

ZOOLOGY

Chair: JOHN S. CASTRALE
Forest Wildlife Office
R.R. 2, Box 477
Mitchell, Indiana 47446

Chair-Elect: TIMOTHY J. BURKHOLDER
Department of Biology
Taylor University
Taylor, Indiana 46989

ABSTRACTS

Use of Artificial Nest Sites by Spottail Darters. JAMES H. BANDOLI, Department of Biology, University of Southern Indiana, Evansville, IN 47712.—The spottail darter (*Etheostoma squamiceps*) is limited to a few small streams in Posey and Vanderburgh Counties. Previous studies suggest that the patchy distribution and generally low population densities seen in this species are due in part to a lack of suitable nesting sites (rocks or other large solid debris). To test this, between 10 and 20 half-cylinder sections of ceramic field tile were added as nest sites to the experimental halves of six stream sections. Each station was censused bi-monthly from March 10 through May 23 for spottail darter nests. Of the 386 spottail darter nests found during the study, 122 (31.6%) were under tiles. The average nest contained 368.6 eggs, and tile nests and rock nests did not differ significantly in egg content. At least half the nests contained multiple clutches, and the smaller average nest size found in experimental areas suggests that the increases in nest availability may have allowed a decrease in the degree of polygyny. Densities of spottail darters did not correlate with the number of nests at each station, suggesting the possibility of local migration to and from breeding areas.

The Role of Visual Cues in the Reproductive Behavior of the Cichlid Fish *Astronotus ocellatus*. SIMON C. BEECHING, Department of Biology, Indiana University, Bloomington, IN 47405.—Visual cues, such as body size or color pattern, may be used by animals to assess potential mates or rivals, and thus serve a signal function in intraspecific interactions. The behavioral significance of body size and of two aspects of color pattern in the cichlid fish *Astronotus ocellatus* was examined by presenting isolated adults with dummy conspecifics. As predicted, subjects spent more time interacting with, and directed more display behaviors toward, larger dummies. Frequencies of overt attack behaviors were not affected by dummy size. The dark-bar color pattern associated with juveniles and with defeated or frightened adults elicited fewer aggressive charges than the normal adult color pattern, suggesting it may serve an aggression inhibiting function. The species-typical ocellus on the caudal peduncle was shown to affect the spatial distribution of bites, and apparently functions as a target for bites in aggressive interactions.

Vagal Postganglionic Pathways to the Sinoatrial Node of the Dog Heart. K.M. BLUEMEL, M. DUFF, M. O'TOOLE, W.C. RANDALL, and R.D. WURSTER, Physiology and Biology Departments, Loyola University, Chicago and Taylor Univer-

sity, Upland, IN 46989.—Vagal ganglion cells which innervate the canine sinoatrial node (SAN) are located in the fat pad overlying and surrounding the right pulmonary vein complex (PVFP). Postganglionic fiber pathways from PVFP to SAN remain to be elucidated. A small bipolar stimulating electrode was applied to the ventral epicardial right atrium (RA) while recording from pickup electrodes on RA and right ventricle (RV). A third electrode pair was sutured to RA for pacing, and A-V conduction time was determined during simultaneous vagal stimulation and rapid atrial pacing. To prevent excitation of the atrium, stimulation was triggered during the RA refractory period. Response maps of stimulus-induced inhibition in rate were made by moving the stimulating electrode, both before and after hexamethonium into PVFP. Ganglionic blockade was evaluated by comparing rate and A-V intervals during vagal stimulation. The research confirms that ganglia in PVFP control SAN rate but *not* AVN conduction. Regulatory postganglionic fibers course directly from ganglia situated in PVFP across atrial myocardium and sulcus terminalis to SAN.

Population Response of Small Mammals to Emergence of Periodic Cicadas.

THEODORE J. COUILLARD, JOHN C. RIDDLE, and DAVID T. KROHNE, Department of Biology, Wabash College, Crawfordsville, IN 47933.—In west-central Indiana, periodic cicadas emerged during the summer of 1987. We studied the population responses of two species of small mammals, the short-tailed shrew (*Blarina brevicauda*) and the white-footed mouse (*Peromyscus leucopus*), in old growth deciduous forest at Allee Memorial Woods field station in Parke County. Density estimates were made on a 3 hectare live-trapping grid using the direct enumeration method and compared with data obtained from the previous eight years when synchronous emergence of cicadas did not occur. Shrew densities in the forest were an order of magnitude higher in the year of cicada emergence than had been recorded in the previous years. There was no apparent effect on densities of white-footed mice. The effects of abundant insect prey on survivorship of the two species and reproduction will be discussed.

