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ABSTRACTS

1 SYMPATRY OF *STREPTOCEPHALUS TORVICORNIS* (WAGA, 1842) AND *S. RUBRICAUDATUS* (KLUNZIGER, 1867) (ANOSTRACA, CRUSTACEA) : HYBRIDIZATION AND NICHE SELECTION.

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S. torvicornis and *S. rubricaudatus* can occur sympatrically, *i.e.* they live at the same time in the same temporary pools. Laboratory hybrids were obtained from no-choice mating tests between *S. torvicornis* and *S. rubricaudatus*. The mixing of species-specific characteristics found in the hybrids is discussed, based on the structure of the setae of the limbs and the antennae of the males. The F1 generation was non fertile. The hatching percentage of the hybrid cysts was much lower than that of the parental populations. Only about half of the hybrids reached maturity. Some of those that did reach the adult stage, died prematurely because of deformation of the filtration apparatus. Feeding *S. torvicornis* and *S. rubricaudatus* with nematodes, cladocerans and rotifers showed that they consume food particles of different size. The same was seen when comparing both sexes of the same species. In general the diet of *S. rubricaudatus* is composed of smaller particles. The considered populations of *S. torvicornis* and *S. rubricaudatus* are reproductive isolated and they have a different feeding ecology.

2 MORPHOLOGICAL ADAPTATIONS TO PECTORAL FIN ADDUCTION IN *POMATOSCHISTUS LOZANOI* (GOBIIDAE).

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Pomatoschistus lozanoi is a goby with a typical benthic life style. Forward propulsion, generated through pectoral fin adduction is of great importance during locomotion. The present morphological study is based on dissections, clearing with staining and serial sectioning of several specimens of *Pomatoschistus lozanoi*. The study gives a detailed description of the osteological and myological components, as well as of the ligaments of the girdle-apparatus. Like several other benthic fishes, gobies seem to have well developed pectoral fins. The strongly branched fin rays articulate with an enlarged distal margin of the rigid shoulder

plate, formed by the plate-like proximal radial bones. Well developed adductor muscles are present between the shoulder girdle and the fin rays, necessary for a powerful pectoral fin adduction. This -drag based- pectoral propulsion is optimised in *Pomatoschistus lozanoi* due to some morphological adaptations in skeletal and muscular structures. Thus in *Pomatoschistus lozanoi* the pectoral girdle seems to be better adapted to pectoral fin adduction than in a generalised teleost fish.

3 CLADISTICS AND METAZOAN RELATIONSHIPS.

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A recently published cladistic analysis of metazoan relationships (1) based on 77 developmental and morphological characters is shown to be defective with respect to both methodological issues and character interpretations. It is therefore not surprising that many conclusions of this analysis are not supported by the data. Originally the analysis was performed with the programs PHYSIS WAGNER.S and PAUP 2.4. From the resulting cladogram it was amongst others concluded that: 1) Hemichordata (= Pterobranchia + Enteropneusta) and Lophophorata (= Ectoprocta + Brachiopoda + Phoronida) are paraphyletic groups, 2) Pseudocoelomata is a sister group to the Acoelomata + Eucoelomata, 3) Acoelomata is a sister group to the Eucoelomata, 4) Entoprocta are deuterostomes and 5) Nemertea is a sister group to the protostomes. However a simple, but more exhaustive, re-analysis of the same data set using the program HENNIG86 showed that none of these conclusions is warranted. Moreover, a scrutiny of the data set revealed several erroneous character interpretations (*e.g.* eutely in Priapulida) or false homologies (*e.g.* the proboscis of Nemertea, Echiura and Enteropneusta). Hence we corrected the data set and re-analysed it again. This yielded a cladogram in which 1) the relationships between Acoelomata, Pseudocoelomata and Eucoelomata were unresolved, 2) both the Hemichordata and Lophophorata appeared as monophyletic groups and 3) both Nemertea and Entoprocta branched off together with Acoelomata + Protostomia. In conclusion, cladistic analyses of metazoan relationships may be very informative, but need to be performed with caution.

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4 SEARCH FOR HOMEOSTASIS THROUGH TIME BUDGETING IN *BARBUS BARBUS* (L.).

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Although fishes may buffer the natural fluctuations of water temperature through various mechanisms, behavioural thermoregulation may undoubtly be regarded as the basic adaptive response to short term environmental changes. Radio telemetry (40 MHz activity circuit transmitters) was used to define how *Barbus barbus* (Pisces, Cyprinidae) apportions its time under various thermal conditions throughout the annual cycle. The activities of 21 telemetered fishes (23-53 cm FL) were studied over 24 h cycles (N = 37) and partial cycles (diurnal or nocturnal, N = 80) in the River Ourthe (Southern Belgium, thermal range : 0-25 °C). The daily activity budgets range between 0 and 720 min over the annual cycle and are significantly dependent on water temperature (polynomial regression, R = 0.83, 36 DF). During the autumnal thermal transition (9-10 °C), the typical bimodal crepuscular rhythm pattern observed in summer (1) turns to a trimodal pattern with the emergence of a diurnal phase. The auroral then crepuscular and finally diurnal activity periods progressively vanish as water temperature decreases till the thermal limit for activity (4.0-4.5 °C), when barbels enter a dormancy period. An opposite progressive shift is observed during the spring thermal transition. Although the crepuscular rhythm pattern is consistent throughout summer, water temperature modulates significantly ($p < 0.05$) the precise timing and respective duration of crepuscular and auroral activities. These results clearly show that the activity budgets, rhythms and timings of *B. barbus* are modulated by water temperature and suggest a form of homeostasis through time budgeting. The progressive activity shifts demonstrated in *B. barbus* contrast with the sharp transitions emphasized in Arctic environments (2) and are discussed within the context of homeostasis and adaptation, in parallel with the feeding and diet plasticity in the species.

(1) E. BARAS and B. CHERRY (1990). *Aquat. Liv. Resour.* 3:283-294.

(2) J. HEGGENES, O.M.W. Krog, O.R. LINDAS, J.G. DOKH and T. BREMMER (1993). *J. Anim. Ecol.* 62:295-308.

5 HORMONAL INDUCTION OF THE PHOSPHORYLATION OF THE GLYCOGEN SYNTHASE ISOLATED FROM *XENOPUS LAEVIS* (*DAUDIN*) OOCYTES.

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The oocyte of *Xenopus laevis* is a unicellular structure whose fecondation and segmentation take place in the outer medium. Therefore it accumulates reserves during its intraovarian development, among these

glycogen. We were interested in the molecular mechanisms leading to the regulation of its synthesis and degradation. In this framework, we focused our attention on the regulation of glycogen synthase, the main enzyme implicated in glycogen biosynthesis. To begin with, we purified this enzyme 1,500 fold, using high speed centrifugation and two types of chromatography (1): an ion-exchange (DEAE-Cellulose) chromatography and an affinity chromatography for glucose-6-phosphate, a potent stimulator of glycogen synthase. After electrophoresis and silver staining, the estimated molecular weight of the subunit of the purified enzyme is 85 kD.

Our second step was to investigate how the process of phosphorylation-dephosphorylation controls glycogen synthase activity. First we showed that the enzyme is inhibited by cAMP-dependent phosphorylation and can be found as a phosphoenzyme in an autoradiographic pattern. In addition, experiments making use of thin layer chromatography are currently in progress to demonstrate that the phosphorylation sites are located on serine residues. Finally, we studied the hormonal induction of glycogenosynthesis during the oogenesis of *Xenopus laevis*. First we demonstrated that insulin stimulates both glucose transport across the oocyte membrane and its incorporation into glycogen (as already observed by Hainaut *et al.*(2). Moreover, following insulin treatment, glycogen synthase is fully converted into its active form, while the phosphorylation rates are largely reduced, particularly among the proteins associated with a glycogen-rich preparation. These results confirm the previous data showing that the effect of insulin leads to a drastic decrease in cAMP levels via the inhibition of adenylate cyclase and the activation of membrane-bound phosphodiesterases.

(1) A. CARABAZA, J. ARINO, J.W. FOX, C. VILLAR-PALASI and J.J. GUINOVART (1990). *Biochem. J.* 268:401-407.

(2) P. HAINAUT, A. KOWALSKI, Y. LE MARCHAND-BRUSTEL, S. GIORGETTI, N. GAUTIER and VAN OBBERGHEN (1991). *Mol. Cell. Endocrinol.*75:133-139.

6 *SACCOSTREA CUCULLATA*(VON BORN, 1778) : FOOD AVAILABILITY IN A MANGROVE CREEK (GAZI, KENYA).

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In this study is checked whether morphological differences of the mangrove oyster *Saccostrea cucullata* (von Born, 1778) can be explained by its food supply. In the first part the theoretical amount of food available for *Saccostrea cucullata* in Gazi (Kenya) is determined, in the form of zooplankton, phytoplankton, particulate organic matter (POC and chlorophyll a) and dissolved organic carbon (DOC). By means of ANOVA we showed that there are few significant differences in the

amount of three of these four variables (zooplankton, phytoplankton, particulate organic matter) as a function of the tide. This means that any differences in food availability for *Saccostrea cucullata* are a result of the difference in immersion time, caused by the different heights above chart datum at which the oysters grow. Zooplankton and DOC seem to be abundant in Gazi bay, POC and total seston show the same amount as in other coastal areas, and phytoplankton and chlorophyll a are present in very low concentrations. Carbon isotope analysis showed that *Saccostrea cucullata* filters detritus from mangrove leaves and from seagrasses, but stomach analysis also gave certainty about intake of diatoms and dinoflagellates. The maximal daily ration of *Saccostrea cucullata* in Gazi creek appears to be highest for DOC, followed by POC and finally zooplankton and phytoplankton.
In the second part of this study we tested the hypothesis that the theoretical amount of available food, as derived from the height above chart datum, is related to the morphological differences of the oysters within the oyster culture in Gazi bay, expressed in lengths and dry weights of the organs. First we showed with ANOVA that formaline has almost no influence on the sizes and the weights of oyster organs. Our results also show that all measured organs are linearly correlated with the shell length, but that the height above chart datum does not show any linear correlation with the shell length.
One of the most important findings of this study is that there are no apparent differences in organ sizes of *Saccostrea cucullata* whether it is growing high or low above chart datum, while there is a large difference in potential feeding time, with always about the same food availability.

7 **BIOLOGICAL / ECOLOGICAL CHARACTERISTICS OF*STREPTOCEPHALUS PROBOSCIDEUS* (CRUSTACEA : ANOSTRACA) AND CONSEQUENCES FOR CYST-BASED APPLICATIONS.** *L. Brendonck* - Royal Belgian Institute of Natural Sciences (IRSNB), Brussels.

Streptocephalus proboscideus, a subtropical fairy shrimp species, can to date be successfully cultured under controlled conditions. The combination of adaptive life cycle traits such as the production of strongly resistant resting eggs (cysts), a high fecundity rate, rapid growth, early maturation, rapid hatching, and short generation time, makes this species attractive for applications not only in aquatic toxicology but also in aquaculture. To obtain monospecific cysts of constant and high quality, however, a culture system is required for their controlled production. The praxis of using resting stages which can be hatched at will, must be weighted against the limited ecological relevance of rain pool species as test organisms in aquatic toxicology, and against the variability in hatching response and hatching success of the cysts.

8 THE LIFE CYCLE OF *ABAX ATER* (COLEOPTERA, CARABIDAE).

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Abax ater is a carabid species which does not fit classical schemes, with a continuous reproduction from spring to autumn and both adult and larval overwintering (1). We studied its life cycle in more detail both in the laboratory under controlled conditions (day/night: 16/8 h, 18/15 °C in summer, 8/16 h, 3/1 °C in winter, humidity near saturation) and outdoor under semi-natural conditions. Three types of life cycles were found: 1) Adults emerge in autumn and breed first the next spring; larval development is interrupted by hibernation, mainly at stage 3, and pupation occurs the next spring, 2) Adults emerge in autumn and breed first the next autumn; larval development is interrupted by hibernation at stage 2 or 3 and pupation occurs the next autumn, 3) Adults emerge in spring and breed first the next spring; larval development is interrupted by hibernation, mainly at stage 3, and pupation occurs the next spring. Thus the life cycle of *Abax ater* appears to be complex and varied; the minimum duration of a complete cycle from one adult generation to the next is 1 1/2year.

(1) M. LOREAU (1985). *Holarct. Ecol.* 8: 228-235.

9 ULTRASTRUCTURAL STUDY OF THE MOUTH PARTS OF THE SOFT SCALE *EUPULVINARIA HYDRANGEAE*.

P. Chalon - Université Libre de Bruxelles (ULB).

We have studied the morphology of the mouthparts of the larva of *Eupulvinaria hydrangeae* (Stfeinw.) (*Homoptera, Coccidae*) developing on *Acer pseudoplatanus*. Using conventional optical microscopy and scanning electronic microscopy, we described the internal organisation of the stylets in the clypeolabral shield and the position of their relative matrices. We also have described the external shape and structure of the stylets and tried to give a rough estimation of their size. As far as the nutrition site is concerned, we observed that the larva feeding on leaves inserts their stylets just near the veins, in the parenchyma. Cryofactures of leaves observed in SEM have shown that the stylets incurve themselves and follow a pathway directing them to the vascular bundles of the leaf. Cryofactures of twigs showed that in this case, the stylets of the larva follow a radial pathway directing them to the pith. Our observations are in good agreement with the hypothesis of the nutrition in the vascular bundles. We also observed a sheat of unknown material covering the labium and surrounding the stylets in the plant. This material has a hard texture and seems to make a tight seal between the insect and the plant.

10 ECOLOGICAL STUDY ON THE GILL PARASITES OF *SIGANUS SUTOR* FROM THE INDIAN OCEAN.

H. Coene, A. Geets and *F. Ollevier - University of Leuven (KUL).*

A preliminary qualitative study on the gill parasite fauna has been carried out. It showed that six species of gill parasites occur on *Siganus sutor* of the Kenyan coastal area : the monogeneans *Pseudohaliotrema sp.*, *Tetrancistrum sigani* and *Microcotyle mouwoi*, Copepoda *Hatschekia sp.* and Caligidae and the Isopod *Gnathia sp.*
The microhabitat selection of the parasites within the host individuals has been investigated through their distribution on the gill arches, sectors and filaments. This study shows that the choice of microhabitat is species specific. Each species has its own specific distribution pattern on the gill arches of the host. Furthermore, it seems that the distribution on a gill arch is not at random. The monogeneans show a clear aggregation per filament. The results have been compared with the different hypotheses put forward in literature on microhabitat selection and niche restriction. The nature of the distribution of parasites within the host population has been questioned. Prevalence, mean intensity and abundance of the metapopulation of gill parasites have been compared between two adult populations of siganids and between an adult and juvenile subpopulation. Similarity in prevalence and mean intensity of infection with gill parasites was shown for the two adult siganid-populations. The comparison between the adult and juvenile siganids concerning their parasite fauna has drawn the attention on the dynamical characteristics of the parasite-host system. Here, distinct differences in prevalence and mean intensity were observed.
The frequency distribution of the parasite populations was compared with mathematical distribution models. Most parasites showed an aggregated distribution which was best described by the negative binomal model.

11 EFFECT OF VARIOUS ENVIRONMENTAL CALCIUM LEVELS ON THE UPTAKE OF COBALT BY THE COMMON CARP,*CYPRINUS CARPIO*.

S. Comhaire, R. Blust, L. Van Ginneken, F. D'Haeseleer and *O.L.J. Vanderborght* - University of Antwerp (RUCA).

The acclimation and exposure effect of various external calcium levels on cobalt uptake by the common carp, *Cyprinus carpio*, was studied in chemically defined freshwater. For this purpose fish (2-6 g) were acclimated during a 16 day period to different external calcium concentrations ranging from 0.1 to 10 mM. Cobalt uptake experiments were performed with fish exposed in water with the same range of

environmental calcium levels. The acclimation and the uptake experiments were conducted at a temperature of 25°C and a pH of 8.00. Tracers of cobalt (^{57}Co) and calcium (^{45}Ca) were used to study the uptake of both metals from the testwater during a 3 hour exposure of the fish. Cobalt uptake by whole fish, gills and blood decreases with increasing environmental calcium concentrations in both the acclimation and the exposure water. A positive correlation between the uptake of cobalt and calcium tracers was found. However, if we compare the total uptake of cobalt with the total uptake of calcium, no relation was found between the uptake of both elements. Although there is a clear effect of environmental calcium on the cobalt uptake, the nature of this interaction remains to be elucidated.

12 ULTRASTRUCTURAL AND CYTOCHEMICAL STUDY OF THE TERGITE EPICUTICLE OF *GLOMERIS MARGINATA* (VILLERS) (MYRIAPODA, DIPLOPODA).

Ph. Compère, A. Ansenne, S. Defize and *G. Goffinet* - University of Liège (ULg).

