

**1 THE NEUROEPITHELIAL ENDOCRINE (NEE) SYSTEM IN THE LUNG OF VARIOUS VERTEBRATES.** *D. Adriaensen, J.-P. Timmermans, D.W. Scheuermann, and M.H.A. De Grootd-Lasseel.* University of Antwerp (RUCA).

Morphological and cytochemical studies have shown that in the epithelial lining of the respiratory tract of man and various animals, single NEE cells and cell groups (neuroepithelial bodies (NEBs)), characterized by electron-dense granules and amine-handling capacities can be found. At present, however, insufficient comparative (phylogenetic) information precludes any reasonable attempt at interpreting the historical sequence of morphological and functional refinements leading to the well-known complex NEBs that are seen in the contemporary mammals. Therefore, we have started a comparative study of the NEE system in the lungs of various vertebrates, including: (1) the newborn cat; (2) the red-eared turtle, *Pseudemys scripta elegans*; (3) a neotenuous salamander, *Ambystoma mexicanum* (Axolotl); (4) a primitive actinopterygian fish, *Polypterus senegalensis*; (5) a lungfish, *Protopterus aethiopicus*. The investigations were performed using light microscopy, scanning and transmission electron microscopy, light-, fluorescence- and electron-microscopical histochemistry and immunocytochemistry. In the lungs of the cat and the turtle NEBs were found, whereas in the axolotl, *Polypterus* and *Protopterus* only solitary NEE cells are present. Multiple neurotransmitters or neuromodulators occur in the NEE system of all the species investigated thus far. Obviously, it will be interesting to extend the phylogenetic study of the NEE system in respiratory organs, including those of invertebrates.

**2 PARTIAL MIGRATION IN THE EUROPEAN ROBIN IS NOT A MIXED-ESS.** *F. Adriaensen.* University of Antwerp (UIA).

We studied individually marked populations of the Continental European Robin (*Erithacus rubecula rubecula*) simultaneously in three different habitats: woodland, parkland and gardens. Resident and migratory Robins were habitat separated during the breeding season. Very few females were found to be resident. In all years local survival of resident males (mean = 50%) was at least equal to survival of migrant males (mean = 17%). Mating success of male Robins decreased with settling date: 74% for earlier settling residents, 44% for birds settling during the migratory period. Survival and mating success combined result in a two (cold winters) to four times (normal winter) higher chance for breeding in residents than in migrants. An unbalanced reproductive success of the resident and migratory morph and several arguments for conditionality in the migratory behaviour show that partial migration in the European Robin is not a mixed-ESS with balanced pay-offs, but a conditional strategy in which every individual Robin makes the best of the environmental situation it can defend its autumn territory in.

**3 FIBRE ORIENTATION AND DEFORMATION IN THE FISH SKIN.** *P. Aerts.* University of Antwerp (UIA).

In fishes, the basal layer of the dermis (stratum compactum) is built up by a mesh-work of crossed connective tissue fibres, oriented at a specific angle to the longitudinal axis of the body. In his paper of 1987, ALEXANDER (1) presented a model to estimate the length changes of these fibres during swimming. One of his basic assumptions is the circular cross-section of each body-half throughout bending. This premise may apply to eel-like fishes, but is certainly invalid for the undulating caudal body-region in most carangiform and subcarangiform fishes. Therefore, an alternative model has been developed in which each body-side is represented by the half of an elliptical surface (other conditions essentially unchanged). The ellips-axes in the straight-body position coincide with the height and width of the fish at a specific location. The model is applied to the caudal region of *Astatotilapia elegans* and to hypothetic specimens. Apparently, a direct relationship between model output and fibre orientation does not exist. Contrary to ALEXANDER (1987), a "neutral fibre angle" (= zero strain during bending) is less obvious, and the concave bodyside always shows negative length changes. Remarkable is the tendency to a constant strain at the convex body-side over a large range of radii of curvature. The hypothesized energy saving function of the crossed fibre system during locomotion remains valid.

(1) R.McN ALEXANDER (1987) – J. Theor. Biol. 124:97-110.

**4 PURIFICATION AND CHARACTERIZATION OF TWO TOXIC PROTEINS FROM THE HEMOLYMPH OF THE POTATO BEETLE, *LEPTINOTARSA DECEMLINEATA* (SAY).** *M. Amelinckx, A. Bortels and A. De Loof.* Catholic University of Leuven (KUL).

In this study we isolated two toxic proteins present in the hemolymph of the potato beetle, *Leptinotarsa decemlineata* (Say), using FPLC. Hemolymph was obtained from larvae of the potato beetle. After centrifugation, the supernatant was layered on a CM-Sephadex C-50 column (BisTris 50 mM, pH 7.0) to eliminate lipids and fatty acids. Further purification was achieved by FPLC on Mono-S (Phosphate 50 mM, pH 7.0) and Mono-Q (Ethanolamine 25 mM, pH 8.9). The toxic substances were traced by using patch-clamp on isolated ventricular cells and freeze-thaw liposomes. Native and SDS-PAGE-electrophoresis showed us that two 67 kDa proteins were purified with a slight difference in the IsoElectric point. Supported by IWONL grants (M.A, A.B).

**5 ISOZYME TAXONOMY OF *ARION INTERMEDIUS* NORMAND, 1852 (MOLLUSCA: PULMONATA).** *T. Backeljau.* Royal Belgian Institute of Natural Sciences, Brussels.

*Arion intermedius* (AI) is traditionally placed in its own subgenus *Microarion*. It has been suggested, however, that the species is so closely related to *A. hortensis* (AH) that it should belong to the subgenus *Kobeltia*. This opinion was contradicted by a re-

cent isozyme analysis which indicated closer affinities between AI and *A. circumscriptus* (AC) (subgenus *Carinarion*). In the present work I re-evaluate this viewpoint by using isoelectric focusing (IEF) of esterases and by modifying the original isozyme data from which the relationship between AI and AC was inferred. To this end, allele frequencies of four (IDH-1, IDH-2, PGM-1, SOD-1) out of the 14 loci in the original study, were corrected, for the original data, as obtained by starch gel electrophoresis, did not distinguish certain electromorphs which could be demonstrated with polyacrylamide gel electrophoresis. Two new loci (AMY, PGD) were also included. The modified allele frequencies were used to calculate Nei's genetic identities between AI, AC, AH, *A. distinctus* (AD) and *A. owenii* (AO). UPGMA dendrograms were constructed for 10 locus combinations. This procedure showed that in eight combinations AI was clustered with AO and this configuration was already obtained by simply changing the original data for IDH-1 and IDH-2. In five dendrograms the AI/AO cluster was grouped with a cluster containing AH and AD. This topology was confirmed by the IEF data of esterases. Hence, these analyses do not support a clustering of AI and AC, but rather confirm the allocation of AI to *Kobeltia*.

## 6 THE HYO-LINGUAL SYSTEM IN LIZARDS: A MULTIFUNCTIONAL DESIGN. *V.L. Bels*. University of Liège.

The tongue of lizards is used during feeding, drinking, chemoreceptive and social activities. Iguanians use the tongue to catch the food whereas food catching in scleroglossans involves the jaws only. Both sister groups use the tongue to bring the odors to the Jacobson's organ and display the tongue in agonistic interactions. The hyoid apparatus is used during all the phases of feeding and drinking, but also mainly involved in social signals such as dewlap and/or throat extensions. First, gross-morphology and histology of the hyoid system are illustrated in *Anolis* lizards. Secondly, the sequential organization of the activities of the throat muscles is presented to tentatively define the motor pattern of their dewlap extension. Finally, based on the data in *Anolis*, I propose a first generalization of (1) the form-function relationship of the visceral skeleton and (2) the motor organization of social behavior involving this skeleton in the iguanian and scleroglossan lizards.

## 7 A POLAR r-STRATEGIST. *M. Bergmans\**, H.-U. Dahms and H.K. Schminke. \*Free University of Brussels (VUB) and Universität Oldenburg, FRG.

Polar organisms are generally viewed as slowly-maturing, parsimoniously reproducing, seasonal breeders. The Antarctic sea ice inhabiting *Drescheriella glacialis* (Copepoda, Harpacticoida), the first polar "invertebrate" to have been reared through the life cycle, shows quite the opposite life history syndrome. A cohort analysis (-1°C, 3,4%) yielded stage durations, survival and fecundity schedules, and synoptic demographic variables. When temperature effects are duly considered, *D. glacialis*' minimum generation time (132 d) follows, and its ultimate exponential growth rate (.028 d<sup>-1</sup>) exceeds, the trend values for its sister taxon *Tisbe*. Also, in physiological time, the weight

of its age-specific fecundity distribution is shifted towards earlier ages as in typical r-strategists. The stage structure observed in winter (!) field samples closely agrees with the stable stage structure of an exponentially growing population, but differs considerably from that expected in a stationary one. As *D. glacialis* nauplii are unable to swim, successful recruitment is conditional on the presence of sea ice, which has a much restricted distribution in summer. Sympagic diatoms peak in summer but a substantial standing crop is available year-round. Continuous reproduction and r-selected traits in *D. glacialis* may reflect a permanently colonizing existence caused by ice floe dynamics and food patch transiency. Research supported by A. von Humboldt-Foundation (MB) and Deutsche Forschungsgemeinschaft (HUD and HKS).

**8 "GEMMAE", A UNIQUE EXOCRINE SOURCE FOR SOCIAL RECOGNITION IN THE FORMICIDAE.** *J. Billen* and *C. Peeters\**. Catholic University of Leuven (KUL) and \*University of Wurzburg, FRG.

Colonies of the primitive Australasian ant genus *Diacamma* are characterized by the absence of a queen, the role of which is now performed by a dominant worker, called the "gamergate". Another most peculiar feature of the genus *Diacamma* is that all workers display a pair of sac-like mesothoracic appendages at the time they emerge from their pupal cocoon. These appendages, which probably correspond with vestigial wing buds, are unique among the Formicidae, and have been called "gemmae". Among the adult individuals, however, only the gamergate retains the gemmae, as she actively removes them from all hatching callow workers. The presumption of an important behavioural function to be linked with these thoracic structures has been confirmed by our recent discovery in *D. australe* that both gemmae are completely filled with glandular cells. Histological examination in this species revealed the occurrence of approximately 500 secretory cells per gemma. Each secretory cell is accompanied by a duct cell, that eventually opens through the dorsal surface of the gemma. The precise ethological role and chemical nature of the glandular secretion remain to be clarified through further research.

**9 MODELLING THE TRANSPORT OF METALS ACROSS BIOLOGICAL INTERFACES.** *R. Blust*. University of Antwerp (RUCA).

The availability of metals to aquatic and terrestrial organisms is determined by: (1) the physical and chemical speciation of the metal in the environment (water, soil, food) and (2) the mechanism of metal translocation across the interface-structures which separate body and environment (exchange epithelia). A quantitative model that can predict the speciation of metals in physically and chemically defined systems has been developed. This model, in conjunction with a mechanistic description of the metal uptake process, is used to estimate the biological availability of metals in different environments. The metal speciation model takes into account metal complexation, adsorption and precipitation processes. The mechanistic description of the metal uptake process considers surface interactions (adsorption, ion exchange, complexation), trans-

port across the environment-body interface (passive diffusion, carrier and channel facilitated transport) and intracellular trapping of metals. The model has been used to analyse experimental data concerning the uptake of copper and cadmium in the brine shrimp *Artemia*, a saline water anostracan crustacean. The rate of metal uptake is determined by the speciation of the metal in the solution. The mechanism of metal translocation is pH sensitive but does not involve strong interactions with the transport system. Metal uptake appears a channel facilitated process. R.B. is a Senior Research Assistant of the NFSR. Supported by FKFO project 2.0033.90.

**10 MORPHOLOGY AND SYSTEMATICS OF TERRESTRIAL NEMATODES FROM ISLA ESPAÑOLA (GALAPAGOS-ARCHIPELAGO).** *G. Borgonie*. State University of Ghent.

Nematodes from three surface samples, collected in March 1988 on Isla Española, were studied. Twenty-three genera were found of which eleven were determined to species level: *Tylenchorhynchus paracti*, *Stegelleta ophioglossa*, *Seleborca mariannae*, *Zeldia tridentata*, *Cephalobus pinguimucronatus*, *Allodorylaimus granuliferus*, *Discolaimus monoplanus*, *Discolaimium sublatum*, *Aporcelaimellus kikereensis*, *Carcharolaimus ramirezi* and *Mylonchulus minor*. Two of these, *T. paracti* and *M. minor*, were studied in detail. S.E.M. photographs and morphometric measurements of *T. paracti* showed it to be nearly identical to *T. capitatus*, and it is considered a junior synonym. *M. minor* was longitudinally cut in half at the level of the stoma in order to obtain S.E.M. photographs of the stomatal interior. Two structures, also visible with the light microscope, are of interest: the twelve small liplets just above the stomatal plates and the small foramina at the bottom of the plates (one in the dorsal plate and two in each subventral).

**11 THE ANALYSIS OF HONEYBEE BEHAVIOUR BY MEANS OF A NEW ELECTRONIC BEE COUNTER.** *G. Borremans*, K. Deges and D. Houbaert. State University of Ghent.

During the last three years, a new computer-operated bee counter was developed. In the past, similar constructions (1) were limited in measurement capacity and needed a large sampling period. Our new system is able to monitor a normal honeybee colony during full activity and works completely autonomously. Sampling periods can be chosen from four seconds to one day. Using a small interval of ten minutes, registration can still last for 50 days without any interruption. The new device analyses the bee activity at the hive entrance, thus providing an idea of the foraging behaviour. The influence of abiotic factors such as temperature, humidity, light intensity and photoperiod (15L: 9D), and the biotic factor "food availability" were studied. Several measurements were recorded in a Bee Flight Room (BFR) (2) and in the field during the last two years, resulting in a massive number of data. Graphical analysis of data from the BFR shows clearly that the main activity period lines up with the light period, although the activity does not stop completely during the dark period. Temperature proved to be positively correlated with days without any interruption. Comparison of activity recordings during days

when pollen was offered twice in the BFR, and on subsequent days when no pollen was offered shows that an increase in the activity at the hive entrance is related to food supply in the BFR.

- (1) D. HOUBAERT, G. BORREMANS and F. J. JACOBS (1989) — Abstr. Int. Symp. Fytofarmacie en Fytiatrie, Gent, 1989.  
 (2) J.P. VAN PRAAGH (1972) — J. Apic. Res. 11:77-88.

**12 CHANNEL-FORMING PROTEINS IN THE LARVAL HEMOLYMPH OF THE POTATO BEETLE, *LEPTINOTARSA DECEMLINEATA* (SAY). A. Bortels, M. Amelinckx, A. De Loof and E. Carmeliet. Catholic University of Leuven (KUL).**

Two proteins with a molecular size of about 67 kDa were isolated from the hemolymph of the potato beetle by using FPLC. Their effect was studied on artificial membranes using the patch-clamp technique (1). Pipette and bath solutions contained (in mM): 100 KCl, 1 CaCl<sub>2</sub> and 5 Hepes adjusted with TrisOH to pH 7.5. Addition of the protein fraction to the bath solution resulted in a stepwise-like increase in membrane conductance. Channels formed by the proteins had relatively large conductances (400 pS in isotonic K<sup>+</sup> solutions). The channel remained open almost all the time. At very negative potentials the channels showed more closures. Many substates were observed. As in artificial membranes, channel-forming activity was also observed in isolated guinea pig ventricular myocytes. The two proteins could be responsible for the neurosecretory effects observed in rat brain synaptosomes after addition of a partially purified protein fraction from the hemolymph (2). A. B. and M. A. hold grants of IWONL.

- (1) M. LEMMENS *et al.* (1989) — Biochim. Biophys. Acta 984:351-359.  
 (2) J.E. YOSHINO *et al.* (1980) — J. Neurochem. 34:635-642.

**13 CONTRIBUTIONS TO THE STUDY ON THE FEEDING BIOLOGY OF THE FAIRY SHRIMP *STREPTOCEPHALUS PROBOSCIDEUS* (CRUSTACEA: BRANCHIOPODA: ANOSTRACA). L. Brendonck. State University of Ghent.**

To create suitable culture conditions for the controlled production of resting eggs of freshwater anostracans, basic information on the feeding habits and requirements of the target species is of major significance. Several aspects of the feeding biology of the fairy shrimp *Streptocephalus proboscideus* have therefore been studied. All experiments were run under laboratory conditions at 25°C in conical glass tubes with moderate bottom aeration and filled with 500 ml of a definite medium. In a first series of experiments food uptake was determined in single specimens during one day, with 12 h.-intervals. In a second series each tube held 10 test animals and food uptake was recorded every hour for a total period of three hours. In both series, three parallel experiments were run for each treatment. Results of food uptake in each treatment are here expressed as the mean ingestion rate (cells removed animal<sup>-1</sup> hour<sup>-1</sup> ± standard deviation). By the

metachronal movement of the thoracal appendages, feeding currents are generated by which particulate material is transported to the filtering appendages. The nightly ingestion rate ( $1.299 \cdot 10^6 \pm 0.979 \cdot 10^6$ ) was not significantly different from the day-measurements ( $0.929 \cdot 10^6 \pm 0.826 \cdot 10^6$ ). The maximum size of ingested gas-filled glass-spheres (5-200  $\mu\text{m}$ ) was 29.5  $\mu\text{m}$  in larvae and 67.1  $\mu\text{m}$  in adult organisms. No qualitative selection could be observed in adult organisms for different algal species added in a definite ratio to the medium. The ingestion rate in distinct size-classes has been investigated for different food concentrations. Highest ingestion rate in adult male organisms (13-14 mm) ( $0.8-1.0 \cdot 10^6$ ) were measured for food concentrations between  $5 \cdot 10^4$  and  $5 \cdot 10^5$  algal cells (*Selenastrum capricornutum*) per ml. At higher food concentrations, ingestion rates dropped rapidly. Significant differences in ingestion rates between the sexes were observed in SR-Water and EEC-Water. In EEC-Water, ingestion rates in females ( $2.012 \cdot 10^6$ ) were more than three times higher than in males ( $0.610 \cdot 10^6$ ). These results could, however, not be confirmed by the second series of experiments. Significant influences of culture medium on ingestion rates were furthermore observed in each sex. For every tested concentration of particles (carmine/algae), gut clearance rates were higher in females (max:  $61 \pm 19$  min, min:  $30 \pm 3$  min) than in males (max:  $72 \pm 23$  min, min:  $47 \pm 15$  min). The shortest retention time of food particles was, in both sexes observed at a concentration of  $1 \cdot 10^6$  carmine particles and  $1 \cdot 10^5$  *Selenastrum* cells per ml. At the latter concentration, also the highest ingestion rates were observed (see above). After 5 minutes, ingested particles were already transmitted into the abdominal segments, where the speed of food transport greatly decreased. The information on continuous, non-selective (on particles of suitable size) filter-feeding habits of the fairy shrimp *Streptocephalus proboscideus* is helpful for maintaining optimal feeding conditions in the cultures, and specifies some quantitative prerequisites to develop alternative diets as a partial or complete substitute for living algae.

**14 THE CULTURE OF FRESHWATER ANOSTRACANS AND CONCHOSTRACANS (CRUSTACEA: BRANCHIOPODA) FOR APPLICATIONS IN AQUACULTURE AND ENVIRONMENTAL SANITATION. L. Brendonck and G. Persoone. State University of Ghent.**

Freshwater anostracans and conchostracans have long-time been considered as biological curiosities. In recent years, however, there is an upsurge of interest to use these branchiopod crustaceans as a new type of live food in aquaculture and as test organisms in aquatic toxicology. Especially their common feature of producing resting eggs makes these animals attractive. Some quantitative reproductive characteristics were studied for the conchostracan *Caenestheriella australis* and the fairy shrimp *Streptocephalus proboscideus*, both cultured in separate couples under laboratory conditions at 25 °C and fed with micro-algae (*Selenastrum capricornutum*). In these two subtropical African species collected from rain pools, high fecundity rates were observed. Results are here presented as averages with standard deviations. Individual females of *Caenestheriella australis* produced a clutch of  $338 \pm 79$  resting eggs every  $1.5 \pm 0.25$  days, for a total number of  $31 \pm 21$  broods. In *Streptocephalus proboscideus*, oviposition took place with a frequency of one clutch of  $167 \pm 16$  resting eggs every  $2.1 \pm 0.9$

days, for a total number of  $31 \pm 27$  broods. Generally, populations living in unpredictable environments (as desert rain pools), causing high density-independent mortality, such as extreme droughts, will be selectively favored to allocate a greater proportion of energy to reproductive activities. Fecundity, however, was found to be affected by daily manipulations and water quality. To assure a good water quality and a constant food concentration in the tanks, a recirculation system for the controlled production of resting eggs was constructed. This system is equipped with separate biological filtration units and an automatic feeding apparatus. At a density of 60 fairy shrimps per litre, an average brood-size of  $199 \pm 49$  resting eggs and a daily sustainable yield of 18,000 eggs (0.072 g. dry weight) per unit (6 l) and per day have been recorded. The construction is readily modified for rearing the more benthic conchostracans. Deposited resting eggs are easily removed for further processing and storage. The use of these cryptobiotic stages as starting material in ecotoxicological testing minimizes technical and financial problems inherent to continuous culturing of live stock. Resting eggs could also be used to inoculate large scale culture systems in aquaculture. Because of their non-selective and filter feeding habits, freshwater branchiopods could furthermore help to control the accumulation of agricultural wastes and tertiary effluents from purification processes by converting organic particulate material into branchiopod biomass. This energetically acceptable culture method offers promising perspectives for the production of an animal protein supplement in stock feed, and for the artificial propagation of several kinds of freshwater fishes.

- 15 **DENSITE DE POPULATION, DISTRIBUTION ET BIOMASSE DE DEUX ESPECES D'HOLOTHURIES (ECHINODERMATA) DANS UN HERBIER A POSIDONIA OCEANICA.** P. Bulteel, P. Coulon et M. Jangoux\*. Free University of Brussels (ULB) and \*University of Mons.

*Holothuria polii* et *Holothuria tubulosa* sont deux espèces d'holothuries très communes en Méditerranée. Elles se rencontrent sur tous les types de fonds allant de la vase à la vase de sable grossier ou rocailloux. Ce sont des organismes détritovores qui se nourrissent de la matière organique associée au sédiment. Dans l'herbier à posidonies leur abondance permet de les considérer parmi les macroinvertébrés dominant de l'écosystème. Dans le cadre d'une étude écologique globale de l'herbier à posidonies (étude basée à Ischia, golfe de Naples), nous avons établi leurs densités de population et par là la biomasse holothurienne au mètre carré d'herbier. Nous avons utilisé une technique de dénombrement des individus sur quadrat en scaphandre autonome. Cette procédure a l'avantage de peu détériorer l'herbier (en comparaison d'un dragage) et permet de récolter les individus cachés dans l'entrelacs des rhizomes de la posidonie. Les résultats obtenus révèlent une décroissance de la densité de population avec la profondeur pour les deux espèces. Inversement, la taille moyenne des individus récoltés (estimée par la mesure de leur poids frais total et du poids sec du tégument) augmente de l'herbier superficiel vers l'herbier profond. Globalement, la biomasse holothurienne par mètre carré diminue avec la profondeur et pourrait traduire une relative raréfaction des ressources nutritives disponibles pour les holothuries en parallèle avec la diminution de la production de l'herbier.

- 16 **PEANUT AGGLUTININ: A SPECIFIC MARKER FOR THE NERVOUS SYSTEM OF *DROSOPHILA MELANOGASTER*.** P. Callaerts, V. Vulsteke and A. De Loof. Catholic University of Leuven (KUL).

A number of developmental events like *e.g.* gastrulation and neurogenesis involve specific cellular interactions that are mediated by glycoproteins. In this study, lectins were used to look for stage-specific glycoproteins in *Drosophila melanogaster* development. Embryos were dechorionated, fixed in a formalin-heptane mixture and processed either for Paraplast embedding and sectioning or for use as whole mounts. Lectins were fluorescein or peroxidase labelled. Of several lectins tested, peanut agglutinin (PNA), a lectin which specifically recognizes the disaccharide  $\beta$ -D-galactose-(1-3)-N-acetyl-galactosamine, proved to be a useful marker for the nervous system of *Drosophila melanogaster*. PNA specifically labels the central (neuropile) and the peripheral (sensory organs) nervous system of the developing embryo. Up to now, anti-horseradish peroxidase antibodies were the reagent of choice for specific labelling of the nervous system of *Drosophila melanogaster* (1). PNA may prove to be a valuable alternative for use in studies of the nervous system. P.C. is a research assistant of the NFSR. (1) J.Y. JAN and Y.N. JAN (1982) — Proc. Natl. Acad. Sci. USA 79:2700-2704.

