1866

ytes. Other studies at our laboratory indicate that the complete removal of all macrophytes with herbicides may result in reduced biomass of fish in lotic ecosystems.

1:50 BOYLE, TERENCE P. Columbia National Fisheries Research Laboratory, Columbia, MO. **Changes in structure and function of aquatic invertebrate communities due to insecticide stress.**

Twelve replicate outdoor experimental ponds were used to study experimental perturbation of the invertebrate community. Four ponds were treated biweekly with 10 μg/l of the chitin inhibiter, dimilin; four ponds were treated monthly; and four were left untreated as controls. Samples taken weekly for 14 weeks after beginning treatments showed planktonic chlorophyll *a*, gross primary production, ^{14}C uptake and algal nitrogen fixation all increased in ponds treated with insecticide due to removal of the zooplankton community. Concentrations of nitrogen and phosphorus were also greater in ponds treated with insecticide and there were different patterns of nutrient cycling between the control and treated ponds. However, despite the greater photosynthetic energy fixation in the treated ponds the total production of bass and bluegill sunfish was considered reduced relative to the control ponds. There was a differential pattern of reproduction between the two species of fish.

2:10 KARR, JAMES R. University of Illinois, Champaign. **Perturbation and the structure of warm water fish communities.**

From the smallest streams to the largest rivers, man's activities have had profound, and usually negative, influences on freshwater fishes. Some negative effects are due to contaminants, while others are associated with changed watershed hydrology, habitat modifications and altered dynamics of energy sources for the aquatic biota. In the Maumee River, major changes in the fish community during the last 150 years include population increases, decreases, extinctions and introductions. The success or failure of individual species can be traced to their tolerance of shifts in the factors noted above. Regrettably, past efforts to evaluate effects of man's activities on fishes have attempted to use water quality as a surrogate for more comprehensive biotic assessment. A more refined biotic monitoring program is required for effective protection of freshwater fish resources.

2:40 RECESS.

2:55 HALL, RONALD. Cornell University, Ithaca, NY. **The role of aluminum in altering the structure and function of aquatic ecosystems.**

A series of experiments were conducted in May 1980 to determine the effect of short-term hydrogen ion and aluminum perturbations on the chemistry and biology of dilute mountain streams. Hydrochloric acid (HCl) and aluminum chloride ($AlCl_3$) were experimentally added separately to different stream orders in the Hubbard Brook Experimental Forest. The experiments were designed to simulate short-term snowmelt episodes during spring. Calcium, Mg and Al were mobilized in the stream water in the experimental sections of all three stream orders, while free fluoride decreased significantly in the same areas. Sodium, NO_3, NH_4, SO_4 and PO_4 were not changed above and below the HCl or $AlCl_3$ perturbations. Our experimental results show that at a pH range (5.25–5.5) that did not elicit a behavioral response of aquatic invertebrates with HCl addition, $AlCl_3$ addition did produce a behavioral response. Therefore, dynamic fluctuation of aluminum chemistry at a pH range (5.2–5.5) that can be tolerated by most aquatic biota may be a primary factor in the alteration of community structure, metabolism and biogeochemistry of poorly buffered aquatic ecosystems.

3:25 GREGORY, STAN. Oregon State University, Corvallis. **Sublethal effects of arsenic on the migration of coho salmon.**

Juvenile coho salmon were exposed to sublethal concentrations (0, 10, 30, 100, 300 $\mu g\ l^{-1}$) of arsenic trioxide for 180 days. Approximately 500 fish from each treatment were tagged and released into a third-order stream on the Olympic Peninsula at a point 4.6 km upstream from the estuary. Downstream migrants were trapped in a weir 100 m upstream from the estuary. Migration was monitored for 33 days; after that time, the upstream section was electroshocked for residual fish. Total outmigration of coho salmon in the 10 ppb, 30 ppb, 100 ppb, and 300 ppb treatment groups was 92%, 88%, 94% and 83% of the migration of the control group, respectively. These observations are discussed in relation to biochemical patterns observed by cooperating researchers. Measurement of outmigration provides a valuable field tool for validation of laboratory assessments of effects of contaminants on smoltification of anadromous salmonids.

3:45 HAWKINS, CHARLES. Oregon State University, Corvallis. **Canopy removal and sediment accumulation perturbation in Northwest streams.**

Modification of riparian canopies and accumulation of fine sediment in streams are two man-induced perturbations that are ubiquitous in watersheds of the Pacific Northwest. Results from a two-year field study show that both sediment concentration and degree of shading affect structure, functional character and abundance of invertebrate communities and production of vertebrate populations. Although invertebrate community structure was not always clearly correlated with presence or absence of a canopy, functional character was. Production and abundance of the vertebrate fauna were related to shifts in

functional organization and abundan
invertebrate herbivores and greater l
both invertebrate and vertebrate abu
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found for some vertebrate species bu

4:15 DAVIS, CRAIG and **ARNOL**
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Wetland ecosystems can be pert
hot water; 2) by harvesting plant and
by draining, filling, ponding, substra
primarily on the recovery of wetlands
that determine the severity of a pertur
magnitude and duration of the perturb
3) the location of the ecosystem (i.e.
extant wetland species, 5) the density
wetland species, 7) the characteristics
source.