***Pseudosuccinea columella*, a Natural Host of *Schistosomatium douthitti* in**

Indiana. DAVID L. DANIELL, Department of Biological Sciences, Butler Univ., Indianapolis, IN 46208.—*Schistosomatium douthitti* (Cort, 1914) Price, 1931 is one of two species of mammalian blood flukes found in North America. During June of 1988, one of 18 *Pseudosuccinea columella* collected along the north shore of Crooked Lake in Noble Co., Indiana was found to be infected with *S. douthitti*. Cercariae emerging from the infected snail were found to be identical in structure and behavior to those of *S. douthitti*. Adult male *S. douthitti* were recovered from the mesenteric veins of two laboratory mice (*Mus musculus*) 33 days and 59 days after exposure to these cercariae. This is the first record of *S. douthitti* in Indiana, and it is the first record of a natural infection of this blood fluke in the snail, *Pseudosuccinea columella*.

Selective Vagal Innervation of Sinoatrial vs. Atrioventricular Nodes in the

Rat Heart. KEVIN W. FIRTH, STEVEN K. HUPRICH, WALTER C. RANDALL, and TIM BURKHOLDER. Biology Department, Taylor University, Upland, IN 46989.—Vagal innervation of sinoatrial (SAN) and atrioventricular (AVN) regions of the rat heart has not been detailed; regulation of cardiac automaticity and conductivity requires further study. In 31 anesthetized (Nembutal, 40 mg/kg) adult animals, electrical stimulation (20 Hz-2.0 msec-3.0-5.0 v) before and after selective surgical excision of ganglia were discretely located in four different sites (Pardini,

JANS 20:91-101, 1987). Electrical potentials were recorded from right atrium, right ventricle, and ECG during vagal stimulation without, and with, atrial pacing. In contrast to vagal innervation of the canine heart, the anatomical course of right and left vagi into SAN and AVN are quite different. Each can be restrictively interrupted by surgical or chemical intervention, producing differential influences upon SAN (automaticity) versus AVN (conductivity) parameters of performance. Selective ablation of one (of four) epicardial fat pads deletes definable portions of cardiac regulation.

Effects of Lead Shot Ingestion on Mortality, Body Weight, and Concentrations of ALAD and Blood Lead in Mourning Doves. JOHNSON HO, MARK OSTER, Department of Life Science, Indiana State University, Terre Haute, IN 47809 and John S. Castrale, Indiana Division of Fish & Wildlife, R.R. 2, Box 477, Mitchell, IN 47446.—Mortality due to ingesting spent lead shotgun pellets has been documented in mourning doves (*Zenaida macroura*). Our objectives were to measure the effects of lead shot ingestion on mortality rates, body weights, and concentrations of lead and the enzyme delta-aminolevulinic acid dehydratase (ALAD) in dove blood. Groups of 5 male and 5 female adult doves were dosed with 0, 1, 2, or 4 #8 lead pellets and monitored prior to dosing and 1, 5, 9, 14, 21, and 28 days after dosing. Three doves died (10% of dosed birds) during the experiment. Weight losses were related to the number of shot ingested, but survivors regained weight after passing shot by day 28. ALAD levels declined from 95-99% within 24 hours after dosing and increased only slightly by day 28. Lead levels are currently being analyzed.

Status and Distribution of the Great Blue Heron in Indiana. GEORGE C. IVERSON, Indiana Department of Natural Resources, Division of Fish and Wildlife, 3900 Soldiers Home Road, West Lafayette, IN 47906.—A statewide survey to monitor the status and distribution of great blue heron nesting colonies throughout Indiana was conducted by the Indiana Nongame and Endangered Wildlife Program in 1987. The purpose of this paper is to report the results of the 1987 Biennial Great Blue Heron Survey and compare these data with the previous 2 statewide surveys conducted in 1983 and 1985. A total of 58 active great blue heron nesting colonies were identified in 1987. The average colony size was 70.5 nests (SE = 10.2, range 1-395 nests/colony). Over 30% of all great blue heron nests (N = 4090) in Indiana occurred in 5 colonies in 1987. More colonies (N = 23) occurred in the Great Lakes Plain physiographic region ($\bar{X}$ = 13.8, df = 2, $P < 0.01$) and fewer (N = 12) colonies were found in the southern Lexington Plain/Highland Rim region. The overall status of the great blue heron in Indiana improved from 1985 to 1987 with an increase in both the total number of active colonies and average colony size (N = 51 colonies, $\bar{X}$ = 56.1 nests/colony in 1985). Conservation strategies are discussed.