- 17 **THERMAL BIOLOGY, MICROHABITAT SELECTION, AND CONSERVATION OF THE INSULAR LIZARD *PODARCIS HISPANICA ATRATA*.** A.M. Castilla and D. Bauwens. University of Antwerp (UIA) and Institute of Nature Conservation, Hasselt.

We studied, in the field and laboratory, aspects of the thermal biology and microhabitat selection of the endangered lizard *Podarcis hispanica atrata* during autumn. Body temperatures (T<sub>b</sub>) of active lizards were within a narrow range, were largely independent of ambient temperatures, and exhibited little diel variation. Activity T<sub>b</sub>s largely coincided with the selected temperatures maintained in a laboratory thermogradient and with T<sub>b</sub>s that maximize running performance. Alternation of basking with other activities and shuttling between sun and shade were obvious aspects of thermoregulatory behaviour. Lizards shifted microhabitat use throughout the day. During early morning and late afternoon, basking lizards were restricted to rocky sites surrounded by shrubs. Near midday lizards used a wider array of microhabitats, and many moved in open grassy sites. Juveniles maintained lower activity T<sub>b</sub>s, had lower selected temperatures, and basked less frequently than the adults. Juveniles occupied open grassy patches more often than the adults. We discuss the relevance of our results for the conservation of this extremely rare lizard and the management of its habitats.

- 18 **THE DEVELOPMENT OF A SHORT-TERM STANDARD TOXICITY TEST WITH THE FAIRY SHRIMP *STREPTOCEPHALUS PROBOSCIDEUS* (CRUSTACEA: ANOSTRACA).** M.D. Centeno, L. Brendonck and G. Persoone. State University of Ghent.

A standard method is presented which aims at determining the acute toxicity of various chemicals and effluents to larvae of the freshwater anostracan *Streptocephalus*

*proboscideus* (Frauenfeld). Resting eggs (cysts) of *S. proboscideus* are used as biological starting material for toxicity tests. Test animals are obtained by controlled hatching of the cysts. For the standardization of the test method, temperature, dilution medium, test duration and photoperiod are assessed to maintain a larval mortality of less than 10 % in the control during the entire period of the test. A protocol was designed for the execution of a 24-hour acute toxicity test with nauplii of *S. proboscideus*, using polystyrene multiwell plates incubated at 25°C in darkness. As the sensitivity of the organisms changes with age, instar II-III nauplii, which are obtained after 24 hours from the start of hatching, were selected. The 24 hour-toxicity of eight chemical compounds towards the selected larval stages of *S. proboscideus* was investigated. Based on the results with the respective calculated LC50's expressed in mg/l, the following response in decreasing sensitivities was obtained: HgCl<sub>2</sub> (0.03) > CuSO<sub>4</sub> (0.21) > CdCl<sub>2</sub> (0.46) > NaPCP (0.80) > trichloroacetic acid (1.18) > K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> (1.89) > ZnSO<sub>4</sub> (3.97) > sodium lauryl sulfate (22.96). The response of the *Streptocephalus proboscideus* larvae falls within the sensitivity range of other current test organisms as *Daphnia magna*, *Brachionus calyciflorus*, *Brachionus plicatilis* and *Artemia salina*, with the absolute values depending on the compound tested.

**19 AN HYPOTHESIS ABOUT THE ORIGIN OF THE WEBERIAN OSSICLES.**  
*M. Chardon* and *M. Gayet\**, University of Liège and \*Museum of Natural History, Paris.

In the reconstruction of the fossil "preweberian" gonorynchiform, *Lusitanichthys characiformis*, Gayet and Chardon proposed that a manubrium (*i.e.* the part of the intercalarium embedded in the interossicular ligament) completed the typical chain of ossicles. Alternatively, it is hypothesized here that the second basidorsal situated in a dorsal position is devoid of any anteroventral process. It would be more parsimonious then to consider that *Lusitanichthys* possesses only two ossicles: a tripus and a scaphium. In another preweberian gonorynchiform, *Chanoides macropoma*, Patterson clearly figures a complete intercalarium with a manubrium. In the lateral development of *Clarias lazera*, the intercalarium develops from the anterior tip of the tripus, without any relation with the second basidorsal. In the development of a lot of Ostariophysi, the ossicles develop not only from basidorsals and basiventrals but also from other discrete mesenchymatous primordia or from the tunica externa or from the interossicular ligament. These cues are in agreement with Sagemehl's forgotten hypothesis that the Weberian chain first arose as a mere ligament. The following evolutionary steps are proposed: (1) a ligament between the gasbladder and the sinus impar; (2) a membranous ossification in the wall of the sinus impar at the anterior end of the ligament and a local ossification of the tunica externa at its posterior end; (3) a manubrium appearing as an intraligamentous ossification; (4) transformation of vertebral arches that fuse with the former ossifications. Steps 3 and 4 may be reversed.

- 20 **PHARYNGEAL JAW MOVEMENTS DURING FEEDING IN *HAPLOCHROMIS BURTONI* (CICHLIDAE).** G. Claes and F. De Vree. University of Antwerp (UIA).

Pharyngeal jaw movements were studied in *Haplochromis burtoni* (a mainly insectivorous African cichlid) during feeding on earthworms and live crickets, using cineradiographic techniques. During pharyngeal processing of food the upper pharyngeal jaws (UPJs) show cyclic protraction and retraction, while the lower pharyngeal jaw (LPJ) shows more or less equal dorso-ventral and antero-posterior displacements. Taking the protracted UPJ-position as an arbitrarily starting point, each cycle can be subdivided into four main phases. 1) During the preparatory phase, the UPJs are retracted while the LPJ is kept immobile. 2) During the power phase, the UPJs are further retracted while the LPJ moves upward (compression) and, subsequently, forward (shearing). 3) The pharyngeal jaws are physically decoupled during the swallowing phase as the LPJ is retracted and kept in its most ventral position; further retraction of the UPJs causes deglutition of the food. 4) During the recovery phase, the jaws move to their initial positions (UPJ protraction, LPJ retraction-adduction). This functional pattern coincides with that of *Oreochromis niloticus*, a mainly herbivorous species. Supported by IWONL grant to G.C. and NFSR 2.9005.84 to F.D.V.

- 21 **AN ELECTROMYOGRAPHIC STUDY OF THE CERVICAL MUSCULATURE DURING FEEDING IN *CAIMAN CROCODILUS*.** J. Cleuren and F. De Vree. University of Antwerp (UIA).

During inertial feeding in *Caiman crocodilus* the head is thrust back and upward during jaw-opening and is pushed anteroventrad during mouth closure. The neck plays a major role in this process. The function of the cervical muscles was examined using electromyography correlated with accelerometers. The major function of the m. transverso-spinalis capitis is cranial elevation, but it also aids the lateral and dorsi-flexion of the neck. The m. spino-capitis posticus is responsible for the lateral flexion, with a small dorsal component, of the neck and cranium. The m. longissimus capitis superficialis has an important role in the lateral flexion of the cranium, in combination with an axial rotation. Preliminary research presumes a cranial depression function for the m. longissimus capitis profundus, and an aid in the lateral flexion, in combination with an axial rotation, for the iliocostalis system. All cervical muscles are active during the inertial feeding process and most muscles have multiple functions. The cranial and cervical elevation are the result of a cooperation of several muscles. The lateral flexion is seldom produced by a pure unilateral contraction of one cervical muscle, but is generated by bilateral activity of several muscles in which the ipsilateral contraction is stronger. Supported by IWONL grant nr. 880217 to J.C. and NFSR 2.9005.90 to F.D.V.

- 22 **THE USE OF TRIAXIAL ACCELEROMETERS IN MOTION ANALYSIS OF FEEDING IN *CAIMAN CROCODYLUS*.** J. Cleuren, G. De Gueldre and F. De Vree. University of Antwerp (UIA).

Former research of the feeding in *Caiman crocodilus* revealed several technical problems and shortcomings in the use of cinematographic and cineradiography due to the unpredictable behavior of crocodiles. An alternative, promising method of motion analysis, the use of triaxial accelerometers, was developed to allow a complete analysis of cranial and cervical movements during inertial feeding. These transducers provide a continuous record of the accelerations in three dimensions and obviate the time-consuming film analysis. Simultaneously recorded high-speed video (200 fps) was used to obtain a correlation between the signals of the accelerometers and the actual displacements. The profile of the dorsoventral acceleration curve gives a good indication of the bite-types. Repositioning and killing-crushing bites differ from transport bites in the presence of two large, positive peaks in the acceleration curve, transport bites are characterized by a single positive peak. The dorsoventral acceleration of swallowing cycles is much smaller. The direction and extent of the lateral displacement can immediately be derived from the lateral acceleration curve. The phases of the feeding cycle (the beginning of fast opening and the end of fast closing) are marked by a corresponding acceleration peak. The accelerometer output substantially simplifies the correlation with the simultaneously recorded electromyograms. Supported by IWONL grant nr. 880217 to J.C. and NFSR 2.9005.90 to F.D.V.

- 23 **JAW GROWTH IN LIVING AND FOSSIL CATARRHINES.** I. Colson\*, R. Orban and G. Lenglet\*. \*Free University of Brussels (ULB) and Royal Belgian Institute of Natural Sciences, Brussels.

Interspecific differences in jaw growth among *Pan paniscus*, *Pan troglodytes*, *Gorilla gorilla*, *Pongo pygmaeus*, *Hylobates* (5 sp.), *Papio* (4 sp.), and *Macaca* (10 sp.) are described biometrically. In order to make comparisons, individual crania were aged on the basis of 5 stages of dental eruption. Growth curves of the lengths and breadths of the maxillary and the mandible yield a variety of patterns. *Pongo*, *Pan*, and *Gorilla* have similar and steady growth trajectories. In Cercopithecidae and Hylobatidae the growth pattern is often characterized by a decrease in velocity from stages 3 to 4. Bivariate regressions reveal a number of size/shape differences between the following groups: *Pongo*, *Pan-Gorilla* (also *Pongo-Pan-Gorilla*), *Hylobates*, *Papio-Macaca* (also *Hylobates-Cercopithecidae*). Such information about ontogenetic development in extant Primates (e.g. differences in growth rates) may help to situate the fossils phylogenetically. So, a sample of 12 *Mesopithecus* separated into two groups (males and females?) shows similarities to the modern genera *Macaca* and *Hylobates*. *Dolichopithecus* (6 ind.) occupies a distinctive position. *Pliopithecus* (4 ind.) possesses characteristics of Hominoids and *Macaca*. *Oreopithecus* conforms more closely to Hominoids than to Cercopithecoids.

- 24 **FINE STRUCTURAL AND CYTOCHEMICAL STUDY OF THE TERGITE EPICUTICLE OF THE WOODLICE *ONISCUS ASELLUS* (CRUSTACEA: ISOPODA).** P. Compère, S. Defise and G. Goffinet. University of Liège.

The epicuticle of insects and arachnids is commonly regarded as a protective waterproofing cuticular layer related to their terrestrial life. However, very little information is available about its fine organization and its possible role in water proofing in land isopod crustaceans. With this in mind, the ultrastructure and the chemical nature of the tergite epicuticular layers were investigated in the common woodlice *Oniscus asellus*. The epicuticle of *O. asellus* is composed of five layers: (1) a proteic "cement" layer discharged at the cuticular surface by numerous dermal gland ducts, (2) a proteic surface coat, (3) the cuticulin layer including four leaflets, two outer proteic ones and two inner ones composed of a stabilized lipid polymer, (4) a "waxy" layer made of free lipids that seem secondarily spread between the two inner cuticulin leaflets and (5) a lipoproteic inner epicuticle. Even while the epicuticle organization of *O. asellus* tergites strongly resemble that of the decapod crustaceans, both "cement" and "waxy" layers seem to be very original features probably related to a terrestrial adaptation. Supported by grants from the Belgian Fund for Joint Basic Research (conventions n°2.4516.86 and 2.4517.89). P.C. is a research assistant of the NFSR.

- 25 **CONTRIBUTION A LA CONNAISSANCE DU GENRE *BRACHYGLUTA* THOMSON, 1859 (COLEOPTERA: PSELAPHIDAE: GONIACERINAE).** G. Coulon. Institut royal des Sciences naturelles de Belgique, Bruxelles.

La systématique des espèces de *Brachygluta* du groupe *haematica* est basée sur les caractères sexuels secondaires portés par les tergites abdominaux des mâles ainsi que sur la conformation de l'édéage. La découverte de systèmes glandulaires, vraisemblablement sécréteurs de phéromones, au niveau du premier tergite abdominal visible des mâles de certaines espèces, permet de reconsidérer les relations phylogénétiques des différents groupements spécifiques et subspécifiques proposés jusqu'à présent et d'expliquer sous un jour nouveau l'existence d'espèces, voire de sous-espèces, sympatriques. *Brachygluta trigonoprocta* et *haematica sinuata* sont signalés comme nouveaux pour la faune belge; leur distribution en Belgique est présentée en même temps que celle de *B. perforata* et de *haematica* s. s.

- 26 **FEEDING OF THE BRINE SHRIMP *ARTEMIA* ON YEAST: EFFECT OF FOOD CONCENTRATION, ANIMAL DENSITY AND YEAST DIGESTIBILITY ON FEEDING RATE.** P. Coutteau. State University of Ghent.

Previous work has shown that baker's yeast, if chemically treated to improve its digestibility, offers promising possibilities as a feed for growing *Artemia* on laboratory scale. In the present communication the use of treated yeast for studying the feeding biology of *Artemia* is demonstrated. The feeding experiments were performed in two different systems: closed tubes (170ml) fixed to a rotating rod and conical tubes (1000ml)

in which seawater was recirculated over a submersed sieve containing the animals. Ingestion rate was calculated from the decrease in cell concentration which was measured with a Coulter counter. The effect of yeast concentration on the ingestion rate of adult brine shrimp was determined in the recirculating system. The data fitted a saturation response with a maximal ingestion rate of  $440 \cdot 10^3$  cells individual<sup>-1</sup> h<sup>-1</sup>, and an incipient limiting concentration of  $600 \cdot 10^3$  cells ml<sup>-1</sup>. Crowding depressed feeding rate only at high densities ( $> 7.5$  individuals ml<sup>-1</sup>) in the recirculating system. By contrast, an animal density of 3 individuals ml<sup>-1</sup> resulted in significantly decreased ingestion rates in the rotating tubes. Interference from oxygen stress, container size and mortality during the experiment may explain this system-dependence of the crowding effect. The influence of food digestibility was studied by comparing feeding on treated and untreated yeast, and various mixtures of both. For the untreated yeast feeding rates were observed which were 50 to 60% lower compared to those obtained for the treated yeast. Carmine red staining of the gut contents revealed that gut passage time is about 50% shorter when *Artemia* is fed the treated yeast. These experiments show that treated baker's yeast is an interesting product to investigate feeding in *Artemia*. Furthermore, the availability of yeast cells of low and high digestibility offers the unique possibility to explore the effect of particle digestibility on the feeding kinetics of a filter-feeder.

27 **WHAT ARE *LEPTOMYSIS* FEEDING ON? AN EXAMPLE OF THE USE OF CARBON STABLE ISOTOPES IN MARINE FOOD-WEBS STUDIES.** P. Dauby. University of Liège.

*Leptomysis* (Crustacea: Mysidacea) is a common genus in the Mediterranean which exhibits a peculiar behaviour: during daytime, individuals form swarms staying just above benthic substrates; at nightfall, these swarms break up and individuals spread around over the bottom, feeding actively on detrital material. The purpose of this study is to identify the origin of the detritic matter consumed by these mysid shrimps. At Calvi, where this research was conducted, three main carbon sources are available for detritus feeders: phytoplankton, seagrasses and benthic algae, each one characterized by a different <sup>13</sup>C/<sup>12</sup>C ratio. In order to determine the share of each possible source in the shrimps diet, we analyzed carbon stable isotope ratios of four *Leptomysis* species, inhabiting different biotopes, during a complete year cycle. It appears that they do not feed exclusively on organic matter originating from their own biotope, that benthic algae are a carbon source of importance, and that seasonal variations are significant. This kind of research allows a better understanding of the carbon pathway in benthic food webs. P.D. is a research assistant of FNRS.

28 **THE PRIMARY STRUCTURE OF *ASCARIS SUUM* HB. I.** De Baere, L. Liu\*, J. Van Beeumen\* and L. Moens. University of Antwerp (UIA) and \*State University of Ghent.

The perenteric fluid of the parasitic worm *Ascaris suum* (common roundworm) contains an extracellular hemoglobin (Hb) (Mr. 320,000), and is built up of eight ident-

ical subunits (Mr. 40,000) (1). The oxygen affinity of *Ascaris* Hb is the highest ever noticed up to now ( $p_{50} = 0.001$  mm Hg) (2). Each subunit contains only one heme group (heme/Mr ratio = 1/40,000 (1), whereas all other globins have a ratio heme/Mr of 1/17,000, and therefore indicates the partial loss of heme binding. To understand these extraordinary characteristics especially, and the structure-function relationship of oxygen and heme binding in general, the primary structure of *Ascaris* Hb is determined and is reaching his completion. Sequence information indicates that each subunit is a covalent dimer of two globin sequences. The high oxygen affinity and the presence of only one heme group in each subunit rather seems to be the result of several subtle changes in the heme surrounding instead of a few dramatic changes at important places. Comparison with known globin sequences and known tertiary structures will help us to reconstruct the heme surrounding. Supported by the IWONL.

(1) T. OKAZAKI, R.W. BRIEHL, J.B. WITTENBERG, B.A. WITTENBERG (1965) – *Biochim. Biophys. Acta* 111:496-502.

(2) T. OKAZAKI AND J.B. WITTENBERG (1965) – *Biochim. Biophys. Acta* 111: 503-511.

**29 MOLECULAR ASPECTS OF IMMUNE RECOGNITION.** *P. De Baetselier.* Free University of Brussels (VUB).

The unispecific cellular elements of the immune system are the lymphocytes. Individual lymphocytes are specialized in that they are committed to respond to a limited group of structurally related antigens. This commitment, which exists prior to the first contact of the immune system with a given antigen, is expressed by the presence on the lymphocyte's membrane of receptors specific for the determinants on that antigen. Lymphocytes differ from each other not only in the specificity of their receptors but also in their functional properties. Two broad classes (or lineages) of lymphocytes are recognized: the B lymphocytes, which are precursors of antibody-secreting cells, and the T, or thymus-dependent, lymphocytes. The B cell receptor, which is a membrane form of immunoglobulin, binds to individual antigenic epitopes on soluble molecules or on particulate surfaces. In contrast, T cells invariably recognize antigens on the surface of other cells. Such membrane bound antigenic signals consist of a peptide fragment cleaved from antigen and a class I or a class II major histocompatibility complex (MHC) protein. The association of a peptidic fragment with either class I or class II MHC molecules will signal the activation of distinct subtypes of T cells, respectively  $CD8^+$  T cells (killers) or  $CD4^+$  T cells (helpers). In addition to antigen specific receptors, lymphocytes express adhesion receptors that regulate their migration and their interactions during immune responses.

**30 MISE EN EVIDENCE D'UNE ACTIVITE GLYCOGENE SYNTHASE AU COURS DU DEVELOPPEMENT D'OOCYTES DE *XENOPUS LAEVIS*.** *P. Debauche* et P. Devos. Université de Namur.

Si le métabolisme du glycogène est bien connu chez les vertébrés supérieurs, peu d'études lui ont consacrées dans les oocytes de *Xenopus laevis*. Ils se présentent pourtant comme un modèle de choix: ce sont des cellules isolées qui doivent élaborer des

réserves énergétiques importantes telles que le glycogène. Dans ce contexte, nous avons mesuré l'activité de la glycogène synthase à divers stades de maturation en utilisant la méthode de Thomas *et al.* (1968)(1). L'enzyme est présent dès le début de la croissance de l'oeuf et l'activité de sa forme a, tout en n'atteignant que 35 à 40% de l'activité totale, est la plus importante lors de la charge en glycogène. Sur oocytes pondus, nous montrons l'effet activateur du Glucose-6-phosphate et l'inhibition exercée par l'ATP. Nous mettons également en évidence le caractère interconvertible de la glycogène synthase: celle-ci est stimulée par les ions  $Mg^{++}$  et est désactivée par phosphorylation dépendant de l'AMP cyclique. En conclusion, nous présentons des arguments permettant d'expliquer l'interconversion de la glycogène synthase d'oocytes de *Xenopus laevis* par un système de phosphorylation. Celui-ci est considéré chez les vertébrés supérieurs comme le mode de régulation prépondérant de cet enzyme. P. Debauche est titulaire d'une bourse IRSIA.

(1) J.A. THOMAS, K.K. SCHLENDER and J. LARNER (1969) – *Annl's Biochem.* 25:486-499.

**31 A SYSTEMATIC REVISION OF THE AFRICAN CHARACID GENUS *BRYCONAETHIOPS* (PISCES: CHARACIDAE).** G. De Boeck, G.G. Teugels and D.F.E. Thys van den Audenaerde. Royal Museum of Central Africa, Tervuren.

The systematics of the genus *Bryconaethiops* have always been very confused. Throughout the years species have been described and synonymised. The last revision was merely based on literature data and recognized only three valid species: *B. boulengeri*, *B. microstoma* and *B. macrops*. Three other nominal species were regarded as synonyms of *B. microstoma*. Furthermore existing identification characters for *B. microstoma* and *B. macrops* proved to be inefficient and several *Bryconaethiops* populations could not be identified using existing keys. In view of its importance, amongst others in fisheries and fishculture, a systematic revision of the genus was necessary. Our research consisted of a detailed morphometric, osteologic (X-rays and stained specimens) and zoogeographic study of a large number of specimens, including the type material for all nominal species, together with a data-analysis of the results. It allowed us to recognize five valid species and three subspecies within the genus *Bryconaethiops*. *B. boulengeri*, *B. microstoma* and *B. macrops* were described in an unambiguous way. *B. yseuxi* was rehabilitated, and the status of the recently described *B. quinquesquamae* was confirmed, the latter greatly enlarging the known distribution range. Besides *B. microstoma microstoma*, we recognised two new subspecies of *B. microstoma*: one endemic to the Epulu river (Zaire) and the other endemic to the Malagarasi river (Tanzania).

**32 THE ROLE OF THE GAMMARIDEAN AMPHIPODS IN THE EASTERN WEDDELL SEA BENTHIC COMMUNITIES.** C. De Broyer and M. Klages\*. Royal Belgian Institute of Natural Sciences, Brussels, and \*Alfred Wegener Institut, Bremerhaven, FRG.

In the framework of an integrated study of the high Antarctic benthos and fish communities undertaken under the European Antarctic EPOS Programme, an attempt

is made to evaluate the role of the gammaridean amphipods in the shelf and slope communities of the Eastern Weddell Sea. The rather exceptional, simultaneous use of a whole set of different gear at each station, the background of preliminary studies on the same locations and the continuous observations and experiments in aquaria of selected representative species, have allowed the accurate investigation of species distribution and habitat structure, the mode of life, the feeding type and the food intake efficiency. These elements are combined to elaborate a preliminary scheme of the functional role of different groups of amphipods by identifying for the first time several amphipod-feeding guilds.

**33 DIFFERENCES IN THE ALIMENTARY REGIME OF SUBSEQUENT DEVELOPMENTAL STAGES OF *XENOPUS FRASERI* BOULANGER (ANURA: PIPIDAE).** L. De Bruyn and J. Hulselmans. University of Antwerp (RUCA).

The clawed toads of the African genus *Xenopus* Wagler are highly specialised aquatic anurans, characterised by the lack of a tongue. Feeding generally occurs underwater, using a hyobranchial pump. A study on the alimentary regime of *X. fraseri* was carried out on a natural population of an artificial temporary pond at Masako, Zaire. *X. fraseri* toads feed on a wide range of organisms, mainly consisting of invertebrates; no remnants of vertebrate prey were found in the stomachs. Differences in the diet of *X. fraseri* are primarily a question of developmental age; only a slight difference can be found between sexes in the adult stage. The food of the smaller, subadult *X. fraseri* is almost completely confined to (small) aquatic organisms. The stomachs of the adult toads contain a higher amount of larger, eventually terrestrial, prey. L.D.B. is a senior research assistant of the NFSR.

**34 PARASITOIDS AS A SELECTIVE FORCE IN THE EVOLUTION OF GALL-FORMING INSECTS.** L. De Bruyn, P. Verdyck and W. Verheyen. University of Antwerp (RUCA).