From a adaptive standpoint, the differentiation of cuticular surface lipid layers reducing water loss is regarded as one of the most important new features in the epicuticle of arthropods that colonised terrestrial habitats. In this respect, diplopods appear as a very original and interesting group to study, since they live in the same wet microhabitats as terrestrial isopod crustaceans and possess a mineralised cuticle as is the rule in crustaceans but are phylogenetically close to insects. The purpose of this study was to determine the fine structure and the chemical nature of the epicuticle layers in the tergites of the diplopod *Glomeris marginata* with the use of cytochemical methods for demonstration of chitin, proteins and lipids. The results combined with the previous ultrastructural observations (1) lead to the conclusion that the cuticle includes two functionally different parts: the upper part is involved in the permeability of the cuticle whilst the lower plays an essentially mechanical role. The upper part includes three surface epicuticular layers probably homologous to those described in insects: the proteinaceous cement layer, the wax layer, and the cuticulin layer. The latter seems to consist of a median leaflet of stabilised lipid polymers sandwiched between two protein leaflets. It is assumed to be a primitive, general feature of the arthropod cuticle, having been identified as the main waterproofing barrier in the cuticle of marine decapod crustaceans (2). The layers playing a mechanical role are the inner epicuticle and the mineralised procuticle. The inner epicuticle consists of a lipoprotein matrix surrounding embedded rod-shaped protein elements and chitin-protein fibres probably of procuticular origin. Structurally and functionally, it can be regarded as a structure

convergent with that of decapod crustaceans, owing to its role as a reinforcement preventing the epicuticle and the mineralised exocuticle from splitting off. *P.C. is Senior Research Assistant of the National Fund for Scientific Research (F.N.R.S., Belgium). Supported by the Fund for Joint Basic Research (convention n°2.4527.89).*

(1) A. ANSENNE, Ph. COMPÈRE and G. GOFFINET (1990). In *Proc. 7th Int. Congr. Myriapodology*, Minelli, A. & Brill, E.J. (eds.), Leiden, 125-134.

(2) Ph. COMPÈRE and G. GOFFINET (1992).*Mém. Soc. r. belge Ent.* 35: 715-720.

13 ULTRASTRUCTURE OF THE INTEGUMENT OF THE SEA SPIDER *PYCNOGONUM LITTORALE* (STRÖM) (PYCNOGONIDA).

Ph. Compère, Ph. Thiry, J.C. Bussers and *G. Goffinet* - University of Liège (ULg).

Recent studies suggest that all arthropod cuticles are structured according to the same basic pattern but have undergone major adaptives changes, keeping with the integument physiology and to the habitat of each species. In this respect, pycnogonids appear as a very original and interresting group to study, being commonly considered to form a class among the chelicerates and believed to descend from an early line of marine arthropods that never became terrestrial. Althought their phylogenetical connection with terrestrial arachnids remains unclear, pycnogonid are quite remote from Mandibulata, some of which have independantly colonised terrestrial habitats. As to the ultrastructure of their integument, no information is available.In this preliminary study of the leg and cephalic cuticle of the coastal sea spider *Pycnogonum littorale,* we show that the cuticle presents the same basic organisation as marine benthic crustaceans, but also original features, confirming that this group is in many respects aberrant. Overlying a classical simple epidermis, the cuticle includes two main layers: a thin surface epicuticle and a much thicker lamellated procuticle. The epicuticle seems to consist of three layers closely resembling those observed in marine decapod crustaceans (1): an outer surface coat, the cuticulin layer, which is assumed to be a primitive, general feature of the arthropod cuticle, and a thin inner epicuticle. The procuticle is not mineralised and shows neither any obvious horizontal subdivision (*i.e.* exo- and endocuticle) nor pore canals. Owing to the relatively important thickness of its lamellae, decreasing gradually toward the epidermis, its appearance fits the benthic structural pattern defined in crustaceans (2). The most unusual features of the pycnogonid integument is the presence of large dermal glands within the cuticle, opening at the cuticle surface through short , epicuticle-lined ducts. On the basis of these and

previous observations, we conclude that the adaptative modifications of the arthropod cuticle result in showing greater differences between closely related marine and terrestrial species than between distant taxa living in the same environment. *P.C. is Senior Research Assistant of the National Fund for Scientific Research (F.N.R.S., Belgium). Supported by the Fund for Joint Basic Research (convention n°2.4527.89).*

(1) Ph. COMPÈRE and G. GOFFINET (1992). *Mém. Soc. r. belge Ent.*.35: 715-720.

(2) K. PÜTZ and F. BUCHHOLZ (1991). *Mar. Biol.*, 110: 49-58.

14 CYTOCHEMICAL DEMONSTRATION OF ACID PHOSPHATASE ACTIVITY IN INVERTEBRATE CALCIUM-SALT-CONTAINING TISSUES BY THE RECENT CERIUM-BASED METHOD.

Ph. Compère, M.-F. Voss-Foucart, S. Nizet, S. Meganck, H. Bouchtia and *G. Goffinet* - University of Liège (ULg).

Acid phosphatase (AcPase) is well-known as a characteristic lysosomal degradative enzyme. It has often been used in cytochemistry to locate these organelles in many tissues of vertebrates, but seldom in invertebrates. The recently modified method for demonstrating AcPases, using cerium as capturing agent (1), has hitherto never been applied to tissues containing calcium salts, probably due to technical difficulties resulting from the dissolution of the phosphates and carbonates that nonspecifically precipitate with cerium. The purpose of this study was to demonstrate lysosomal AcPase activity in calcium-salt-containing invertebrate tissues by the cerium-based cytochemical method (1) after prior EDTA-decalcification. The technique was applied to two tissues of premoulting *Carcinus maenas* crabs: the epidermis underlying the mineralised cuticle and the digestive gland whose resorbing cells contain calcium-phosphate spherules. To test the effect of the EDTA treatment and the reliability of our results, we applied the method to a control material, the liver of the japanese quail *Coturnix coturnix japonica*, and AcPase activity was demonstrated in parallel by the classical histochemical method on cryosections of the same tissues. The sites of AcPase activity identified were the same, using both histochemical and cytochemical methods. As expected, primary and secondary lysosomes are identified in quail liver. In the crab epidermis and resorbing cells of the digestive gland, a positive reaction occurs in the terminal cisternae of the Golgi complexes and in lysosomes located in the apical half of the cells. On the basis of these observations, we conclude that the cerium-based method is suitable for ultrastructural demonstration of lysosomal AcPase activity in calcium-salt-containing

tissues. It yields a finer precipitate than previous lead-based methods and does not interfere with the EDTA-decalcification treatment. *P.C. is Senior Research Assistant of the National Fund for Scientific Research (F.N.R.S., Belgium). Supported by the Fund for Joint Basic Research (convention n°2.4527.89).*

(1) K.-J. HALBHUBER, N. ZIMMERMAN and W. LINSS (1988). *Histochemistry* 88: 375-381.

15 RELATIVE MASSES OF THE SKELETAL ELEMENTS IN BIRDS. *J. Cubo, M. Majoral, C. Viladiu* and *A. Casinos.* University of Barcelona, Spain.

The dry mass from different skeletal elements of 44 sepecimens, belonging to 39 species of birds, was measured. The body mass range was 5.7-1430g. Correlations of the mass of the skeletal elements to body mass were established by means of Model II of regression. Positive allometry was found in the case of the femur, clavicle, sternum and caudal vertebrate. For every long bone the slope calculated was not significantly different from that corresponding to the same bone in insectivores and rodents (1) but statistically significant differences were found in the case of humerus, ulna-radius and tibia-tarsus when y-interceptions were compared. Birds always showed higher y-interceptions. Some species display special values for some of their skeletal elements. For example, Phasianidae have lighter fore-limb bone masses than exptected. In contrast, some Ardeidae show especially heavy hind limb bones. This kind of situation is discussed in relation to their particular adaptative meaning, such as the short sustained flight of most of the Phasianidae or the particular aquatic habitat of the Ardeidae. The possibility that some of the long bones were heavier in birds than in insectivores and rodents, is examined.

(1) J. BOU and A. CASINOS (1985). *Fortschr. Zool.* 30:61-64.

16 SWIMMING KINEMATICS IN THE AXOLOTL (*AMBYSTOMA MEXICANUM*): DO THEY REFLECT THE SAME MECHANISM AS IN FISHES ? *K. D'Août, P. Aerts* and *F. De Vree* - University of Antwerp (UIA).

The kinematics of straight forward swimming at a constant speed was studied in the neotenic salamander *Ambystoma mexicanum* by means of high-speed video. *Ambystoma mexicanum* has an undulatory, anguilliform (eel-like) swimming mode. Important parameters of the propulsive wave (wavelength, frequency, speed and amplitude), and two measures for the mechanical swimming efficiency were calculated: the propeller efficiency (dimensionless) and the specific stride length (body

lengths per swimming cycle). Swimming speed was found to be frequency-regulated, while the wavelength of the propulsive wave appeared to be constant. Hence, the speed of the propulsive wave increases with increasing swimming speed. The amplitude of the propulsive wave is minimal just posteriorly to the head and increases considerably to reach a maximum at the tail tip. The mechanical efficiency was found to increase in a hyperbolical manner with increasing swimming speed. Both the propeller efficiency and the specific stride length are thus maximal at high swimming speeds (more than 2.5 body lengths per second), with values of about 0.67 and 0.38 respectively. These characteristics are also typical for anguilliform swimmers among fishes. For the eel (*Anguilla anguilla*), comparable propulsion wave characteristics have since long been described (1). A propeller efficiency of 0.65 (2) and a stride length of 0.49-0.55 body lengths per second (1, 3) were calculated. Despite the striking analogy in swimming kinematics for the axolotl and the eel, the considerable difference in stride length might reflect a different underlying swimming mechanism. This can be due to a different muscle activation pattern, but to morphological differences as well. For instance, the more homogeneous cross-sectional shape and mass distribution over the eel body when compared to the axolotl, might be related to the observed difference in stride length and reflect a different swimming mechanism. *Supported by I.W.O.N.L. grant 920137 (K.D.) and F.K.F.O. grant 2.9005.90 (F.D.V.).*

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(2) T.L.WILLIAMS (1986). *Werner-Gren Int.Symp.* Ser. 45: 141-155.
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17 THE ACTUAL FOOD OF MACROCONSUMERS GRAZING ON LEAVES OR INGESTING DETRITUS OF *POSIDONIA OCEANICA* SEAGRASSES : A δ^{13} C STUDY.

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The grazers *Paracentrotus lividus* (Echinoid), *Idotea baltica* (Isopod) and *Sarpa salpa* (Teleost), and the detritivorous *Holothuria tubulosa* are among the only macroconsumers observed feeding on *Posidonia* seagrasses material in the Mediterranean. A question however remains : do these animals actually assimilate the organic matter of this tough plant or do they preferentially feed on its epiphytes ? The analysis of stable carbon isotope ratios in animal tissues allows to elucidate the origin of organic carbon because δ^{13} C of the two plant groups are well distinct (between -14 and -11‰) clearly showing that this isopod assimilates seagrass carbon (this is confirmed by laboratory feeding

experiments). The viscera of the *Paracentrotus* sea urchin present a mean δ^{13} C of -17.8 ‰, giving evidence of an epiphyte-based dietary. *Sarpa* δ^{13} C values range from -16.4 (gut wall) to - 18.6‰ (liver), showing that this fish, though it obviously ingests *Posidonia* blades, preferentially assimilates epiphytic carbon; it is worth noticing that *Sarpa* also feeds on large seaweeds growing beside the seagrass bed. The sea cucumber *Holothuria*, eating sediments within the bed (whose δ^{13} C averages -15.5‰, intermediate between *Posidonia* and epiphytes) has tissue δ^{13} C values close to its food source (except for the hemal systgem; -17.9‰); values for faeces are slightly more enriched in δ^{13} C than food, indicating a preferential assimilation of epiphytic carbon. In conclusion, it appears that *Posidonia* carbon plays a minor role in the diet of the seagrass bed macroconsumers and that inconspicuous epiphytic algae, despite their apparent small standing stock, constitute the main carbon source for herbivores.

18 POTENTIAL SELECTIVE PRESSURES AND HOST PLANT SELECTION IN A GALL-FORMING FLY.

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Lipara lucens (Diptera, Chloropidae) is a strict monophagous gall-forming parasite of the common reed, *Phragmites australis* (Poaceae). When *Lipara* galls are opened, a number of larvae turn out to be parasitized or eaten by birds. Here, we analyse the influence of hostplant resistance and natural enemies on hostplant selection. To analyse the impact of the herbivorous enemies, we carried out a field experiment. Galls were collected in several reedbeds and transported to the laboratory where they were dissected and the contents identified. The results show that survival of *L. lucens* is shootdiameter dependent. All mortality factors together give rise to a higher survival chance of about 40% on the thicker shoots where all galls carried fully developed larvae. However, the mortality rate was highly different in the reedbeds sampled. In 43% of the localities, natural enemies are even completely absent. The diameter of a reedshoot also influences the survival of the *L. lucens* larvae. In a survival experiment, the highest proportion of galled shoots was found on thin shoots. Thicker shoots produced proportionally less galls. As a result, host resistance to herbivores and mortality due to parasitoids oppose an opposite, shootdiameter-dependent, selective pressure on the gall-forming herbivore. Female oviposition preference experiments showed the female flies oviposit on shoots where the expected larval performance is highest.

19 THE LIMNETIC ZOOPLANKTON OF A TROPICAL FLOODPLAIN LAKE : AN ENCLOSURE EXPERIMENT.

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During the dry season, the zooplankton community of the floodplain lake Iyi-Efi (Imo State, Nigeria ; maximum depth : 3 m, surface : 46.000 m^2) is dominated by small zooplankton at low densities. Due to low water levels, fishes are abundant. In order to estimate the impact of size selective fish predation on the peculiar structure of the zooplankton community, four polyethylene enclosures (cilinders with a length of 2.5 m and a diameter of 0.5 m) were established during the period 16/1 - 7/2/'93. The enclosures were weekly sampled, as well as the lake itself. Probably due to the exclusion of fish, mean densities, biomass and body size increased already remarkably one week after the start of the experiment. The increase of total zooplankton biomass, at food levels hardly as high as those in the lake, indicate that food quantity is not a limiting factor in the lake's secondary production during the dry season. With the exception of the less conspicuous nauplii, the vertical distribution of the lake zooplankton revealed a strong preference for the turbid water layer near the bottom. This phenomenon may be explained as a behavioural adaptation to visual fish predation (1). In this respect, food distribution should not be considered as the cause, for chlorophyll a was found to be homogenously distributed, whereas primary production peaked at a depth of 0.4 m.

(1) W. LAMPERT (1989). *Functional Ecology*. 3:321-27.

20 HOW DOES THE INTERTIDAL SNAIL *MONODONTA LINEATA* (GASTROPOD, TROCHID) RECOGNIZE THE EMERSION/SUBMERSION RATIO : A HYPOTHESIS.

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The snail *M.lineata* only occurs at high levels of the intertidal zone (1). Thompson (2) showed that this zonation does not result from interspecific interactions or food requirements. He concluded that some means of recognizing the emersion/submersion ratio must be involved. The purpose of this study was to search for signals associated with this ratio. In a first set of experiments, we have observed that the zone homing behavior described for animals placed at low levels (2) also exists for animals placed below the low tide level. This shows that *M.lineata* is able to recognize a weak emersion/submersion ratio even when no emersion occurs. Therefore, we have searched signals related to submersion only. Seeing that respiration is quitely different in aquatic and aerial media, the blood acid-base disturbances of *M.lineata* were studied as a hypothetical signal.The pH was measured with a Radiometer microelectrode G 299/A

The $pC0_2$ and concentration in $HC0_3$- were estimated following the Cameroun method (3). Firstly the emersion/submersion ratio imposed was 3/1 with a 12h period. Acidosis and alcalosis occured during emersion and submersion respectively. While pH remained almost constant during immersion, acidosis appeared progressively compensated. With a 1/3 emersion/submersion ratio, the disturbances of the pH were more important. When the animals were immerged after 9h of emersion, the $C0_2$ partial pressure and the bicarbonate concentration decreased from approximately 4 torrs and 4.5 mmol/l. to 2 torrs and 2.5 mmol/l. respectively. This values remained weak as long as the submersion continued. A submersion after 3h of emersion induced a more important decrease of these factors. The results show that the blood acid-base disturbances could informe *M.lineata* about the emersion/submersion ratio it encounters. Works on this hypothesis are now in progress.

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(2) T.E. THOMPSON (1968). *Sch. Sci. Rev.* 149:97-102.
(3) J.N. CAMEROUN (1971). *J. Appl. Physiol.* 31:632-634.

21 STUDY OF THE MACROFAUNA ASSOCIATED WITH SEAGRASSES IN GAZI BAY (KENYA), WITH EMPHASIS ON THE CRUSTACEA.

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Little information is available about the macrofauna of Eastafrican seagrassbeds. This study aims to contribute to the knowledge of this macrofauna. Seven stations were sampled in the seagrass beds of Gazi Bay (Kenya). Three of them are situated in the western and the side creek and include *Cymodocea rotundata* and *C. serrulata*. Three stations in the eastern creek include *Thalassodendron ciliatum* and one *T. ciliatum* station is situated in the bay. The benthos of the seagrass beds has also been studied. A distinction has been made between the leaves, stalks and roots. The faunal analysis shows the Crustacea to be dominant : Amphipoda, Isopoda, Tanaidacea, Cumacea, Copepoda, and Ostracoda are the most important taxa. The Decapoda are represented in very small numbers. The animals are, if possible, identified up to the genus-level and a morphological description is given. Their occurence in Gazi Bay has been discussed. A key to the families and genera has been made. The structure of the macrofauna has been investigated by two multivariate analyses techniques, TWINSPAN and CCA. These analyses show a difference between the *Cymodocea*-community, the *Thalassodendron ciliatum*-community of the eastern creek, and the *T. ciliatum*-community of the bay. These three communities can also be divided in a leaf-, stalk-, and rootgroup. The eastern and western creek, following a vegetative study (1), are compared by means of the densities of their macrofauna.

