

## ECOLOGY

Chairman: THOMAS S. McCOMISH, Ball State University  
JAMES R. GAMMON, DePauw University, was elected Chairman for 1970

### ABSTRACTS

**The Annual Growth Cycle of the Bluegill.** THOMAS S. McCOMISH, Ball State University, and RICHARD O. ANDERSON, University of Missouri.—Continuous growth experiments were conducted from fall 1965 through 1967 with bluegill, *Lepomis macrochirus*, under similar natural seasonal photo-periodicity and temperature fluctuations to those occurring in ponds near Columbia, Missouri. Each fish was isolated in an aquarium and fed frozen chironomid larvae in excess. Growth in length and weight; food consumed; conversion efficiency of live, dry, and protein weights; and caloric energy were measured monthly.

Growth of yearling bluegill increased steadily from March to a peak in June and July followed by a steady decline to a low in December. Food consumed followed a similar pattern. Growth of two-year-old sexually mature bluegill started in March, peaked in May, decreased steadily to a low in July, followed by a steady increase to a second peak in September, and decreased to a low point in November. Food consumed and conversion efficiencies followed similar patterns.

The mid-summer slump in growth for two-year-old bluegill was correlated with temperature. The May and September growth peaks occurred at 20 to 22° C and the mid-summer low at about 27° C. Metabolic rate was implicated in the growth cycle as a function of temperature, season, size, and perhaps sexual maturation in preparation for spawning.

**The Effect of Photoperiod on Growth of Bluegill.** PAUL G. DAVIDSON and THOMAS S. McCOMISH, Ball State University.—Growth experiments were conducted with bluegill, *Lepomis macrochirus*, for 102 days under 3 different photoperiods at 26° C. One photoperiod increased from 15.50 to 19.78 hours daily, another decreased from 15.50 to 12.25 hours daily, and a third was held constant at 15.50 hours daily. Growth, food consumption (mealworms, *Tenebrio molitor*), and food conversion efficiency were evaluated for bluegill in each set of conditions.

Under the conditions used in this experiment there was no apparent effect of photoperiod on the growth of bluegill. This was true for all measurements of growth in length, growth in weight, food consumption and food conversion efficiency. It was also true when males and females were compared for each of these measurements.

These results were not expected. A possible explanation is that the relatively high temperature of 26° C increased metabolism enough to mask the effects of photoperiod.

**The Response of Fish to Heated Effluents.** JAMES R. GAMMON, DePauw University.—The specter of temperature elevation of surface waters due to electric generating stations has caused great concern to aquatic ecologists because of projected construction estimates. The distribution and abundance of adult fish in two three-mile segments of the Wabash River have been studied since 1967. One site is bisected by an 860 megawatt station, while the other will receive heated effluents beginning in 1970.

During normal summer flows the temperature of the effluent was about 7° C higher than the river water. Complete mixing was achieved about  $\frac{3}{4}$  mile below the effluent jetty at which point the temperature was about 4° C higher. Some species populations were estimated by mark-and-recapture techniques using hoop nets and electrofishing apparatus, but for most species only relative indices of abundance based on catch data could be obtained.

Consistent differences in the distribution patterns were noted for some species which seemed related to temperature. Species which tended to avoid the heated water included northern river carpsucker (*Carpiodes carpio carpio*), golden redhorse (*Moxostoma erythrurum*), shorthead redhorse (*M. breviceps*), spotted bass (*Micropterus punctulatus*), long-ear sunfish (*Lepomis megalotis megalotis*), and sauger (*Stizostedion canadense*). Species which were significantly more abundant in the heated water included carp (*Cyprinus carpio*), buffalo fish (mostly *Ictiobus bubalus*), gar (*Lepisosteus osseus* and *L. platostomus*), channel catfish (*Ictalurus punctatus*) and flathead catfish (*Pilodictis olivarius*).

**Preliminary Experiments on Growth of Bluegill with Varied Feeding Frequency and Constant Ration.** THOMAS E. MANGUM, III and THOMAS S. MCCOMISH, Ball State University.—Growth of bluegill, *Lepomis macrochirus*, in length and weight, and food conversion were compared between groups of fish fed once and three times daily. Daily ration and environmental conditions were constant between groups. Groups fed three times daily showed greater growth and conversion efficiencies in most cases. Differences, however, were small and not significant.

**The Relationship Between Growth and Social Hierarchy in the Green Sunfish.** RUTH A. WILSEY and THOMAS S. MCCOMISH, Ball State University.—Growth in weight and length, and food conversion efficiencies were compared between similar sized control and paired female green sunfish (*Lepomis cyanellus*) in aquaria. Growth was related to hierarchy. Prior residence and size were major factors in hierarchy establishment. Interaction between paired fish stimulated growth and food consumption to an optimal level beyond which a decline was observed. Control and paired fish grew more than subordinate fish. Control fish converted food more efficiently than paired fish. Social interaction resulted in the death of four subordinate fish. This was related, at least in part, to elevated maintenance levels and food consumption reductions. Growth and conversion efficiency of dominant fish after the death of subordinates improved in direct relation to the length of the recovery period.

