lafayette, Indiana 47907.____Zinc was added to soils collected from an urban site in East Chicago and a rural site located on the Willow Slough Fish and Wildlife Area. The urban site had been contaminated with Zn, Cd, Pb and Cu through atmospheric industrial fallout. Germination, survival, height growth and dry weight yield were determined for little bluestem (*Andropogon scoparius*). Metal concentrations in the soil and plants were determined with an atomic absorption spectrophotometer.

Height growth and dry weight yeild were affected while germination and survival were not. This response was non-linear and apparently due to soil chemistry effects on Zn availability (as measured by DTPA extraction) rather than plant physiological effects on Zn uptake. The nature of the results also indicate the existance of a critical limit for zinc toxicity effects.

Growth, as measured by dry weight yield and height is stunded on the urban soil control treatment as compared to the rural soil control group. Zinc additions to the rural soil result in a similar stunting of growth. It is hypothesized that zinc toxicity may be the factor limiting growth on the urban soil.

Zinc additions significantly decreased the levels of DTPA extractable Cd, Pb, and Cu, and apparently decreased the plant concentrations of Pb and Cu and increased the plant Cd concentration although these effects were not significant.

Log Input and Decomposition in and Old-Growth Douglas-fir Forest. *MACMILLAN, PAUL C., Department of Biology, Hanover College, Hanover, Indiana 47243, J. E. MEANS and K. CROMACK, JR., School of Forestry, Oregon State University, Corvallis, Oregon 97330.____A 5-class scheme of Douglas-fir log decomposition will be presented: 1 = most recent, to 5 = most decayed. This scheme was used in our study of log input and decomposition in a 450 yr old stand in western Oregon. The numbers of Douglas-fir logs by decay class were 27, 15, 21, 39 & 128 logs/ha. Log biomass by decay class ranged from 324 to 15 mt/ha, for a total of 587 mt/ha for all all classes. Estimated log input rates varied from 0.76 to 2.32 (mean = 1.33) logs/yr/ha. Mean wood density by decay class ranged from 543 to 151 mg/cc; one-half of the original density was reached in approximately 94 yr residence time. A decay rate of k = -0.0074 was obtained using the exponential decay model. With this and other data on Douglas-fir decomposition we found a correlation of decay rate as a function of surface to volume ratio (r = 0.99) using the power function model.

Trends in the structural organization of an early successional system: The Devon Project. EDWIN R. SQUIERS, Department of Biology, Taylor University, Upland, Indiana 46989......The organizational dynamics of an early secondary succession system were studied on experimental plots at the Waterloo Mills Field Research Station, Devon, PA. Data were obtained by intensive sampling of replicated subplots within a randomized complete block design containing a control (natural revegetation) and treatments (supplemental seeding of 15 and 34 species of local "weeds"). Univariate and multivariate analytical techniques were used to evaluate presence-and-absence, frequency, and cover data collected annually for six years (1964-1969) after fallowing. The results indicate that the

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structural organization of this system may be described as three intergrading phases: Phase I, a period of temporally associated populations of annuals; Phase II, a period of temporal/spatial discontinuity; and Phase III, a period of spatially associated populations of herbaceous and woody perennials. The recognition of the temporal/spatial shift in community organization as well as other trends in these data suggest that several commonly held assumpions relating to the study of secondary succession are invalid.

Restoration of Eutrophic—Evaluation of Fly Ash as a Bottom Sealant. RICHARD W. GREENE*, DAVID F. SPENCER, QUENTIN E. ROSS, HUNG-YIU YEUNG and THOMAS L. THEIS._____For the past several years, the Departments of Biology and Civil Engineering at Notre Dame have been involved in an interdisciplinary project designed to determine the usefulness of fly ash as a bottom sealant during lake restoration treatments. Lake Charles East, an eutrophic lake in northeastern Indiana, was treated with lime in order to precipitate phosphates from the water column. Following the liming, a two-inch layer of fly ash was applied to the lake bottom in order to seal the sediments and retard phosphate regeneration back into the water. In the two years since the lake treatment positive changes have been noted in both the physical and biological properties of the site.