The densities of the epifauna of the western creek (1653 ind/m^2) are much lower than in the eastern creek (21412 ind/m^2). The densities of the benthos of the eastern creek (20085 ind/m^2) are much lower than in the western creek (46337 ind/m^2). An indirect assessment of the standing stock of the eastern creek gives a value between 0.02 and 166 g DW/m^2, that of the western creek between 0.0238 and 192 g DW/m^2.

(1) P.H. VANAVESAATH, G. VAN DER VELDE and E. COPPPEJANS (1993).In : Dynamics and Assessment of Kenyan Mangrove Ecosystems, Final Report, A.F. Woitchik, ANCH, 35-55, Vrije Universiteit Brussel, Belgium.

22 IMMUNOCYTOLOGICAL LOCATION OF ANTIGENS OF *OSTERTAGIA OSTERTAGI* AND *COOPERIA ONCOPHORA*.

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Cryostat sections of the developmental stages (L3, L4 and adult) of *Ostertagia ostertagi* and *Cooperia oncophora*, probed with sera from calves monoinfected with one of the two gastrointestinal nematodes, were used in an indirect immunofluorescence assay. In addition the indirect immunofluorescence assay was also performed on whole nematodes after collagenase permeabilisation to remove the cuticle. Incubation with negative sera showed frequently a slight fluorescence caused by reaction of preinfective sera with nematode antigens. The cuticle of all stages, except for the adults of *Cooperia oncophora,* contained antigens that reacted with anti-*Ostertagia ostertagi* and anti-*Cooperia oncophora* antibodies. L3 exsheathment fluid showed to be strongly antigenic. Furthermore fluorescence of pharynx, anal and reproductive pori in the adult stages suggested the antigenicity of excretion-secretion products. In both the adult and L4 stages fluorescence of the intestine was observed, probably due to the uptake of host immunoglobulines. The fluorescence observed in the muscular body layer and in the uterus might be related to the basal lamina. Anti-*Cooperia oncophora* serum strongly reacted with antigens of *Ostertagia ostertagi* confirming the existence of cross-reacting epitopes between both species. Collagenase permeabilisation showed not to be efficient on these nematodes because of the different cuticle structure.

23 CO-ADAPTATION OF LIFE HISTORY CHARACTERISTICS AND HABITAT PREFERENCE IN *DAPHNIA* (CRUSTACEA, CLADOCERA)

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Though recent studies indicate that plasticity in dial vertical migration behaviour of zooplankton is high (1, 2), evidence has accrued for a genetic polymorphism with respect to the behaviour, both from field studies using electrophoretic markers (3-4) and from laboratory studies showing a genetic component to the variability in phototactic behaviour in *Daphnia* (5-6). Differences in phototactic behaviour correspond to differences in habitat preference in *Daphnia magna*: positively phototactic clones are characterized by a shallow day-depth, whereas intermediately and negatively phototactic clones remain in deeper water during the day (7). We have conducted life table experiments with *D. magna* clones differing in phototactic behaviour to test for co-adaptation between life histories and day-time vertical distribution. Highly significant interclonal differences were observed for several life history traits. Differences in adult body size, size of the neonates, average duration of the adult instar, and clutch sizes were associated with differences in phototactic behaviour. Positively phototactic clones combine a small adult body size with a high intrinsic rate of increase, by producing offspring at a relatively fast rate. They do so at the cost of producing small neonates that are less starvation-resistant than those from negatively and intermediately phototactic clones. They can afford this cost because they are less likely to face starvation as they remain in the relatively food-rich surface waters. Clones residing at greater depth during the day grow larger, and produce offspring of better quality. Though our observations need corroboration from data on the life history of migrating and non-migrating clones of lake-dwelling *Daphnia* species, our results indicate that vertical migration "strategies" may include differences in life history strategies.

(1) W.E. NEILL (1990). *Nature* 345:524-526.
(2) J. RINGELBERG (1991). *J. Plankton Res.* 13:83-89.
(3) L. WEIDER (1984). *Limnol. Oceanogr.* 29:225-235.
(4) J. MÜLLER and A. SEITZ (1993). *Arch. Hydrobiol. Beih. Ergebn. Limnol.* 39:167-174.
(5) L. DE MEESTER (1991). *Hydrobiologia* 225:217-227.
(6) L. DE MEESTER (1993). *Ecology* 74:1467-1474.
(7) L. DE MEESTER (1993). *Arch. Hydrobiol.Beih. Ergebn. Limnol.* 39:137-155.

24 THE VERTICAL DISTRIBUTION OF ROTIFERS IN A COASTAL MEROMICTIC LAKE OF PAPUA NEW GUINEA (LAKE NAGADA, MADANG PROVINCE).

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Lake Nagada is a coastal meromictic lake in NE Papua New Guinea (1). As part of a field study on the limnology of this lake, we studied the day- and nighttime vertical distribution of the rotifer *Brachionus* cf. *plicatilis* ("S-type") (2) in relation to the stratification of abiotic factors (temperature, conductivity, redox potential, pH, dissolved oxygen, total sulfides, and light transmission) as well as of phytoplankton and photosynthetic bacteria. At the end of May 1992, the thermocline was situated at 2.00 m depth, whereas the chemocline was at 4.75 m depth. A phytoplankton peak concentration was observed at the thermocline (1.5 - 2 m), whereas a dense bacterial plate occurred at the chemocline. Light intensity dropped sharply to less than 0.1 % at the depth of the bacterial plate. The day- and nighttime vertical distribution of *Brachionus* cf. *plicatilis* was sampled at 0.5 m intervals. During the day, a bimodal distribution was observed, with a peak of more than 900 ind. l^{-1} at 1-1.5 m depth, and a smaller peak of about 400 ind. l^{-1} at 4.5 m. A small number of individuals was found below the chemocline (up to 6.5 m depth). At night, there was a clearcut unimodal distribution, with a peak concentration of 1040 ind. l^{-1} at 1.5 m. Our results indicate two subpopulations of *B.* cf. *plicatilis* in Lake Nagada, with the animals residing near the chemocline during the day migrating to the phytoplankton maximum during the night.

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25 ROOSTS OF BLACK-HEADED GULLS : KEY OF A SELF-ORGANIZED DISPERSAL SYSTEM.

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Self organizing principle suggests that very simple interactions between numerous agents lead to very sophisticated adaptive behaviours on the hole system of these interacting agents. Self-organization has been evidenced as the leading principle of several adaptive mass behaviour in social animals, mostly social insects. Here we construct a model based on field observations and experiments on the social behaviours of wintering black-headed gulls, particularly roosting behaviour. This model leads from the simple rules structuring flocks of gulls till the complex adaptive system regulating the daily distribution of lens of thousands of them over wide

areas. These simple rules will be linked to this complexity through spatial structure of daily moves and nocturnal roosting behaviours. This model is both an illustration of the self-organizing principle as a mean of regulating bird dispersal and a new hypothesis about the function of communal roosting behaviour in birds.

26 INFLUENCE OF COPPER ON SOME ASPECTS OF THE ENERGY METABOLISM OF THE COMMON CARP *CYPRINUS CARPIO*. *H. De Smet, G. De Boeck* and *R. Blust* - University of Antwerp (RUCA).

The influence of copper on the oxygen consumption, nitrogen excretion and oxygen consumption/nitrogen excretion ratio (O/N ratio) of carp (15-25g) was determined at three different concentrations of the metal, during the first ten hours and after one week of exposure. Experiments were performed in a respiration chamber with the use of an oxygen-and ammonia-electrode. At a concentration of 250 µg/l an immediate significant drop of 60% in the O/N ratio was observed. This was followed by a transient, partial, but significant recovery. Finally, the O/N ratio stabilised at the level reached during the first hour of exposure. The same pattern was observed at a copper concentration of 125 µg/l, but the initial drop in O/N ratio was less (45%). At a copper concentration of 62.5 µg/l the response of the fish was not significantly different from control values. The sudden drop in the O/N ratio during the first hours was caused by a decrease in oxygen consumption compared to a smaller decrease in ammonia excretion. One week later however, ammonia excretion was fully restored to the initial level whereas oxygen consumption remained low. When the carps were exposed to an additional stressor, *i.e.* hypoxia, the critical oxygen concentration shifted from 1 mg/l (for clean water) to 3.5 mg/l (for exposure to a copper concentration of 125 µg/l and during one week). Under normal conditions, the ammonia excretion rate decreased after the critical ammonia concentration of 1 mg/l. At 125 µg/l Cu however, the ammonia excretion rate declined gradually. These changes clearly indicate that the fishes who were exposed to a sublethal concentration of copper, were more sensitive to the additional stressor than the controls.

27 PALEONTOLOGICAL STUDY OF THE NEERREPEN SANDS (GHOST-, ICHNO- AND MICROFOSSILS IN THE TUNGRIAN ID). *J. Deville* - University of Gent (RUG).

Until now there were few founds of macrofossils in the Neerrepen sands. It's very difficult to get ghost fossils out of the sand. When they

are prepared from above, you will never get a good, determinable impression. Therefore we used, so far as known a new method to prepare ghost fossils of the Neerrepen sands. We got a block of sand out of the wall and then we prepared from below. The results is a much better impression and the determination is more easely. Afterwards about 150 fossils were fixed with a solution of joiner's glue and water. The result of my study show that for Belgium 10 new molluscs were found in the Neerrepen sands. That means there are two new discoveries for the North-west of Europ. For Gliber and de Heinzelin (1), the Grimmertingen sands and the Neerrepen sands belong to the same naval cycle. They pretend that in spite of the subnaval gap (hardground), the fauna with *Cubitostrea ventilabrum* is toncinuous in the Neerrepen sands. My study proves that there is a difference in the fauna and that the subnaval gap is important. It proves that the Neerrepen sands are coast disposals. The Grimmertingen sands are pure naval disposals. The stratigraphical spread of *Paliliolum hausmanni hausmanni* and *Hiberia stettinensis* has to be reniewed. The comparison of the microfossils I found with those of other studies of the Belgian catchment area (2) proves that the Neerrepen sands belong to the Upper-Eocene.

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28 POPULATION GENETICS IN *LITTORINA STRIATA* ON A MICROGEOGRAPHICAL SCALE. *H. De Wolf*, T. Backeljau**, K. Breugelmans** and *C. Brito**** - * University of Antwerp (RUCA), **Royal Belgian Institute of Natural Sciences, Brussels and ***Universade dos Açores, Ponta Delgada, Sao Miguel, Açores.

The periwinkle *Littorina striata* is a planctotrophic developer. According to Scheltema (1) and Crisp (2), it is expected to have great dispersal abilities resulting in a high degree of gene flow. Scheltema (1) and Crisp (2) consider gene flow as a homogenising force, diminishing population differentiation in both genetic and phenotypic traits. In contrast to these ideas *L.striata* exhibits a high degree of shell variation even on a microgeographical scale. On Ilheu de Vila Franca, which is a volcanic crater in the Açores, different morphotypes of *L.striata* are found. The shell surface of the periwinkle can be smooth or nodulous. A white band on the last whirl can be present or absent. In addition all morphotypes can be erodated. Although different morphotypes do co-occur, nodulous animals are mostly found on the sheltered inside, whereas the other morphotypes are found on the exposed outside of the crater. Six populations of *L.striata* from Ilheu de Vila Franca and Vila Franca (Sao Miguel, Açores) were surveyed for electrophoretic variation at four

enzyme loci (GPI, PGD, MDH and MPI). All six populations were found being in Hardy Weinberg equilibrium. Only at locus MPI, a significant genetic heterogeneity was observed. No genetic heterogeneity was found between smooth, nodulous and males and females. Wright's F-statistics showed no population differentiation (Fst=0.014). Based on the value of Fst, gene flow was estimated: Nm=17.06. This preliminary study does not find a convincing genetic basis for the observed morphological heterogeneity. Therefore phenotypic plasticity could account for the observed morphological differences. Natural selection can however not be ignored since only a small part of the genome was investigated.

(1) R.S. SCHELTEMA (1971). *Biological Bulletin* 140:284-322.
(2) D. CRISP (1978). *Ecology and Evolution*. Plenum Press, New York.

29 LOCATION OF THE NORADRENERGIC SYSTEM IN THE CHICKEN BRAIN(*GALLUS DOMESTICUS*) AND RESEARCH FOR HYPOTHALAMIC INTERACTIONS BETWEEN BIOGENIC AMINES AND NEUROPEPTIDES IN THE CHICKEN.

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The present work can be situated in a long term project trying to elucidate the role of biogenic amines and neuropeptides in the antithesis between growth and reproduction in the domestic fowl. In a first part of the study the immunocytochemical (ICC) distribution of noradrenergic structures was described throughout the brain of 4 weeks old broiler chickens, using antibodies directed against both noradrenaline (NA) and the enzym dopamine-b-hydroxylase (DbH). The distribution of immunopositive NA-neurons is confined to the brain stem and the medulla oblongata. Noradrenergic perikarya can be observed in the caudal and dorsal part of the locus ceruleus and in the caudal nucleus subceruleus ventralis. A few NA-containing neurons are present in the medulla in a ventrolateral to dorsal position. NA-immunoreactive fibres and terminals are distributed throughout most brain regions, with local differences in density. The distribution patterns of both NA and DbH overlap in most brain regions, except in the medulla where no DbH-ir cells are found. This is probably a conseqence of the sensitivity of the used anti-DbH, that fails to detect these particular cells.

In the second part of the study, possible relations between biogenic amines and neuropeptides were investigated. This resulted in two series of light microscopic double immunostainings. A first one involves TH, an important enzyme in the synthesis of DA, and various peptides [b-endorphin (b-END), luteinizing hormone releasing hormone-I (LHRH I), neuropeptide Y (NPY), cholesystokinin (CCK) and vasotocin (VT)], while in a second series interactions between 5-HT and b-END, LHRH I,

CCK and VT were investigated. There is found no proof of coexistence between TH, 5-HT and the several peptides used. However, in all cases examined, except for the double staining of TH and NPY, intimate associations between TH- or 5-HT-containing fibres and -terminals and neuropeptide containing neurons can be observed. Those contacts seem the most abundant in the periventricular region of the hypothalamus.
These results suggest that neurosecretion of peptide hormones from hypothalamic cells might be controlled by dopamine and serotonin. Because light microscopical studies cannot reveal the existence of true synaptic contacts, electron microscopy is required in the near future.

30 IS MOVING A SUITABLE METHOD FOR CONSERVING NATURAL POPULATIONS OF ROVE BEETLES (COLEOPTERA STAPHYLINIDAE) IN CALCAREOUS SHALE GRASSLANDS ?

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In Belgium, calcareous grasslands are semi-natural, threatened biotopes the management of which requires human (mowing) and/or animal (grazing) activities in order to conserve their steppic physiognomy. The aim of the present study is to evaluate the impact of mowing upon populations of rove beetles living in a calcareous shale grassland located in Vierves-sur-Viroin (UTM MOMT FR 14). Staphylinid populations were sampled during a one-year cycle using pitfall traps distributed in six study stands. These stands were choosen in accordance with the topography of the site (north side, south side or plateau), and in each topographic condition one stand was mowed before the beginning of our sampling. The total numbers of Staphylinid species recorded (69) were quite similar to those found in chalk-grasslands (from 13 species on the south side to 38 species on the north side) while the total numbers of captured individuals appeared significantly lower (from 41 on the south side to 126 on the north side). This is likely due to contrasted and hard temperature conditions (*e.g.* on the south side, mean annual maximum and minimum temperatures were 40.3°C and 2.2°C, respectively). Several uncommon thermophilous species (e.g. *Xantholinus detryi*) and myrmecophilous ones (e.g. *Zyras limbatus*) were recorded on the south side or on the plateau while more common and hygrophilous species (*e.g. Tachinus corticinus*) were found on the north side. On the other hand, the results of a correspondence analysis led to the conclution that exposure, in the first place, pH and soil thickness, in the second place, are important environmental factors for staphylinid populations, and that moving seems to have a fairly unimportant effect. The management of calcareous shale grasslands poses a dilemma : to preserve the diversity of staphylinid assemblages it seems necessary to manage north sides of calcareous

grasslands; and, to maintain thermophilous and myrmecophilous species it would be preferable not to manage both the south sides and the plateau! Nevertheless, as microclimate and management are not inseparable, only the conservation of an ecological mosaic could guarantee the success of staphylinid populations. Such developments need to be explored.

31 THE VOCAL REPERTOIRE OF BONOBO'S (*PAN PANISCUS*) IN CAPTIVITY.

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Research on vocal communication of chimpanzees, esp. of pygmy chimpanzees (*Pan paniscus*), is very limited. De Waal (1) and Beyers (2) described the repertoire while Mori (3) only mentioned some vocalisations. The knowledge of the vocal repertoire however is very important to understand the social structure. Before analysing the function and sentence of vocalisations, one has to find out what vocalisations are uttered in what context or in combination whith which behavioural elements. Every individual of a captive group of bonobo's in Planckendael (8 individuals) was observed 42.5hrs. All gestures and vocalisations were recorded. The context in which they occured was quantified. From the sonograms, 15 different vocalisations were described, 11 of which in common with De Waal's (1) repertoire of 12 vocalisations. Although our results were highly comparable with those of De Waal (1), the context and especially the frequency of utterance could be very different.
A variety of factors can explain these differences between the two studies: 1) both studies were carried out on small groups. So the interindividual differences in behavioural patterns and/or vocalisations may become very important; 2) we observed also at night unlike the other researchers. Differences cannot be interpreted as De Waal's results do not permit to make quantified correlations between behavioural elements and vocalisations. The present study gives a supplement to the known repertoire. Our data can be used as a manual for further research on bonobo vocal communication.
Our results also stress the need for more research, especially on larger groups.