4:45 DISCUSSION

SESSION 8. Symposium: Theor
(Part 2). Organized and co
Affairs, Indiana University, Bl

1:00 KUNZ, THOMAS H. and **EDY**
persal and foraging behavio

Seasonal changes in nightly dispe
expected changes in energy demands
with bats feeding most often in the rich
a variety of insects, taking them in pro
unpredictable, and more selectively w
reflected the relative energy demands
varied with moon phase, ambient tem
giving-up time is prompted by low forag
on cool nights with a bright moon, or b

1:40 CAMERON, GUY N. and **W. B**
patch utilization by the cotto

Movement through a mosaic of pa
lyzed by livetrapping and radiotracking.
as good, average and poor quality on th
in conjunction with plant species com
countering each patch type and of an i
which patch type was currently occupi
mined. It was hypothesized that individ
aging) within good quality patches but
patches. Results from this study are us
in this species.

2:20 BATZLI, GEORGE O. Universi
nization of herbivores.

Nutritional adaptations determine
energy from plants. Both the ability of h
plants in relation to daily nutritional re
Simple cost-benefit arguments indicate
the constraint of time available for the
smaller herbivores to use more-digestibl
Once herbivores have developed food p
in the enforcement of dietary choice b
habitats within a community of closely r
current competitive interactions. The
points.

3:00 RECESS.

3:20 CODY, MARTIN L. University o
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ebrate fauna were related to shifts in

functional organization and abundance of the invertebrate community: open sites consistently had more invertebrate herbivores and greater biomass of vertebrates than shaded sites. Among shaded streams, both invertebrate and vertebrate abundances were negatively correlated with percent fine sediment (<1 mm). Among streams with no canopy, significant correlations between sediment and abundance were found for some vertebrate species but not for total invertebrates or total vertebrates.

4:15 **DAVIS, CRAIG** and **ARNOLD G. VAN DER VALK.** Iowa State University, Ames. **Factors contributing to the recovery of wetland ecosystems from man-induced perturbation.**

Wetland ecosystems can be perturbed by 1) the addition of pollutants, nutrient-enriched water, or hot water; 2) by harvesting plant and/or animal biomass; and 3) by altering normal hydrologic dynamics by draining, filling, ponding, substrate mining or water depth stabilization. This presentation focuses primarily on the recovery of wetlands from perturbations that result in changes in water depth. Factors that determine the severity of a perturbation and the response of the wetland community include: 1) the magnitude and duration of the perturbation, 2) the hydrologic conditions at the outset of the perturbation, 3) the location of the ecosystem (i.e. latitude, elevation, physiography, etc.), 4) the growth form of the extant wetland species, 5) the density of the vegetation, 6) the life history characteristics of the individual wetland species, 7) the characteristics of the wetland seed bank, and 8) the availability of a suitable seed source.

4:45 **DISCUSSION**

SESSION 8. Symposium: Theoretical and Empirical Analysis of Feeding and Foraging (Part 2).

Organized and convened by **J. C. RANDOLPH,** School of Public and Environmental Affairs, Indiana University, Blooming, IN 47405 (Tel. 812/337-9485). **CHEMISTRY 122.**

1:00 **KUNZ, THOMAS H.** and **EDYTHE L. P. ANTHONY.** Boston University, Boston, MA. **Nightly dispersal and foraging behavior of an insectivorous bat.**

Seasonal changes in nightly dispersal of bats (*Myotis lucifugus*) from a daily refuge coincided with expected changes in energy demands and prey dispersion. Resource patches were exploited optimally, with bats feeding most often in the richest patches (pond edges and near the water surface). Bats fed on a variety of insects, taking them in proportion to their abundance when insect abundance was low and unpredictable, and more selectively when insect abundance was high. The amount of food consumed reflected the relative energy demands of pregnancy and lactation, but the length of foraging periods varied with moon phase, ambient temperature and insect abundance as well. Our data suggest that giving-up time is prompted by low foraging success, high energy cost of flight, high risks from predation on cool nights with a bright moon, or by satiation on warm nights during the dark phase of the moon.

1:40 **CAMERON, GUY N.** and **W. BRADLEY KINCAID.** University of Houston, Houston, TX. **Resource patch utilization by the cotton rat.**

Movement through a mosaic of patch types by the hispid cotton rat (*Sigmodon hispidus*) was analyzed by livetrapping and radiotracking. Encounter, evaluation and utilization of resource patches (defined as good, average and poor quality on the basis of nutrient composition of resouce plants) were evaluated in conjunction with plant species composition and dispersion of each patch type. Probabilities of encountering each patch type and of an individual moving to any of the other patch types depending upon which patch type was currently occupied were determined. Movements within patches were also determined. It was hypothesized that individuals would move in a localized, multi-dimensional fashion (foraging) within good quality patches but in a linear, unidirectional fashion (searching) within poor quality patches. Results from this study are used to explain the non-random habitat distribution which occurs in this species.

2:20 **BATZLI, GEORGE O.** University of Illinois, Urbana. **Nutritional ecology and community organization of herbivores.**

Nutritional adaptations determine the rate at which herbivores can harvest usable nutrients and energy from plants. Both the ability of herbivores to process particular plants and the availability of the plants in relation to daily nutritional requirements of the herbivore influence the selection of forage. Simple cost-benefit arguments indicate that herbivores should maximize net energy/nutrient gain within the constraint of time available for their foraging. Although theoretical relationships seem to require smaller herbivores to use more-digestible food, empirical data do not necessarily support this conclusion. Once herbivores have developed food preferences, adaptations for improved use of that diet may result in the enforcement of dietary choice by characteristics of the plants. Thus, partitioning of food and habitats within a community of closely related species can result from nutritional adaptations rather than current competitive interactions. The example of microtine rodents in arctic tundra illustrates these points.

3:00 **RECESS.**

3:20 **CODY, MARTIN L.** University of California, Los Angeles. **Foraging patterns and bird communities.**