The study was supported by Grant #R801245 from the U.S. Environmental Protection Agency.

Determination of Trace Elements in Indiana Air and Sludge Samples, Using Neutron Activation Analysis. CRAIG CAUPP, EVA LIU, and TOUFIQ A. SIDDIQI, School of Public and Environmental Affairs, Indiana University, Bloomington, Indiana.....A major advantage of using neutron activation analysis is the ability to determine the concentrations of several elements with only one set of measurements. Using the research reactor at the University of Missouri, Columbia, we have determined the concentrations of Ag, Au, Ce, Co, Cr, Cs, Cu, Eu, La, Sb, Sc, Ta, V, and Zn in sludge samples from Bloomington and Warsaw (Indiana) as well as amounts of Al, Br, Ca, Cl, Co, Cr, Cu, Fe, Mn, Na, Sc, Ti, V and Zn in an Indianapolis air sample. These results are compared to data obtained elsewhere in the nation, and their health implications are discussed.

Determination of Primary Production in Four Borrow Pit Lakes in East-central Indiana. BYRON G. TORKE and BRADLEY J. HALL, Department of Biology, Ball State University, Muncie, Indiana 47306......During 1976, gross primary production values were determined for four borrow-pit lakes located in Delaware and Grant counties along state highway I-69. Oxygen evolution was measured for various depths utilizing the light-dark bottle method. Chemical parameters and plankton populations were also assessed, and their relations to pond productivity are discussed. Frequent wind mixing of these shallow ponds is probably a major factor affecting productivity. In general all four ponds showed moderate to high production values, indicating that production values are more than adequate to support fish populations for recreational fishing use.

Frozen Chironomid Larvae as Food in Feeding Experiments with Bluegills. T. S. MCCOMISH, Department of Biology, Ball State University, Muncie, Indiana

47306 and R. O. ANDERSON, Missouri Cooperative Fishery Research Unit, University of Missouri, Columbia, Missouri 65201.____Large quantities of chironomid larvae were collected from a sewage lagoon, cleared of debris, and frozen for use in fish feeding experiments. Bluegills (*Lepomis macrochirus*) fed frozen larvae accepted them as readily as live larvae. Changes in the proximate composition of previously frozen larvae soaked in water for 18 hours were insignificant. Size and proximate composition of larvae fluctuated seasonally. Gut contents significantly affected the proximate consumption and energy content of larvae.

A Study of Periphyton Production in the Wabash River. ANNE SPACIE, Department of Forestry and Natural Resources, Purdue University, West Lafayette, Indiana 47907......The production of periphytic algae in the Wabash River near Lafayette, Indiana was measured during three consecutive years. Colonization of attached algae on floating artificial substrates was estimated by chlorophyll-a content. Biomass and species composition of selected periphyton samples were also determined.

Chlorophyll-a production was similar at sites above and below Lafayette during the three periods studied. No seasonal trends were evident between July and November. Typical levels of 4 - 40 mg chlorophyll- a/m^2 were found at Lafayette and at sites 80 miles downstream near Clinton. Production at sites within the town of Lafayette was significantly lower than production at sites further up or downstream. Possible explanations for this suppression, including differences in solar radiation, current velocity, and water quality are discussed.

Impingement at the NIPSCO Michigan city generating Station—Preliminary results and a comparison of analysis methods. MORGAN, D. W.* and L. D. CLINE. 1977.____The Aquatic Behavior Laboratory, as part of the three year project to determine effects of the Michigan City generating Station on fish populations of southern Lake Michigan, conducted a year-long monitoring project of fish impinged on the station's travelling screens. All fish were removed hourly for a 24-hour period every 4th day from December 1975 thru November 1976. There wer then identified to species, weighed, measured, and sexed. Over 30,000 fish of more than 50 species were removed, with the alewife accounting for more than 28,000 individuals, followed by gizzard shad (696), spottail shiner (558), rainbow smelt (89), bluegill (89) and yellow perch (86).