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(2) I. BEYERS (1987). Thesis, U.I.A.
(3) A. MORI (1984). *Primates* 25 (3) :255-278.

32 AGE-INDEPENDENT SONG LEARNING IN THE EUROPEAN STARLING.

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In most songbird species that have been studied, song learning is restricted to one or two periods during the first year of life. In only a few species, of which the domestic canary *Serinus canaria* is best known, males continue to produce new songs in adulthood. European starlings *Sturnus vulgaris* have large repertoires extending from 20 to 70 song types and are known for their ability to incorporate heterospecific imitations into their songs. Yearling males have smaller repertoires and sing shorter song bouts than older males suggesting that starlings are able to learn new song types as adults. We recorded the song of captive starlings in two successive years to see if changes occurred in song repertoire size and average song bout length. As four males were raised in captivity by four different males, we could also focus on choices of song models. Most males sang new song types in their second year of recording. Males which were yearlings when recorded for the first time increased their average song bout length significantly while the average song bout length of older males did not increase. Yearling males also increased their song repertoire size significantly more than older males. Nevertheless most older males were also found to have modified their repertoire. Our results indicate that starlings are 'age- independent' learners, but also suggest that the ability to incorporate new song types into the song decreases with age. We also focused upon choices of song models by male starlings that were raised in captivity. All males copied a large proportion of their song from adult males with whom they shared the aviary.

33 GUT TURN OVER TIME IN *EUDRILUS EUGENIAE* (OLIGOCHETA, EUDRILIDAE).

H. Er-Rai and *G. Josens* - Université Libre de Bruxelles (ULB).

Gut turn over time is an essential parameter for assessing the quantitative role of earthworms and their energy budget. This is the scope of our study for a tropical species : *Eudrilius eugeniae* (Kinberg). The gut turn over time was measured in the laboratory by a) casts accumulation during 12 to 96 hours without any handling of the worms, b) direct observation of the transit and c) bran tracing.
The two latter methods gave consistent results, suggesting that the turn over time was independent of the size of the worms : 5.2±0.5 hours at 25° C. However, these two methods implied frequent handling of the animals and were performed during day-time. The cast accumulation method proved, in accordance with Madge's field (1) observations that soil consumption and thus cast production was much higher during night-

time than day-time. Therefore, we will rely only on results obtained on complete daily cycles. Our results can be summarised in three points :1) Gut turn over time was 2.8 times faster at 30° than at 20°C; 2) Significant correlation was found between gut turn over time and worm's size; 3) Gut turn over time was 1.9 times longer when the worms were fed on mineral soil (versus leaf mould).

(1) D.S. MADGE (1969). *Pedobiologia* 9:188-214.

34 DISTRIBUTION OF *FRANKLINIELLA OCCIDENTALIS* WITHIN THE SWEET PEPPER PLANT.

C. Gerin - Université Catholique de Louvain (UCL).

Recent studies (1) showed that adult *Frankliniella occidentalis* is most present in flowers. Nevertheless, feeding and egg laying are principally realized on leaves. It is thus hypothesized that individuals move within the plant. The thrips spatial repartition has been established on pepper plants for 24 hours. The experiment was realized with 5 groups of 12 plants. When populations of thrips and full-blown flowers were numerous, a plant of each group was cut every two hours. The thrips were collected from all leaves and flowers and were counted under a stereomicroscope. Comparison of the numbers of thrips at different hours show that larvae and, at a larger extent, adults move from leaves to flowers and conversely. These movements are probably due to a searching behaviour for essential nutrients, *e.g.* pollen (2) which are available in the flowers. To verify this hypothesis, the effect of pollen and nectar on the population dynamics of the thrips should be studied.

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(2) P.J. TRICHILO and T.F. LEIGH (1988). *Ann. Ent. Soc. Am.* 81: 64-70.

35 LIVING FORAMINIFERA OF LAING ISLAND (PAPUA NEW-GUINEA) : DIVERSITY DISTRIBUTION AND CORRELATIONS.

Y. Gerrienne, J.C. Bussers, M. Poulicek, P. Vandewalle and *C. Jeuniaux* - University of Liège (ULg).

Mathematical analyses using quantitative data, are rarely used for the study of the ecology of living Foraminifera. Our study is the first to use such methods for living Foraminifera of coral reefs. In this way, diversity and similarities between transects were calculated for fifteen species of Foraminifera living on the calcareous algae *Halimeda*. Two reefs were prospected : Laing Island reef (144°50' long.e; 4° 10' lat. s.) and Boisa Island reef (144°57' long.e; 4°00' lat. s.). They are both situated

in the Bismarck sea (Papua New-Guinea) but Laing Island is near the coast and, as a consequence, received the organic matter and the dilution carried down by two rivers which mouths are situated about ten kilometres to the north. The diversity measures (Shannon index; Laing Island reef) show that the dilution and turbidity are responsible of the lower diversity observed in the sheltered and exposed areas and the higher diversity observed in the semi-exposed areas. These factors seem, in another way, to be responsible of the higher diversity observed for the Boisa Island reef. The similarities between transects (Laing island reef), calculated with the Kulczynski coefficient, show a partition between eastern and western coasts. Nevertheless, the eastern transect and the lagoon transect are quite similar although they are situated respectively on eastern coast and western coast. This paradoxical similarity seems to be in relation with waves'force and bacterial activity. Finally, it is interesting to note the absence of significative similarity between Boisa Island and Laing island. We come to the conclusion that dilution, turbidity, waves'forces and bacterial activity are some factors influencing the epiphyte fauna of Foraminifera. The fauna of Laing Island reef, unlike Boisa Island's, seems to be disturbed by the dilution and the organic matter carried down by the two rivers.

36 THE EFFECT OF EARLY EXPERIENCE ON LEARNING IN THE GREAT TIT (*PARUS MAJOR*).

M. Ghielli, F. Adriaensen and *A.A. Dhondt* - Universitaire Instelling Antwerpen (UIA).

In a laboratory situation, 14 will-caught great tits, eight juveniles and six older ones, were subjected to learning problems. Two experiments were carried out, in which an individual was to learn to solve a particular problem. The design was based on operant conditioning procedures. In one experiment, punishment (turning of the light), in the other reward (providing food), was used as a tool for reinforcing and motivate the animals. Data were obtained by personal observations as well as by computer sampling. After performing principal component analysis on these raw data, individuals were characterized by criteria indicating activity, fear, food-uptake and learning. A multiple regression of the learning criteria showed that intrinsic behavioral characteristics, as well as created motivations have an influence on individual performances. However, variation in these qualities cannot provide an explanation for all the variation in learning between individuals. In fact, analysis of variance for learning proved a significantly better performance of the adult group, for a distinct part of the learning results. The significance was not found in any of the other investigated behavioral aspects. Therefore its explanation must be sought in the age difference between the groups. Adult great tits thus perform better in solving learning problems which resemble those met in true situations. This might be explained by the greater experience of the

adults, or the adult group might already be a selected 'smarter' group. In either case, the adaptiveness of "learning" is shown.

37 A NOVEL EXOCRINE GLAND IN THE ARMY ANT AENICTUS AND ITS FUNCTION IN TRAIL FOLLOWING.

B. Gobin, J. Billen,* N.J. Oldham*** and *E.D. Morgan*** - * Catholic University of Leuven (KUL) and ** Keele University, England.

The Old World army ant genus *Aenictus* comprises approximately 50 species, that are distributed over the Indo-Australian region and Africa. They are all blind, and form impressive raiding columns, in which pheromonal communication along with tactile stimuli are assumed to play a major role. The existence of trail pheromones, nor the exocrine glands involved, however, have been studied so far.
Our recent morphological and ultrastructural investigations in *Aenictus rotundatus* from Kenya and *Aenictus* sp. from Hong Kong revealed the existence of hitherto unknown paired exocrine glands in the abdomen. They appear as two reddish organs underneath the seventh tergite, that are connected with the cloacal chamber through a number of slender ducts. Chemical examination of these novel glands showed methyl-anthranilate to be the major component (approx. 100 ng/worker).
Behavioural experiments with the Hong Kong species, using hexane extracts of this gland, clearly illustrated the role of this gland in the generation of very strong trail following. Using the pure substances, we may tentatively conclude that the trail pheromone consists of an activating substance to initiate trail following and a second substance which continues the activity.

38 MORPHOLOGY AND ULTRASTRUCTURE OF THE TIBIAL GLANDS IN THE PREDATORY BY *PLATYPALPUS* (DIPTERA, EMPIDOIDEA, HYBOTIDAE).

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The glands of the fore tibiae are a synapomorphic character of the family Hybotidae. Their function and structure are unknown. The morphology of the glands is reconstructed in a number of *Platypalpus* species by means of a light microscopic study of semi-thin sections and by TEM. The glands are composed of at least two glandular systems. The first consists of a large multicellular gland filling up three quarters of the fore tibiae. According to the species this gland is tubular or can have short side tubes and/or the tip can be folded. The turgescent secretory cells

contain large amounts of RER, Golgi bodies and multilamellar bodies suggesting a large protein production. The cells are connected by thin microvilli to a central sclerotized duct. Products are secreted in the large intercellular space between the cell bodies and the duct. From there they are evacuated through small pores (not pore canals) or short cuticular ducts into the lumen of the central duct. This duct opens to the exterior in the center of a plate-like structure anteriorly near the base of the tibiae which we call the anterior plate. No opening or closing mechanisms have been observed. The second gland is smaller and composed of a number of secretory cells laying underneath the anterior plate. The cells seem to open individually to the exterior through the anterior plate. The ultrastructure of this glands was not yet investigated. The anterior plate is composed of a thin cuticular plate bearing numerous microtrichia grapped in a mucous substance. This mucus has the same staining properties as the substance in the end of the central duct. Differences in staining between the two glands indicate a different type of secretion. The ultrastructure of the large gland suggests synthesis of protein rich substances. Hence the synthesis of pheromones is most unlikely. As to the function, no clues are found yet in the sexual or territorial behaviour of *Platypalpus*. The only occasion when the gland openings touch a substrate is during prey handling. The possible effects of this are not clear.

39 EMPIDOID FLIES (INSECTA, DIPTERA) ASSOCIATED WITH CRAB BURROWS (CRUSTACEA, DECAPODA) : OPPORTUNISM OR COMMENSALISM ?

P. Grootaert and *I. Van de Velde* - Royal Belgian Institute of Natural Sciences (KBIN), Brussels.

Although quite large numbers of empidoid flies are caught in white pan traps in the supralittoral zone, they are rarely seen on the beach or on the vegetation. This suggests that they are active only during a short period of the day and seek shelter for the rest of the day. In addition, we observed on several occasions empidoid flies in crab burrows along the tropical coasts of the Pacific and the Atlantic Ocean. Hitherto nothing is know about the association of empidoid flies (Dolichopodidae and Hybotidae) with crab burrows. Therefore the burrows were systematically examined for the presence of flies by blowing the holes with compressed air or by simple hand captures. On sandy beaches in the western Pacific (northern Papua New Guinea) up to eight adults of the hybotid *Chersodromia flavipyga* were found in the vertical burrows of young ghost crabs (*Ocypoda*) which live in the lower supralittoral. In the upper part of the supralittoral with a pioneer vegetation of *Canavalia maritima* where the older ghost crabs live in larger and oblique burrows, at least 3 species of the dolichopodid *Asyndetus* were encountered. On Laing Island, the very large burrows of gecarcinid crabs on the borders of the

mangrove serve as a hiding place for a large amount of mosquitos. At the same time they contain one or more dolichopodids belonging to the genera *Teuchophorus*, *Diaphorus* or *Cryptophleps* and very often the hybotid *Nanodromia*. In the present situation on Laing Island, these Diptera are in the first place seeking shelter against the heavy winds but it is not unlikely that some of the dolichopodids feed on the mosquitos inside the burrows and that their larvae live in the wet soil surrounding the burrows. On the Caribbean and Pacific coasts of Mexico, three and two species of *Asyndetus* respectively were found in the larger burrows of the ghost crabs on the upper beach. Here the burrows provide a refuge from extreme environmental conditions like heath, drought and heavy wind and a concealment from predators. The burrow offers a high humidity, a low constant temperature and moreover a suitable place for the development of the larvae. Since the larvae of empidoids are supposed to be predatory, more detailed research has to be done to reveal if there exists a direct relationship between the crab and the fly as far as feeding strategies are concerned.

40 TOWARDS AN INTEGRATED PEST MANAGEMENT STRATEGY AGAINST *DYSAPHIS PLANTAGINEA* PASSERINI (HOMOPTERA : APHIDIDAE) IN APPLE ORCHARDS. *P. Guillaume* - Faculté des Sciences agronomiques de Gembloux.

This project analyses the possibilities of an integrated pest management strategy against the rosy apple aphid, *Dysaphis plantaginea* Pass., in the context of an apple production certified by a label. *D. plantaginea* induces heavy economical losses, very early in the season, when farmers neglect the use of chemical sprays. This research consists of a statistical analysis of catch numbers at the suction trap in Arras from 1978 to 1991.The understanding of weather influences is a prerequisite to a forecasting model of years during which the aphids reach economic thresholds. There are several critical periods in the development of rosy apple aphid populations: 1) two density dependant regulations explain the abundance of further catches; the first one occurs during the "egg" stage, the second one when the aphid is settled on his secondary host plant, *Plantago* sp. 2) rain and wind, when aphids are flying between the two (necessary) host plants, lead to a high mortality rate among these winged forms. Nevertheless, these informations should still be read carefully because the suction traps only sample alatae populations. Therefore, in the future a survey of rosy apple aphids in orchards will be necessary to achieve an efficient integrated strategy against this pest.

41 STAPHYLINIDAE FROM A SEASHORE HABITAT : THE ZWIN SALTMARSH AT KNOKKE, BELGIUM (INSECTA, COLEOPTERA).

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During a year-round survey, the rove beetle fauna of a saltmarsh at the east-coast of Belgium was studied. 81 species, belonging to 11 subfamilies, were collected in five micro-habitats : three stations where situated in the saltmarsh which was irregularly flooded by the sea during spring and autumn, the other stations were situated at the egde of the saltmarsh and a small dune, and in the dune itself. The species can be grouped into two major categories : typical halobiont species, generally of a restricted distribution and a second group with mostly eurytope ubiquists. The dominant species, amongs the small group of halobionts are *Bledius tricornis*, *Bledius unicornis* and *Quedius simplicifrons* all occuring in the saltmarsh. Among the dominant eurytopic species we found *Xantholinus linearis*, *Ocypus olens* and *Drusilla canaliculata*, all widely distributed and *Oxypoda brachyptera* at the edge of the sand dune. A number of very rare species are recorded : *Lamprinodes saginatus* and *Oxypoda lurida*. The *Bledius unicornis* population in the Zwin is probably the last in Belgium. Furthermore faunistical and phenological information is given on the most typical species and some notes are given on parasitic fungi and phoretic nematodes. Finally we can state that the *Staphylinidae* fauna from the Zwin saltmarsh is rather poor and this for two reasons : 1) the high salinity of the soil and 2) the frequent flooding of the area. It appears to be much less diverse than the other Belgian saltmarsh at Nieuwpoort.

42 RELATIONSHIP BETWEEN HOST-PLANT VARIETY AND APHID PHENOLOGY IN MAIZE CROPS.

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The host plant constitutes one of the major factors which act on the expression of aphid population growth potential. It influences aphid developement by means of food quality, but also through morphological adaptations such as pilosity or sclerotinisation of cell membranes, and by means of biochemical compounds (reppellent or toxic compounds). In this context, we have analysed the demographic growth and development of aphids on four maize varieties (Topaze, Magda, Dea, Solida) in the laboratory and in field conditions. Three aphid species were tested: *Rhopalosiphum padi, Methopolophium dirhodum* and *Sitobion avenae*. In the laboratory, the method used was the characterization of the demographical parameters during the beginning of the adult life (1). In the field, aphid numbers were weekly recorded on 10 plants of each variety. Simultaneously, a leaf occupation index was established on 40 plants per

variety. It appears that in laboratory conditions, the growth was strongly influenced by variety and significative differences were observed. Aphid growth was the lowest on Magda, then on Dea, Topaze and Solida respectively. These results were confirmed by the field experiments, where the aphid population increase was the lowest on Magda and the highest on Solida. Topaze and Dea were however reversed in this classification. The leaf occupation index did not show differences according to varieties, indicating that leaf colonisation is independant of aphid densities. These results are an interesting background in the context of plant selection for integrated pest managment (1).

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43 PREY CAPTURE IN *AGAMA STELLIO*: AN ELECTROMYOGRAPHICAL ANALYSIS.