In the past, studies on plant-insect interactions were mainly focussed on the direct mutual effects of the producer and its parasitic herbivores. As a consequence, theory development was primarily based on these two trophic level systems. However, the hostplant not only influences the development and survival of its parasite directly through the nutritional quality and/or quantity of the feeding tissues, but also indirectly because it may serve as a refuge for the herbivore to its natural enemies (predators, parasitoids). Galls are an important food source for gall-making insects. In many cases however, some features of gall morphology have no apparent relationship to the nutritional status (gall radius much larger than can be explained by the required food supply, the presence of large airholes,...). The importance may be that larger galls deter attack by parasitoids with limited ovipositor length. Results from our study showed the parasitoid *Stenomalina liparae* may act as a selective force on the gall maker *Lipara lucens*. The habitat selection of this species, which induces terminal stem galls on the common reed,

*Phragmites australis*, is strongly influenced by the diameter of the reedshoots. The parasitoid is only found in galls formed on the thinnest shoots; no mortality occurs on the thicker shoots. L.D.B. is a senior research assistant of the NFSR.

- 35 **A NEW DRACONEMATID SPECIES FROM A MANGROVE ON MOTUPORE ISLAND (PAPUA NEW GUINEA) WITH SOME REFLECTIONS ON THE PHYLOGENY OF THE DRACONEMATIDAE.** *W. Decraemer.* Royal Belgian Institute of Natural Sciences, Brussels.

During a survey of the nematofauna of Papua New Guinea, a sample from a mangrove on Motupore Island appeared of special taxonomic interest. Apart from *Draconema haswelli* and *Paradraconema floridense*, a new species of the Draconematidae was discovered: *Tenuidraconema fiersi* gen.n., sp.n. (1) It belongs to a new genus of the Prochaetosomatinae showing affinities with the Draconematinae. A character analysis was carried out respectively within the Draconematinae and the Prochaetosomatinae, the two subfamilies of the monophyletic family Draconematidae. (1) W. DECRAEMER (1989) – Bull. K.B.I.N., Biol. 59:5-24.

- 36 **THE OCCURRENCE OF TRICHODORID NEMATODES IN AUSTRALIA.** *W. Decraemer* and *F. Reay\**. Royal Belgian Institute of Natural Sciences, Brussels and \*The University of Adelaide, Glen Osmond South Australia.

So far, trichodorids in Australia are only represented by the genus *Paratrichodorus*. Most records are from crop plants, especially horticultural crops, and records from bushland soils are uncommon. During a survey of plant parasitic nematodes associated with native vegetation, two new species of *Paratrichodorus* were found which closely resemble *P. grandis*. Five other species of *Paratrichodorus* are known from Australia, of which *P. minor* and *P. lobatus* are the most widespread.

- 37 **CAN A FENESTRA IN THE SUSPENSORIUM OF GOBIES (GOBIIDAE: TELEOSTEI) BE FUNCTIONALLY EXPLAINED?** *D. Decleyre, P. Aerts\** and *W. Verraes.* State University of Ghent and \*University of Antwerp (UIA).

Gobioids possess a centrally positioned fenestra in their suspensoria, laterally covered by the powerful adductor mandibulae muscles. A functional explanation for the presence of this fenestra might be obtained from the morphological study of both the suspensorium and the adductor muscles of the lower jaw. Such a study was carried out on members of the *Pomatoschistus* genus. The formation of a fenestra not only can account for a substantial saving in skeletal material, but also allows the medial part of the jaw adductor (A<sub>3</sub>) to bulge medially into the mouth cavity during forceful biting.

Thus, A<sub>3</sub> escapes the stresses exerted by the more powerful lateral sections (A<sub>1</sub> and A<sub>2</sub>). In this way, a more voluminous and stronger adductor muscle could evolve in gobioids. Moreover, the appearance of the gobioid lower jaw adductor and its insertion structures shows a remarkable convergence with the ceratopsian dinosaur *Chasmosaurus*; (1) the jaw adductors of the reptile also inserted on a fenestrated bony plate and (2) in both cases jaws as well as muscles are relatively long. For these reasons, it can be argued that gobioids are also adapted to 'impulse biting'. This is slicing the food by fast jaw closure like a pair of scissors, rather than slowly exerting large forces on the prey ('force bite'). As both impulse biting and suction feeding are favoured by the possession of long jaws, the gobioid construction allows a good compromise between biting and suction.

**38 INTERCELLULAR COMMUNICATION DURING EMBRYONIC DEVELOPMENT: IMPLICATIONS OF THE "CELL AS A MINIATURE ELECTROPHORESIS CHAMBER" CONCEPT.** A. De Loof. Catholic University of Leuven (KUL).

Why do (fertilised) eggs differentiate at all into complex multicellular organisms? Mainly because they have lost the potential of symmetrical mitosis during the first, second or/and subsequent cleavages and because the cells which are generated keep sticking together in well defined patterns instead of being dispersed. At the moment the blastula forms, the composing cells stick so tightly together that the young embryo becomes an epithelium which can separate an inner fluid compartment from the outer fluid environment: the embryo can start functioning as a transporting epithelium. At gastrulation this epithelium starts infolding and from now on, a lot of compartments, usually all lined by specific epithelial cell types will be formed (the alimentary canal with its appendages, the coelomic cavity, the amnion when present etc. ...). As differentiation goes on, an organism is gradually formed with a well defined phenotype and consisting of a species specific number of cell types, mostly grouped in tissues, which all have the same genome, but which differ mainly in the properties of their cytoskeleton and of their plasmamembrane (and perhaps of some cell organelles like the nucleus too), both being mutually interdependent. Following properties of the plasma membrane are important: its chemical composition (especially the differences in membrane proteins and their exact topological position over the cell surface) and the permeability to ions (mainly controlled by specialised membrane proteins, the ion pumps and ion channels). In many cell types, if not in all, some ion pumps and channels are positioned in such a way (perhaps anchored to the cytoskeleton), that the cell can drive a flux of ions through itself: if this flux is electrogenic (probably the rule rather than the exception), the cell can also drive an electric current through itself, and thus perhaps behave as a miniature electrophoresis chamber (1). This often overlooked "electrical dimension" of cells might help guiding some cell types towards their final topological destiny inside the embryo, this in collaboration with the different means of chemical communication (inducers, cell adhesion molecules, e.g.). In the unifying "cell as a miniature electrophoresis chamber" concept the causal relationship between the properties of the plasmamembrane and the activity of the nucleus (selective gene activation) is emphasised.

(1) A. DE LOOF (1986) — Int. Rev. Cytol. 104:251-352.

- 39 **GENETIC POLYMORPHISM FOR PHOTOTACTIC BEHAVIOUR IN *DAPHNIA MAGNA*: THE VERTICAL DISTRIBUTION OF DIFFERENT GENOTYPES UNDER SEMI-NATURAL CONDITIONS.** L. De Meester and J. Van Uytvanck. State University of Ghent.

*D. magna* clones can show highly repeatable differences in phototactic behaviour (1). We examined the vertical distribution of three clones representing the three main phenotypes (positive, negative and intermediate phototaxis) in 55 cm deep out-door containers. The day-time vertical distribution was in good agreement with predictions based on laboratory observations of phototactic behaviour. The average depth differed significantly between genotypes, the difference being most pronounced when the animals were well fed. Our results illustrate that genotypic differences in phototactic behaviour of *D. magna* are not a laboratory artefact. It follows that contrasting vertical distribution/migration patterns of *Daphnia* (sub)populations can be the result of differential natural selection. We also observed that adding (encaged) *Chaoborus* larvae to the container induced a slightly altered vertical distribution of the juveniles of the intermediately phototactic clone. L.D.M. is a research assistant of the N.F.S.R.  
(1) L. DE MEESTER (1989) – *Oecologia* 78:142-144.

- 40 **FEEDING-SITE FIDELITY AND WEEK-ENDS ACCOMODATION OF THE BLACK-HEADED GULL IN WINTER. A TEST OF THE FIRST COMPONENT OF THE INFORMATION CENTER HYPOTHESIS.** G. De Schutter. Catholic University Leuven (UCL), Louvain-la-Neuve.

Mock *et al.* (1) identified seven components of the information center hypothesis proposed by Ward and Zahavi (2). The first one is that successful feeding birds are faithful to the site where they have been successful. This assumption was tested by colour-ringed marking of 700 black-headed gulls (*Larus ridibundus*) on a dump site in central Belgium. This experience denotes a large infidelity of the birds, despite the fact that they must have been successful. The accomodation of the black-headed gulls to the weekly closure of their feeding site (they avoid going when closed) is also considered in view of the information center hypothesis. The proposition of Ward and Zahavi can't account for such an accomodation. In conclusion, these results are inconsistent with the information-transfer mechanism as proposed by Ward and Zahavi, but do not exclude the existence of an information center. Three different forms of redistribution between the feeding-sites are proposed.

- (1) D.W. MOCK, T.C. LAMEY and D.B.A. THOMPSON (1988) – *Ornis Scand.* 19:231-248.  
(2) P. WARD and A. ZAHAVI (1973) – *Ibis* 115:517-534.

- 41 **DISTRIBUTION AND SPECIATION OF CARABID BEETLES IN GALAPAGOS.** K. Desender, L. Baert and J.-P. Maelfait\*. Royal Belgian Institute of Natural Sciences, Brussels, and \*Institute of Nature Conservation, Hasselt.

During several recent expeditions, we collected carabid beetles on most of the important islands of the Galápagos archipelago. About 40 species belonging to 11 gen-

era are known to us from the islands. Nearly 95% of the species are endemic to one or more islands in the archipelago. In this communication, the distribution patterns (concerning 75% of the known species) are described in relation to morphological, ecological and dispersal power characteristics of these species. This leads to suggestions of how and when speciation might have occurred in different groups. The extent of individual distribution patterns as well as the degree of radiation having occurred in different taxa suggest a variety of modes of speciation ranging from large to small scale allopatric and parapatric speciation events. Cases of parapatric speciation are suggested in sister species with adjacent ranges but without obvious ecological or geographic barriers between them. They are further substantiated by a possible case of incipient speciation by means of reproductive character displacement ('Wallace-effect'). A suspected case of introgressive hybridization leads to the hypothesis of allopatric speciation (separation by altitude/habitat) and secondary contact of the sister species. Finally, two species seem to have been unintentionally introduced recently. In conclusion, the carabid beetles of Galápagos show a wide variety of distribution and speciation patterns and contribute in this way to the well known fascination of these islands for the ecologist and evolutionary biologist.

- 42 **CARABID BEETLES AS BIO-INDICATORS IN BELGIAN COASTAL DUNES.** *K. Desender, J.-P. Maelfait\* and L. Baert.* Royal Belgian Institute of Natural Sciences, Brussels, and \*Institute of Nature Conservation, Hasselt.

This communication illustrates how carabid beetles can be used within the framework of ecological surveys and monitoring for nature conservation purposes. Pitfall data, collected in coastal dune ecosystems, have therefore been analyzed in a multivariate way on two different scales. First, we show that by means of these animals different dune habitat types can be compared for what concerns their ecological value (their interest for nature conservation). Secondly, these beetles can be used for the evaluation of the effects of different management regimes. As an illustration of this application we assessed the changes in the carabid beetle community of a dune grassland between 1973 and 1987. This area was abandoned after the second world war and managed again from the early 80's onwards. The nature of changes in the beetle communities leads us to propositions for the improvement of future management. Indications are found for a further progression of the desiccation of the study area due to intensified ground water catchment. So, in conclusion, our results show that carabid beetles are good ecological indicators for spatial and temporal variation of dune ecosystems. Sampling of ground beetles can therefore be used to evaluate changes in these systems caused by external as well as internal influences.

- 43 **PLANKTONIC AND PERIPHYTIC MONOGONONT ROTIFERA FROM THE ARCTIC.** *W.H. De Smet.* University of Antwerp (RUCA).

Until now there has been a paucity of investigations on the rotifers of the Arctic. Our research initiates the study of the rotifer fauna of inland water bodies on the Sval-

bard archipelago: Barentsøya (78°30'N), Bjørnøya (74°30'N), Edgeøya (77°30'N), Hopen (76°31'N), Spitsbergen (78°N), and the North West Territories, Canada: Devon Island (75°33'N), Little Cornwallis Island (75°35'N). Rotifers are far more abundant than had previously been expected: 116 monogonont taxa have been found. The plankton fauna is characterized by the diverse genus *Notholca*. The absence of the genus *Brachionus* is striking. The most frequently occurring species by number are *Polyarthra dolichoptera*, *Notholca foliacea*, *Kellicottia longispina*, *K. hiemalis*, *K. quadrata* and *Synchaeta lakowitziana*. Periphytic habitats are dominated both qualitatively and quantitatively, by the genera *Colurella*, *Lepadella*, *Cephalodella* and *Trichocera*. Other frequently occurring species are *Mytilina mucronata*, *Eosphora najas*, *Notommata cyrtopus*, *N. glyphura* and *Resticula nyssa*. The genus *Lecane* is poorly represented. Species richness of single samples is low and ranges from 1 to 31 (N = 43, mean 7) and 1 to 29 (N = 45, mean 14) for the plankton, respectively periphyton assemblages. The huge majority of the species is cosmopolitan. There is a limited number of species characteristic of cold waters (*Notholca* spp., *Lecane rotundata*, *Synchaeta lakowitziana*). *Notholca latistyla*, *Lecane piepelsi*, *Keratella cochlearis polaris* and *Trichocerca longistyla* are restricted to the Arctic.

44 **COLLECTIVE EXPLORATION OF UNKNOWN AREAS : AN EXAMPLE OF SELF-ORGANIZING PROCESSES IN ANT SOCIETIES.** C. Detrain. Free University of Brussels (ULB).

In ant societies, chemical trails laid by the workers are known to organize their foraging activity. Similarly, we suspect, the laying of chemical marks by the workers could lead to a structured exploration of unknown areas. We present, here, the first experimental evidence of such a collective exploration in the ant *Pheidole pallidula* as well as a quantitative analysis of the mechanisms involved. The exploratory pattern strongly differs according to colony size. In a large colony, an exploratory trail leading to the edge of the explored region progressively appears. In a small colony, the trail usually absent and the new area seems to be individually explored. Unexpectedly, when quantified by video analysis, the individual trail-laying behaviour of the exploring ants is identical in both large and small societies. Foragers of small societies are thus marking just as much per individual as those of larger ones. Because of the smaller number of participants and for this reason alone, the small colony would be unable to generate the self-organizing pattern of exploratory trails. Exploration in other species and group raiding in army ants (1) could be explained using the same model. Supported by the Belgian National Foundation for Scientific Research and the Venture Research Unit of British Petroleum.

(1) J.L. DENEUBOURG, S. GOSS, N. FRANKS and J.M. PASTEELS (1989) – J. Insect Behaviour 2:719-725.

- 45 **THE MORPHOLOGICAL BASIS OF CRANIAL KINESIS IN *GEKKO GEKKO* (REPTILIA: SAURIA).** F. De Vree and G. De Gueldre. University of Antwerp (UIA).

The skulls of most reptiles differ from those of mammals by the presence of numerous potentially movable joints that allow intracranial kinesis. Most extant lizards are thought to possess an amphikinetic skull, comprising two kinetic joint systems (metakinetic and mesokinetic) which allow to elevate and depress the upper jaw. Predicted joint morphologies (Frazzetta, 1962) (1) are compared to actual joint morphologies in the gecko, a lizard with a highly kinetic head. The metakinetic system requires rotation of the maxillary segment (all skull elements except the braincase) about the occipital metakinetic axis combined with sliding at the metakinetic and basiptyergoid joints. In the gecko, the paraoccipital process rotates about its modified sutural contact (metakinetic axis) with the supratemporal process of the parietal, the squamosal and the dorsal quadrate. The ascending process of the occipital and the parietal are connected by a syndesmosis thus permitting some rotation and translation at this metakinetic joint. The synovial basiptyergoid joint permits a fair amount of primarily anteroposterior sliding. The mesokinetic (four bar) system requires rotation at the mesokinetic, lateral hinge, pterygoquadrate and quadratosquamosal joints as well as translation at the basiptyergoid joint. The mesokinetic joint is a modified sutural joint permitting the required rotation. The lateral hinge joint combines rotation between pterygoid-ectopterygoid and the maxilla with bending between the pterygoid and palatine. The pterygoquadrate is a modified sutural joint with a stout syndesmosis permitting only rotation between the two bony elements. The dorsal quadrate pivots about its sutural contact with the squamosal and paroccipital process. The epiptyergoid rotates about its synovial columnar joint with the pterygoid and its syndesmosis joint with the prootic. Thus the structure of the intracranial joints of the gecko are consistent with the mechanical requirements of both metakinesis and mesokinesis. The configuration of basal (pterygoid, ectopterygoid, palatines) and epiptyergoid units is important from a functional viewpoint as it provides the mechanical coupling required to produce both types of kinesis simultaneously.

(1) T.H. FRAZZETTA (1962) — J. Morphol. 111:287-319.

- 46 ***ARTEMIA* HEMOLYMPH OXYGEN BINDING CHARACTERISTICS: CATION EFFECTS.** B. De Wachter\*, H. Jonkers and G. Wolf. University of Antwerp (RUCA).

The brine shrimp is a strong osmoregulator. Nevertheless, the composition of the body fluid does change with changing salinities (1). *Artemia franciscana* has been acclimatized to a salinity of 1‰ and an oxygen pressure of 7 kPa (= 1.9 ml O<sub>2</sub>/l). 4 μliter hemolymph was punctured and diluted with buffered (10mM HEPES pH 8.0) calcium nitrate, magnesium nitrate, EGTA or sodium nitrate. Oxygen binding properties of the mixture were measured by the diffusion chamber technique (25°C). Both Ca and Mg raise the oxygen affinity of the hemolymph; with the most pronounced effect for Mg. Na has no clear effect on the oxygen affinity. The effects of these cations on the cooperativity is much less explicit. The influence of EGTA is maximal at a concentration of about 80 mM. The oxygen affinity shows there a minimum. These results are in agree-

ment with the earlier reported results of cation effects on other invertebrate respiratory pigments (2,3). They are in contrast with the results of the effect of salinity acclimation on the oxygen properties of brine shrimp hemolymph (4), which causes only a slight increase in p50. Supported by IWONL grant (to B.D.W.)

(1) P.C. CROGHAN (1958) – J. exp. Zool. 35:219-233.

(2) C.P. MANGUM (1989) – Abstr. Symp. Invert. Dioxygen Carr. Leuven:52.

(3) S. MORRIS *et al.* (1988) – Comp. Biochem. Physiol. 90A(1):31-39.

(4) B. DE WACHTER *et al.* (1989) – Arch. Int. Physiol. Biochem. 97:c12.

**47 THE MANY MEANINGS OF GREAT TIT SONG.** *A. A. Dhondt* and *M. Lambrechts\**. University of Antwerp (UIA) and \*University of Wisconsin, USA.

Since the mid seventies about 30 papers have been published on various aspects of Great Tit song in order to search for answers to the complicated question why birds in general and Great Tits in particular invest so much energy in singing. The traditional functions of song (territory defence and mate attraction) have experimentally been shown to be correct. The main emphasis in song research has been on what birds sing and on the function of a repertoire. Large repertoires are better because they are more efficient at keeping out intruders, and sexually stimulate females more. Males with large repertoires have a larger lifetime fitness. Several other hypotheses have also been formulated to explain the function of a large repertoire. Most studies, therefore, have been about the size and the composition of the repertoire, and have thus been seeking answers to the question 'What do birds sing'. In the Antwerp study of song we have also asked the question 'How do birds sing'. We have found systematic inter-individual differences in the way birds produce the same song type. The way a bird sings informs the listener not only about the identity of the male, but also about its quality, in the real biological sense. Birds that are better singers live longer, have a higher lifetime reproductive success, are dominant in winter and settle earlier on territories. Our ability to individually recognize male quality in tits has furthermore given us a handle to study a new series of problems.

**48 AN ADAPTED TECHNIQUE FOR THE BIO-ENRICHMENT OF ONGROWN ARTEMIA AS FOOD SOURCE IN MARINE LARVICULTURE.** *J. Dhont*. State University Ghent.

The importance of highly unsaturated fatty acids (HUFA's), especially 20: 5n3 and 22: 6n3, for larvae of marine fish and shrimp is well documented and techniques for enriching rotifers and *Artemia* nauplii with those fatty acids have been developed. Recently the advantages of using ongrown *Artemia* are becoming obvious but so far no specific enrichment techniques were developed. The classical technique for nauplii enrichment consists of the transfer of high nauplii concentrations in a strongly aerated emulsion of finally dispersed oil droplets, containing all essential fatty acids. The nauplii are continuously filtering out those oil droplets and after 24 to 48 hours, their gut is completely stuffed with lipids. With this method, total n-3 levels of 55 mg/gDW can be

reached. Up to now, ongrown *Artemia* are enriched in the same way but, since their filter feeding apparatus is further developed, their higher feeding efficiency allows similar enrichment levels within 4 to 6 hours against 24 to 48 hours with nauplii. With the novel enrichment technique we are distributing the enrichment medium along with the food during the culture period. In this way we are taking advantage of the higher filter efficiency and of the fact that ongrown brine shrimp have to be cultured, thus fed, contrary to nauplii who are just hatched and enriched. This method has several advantages: much higher lipid levels are reached ( $> 60$  mg total n-3/gDW as compared to  $< 20$  mg/gDW); the procedure is simple and less critical concerning oxygen drops. Finally, with this method, *Artemia* that are harvested before the end of the culture are already partially enriched. Research supported by the IWONL.

- 49 **CYCLE REPRODUCTIF DE *PRAOMYS JACKSONI* (DE WINTON, 1897) DE LA FORET OMBROPHILE DE BASSE ALTITUDE DU ZAIRE (KISANGANI, MASAKO).** A. Dudu\*, H. Gevaerts\*\*, R. Verhagen et W. Verheyen. Université d'Anvers (RUCA), \*Université de Kisangani, Zaïre, \*\*Centre universitaire du Limbourg, Diepenbeek.

La reproduction d'une population de *P. jacksoni* est étudiée de 1985 à 1987 dans la Réserve Forestière de Masako (00°36'N, 25°13'E, 500 m d'altitude). Les données examinées ont été obtenues sur 552 mâles et 386 femelles, récoltés durant trois années selon un protocole de travail mensuel régulier. Les mâles se sont reproduits toute année, sans aucun cycle saisonnier de reproduction; cependant, on a noté des variations au niveau de la reproduction d'une année à une autre. Les femelles ont montré également une reproduction continue durant l'année, avec des variations semblables à celles des mâles d'une année à une autre. Une portée moyenne de 3,0 embryons paraît générale à toute saison. Les femelles adultes sont sexuellement actives à plus de 90 % par saison. Les jeunes deviennent sexuels actifs quand ils pèsent 21 à 30 g, mais certaines jeunes femelles le sont parfois à moins de 21 g. L'étude semble indiquer l'absence d'une périodicité de l'intensité reproductive chez l'espèce dans les conditions écologiques locales, bien que la durée d'une saison sèche prononcée aurait une incidence négative sur la reproduction de *P. jacksoni*.

- 50 **LES ORGANES LATÉRAUX DE *MYZOSTOMUM CIRRIFERUM* (ANNELIDA: MYZOSTOMIDA).** I. Eeckhaut et M. Jangoux. Université de Mons-Hainaut, Mons.

Annélides de petite taille au corps discoïde, les myzostomides sont tous des symbiotes obligés d'échinodermes. A l'état adulte, *Myzostomum cirriferum* est commensal de la comatule *Antedon bifida*; il se déplace sur le tégument de l'hôte, se nourrissant du flux particulaire charié par les sillons ambulacraires. *Myzostomum cirriferum* présente quatre paires d'organes latéraux (i.e., ventro-latéraux), alternant avec les paires de parapodes. Ces organes sont circulaires et sont formés d'un bourrelet tégumentaire entourant une masse villeuse centrale. Les organes latéraux sont très actifs; ils sont

animés de rapides mouvements de va-et-vient. La structure du bourrelet est conforme à celle du tégument environnant si ce n'est un plus grand développement de la musculature pariétale. La masse villeuse est formée principalement de cellules ciliées pourvues de microvillosités longues et serrées; entre ces cellules s'observent des mucocytes. Un plexus nerveux s'y observe également dont les terminaisons sont toujours proches de la base des cellules ciliées. Les organes latéraux seraient selon les auteurs, des ventouses ou des récepteurs sensoriels. Leur structure fine plaide en faveur de la deuxième hypothèse : ce pourraient être des organes servant à tester le substrat, empêchant ainsi le myzostome de s'éloigner de son hôte.