Biological data obtained during this project will be discussed in relation to known fish movements and populations in southern Lake Michigan, and three alternative methods of determining total impact by impingement of power generating stations employing once-through cooling will be presented and compared. Suggestions for analysis of similar future impact studies will be presented.

Factors Affecting Ichthyoplankton Entrainment in the Michigan City Generating Station Condenser Cooling Water System. BEST, C. D.* and D. W. MORGON. 1977.____Analysis of ichthyoplankton entrainment data collected at the NIPSCO Michigan City Generating Station indicates a correlation between temperature changes and density of alewife, carp, and spottail shiner larvae. The plankton sampling program was conducted from 3 May to 23 August, 1976, with the first occurrence of the 3 species found on 27 May when average temperatures of intake and discharge waters were 15.4° C and 20.0° C respectively.

Mean larval densities varied directly with temperature from 12 June to 14 July. The first major increase in the density of carp, alewife and spottail shiner larvae occurred on 16 June when average intake temperature was 21.1° C and average discharge temperature was 27.2° C. The mean density of all larvae dropped sharply on July 26th when water temperatures averaged 24.1° C at the intake crib and 31.7° C in the discharge plume. Thereafter, mean density of larvae varied inversely with discharge temperature changes, with relatively fewer larvae being found when temperatures were above 29.0° C.

No significant correlation was found between larval density and plant flow, rainfall, or barometric pressure.

Fish Communities in the Vicinity of the Michigan City Generating Station— Preliminary results. DAWIS, D. M.* and D. W. MORGAN. 1977._____As part of the three year study to determine effects of the Michigan City Generating Station on fish populations in southern Lake Michigan, a gill net sampling program was started in June 1977. This ongoing project includes four sampling sites designed to delineate differences, if any, in fish community structure due to generating station intake and discharge and/or the Michigan City breakwater system. The sites are being sampled under three wind conditions: less than 5 kts., and greater than 5 kts from the northeast and southwest. Six-hour sets are made during consecutive day and night periods. Gill net mesh sizes range from 1" to 8" (stretched) mesh. All fish are identified to species, weighed, measured (T.L.), and sexed, and concurrent water chemistry data (D.O., temperature, conductivity, and pH) and current data (direction and speed) are taken at start and finish of each set.

Preliminary results indicate differences in community structure due to location and time of day. Analyses of possible correlations with water temperature, chemical and current characteristics, and weather conditions are currently being undertaken and will be provisionally discussed.

Seasonal Distribution of Bythinia tentaculata in Hamlin Lake, Mason County, Michigan. DONALD E. MILLER, Department of Biology, Ball State University, Muncie, Indiana 47306.____Bythinia (Bithynia, Bulimus) tentaculata has been reported in the Great Lakes and associated bodies of water where it probably was introduced from Europe. It is now abundant in Hamlin Lake, Mason County, Michigan.

Observations and collections of these snails were made from June, 1972 to June, 1977. Although winter observations were limited, adults appeared to overwinter on the lake bottom and on various types of supports in water one to two meters deep. Soon after ice-off (March 9, 1973; March 27, 1974; April 17, 1975; March 24, 1976; and March 30, 1977), adult snails migrated to shallow water where they found supports and soon began to deposit eggs: by April 29, 1976 and April 23, 1977. Microscope slides gave the best picture of egg abundance. At the peak of egg deposition, up to 45 egg masses were found on one microscope slide. By early May up to 48 snails were found on two sides of a 25 x 77mm microscope slide. At greatest abundance the snails occupied up to 30 per cent of the surface of some dock posts, microcsope slides, and other supports. At times 90 per cent or more of microscope slide surfaces were covered by snails and snail eggs. The population declined by late August, but even then substantial numbers were found on limited areas of some supports. Snails did not again become abundant on supports until the following spring. Distribution and abundance of *Bythinia* varied in different localities and depths in the lake. An accurate picture of abundance and distribution requires observations at several stations. At times, other species of snails, especially *Goniobasis livescens*, were present at the collection sites.