A. Herrel, J. Cleuren and *F. De Vree* - University of Antwerp (UIA).

During prey capture in *Agama stellio* the activity of both jaw and hyolingual muscles was recorded in combination with high-speed video. Quantification of the EMG's allowed to determine the exact onset- and ofset-time of the muscle activity. Based on velocity changes in gape angle the strike was subdivided into subsequent kinematic phases: Slow Open (SO), Fast Open (FO), Fast Close (FC) and Slow Close generally accompanied by a Power Stroke (SC/PS). The first activity occurs in the tongue protractor, the hyoid protractor and the ring muscle at the beginning of the SO-phase. This results in the projection of the tongue beyond the anterior margin of the jaw. The intensity of the activity in the tongue protractor and the ring muscle increases to reach a maximum at prey contact just before the fast opening of the mouth. During the second part of the SO-phase a low level activity is present in the jaw closers which results in a sharp decline of the jaw opening velocity. At the end of the SO-phase a bilateral activity occurs in the jaw openers initiating the FO-phase and ending at maximal gape. Simultaneously the hyoid retractor becomes active and causes, in cooperation with the tongue retractor, tongue retraction. At maximal gape all the jaw closers contract simultaneously and produce the FC-phase. After a short pause they contract again during the SC/PS-phase which results in the crushing of the prey. Our results support the hypothesis of tongue projection in agamids (1) and show many similarities with the muscle activity patterns during the strike in chameleons. The tongue projection mechanism in agamids might thus indeed be an ideal mechanical precursor for the highly derived

ballistic tongue projection mechanism in chameleonids. (*Supported by IWONL-grant 920136 to A.H. and FKFO-grant 2.9005.90 to F.D.V.*).
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44 QUANTITATIVE APPROACH OF THE RELATIONSHIP BETWEEN *SARPA* SALPA (TELEOSTEI, SPARIDAE) AND THE *POSIDONIA OCEANICA* SEAGRASS BEDS IN THE MEDITERRANEAN.

J.S. Houziaux, A. Lecloux, C. Michel and *J. Voss* - University of Liège (ULg).

Sarpa salpa is the only Mediterranean seagrass grazer fish. This gregarious species can be observed from 0 to 40 meter deep, especially on rocky shores. Despite the growing interest of scientists for the *Posidonia oceanica* seagrass beds, very little is known about this "herbivorous" fish. Recent observations in Calvi Bay (Corsica) revealed a significant diminution of the average leave's length on the -10 m isobath (1). These results have motived us to start quantitative studies on the *Sarpa salpa* population of the region. Field observations were realised in Scuba diving in an area of about 40,000 m^2, near Calvi. Total abundance and biomass estimation revealed a density of about 0.1 fish / m^2. We noted an important vertical migration of big individuals, going deeper between May and June. This may be in relation with the important development of the epibiontic community of the *Posidonia* leaves, but also with the approach of the mating season (occurring in September at about 40 meter deep). We have realised an approximation of the impact of the fish on the seagrasses. Therefore, we measured the average weight of an ingested *Posidonia* particle (which look undigested) and the average number of bites given per time unit. We associated to this data the density value and found that about 0.02 % of the *Posidonia* biomass is daily eaten. Biochemical analyses (enzymatic activities) on the digestive tractus show that *Sarpa salpa* is able to digest the animal fraction of its alimentation(*i.e.* epibiontic community of the *Posidonia* leaves and algae). The strictly herbivorous status given to this fish may thus be very debatable.This first global approach of this species shows that it probably has an important place in the ecosystem. Future studies must be improved in this way for a better comprehension of the relations between grazers and seagrasses.

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45 EFFECTS OF NATURAL AND EXPERIMENTAL PCB CONTAMINATION ON THE MIXED-FUNCTION OXIDASES IN THE BARBEL, *BARBUS BARBUS*.

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Xenobiotics such as PCB are known to be strong inducers of hepatic mixed-function oxidases (MFO) in fishes, but their effects are often experimentally measured after an intraperitoneal injection, a non natural route. As MFO induction can lead to negative effects on reproduction (by increasing steroids catabolism), it was of interest to compare natural and experimental contamination effects on the oxidase activities. Four year old barbels were contaminated with PCB at environmentally relevant to eight times higher concentrations; the pollutant was either added in food (1.6 to 12 µg PCB/g D.W.) or dissolved in water (80 or 300 ng PCB/l). After a one-month treatment with environmental concentration in food, no significant induction of oxidases can be observed. However, when food and water contain five or eight times higher concentrations, a significant increase of cytochrome P-450 and oxidase activities can be observed after one or 3 months of exposure. Two P-450 dependent enzymes are particularly sensitive : the 7-ethoxyresorufin O-deethylase (EROD) and the 7-ethoxycoumarin O-deethylase (ECOD). PCB liver concentration is higher in fishes contaminated via food than through direct uptake from water, but no difference of MFO induction is observed according to the way of uptake. During the subsequent period of detoxification in clean water, a decrease of all enzymatic activities is observed within a few weeks. A significant relationship is pointed out between PCB concentration in liver and oxidase activities when measured just at the end of the period of uptake. All P-450 dependent oxidases of wild specimens captured in a PCB contaminated river (the Meuse) show induced activities due to chronic contact with toxicants. However, the level of induction is proportionnally lower than in experimental fishes. As it has been proposed, hepatic MFO activities are sensitive indicators of water pollution by PCB. Their possible negative effects on the barbel reproduction are to be studied. *J.L.H. acknowledges an IRSIA grant).*

46 ON THE RELATIONSHIP BETWEEN OXYGEN MICROSTRATIFICATION IN A POND AND THE DISTRIBUTION OF THE BENTHIC CHIRONOMID FAUNA.

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Our objective is to elucidate the influence of the oxygen microstratification in shallow waters on the distribution of the benthic fauna. Our research was focused on the Chironomidae, abundant in our study site : a small eutrophic pond at Niel (near Boom, Belgium). It is well known that oxygen controls the specific occurrence and distribution of chironomid larvae in standing waters (1). However, it is not clear how the "respiratory environment" (2) of these organisms is defined. Oxygen concentrations in the water column were measured with a Clark Au-Ag electrode (WTW EO 196). Oxygen at the sediment-water interface and in the sediment was measured in core samples with Clark-style micro-electrodes (Diamond 737GC). The sediment microprofiles demonstrate a sharp dropping of the oxygen concentration to zero in the upper sediment film of maximum 2 mm The composition of the chironomid community appears to be correlated to the oxygen concentration in the water column. The correlation between the chironomid fauna and the sediment oxygen microprofiles is lower than expected and more complex. The results suggest species-specific behaviour : some species are supposed to ventilate oxygen rich water from above the sediment-water interface, but other, more digging species, appear to depend on the oxygen in the sediment.[*{L. Int Panis is Research assistant of the Belgian National Fund for Scientific Research (N.F.W.O.)*].

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(2) L. BRUNDIN(1951). *Rep. Freshw. Res.* Drottningholm. 32:32-43.

47 SOME ASPECTS ON FAUNISTICS AND ECOLOGY OF CHIRONOMIDAE LARVAE IN LAKE TANGANYIKA AND THE NTAHANGWA RIVER (BURUNDI).

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A first contribution to the knowledge of the chironomid larvae in the Northern Bay of Lake Tanganyika and the River Ntahangwa (Burundi) is presented. In total, 32 different larval types were recovered from littoral and profundal (max. depth 64 m) ponar samples in Gitaza and Bujumbura Bay and from two series of handnet samples along the River Ntahangwa.

Most genera differed by their diagnosis in some details from the diagnoses given in 'Chironomidae of the Holarctic region, Part 1 Larvae' (1). Following genera could however be recognized with certainty: *Paratanytarsus*, *Tanytarsus*, *Cricotopus*, *Microchironomus* and *Polypedilum*. Four genera are new to 'the catalogue of the Diptera of the Afrotropical region' (2): *Paratanytarsus*, *Parachaetocladius*, *Zavrelimyia* and *Rheopelopia*. The chironomid taxocenes are different in Lake Tanganyika and the River Ntahangwa. Three species of *Polypedilum* and one of *Cladotanytarsus* have a characteristic litoral distribution (sandy substrate), while *Clinotanypus*, a Chironomini genus, *Microchironomus* and *Procladius* are sublitoral (20-35 m depth) to profundal (the last two species up to 64 m depth)(fine sand, silt and mica particles). The larval densities in the lake never exceeded 200 individuals.m^{-2}. For the River Ntahangwa we observed a spatial and temporal succession of chironomid species: the ratio Chironomini/Orthocladiinae increased steadily with increasing eutrophication downstream the river, which receives domestic sewage from the city of Bujumbura. Densities were higher during the dry season than at the beginning of the rainy season. Moreover, species dominance downstream was different in the dry and in the rainy season. Especially the oligotrophic Lake Tanganyika, of great economic and ecological value and threatened by pesticide and urban pollution, should carefully be monitored for changes in chironomid diversity and temporal and spatial patterns, as these are known to exhibit some value as pollution bioindicators.

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48 ESTABLISHMENT OF THE PCB CONTAMINATION BY THE TROPHIC PATHWAY OF A FRESHWATER PLANKTONIC ROTIFER SPECIES, *BRACHIONUS CALYCIFLORUS*.

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Ingestion and assimilation rates of the rotifer species *Brachionus calyciflorus* were established in order to determine the PCB contamination of zooplankton by ingestion of contaminated food (*i.e.* by the indirect pathway) in the river Meuse (Belgium). Ingestion and assimilation rates of the rotifers were measured using ^{14}C-labelled algae (*Dictyosphaerium ehrenbergianum*). Besides, the concentration of PCBs of the phytoplankton and the zooplankton living in the river Meuse were

determined. The ingestion rate of *Brachionus calyciflorus* ranged from 1.62 to 17ngC/ind.h. when the concentration of algae present in the culture medium varied from 14 to 300 algal cells/l (that is 0.14 to 3 mg C/l) at a temperature of 23 ± 1°C. The assimilation rate measured in a culture medium containing 300 algal cells/l was about 50% of the ingestion rate measured in a culture medium containing 300 algal cells/l was about 50% of the ingestion rate. The PCB contamination level measured in the phytoplankton of the river Meuse was about 3µ PCBs/g D.W. and the PCBs concentration of the zooplankton varied from 0.6 to 1µg PCBs/g D.W. On the basis of these data, the concentration of PCBs accumulated by the zooplankton of this river by ingestion of contaminated food was calculated. The minimal value found was 1.7 µg PCBs/g D.W. So these experiments show that the PCB contamination of zooplankton by the indirect pathway is sufficient to justify the concentration of PCBs measured in the zooplankton of the river. (*C. J.-J. acknowledges a* IRSIA *grant*).

49 AN ECOGENETIC STUDY OF *ARION FASCIATUS S.L.* (MOLLUSCA, PULMONATA) IN BELGIUM.

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In the pulmonate land slug *Arion fasciatus s.l.* three morphotypes can be distinguished: *Arion fasciatus s.s.*, *A. silvaticus* and *A. circumscriptus*. Each morphotype consists of a number of monomorphic genetic strains due to an autogamous mode of reproduction, most probably self-fertilization. Between half September 1992 and half April 1993, 279 individuals from 62 populations were collected in Belgium. The slugs were found in a great variety of habitat types, which can be subdivided in two groups: the open habitat types (meadows, roadsides, dumps and rugged places) and the closed habitat types (mixed woods, willow-woods, elm-woods, poplar-woods, fir-woods and orchards). By using polyacrylamide gel electrophoresis, 13 different strains could be distinguished (11 for *A. silvaticus*, 2 for *A. circumscriptus*). This raised the total recorded strains to 21 (3 for *A. fasciatus s.s.*, 16 for *A. silvaticus* and 2 for *A. circumscriptus*). No heterozygotes were found, indicating an autogamous mode of reproduction. The adults were also studied morphologically (three qualitative characteristics: pigmentation of the mantle, pigmentation of the body sides and pigmentation of the epiphallus) and anatomically (13 measurements of the genitalia). *A. silvaticus* differs from *A. circumscriptus* only in the qualitative characteristics. *A. circumscriptus* has a spotted mantle, dark body sides and a spotted

epiphallus. *A. silvaticus* instead, has a smoothly coloured mantle, bright body sides and no pigmentation on the epiphallus. There is, however, no single characteristic which can separate the two morphotypes. Ecologically, *A. circumscriptus* seems to possess a much smaller niche compared to *A. silvaticus*, which seems to be a real habitat generalist. The 13 strains are unequally distributed between the open, as well as between the closed habitat types. At many places the two morphotypes, as well as different strains, are found together. Further investigations are needed to examine how these coexisting morphotypes and strains interact in an eco-ethological way.

50 POLYGYNY IN THE BLUE TIT (*PARUS CAERULEUS*): WHY DO FEMALES MATE WITH ALREADY MATED MALES ? *B. Kempenaers* - University of Antwerp (UIA).

The origin of polygyny and its effects on reproductive success was studied in a colour-ringed population of the blue tit. Each year about 20% of males and about 35% of females engaged in a polygynous mating. Polygynous males fledged more young and survived better than monogamous ones. On average primary females did not fledge fewer young than monogamous ones, but they received less male help. Secondary females had lower reproductive success than either primary or monogamous females. Polygyny could arise when a male annexed a neighbouring territory after the owner disappeared (replacement polygyny), or when a female settled on an already occupied territory. Females either settled early during winter (year-round polygyny) or during the breeding season (successive polygyny). Replacement and successive polygyny seem to result from a female-biased sex ratio during the breeding season. This biased sex ratio was caused by a female-biased immigration from January to March. Predation of males could also be significant. The biased sex ratio caused severe competition for breeding opportunities between females. Settlement of floater females was limited as a result of strong female-female aggression, especially early in the breeding season. In this study, the polygyny-threshold model could not be used to explain polygyny, since one of its basic assumptions, that females are free to settle where they choose, was violated. It is argued that the model can work on a larger scale.

51 GROWTH RATES AND AGE STRUCTURES *VS* VITAL SCHEDULES IN A TENUIPALPID MITE POPULATION.

J.S. Kennedy - Université Catholique de Louvain (UCL).

The growth potentialities and age structure consequences *vis-à-vis* the two important vital schedules *viz.*, survivorship and fecundity were analysed from the life and fecundity table of *Brevipalpus phoenicis* Geijskes developed at 26°C. The value of r_m was found to be moderately sensitive to the alterations of the vital schedules. Nevertheless I have found that a reduction in the growth rate due to the alteration of survivorship would yield the age profile skewed towards the young ones and the alteration of fecundity would yield such skew towards adults. This sort of analysis helps on to find out the cause of reduction of the growth rates in the field, to construct the field mortality curves, to find out the cause of population explosion after insecticide application and to develop trade-off between survivorship and fecundity for a host plant resistance breeding programme. Thus interpretations for such skew in a population were focused on management considerations for this pest.

52 GROWTH AND REPRODUCTION OF TWO *CHRYSICHTHYS* SPECIES (SILURIFORMS, BAGRIDAE), *C. NIGRODIGITATUS* AND *C. AURATUS*, IN LAKE NOKOUÉ AND PORTO-NOVO LAGOON (BENIN).

*Ph. Laleye** and *J.-C. Philippart*** - *Université du Bénin, Cotonou and **University of Liège (ULg).

In 1990-1991, *Chrysichthys* (*C. nigrodigitatus* and *C. auratus)* were sampled (nets and traps) in the Lake Nokoue - Porto Novo Lagoon complex (180 km^2) in Southern Benin (Western Africa). The age of fishes was determined by the means of periodic marks on transversal cuts of the spiny ray of the dorsal fin. The comparative study of age, size, growth and reproduction in the two species reveals that *C. nigrodigitatus* grows much faster than *C. auratus* (total length at 3 years of age, L_3 = 20 and 16 cm, respectively) and reaches larger size and weight (maximum observed total lengths-weights= 69 cm - 3.670 g and 40 cm - 527 g; maximum total lengths expected from Von Bertalanffy models L_∞ = 93 cm and 40 cm, respectively). *C. auratus* reaches sexual maturity at 8 cm (minimum size)-13 cm (100 % mature fishes), corresponding to 2-3 years while the corresponding values are 24-35 cm and 4-7 years in *C. nigrodigitatus*. The relative fecundity (number of ova / kg of fresh body weight) is higher in *C. auratus* than in *C. nigrodigitatus* (17.658 ± 7.017 vs 11.172 ± 5.019 ova/kg) although the diameter of the ova is larger in the latter species. Spawning activities reach a peak during the spates (August-September) but start on the average one month earlier in *C. auratus*. These

results clearly evidence that the two species have different life history strategies in the waters of Southern Benin and that the degree of iteroparity is higher in *C. nigrodigitatus* (K-strategy) than in *C. auratus* (r-strategy). These demographic traits also suggest that the populations of *C. nigrodigitatus* would be more affected by the considerable increase of fishing exploitation and intensity attended nowadays in Southern Benin (100-130,000 fishermen in 1987 vs 30,000 in 1982). This hypothesis is supported by the catch statistics that reveal that most (86 %) *C. nigrodigitatus* caught in Southern Benin are immature *Ph.L. acknowledges an AGCD grant. J.C.P. is Chercheur qualifié* FNRS.

53 CULTURE OF HEPATOCYTES AS AN EXPERIMENTAL *IN VITRO* MODEL TO EVALUATE THE CYTOTOXICITY OF MICROPOLLUTANTS : BIOCHEMICAL AND ULTRASTRUCTURAL ASPECTS.