Does Pretesting With Norepinephrine Affect the Response of Arterial Smooth Muscle to Vasopressin *In Vitro*? THOMAS A. LESH, Muncie Center for Medical Education, Ball State University, Muncie, IN 47306.—Prior to dose-response studies of hormone effects on isolated smooth muscle tissue, it is useful to test the viability of the preparation with a standard stimulus that will not alter the outcome of the study. The suitability of norepinephrine for such pretesting, as applied specifically to studies of arginine vasopressin (AVP), was evaluated in 8 pairs of arterial rings from Sprague-Dawley rats. Rings dissected from the abdominal aorta, with endothelium removed, were connected to isometric force

transducers and maintained in baths of oxygenated Krebs bicarbonate solution. One ring of each pair was exposed to norepinephrine, 5×10^{-6} M; after this was washed out, cumulative dose-response curves for AVP were obtained on both rings. No significant differences could be shown between the responses of the 2 series of rings, and a correlation was found between the magnitudes of the standard norepinephrine and maximal AVP responses ($r = .915$; $P < 0.01$).

Serologic Relationships of the Rattlesnakes. SHERMAN A. MINTON, Indiana University School of Medicine, Indianapolis, IN 46223.—Antiserum against serum albumin of the rattlesnake *Crotalus viridis* was reacted against plasma samples from 16 other species of rattlesnakes, 11 pit vipers of 6 other genera, 6 species of *Vipera*, and 57 other species of snakes belonging to 9 families and 50 genera. Ouchterlony tests were used for screening samples. Species whose plasma gave a positive reaction at a concentration of 75 mcg/ml or less were further evaluated using radial immunodiffusion. Serologically rattlesnakes form a tight group with *Sistrurus miliarius* and *Crotalus horridus* most divergent. *Agkistrodon* (3 Asian and 3 American species) and the Asian *Deinagkistrodon* are rattlesnakes' closest serologic relatives followed by the neotropical *Bothrops asper*, *Hypnale* of Sri Lanka, and the 6 Eurasian species of *Vipera*. Most remote of the viperids are *Trimeresurus albolabris* and *Calloselasma rhodostoma* of southeast Asia. Plasmas of primitive snakes such as boids were nonreactive even at the highest concentrations used. Plasmas of the more advanced colubrids and elapids usually gave cross reactions at higher concentrations but few were reactive at 75 mcg/ml or less.

Dominance Interactions Among Familiar and Unfamiliar Dark-eyed Juncos. AMY MOORE and DORIS J. WATT, Department of Biology, St. Mary's College, Notre Dame, IN 46556.—We captured dark-eyed juncos (*Junco hyemalis*) from three different flocks in different areas around South Bend, Indiana, in March 1988. We combined experimental flocks composed of six birds from the same flock, "familiar," and six birds from another flock, "strangers," and introduced them into large indoor aviaries. Avoidance and attack behavior patterns of these groups are best explained using the sex-signalling hypothesis of plumage coloration.

Development of Osteoporosis in Ovariectomized Sprague-Dawley Rats. NANCY P. NEKVASIL and ANNA D'AMICO, Biology Department, Saint Mary's College, Notre Dame, IN 46556.—Ovariectomized Sprague-Dawley rats given various therapies were followed for a period of three months in order to examine the loss of bone that occurs with the absence of estrogen. The degree of bone loss varied based on the treatments following ovariectomization. Decreasing density of bone was demonstrated as follows: intact group (with ovaries), ovariectomized rats with estrogen replacement therapy (ERT) and calcium supplementation, calcium supplements alone, ovariectomized with no further intervention (3 months), and long-term post-ovariectomized (9 months) animal. Calcium therapy appears to aid in the delay of bone loss but calcium supplementation with estrogen is more effective. Severe osteoporosis was demonstrated in one animal who had been ovary-free for 9 months (equivalent to 27 human years). This animal had not had any estrogen or calcium supplements. Osteoporosis is visually detectable even by crude methods by 3 months after removal of the major estrogen source. With appropriate treatments soon after loss of ovarian function, it is possible to delay the onset and/or progression of osteoporosis.

The Presence of the Meningeal Worm, *Parelaphostrongylus tenuis* (Nematoda: Metastrongyloidea), in White-tailed Deer from Indiana, with Notes on the Gastropod Intermediate Hosts. THOMAS R. PLATT, Department of Biology, Saint Mary's College, Notre Dame, IN 46556.—Adults of the meningeal worm are reported from the brain of white-tailed deer in Indiana for the first time. Three of 9 hunter-killed animals taken at the Kingsbury State Fish and Wildlife Area during the 1987 hunting season were positive for adult *P. tenuis*. Collection of terrestrial gastropods, the intermediate hosts of meningeal worm, during the summer of 1988 was hampered by the extensive drought in the mid-west. Examination of more than 300 individuals confirmed 1987 results that three species, *Discus cronkhitei*, *Cochlicopa* spp., and *Deroceras laeve*, are the principal candidates for local transmission of this parasite. The data were insufficient to identify local areas of transmission within Kingsbury.