The Fish Community as an Indicator of Water Quality. J. R. GAMMON, Department of Zoology, DePauw University, Greencastle, Indiana 46135.____Although regulations for water quality standards stress the general goal of maintaining "balanced" aquatic communities, little progress has been made in establishing what a "balanced" aquatic community consists of.

Among a variety of community paramenters based upon electrofishing catches of fish from rivers, a composite index of well-being incorporating relative density, relative biomass, Shannon index of diversity based on numeric data, and Shannon index based on biomass appears to reflect environmental conditions better than any single parameter. Profiles of water quality based upon the composite index are presented for the Wabash River, 200 miles of the Ohio River, and the middle Great Miami River.

Success of the Holdridge Life Zone Model in yielding Potential Evapotranspiration Estimates for U.S. Weather Stations. A. A. LINDSEY, Purdue University.____Biological and physical aspects of the Holdridge life zone model are closely related, but the biological ones have not been persuasively tested against external criteria. However, validation of Holdridge's concept is possible from physical data from an independent method, by comparison of results for potential evapotranspiration between the Holdridge and the (standard) Thornthwaite method. In comparing such results for 300 weather stations scattered through the 50 states, I found a mere 1.65 per cent difference, in the mean of all stations combined, from the corresponding Thornthwaite mean. This results from the canceling out of consistent bias in Holdridge from the Thornthwaite results, in that Holdridge's method overestimated potential evapotranspiration in all four Warm Temperate life zones studied, and consistently underestimated it in the three Cool Temperate and three Warm Temperate Montane life zones. The Holdridge approach has a general tendency to underestimate this value, overall.

Holdridge's procedure, using the 300 stations lumped, was more variable, its coefficient of variability being 33.9 compared with a CV of 27.3 for Thornthwaite. The coefficient of correlation (r) between the two methods was rather good (0.94). In a breakdown by life zones, five of the major zones had rvalues of 0.96 through 0.99. These statistical results, though showing that Holdridge's method is inferior to Thornthwaite's for potential evapotranspiration, furnish strong physical or climatological confirmation of the basic concept of Holdridge's system overall.

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Evaluation of a Ruffed Grouse Reintroduction in Northern Indiana, SEAN T. KELLY* and CHARLES M. KIRKPATRICK, Department of Forestry, Purdue University, West Lafayette, Indiana 47907.____Throughout northern Indiana, in the late 1800's and early 1900's, once substantial ruffed grouse (Bonasa umbellus) populations were extirpated by intensive agriculture. Land abandonment and public land purchases have recently produced potentially suitable grouse habitat, and since 1952 the Indiana Department of Natural Resources has attempted to restore the species to part of its former range. One reintroduction was made at Jasper-Pulaski Fish and Wildlife Area, where 89 wild-trapped birds were released in the falls of 1970 and 1971. This study evaluated the success of that reintroduction. Drumming counts conducted during the springs of 1976 and 1977 revealed 14 and 20 drumming activity centers, respectively. Density estimates derived from seasonal strip censuses ranged from 6-31 birds per 100 hectares. Flush counts indicated that birds used the upland hardwood-brush type during all seasons except winter when the birds moved to the lowland woody community, possibly because of changes in food availability. Reproduction was suggested in 1977 by the capture of three unbanded drumming males, and confirmed by the sighting of five broods during the summer field season. The ruffed grouse appears to be the established on this area, and the success of this reintroduction indicates that restocking is a viable means of reestablishing the ruffed grouse in other forested portions of northern Indiana.