V. Lambert, M. Dubois, P. Kremers, J.P. Thomé and *G. Goffinet* - University of Liège (ULg).

The cytobiochemical and ultrastructural alterations generated by several micropollutants were studied on cultured cells (fetal quail and rat hepatocytes and the human HEP G2 cell line). The pollutants used were : 3, 3', 4, 4' Tetrachlorobiphenyl (TCB); Aroclor 1254; dieldrin; 2,4 D; 2, 4, 5 T; hexachlorobenzene; trichlorfon; pentachlorophenol (PCP); α-endosulfan; lindane and diflubenzuron. Intra- and extracellular LDH was measured to evaluate the alterations of the plasma membrane. The mitochondrial activity was monitored by the MTT test (1) and the morphological alterations were observed by transmission electron microscopy. MTT and LDH tests are significatively affected only for pollutant concentrations higher than 250µM in the culture medium. PCP, Aroclor 1254, diflubenzuron, trichlorfon, α-endosulfan and lindane are the most toxic compounds for quail hepatocytes, whereas Aroclor 1254 and PCP are the most toxic for rat hepatocytes and HEP G2 cells. Neither mitochondrial activity nor LDH leakage of quail and rat hepatocytes are modified by 2,4 D. Important ultrastructural modifications are observed with toxic concentrations higher than 100 µM, namely a decrease of the peripheric ribosome number, a dissolution of mitochondrial cristae, the appearance of laminated concentric membranes, alterations of the plasma membranes and the presence of large intracellular vacuoles. Aroclor at the concentration of 1µM is able to induce very significantly the drug metabolising enzymes and namely CYP1A1. As a conclusion, hepatocytes in culture constitute an interesting alternative method to study the action of mechanisms of micropollutants on living organisms.

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54 O:N RATIO OF CADMIUM CONTAMINATED MUSSELS *MYTILUS EDULIS*.

A. Langer, C. Daemers-Lambert and *J.M. Bouquegneau* - University of Liège (ULg).

A diminution of the O:N ratio (consumed oxygen versus excreted nitrogen) can be used as a stress index (1). In this work, we have studied the effect of cadmium (2 ppm in the medium for 10 days) on the O:N ratio of mussels *Mytilus edulis*. During the first six days of contamination, the Cd accumulation appeared to be mainly regulated by mechanisms involved in the homeostasis of Cu and Zn, after what Cd was specifically bound to metalloproteins exhibiting apparent molecular weight of 30.000 (probably polymers of Cd-thioneins). We observed a concomittant increase of the O:N ratio and a synthesis of the Cd-binding proteins in response to the metal stress. In this case, the concept of a decrease of the O:N ratio with a pollutant stress becomes very debatable.

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55 MECHANICALLY-RELATED CONTROL OF BONE ARCHITECTURE.

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The bony skeleton is involkved in two crucial control processes. One of these uses the stores of calcium locked in the bone tissue to maintain serum calcium. The other adapts the mass and architecture of the bone tissue to enable it to withstand, the loads imposed during functional activity. The control mechanism for maintaining serum calcium depends substantially upon calcium regulating hormones. These hormones are capable of adjusting serum calcium because they have profound and well documented concentration-dependant effects on bone remodelling, intestinal absorption, and renal excretion of calcium. Their own secretion into the blood stream is regulated by serum calcium concentration. This constitutes a classic feedback loop.

Although many of the active agents involved in metabolic control of modelling/remodelling have been identified it has been a source of frustration for many workers that none of them has proved capable of providing a sustained net osteogenic effect with accompanying increase in structural properties. The reason for this is not hard to divine. None of the known agents responsible for metabolically-related remodelling has any "interest" in bone mass or bone architecture. Bone mass is always sufficient for immediate calcium requirements, and a trabecula oriented in one direction is as available and useful a source of mineral as one oriented

in another. Not only does the calcium regulating process have no interest in bone mass or architecture it has no means by which to derive feedback from these variables in order to control them. Any expectation that there should be an "osteo-regulatory hormone" is therefore doomed. Regulating bone mass, and architecture, is the responsibility of a system whose feedback is derived from the only functional variable to which bone mass and orientation at each location is of interest; namely load-bearing.

The purpose of loading-relatred control of bone architecture is presumably to influence modelling and remodelling behaviour to ensure that at each location there is sufficient bone tissue, with appropriate material properties, advantageously placed to withstand, with only easily reparable microdamage, the functional load-bearing prevailing at that location.

In order to be able to maintain a satisfactory relationship between customary loading and load-bearing capacity it is necessary for the cells responsible for controlling bone architecture to have relevant feedback on the appropriateness that relationship. The structural variables controlled by the bone cell population are the mass, material properties, and spatial organisation of the bone tissue present. The product of these variables and the structure's applied load is the strain (proportional change in dimension) which the load engenders. Since the objective of the bone cell population is presumably to ensure that the variables over which they have control are appropriate in relation to the applied load it is logical to propose that their mechanically-related feedback should be the strain which such loading engenders within the bone matrix.

Not only is load-induced strain a parameter which can affect cells directly or indirectly through one of its derivatives such as intra-lacunar pressure, fluid flow etc, it is a functional variable which contains all the information necessary for the control of bone architecture in relation to bone loading.

For tissue loading to influence remodelling it must first elicit some biological response within a sensitive cell population. We have documented some instances of this response which may be part of the early stages in a cascade of reactions in this and other populations of cells involved in the conrol of modelling/remodelling. Our data suggests an immediate local strain magnitude-related response in osteocytes which, because of their location, do not themselves participate in the modelling or remodelling response. This suggests that these cells have a primary strain sensitive role. They are certainly well placed to function in this way. Not only are they distributed throughout the bone matrix, but they communicate with each other and with the cells on the bone surface, through gap junction connections. Such connections are specifically designed for the passage of information from one cell to another.

Although, the agents of calcium regulation cannot themselves contribute a functional stimulus to the synthesis or placement of tissue to produce a mechanically suitable architecture it is evident that without the mechanisms of calcium metabolism structurally appropriate anatomical features if produced could not be mineralised, and remodelling could not be

completed. However, in this respect calcium regulating hormones are enabling rather than controlling the achievement and maintenance of bone architecture. It is clear also that no functional changes in an individual's nutritional and hormonal circumstances can disable the capacity of any loading-related functionally adaptive process either to establish or maintain a structurally competent skeleton. Specific insufficiencies such as a low calcium diet are obvious examples, but hormonal inbalance, the effect of age perse, the effect of drugs can all prevent the attainment and maintenance of structural competence.
In a perfect situation with no nutritional, metabolic, or hormonal impediment there would be full expression on bone mass and architecture which the load-bearing stimulus exerts on a original, genetically-determined template. It is logical therefore that the flow-path of the various influences on bone mass should involve a primary functional stimulus derived from some measure of the appropriateness of current bone architecture in relation to current load-bearing and this this should be modified by non-mechanical influences downstream. Rectifying deficiencies in these downstream influences can only allow full expression of the mechanical stimulus, it cannot produce a bone mass which is greater, or a bone architecture which is more appropriate, than that which is required mechanically.

56 VARIABLE GROWTH : A TRAP FOR MORPHOMETRIC PHYLOGENY.

H. Leirs, W. Verheyen, R. Verhagen and *L. De Bruyn* - University of Antwerp (RUCA).

Using morphometrics in the study of phylogeny assumes that the observed morphological differences are somehow linked to differences in phylogenetic relationships between taxa. However, it is well documented that also other factors, like sex, age and environment, can have an important effect on the morphology of an organism. Therefore, morphometrists should avoid using measurements that are affected by these factors, or use data samples that are as equal in these respects as possible. The problems that can arise when not all ecological information is available, are illustrated with an example of *Mastomys natalensis* rats from Tanzania. This animal shows an interannual variation of growth rate : in years when the first part of the rainy season is dry, a very slow growing generation occurs ; in other years, similar generations will grow much faster. This means that animals of the same age, collected from similar habitats, in different years but in the same month of the year, can still vary in growth history and thus cranial measurements. In a cluster analysis for 6 different groups collected in several months from the same locality in Tanzania (Morogoro) and 14 other *Mastomys* populations from Tanzania, Rwanda, Zaire and Ivory Coast, the animals of March 1988 (at the end of a long growth stop) separate from the other ones at a large distance, even

after some of those that are from a geographically remote area. If the animals with the long growth stop would have been the only ones collected in Morogoro, taxonomists would have been tempted to consider them as something special. Morphometrists thus should not only take into account seasonal growth patterns but even interannual variation in these patterns.

57 HOW PENGUINS SAVE ENERGY AND ANTICIPATE A CRITICAL DEPLETION IN THEIR BODY FUELS.

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Only feeding at sea, penguins rely on their body fuel reserves when ashore or on sea-ice breeding or molting. Compared to other sea-birds, the duration of these spontaneous fasts may be remarkably long, *e.g.* 4 months for the male emperor penguins. These fasts may moreover coincide with low ambient temperatutres (down to -50°C) and high winds (upt to above 200 km/h). In addition, these fasts may become forced-fasts when the mate does not come back at the usual time for relieve. The fasting bird then prolonges its fast but eventually abandons. Two major questions arise in this context : 1) How penguins manage to minimize energy expenditure in order to survive a long fast ? 2) How do they know when to leave before it is critical ? Because of their excellent body insulation (for about 90% due to geathers), penguins appear to be at thermoneutral temperature in their natural environment, except the emperor penguin because of the extreme conditions it endures. Still, by huddling together, emperors manage to avoid any cold-induced increase in energy expenditure. Prior to the fast, fat storage has been adjusted so that body protein breakdown during fasting is the lowest possible. However, at same stage, there is a further rise in protein utilization. This rise seems to be triggered by a critical level reached in lipid reserves, although these reserves are then still sufficient for en emperor penguin to walk over a distance of about 200 km. This further stage marked by a rise in protein utilization appears to be the limit when the bird does not fast any more, therefore suggesting that some signal then induces refeeding.
These data and those from other studies enable to get a better understanding on how the initial ratio between fat and protein reserves determines the ability to tolerate a prolonged fast. They also give a better insight on why extended fasts are safe for wild animals, in contrast to starvation as a treatment for human obesity.

58 HOW HERBIVORES AND OTHER ANIMALS BENEFIT PLANTS AND ECOSYSTEMS. *M. Loreau* - Université Libre de Bruxelles (ULB).

Herbivores and other animals are not mere "parasites" living at the expense of plant : they also play positive functions in ecosystems which can even benefit plants. This idea, however, has recently been the subject of a strong controversy. To address this issue, I investigated the conditions under which consumers are able to optimize energy flow and plant productivity in ecosystems using a simple, general theoretical model of a nutrient-limited ecosystem. A quite general condition for optimization of energy flow and plant productivity by consumers was found to be simply that these act to accelerate the circulation of matter within the ecosystem and that their consumption rates be moderate. A second condition is that the total quantity of nutrients in the ecosystem is higher than some threshold value. This condition, however, is dependent on the functional form of the nutrient uptake by the producers. There is evidence that these conditions are met in many natural ecosystems. Therefore animals as a group should generally contribute to increasing energy flow and plant productivity in these ecosystems.

59 COMORO LAND BIRDS: RELATIONSHIP OF INSULAR SYNDROME CHARACTERS IN MORPHOLOGY AND IN POPULATION STRUCTURE. *M. Louette**, *J. Stevens***and *M. Herremans****- *Royal Museum of Central Africa (KMDA), **Provinciaal Natuurcentrum, Hasselt and ***Department of Wildlife and National Parks, Gaborone.

The oceanic Comoro archipelago, composed of four not quite similar-sized (211-1184 km2) steep volcanic and mesic islands, situated midway between Africa and Madagascar, contains an avifauna diverse as to provenance, age and number of colonizing invasions, inter-island exchange and diversification. We investigated birds during seven field trips since 1981 and studied Museum specimens. An array of phenomena related to the insular syndrome was found, although no "showcase" as the ecomorphology of the bill in the multiple ground finches on the Galapagos (There is in fact one case of sexual diversification in bill size in a sunbird on the Comoro archipelago). Furthermore, one does not encounter flightless birds, distributed worldwide on oceanic islands (although the lack of subfossil material prevents one in being conclusive). In general morphology (plumage features, allometry in measurements) and in behaviour (song) there are at least 16 cases of neoteny among 57 endemic Comoro land bird taxa (1). We find some neotenic taxa maintain denser populations, yielding higher numbers, a clear advantage in avoiding

extinction on small oceanic islands. We demonstrate that in habitat preference, there is a clear difference according to degree of endemism. Not unexpected newly arrived birds perform better in a man-altered habitat (2). There are only few cases of vigorous expansion of newly-introduced birds, but nevertheless they are a threat for the indigenous avifauna.

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60 MORPHOGENESIS OF TUNIC SPINES IN THE SEA PEACH *HALOCYNTHIA PAPILLOSA*: ULTRASTRUCTURAL AND CYTOCHEMICAL ASPECTS.

B. Lübbering and *G. Goffinet* - University of Liège (ULg).

Multipointed protrusions, the tunic spines, characterise the adult tunic of *Halocynthia papillosa*. Ultrastructural and cytochemical methods were employed to survey tunic morphogenesis during early developmental stages of *Halocynthia papillosa*. The first tunic elements are secreted at the initial tail bud stage. Already at stage M 2d (2 days after the onset of metamorphosis), the first spines are formed, but spine morphogenesis at this stage is quite different from spine morphogenesis at later stages. At early stages, claw-like protrusions bud from swellings of the tunic. When new spines are formed at later stages, first a small multipointed spine appears. Subsequently a cuticular plate develops, carrying the spine which eventually elongates and thickens. By then, the fully developed spine resembles the spines that cover the surface of the adult tunic. From stage M 2d onwards fibro-granular material is found in the fundamental layer of the juvenile tunic. First, this material is found only in close proximity to developing spines. Later on, it is distributed throughout the whole fundamental layer, but it is concentrated near the tips of the spines where it joins the cuticle. The cytochemical test for thiol groups (silver methenamine) demonstrates that the fibro-granular material consists of sulphur rich proteins. It is synthesised in epidermal granules and discharged into the tunic. Although the mode of displacement is not understood, this material obviously crosses the fundamental layer of the tunic and joins the cuticle in regions of spine morphogenesis. X-ray microanalysis on the adult tunic confirms that the cuticle of spines contains sulphur.

61 THE LIPOPROTEIN PROFILE IN EUROPEAN EELS (*ANGUILLA ANGUILLA*) DURING ESTRADIOL-INDUCED VITELLOGENESIS.

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Estradiol-induced vitellogenesis is characterized by a reorchestration of the liver metabolism as well as a modification of numerous plasma parameters. Plasma proteins, lipids, triglycerides and cholesterol concentrations increase suggests major variations of the lipid transport system. A closer approach investigating the profile of each lipoprotein fraction shows the predominance of the LDL (Low Density Lipoprotein) under estrogen treatment while HDL (High Density Lipoprotein) dominates the profile observed in nature. The estimated levels of triglyceride-rich lipoprotein also show a large increase. Such variations, opposite to the mammal ones in similar circumpstances are partially explained by the Lipoprotein Lipase (LPL) distribution and activity under estradiol regulation. In fact, the Salt-Resistant Lipase (SRL) present in fish extrahepatic tissues and activated by the estrogen seems responsible for an excessive removal of HDL from the circulation.

62 ZOOGEOGRAPHY OF THE COPEPODA AND ROTIFERA OF THE SEYCHELLES.

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The copepod and rotifer fauna present in some samples from the Islands of Mahé, Praslin and La Digue of the Seychelles is reported and discussed. No Copepoda or Rotifera were previously known from the islands. Five species of Copepoda and 34 of Rotifera are recorded, none of which is of special taxonomic importance. Only the record of *Halicyclops thermophilus spinifer* Kiefer is remarkable, as it extends the known area of this species from India and Iran (1) to the archipelago. The rotifer fauna of the Seychelles is closer to that of the Comoro Islands than to that of Madagascar (2) (Sorensen similarity : 0.58 versus 0.27). The presence of a species hitherto known from Iran and India, together with the apparent affinity of the zooplankton of the Seychelles with that of the Comoro Islands confirms existing knowledge on the origin and history of the archipelago.

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63 EFFECT OF PENTOXIFYLLINE ON ACROSOME REACTION IN HUMAN SPERMATOZOA.

C. Maréchal and *D. Raick* - University of Liège (ULg).

The use of pentoxifylline (PTF) has been reported to stimulate the motility of ejaculated spermatozoa (1) and to increase their fertilizing capacity in vitro (2, 3). In this study, we evaluated the effect of PTF on acrosome reaction by using transmission electron microscopy (TEM) because it allows not only an accurate evaluation of acrosome reacted spermatozoa (AR) but also a discrimination between the different stages of this process. Semen samples were obtained from 9 fertile and 23 subfertile men. A part of each ejaculate was directely fixed (controls). The rest of sperm was washed, divided into four aliquots subsequently submitted to a 20 minutes incubation at 37°C in each of these conditions:1) Earle's medium alone; 2) Earle's medium with PTF (1mg/ml); 3) Earle's medium with 50% follicular fluid (FF); 4) Earle's medium with PTF and then with FF. Our results show that 1) In comparison with the controls, the incubation with Earle's medium alone resulted in a doubling of AR rates (approximately from10 to 20%), incubation with PTF increased threefold the AR rates (approximately from 10 to 30%) and incubation with FF allowed to reach only 25% AR. In these conditions, no significant differences were observed between fertile and infertile men; 2) The successive use of PTF and FF produced a significant augmentation of AR rates as compared with PTF alone in fertile men (34.6% versus 29.5%) but not in the subfertile ones (37.2% versus 34%); 3) In each experimental condition , we observed a reduction of the early stages of the AR in favour of the late stages. This effect was particularly pronounced with the treatment with PTF and FF. In conclusion, PTF was found to increase AR rate in fertile and subfertile sperm. In this respect, it appeared to be more effective than FF, a well known physiological inductor of AR. The incubation with PTF and FF allowed to get more quickly the late stages of AR.