**51 SONG AND MATE CHOICE IN THE EUROPEAN STARLING.** *M. Eens, R. Pinxten and R.F. Verheyen.* University of Antwerp (UIA).

During the breeding season, male starlings *Sturnus vulgaris* sing very long and complex song bouts consisting of a rapid succession of many different song types. Field observations as well as experiments carried out in captivity indicate that song functions largely in male-female interactions. We looked at individual differences in song characteristics between males and related song behaviour to factors such as male age, pairing date, polygyny and male breeding success. We also experimentally tested whether song has an effect on female mating decisions. We observed marked differences between males in average song bout length and in repertoire size. Yearling males sang shorter average song bout lengths and had smaller repertoire sizes than older males. Average song bout length and repertoire size were negatively correlated with pairing date. Repertoire size and average song bout length were positively correlated with the number of females attracted and with male breeding success. Choice-experiments carried out in outdoor aviaries indicate that females mate significantly more often with males having larger repertoire sizes and singing longer average song bouts. It is concluded that male song in the European starling has probably evolved as a result of intersexual selection by female choice.

**52 LES PODIA LOCOMOTEURS D'*HOLOTHURIA FORSKALI* (ECHINODERMATA: HOLOTHUROIDEA).** *P. Flammang et M. Jangoux.* Université de Mons-Hainaut, Mons.

Les podia —*i.e.*, l'ensemble des appendices ambulacraires ayant des relations avec le substrat — sont, selon les groupes d'échinodermes, locomoteurs ou manipulateurs. Les podia locomoteurs sont généralement terminés en ventouse et servent au déplacement sur substrat dur (*e.g.*, les podia d'astéries); les podia manipulateurs sont digités ou pécicillés et permettent la manipulation des sédiments (*e.g.*, les podia des oursins fouisseurs). Dans tous les cas, les relations podion-substrat sont régies par des sécrétions de l'épiderme podiaire apical qui assurent l'adhésion puis la dé-adhésion des podia au substrat. Les holothuries aspidochirotés se singularisent en ceci que leurs podia ventraux, bien que locomoteurs, ont un disque apical non différencié en ventouse. A l'instar des podia locomoteurs classiques, l'épiderme de l'apex podiaire est unifor-

mément glandulaire; il se distingue par là de celui des podia manipulateurs qui présentent tous des papilles sécrétrices. Toutefois les types cellulaires qu'on y observe sont semblables à ceux qui caractérisent les podia manipulateurs. Les podia locomoteurs d'*H. forskali* ont donc une structure "en compromis", ce qui expliquerait peut être leur aptitude à se déplacer aussi efficacement sur substrat dur que sur substrat meuble.

- 53 IMMUNOCYTOCHEMICAL LOCALIZATION OF AROMATASE AND ESTROGEN RECEPTORS IN THE BRAIN.** A. Foidart, C. Surlemont, N. Harada\*, C. Leranath, F. Naftolin\*\* and J. Balthazart. University of Liège, \*Fujita-Gakuen Health University, Toyoake, Japan and \*\*Yale University, New Haven, USA.

The distributions of aromatase (ARO) and estrogen receptors (ER) were studied, for the first time in the brain of a vertebrate, the Japanese quail (*Coturnix coturnix japonica*), by double label immunocytochemical technique using a rabbit polyclonal antiserum against human placental ARO (J.Biochem.103: 106,1988) and Abbott's monoclonal antibody H222SPg against human ER. Aromatase-immunoreactive cells (ARO-ir) were found in the medial preoptic nucleus (POM), in the septal region and in a large cell cluster extending from the dorso-lateral aspect of the ventromedial nucleus to the tuberal region of the hypothalamus. Estrogen receptor-immunoreactive cells (ER-ir) were also found in each of these brain areas but their distribution was much broader and included larger parts of the preoptic, septal and tuberal regions. In the ventromedial and tuberal hypothalamus, the majority of the ARO-ir cells (over 75%) also contained immunoreactive ER. By contrast, only a limited proportion of the ARO-ir cells were double labeled in the preoptic area and in the septum (respectively 20 % in the POM and 4% in the septum). In addition, a pre-embedding immunostaining combined with electron microscopy reveal that ARO-ir was limited to certain neurons and filled the entire perikaryon, including presynaptic boutons. There were ARO-ir positive boutons forming synapses with ARO-ir neurons (Abst.669, The Endocrine Society, 1990). The present study shows that ER-ir is more broadly distributed and only present in some of the ARO-ir cells. These findings indicate that estrogens produced by central aromatisation have not only ER-mediated actions, but act also by some other unconventional mechanism including the synaptic level. Supported by NIH HD22064, FNRS and EEC (SC1-0230-C/TT) to JB, NS266068 and NIH HD2383 to CL and NIH HD13587 to FN.

- 54 LES PAILLES SENSORIELLES D'HOLOTHURIA FORSKALI (ECHINODERMATA: HOLOTHUROIDEA).** D. Fourmeau, D. Van den Spiegel et M. Jangoux. Université de Mons-Hainaut, Mons.

A l'instar des autres holothuries aspidochirotés, *Holothuria forskali* porte sur sa face dorsale des tentacules ambulacraires modifiés en papilles sensorielles. Celles-ci s'organisent en six bandes longitudinales, chaque bande présentant quelques cinquante papilles. Les papilles ont l'aspect de petits cônes terminés par un bouton apical, la base

papillaire et le bouton apical étant fortement pigmentés. La structure générale des papilles est conforme, pour l'essentiel, à celle des podia locomoteurs. L'épiderme toutefois diffère sensiblement de celui des podia. A hauteur du bouton apical, il est exclusivement formé de cellules sensorielles de deux types (à cils longs et à cils courts, et pourvues toutes de nombreuses microvillosités) et qui présentent, à leur base, d'étroites relations avec un plexus nerveux très développé. Le plexus pénètre le conjonctif sous-jacent en formant des faisceaux de neurites en contact direct avec le cylindre nerveux central de la papille qui, lui-même, contacte un des cinq cordons nerveux radiaires de l'holothurie. Diverses stimulations - mécaniques, lumineuses et chimiques - ont été appliquées aux papilles. Les résultats obtenus montrent qu'elles ne sont sensibles qu'aux seules stimulations mécaniques.

**55 FACTORS INFLUENCING SOCIAL ATTRACTION IN A CICHLID FISH, *MELANOCHROMIS AURATUS* (PISCES: CICHLIDAE). N. Frans and M. Nelissen. University of Antwerp (RUCA).**

Animals that live in groups must be attracted by the group. The attraction among members of a group holding them together is called social attraction. In order to gain information about the factors influencing social attraction this study is carried out with *Melanochromis auratus*, a cichlid fish from Lake Malawi. We tested several factors that might have an influence on the social attraction with the aid of choice experiments. Therefore an aquarium tank was divided into three compartments by two glass partitions. The outer compartments were identical in order to make no difference between left and right. During 10 minutes we recorded the time that the test fish took to approach the glass partition within a distance of less than 20 cm. This time is considered to be a measurement of the motivation of the fish to belong to the choice behind the partition. The first experiment showed us that social attraction exists within groups of *M. auratus*. In a second experiment it was obvious that *M. auratus* recognizes its own group. The difference in social attraction between a known and a strange group was not clear, nor between high and low ranked conspecifics. *M. auratus* shows no social attraction to an other studied species (*Pseudotropheus zebra*). A fifth experiment made clear that social attraction is probably influenced by group size. These results are applicable to high as well as to low ranked animals. Further study is required.

**56 DIFFERENTIAL BINDING OF LECTINS TO THE SKIN OF ANURA. F. Gen-ten and A. Danguy. Free University of Brussels (ULB).**

The distribution of structural and secretory glycoconjugates in the epidermis and dermal glands of fully aquatic (*Xenopus laevis*) and semi-terrestrial (*Bufo bufo*) anurans was studied by the avidin-biotin-peroxidase histochemical staining method using a wide range of biotinylated lectins which recognize alpha-D-mannosyl, alpha-D-glucosyl, beta-D-galactosyl, N-acetylgalactosaminyl, N-acetylglucosaminyl, glucosyl residues, sialic acid or some oligosaccharide sequences. A species-specific compartmentalization of sugar moieties to certain parts of the epidermis was observed. Secretory products

in the mucous glands of both species were positive with all agglutinins applied but *Ulex europaeus-I* (specific for L-fucose). However the amount of N-acetylgalactosamine, D-galactose, sialic acid and N-acetyl-glucosamine varied in accordance with the species studied. On the contrary marked differences in carbohydrate residues between the two species were recorded in the granular (poison) glands. These results may be relevant of a relationship existing between habitat selection and the glycosaminoglycans content of the integument. Supported by a grant from the NFSR.

**57 BIMODAL RESPONSE OF MICROGLIA AFTER X-IRRADIATION OF THE ADULT RAT BRAIN.** *E. Gianfelici de Reyners* and *H. Reyners*. Belgian Nuclear Research Center, Mol.

The response of the microglial cells to X-rays was evaluated in the mid cerebral cortex of the adult rat after focal irradiation of the head at the age of 3 months with doses ranging from 0 to 60 Gy. The cells were recognized with the electron microscope and their density measured at 7, 15, 30 and 90 days after X-irradiation. The dose-effect relationship of microglia was quite unusual from a radiobiological point of view. Indeed, the microglial cell population first decreased with the increasing dose and presented a minimum of about 55 % of the control level after 15 Gy, but after higher doses, the density rose and after 60 Gy, even became larger than in the controls ! A possible interpretation of the phenomenon was to invoke diapedesis which could restore the microglial cells when their level drops below a certain threshold. However, autoradiographic analysis reveals an intense mitotic activity of cortical microglia at 3 weeks after a 15-20 Gy exposure; consequently, the restoration of these cells could also depend on the surviving cells or on a pool of other radioresistant stem cells. Supported by EULEP.

**58 QUANTITATIVE DISTRIBUTION OF BENTHIC INVERTEBRATES IN LAKE BAIKAL (SIBERIA-USSR).** *B. Goddeeris* and *K. Martens*. Royal Belgian Institute of Natural Sciences, Brussels.

A long term collaboration on the spatial and seasonal distribution of mainly Ostracoda and larval Chironomidae in lake Baikal was established between the freshwater Biology Section at the RBINSc and the Limnological Institute at Irkutsk. During a three week visit in August 1990, an initial sampling program was successfully effected in the southern basin of the lake. Samples were taken along two depth transects on soft sediments: south of the Selenga delta (20-80m) and on the Posolkay Bank (50-1200m). All material was collected with a modified Reineck Box corer, from which four replicate subsamples were taken with plastic tubes (diameter 6.9cm, surface ca. 40cm<sup>2</sup>), to a sediment depth of ca. 30cm. These cores were subsequently divided, with an extruder, into six vertical segments. This sampling grid will yield information on vertical distribution in the sediment of various organisms and on their preferences of sediment type and depth. Future collaboration will furthermore focus on composition of benthic communities, aspects of seasonality of mainly chironomids, sampling of steeper slopes with the submarine vessel "Pisces" and taxonomic problems in the organisms under study.

**59 THE ENDOSTYLE OF TUNICATES, A DIGESTIVE ORGAN ?** *J. Godeaux.*  
University of Liège.

The electron microscopic observations carried out since 1958 on the endostyle of various Tunicates have revealed the presence of a highly organized rough endoplasmic reticulum in the giant (polyploid?) glandular cells of this organ. The presence of such a developed ergastoplasm fully supports the hypothesis that these cells are capable of synthesizing digestive enzymes (1)(2). Thanks to a semi-quantitative micromethod (API-ZYm), the enzymatic activities of extracts of endostyle and stomach (3), at different concentrations, were tested and proved the glycosidases well represented and active in the endostyle, especially the  $\beta$ -glycosidases together with  $\alpha$ -fucosidase. Besides glycosidases, acid phosphatase (lysosomes) and phosphoamidase were active in both extracts. The esterases (-C4, -C8 and -C14) are very weak, chymotrypsine-like enzyme is missing in both organs, but a trypsin-like activity was detected in the stomach. These results have been confirmed by spectrometric micromethods which showed the presence of a trypsin-like enzyme in the stomach and of a chymotrypsine-like enzyme in both organs (after activation by enterokinase); carboxypeptidase A, lactase ( $\beta$ -galactosidase-, maltase ( $\alpha$ -glycosidase), amylase ( $\alpha$ -glycosidase) and invertase ( $\alpha$ -glycosidase) were detected, the stomach extracts being usually the more active. Lipase has no activity in the endostyle and only a very weak one in the stomach. Catalase is present and chitinase missing in both extracts. The presence of digestive exoenzymes in the extracts of the endostyle leads to the conclusion that this organ functions in digestion as its secretion products are mixed with the food particles as soon they are trapped by the mucus, a property evidently bound to microphagy.

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 (2) J. GODEAUX (1981) — *Annl. Soc. r. Zool. Belg.* 111:151-162.  
 (3) J. GODEAUX (1989) — *Bull. Marine Science* 45: 228-242.

**60 HOST (PREY) RECOGNITION BY INSECT PARASITIDS AND PREDATORS.** J.-C. Grégoire. Free University of Brussels (ULB).

Insect parasitoids and specific predators recognize their prey at various levels, using a diversity of chemical and physical clues. For parasitoids, several successive stages of host recognition are usually described: (a) host habitat location, often consisting in the host's host-plant location; (b) host location, at long and short range; (c) host acceptance, where chemical and/or physical signals induce oviposition; (d) host discrimination which allows a parasitoid to recognize an already parasitised host. Prey recognition by predators has been less studied, perhaps because many of them are not as specific as most of the parasitoids. In some very specific predator, however, it is possible to outline a sequence of behavioural steps similar to that of the parasitoids. The case of *Rhizophagus grandis* Gyll., a specific predator of the bark beetle *Dendroctonus micans* (Kug.), is a good example. Host habitat location is linked to the odour and silhouette of spruce (the prey's host-tree); host location is achieved through long- and short-range response to chemical signals produced by the prey; host acceptance and host discrimination are mediated by chemical oviposition stimuli.

- 61 **LES SQUAMATES DU GISEMENT D'AGE "MONTIEN CONTINENTAL" DE HAININ (HAINAUT, BELGIQUE).** *M.Cl. Groessens-Van Dyck.* Université Catholique de Louvain, Louvain-la-Neuve.

En 1970, le laboratoire de Géologie des Facultés polytechniques de Mons a creusé un puits à travers le "Montien continental" à Hainin. Ce puits livra une flore et une faune d'un intérêt stratigraphique, paléontologique et paléoécologique incontestable. Son âge en fait en effet un des plus anciens sites paléontologiques du Tertiaire européen. La sédimentologie a permis d'établir qu'il s'agissait d'un milieu lacustre. De nombreux genres et espèces de Mammifères, Amphibiens et Reptiles constituent l'ensemble de la faune. Les restes de Squamates sont tous assez fragmentaires. Cependant certains d'entre eux ont pu être déterminés au niveau générique et même spécifique. Ainsi, le serpent *Dunnophis* et les Lacertidae *Plesiolacerta* et *Eolacerta* ont été identifiés, une nouvelle espèce *Eolacerta bonei* est même décrite. Quelques vertèbres d'Amphisbaeniens et le corps vertébral d'une vertèbre de Varanidae viennent encore étoffer cette partie de la faune. Il s'agit pour la plupart de ces formes de leur première occurrence reconnue dans le Tertiaire européen; celle-ci avance l'apparition de certaines formes sur notre continent. Les Amphisbaeniens n'étaient connus qu'à partir de l'Eocène. La succession des Amphisbaeniens et du serpent *Dunnophis* retrace parfaitement l'assèchement relatif du lac reconnu par la sédimentologie.

- 62 **LOW RANGE DISPERSAL OF EMPIDOIDEA (INSECTA: DIPTERA) IN A HETEROGENEOUS ENVIRONMENT IN CENTRAL BRITTANY (FRANCE).** *P. Grootaert, P. Tréhen\* and Y. Delettre\*.* Royal Belgian Institute of Natural Sciences, Brussels, and \*University of Rennes, France.

The interactions of the empidid fauna of four small adjacent biotopes were investigated. The biotopes studied were a pool bank, a woodland, a grassland and a heathland. From the pool towards the heathland, there is a decrease in soil humidity and relative humidity of the air while there is an increase in temperature and light intensity. By means of emergence traps, the spots where the larvae live can be determined whereas yellow watertraps give an indication of the dispersal of the adult flies. The diversity of the species emerging was nearly identical at each site; however, the highest number of individuals emerged in the heath and the numbers rapidly declined towards the pool bank. The greatest activity (aerial drift - dispersal) was found in the wood and near the pool banks. Fourteen times less activity was found in the heathland. The latter seemed to be a site of reproduction but mating and feeding of the adult flies took place in the wood (shelter).

- 63 **REPRODUCTIVE ISOLATION OF *HILARA* SPECIES: SWARMING BEHAVIOUR (INSECTA: DIPTERA: EMPIDOIDEA).** *P. Grootaert and P. Tréhen\*.* Royal Belgian Institute of Natural Sciences, Brussels, and \*University of Rennes, France.

Behaviour of *Hilara* was studied in the surroundings of the biological station of Paimpont in Brittany. The influence of temperature, light, wind speed, relative humidity,

type of water surface and vegetation on the choice of the habitat and swarming were measured. Nineteen species of *Hilara* were found at this site. Some of them occurred separated in time but the swarming time of the dominant species overlapped partially.

*Hilara maura* is dominant in early spring. Its behaviour depends upon temperature (period of the day). Above 12°C, males hunt and isolated mating occurs; above 15.8°C, females form orientated aquatic swarms; above 22°C, females form also orientated terrestrial swarms. Swarming is apparently a response to density of individuals. Density itself depends on climatological conditions. Male swarms were observed in *H. medeteriformis* and *H. pilosa*. It is supposed that the formation of male swarms (male + cocoon) depends on the density of females. The choice of the habitat is related to the light intensity.

- 64 **A COMPARISON OF THE SWARMING BEHAVIOUR OF THREE SPECIES OF *HILARA* (INSECTA: DIPTERA: EMPIDOIDEA).** P. Grootaert, P. Tréhen\* and E. Brunel\*\*. Royal Belgian Institute of Natural Sciences, Brussels, \*University of Rennes, France, and \*\*Institut National de Recherche Agronomique, Le Rheu, France.

The swarming behaviour of the species *Hilara medeteriformis*, *H. fulvibarba* and *H. manicata* is described and illustrated. The prey and the silk glands are studied with scanning electron microscopy. Females of *H. medeteriformis* form orientated, horizontal swarms above the land. They move along a horizontal axis. The speed of the coming and going along this axis is different. Males hunt above the water surface of lakes at some distance of the female swarms. Females of *H. fulvibarba*, a sister species of the former, swarm above the hunting males in sunny areas of lakes. Females of *H. manicata* swarm above the hunting males on different types of water surfaces in half-shade. There are alternating periods of a fast, more or less orientated movement in a horizontal plane and a slow obliquely rising movement. The orientation of this movement is not always the same during each period. It depends on the direction that the females, that start to rise, take. The other females follow.

- 65 **BIOLOGICAL ACTIVITY OF EXTRACTS OF *CITRUS* SP. AGAINST *SPODOPTERA FRUGIPERDA* (SMITH) (LEP.: NOCTUIDAE).** E. Haubruge, R.E. Andrew C., J.-C. Gilson, J.-L. Hemptinne and C. Gaspar. Faculté des Sciences Agronomiques de Gembloux.

Limonoids are synthesized in the young leaves of *Citrus* sp. and are transported to the fruits where they accumulate during maturation. *Citrus* extracts are known to reduce the rate of food intake of several species of phytophagous insects. In the context of the present study, the impact of limonoids of *Citrus aurantium*, *C. grandis* and *C. paradisi* on *Spodoptera frugiperda* (Smith) was investigated. The chemicals were extracted from the essential oil of *C. aurantium* and respectively from the skin, the pulp and the seeds of *C. grandis* and *C. paradisi*. Experiments were carried on by mixing the limonoids with the artificial diet on which the larvae of *S. frugiperda* were fed. It ap-

peared that only three fractions (the extracts from the skin and the pulp of *C. paradisi* as well as the essential oil of *C. aurantium*) had a significant impact on the larvae. The effects recorded ranged from a reduced growth to dramatic larval and pupal mortality according to the concentrations of the limonoids in the diet.

**66 TOXICITY AND ACCUMULATION OF COPPER BY A FRESH WATER FISH, *RUTILUS RUTILUS* L.** K. Hellemans and M. Baillieul. University of Antwerp (RUCA).

Roach were exposed to lethal (1x and 10x 96h LC50) and sublethal (1/45x and 1/2x/96h LC50) free copper ion concentrations. The chemical speciation of copper was controlled by using reconstituted water as the experimental medium. NTA (nitrilotriacetic acid) was used as metal ion buffer. The speciation of copper was calculated with the aid of a speciation model based on the stability constants of the metal complexes formed in freshwater. The 96h LC50 value was determined to be  $0.6 \mu\text{M Cu}^{2+}$ . The kinetic experiments carried out under the same temperature and pH conditions showed that accumulation of copper in the gills of roach is both a time and a concentration dependent process. Accumulation of copper starts immediately after the administration of an acute lethal concentration ( $6.1 \mu\text{M Cu}^{2+}$ ). After an elimination period of 15h there was a strong reduction in the amount of copper in the gills. Dead fish exposed to  $6.1 \mu\text{M Cu}^{2+}$  for 6 h also accumulate copper in the gills. The copper uptake equals the amount accumulated by living roach under the same conditions. Roach exposed to sublethal concentrations ( $0.01 \mu\text{M}$  and  $0.31 \mu\text{M Cu}^{2+}$ ) only accumulate copper in the gills after an exposure of at least 24h. The increase of the level of copper in the gills is largely due to the adsorption of the cupric ions in the mucus barrier at the gill interface. The role of the mucus excretion on the bioavailability of copper ions will be investigated.

**67 THE RELATIONSHIPS BETWEEN CEREAL GRAINS AND THEIR INSECT PESTS: A SOURCE OF IMPROVEMENT FOR THE PROTECTION OF STORED CROPS.** E. Haubruge, J.-L. Hemptinne and C. Gaspar. Faculté des Sciences Agronomiques de Gembloux.

Control of populations of insect pests that develop in stored cereals is mainly achieved by spraying the grains with pesticides. This strategy could very soon reach its limit as target species are becoming resistant to most of the available insecticides. In addition, the use of pesticides is more regulated in terms of tolerable residues in the grains. On the other hand, methods of biological control and particularly the resistance of grains to insects have received little attention. Here, the literature is reviewed in order to find data on the relationships between stored grains of cereals and grain weevils. It is assumed that the host-selection process of these insects is similar to the chain of events that enable phytophagous insects to develop on the right plant. In the particular case of grain weevils, four steps of the behavioural chain (*i.e.* host-habitat finding, host finding, host recognition and host acceptance) are poorly known. There are how-

ever indications of different levels of suitability of host as wheat breeds affect differently the development of weevil larvae. This information in itself could be a promising start for further research on new strategies of pest control in silos but there is a dramatic need for studies on insect-stored grain interactions.

- 68** **NORMAL SUBSTRATE SENSITIVITY OF THE 5'-MONODEIODINASE ENZYME IN DWARF CHICK EMBRYOS.** *L.M. Huybrechts, V.M. Darras, A. Vanderpooten, E. Dewil, E. Decuyper and E.R. Kühn.* Catholic University of Leuven (KUL).

The effect of an injection of thyroxine (T4), growth hormone (GH) or a combination of both on plasma triiodothyronine (T3) and liver 5'-monodeiodinase (5'-D) activity was investigated in normal and sex-linked dwarf 17 day old embryos. T4 injections resulted in increased circulating T3 levels without affecting liver 5'-D activity. This was the case in both normal and dwarf embryos, indicating that the enzyme system in dwarf birds is not affected by the dwarf gene. Injections of GH increased liver 5'-D activity and also plasma T3 levels in normal birds. When T4 was injected simultaneously or after an initial GH stimulation, a higher T3 production was observed. In dwarf embryos this stimulatory effect of GH was completely absent, which can be explained by a lack of GH receptors. It is subsequently hypothesized that this lack of stimulation is a major cause for the observed dwarf growth during postnatal development.

- 69** **APPLICABILITY OF THE ABUNDANCE BIOMASS COMPARISON METHOD OF WARWICK FOR THE DETECTION OF POLLUTION IN PONDS.** *L. Int Panis.* University of Antwerp (UIA).