**A Taxonomic Survey of the Ostracods of Delaware County, Indiana.** DANIEL R. GOINS, Ball State University.—A survey of ostracods (Class Crustacea, Order Ostracoda) was taken throughout Delaware County, during May and June, 1968. One hundred random samples were taken from creeks, drainage ditches, farm ponds, temporary streams and ponds, and rivers in this county. A bottom dredge net was used to sample bodies of water, and collections were preserved in 50% alcohol in pint jars.

Sixty-two% of the samples contained ostracods. Many of these ostracods were dissected in the laboratory and mounted in permanent media on microscope slides. The ostracods were then identified and recorded. Comprehensive surveys of ostracods have been made in Ohio and Illinois, but only one collection previously had been reported from Indiana. This study increased the known Indiana genera from 3 to 19 and revealed several new species. Names and descriptions of these new genera and species will be published in the near future.

**The Influence of Environmental Factors on the Concentration of Hydrocyanic Acid in *Manihot esculenta*.** ROBERT D. HART and WM. B. CRANKSHAW, Ball State University.—Manioc or yuca (*Manihot esculenta*), a common cultigen of milpa agriculture in the tropics, varies from site to site with respect to the concentration of hydrocyanic acid in the tubers.

A short term study was conducted to determine the possibility of a correlation between acid concentration and microclimatic factors. A site was selected on the edge of the Amazon Basin in the rain forest of eastern Ecuador to conduct the study.

Microclimatic factors were measured at 7 stations along a 60 m transect through a milpa of manioc. These factors included insolation, precipitation, air temperature, soil temperatures, and soil moisture. At the termination of the field study, the manioc plant closest to each station was removed and assayed for hydrocyanic acid content. Soil samples were also taken at each station and analyzed for percent nitrogen, phosphate and potassium.

Regression analysis indicated that the highest correlation existed between insolation and temperatures and acid content. Enzyme action converting cyanogenetic glucoside to hydrocyanic acid seems to be inhibited by the stress situation of high air and soil temperatures.

**A Comparison of Dominance Expressions for Tree Species in Foley Woods, Edgar County, Illinois.** M. T. JACKSON, Indiana State University, and R. O. PETTY, Wabash College.—Foley Woods is a 120-acre stand occupying a till plain depression just north of the Wisconsin terminal moraine. The diverse stand (39 tree species) is notable as a western edge outlier of American beech near the prairie border. Sugar maple, red oak, bur oak, white oak, shellbark hickory, white and green ash, and basswood lead in importance.

Canopy openings created by selective cutting of large trees have allowed sugar maple and elm to increase greatly in density in the smaller size classes. High densities of small trees give these species a two-

factor importance value index (the average of relative density and relative basal area) disproportionately higher than their actual contribution to stand dominance.

To evaluate this disparity, a 10% sample of the south 80 acres was tallied by taking forty 1/5-acre line strips (200 × 43.56 feet). All trees over 2 inches dbh were recorded and line-intercept crown cover was determined for each plot. Density, frequency, basal area, cover, average diameter and average basal area were determined for each species. Various two-, three- and four-attribute importance value indices, and other synthetic indices were examined. The indices were weighed against relative cover to determine which integrating expressions best reflect the contribution of each species to total stand dominance. A Density-Double Dominance Index in which relative density plus relative basal area weighted twice were averaged

$$\left( \frac{D_3 + B_3 + B_3}{3} \right)$$

gave the best approximation of importance. Relative basal area alone was the next most accurate expression, followed by the four factor index (the average of the relative values of density, basal area, frequency and cover).

**Testing the Quarter Method against Full Tallies in Old-growth Forests.** DAMIAN SCHMELZ, St. Meinrad College.—The quarter method, although used with good results by workers interested in the general characteristics of many stands, has been criticized for its bias for species tending toward clumped dispersal, for the amount of work involved in office computations of vegetational attributes, for the difficulty in computing standard error, and for its relative field-inefficiency when compared with other rapid sampling methods. A further criticism of the accuracy of the quarter method results from a comparison of data obtained by this method with that obtained by full tallies in seven old-growth stands in Indiana. The stands ranged in size from 4 to 21 acres. Two or three quarter point samples were obtained for each stand, giving a total of 17 samples for comparison. The number of points in each sample averaged two per acre. The quarter method consistently overestimated the stand basal area, from 1.0% to 99%, averaging 39%. Stand density was overestimated in most samples, by as much as 60%. Of the total number of species in each stand, from 43% to 73% were recorded by the samples. One of the five most important species was missed in five samples, and the order among them was different in ten samples. In one sample the most important species was different, and in six samples the second most important species was different. The quarter method is not judged useful for any detailed analysis of hardwood forests.