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64 EVOLUTIONARY TRENDS WITHIN THE GENUS *ARCHILOA* (PLATYHELMINTHES, PROSERIATA).

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We recently revised the *Archiloa* genus complex and recognised seven different genera of which phylogenetic relationships were hypothesised. Six of them are monophyletic and occur in restricted biogeographical areas. The genus *Archilina* Ax 1959, however, has a cosmopolitan distribution and is not characterised by an apomorphy, indicating the paraphyletic status of this genus (Martens and Currini-Galletti, in press). The genus now contains 15 species from which eleven are new (7 from the Mediterranean, 2 from the Red Sea and 2 from Puerto Rico). At this moment it is not yet possible to draw the phylogenetic relationships among all these species but some evolutionary trends can be recognised. In the two Caribbean species the bursa lies next to or behind the copulatory organ and both species have a karyotype deviating from that in the other *Archilina* species. These species may represent a separate evolutionary line within the genus. In three species from central Mediterranean the number of cirrus spines is reduced, and these three species probably constitute a monophyletic taxon. Other species from different geographical areas show a tendency to have enlarged proximal cirrus spines which can form a stylet-like structure or a true stylet within the cirrus originating from the fusion of the large proximal spines. This tendency seems to be a parallelism that arrised in the different geographical areas.

65 ON THE SPATIAL DISTRIBUTION OF GAMMARIDS (CRUSTACEA, AMPHIPODA) IN THE SELENGA REGION OF LAKE BAIKAL (SIBERIA, RUSSIA).

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The Selenga region of Lake Baikal constitutes a delta between the central and southern basins of the lake and contains large amounts of suspended material transported by the Selenga river. Four transects were sampled on soft sediment during the August 1991 expedition of the R/V 'Vereschagin' in the surroundings of the delta (south, north, opposite, Murinsk bank). The vertical and bathymetric distributions of gammarids (a.o. biological groups) were studied, the former in correlation with measurements of oxygen penetration depths in the sediment. An exponential decrease between density of gammarids and sediment depth was observed. A significant positive correlation was noted between the maximum sediment depth at which gammarids were present and the depth

of oxygen penetration in the sediment as well as the thickness of the oxidized layer. Ninety-six percents of gammarids were present in the upper three cm (which corresponds to the oxidized layer) although some species were able to penetrate as deep as seven cm. By far the highest densities were found in the upper 250m of the lake, *i.e.* the water volume which mixes twice a year. The near total absence of gammarids in our abyssal samples is probably due to a strong decrease in density with increasing bathymetric depth and possibly also a patchy distribution of these organisms.

66 DOES HABITAT FRAGMENTATION AFFECT MOVEMENTS BY NUTHATCHES *SITTA EUROPAEA* (AVES) ?

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It is widely assumed that one of the main effects of habitat fragmentation is a reduction in movements by organisms between habitat patches. This may reduce the viability of the entire (meta)population through demographical and population genetical mechanisms (1). However, this assumption is largely untested, as there are no comparative data on dispersal patterns of the same species in different landscapes. Here I present results on a study of natal dispersal by colour-ringed nuthatch *Sitta europaea* nestlings. The main study site is a 200 km^2 area south of Antwerp containing many small (2-10) forest fragments and parks, which cover less than 2% of the entire landscape. From large-scale censuses I conclude that most dispersers actually left the study area, with an estimated median dispersal distance over 5 km (compared to 1 km in less fragmented areas) (2). The large dispersal distance probably compensates for the low density of suitable territories. In fact, dispersal distances in different landscapes become quite similar if translated into number of territories. I conclude that habitat fragmentation on this scale does not strongly affect nuthatch population structure. However, once they are settled, nuthatches are much less likely to leave their territory in the fragmented landscape than in a large forest with contiguous territories. This behavioural isolation may reduce the effectiveness of habitat selection (moving to better territories) and finding mates. *Supported by NFSR as senior research associate.*

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67 INTRASPECIFIC BROOD PARASITISM AND CO-OPERATIVE NESTING IN THE MOORHEN, *GALLINULA CHLOROPUS*.

A. Merckx, M. Eens, R. Pinxten and *R.F. Verheyen* - University of Antwerp (RUCA).

During the breeding season of 1993, we studied the breeding biology and the occurrence of intraspecific brood parasitism in the moorhen at the Plankendael Park in Mechelen, Belgium. Intraspecific brood parasitism or egg-dumping occurs when a female lays one or more eggs in the nests of conspecifics without taking part in the processes of incubation and/or caring for the hatchlings. Fifteen nests were checked daily during the entire breeding cycle. We used three kinds of evidence to determine whether more than one female had laid in a nest : 1) More than one egg laid in a single nest each day. 2) Eggs laid in a nest after the host female had completed her own clutch. 3) A type of egg different from those of the host female was laid in the nest. A quarter of the nests belonged to cooperative nesters (*i.e.* two females that are paired with the same male and lay synchronously in the same nest). We found parasitic eggs in at least 87% of the nests. The number of eggs dumped in a nest ranged from 1 to 8, and the most common number was 3. At least 24% of the eggs were parasitic. The hatching success of parasitic eggs was significantly lower than the hatching success of non-parasitic eggs. Parasitic moorhens dumped their eggs at random during the host's laying and incubation period. The hatching success of parasitic eggs laid early (days 1-12) in the host's laying and incubation period was significantly higher than the success of parasitic eggs dumped later (days 13+). Eggs dumped during the second half of this period rarely hatched because they were deserted by the host pair once they began to care for their own hatched brood. The parasitic eggs laid early were as likely to hatch as the non-parasitic eggs. The mean success of the parasitic eggs was low because most eggs were dumped late and these eggs were deserted by the host.

68 POPULATION ECOLOGY OF EDAPHIC ORIBATID MITES (ACARI, ORIBATIDA) IN THREE CONTIGUOUS ECOSYSTEMS, HAUT-SHABA, ZAÏRE.

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Population ecology and species taxonomy of soil mites are deserved to be studied in Haut-Shaba before the disappearance of much of its natural sites due to anthropic pressure along with environmental alteration. For this purpose 18 stations distributed in 9 types of habitats in a regressive series of Luiswishi site which includes dry evergreen forest, woodland and savannah. A total number of 22355 adults and 3829 juveniles of Oribatids were collected during the sampling season in

1984-1985. Out of the 149 species identified, 94 were found in climatic forest, 86 in woodland and 105 in savannah. However, 24, 7 and 29 species were found to be exclusive in climatic forest, woodland and savannah respectively and 47 species are common to all the three contiguous ecosystems. Further, 19 species are common in woodland and savannah, 13 in evergreen forest and woodland and 10 in evergreen forest and savannah. The number of exclusive Oribatids in the termitoria increases with the regression of vegetation. Within each vegetation zone there is a habitat where much characteristic taxa are concentrated. The relative abundance and specific diversity in the population structure change with the alternation of wet and dry seasons. Deforestation and busch fire, that expose the soil fauna to blunt environmental change eventually lead to the absence of sensitive species of climatic forest in woodland and savannah.

69 MODELLING THE OPTIMAL COPULATION DURATION IN INSECTS. *E. Nuyts** and *S.N.K. Michiels* ** - *Limburgs Universitair Centrum (LUC) and **Max-Planck Institut fur Verhaltens-physiologie, Seewiesen (Starnberg), Germany.

Insect copulation duration is strongly influenced by the existence of sperm precedence mechanisms. We made an optimization model (1), to predict the effects of sperm precedence patterns, costs and clutch size on the copulation duration for which "number of fertilized eggs" / "costs" is maximized. The model predicts that if we compare different males, 1)Males that face higher risks copulate longer: (a) After copulation, mixing of sperm within the female genital stores, called long term sperm mixing, may favour the last male or the first one (depending on the species under consideration). If long term sperm mixing decreases (resp. increases) the percent of the eggs sired by the last male, a male that expects a longer time between copulation and first oviposition copulates longer (resp. shorter). (b) The higher the probability of take-over, the longer a male copulates. (c) Copulation duration also increases with the mate encounter time for the male; 2) Males with higher energetic or territorial costs copulate shorter; 3) Average clutch size does not influence duration of copulation.
When a male copulates with different females, the male copulates shorter with 1) a female with few eggs; 2) a female that causes a high probability of take-over; 3) a female with a small first clutch. In addition, we predict for species that do not fulfill one of two assumptions (differentiability and the optimisation principle itself), that an extra factor determines the duration of copulation. For most species of odonates for which data are available either the predictions of the model are supported, or the extra factor was found. Hence, the extended model seems to be well suited to predict behaviour in odonates.

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70 MORPHOLOGIC STUDY OF THE MUSCULATURE IN THE THIRD EYELID OF THE DOMESTIC CAT (*FELIX CATUS DOMESTICUS*).

J. Nuyttens and *P. Simoens* - University of Gent (RUG).

Active protrusion of the third eyelid (*plica semilunaris conjunctivae* or nictitating membrane) is frequently observed in the cat. As a prerequisite for understanding the biomechanics ot this phenomenon, the morphology of the muscles of the third eyelid was examined in this study. Eight pairs of feline eyes and eyelids were investigated macroscopically and by means of histological sections (Von Gieson and Resorcine-fuchsine stainings). In the literature a medial and ventral smooth muscle to the nictitating membrane have been described. Actually a complex system of smooth muscles is present consisting of nine different strands which attach to the cartilage within the third eyelid. Four of these strands are dorsomedially situated. They originate from the *m. levator palpebrae superioris*, the *trochlea* and the *m. rectus medialis*. Five smooth muscle strands, given off by the *m. obliquus ventralis*, the *m. rectus ventralis* and the *m. rectus lateralis*, insert ventrally upon the cartilage. Previous literature reports have described striated muscles which extend into the nictitating membrane and are derived from the *m. rectus lateralis* and the *m. levator palpebrae superioris*. However, despite careful and systematic examination, no striated muscle fibers to the feline nictitating membrane could be demonstrated in this study. These findings provide new insights into the functional morphology and pathology of the third eyelid in the cat.

71 SUBLETHAL EFFECTS OF POLLUTED RIVER SEDIMENTS ON *CHIRONOMUS RIPARIUS* LARVAE (DIPTERA, NEMATOCERA) UNDER DIFFERENT TEMPERATURE AND FOOD CONDITIONS.

P. Parren, L. Janssens de Bisthoven and *F. Ollevier* - Catholic University of Leuven (KUL).

Field populations of *Chironomus riparius* larvae in the river Laan (Dijle basin, Scheldt watershed) show high incidences of mentum deformities. These are most probably induced by heavy metals and pesticides locked in the aquatic sediments. Temperature (13°C and 18°C) and food quantity (5mg and 30mg tetraphyl/larvae) were modulated in laboratory experiments in order to investigate whether these parameters do influence the inducement of deformities of instar 4 larvae (native from Laan imagines) reared in Laan sediments. As a control, the artificial

substrate siliceous earth (celite) was used. The development rate was primarily modulated by temperature (start of emergence at 18°C: day 17-18; at 13°C: day 34 and 48). Only at 13°C, a depleted food regime did show a delaying effect on the start of emergence (30mg food/larvae:day 34; 5mg food/larvae day 48). In the high food condition, larval mortality was independent of temperature. In the low food condition however, larval mortality was higher and even more pronounced at the lower temperature condition. At 18°C (in the high food regime), the percentage of larvae with deformed menta was comparable with the percentage found in natural populations (10%). In the low food condition this percentage was lower (6.6%). At 13°C, the deformity percentage reached control values. These results suggest that the metabolic rate of the larvae has a greater effect on the occurrence of deformities than the exposure time (temperature effect). Moreover, it seems that bioaccumulation is enhanced by a higher food quantity, as is attested by the deformity percentages. This however, implies that a significant fraction of the pollutants is accumulated after association with ingested food particles, hence through the gut wall. This is in accordance with data from Kranzberg (1).

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72 ECOPHYSIOLOGY OF SALT ACCLIMATION IN CRUSTACEANS.

A.Pequeux - University of Liège (ULg).

With their marine, fresh water and euryhaline representatives, crustaceans exhibit almost any of the known possible patterns of osmo-ionoregulation (1, 2). That group therefore appears as a choice material to tackle the question of ecophysiology of salt acclimation from a comparative point of view. In crustaceans, osmo-ionoregulation can be effected in two different ways whose significance is always to avoid water movements at the cellular level. The first one, of general occurrence and considered as a prerequisit for adaptation to salinity changes, is to maintain the intracellular fluid isosmotic to the extracellular fluid, either body fluids, either environment. The second one is to control the concentration of the extracellular fluids at a more or less constant level regardless of the external salinity. This review will focus on the second way whose mechanisms are active essentially in boundary epithelia. The gills will be shown to be the prominent structure responsable for the blood NaCl balance and regulation in marine, marine euryhaline and brackish water species. The review will therefore deal mostly with recent physiological and ultrastructural data on gill tissue and provide information leading to a characterization of the particular mechanisms and driving forces at work at that level. It will refer largely to experiments using perfused preparations of gills isolated from the chinese crab *Eriocheir sinensis* taken as a model. The applicability of the chinese crab model to other crustaceans will be considered. It will be shown also that the cuticle lining the epithelium is

largely involved in ionic regulation in crustaceans. It does contribute indeed to reduce ionic leaks in regulators and yet allows for the entry of ions across specific "channels" at the sites where active uptake takes place (3). An attempt is made to understand how both the cuticle and the epithelium fit in a working epithelio-cuticular complex.

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73 OCCURRENCE AND IMPACT OF AN EPIZOOTIC DISEASE (*MYXOBOLUS* SP., *PROTOZOA*, *MYXOSPORIDIA*) ON A POPULATION OF THE CYPRINID FISH *BARBUS BARBUS* (L.) IN THE RIVER OURTHE (BELGIUM), DURING THE SUMMER OF 1993.

J.-C. Philippart and *E. Baras* - University of Liège (ULg).

In late June 1993, the first symptoms of an epizoocy ("Beulenkrankheit der Barben") (1) caused by *Myxobolus* sp. (*Protozoa, Myxosporidia*) were detected in a population of *Barbus barbus* (*Pisces, Cyprinidae*) from the mid River Ourthe (River Meuse Basin, Southern Belgium). The infestation dynamics was studied throughout summer by electrofishing (EPMC, 2.4 KVA) in the station where the epizoocy was first documented and completed by surveys in various stations upstream and downstream (longitudinal extension = 30 km). The infestation dynamics suggest a single infestation centre, with more than 50 % of the barbel population nearby infested by the protozoans. All age classes above 2+ (15 cm, fork length) were affected by the disease and specially the large barbels (≥ 35 cm FL, mainly females; ± 90 %). No trace of infestation was detected in the alevins and juveniles. The upstream extension of the infested stretch (± 1.5 km) is consistent with the home range behaviour and weak summer mobility demonstrated in adult barbels (2). Census of abundance and composition of shoals of barbels suggest that 95 % of the infested fishes die from the epizootic disease or leave the stretch. The downstream movements of these fishes spread the disease far beyond the distances expected from home range behaviour, extending the infested area on 20 km and potentially threatening the populations of the lower part of the River Ourthe. The impact of the epizootic disease on barbel stock is estimated at ± 0.54 - 0.67 ton/km within the infested

stretch. Besides, since many large females were infested, the population dynamics could be strongly influenced affected within he next 5 years. Although not clearly evident, it is believed that this epizootic disease emerged from the conjunction of exceptionally dry and hot weather during spring in the most densely populated stretch of the river.

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74 EXTRA-PAIR PATERNITY IN THE EUROPEAN STARLING.

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The frequency of extra-pair paternity was determined, using multilocus DNA fingerprinting, in a single population of the European starling *Sturnus vulgaris*. Fourteen families including 62 chicks were analysed. The results were compared with behavioural data about the rates of within-pair and extra-pair copulations. Extra-pair copulations were not observed. Starlings copulate repeatedly on all days prior to, as well as during, the laying period. Therefore, we should expect the frequency of extra-pair fertilizations to be low. However, the DNA fingerprint data revealed six offspring (9.7%) from four broods (28.6%) where the putative father of the chick was not the genetic father. Behavioural observations suggest that at least three cases of extra-pair paternity (three offspring from two broods) could have arisen through rapid mate replacement rather than through extra- pair copulations.

75 CAN FEMALE GREAT TITS CHOOSE THE BEST MATE ?

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Female preference for conspicuous male plumage characters is suggested as the evolutio nary mechanism to explain the existence of these characters (1). In the Great Tit (*Parus major*) the ventral black breast-stripe is very conspicuous and the variation in its width relates to the amount of help the male invests in his brood (2). Since this implies a benefit to females mated with a male with a large stripe, we examined whether females try and can become mated to these males. We studied a population of individually marked Great Tits from November 1991 untill April 1993 in a study area near Antwerp. During this period daily routine observations were made on the location, territorial and mated status of all individuals. We found that the members of both sexes first settle down before they try to become mated. Doing so, only direct neighbours are potential partners for a settled female. The availability of unpaired males depends on winter

social behaviour, the timing of immigration and the location in the study area. However, when 2 individuals of the appropriate sex, with overlapping domiciles were present, pair formation followed directly. To enlarge the opportunity for females to choose between several males, we removed 13 paired females, leaving 13 unpaired males. The subsequent repairing and our knowledge of habitat quality in the sudy area (3) proved that males in the best parts of the study area became remated earliest. We conclude that female Great Tits first try to settle on a good quality territory and then try to associate as soon as possible with an unpaired male, settled nearby. Any female preference for male characters is therefore limited.