WARWICK (1) proposed a biological system, using the configuration of k-dominance graphs for numbers and biomass, to detect pollution. Due to the elimination of heavier K-selected species and the increase in numbers of the small r strategists in disturbed communities, WARWICK found that, at polluted sites, the numbers curve lies above the biomass curve, whereas under stable conditions the opposite is true. Until now all data supporting the system came from marine test sites. To test the system in fresh water, samples of benthic invertebrates and water were taken in five ponds with a different degree of pollution. Some are located in the same area to avoid confusion with faunal differences not caused by pollution. Biological samples were taken with a Ponar grab which performed better than a handnet. Average numbers and species richness were higher in a Ponar sample (235cm<sup>2</sup>) than in a handnet sample (5m). Two results are important. First there are big differences between the samples for most species in all ponds. It is believed that water depth and substrate type influence community structure and the configuration of the ABC-plots. Second, a very large sample is needed to catch the rare K-selected species and draw accurate ABC-plots. If they are not caught, the configuration of the plots alters and the polluted state is indicated. These results show that, at this time, the ABC method cannot be used to detect pollution in ponds. More research is needed to assess the effects of environmental factors on the communities.

(1) R.M. WARWICK (1986) – *Marine Biology* 92:557-562.

- 70 **IN VITRO INCUBATION OF PROTOSCOLECES (*ECHINOCOCCUS GRANULOSUS*) TOGETHER WITH IMMUNOCYTES AND SERUM OF THE LABORATORY WHITE MOUSE.** D. Janssen and M. Rueda Rubio\*. State University of Ghent, Belgium and \*University of Granada, Spain.

Experimental secondary echinococcosis of the parasite *Echinococcus granulosus* in the laboratory white mouse revealed the existence of concomitant immunity. This raises the following question: how does an immunized host control the invasion of newly introduced protoscoleces? We incubated *in vitro* protoscoleces, isolated from hydatid cysts from the peritoneum of infected mice, together with non-adherent spleen cells, adherent and non-adherent peritoneal cells, from immune and control mice. The effect of normal and immune mouse sera on leukocyte-protoscoleces interactions was studied. The interactions using living or heat-killed protoscoleces were compared. It was shown in the mouse that immune serum causes adherence of protoscoleces to leukocytes from immune mice and normal mice. When no serum was present, only immune peritoneal lymphocytes adhered readily and preferentially to the anterior and posterior parts of living protoscoleces, whereas they adhered to the entire surface of dead protoscoleces. Neither the adherence of leukocytes nor mouse serum was capable of killing the protoscoleces during 24 h of culture *in vitro*. It is concluded that there is a specific recognition of protoscoleces by local (*e.g.* from the peritoneal cavity) non-adherent leukocytes, and by immune serum from infected hosts, but the results also show that these processes *in vitro* are not sufficient to explain the immunological control of secondary infecting protoscoleces *in vivo*.

- 71 **COMPARATIVE MORPHOLOGY AND BIOMETRY OF LIMB BONES OF *URSUS DENINGERI* FROM BELLE-ROCHE (SPRIMONT, BELGIUM), *URSUS SPELAEUS* AND *URSUS ARCTOS*.** E. Javaux and J.-M. Cordy. University of Liège.

Until 1980, the middle Pleistocene site of Belle-Roche had been excavated by the University of Liège under the direction of Dr. J.-M. Cordy. The most abundant species is *Ursus deningeri* VON REICHENAU. The anatomy and the biometry of the limb bones of this species were compared with those of two species of reference: *Ursus arctos* and *Ursus spelaeus*. The differentiation between *U. arctos* and *U. spelaeus* is very clear. In the same way, *U. deningeri* can be distinguished from others through its complex morphology including arctoid, speleoid and middle characters. Furthermore, the tibia of *U. deningeri* shows some peculiar characters. This seems to demonstrate a certain specialization. The fact that *U. arctos* and *U. spelaeus* have a common ancestor, *U. etruscus*, is generally admitted. Nevertheless it has not been clearly demonstrated that *U. deningeri* is intermediate between this ancestor and *U. spelaeus*. The specialization of *U. deningeri*, shown in this study, may imply that this fossil bear rather belongs to a parallel branch.

- 72 **DISTRIBUTION AND ECOLOGICAL ROLE OF SEABIRDS AND MARINE MAMMALS IN THE WEDDELL SEA, ANTARCTICA: EARLY SPRING.** C.R. Joiris. Free University of Brussels (VUB).

The early spring distribution of animals belonging to the higher trophic levels (seabirds, pinnipeds and cetaceans) was quantitatively determined in the northern Weddell Sea during the EPOS 1 cruise of the icebreaking RV Polarstern, at 291 half hour counts from October 18 to November 16, 1988 (+ 94 counts in sub-antarctic and subtropical water). The bird populations were dominated by Adélie Penguins *Pygoscelis adeliae*, representing 90% of the total avian density in the closed pack ice (CPI), with a mean density of 31 penguins per km<sup>2</sup>. The main pinniped was the crabeater seal *Lobodon carcinophagus*, with a mean density of 1.2/km<sup>2</sup> in the CPI and local concentrations reaching 14/km<sup>2</sup>. Expressed as biomass, comparable mean values of about 100 kg/km<sup>2</sup> were found in the Antarctic zone for seabirds and seals, and 180 for baleen cetaceans (140, 180 and 220 kg/km<sup>2</sup> respectively in the CPI), while marine mammals were almost absent, and the birds' density much lower, in open water. A mean value of food intake by higher trophic levels was calculated as 1.7 mg C/m<sup>2</sup>/d for the Antarctic zone (2.3 in the CPI); the krill consumers being the most numerous, this ingestion probably corresponds to about 1.5 mg C krill/m<sup>2</sup>/d.

- 73 **QUANTITATIVE SAMPLING OF POPULATIONS OF EISENIA ANDREI BOUCHE IN MANURE HEAPS.** G. Josens and B. Spineux. Free University of Brussels (ULB).

*Eisenia andrei* has been studied, up to now, mainly under laboratory conditions. In spite of its interest in vermiculture, quantitative population studies in open air conditions are still lacking. As for other soil invertebrates it is important to study this species in respect with quantitative sampling strategies, using numerous small samples dispersed randomly. However the smaller the sample, the higher the number of worms that will be cut: we propose a solution to this problem. The samples are taken with a sharpened serrated cylindrical soil corer (50 cm high and 6.5 cm in diameter) and fixed in 1 liter of 10 % formaline. They are sorted two days later by washing on a 1 mm mesh sieve. All the worms are measured (weight and diameter); those that had been cut are recorded as proportions of whole worms by means of regressions between diameter and weight. A mathematical model enabled us to estimate the percentages of worms of each size that should have been cut. The actual percentages of cut worms were much lower than foreseen, as a result of the non linearity of the worms and of their ability of rapid contraction while the corer was drilled into the heap of manure, reducing their length by 26 - 34 %. This method was used and revealed to be efficient for studies of structure and dynamics of *Eisenia andrei* populations in open air conditions.

- 74 **RICHESSSE SPECIFIQUE ET DISTRIBUTION DES AMPHIBIENS DU GENRE *HYPEROLIUS* (HYPEROLIIDAE) DANS LE FORESTIER CENTRAL DU ZAIRE.** M. Kazadi, J. Hulselmans\* et H. Gevaerts\*\*. Université de Kisangani, Zaire, \*Université d'Anvers (RUCA) et \*\*Centre universitaire du Limbourg, Diepenbeek.

L'Examen des collections des *Hyperolius* du Forestier Central conservées au Musée Royal d'Afrique Centrale à Tervuren et au Musée de L'Institut des Sciences Naturelles à Bruxelles, ainsi que l'apport d'une nouvelle collection que nous avons organisée à Kisangani pendant 576 heures des nuits sur terrain d'août 1985 à août 1987, nous permettent de présenter la composition taxonomique actuelle du genre *Hyperolius*. Sur un total de 21 espèces recensées, deux espèces les plus répandues sont représentées chacune dans 31% et 56.8% des localités explorées et cinq dans une localité chacune. Les localités les plus riches en espèces sont Eala (28.57%), Boteka et Kisangani (33.33%). La nouvelle collection a révélé l'existence de deux espèces non connues dans le Forestier Central et de deux autres espèces du Forestier dont la distribution s'élargit pour la première fois jusqu'à Kisangani. Les espèces savaniques y recensées auraient envahi celui-ci lors des fluctuations paléo-climatiques. Ces résultats indiquent que le Forestier Central est pauvre en espèces compte tenu de sa vaste étendue et que des recherches plus fouillées sur terrain accouplée de la révision du genre augmenteront certes le nombre d'espèces.

- 75 **DO MALE BLUE TITS (*PARUS CAERULEUS*) GUARD THEIR MATES ?** B. Kempenaers and A.A. Dhondt. University of Antwerp (UIA).

To increase their reproductive success male birds can try to become polygynous and/or engage in extra-pair copulations (EPC's). At the same time a male has to avoid suffering from EPC's himself. One way to do this is by guarding his fertile female. In 1989 we studied a colour ringed Blue Tit population in a 17 ha wooden estate, provided with 100 small-holed nestboxes. Blue Tits are territorial during the breeding season. Most males remain monogamous, but some are able to attract more than one female. Males do invest heavily in paternal care. When polygamous, the male often (but not always) helps to feed the chicks at both nests. The calculation of a breeding synchrony index (1) showed that the population was moderately synchronous. Male Blue Tits do guard their mate(s). They stayed closest to their female(s) during the fertile period. Monogamous males stayed closer to their female than polygamous males. Polygamous males stayed closer to their primary female than to their secondary. In the fertile period the male followed his female more often than in the prefertile period. This is the first study showing that bigamous males try to guard both females. Lost paternity could be an important cost of being a polygynous male, if the females have overlapping fertile periods. DNA-fingerprint analyses are being done to find out. Supported by grants from IWONL (to B.K.) and NFSR (to A.D.).

(1) M. BJÖRKLUND and B. WESTMAN (1986) — *Ornis Scandinavica* 17:99-105.

**76 AN ECOLOGICAL BASIS FOR RODENT CONTROL: OPTIMISM AND REALITY.** *H. Leirs.* University of Antwerp (RUCA).

Rodent control is one of the most difficult disciplines in pest control. Largely, this should be attributed to the characteristics of these animals and it is often emphasized that control programs need a better underlying ecological basis. The optimistic view is that ecological insights can provide useful tools and ideas for rodent control strategies (population management, forecasting, biological control,...). Certainly, several ecological principles have proven indeed to be very useful. However, the reality is that many rodent ecology studies have not succeeded in this ambition. Here, we will discuss some of the reasons for this strange discrepancy. Historically, pest controllers and ecologists don't live together: they work for different institutes which get their money from very different sources and have very different duties. Thus, there is a lack of communication which makes it difficult to overcome the different approach of ecological information. An example is the different attitude of both groups towards ecological models, e.g. a mathematical population dynamics model  $N = f_1(x_1) + f_2(x_2) + \dots + f_n(x_n) + c$ . Ecologists use this model as an abstract way of understanding reality: they are primarily interested in the nature of the functions  $f_i()$ . The pest controller wants to use the model as a tool in decision-making: he collects parameter-values, throws them into a black box, and expects a realistic value for  $N$ . Moreover, in order to understand certain processes, an ecologist will try to keep most conditions constant during his study. A pest controller is not able to do so. The amount of variables that he has to take into consideration is enormous, not even restricted to biology, but including agriculture, economy, sociology,... The differences in attitude are even enlarged by the different scales, both temporal and spatial, on which ecologists and pest controllers work. Finally, neither group fully appreciates the other one: "pest control is not academic enough", "ecology is just rodent watching". We conclude that the relative inefficiency to provide useful results for rodent control is not an intrinsic feature of ecology, but rather due to "cultural" differences and structural barriers between ecologists and pest controllers. It is argued that "pest ecologists" should be trained and concerned in both fields. H.L. is a research assistant of the NFSR.

**77 MAINBIB : A NEW PERSONAL COMPUTER PROGRAM FOR THE MAINTENANCE OF SCIENTIFIC LIBRARIES.** *H. Leirs and L. De Bruyn.* University of Antwerp (RUCA).

Scientific research teams need a fast, easy, informative and complete filing and retrieval system for their scientific reference library. Personal computers are great tools to store bibliographic information..., but only if the appropriate software exists. Existing programs are difficult to use, and never satisfy all scientific needs. Our own experience with this problem urged us to develop a highly versatile and easy-to-use PC-program, where modifications to personal needs and interests are the prime objective. This program is now available under the name **MAINBIB**. Some of the most important features include full data for up to 99,999 different references; easy-to-use bar menus; the screen looks as a traditional file card; personalized output on reprint request cards, interlibrary requests, reference lists...; reference lists according to journal publisher's rules; a journal catalog stores full and abbreviated journal names and use them when

needed; work simultaneously on different PC's without network hardware; read data that were selected from Current-Contents-on-diskette; retrieve references by author's names, year of publication, word from title,...; powerful and fast keyword system for refinement in selecting the right references; easy communication with other programs since the files have a dBase-structure; and more... Additional information is available from the authors during the Congress of afterwards. H.L. is a research assistant and L.D.B. is a senior research assistant of the NFSR.

**78 SEASONAL VARIATION IN THE DIET OF *MASTOMYS NATALENSIS* IN TANZANIA: RELATION WITH THE REPRODUCTIVE SEASON.** H. Leirs, R. Verhagen, J. Stuyck and W. Verheyen. University of Antwerp (RUCA).

In Morogoro, Tanzania, the multimammate rat *Mastomys natalensis* (Smith, 1834) starts breeding soon after the onset of a heavy rain period, even though it occurs off-season (1). In several graminivorous or desert rodents similar relations have been explained through a physiological reaction of the rodents to secondary plant compounds in their diet (2). These chemicals are found in growing grass which is present soon after the onset of rains as well. To test if such an explanation would make any sense for *Mastomys*, we analyzed the stomachs of 136 animals, snap-trapped on fallow fields in Morogoro, between April 1988 and February 1989. After washing, sieving (0.212 mm) and clearing in nitric acid, the food items were counted under the microscope, scored relative to their surface and attributed to one of five categories (grass, seeds, other plant material, arthropods, other). Seasonal comparison of the diet shows that the rodents are omnivorous, with grass being important in the beginning of the rainy season. Although these data provide no sound evidence for the proposed hypothesis, they are certainly suggestive enough to justify further study of the role of chemicals in grass to trigger reproductive activity in *Mastomys*. H.L. is a research assistant of the NFSR.

(1) H. LEIRS *et al.* (1989) — *Annls Soc.r.Zool.Belg.* 119:59-64.

(2) H. KORN (1989) — *Can. J. Zool.* 67:2220-2224.

**79 ACTIVITE BIOLOGIQUE DE DEUX REGULATEURS DE CROISSANCE A L'EGARD DE *SITOPHILUS ZEAMAI*, *SITOPHILUS GRANARIUS* ETRHI-ZOPERTHA DOMINICA.** C. Letellier, E. Haubruge et Ch. Gaspar. Faculté des Sciences Agronomiques, Gembloux.

Du fait de leur faible toxicité à l'égard des vertébrés, les régulateurs de croissance (IGR) présentent une alternative intéressante aux organophosphorés et aux fumigants auxquels de nombreux insectes sont résistants. Des grains traités à l'aide de 0,5 ppm de diflubenzuron (DFB) et de 5 ppm de fenoxycarb ne permettent pas aux insectes de se reproduire. L'action de ces 2 IGR sur la reproduction de *S. zeamais* et sur les chances de survie des oeufs et des différents stades larvaires de cet insecte cachés dans les grains a été étudiée. Le DFB stérilise les femelles dont la production d'oeufs n'est cependant pas affectée dans les grains traités. Il existe donc un effet ovicide par contamination des femelles. Les stades immatures se trouvant dans les grains au mo-

ment du traitement au DFB ne sont pas touchés. Le fenoxycarb n'affecte pas les femelles. Par contre, ce produit pénètre en surface des grains et est toxique pour les oeufs et les larves de premiers stades. Des stratégies de lutte intégrée pourraient être élaborées afin d'assurer une protection efficace des grains sans promouvoir de résistance.

**80 NUTRITION AND DIGESTION CHARACTERISTICS OF *BABYROUSA BABYRUSSA* L. K. Leus and A.A. Dhondt. University of Antwerp (UIA).**

The babirusa has a stomach structure and foraging behaviour different from the other Suidae. Therefore we attempted to find indications for the possibility of babirusa being a forestomach-fermenter. The following items were studied: (1) their food preference by choice experiments; (2) the rate of food passage by giving the animals plastic beads; (3) their reaction on cellulose-rich food items by feeding them grass, leaves and twigs. All the practical work was done at the Antwerp Zoo. The animals preferred apples, bananas and bread. The 5% excretion time of the beads was 8.5 h and the 95% time was 43.5 h. This rate does not differ from that of domesticated pigs. The animals were capable of digesting leaves and twigs without harmful consequences, although the digestion of the leaves remained incomplete. However, feeding on a continued diet of grass resulted in diarrhoea. These results do not suggest a specialised forestomach-fermentation. To determine the real digestion mechanism of the babirusa, further investigation is needed.

**81 ETUDE DE LA FIXATION DE CERTAINES LECTINES DURANT LA CEPHALOGENESE DE L'EMBRYON DE SOURIS. S. Louryan. Université Libre de Bruxelles (ULB).**

La fixation des lectines wheat germ agglutinin (WGA), Peanut agglutinin (PNA), *Ricinus communis* agglutinin (RCA-I), *Ulex europaeus* agglutinin (VEA-I), soybean agglutinin (SBA) et *dolchos biflorus* agglutinin (DBA) a été étudiée au cours de l'ontogenèse céphalique viscérale de l'embryon de souris (11 à 18 jours), à l'aide d'une technique avidine-biotino-peroxydase, en microscopie photonique. La PNA, pour autant que son application soit précédée d'une pré-incubation à la neuraminidase, permet une révélation précoce et transitoire des blastèmes presquelettiques dans les arcs branchiaux, en rapport avec le dépôt de la matrice exocellulaire. L'application de la PNA et de la RCA sur les germes dentaires révèle diverses localisations différentielles qui sont mises en corrélation avec les multiples interactions épithélio-mésenchymateuses qui président à l'ontogenèse dentaire. La RCA permet également d'observer un riche réseau artériolaire. De nombreuses lectines présentent des sites de fixation sur les tendons ainsi que sur le disque de l'articulation temporo-mandibulaire, ce qui renforce l'hypothèse qui associe étroitement ce dernier au tendon du muscle ptérygoidien latéral. La DBA et la PNA se fixent également sur l'épithélium salivaire. La fixation des lectines apparaît donc comme un témoin précieux des modifications histochimiques associées à l'ontogenèse céphalique et à ce titre doit être mise en corrélation avec diverses données histochimiques. Recherche supportée par le crédit GB1621CB2380 du FNRS.

- 82 **THE SPIDER FAUNA OF A NORTH AND SOUTH FACING MOTORWAY VERGE.** J.-P. Maelfait\*, L. Baert and K. Desender. \*Institute of Nature Conservation, Hasselt and Royal Belgian Institute of Natural Sciences, Brussels.

Broad north and south facing verges along the E17 motorway were sampled along their slopes with transects of pitfall traps. This revealed quite rich spider faunas of which the composition differed markedly in agreement with slope orientation, soil moisture content and vegetation management. Our results show that these sites function as a refuge for invertebrates of open, low productive habitats. The authorities responsible for these man-made structures could therefore contribute to nature conservation by incorporating regional and local variation of the abiotic environment in their management plans. Planting trees or shrubs on such habitats would certainly mean the loss of their high ecological value.

- 83 **EFFECTS OF DIFFERENT MANAGEMENT PRACTICES ON THE SPIDER COMMUNITIES OF DRY HEATHLAND.** J.-P. Maelfait\*, R. Jocqué\*\*, L. Baert and K. Desender. \*Institute of Nature Conservation, Hasselt, \*\*Royal Museum of Central Africa, Tervuren and Royal Belgian Institute of Natural Sciences, Brussels.

This communication deals with spider communities of dry heathland and how these are influenced by different management measures and vegetation structure. We analyzed two sets of data, both gathered in the nature reserve "De Kalmthoutse heide" (Kalmthout, Belgium) : a first during the seventies, a second during 87/88. During the seventies the following situations were studied: old *Calluna* heathland, burned heathland just after and two and four years after the fire, and mown heath with and without removal of the dead biomass two and six years after mowing. Each situation was sampled with six pitfall traps during a complete year cycle. The purpose of the sampling made during 87/88 was to look on a much finer scale for the relationship between vegetation structure of *Calluna* heathland and spider distribution. A series of twelve traps was operative in places differing in vegetation and litter structure. Analysis of the captures of both campaigns reveals that the occurrence and distribution of *Calluna* heathland spiders are strongly influenced by the vertical as well as the horizontal structure of that vegetation and its litter layer. That is why different management measures like burning, mowing and grazing cause specific variation in these spider communities. Although *Calluna* heath is an almost monospecific plant community, variation in its structure offers possibilities for many spider species. This implies that spider sampling is a very good tool for monitoring the effects of different management practices applied in these habitats.

- 84 THE RELATION BETWEEN THE HETEROGENEITY OF FOREST COMPLEXES AND THE RICHNESS OF THEIR SPIDER FAUNA.** *J.-P. Maelfait\**, H. Segers\*\*, L. Baert and K. Desender. \*Institute of Nature Conservation, Hasselt, \*\*State University of Ghent and Royal Belgian Institute of Natural Sciences, Brussels.

The purpose of this communication is to discuss the results obtained from a comparison of the spider communities occurring on the soil surface of 37 woodland habitats of Flanders, a region with a very low forest cover. For each stand we used the numbers of individuals caught per species in three pitfall traps. They were operated during a complete year cycle. The sampled woodlots are part of several complexes distributed over the whole region. We obtained an ordination which was not interpretable in terms of the environmental factors measured or observed in each of these stands. This indicates the overriding importance of the complex of which a stand is part of in the determination of its spider fauna. There is no relation between the size of a forest complex and the number of species found in any of its particular stands. This result can be explained if we assume that the spider fauna of a particular stand is not only determined by the environmental conditions prevailing in it but is also highly influenced by the surrounding communities. A richer spider fauna in stands of small forest complexes could be caused by the penetration and colonization of species having their optimal habitats in the surrounding open biotopes. Forest stands embedded in complexes with an intermingling of different open and woodland habitat types therefore have a richer spider fauna.

- 85 FAUNAL INTERESTS OF WET DUNE GRASSLANDS ALONG THE BELGIAN COAST.** *J.-P. Maelfait\**, L. Baert and K. Desender, \*Institute of Nature Conservation, Hasselt and Royal Belgian Institute of Natural Sciences, Brussels.

The aim of this communication is to evaluate the faunal interests of two yearly mown wet dune grasslands of the nature reserve "De Westhoek" (De Panne, Belgium). An important threat to the botanical values of the reserve is that the major part of its dune slacks is being overgrown by dune shrub. Therefore, a general aim of the management is to clear parts of that shrub by means of cutting, and also to protect the remaining open areas against the invasion of sea buckthorn. Due to the unusually high rainfall during the first half of 1988 the two sampling localities were flooded from the second half of January till the end of June. To analyse the variation in the composition of the arthropod community we used two taxonomical groups which are good ecological indicators: spiders and carabid beetles. To evaluate the faunal interests of the two grasslands we compared their spider and carabid communities with those of nearby sea buckthorn shrubs and patches of rough vegetation. This leads to the conclusion that although priority should be given to the management of the young wet grassland, the other investigated habitats also have their special species and thus also deserve our attention. For the plants the immediate effect of the flooding was dramatic. To illustrate the short term effect of the flooding on the fauna we contrasted the captures of carabids made during August 1987 and August 1988. From these data we can conclude that the elimination of sea buckthorn shrub somewhat further around the wet dune grasslands would create better chances for the survival of plant as well as of invertebrate populations during a winter flooding.

- 86 **ASPECTS ENERGETIQUES DES OUVRIERES ET SEXUES DE LA FOURMI *LEPTOTHORAX UNIFASCIATUS* (LATR.) (HYMENOPTERA: FORMICIDAE) AU COURS DE LEUR DEVELOPPEMENT.** P. Martin. Université Libre de Bruxelles (ULB).