Mate Choice in Zebra Finches. ELLEN M. ROTH and DORIS J. WATT, Department of Biology, St. Mary's College, Notre Dame, IN 46556.—Eleven female and 19 male zebra finches (*Poephila guttata*) were introduced into a large aviary containing eleven nests. Observations of mate choice, reproductive success, and pair fidelity were made over a four-month period. In 9 of 10 pairs, birds mated with others of their own color type.

Evidence for Tissue Degrowth in *Lymnaea* (Pulmonata, Basommatophora). DAVID A. SMITH and CHRISTOPHER C. HENDERSON, Wabash College, Department of Biology, Crawfordsville, IN 47933.—Adult *Lymnaea* were sampled from Sugar Creek, Crawfordsville, between October and December, 1987. Baseline analysis showed that tissue dry-weight (TDW) related to shell dry-weight (SDW) as, $TDW = 0.23 SDW + 0.37$ ($r = 0.97$, $N = 160$, $P < 0.001$). This relationship was used as a predictor of TDW and differences between actual and predicted TDWs were used as estimates of tissue degrowth. Results showed significant levels of degrowth in *Lymnaea*. Tissue losses during ten weeks averaged -27% of predicted biomass (range of -3% to -41%). This level of tissue loss corresponds to that reported for *Helisoma* (50% loss in 132 days). Tissue losses here may be influenced by decreasing water temperature (to $< 4^{\circ}\text{C}$) and by associated declines in algal biomass. Metabolic modifications, and their control, allowing individual survival during periods of degrowth are of significant physiological interest.

Rate and Temperature in Early Development of *Rana pipiens*. JASON S. VANLIESHOUT, Department of Biology, University of Notre Dame, Notre Dame, IN 46556 and GRAYSON S. DAVIS, Department of Biology, Valparaiso University, Valparaiso, IN 46383.—Fertilized *Rana pipiens* eggs can develop into tadpoles with nearly 100% viability over a wide range of temperatures ($14\text{--}24^{\circ}\text{C}$); the higher the temperature, the faster is development. Within that range of viability and for *R. pipiens* from a given locale, the relationship between the rate of development to any given stage and temperature is linear. (If biochemical reactions were the rate-limiting step of development, this would not be the case.) Therefore, with a normal table of development for a given temperature and the regression of temperature and rate, an investigator can determine the time and temperature necessary to conveniently provide embryos of any stage. We report: 1) normal tables of development for three novel, intermediate stages (between Shumway Stages 11 and 12) especially useful for experiments on gastrulation; and 2) that the regression between rate of development and temperature has not changed for Vermont *R. pipiens* from that reported by Bachman in 1940.

Physical and Biochemical Characterization of Insect Anti-freeze Proteins.

DING WEN WU, JOHN G. DUMAN, and CHARLES A. KNIGHT¹, Department of Biological Sciences, University of Notre Dame, Notre Dame, IN 46556 and ¹National Center for Atmospheric Research, Boulder, CO 80307.—Overwintering larvae of the beetle *Dendroides canadensis* maintain high levels of thermal hysteresis producing proteins both in the hemolymph and in the mid-gut fluid. This presumably promotes freeze resistance by lowering the freezing point and promoting supercooling of the body fluids. The effects of various conditions including addition of Ab on the thermal hysteresis activity was determined for the *Denroides* proteins and for those from *Tenebrio molitor*. By slowly growing large hemispherical ice single crystals at very low antifreeze concentrations, it was shown that the proteins interact preferentially on the prism planes and thereby inhibit growth on these planes. The antifreeze proteins did not lower the short term nucleation temperature of buffer solutions which contained *Dendroides* hemolymph proteins with ice nucleating activity. However, the antifreeze proteins did stabilize the supercooled state over long periods.

Hormonal Control of Hemolymph Protein Involved in Cold Tolerance in Freeze Susceptible Insects. LEI XU and JOHN G. DUMAN, Department of Biological Sciences, University of Notre Dame, Notre Dame, IN 46556.—Initial studies (Horwath and Duman, 1983) showed that topical application of juvenile hormone induced thermal hysteresis protein (THP) production in larvae of the beetle *Dendroides canadensis*. These *in vivo* studies were extended to determine dose response curves for JH and the time course for induction of THPs. To monitor changes in THP levels, measurements of thermal hysteresis activity and immunoblots (Western blots and dot blots with polyclonal antibodies raised to purified THP) were used. As might be expected, dose response curves showed that the sensitivity of freshly collected larvae varied seasonally. Larvae were most sensitive in late summer while at certain times in early summer they were non-inducible. JH application also stimulated THP production in *Tenebrio molitor* larvae. *In vivo* fat body culture demonstrated that the fat body is the site of THP production, both in *Dendroides* and *Tenebrio*. Addition of JH to the culture medium stimulated THP production in both species, but only when the fat body was taken from larvae pretreated with JH.