Les poids secs, contenus énergétiques, pourcentages de lipides et teneurs en cendres ont été mesurés pour les différentes castes de *Leptothorax unifasciatus* depuis le stade oeuf jusqu'à l'imago âgé. L'évolution de ces paramètres montre plusieurs différences selon les castes, interprétables dans le cadre des modalités reproductives de cette espèce. Les ouvrières accumulent des lipides pendant la vie nymphale, probablement destinés au nourrissage futur des jeunes larves. Le contenu énergétique des mâles diminue continuellement depuis le stade prénymphe et les adultes sont pratiquement vidés de leur contenu lipidique. Ce dernier semble être converti en hydrates de carbone, spécifiques au vol nuptial. Les reines accumulent des lipides après l'émergence imaginale, caractéristique des espèces à fondation indépendante. Cependant, contrairement aux données de la littérature, une importante partie de cette accumulation se passe pendant la fin de la vie larvaire. Cet enrichissement lipidique peut rendre compte du coût d'une fondation indépendante. Des éléments laissent supposer que le coût des sexués et l'effectif des ouvrières sont des paramètres-clés déterminant le moment où une société commence à produire les sexués au cours de son développement.

- 87 **EFFECTS OF HABITAT FRAGMENTATION ON POPULATION ECOLOGY OF SMALL WOODLAND BIRDS: A PRELIMINARY REPORT.** E. Matthysen, F. Adriaensen and A.A. Dhondt. University of Antwerp (UIA).

Studies on effects of habitat fragmentation have mainly focused on species diversity and presence/absence of species, and less on population processes. Since 1989 a population of Nuthatches *Sitta europaea* has been studied in small (1 - 50 ha) deciduous woodlots and parks isolated by 100 m to a few km. Previous studies have shown that presence of Nuthatches is sensitive to area and isolation effects. We found the species in virtually all areas with suitable vegetation and larger than 2-3 ha. Resightings of birds marked as nestlings show that natal dispersal is limited to a few km and suggest a possible effect of "stepping stones". Further information on movements after initial settlement is required to evaluate the impact of isolation on patch occupation and population dynamics. The empirical data will be used to adjust and test metapopulation models developed for this species (Rijksinstituut voor Natuurbeheer, The Netherlands). Breeding failure due to nest-site take-over by Starlings *Sturnus vulgaris* may be more common in small woodlots in comparison to an earlier study in a large (150 ha) wooded area. More data are required to verify these preliminary results and suggestions. Food availability for insectivorous birds is studied in woodlots varying in size and isolation by monitoring breeding success of Great Tit *Parus major* and Blue Tit *P. caeruleus* and estimating caterpillar numbers by frass fall. This will allow us to evaluate effects of fragmentation on different trophic levels.

- 88 **THE PURIFICATION AND CHARACTERISATION OF A YEAST HEMOGLOBIN OF *CANDIDA NORVEGENSIS* (DIETRICHSON, 1954) (VAN UDEN ET FARINHA).** *J. Mertens* and *D. Debonnaire*. University of Antwerp (UIA).

The observation that hemoglobins occur more frequently in plants and fungi than originally expected (1) has recently attracted attention to the study of the structure and evolution of globins in primitive organisms. We studied the hemoglobin of the yeast *Candida norvegensis*. The yeast was grown in an aerated pepton medium. The cells were disintegrated by ultrasonication and the released hemoglobin purified in high yield through (ultra)centrifugation, ammoniumsulfate precipitation, ion exchange chromatography and finally through reverse phase chromatography. Spectral and electrophoretic analysis proved the homogeneity of the obtained protein solution. In contrast to previous reports (2) a single globin chain was identified with a molecular weight of 40,000. Next to the heme group the presence of a second prosthetic group, FAD, was confirmed. This suggests that most likely the molecule is built up out of two structural domains, a heme binding domain (16,000) and a FAD binding domain (40,000). Therefore it is essential to determine the primary sequence of this exceptional hemoglobin and to reveal the function of it in the yeast cell.

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(2) *R. OSCHINO, T. ASAKURA, N. OSHINO and B. CHANCE* (1973) — *Eur. J. Biochem.* 35:581-590.

- 89 **THE DISTRIBUTION OF ACTIN FILAMENTS IN TWO DIFFERENT CELL TYPES IN LARVAL AND PUPAL MALPIGHIAN TUBULES OF THE FLESH-FLY, *SARCOPHAGA BULLATA*.** *W. Meulemans* and *A. De Loof*. Catholic University Leuven (KUL).

The distribution of actin filaments in cells of whole-mounted Malpighian tubules of the fleshfly *Sarcophaga bullata* was investigated by means of the rhodamine phalloidin staining method in combination with fixation and detergent extraction. These tubules, like the proximal tubule of the vertebrate kidney, form an isosmotic filtrate of the haemolymph. In larval Malpighian tubules the large active primary cells contain a well developed apical brush border and a pattern of basal actin filament bundles. Active pupal primary cells show a pattern of numerous thick parallel actin bundles at their basal membrane. Inactive pupal primary cells only contain a fine meshwork of actin filaments. The secondary cell type displays a less stained apical microvillar zone and has no basal actin bundles. In late larval tubules prior to pupation the microvillar zone shows increased labelling. Actin filament bundles are formed in the protrusions of differentiating secondary cells, in late pupal Malpighian tubules. Supported by an IWONL grant (W.M.).

**90 CARACTERISTIQUES REPRODUCTRICES DANS UNE POPULATION DE *LOPHUROMYS FLAVOPUNCTATUS* DE LA SAVANE ANTHROPIQUE DE TSHIBATI. M. Musonera. Université d'Anvers (RUCA).**

La reproduction de *Lophuromys flavopunctatus* (Rodentia: Muridae) a été étudiée dans une zone agraire dans la localité de Tshibati (Zaire). 388 animaux adultes dont 214 mâles et 174 femelles ont été utilisés dans cette étude. L'activité reproductrice a été suivie pendant deux cycles annuels : de janvier 1985 à décembre 1986. Le poids du corps et l'état des organes génitaux ont fourni des renseignements sur la maturité sexuelle et la période de reproduction. Durant la période d'étude, le climat a été caractérisé par une saisonnalité bien marquée : la saison pluvieuse qui a duré neuf mois (du mois de septembre au mois de mai) et la saison sèche limitée à trois mois (de juin à août). La température moyenne mensuelle et l'humidité relative n'ont pas beaucoup varié durant les deux années. L'étude montre que *L. flavopunctatus* est une espèce à reproduction saisonnière. Dans la nature, les naissances et les gestations ont été enregistrées au cours d'une période définie de l'année. La reproduction débute avec le retour des pluies en septembre, dès le mois d'avril, l'activité sexuelle se ralentit dans l'ensemble de la population et décline pendant la saison sèche. La reproduction de ce rat semble être placée davantage sous la dépendance d'un facteur macroclimatique régional (la pluie), mais il paraît que ce facteur ne soit pas la seule variable.

**91 VARIABILITE MORPHOLOGIQUE D'*IPS TYPOGRAPHUS* EN RELATION AVEC DIVERSES CARACTERISTIQUES ECOLOGIQUES. L. Nef. Université Catholique de Louvain, Louvain-la-Neuve.**

Dans le cadre d'études sur les mécanismes de résistance de *Picea abies* envers *I. typographus*, une recherche a porté sur les relations entre la variabilité morphologique de ce dernier et certaines caractéristiques environnementales. Les insectes adultes ont été piégés durant 4 semaines d'une période d'essaimage en 1987 ou 1988 dans 12 pesières à des altitudes allant de 150 à 600 m, puis mesurés par analyseur d'images. Ont en outre été mesurées diverses caractéristiques physiques des stations et peuplements, ainsi que des caractéristiques chimiques du sol et des arbres (terpènes et éléments minéraux de l'écorce). La longueur moyenne des insectes varie d'un site à l'autre et montre en particulier une corrélation positive très significative avec l'altitude:  $R^2=0,627$ . L'utilisation de plusieurs variables explicatives a en outre révélé des corrélations très élevées entre cette longueur et (1) l'altitude et la vitesse de croissance des arbres (expression de la qualité stationnelle pour l'épicéa:  $R^2=0,765$ ), (2) les teneurs du sol en (-) Zn et N et (+) P et Cu ( $R^2=0,907$ ), et (3) des teneurs en certains mono- et sesquiterpènes de l'écorce, ceux-ci dépendant partiellement des caractéristiques stationnelles ( $R^2=0,848$  avec 4 terpènes déjà). Aucune relation intéressante n'a été trouvée avec les éléments minéraux de l'écorce. Une conclusion générale est que la longueur de ces insectes est reliée avec les principales caractéristiques biochimiques de leur arbre-hôte; par contre, elle est en relation négative avec l'intensité des attaques sur l'épicéa. Recherches subsidiées par l'IRSIA.

- 92 **THE DYNAMICS OF DOMINANCE RELATIONSHIPS IN A CICHLID FISH APPLIED TO THE "JIGSAW PUZZLE" APPROACH.** *M. Nelissen*. University of Antwerp (RUCA).

To understand the mechanisms underlying the development and maintenance of dominance relationships in a linear hierarchy, the agonistic behaviour of a cichlid fish, *Melanochromis auratus*, was studied and compared to Chase's model of the "jigsaw puzzle". Chase's approach implies that in a group the formation of a linear dominance hierarchy (1) can not be explained by individual differences, (2) nor by pair-wise interactions alone, (3) but by triadic interactions. (4) All triadic relationships have to be transitive, which is realized by a predominant occurrence of "double attacks" and "double receives" in all triads. We analyzed dominance behaviour in groups of *M. auratus*. The lawfulness of the relationships seems to be an important factor in stabilizing the hierarchy. Applying Chase's model, we found some agreements (+) with as well as some shortcomings (-) of the model. (1-) There are correlations between significant individual differences and ranks. (2+) Pair-wise established dominance relationships differ completely from those formed in groups. (3+) We found triads of sequences occurring significantly more than at random, (4+) in which "double attacks" and "double receives" are most frequent. But also other "group factors" have to be taken into account to explain this hierarchy. Moreover, the "jigsaw puzzle" does not coincide with our findings on the formation of the hierarchy in which several phases can be distinguished.

- 93 **PARTICULARITES DE L'INCUBATION BOURSALE CHEZ L'OPHIURE AMPHIPHOLIS SQUAMATA (ECHINODERMATA).** *V. Nisolle*, *M. Jangoux* et *V. Alvà\**. Université de Mons-Hainaut, Mons et \*Université Libre de Bruxelles.

*Amphipholis squamata*, ophiure intertidale commune des côtes européenne, incube ses jeunes jusqu'à des stades très avancés de développement (i.e., stades juvénile à pré-adulte). Les relations entre l'incubant et les incubés diffèrent sensiblement selon l'état de développement de ces derniers : les embryons se développent librement dans la cavité boursale; en fin de vie embryonnaire et pendant toute la vie larvaire (stade bilatérale) les incubés sont attachés à la paroi boursale de façon typique; l'attache larvaire régresse après la métamorphose et les incubés (stades pentagonale et juvénile) poursuivent leur développement sans présenter d'autre relation anatomique avec leur mère que d'être dans la cavité boursale. L'attache larvaire consiste en un manchon épidermique qui assure une continuité parfaite entre l'épiderme larvaire et celui de la paroi boursale; ce manchon entoure un cylindre fait d'un tissu conjonctif hémal issu de la paroi boursale et pénétrant le mésenchyme larvaire : la larve est donc anatomiquement annexée à sa mère. Tout ceci indique qu'existe une relation trophique, transitoire mais nette, entre incubant et larves incubés. Le type de relation, unique chez les échinodermes, explique l'apparent paradoxe de l'incubation par *Amphipholis squamata*, espèce dont les oeufs sont de petites tailles et pauvres en vitellus.

- 94 **ISOLATION AND IDENTIFICATION OF MYOTROPIC PEPTIDES FROM THE MALE ACCESSORY GLANDS OF *LOCUSTA MIGRATORIA*.** L. Paemen, L. Schoofs, P. Proost\*, J. Van Damme\* and A. De Loof. Catholic University of Leuven (KUL) and \*Rega Institute, Leuven.

Extracts of male accessory glands of *Locusta*, fractionated by high pressure liquid chromatography, contain several fractions which stimulate oviduct contraction *in vitro*. Myotropic factors were detected in all four different tubule types of the glands, as well as in the spermatophore. Extracts of spermathecae of mated females contain more myotropic fractions than extracts of virgins. These results suggest that some of the myotropic factors present in the male accessory glands are transferred to the female during copulation. Starting from 4400 gland masses three myotropic peptides have been isolated (HPLC) and identified: Arg-Tyr-Leu-Pro-Thr-COOH (Proctolin), Gly-Phe-Lys-Asn-Val-Ala-Leu-Ser-Thr-Ala-Arg-Gly-Phe-CONH<sub>2</sub> (Lom-AG-myotropin I) Ala-His-Arg-Phe-Ala-Ala-Glu-Asp-Phe-Gly-Ala-Leu-Asp-Thr-Ala-COOH (Lom-AG-myotropin II). These sequences have been confirmed by chemical synthesis. Proctolin has been identified in several insect species and is believed to act as a neurotransmitter. The other two peptides are completely new and show no sequence similarity to any known peptides in vertebrates or invertebrates.

- 95 **THE GLOBIN COMPOSITION OF THE HEMOGLOBIN(S) OF *DAPHNIA PULEX*.** K. Peeters and L. Moens, University of Antwerp (UIA).

*Daphnia* species possess several extracellular hemoglobins. In *Daphnia magna*, the relative amount of the hemoglobins differs when the animals are cultured at different oxygen pressures (1). A similar situation occurs in *Artemia* where the three hemoglobin phenotypes are built up of two globin chains (genotype  $\alpha$  and  $\beta$ ). The biosynthesis of globin chain  $\alpha$  is induced by low oxygen tension (2). Data about the globin chain composition of *Daphnia* hemoglobin phenotypes are lacking. The hemoglobin of *Daphnia pulex* has a Mr of 420-450,000 and is built up of four different globin chains ( $\alpha$ ,  $\beta_1$ ,  $\beta_2$ ,  $\gamma$ ) with Mr 33-35,000. Preliminary experiments using iso-electro focusing, indicate the presence of at least four hemoglobin fractions, which are all built up of the four globin chains. Using semi-preparative SDS-PAGE, three globin chain fractions are isolated:  $\alpha$ ,  $\beta_1 + \beta_2$ ,  $\gamma$ . The amino acid composition and peptide patterns after enzymatic cleavage of the globin chains are compared. The  $\beta$  and  $\gamma$  globin chains are virtually the same, while the  $\alpha$  chain differs from the others to a larger extent.

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- 96 **POLYGAMY IN THE STARLING: WHY DO FEMALES MATE WITH ALREADY-MATED MALES?** R. Pinxten, M. Eens and R.F. Verheyen. University of Antwerp (UIA).

Polygyny among European Starlings, *Sturnus vulgaris*, monoterritorial, colonially breeding passerines, was studied for four years. In nestbox colonies around Antwerp, primary females did not breed less successfully than monogamous females. Secondary

females generally fledged significantly fewer young than monogamous females. Secondary females could be classified into two categories. Category I females did not have the opportunity to select bachelor males at the time of mating, and these secondary matings may therefore be explained by the female-biased sex ratio at that time. Category II females, which could choose between mated and unmated males, fledged only 68% as many young as did simultaneously laying monogamous or primary females and their young weighed less. These results conflict with the predictions of the polygyny threshold model and the sexy son hypothesis, that secondary females should gain evolutionary advantage in either the short or long term. On the present evidence, it is not clear why category II females mated with already-mated males. Circumstantial evidence that they might have been unaware of the male's marital status at mating is presented.

**97 ESSAI D'ESTIMATION DE LA STATURE DE LA POPULATION MEROVINGIENNE DE TORGNY.** *C. Polet.* Institut royal des Sciences naturelles de Belgique et Université Libre de Bruxelles.

Certaines mensurations squelettiques fortement corrélées avec la stature peuvent être utilisées pour estimer la taille d'un individu. Evaluer la stature à partir d'ossements fragmentaires nécessite une opération supplémentaire: il faut estimer les longueurs manquantes. La population qui est l'objet de notre étude a vécu à Torgny (province de Luxembourg) du VI<sup>ème</sup> au VII<sup>ème</sup> siècle. Des estimations de la stature de ces Mérovingiens ont été réalisées à l'aide des tibias des fémurs et des métacarpiens. Pour estimer les longueurs manquantes, nous n'avons pas pu, vu le mauvais état de conservation du matériel, appliquer les méthodes de régression de la littérature. Notre méthode d'estimation fait appel à des mesures qui sont réalisables même si les surfaces osseuses sont détériorées (ce sont des mensurations "classiques" comme des diamètres, des périmètres,...). Nous avons ensuite utilisé les méthodes d'estimation de la taille de Trotter et Gleser (1952) et d'Olivier *et al.* (1978). La moyenne des tailles masculines obtenues avec la première méthode est de 171,1 cm, avec la seconde méthode de 175,3 cm; la moyenne des tailles féminines est respectivement de 162,3 cm et de 165,1 cm. La population de Torgny se distingue d'autres populations médiévales par la plus grande longueur de ses fémurs; une confrontation de la moyenne de ses statures avec celles de populations belges récentes indique qu'elle se rapproche plus de la taille des Belges du XX<sup>ème</sup> siècle que de celle des Belges du XIX<sup>ème</sup> siècle.

**98 MORPHOLOGY OF THE GLANDULAR SYSTEM IN THE LEAF-CUTTING ANTS *ATTA SEXDENS SEXDENS* (L., 1758) AND *ATTA SEXDENS RUBROPILOSA* FOREL, 1908 (HYMENOPTERA: FORMICIDAE).** *E. Schoeters.* Catholic University of Leuven (KUL).

Until now, the complete glandular morphology in the highly polymorphic leaf-cutting ants has never been studied in detail. Therefore, a comparative morphological survey has been aimed at in the female castes. The ants examined were obtained from

laboratory colonies, originally from Cayenne, French Guyana, and Vicosá, Brasil. In order to obtain our results, semi-thin sections for light microscopy were made and stained with methylene blue and thionin. Thin sections for electron microscopy were also made. The appearance of the exocrine glandular repertoire in the two subspecies investigated proved to be consistent with the general situation in myrmicine ants, but with some characteristics. The occurrence of an intramandibular gland is one important peculiarity. It is the first time that more detailed morphological data concerning this gland in ants have become available. The preliminary ultrastructural examination revealed the presence in the secretory cells of a well developed smooth endoplasmic reticulum, so a pheromonal role is possible. The simple morphology of the opening of the mandibular gland duct is rather unexpected. Another peculiarity is the existence of a morphological difference of the secretory filaments of the venom gland related to the worker's size: the smallest individuals are characterized by a relatively long, unpaired filament with a distal bifurcation. This bifurcation occurs more proximally in bigger workers. This is the first report of such an intraspecific morphological variation. In the abdomen, no pygidial glands nor sternal glands were found.

- 99 **INSECT NEUROPEPTIDES : ISOLATION, IDENTIFICATION AND LOCALIZATION.** L. Schoofs, G.M. Holman\*, T.K. Hayes\*\*, R.J. Nachman\*, A. Tips and A. De Loof. Catholic University of Leuven, Belgium; \*US Department of Agriculture and \*\*Texas A & M University, College Station, Texas.

From an extract of 9,000 brain-corpora cardiaca-corpora allata-suboesophageal ganglion complexes of the migratory locust, 32 myotropic and 12 myoinhibiting peptides were isolated, using a *Leucophaea* hindgut motility assay. The amino acid sequences of 12 locust peptides have been determined and verified by synthesis. These 12 peptides can be grouped into five distinct families. Locustasulfakinin shows sequence homologies with peptides of the vertebrate gastrin/cholecystokinin (CCK) peptide family. The locustatachykinins (four) make up a subfamily of the tachykinin peptide family. The sequence homology and analogous biological activity of these vertebrate and invertebrate peptides substantiates the evidence of long evolutionary history of the gastrin/CCK and tachykinin peptide families. The locustamyotropins (four) and locustapyrokinin have a common Phe-X-Pro-Arg-LeuNH<sub>2</sub> carboxyterminal, X being a valine, serine or threonine. An affinity purified antiserum directed against this carboxy-terminal sequence stains cell bodies in the locust brain and nerve fibers in a neurohaemal organ, the corpora cardiaca, suggesting a hormonal role. Locustamyosuppressin shows sequence similarity to the molluscan FMRFamide. A second inhibitor, locustamyoinhibiting peptide has a GWamide-carboxy-terminal and is related to the molluscan muscle inhibitor, APGWamide (1). Three myotropic peptides have been identified in *Sarcophaga bullata*, one of which is a sulfakinin, and two of which are unique in their primary structure.

(1) SMITH *et al.* (1990) – Gen. Comp. Endocrinol. (in press).

- 100 **BIOSTRATIGRAPHICAL IMPLICATIONS OF THE EVOLUTION OF THE UNGULATES ASSOCIATIONS IN THE LATE PLEISTOCENE OF BELGIUM: THE CASE OF THE SCLADINIA CAVE AT SCLAYN (NAMUR).** P. Simonet. University of Liège.

The excavation of the Scladinia cave has provided very important and stratigraphically well situated paleontological material. This long upper Pleistocene sequence (-128,000 to -38,000 B.P.) has given, in each layer, a great association of large mammals. The study of the remains of the Ungulates and the approach of the evolution of their associations permits the construction of the first scheme of biostratigraphical evolution on the large mammals in North-Western Europe. Indeed, the variations of the proportions of the different species, having each their definite ecological requirements, permit to point out the large variations of the paleo-environment during the Eemian Interglacial (*sensu* G. Woillard)(1) and the Weichselian glaciation. The Interglacial fauna is dominated by the woodland species (Red Deer, Roe Deer, Fallow Deer and Wild Boar) whereas the upper part of the sequence is represented by an openland fauna (Horse, Wild Cattle, Mammoth and Woolly Rhinoceros). To reinforce the informations given by the Ungulates, we have used some very typical climatic indicators such as the Porcupine of mediterranean affinities and the arctic fox. All these results are generally in very good agreement with the conclusions of palynological and micromammalian studies (2).

(1) G. WOILLARD (1978) — Quater. Research 9:1-21.

(2) OTTE *et al.* (1986) — Bull. AFEQ (1986), 1/2:168-177.

- 101 **PURIFICATION AND CHARACTERIZATION OF TRYPSIN FROM *GLOSSINA PALPALIS PALPALIS* (DIPTERA: GLOSSINIDAE).** H. Shuyts and J. Van Den Abbeele\*. Institute of Tropical Medicine, Antwerp and \*University of Antwerp (RUCA).

Trypsin is quantitatively the major proteolytic enzyme of *Glossina palpalis palpalis*. We found that 50-60% of total digestive proteolysis was carried out by trypsin. Trypsin was isolated from midgut homogenates by gel filtration on a Sephadex G-75 chromatography followed by affinity chromatography on a soybean inhibitor CH-Sepharose 4B column. The procedure resulted in a 36-fold purification of trypsin with a high specific activity (238 U/mg) but a low yield of activity (35%). The purification of trypsin revealed that three fractions with trypsin activity were identified after polyacrylamide gel electrophoresis (PAGE). In comparison with the whole midgut homogenate, only minor protein impurities could be detected on the gel. Trypsin was further characterized using SDS-PAGE and isoëlectric focusing. Isoëlectric focusing of purified trypsin revealed at least three fractions with an isoëlectric point of respectively pI = 5.1, pI = 5.3 and pI = 8.5. Only two fractions could be distinguished after SDS-PAGE. The molecular weight of these fractions was estimated to 24000 and 26500 Dalton. It is still unclear whether these fractions correspond to different trypsin-like enzymes. More thorough investigation is necessary to determine the possible differences between these fractions with trypsin activity.

102 **LES SOURIS DOMESTIQUES EN BELGIQUE, UNE SITUATION EN PLEINE EVOLUTION.** S. Smets et V. Bauchau. Université Catholique de Louvain (UCL), Louvain-la-Neuve.

Le caryotype standard de la souris (*Mus domesticus*) présente 40 chromosomes tous acrocentriques. Des fusions de chromosomes (translocations Robertsoniennes) peuvent se produire spontanément et réduire ainsi le nombre diploïde de l'espèce. Des populations de ce type (dites populations Robertsoniennes) ont été découvertes en Belgique. Nous avons caryotypé 447 individus pour 97 localités. Parmi ces souris nous en avons trouvé 323 présentant au moins un métacentrique et ce dans 49 localités qui forment une zone entourée d'individus normaux. Le nombre diploïde des souris étudiées jusqu'à présent en Belgique va de 40 à 36. Les fusions en présence sont la Rb(4.12) et la Rb(5.10). Nous avons capturé en trois périodes de piégeage successives 156 souris dans la même remise. Celles-ci possèdent de 37 à 40 chromosomes. L'évolution des fréquences de ces différents caryotypes nous montre un changement assez net dans la structure de la population avec, entre autre, la disparition du caryotype normal et une poussée des individus présentant 37 chromosomes. L'existence de la fusion Rb(4.12) dans 14 autres populations Robertsoniennes de souris sauvages en Europe pose le problème de l'origine de la dispersion et de la fixation de telles mutations. La population Robertsonienne en Belgique pourrait être le résultat de l'introggression relativement récente de quelques individus en un points précis à partir duquel les fusions ont diffusé. Il semble très intéressant de poursuivre l'étude des populations Robertsoniennes belges car elles sont jeunes et donc en pleine évolution. Recherche réalisée grâce au soutien financier de l'IRSIA.

103 **CHANGES OF NATIVE FOREST BIRD ABUNDANCES ON GRAND COMO-RO.** J. Stevens and M. Louette. Royal Museum of Central Africa, Tervuren.

Land bird abundances, obtained by point counts in September 1985 are compared with November-December 1989. Of the 17 1985 stations (station: 20 counting samples of 15 minutes each by two observers), situated on an altitudinal transect from 0 to 2000 m, eight were repeated in 1989 and six new ones were added. The overall abundance of most species did not differ significantly between both years. Most differences are interpreted as normal within-year fluctuations. Most important between-year changes are attributed to short-term vegetation changes: increase of *Columba polleni*, *Coracopsis vasa*, *Zoonavena grandidieri*, *Coracina cinerea* in Nioumbadjou after abandonment of the forest exploitations; decrease of *Coracina cinerea* at M'Lima Mani North after replacement of the natural shrub layer by bananas and taro. The large numbers of *Coracopsis nigra* in 1989 in comparison with 1985 probably is part of a long term population increase as suggested by data from 1958 (1), 1981 and 1983. Supported by International Council for Bird Preservation (ICBP).

(1) C.W. BENSON (1960) — Ibis 103b:5-106.

- 104 **SHAPE VARIATION OF TWO-DIMENSIONAL OUTLINES OF *PATELLA VULGATA*.** J. F. Tack and E. Vanden Berghe\*. Free University of Brussels and \*University of Nairobi, Kenya.

The outlines of *Patella vulgata* are numerically characterized using elliptic Fourier analysis. The resulting Fourier coefficients can be normalized so that they are invariant to changes in rotation and magnification of the original silhouette. The Fourier coefficients can be used as variables in multivariate analysis of form. Cluster analysis distinguishes different populations of the limpet *Patella vulgata*. The technique demonstrates an association between the morphology and the habitat of *Patella vulgata*. The outlines of the limpets inhabiting the lower levels of the tidal area are quite distinct from those of the limpets inhabiting the higher levels of the tidal area.

- 105 **FEATURES OF AN INTRADIGESTIVE BACTERIAL SYMBIOSIS IN THE BURROWING ECHINOIDECHINOCARDIUM CORDATUM.** A. Temara and C. De Ridder. Free University of Brussels (ULB).

*E. cordatum* lodges in its intestinal caecum nodules built by symbiotic filamentous bacteria (1). Morphological and physiological investigations showed that these symbiotic bacteria are closely related to the members of the *Thiothrix* genus which gathers sulfoxidizing bacteria: they are able to oxidize reduced sulfur compounds ( $S^2$ ,  $S_2O_3^{2-}$ ), to stock elemental sulfur in their cells and to oxidize it in the absence of reduced sulfur compounds. Lack of activity of ribulose-1, 5-biphosphate carboxylase and occurrence of linolenic acid have been observed in the symbiotic bacteria. These results point out respectively that the bacteria are chemolithoheterotrophs and are able to synthesize an essential fatty acid. Morphological features of the caecal wall epithelium suggest that it is the site of exchanges between the general coelom and the intestinal lumen. Experimental investigations have shown that the caecum accumulates urchin's catabolites produced in the coelomic cavity. The symbiosis could be of the mutualistic type: sulfoxidizing bacteria could detoxify intradigestive sulfide and produce essential fatty acids; excreted urchin's catabolites could be used as nutrients by symbiotic bacteria.

(1) C. DE RIDDER *et al.* (1985) — J. Exp. Mar. Biol. Ecol. 96:65-75.

- 106 **NEUROCHEMICAL FEATURES OF MORPHOLOGICALLY IDENTIFIED ENTERIC NEURONS IN THE GANGLIONIC NERVE NETWORKS OF THE PORCINE SMALL INTESTINE.** J.-P. Timmermans, D. Adriaensen, D.W. Scheuermann, W. Stach\* and M.H.A. De Groodt-Lasseel. University of Antwerp (RUCA), and \*University of Rostock, FRG.

The enteric nervous system is an integrative widely independent complex of neuronal circuitries which is capable of displaying reflex activity even without input from the central nervous system. This autonomic functioning can be ascribed to the features of the intrinsic neurons. With the aid of immunocytochemical techniques in combination

with microsurgical interventions, such as myotomy and myectomy, the morphological characteristics and the neurochemical content of these enteric neurons could, at least partially, be determined in the small intestine of the domestic pig. In the myenteric plexus, the chemical coding of Dogiel type I, II, III and of a population of minineurons could be extended. The outer submucosal nerve network (Schabadasch' plexus) also harbours these neuron populations except the Dogiel type I-neurons. In the inner submucosal nerve network (Meissner's plexus) three distinct groups of neurons were identified : Dogiel type II-neurons and two separate populations of minineurons. The difference in coexistence pattern of neurotransmitters/neuromodulators in a morphologically defined neuron type between the enteric nerve plexuses might be related to its distinct targets. Supported by grant No. 3.0005.89 from the Fund for Medical Scientific Research.

**107 PARENTAL FEEDING IN THE GREAT CRESTED GREBE IN RELATION TO FOOD AVAILABILITY.** *P. Ulenaers* and *A.A. Dhondt*. University of Antwerp (UIA).

As it is difficult to quantify food availability in field situations, there exists no careful investigation of parental feeding of Great Crested Grebes in relation to available prey sizes and age of the chicks. During the period 1986-1988 we studied prey size selection and feeding rate of Grebes' chicks on a fish-farm. We possessed data on the amount and species of fish stocked. From their first days onwards chicks received very small fish, and fish size increased as they grew older. On carp ponds parents with small young delivered more prey per time interval than on roach ponds, but the rate of fish biomass delivery did not differ between pond types. On carp ponds parents were not able to adjust fish size to the age of the young from the age of five weeks onwards, probably because larger prey were lacking. For small young the amount of food delivery by the parents was correlated with food availability. Supported by an IWONL grant (P.U.).

**108 SKIN BASEMENT MEMBRANE ULTRASTRUCTURE IS DEPENDENT ON THE FIXATION PROCEDURE.** *P. Valkenberg*, *M. Leclercq-Smekens* and *R. Leloup*. University of Namur.

Usual ultrastructural investigations have established that the basement membrane, also called epidermal-dermal junction (EDJ) in skin, is divided into three layers: (a) the *lamina lucida*, a layer of low electron density apposed to the plasma membrane of the epidermal cells; (b) the *lamina densa*, a layer of high electron density, consisting of fibrillar material, and (c) the *lamina fibroreticularis*, a less distinct layer which blends into the surrounding connective tissue. However, this complex morphology is under discussion by some authors (1,2). So different chemical fixations were used (tannic acid or ruthenium red in addition to the routine fixation by glutaraldehyde and osmium tetroxide); we observed a modified model of the EDJ, whilst all types of fixation demonstrated three organized layers. On the other hand, after rapid freezing fixation

followed by freeze-substitution we obtained a more homogeneous structure: the junction appeared as a uniform dense zone without the classical three layers (without lucent *lamina lucida*) and continuous with the extracellular matrix of the connective tissue. However, under certain experimental conditions, a layer of higher electron density was observed in the middle of the EDJ. Using a cryoprotective agent (glycerol) before freezing, we distinguished two appearances of the junction: one according to the classical model, the second according to the homogeneous model. Our results suggest that, during the classical chemical fixation procedure, translocations and aggregations occur, inducing the packing of the EDJ's components to form an electron denser layer, some distance away from the plasma membrane. Accordingly, the classical three layers morphology could be considered as artefactual.

(1) J.R. GORDON and M.R. BERNFIELD (1980) — *Dev. Biol.* 74:118-135.

(2) M. GOLDBERG and F. ESCAIG-HAYE (1986) — *Eur. J. Cell Biol.* 42:365-368.

**109 ETUDE DU COMPORTEMENT ALIMENTAIRE DU PHYTOSEIULUS PERSIMILIS ATHIAS-HENRIOT.** L. Van Asselt, G. Van Impe, P. Nihoul. Université Catholique de Louvain (UCL), Louvain-la-Neuve.

De nombreux auteurs ont considéré que l'acarien prédateur *Phytoseiulus persimilis* faisait preuve d'une prédation préférentielle sur le stade oeuf de l'acarien phytophage *Tetranychus urticae* (1). L'étude, des préférences alimentaires de *Phytoseiulus persimilis*, nous a permis de nuancer cette affirmation. Neuf catégories d'individus ont été répertoriées chez le *Tetranychus urticae*, à savoir: les oeufs, larves, protochrysalides, protonymphes, deutochrysalides, deutonymphes, téléochrysalides, adultes mâles et adultes femelles. Successivement, 250 mâles et 250 femelles de *Phytoseiulus persimilis* ont été placés au sein de populations définies de *Tetranychus urticae*. Cette méthode présente l'avantage d'être fort proche des conditions naturelles de prédation. Pour chacun des prédateurs, nous avons relevé le type de proies consommées lors des deux premiers repas. Le *Phytoseiulus persimilis* à jeun manifeste une prédation accrue sur les femelles de *Tetranychus urticae*, comportement ignoré jusqu'à ce jour. Le comportement a été observé aussi bien chez les mâles que chez les femelles du prédateur (avec néanmoins des intensités de prédation différentes). Par contre, lorsque le *Phytoseiulus persimilis* n'est plus affamé, ils se nourrit préférentiellement des oeufs de *Tetranychus urticae* ce qui correspond aux données de la littérature.

(1) M.W. SABELIS, B.P. AFMAN and P.T. SLIM (1984) — In *Acarology VI*, Vol.1. Edited by D.A. GRIFFITHS and C.E. BOWMAN:431-440.

**110 MEIOFAUNA FROM SEAGRASSBEDS NEAR MANGROVES IN KENYAN COSTAL BIOTOPES.** P. Van Avermaet and M. Vincx. State University of Ghent.

The epiphytic meiofauna of *Thalassodendron ciliatum* has been studied at two different sites along the Kenyan coast: Gazi Bay and Nyali Beach. Eighteen taxa have been found from which the nematodes and copepods were the most dominant groups.

It is however remarkable that the diversity and numbers of animals are significantly higher in Gazi (1300 - 6800 individuals per g dw sea grass) than in Nyali (300-600 ind. per g dw seagrass). This is related to the abiotic features of both sites (current patterns, length of seagrasses...). The nematodes are identified to the genus level. 88 genera were found with *Anticoma*, *Euchromadora*, *Prochromadorella*, *Spilophorella* and *Viscosia* as the dominant ones. The dominant family is the Chromadoridae. Multivariate analysis of the data showed striking differences between the two sites. The characteristics of the epiphytic nematodes are discussed. This study is part of an ecological approach of the dynamics and assessment of Kenyan mangrove ecosystems.

- 111 HOMMAGE L'ILE DE BEAUT: ALTITUDINAL VARIATION IN THE THERMAL BIOLOGY OF THE LIZARD *PODARCIS TILIGUERTA*.** R. Van Damme, D. Bauwens\*, A.M. Castilla\*\* and R.F. Verheyen. University of Antwerp (UIA) and \*Institute of Nature Conservation, Hasselt, and \*\*University of Madrid, Spain.

We studied aspects of the thermal biology in two populations of the lizard *Podarcis tiliguerta* along a 1450 m altitudinal gradient. Body temperatures (T<sub>b</sub>) at high altitudes average lower, are more variable, but are more elevated above environmental temperatures than at sea level. Lizards partially reduced the impact of altitudinal changes in thermal loads through subtle behavioural adjustments. A comparison of the thermal preferences in the laboratory, the maximal operative temperatures predicted from a biophysical model, and the activity T<sub>b</sub>s at both sites, indicates that the main response to changing environmental conditions is an active shift in thermoregulatory set points. Integration of field T<sub>b</sub>s and laboratory data on temperature specific sprint speeds predict that the mountain lizards experience reduced running abilities that are especially acute in the early morning. Despite this impairment of running performance, the thermal sensitivity of running speed has not evolved to match the T<sub>b</sub>s experienced by both populations. This result supports the view that the thermal physiology of this lizard is evolutionarily conservative, but the lack of information on the relation between running performance and fitness components impedes rejection of alternative hypotheses.

- 112 CELL RECOGNITION IN SPONGES: EFFICIENCY OF UPTAKE AND DIGESTION OF BACTERIA BY FRESHWATER SPONGES.** G. Van de Vyver, E. Richelle and Z. Moreau\*. Free University of Brussels (ULB) and \*Royal Belgian Institute of Natural Sciences, Brussels.

Sponges are suspension feeders capable to retain a broad variety of particles ranging from organic matter to bacteria and even protozoa. The present study analyses the bacterial retention and digestion mechanisms for three freshwater sponges common in Belgium. *Ephydatia fluviatilis*, *Ephydatia mulleri* and *Spongilla lagustris*. The sponges cultured in standardized conditions (1) were fed with five different bacteria species: *Escherichia coli*, *Enterobacter agglomerans*, *Klebsiella pneumoniae*, *Pseudomonas aerugi-*

*nosa* and *Staphylococcus aureus*. For all the experiments, the sponges were pulsed with  $^3\text{H}$  labelled bacteria at a concentration of 107 bacteria/ml (2, 3). The uptake rate was determined by measuring the amount of radioactivity associated with sponges in the course of time. In order to examine digestion, sponges were placed in fresh sterile medium during different incubation times after the pulse with labelled bacteria. Kinetic digestion was established by measuring radioactivity label in sponges and external medium. Within the range of bacterial concentration used, our results indicate that, despite a high rate of retention and digestion for all bacteria tested, the efficiency varies according to the species of the sponges and the bacteria used. Nevertheless, for a defined sponge species fed with a determined bacteria species our data indicate a regulation of the number of bacteria retained by unit of time. The rate and level of digestion activity affects retention capacity. The most efficiently bacteria are digested, the highest is the retention efficiency.

(1) R. RASMONT (1961) – Ann. Soc. roy. Zool. Belg. 91:147-156.

(2) Ph. WILLENZ, B. VRAY, M.P. MAILLARD and G. VAN DE VYVER (1986) – Physiol. Zool. 59:495-504.

(3) J. HUYSECOM, E. RICHELLE, G. VAN DE VYVER and B. VRAY (1988) – Physiol. Zool. 61:535-542.

**113 MOUVEMENTS DES MÂCHOIRES PHARYNGIENNES CHEZ *SERRANUS SCRIBA* (PISCES: PERCIFORMES) PENDANT LA PRISE DE NOURRI-  
TURE.** P. Vandewalle et M. Havard. Université de Liège.

L'étude des mouvements des mâchoires pharyngiennes d'un Perciforme peu spécialisé pendant la prise de nourriture n'a jamais encore été réalisée. Le travail entrepris veut combler cette lacune. Les mâchoires pharyngiennes ont été marquées au plomb et leurs mouvements de prise de différentes nourriture ont été suivis en cinéradiographie. Les mâchoires pharyngiennes de *S. scriba* sont animées de mouvements cycliques variables qui n'assurent que le transloct de proies avec carapace ou tégument. Il n'y a pas de mouvements stéréotypés comme chez des poissons plus évolués. En outre, les mâchoires grandes et droites ne sont pas en mouvement de façon semblable et les éléments qui constituent les mâchoires supérieures peuvent être déplacés de manières différentes. *S. scriba* peut adopter vis-à-vis de la proie des stratégies adaptées à des situations particulières. Recherche subsidiée par le FNRS, crédit n° 2.9005.84.

**114 THE VERTICAL DISTRIBUTION PATTERNS OF MEIOBENTHIC DENSITY AND BIOMASS IN TROPICAL MANGROVE SEDIMENTS.** S. Vanhove and M. Vincx. State University of Ghent.

Until now little information has been available on the vertical distribution of meiofauna in tropical mangroves. In the summer of 1989 the sediments of five vegetation types (*Avicennia*, *Bruguiera*, *Ceriops*, *Rhizophora*, *Sonneratia*) in the mixed mangrove of Gazi Bay (Kenya) were sampled using handcorers (20 cm), during neap and spring tide. In order to correlate density and biomass with abiotic factors, analysis

of particle size, organic matter (by means of total organic content and Kjeldahl-N) and nutrients was performed. Salinity, temperature, pH and redox layer were also recorded. A total of 17 taxa were observed and high densities were encountered (mean: 3802 ind/10 cm<sup>2</sup>). Nematodes dominated; the remainder was made up of copepods, turbellarians, oligochaetes, polychaetes and rotifers. The data indicate that high densities still occur at greater depth (up to about 20 cm). A considerable difference in biomass of nematodes is observed between the stations. It is suggested that particle size (medium sand and mud levels up to 8%) and oxygen conditions are the major factors influencing meiobenthic distribution. The importance of nutrients and organic matter could not be assessed. Fiddler crabs probably have a significant impact on the abiotic and biotic environment of the mangrove meiobenthos. No profound comparison with an analogous study was possible (1).

(1) A.H. DYE (1983) — Estuarine, Coastal and Shelf Science 16:591-598.

**115 ELECTRON MICROSCOPY OF SURFACTANT SECRETING TYPE II EPITHELIAL CELLS IN THE LABORATORY RAT LUNG.** *F. Van Meir* and *D.W. Scheuermann*. University of Antwerp (RUCA).

Type II pneumocytes, recognized by their characteristic lamellar inclusion bodies, are pluripotential cells which are involved in the stabilization and the defence mechanisms of the lung alveoli. These cells also have the capacity to differentiate into squamous type I cells, necessary to facilitate gas exchange. Moreover, type II pneumocytes may be precursors of type III alveolar brush cells that show characteristics of receptor cells. Because of their transeptal localization and their presence near interalveolar gaps the type II cells might be engaged in the formation of the interalveolar pores of Kohn. The phospholipids, synthesized and secreted by the type II cells, make up the most important component of the surfactant layer present on the alveolar surface and prevent alveolar collapse. Electron microscopic morphometrical and cytochemical observations made on different cell organelles which are thought to be involved in the formation of the secretory lamellar bodies are reported. Catalase cytochemistry demonstrates clustered and single microperoxisomes in close contact, but not in continuity, with the rough endoplasmic reticulum. Lysosomal inclusions such as multivesicular bodies and autophagosomal structures contain lamellar structures and give origin to mature lamellar bodies. Acid phosphatase activity in the lamellar bodies confirms their lysosomal origin. Morphometry of these different inclusion types provides arguments for the proposed maturation process.

**116 CONTRACTILE CELLS IN THE QUAIL OVARY.** *L. Van Nassauw*, *V. Van Hertbruggen*, *F. Harrison* and *M. Callebaut*. University of Antwerp (RUCA).

In the present study, we demonstrated the presence of the typical ultrastructural characteristics of smooth-muscle cells in the cells of the ovarian chordae and of the tunica albuginea. The cells of the theca externa of the largest pre-ovulatory follicle were also found to contain these features. In the theca interna, pericytes were detected in

the wall of sinusoids. The theca of primordial follicles was composed of microfilament-bearing cells. It was suggested that these cells are the putative precursors of thecal smooth-muscle cells. The surface epithelial cells also contained bundles of microfilaments, orientated parallel to the long axis of the cell. The smooth-muscle layers of ovarian blood vessels were slightly spiral. In the wall of the most recent post-ovulatory follicle, it was seen that the thecal cells were extremely contracted in contrast with the other follicular smooth-muscle cells. This result allowed us to conclude that during ovulation, the cells of the theca externa mainly contracted. At this moment, the prevailing hypothesis is that the function of the theca externa, being the contractile force during ovulation, in the ovulatory process is to maintain a constant intrafollicular pressure. Supported by grant 3.0037.90 by NFSR.

**117 MEIOBENTHOS RESEARCH IN THE GULF OF BISKAY.** *A. Vanreusel* and *M. Vincx*. State University of Ghent.

Meiobenthos (*i.e.* benthic metazoa < 2mm) research in the gulf of Biscay is started in 1989 in the framework of the 'Joint Global Ocean Flux Studies' (or JGOFS), and aims at the evaluation of the role of the meiobenthos in the total energy flux of marine benthic ecosystems. The importance of meiobenthos in this context has often been inferred from its numerical abundance in the sediments (from 100 up to 10,000 individuals per 10 cm<sup>2</sup>). However, reliable data, especially for the deeper areas of the ocean, are scarce. During the first JGOFS sampling expedition with the Belgica in september 1989, sediment samples were taken on two locations on the continental slope near the Spanish coast (La Coruna, depths of 200 and 300 m). In order to get a preliminary impression of the meiobenthos in this area, density, biomass, organic carbon content (standing stock) and production were determined. These biotic parameters were correlated with environmental parameters, such as sediment composition, chlorophyll *a* content, redox potential and nutrient concentrations. Densities in both stations are in accordance with those of other study areas of a comparable depth and chlorophyll *a* content. The low total biomass is in first place related to the presence of small species. The meiobenthic production in this area is relatively high.

**118 THERMAL ECOLOGY OF THE ADDER *VIPERA BERUS*.** *G. Van Spaendonk*, *R. Van Damme* and *R.F. Verheyen*. University of Antwerp (UIA).

The common viper *Vipera berus* is the world's most northerly distributed snake. Its thermal environment is characterized by low and strongly fluctuating temperatures. To assess possible behavioural and physiological adaptations to this reptile-unfriendly environment, we (1) determined the thermal sensitivity of an ecologically relevant process (locomotion) and (2) radio-tracked behaviour and body temperatures of vipers in the field. Optimal temperature for crawling performance proved to be surprisingly high (between 35 and 40°C), especially when compared with field body temperature data existing in the literature (mean *tb* = 22°C). Our field observations revealed however that during sunny weather, *Vipera berus* basks intensively and thus attains body tempera-

tures of + 34°C, which allow locomotory performance at optimal levels. Our data give support to the static view of thermal physiology, which claims that thermal physiology is evolutionarily stationary and resistant to directional selection. In this species, adaptations to the harsh thermal environment seem primarily behavioural. Our data also show that body temperature of snakes measured with ordinary thermometers should be interpreted with caution.

**119 NUTRITIONAL AND CULTURE IMPROVEMENT OF THE ROTIFER *BRACHIONUS PLICATILIS* USING ARTIFICIAL DIETS.** P. Van Sprang. State University of Ghent.

The success of the culture of marine finfish larvae is based to a large extent on the availability of nutritionally high quality rotifers (*Brachionus plicatilis*). The present poster describes some results dealing with the improvement of the culture performance and the nutritional value of the rotifer *B. plicatilis* using artificial diets as a complete substitution of the classical diet of microalgae. The culture and enrichment experiments were performed in 100 l conical tanks. The performance of a combined artificial culture and enrichment diet (Culture Selco: CS) was evaluated in comparison with baker's yeast (BY) on rotifer growth and their n-3 HUFA content. The rotifers were cultured for one month. Rotifer density was recorded every day. Enrichment of rotifers was carried out in separate tanks for 6 to 8 h. The enrichment diets Protein Selco (PS), Selco (S), Super Selco (SS) and Dry Selco (DS) were added in two rations. In comparison to BY higher production yields are obtained with CS as sole diet (6,000 rot/1/day vs 30,000 rot/1/day). The results with CS are comparable with those obtained with microalgae. The HUFA accumulation in rotifer fed CS during the culture is increasing steadily until day 10. After that period, the HUFA content of rotifers seems to reach a plateau at 17 mg/g DW. The n-3 HUFA level in rotifers fed BY decreases rapidly to a value of 1.1 mg/g DW. The enrichment of rotifers with different enrichment products (PS, S, SS and DS) reveals the importance of the initial HUFA level to reach maximal enrichment levels. Appreciable amounts of HUFA can be accumulated in the last two hours of enrichment. A maximal level of 81 mg/g DW was obtained with SS after 8 h enrichment. The present results show that an artificial diet (CS) can completely replace the microalgae or fresh baker's yeast. This diet gives good production yields and builds up relatively high levels of essential fatty acids in the rotifers. The enrichment experiments show that both the culture on CS and the consequent enrichment are required to reach maximal HUFA levels in rotifers.

**120 THE INFLUENCE OF EPIGENETIC VERSUS GENETIC FACTORS ON THE PHOTOTACTIC BEHAVIOUR OF *DAPHNIA MAGNA*.** J. Van Uyvanck and L. De Meester. State University of Ghent.

This work is part of a study on the heritability of phototactic behaviour of *Daphnia magna*. We studied the influence of several environmental factors upon the phototactic responses of four clones, selected for their very different phototactic beha-

viour under optimal conditions. Experiments were done in small perspex columns (25 cm high, 5 cm i.d.), illuminated from above with a 150 W fiber light source. Using interference colour filters, we determined that a maximal positively phototactic response occurred at wavelengths between 500 and 580 nm, though differences in the response at different wavelengths were small. When pH of the medium was raised, animals tended to be more positively phototactic. A less positive phototactic response occurred when the animals were cultured at high (27°C) temperature or when they were confronted with a temperature gradient in the column. Responses to temperature changes at the start of the experiment were more variable and clone-dependent. Importantly, differences between genotypes remained highly significant under all circumstances tested, as illustrated by high heritability (broad sense) estimates ( $h_B^2 > 0.70$ ).

**121 ON THE PHENOLOGY OF SOME WEST-EUROPEAN FLEA-BEETLES (COLEOPTERA: CHRYSOMELIDAE: ALTICINAE).** P. Verdyck and L. De Bruyn. University of Antwerp (RUCA).

In order to understand life-cycle strategies of species it is necessary to know the numerical fluctuations of their populations. Previously little has been known about these fluctuations in the Alticinae. In the present study we take a look at the annual fluctuations (phenology) in some flea-beetle species. During a 30 week sampling period (April to November 1989) pitfall traps were used to catch flea-beetles in several biotopes. The traps were emptied at weekly intervals. Almost all species are univoltine. Three distinguishable phenology types were found. *Aphthona coerulea* hibernates as an adult and throughout the year the number of specimens does not fluctuate very much. The consecutive generations strongly overlap. *Phyllotreta ochripes* also hibernates as an adult, but consecutive generations are clearly separated by a larval stage. Probably because of high winter mortality, the number of adults is smaller in spring than in autumn. *Longitarsus symphyti* hibernates as an egg or a larva. Consecutive generations are clearly separated. In one phenology-type, different sub-types can be noticed. Possibly to avoid competition the times of the peak-numbers differ slightly between different species that use the same host plants. L.D.B. is a senior research assistant at the NFSR.

**122 INSECT NEUROPEPTIDES: AN IMMUNOLOGICAL APPROACH.** P. Verhaert and A. De Loof. Catholic University of Leuven (KUL).

With the recent development of highly sensitive analytical technology, it has become clear that also very small invertebrate species, including insects (previously considered as *de facto* nearly "inaccessible" animals), possess biochemically astonishingly complex neuroendocrine systems, which are remarkably comparable to those of higher vertebrates. This image primarily emerged from an overwhelming number of immunohistochemical data documenting the presence of many different (poly)peptide-like chemicals in relevant invertebrate tissues (e.g. brain, intestinal mucosa), which are antigenically similar to neurohormones of vertebrates. Currently, much effort is going to isolation and chemical identification of this unexplored wealth of different insect neur-

opeptides. Yet, a survey of the different purification schemes which are presently being used for insect neurohormones (see *e.g.* (1) for recent review), indicates that the above immunochemical clues seem to be largely overlooked, and certainly not systematically considered (let alone pursued) when new isolation procedures for insect neurohormones are being designed. However, we believe that elaborating on the immunological aspect of the study of invertebrate neuropeptides may lead to a novel approach of the purification problem, which may well complement the bioassay-monitored extraction procedures that are mainly followed nowadays. The results of our heterologous experiments (including immunohistochemistry and Western blottings) in the American cockroach, with a variety of different (monoclonal) neuropeptide antibodies, suggest that it may be possible, at least, for some insect neuropeptides, to develop isolation schemes on the basis of their antigenical/immunochemical characteristics. These may be direct methods, *e.g.* immuno-affinity chromatography, or indirect ones, such as step-wise fractionations/extractions with (radio)-immunological monitoring. P.V. is a senior research assistant of the NFSR.

(1) D.A. SCHOOLEY, H. KATAOKA, S.J. KRAMER, A. TOSCHI (1990) — In: *Insect Neurochemistry and Neurophysiology* — 1989 (BORKOVEC A.B., MASLER E.P., eds.) Humana press:39-62.

**123 AN ECOLOGICAL STUDY OF SMALL MAMMALS IN A MIOMBO FOREST NEAR MOROGORO, TANZANIA.** *R. Verhagen*, H. Leirs, J. Stuyck and W. Verheyen. University of Antwerp (RUCA).

A community of small mammals was studied in a Miombo forest near Morogoro, Tanzania from April 1988 to February 1989. Using capture-mark-release methods, 11 small mammal species were captured on a 4 ha trapping grid of which six species were present throughout the whole study period. The average population density ranged from 15 to 34 individuals/ha. The highest population numbers were recorded during the mid-dry season (August) and at the middle of the wet season (February). The high population numbers at the mid-dry season are partly due to recruitment of young into the population and partly to immigration of individuals normally inhabiting the surrounding grasslands. Each species had different reproduction and survival characteristics which for some species can be related to climatological conditions and food abundance. It is concluded that Miombo forest is normally inhabited by five to six small mammal species but serves as a survival habitat for other species when conditions in their habitat (grassland) become too harsh. H.L. is a research assistant of the NFSR.

**124 THE EFFECT OF TEMPERATURE ON THE OXYGEN REQUIREMENTS OF DIFFERENT SIZE CLASSES OF *OREOCHROMIS NILOTICUS* L.** *E. Verheyen*, A. Fontaine and W. Declair. University of Antwerp (RUCA).

The influence of various environmental conditions on different aspects of the respiration physiology of obligatory water breathing fishes is well understood. However, the literature consists mainly of studies on the metabolic requirements of eggs, fry or

adult fish measured under normoxic conditions and at acclimation temperatures. Our study deals with the effects of acutely changing environmental temperature (25 to 30°) on routine oxygen uptake rate ( $VO_2 r$ ) and the critical oxygen tension ( $P_c$ ) in different size classes of *O. niloticus* (range 2-250 g). This African cichlid prevails in waters prone to important diurnal fluctuations of temperature and dissolved oxygen. Our results show that the effect of increasing water temperature on the aerobic metabolic rate is size dependent. The  $VO_2 r$  of small specimens increases less than in larger specimens. This difference in response corresponds with literature data on energy conservation, enhanced growth and earlier sexual maturity in juvenile tilapiines at high water temperatures. In addition, our results suggest that an increased  $VO_2 r$  is accompanied by a corresponding increase of  $P_c$ . Therefore, small *O. niloticus* may be better equipped to regulate their oxygen uptake rate in water that is both warm and hypoxic than large specimens. Supported by FKFO program 2.9005.84.

**125 THE ASIATIC CHIPMUNK *EUTAMIAS SIBIRICUS* IN THE ZONIEN-FOREST.** J. Verroken and C.R. Joiris. Free University of Brussels (VUB).

The asiatic chipmunk *Eutamias sibiricus* was first imported in Belgium in the beginning of the 60's. In 1974, the first free living individual was observed in the Zoniën-forest (4383 ha), a deciduous forest near Brussels, where species appeared not only to survive but also to reproduce. This phenomenon occurred not only in this forest but was also reported -on a smaller scale- elsewhere in Belgium and even in other countries as Germany, France, Austria, and The Netherlands. A study of the distribution and a population estimate were realized in the Zoniën-forest by means of the transect method. The countings were performed between the end of February and the beginning of November 1988. The observations of two fixed circuits were used to make an observation probability estimate, according to time of the year, which allowed interpretation of single counts elsewhere in the forest. Afterwards extrapolations for the whole forest could be made. We also compared our results with previous transect-count performed in 1981. This study made clear that the Asiatic chipmunk is now well established in the Zoniën-forest. It expanded its range and increased strongly in numbers. At the end of 1988 the total population of Asiatic chipmunk at the Zoniën-forest was estimated to be approximately 1500, against ca. 60 in 1981, or a 25-fold increase in seven years. High population densities in valleys suggested microhabitat preferences which could not be directly related to the species diversity of the vegetation. Based on scarce observations no aggressive interactions with the red squirrel *Sciurus vulgaris* were noticed. However, the increase in ground-breeding passerines, therefore more detailed study is needed in order to assess the effects of this introduced species on the forest ecosystem.

**126 ARE BELGIAN LAPWINGS "REGIONALISED"? HABITAT SELECTION IN BREEDING LAPWINGS.** A. Versailles. Catholic University of Leuven (UCL), Louvain-la-Neuve.

Habitat selection is usually studied by analysis of ultimate relations between habitat characteristics and individual fitness. My approach is rather an analysis of proximal relations associated with choice mechanisms. These mechanisms are to be based on in-

dicative features of the chosen habitat. Two study areas were chosen: one in polders near Zeebrugge and the other in the Condroz. In these two study areas, proportions between meadows and crops are similar. During Spring in 1989 and 1990, I've mapped each nest position in these two study areas. Nests were checked regularly until hatching with the aim of estimating hatching success. In the polders, first breeders choose meadows at the beginning of the breeding season; but later breeders prefer corn fields to meadows. However, in the Condruzian area, nests are only in crop land: first in ploughed land and later, in crop fields (corn, beet, market garden produce). Using remote sensed data from this area (Landsat TM - 16/05/89), I've extracted pixel values corresponding to nest positions for Spring 1989. They have exactly the same mean and standard deviation as spectral values of crop fields (other than cereal ones). But lapwings don't use all these fields. Maybe because of their low number, or because spectral information, sufficient to determine potential habitat, is insufficient to define preferential habitat. On a local scale, other parameters such as spatial information must be used to restrict potential habitat. On a regional scale, transects are needed to determine whether a Belgian gradient in habitat choice exists. At this stage, "Flemish lapwings" seems to be more "bilingual" than "walloon" ones. Supported by an IRSIA grant.

- 127 **STUDY OF THE TROUBLES INDUCED BY HYPOXIA ON MEMORY, AND OF THE PIRACETAM POTENTIAL PROTECTION AGAINST THEM.** *N. Waegeneer, J. Bruhwylers, E. Chleide and M. Mercier.* University of Namur.

A reduction of the oxygen provision to the brain is frequently considered as the cause of the mnemonic perturbations of some patients. The hypoxic model is largely used with animals in order to mimic the clinical conditions of oxygen-deprived amnesia. It also allows the deepening of geriatric research, because that model appears to cause mnemonic disturbances similar to those observed in the ageing process. In our study, rats submitted to a complex learning of time regulation, were hypoxied daily (3.5% oxygen-10 min). The effects of this treatment on the learning capacity have been measured during 27 days. The obtained results show that a disturbance of the memory process does exist. They also allow us to disregard possible non-specific effects such as anxiety, circadian rhythm of general activity, behavioural disinhibition,.. The protecting action of piracetam (Nootropil-UCB) against the deleterious effects of hypoxia was investigated in a second phase. The results show that this molecule affords an effective protection by not only allowing the animal to learn the time regulation, but also stabilising the acquired performance. It seems however that piracetam does not re-establish the normal learning speed.

- 128 **VERTICAL CHANGES IN MITES (ACARI).** *G. Wauthy, V. Bauchau\* and T. Backeljau.* Royal Belgian Institute of Natural Sciences, Brussels and \*Catholic University of Leuven (UCL), Louvain-la-Neuve.

Mites are a large group of chelicerates inhabiting a wide range of habitats and showing an extreme morphological and life history diversity. Moreover, developmental

stages of mites commonly show numerical variations of certain morphological traits. Mites are therefore apt to study relationships between phylogeny and ontogeny. The phylogeny of actinotrichid mites reveals numerical regressions of phaneres, e.g. in adult oribatids high numbers ( $\geq 20$ ) of solenidia on the legs is a plesiomorphic condition, whereas low numbers ( $\leq 12$ ) is an apomorphic one. This evolution proceeds by vertical changes (= intraspecific presence/absence variations of bilateral exoskeleton elements in a stage). Thus a population in which a phanere is present in all stages (+ +) will evolve to a population in which this phanere is lacking (-- ) via a set of mixed populations of + +, + -, - + and -- phenotypes. In amphistasic phaneres these four phenotypes occur in one stage only, whereas in eustasic phaneres a phenotype is stable throughout all stages. A first model of such evolution assumes that (1) both body sides evolve independently and (2) that phenotype frequencies change from generation to generation. Yet, the first assumption is violated for there are no significant differences between phanere frequencies between body sides. An alternative model assumes that phanere expression depends on a "threshold character". Below this threshold the depending character will be expressed in one way, above this threshold in another. Hence, when allele frequencies of underlying genes change, the mean frequency of phanere expressions may change too. However, the application of this model to mites needs further investigation.

**129** **ENERGETIC ADAPTATION OF THE GILLS OF THE EURYHALINE CRAB**  
***ERIOCHEIR SINENSIS* TO HYPOSMOTIC STRESS.** L. Welcomme and P.  
Devos. University of Namur.

The euryhaline crab *E. sinensis* shows morphological and metabolical adaptations to an hyposmotic stress. The prominent part played by the posterior gills is already well documented: in freshwater, these gills exhibit a higher metabolic rate and a more important active ion transport than in seawater. In contrast, the epithelium of the anterior gills remains of a respiratory-type whatever the environmental situation. The modifications observed in the posterior gills are accompanied by an energetic adjustment at the level of the oxidative metabolism. The model of Witham is applicable to these gills indicating the important part taken by the active ion transport systems in this metabolism. On the other hand, the localization of very important glycogen reserves in an extra epithelial lamina located in the hemal space and the higher consumption of this polysaccharide by the posterior gills submitted to hyposmotic conditions suggest a well-suited glucose transport mechanism at the level of the epithelial membranes. When the crab is adapted to freshwater, the intracellular glucose capture is higher in the posterior than in the anterior gills. Moreover, studies on the gills of another euryhaline crab, *Carcinus maenas*, show that there are more glucose transporters with a higher  $K_a$  in the posterior gills when the crabs are adapted to diluted seawater (1:3) instead of undiluted seawater.

- 130 **PHYSIOLOGICAL EFFECTS OF LOW pH AND ALUMINIUM ON TWO POPULATIONS OF THE BROWN BULLHEAD, *ICTALURUS NEBULOSUS* (LESUEUR).** H. Witters, K. Bogaerts, S. Vets, S. Van Puymbroeck and O. Vanderborgh\*. Belgian Nuclear Research Centre, Mol and \*University of Antwerp (UIA).

During a field survey in extremely acidified boglakes (average pH = 4.2) relatively large populations of brown bullheads, *Ictalurus nebulosus* were found. Our experiments aimed to investigate whether populations of *I. nebulosus* from an acid lake are physiologically adapted to low pH and therefore exhibit physiological differences to fish from a non-acid lake. Two populations of brown bullheads from an acid lake (Zwart Water, pH 4.2) and a neutral lake (Zegge, pH 7.0) showed significant differences in ionregulatory and haematological variables. Most of these physiological differences disappeared after an acclimation of both populations to pH 6.8 or to pH 4.2 for five weeks. The physiological response of both populations to a subsequent pH-decrease to pH 4.2 or a pH-increase to pH 6.8 remained similar during 14 days. Exposure of both populations to low pH (4.2 and 5.0) with Al (0.5 mg/l) induced comparable changes of the ionregulatory and haematological parameters. Measurements on gill Al accumulation however showed significantly higher Al levels on the gills of the acid lake population, which was not accompanied by higher Al toxicity. Thus, our results demonstrate that pH differences of natural waters have not yet given rise to physiological strains of *I. nebulosus*. Although some indication is found for functional structural differences at the branchial site between the acid lake and neutral lake population. Partly supported by the CEC, contract nr EV4V-0116(B).

- 131 **MANGANESE TOXICITY TO ADULT RAINBOW TROUT, *ONCORHYNCHUS MYKISS* (WALBAUM).** H. Witters, P. Van Hooydonk, P. Berckmans, S. Van Puymbroeck and O. Vanderborgh\*. Belgian Nuclear Research Centre, Mol and \*University of Antwerp (UIA).

The high acidity of rainwater appears to cause mineral and metal leaching from soils with a low buffering capacity. Beside aluminium, increased levels of manganese (Mn) (up to 1.0 mg Mn/l = 0.02 mmol Mn/l) have been demonstrated in acidified surface waters. Effects of a range of Mn-concentrations at different pH values were investigated for mortality and some physiological variables in adult rainbow trout, *Oncorhynchus mykiss*. It was shown in a 96 h mortality study that Mn-toxicity was similar at pH 5, pH 6 and pH 7 and that even Mn-levels of 1 to 2 mg/l caused 20% mortality. Measurements of plasma ion concentrations gave significantly decreased Ca levels while NaCl levels were poorly affected at 2 mg Mn/l. Data on whole body ion fluxes confirmed this discrepancy. The whole body Na balance remained the same in fish exposed to 0 and 2 mg Mn/l while a negative whole body Ca balance was observed at 2 mg Mn/l which was entirely due to a 95% inhibition of the Ca-influx. An interference of Mn with the active transport system of Ca, which is localized at the basal membrane of the gill chloride cells is suggested. Moreover, Mn is likely to have negative effects on the reproductive cycle of fish due to its interference with the Ca metabolism.

**132 OSTRACODA CYTHERACEA FROM LAKE TANGANYIKA.** *K. Wouters.*  
Royal Belgian Institute of Natural Sciences, Brussels.

Most papers on Tanganyikan ostracods are dealing with swimming forms collected with plankton nets. Bottom dwellers, unable to swim, were therefore only rarely found. Sediment samples from Lake Tanganyika, however, yield a very rich bottom dwelling ostracod fauna, consisting largely of unknown endemic genera, mainly belonging to the superfamily Cytheracea. Detailed taxonomic analysis is required before the phylogenetic importance of these cytheraceans can be fully understood. Some genera, such as *Kavalacythereis* and *Proparacytheridea* show relationships to fossil and extant genera hitherto known from South America only. Others show affinities to East African brackish water ostracods, including the widely radiated *Cyprideis*-lineage in the lake. With regard to the cytheracean fauna, Lake Tanganyika is a *Cyprideis*-lake, whereas in Lake Baikal *Cytherissa* prevails. The Tanganyikan ostracod fauna consists of different elements: (1) an East African element, comprising various common cypridacean taxa, (2) endemic cytheracean genera and species related to brackish water ostracods and (3) an endemic and probably ancient freshwater cytheracean ostracod fauna. As in some other groups, e.g. gastropods, some bottom dwelling ostracods in the lake have a "thalassoid" aspect. The taxonomy of this particular ostracod fauna could yield important new data, related to the history of the lake.

**133 INTAKE OF PCBs, PAHs AND CADMIUM BY WATER BIRDS IN THE WESTERN SCHELDT ESTUARY: WHO IS MOST AT RISK?** J. Stronkhorst, P. Meire\*, P. Meininger, T. Ysebaert\* and J. van Buuren. Ministry of Transport and Public Works, Tidal Waters Division, the Netherlands, \*State University of Ghent.

The Western Scheldt is one of the most contaminated estuaries in W-Europe. According to the Ramsar Convention, the Western Scheldt is of international importance for 21 species of water birds. The intake per bird species was calculated using estimations of (1) mean annual weight, (2) energy consumption based on the basal metabolic rate (BMR), (3) food choice in the estuary, (4) residence time in the estuary, (5) home range area (marine, transition or brackish part of the estuary) and (6) concentrations of PCBs, PAHs and cadmium in the food, determined in 1987-1989 in five food sources, namely crustaceans (*Corophium*, *Crangon*), polychaets (*Arenicola*, *Nereis*), molluscs (*Macoma*, *Mytilus*), microphytobenthos and fish (*Clupea*, *Platichthys*). The intake ( $\mu\text{g}/\text{year}/\text{kg}$  body weight) is high for species with a high BMR/body weight ratio (e.g. Dunlin), a specific food choice or a long residence time in the estuary (e.g. Oystercatcher). The residence time has a high uncertainty and determines greatly the deviation on the calculated mean intake. Similar calculations in other W-European coastal wetlands can be used to estimate the total exposure of pollutants to water birds. With these results species with potentially high risks can be determined.

- 134 **THE MACROZOOBENTHOS OF THE SUBTIDAL MARINE AND BRACKISH PART OF THE WESTERN SCHELDT.** T. Ysebaert, P. Meire, K. Devos and J. Seys. State University of Ghent.

The Western Scheldt, one of the few remaining estuaries in The Netherlands, shows the normal estuarine gradient from a brackish to a marine tidal system (mean chlorinity 9 g Cl/l and 16 g Cl/l resp.). Its subtidal macrozoobenthos was surveyed in 1988 (marine part) and 1989 (brackish part), by means of 80 and 57 Van Veen grab samples (0-15 m depth). Species diversity was much higher in the marine part, due to a higher and less fluctuating salinity, as compared to the brackish part (58 against 20 species). In both parts, most of the samples (> 50%) had a very low average density with < 100 ind/m<sup>2</sup>. Total mean density was dominated by annelids (*Heteromastus filiformis*, *Tharyx marioni*, and *Oligochaeta*) in the marine part, and by arthropods (*Bathyporeia spec.* and *Haustorius arenarius*) in the brackish part. Also, 78% (marine) and 96% (brackish) of the samples had an average biomass < 1 g AFDW/m<sup>2</sup>. However, total mean biomass was much higher in the marine part, due to the abundance of the cockle *Cerastoderma edule* in three samplings. In the brackish part, total mean biomass was dominated by arthropods (*Bathyporeia spec.* and *Haustorius arenarius*). Diversity, density and biomass appeared to be highest near the intertidal sand and mudflats and were lowest in the gullies. Multivariate statistical analyses (TWINSPAN and DECORANA) indicated a distinct overlap between samples of both parts, characterized by a macrozoobenthic community of mainly arthropods (*Bathyporeia spec.*, *Haustorius arenarius*, *Eurydice pulchra*, etc.). These species are well adapted to live in highly exposed and disturbed sediments. It is concluded that the macrozoobenthic species composition along the marine and brackish parts of the Western Scheldt is mainly determined by salinity, but that on the other hand the highly dynamic character of the Western Scheldt results in a typical macrozoobenthic community of mobile arthropods in both parts.

- 135 **CONTRIBUTION TO THE STUDY OF POPULATION DYNAMICS OF THE PUMPKINSEED SUNFISH (*LEPOMIS GIBBOSUS*) IN FLANDERS, BELGIUM.** R. Ysebaert, J. Coeck\*, L. Bervoets and R. Verheyen. University of Antwerp (UIA) and \*Institute of Nature Conservation, Hasselt).

At the beginning of this century the pumpkinseed sunfish (*Lepomis gibbosus*) was first introduced in Belgium (1). Nowadays it is spread over various freshwater ecosystems in Flanders. This study was carried out on populations occurring in a lowland river the Grote Nete, a fish pond in Blaasveld and an acid-stressed fen in Zonhoven. Fish were captured from October 1989 to March 1990 with electrical fishing gear. Population numbers were estimated by catch-effort and mark-recapture methods. Length frequency distributions and scale analyses were combined to determine age and growth. Back-calculated fork lengths were used to compare growth with literature data. Fulton's coefficient of condition was calculated for fork length. The age distribution points out a low reproductive level in the Grote Nete. Also densities are much lower in this ecosystem compared to the fish pond and the fen. The population of the acid-stressed fen is characterized by a very high density but a significantly lower growth rate. Condition is best in standing waters especially in the eutrophied fish pond in Blaasveld.

Comparing European literature data, growth of Flemish pumpkinseed populations is found to be neither fast nor slow. It can be postulated that most North American populations show a much higher growth rate.

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F.U.N.D.P.	Facultés Universitaires Notre-Dame de la Paix
I.N.	Instituut voor Natuurbehoud.
I.T.G.	Instituut voor Tropische Geneeskunde
I.R.S.N.B.	Institut royal des Sciences naturelles de Belgique
K.B.I.N.	Koninklijk Belgisch Instituut voor Natuurwetenschappen
K.M.M.A.	Koninklijk Museum voor Midden-Afrika
K.U.L.	Katholieke Universiteit Leuven
L.U.C.	Limburgs Universitair Centrum
R.U.C.A.	Rijksuniversitair Centrum Antwerpen
R.U.G.	Rijksuniversiteit Gent
S.C.K.	Studiecentrum voor Kernenergie
U.A.	Universiteit Antwerpen
U.C.L.	Université Catholique de Louvain
U.I.A.	Universitaire Instelling Antwerpen
U.L.B.	Université Libre de Bruxelles
U.Lg.	Université de Liège
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