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76 FACTORS AFFECTING THE RESPONSES OF EMPIDOIDEA (INSECTA DIPTERA) TO COLOURED TRAPS. *M. Pollet* and *P. Grootaert* - Koninklijk Belgisch Instituut voor Natuurwetenschappen (KBIN).

Although sweepnets and Malaise traps are far more often used to collect flying insects, water traps are particularly suitable to gather detailed information on the ecology of Diptera. Two factors affecting capture yields of Empidoidea are definitely installation height and trap colour (1, 2). In the present study, a dune woodland site was sample during 1991 with white (W), yellow (Y) and bluish green (BG) traps at two heights (7cm, 60cm). The main aims were to investigate (i) the vertical distribution and (ii) the attractivenesss of the coloured traps on Empidoidea. Data were analyzed by means of multivariate analyses such as CCA (3) and TWINSPAN (4). The two major dipteran families, Dolichopodidae and Empididae (incl. Hybotidae), were analysed separately because of their highly different behaviour and ecological demands. A total of 3,561 Dolichopodidae and 679 Empididae were collected, belonging to 29 and 26 species resp. Among these, several species appeared to occur or to be abundant only in the coastal dune area. In Dolichopodidae, W and BG traps yielded slightly more abundant species than the Y traps (11 versus 8 sp.), which, on the contrary, collected almost twice and three times as many specimens collected. Tree-trunk dwellers (*Medetera jacula, M. truncorum, Neurigona quadrifasciata*) were found in highest numbers in the BG traps whereas most of the other species preferred the Y traps to the W traps. Except for *S. notatus* with a predominance at 50 cm height, other dolichopodids were most abundantly found near the soil surface. This phenomenon was less pronounced in most arboreal species. *Platypalpus annulipes*, a small predator, is the dominant species at 60cm and only 30% of its activity takes place near the soil. *Empis punctata*, a large nectar

feeder; is almost exclusively found in the 60cm zone. Only 10% of its activity is on ground level. *Tachydromia aemula*, *Platypalpus excisus* and *P. pygialis* are true bottom dwellers. *Tachypeza nubila*, an ubiquist very commonly found on tree trunks and *P. strigifrons* are found in equal numbers in both layers. The multivariate analyses showed that the yields of dolichopodids in most of the trap were quite similar, containing most of the abundant species occurring in the sampling site. An exception was made by the BG traps at 50cm height and the Y traps at soil surface level, the yields of which revealed significantly different species compositions, determined by the presence or absence resp. of mostly three-inhabiting species. In Empididae, these analyses proved that the installation height of the traps was the most important factor. It can be concluded that the yellow water traps give the best yields but the white traps on the soil give a reliable picture of the diversity and abundance of most species. Our present results correspond completely with our previous findings (1, 2).

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77 ESTIMATING THE NATURAL VALUE OF THE COASTAL DUNES ON THE BASIS OF THEIR EMPIDOIDEA FAUNA (DIPTERA).

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The coastal dune landscape is endangered in many ways, from excessive urbanization to groundwater extraction. In order to evaluate this area on the basis of its Empidoidea fauna, the following characteristic dune habitats were selected : marram dunes, dry dune grassland, a dune slack, scrubby vegetations and 3 different dune woodlands. During two year cycles, 5 (1989) and 4 (1992) sites were sampled with white water traps at soil surface level. In addition, environmental variables such as temperature, light intensity, aerial and soil humidity and the vegetation and humus layer development were recorded. Data on the most abundant species were analyzed by means of multivariate analyses [DCA, CCA, (1);

TWINSPAN, (2)]. In the CCA, both species and environmental data were used. A total of 10,894 dolichopodids and 2,585 empidids were collected over the two years of investigation, belonging to 54 and 41 species resp. Species diversity and abundances increased from dry to humid sites in dolichopodids and from open to canopied sites in empidids. The dry, sun and wind exposed areas demonstrated the poorest faunas including xerophilous dolichopodid species (*Medetera micacea, M. pterophiloides*). In the dune slack, a rich dolichopodid community was present, consisting of mainly small species (*Chrysotus palustris, C. pulchellus, Medetera saxatilis, M. truncorum*), whereas the minute soil-dwelling predator, *Chersodromia cursitans*, and *Hilara lundbecki*, a hunter on water surfaces, were the only abundant empidid species. Although the open areas are very rich in flowering plants during spring, no empidid nectar feeders such as *Empids* sp. and *Rhamphomya* sp. were obtained. Faunas of dry well-lit woodland sites were less diverse and species occurred in relatively low numbers. Despite its small size, the scrubby willow vegetation investigated showed characteristic dolichopodid inhabitants (*Dolichopus migrans, Sciapus laetus*) too. The empidoid fauna of humid woodland sites was very diverse comprising several large woodland-inhabiting dolichopodids (*Dolichopus* sp., *Hercostomus* sp.). The species composition of the 2 humid woodland sites sampled was very similar in dolichopodids but clearly different in empidids. In the well-lit sites, *Hybos culiciformis*, a hunter in flight, and the predatory *Platypalpus excisus* were dominant, whereas leaf-running predators such as *Chelipoda vocatoria* and several *Platypalpus* sp. and the presumably nectar-feeding *Empis punctata* reached their highest abundances in the densely covered sites. These wind and sun protected sites seem to act as a refugium for species such as *P. strigifrons* from where the adjacent areas can permanently be recolonized. On the one hand, each habitat type proved to house typical species and might act as a refugium for other species. Hence they contribute to the conservation of the species diversity in our dune landscape. At the other hand, ± 50% of all abundant dolichopodid species collected show a distribution in Belgium which is either entirely restricted to the coastal dune region or confined to the northern part of Belgium. Moreover, thus far large populations of these species were encountered almost exclusively in the dunes. It can thus be concluded that the dune area is essential for the survival of these species in Belgium.

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78 MICROBIAL ACTIVITIES IN SEDIMENTS AROUND LAING ISLAND (PAPUA NEW GUINEA).

M. Poulicek, J.C. Bussers and *P. Vandewalle* - University of Liège (ULg).

During a five week mission in Laing island (Papua New Guinea) in November and early December 1992, 50 sedimentary samples were gathered by scuba diving around the reef, in the lagoon, in Hansa bay and on the reef of Boïsa island. 10 transects were covered from the upper reef down to 30 meters. Additional samples were gathered by hand sampling on the reef platform and on the beaches. Fresh pore water was extracted and assayed for microbial ATP biomass, alkaline and acidic phosphatase activities (used as index of metabolic activity) and 16 hydrolases activities (lipolytic activities [3], proteolytic activities [5] and glycolytic activities [8]) using α-naphtol coupled artificial substrates. The activities appear largely heterogeneous : ATP biomass is much higher in the lagoon stations than anywhere else, but the communities of the micro-organisms are less active (the metabolic and heterotrophic indexes are low). On the other hand, on the beaches and on the reef platform, the less abundant micro-organisms (low ATP biomass) are much more active (high metabolic and heterotrophic indexes). Deeper sediments appear to have lower ATP biomass and low activities. Everywhere lipolytic and proteolytic activities dominate the hydrolases except in one station. Lipolysis appears particularly important in the lagoon.
In a future work (V.Bollinne and M.Poulicek, in prep.) the microbial activities will be correlated with sedimentary characteristics (grain size and sorting, nature of grains, organic content).

79 SENSORIAL EQUIPMENT AND EFFECT OF THE HOST-PLANT ON THE FIXATION BEHAVIOUR OF THE CASSAVA MEALYBUG *PHENACOCCUS MANIHOTI* MATILE-FERRERO (HOMOPTERA, PSEUDOCOCCIDAE).

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For the last two decades Cassava cultivation, a major power supply for the two hundred million Africans, has suffered important damages caused by the Cassava mealybug, *P. manihoti*. As part of the study of the relationship between the mealybug and its host-plants, on the one hand we have characterized, thanks to a video camera, the different behavioural sequences typical in the vegetal's recognition and, on the other hand, we have studied the mealybug's sensorial equipment by T.E.M. and S.E.M. We first studied the fixing behaviour in a wide sense (before the mealybug's stop on the vegetal) on two Cassava varieties (*Manihot esculenta*, Euphorbiaceae, var *Incoza* and *M'Pembé*), the Faux-caoutchouc (an hybrid of *M. esculenta* and *M. glaziovii* Mull. Arg) and *Talinum* (*T.*

triangularae, Portulacaceae). Our results expressed by behavioural significantly different sequences show a good fixation on both Cassava varieties, a moderate one on the hybrid Faux-caoutchouc and a poor one on the *Talinum*, significantly different. The studies of fixing behaviour in a "*sensu stricto*" (after the mealybug's stop on the vegetal) realised on the Cassava variety *M'Pembé*, reveals a typical fixing behaviour. However, a temporal variability remains between individuals. The study on the mealybug's sensorial equipment (leg, labium, antenna) allows us to identify chimiosensorial functions (olfactory and gustatory) of the antenna and labium. The olfactory function of the labium has been discovered for the first time in Sternorryncha Homoptera.Our study shows the complexity of the mealybug's host selection during the fixing phase. Even partial, suggests the cultivation of Cassava varieties having the Faux-caoutchouc's phylloplan characteristics. So the use of plant resistance will intensify the effects of the other components of "integrated control".

80 EXPERIMENTAL AND FIELD STUDIES ON THE EFFECT OF SELECTED HEAVY METALS ON THREE FRESHWATER SPONGE SPECIES : *EPHYDATIA FLUVIATILIS*, *EPHYDATIA MUELLERI* AND *SPONGILLA LACUSTRIS*.

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The present work is the first study on the effect of metals on freshwater sponges, based on field and laboratory experiments. Three species, *Ephydatia fluviatilis*, *E.muelleri* and *Spongilla lacustris* were implanted in variously polluted natural sites. After one month, they showed a substantial vegetative growth in spite of high metal levels in water for Ba, Ca, Cr, Mn, Mo, Ni, Pb or Zn, according to the site of transfer. The quantification of their metal content shows that at the end of the experiment, sponges have accumulated many heavy metals in a pattern related to metal distribution in the ambient water. EDS and WDS analyses have revealed that metals are not accumulated in the spicules but in the organic skeleton and living tissue. In vitro experiments, using a toxicity test developed in our laboratory, have established that Pb was more toxic than Cu and Zn and that *S. lacustris* was the least sensitive. These results show that in their natural habitat freshwater sponges can grow and even thrive at metal concentrations higher than the threshold concentration measured in the laboratory. This suggests the existence of detoxification mechanisms in sponges.

81 A COMPARISON OF ALLOZYME AND mtDNA PHYLOGENIES OF SOME ENDEMIC TANGANYIKAN CICHLID FISHES (PISCES : CICHLIDAE). *L. Rüber* and *E. Verheyen* - Royal Belgian Institute of Natural Sciences (IRSNB), Brussels.

Since more than a century biologists attempt to understand the origin of the endemic flock(s) of cichlid fishes that occur in Lake Tanganyika. In view of the claimed absence of usefull morphological characters for phylogenetic analyses on these fishes, a number of recent studies implement molecular methods to study their phylogeny. We compared the mtDNA phylogenies of endemic Tanganyikan cichlid fishes based upon published (1) und unpublished mtDNA cytb sequences (2) with a recent phylogeny of these fishes derived from allozyme data (3). Since the author of the latter study used allozyme loci as characters defined only by the most commonly occuring allele we reanalysed these data and followed different alternative assumptions.

First we considered all the electrophoretically detected alleles as binary characters with either character states presence or absence, also known as the "independent alleles" model. As this method often has limitations in it's use (*e.g.* unequal weighting of polymorphic loci or problems when no alleles are shared with the outgroup) we also reanalysed these allozyme data under the usually recommended assumption that the locus is the character and that the allelic combinations are its (multistate) character states. Genetic and phenetic distances well as parsimony analysis of allozyme and mtDNA cytb sequence data were used for the construction of phylogenetic trees. Regardless of the choice of characters and the different methods of tree building used, the positions of four taxa (*Eretmodus*, *Cyprichromis*, *Perissodus* and *Plecodus*) change between the trees obtained using all alleles versus trees obtained with only the most common alleles. (Re)weighting of the data suggests that the observed topological instabilities are the result of highly polymorphic loci : Gpi-2, Idh-2, Mpi and Pgdh. The mtDNA and allozyme based phylogenies differ for the topology of a few taxa including representatives among the "oldest" Tanganyikan lineages like *Oreochromis* and *Bathybates*. Interestingly, the same branches (*Eretmodus*, *Cyprichromis*, *Perissodus* and *Plecodus*) are weakly supported for both DNA and allozyme phylogenics. In view of the observation that the mtDNA and allozyme phylogenies are not identical, future studies will attempt to establish the reliability of these methods (*e.g.* by studying different "slower" and "faster" mtDNA genes for cichlid taxa separated by different evolutionary distances.

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82 HISTOLOGICAL INJURIES CAUSED BY *FRANKLINIELLA OCCIDENTALIS* TO SWEET PEPPER LEAVES. *A. Salesse, P. Nihoul* and *G. Van Impe* - Université Catholique de Louvain (UCL).

The Western Flower Thrips *Frankliniella occidentalis* is a serious pest on a wide range of vegetables and ornamentals. Direct injuries result from feeding and egg laying mainly on the abaxial surface of the leaf. The histology of these damages was analysed in the sweet pepper *Capsicum annuum*. Injury due to egg laying is few extended in the spongy mesophyll of the leaf. However, after the emergence of the larva, cell rupture, cell division, and polyphenol accumulation occur, thus extending injury up to the upper epidermis, but this remains localized to the laying site. By its feeding activity, the thrips destroys larger leaf areas, but still in the lower tissues. Cells of the lower epidermis die and collapse, while those of the spongy mesophyll undergo cellular replication, creating a dense tissue without intercellular spaces. Consequently, air exchange may be severely affected, contrary to photosynthesis, as the palisade parenchyma (which contains the highest number of chloroplasts) remains unaltered. Regarding the length of the maxillary stylets of the thrips (1), we conclude that the mouthparts of the thrips do not penetrate the palisade parenchyma when sucking from the abaxial surface of the leaf. These observations contribute to reveal the impact of thrips attacks on the plant physiology and subsequently on crop production.

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83 BIRDS OVER EVEREST - *P. Scheid* - Ruhr-Universität Bochum, Germany.

Birds are well known for their exquisite high altitude tolerance. Remarkable is the bar-headed goose, *Anser indicus*, which has been observed to pass over the top of Mt. Everest (altitude, 8848 m) on its migrational path between India and its breeding places in Tibet. What are the mechanisms for this tolerance ? Avian lungs consist of the lung proper and the air sacs, which act as bellows to prôpel the air through the parabronchial tubes of the lung. In the periparabronchial tissue fine air capillaries meet with blood capillaries for gas exchange. The cross-current system is accepted as an appropriate model for parabronchial gas exchange, and its intrinsic gas exchange efficiency has been shown to exceed that of the alveolar pool system of the mammalian lung (1). We have studied gas exchange in ducks subjected to inspired hypoxia with inspired O_2 partial pressures (P_{O_2}) as low as about 25 Torr (2). We found ventilation to increase markedly with increasing hypoxia. The surprising finding was, however, that the arterial P_{O_2} was only a few Torr less than

inspired P_{O2}, showing that ventilation was functionally infinitely high, creating almost inspired gas concentrations deep in the lung, at the gas exchange surfaces of the air capillaries. We have used these experimental data to calculate the gain in altitude that the bird would obtain from having a cross-current rather than an alveolar pool system for gas exchange (3). Due to the higher gas exchange efficiency the bird could be shown to reach a higher altitude than a mammal for the same level of arterial P_{O2}. This altitude gain was about 1,000 m at an altitude of 7,800 m. However, with further increasing altitude, this gain diminished, and was virtually zero at 11,000 m. This can easily be understood : with infinite ventilation, and thus inspired gas at the exchange surface in the lung, the arrangement of blood and air flow, the basis for the cross-current system and its high efficiency, becomes irrelevant. Thus, at the highest altitude, where the achievement of the bird is most surprising, the efficiency of the parabronchial avian lung cannot be recruited as an explanation and other factors must play a role which, however, have not been evaluated with certainty to date.

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84 SELECTIVE FEEDING AND MINE STRUCTURE OF THE LEAFMINER *AGROMYZA PHRAGMITIDIS* (DIPTERA).

J. Scheirs, L. De Bruyn, D. Vandenbussche, P. Verdyck and *K. Jordaens* - University of Antwerp (RUCA).

Agromyza phragmitidis is a monophagous leafminer of common reed (*Phragmites australis*). The larvae of *A. phragmitidis* form a blotch mine which contains one or several larvae. We studied the mining pattern of this species in order to investigate the response of the larvae of the structural heterogeneity of the different leaf tissues. Mined reed leafs were collected in the field and sections through the mines were made. Afterwads, we described the inner and the outer morphology of the mine. The vascular bundles have a great influence on the mining activities of the larvae. The larvae avoid the consumption of vascular bundles. There are three types of vascular bundles in a reed leaf : the main vein, strengthened veins and smaller veins. We observed a different response of the larvae to those three types of bundles. When the larvae are young they gnaw neither of the three types of veins. When they become older they start consuming the smaller and the strengthened veins. The smaller veins are eaten as a whole. Only the upper part, in some cases the lower part, of the strengthened veins is consumed. When there is a lack of food or place for

the mining larvae they cross the main vein. The cross section with the main vein is never long and only a small part of the main vein is consumed.

85 HOST PLANT RANGE OF THE LEAFMINERS *CHROMATOMYA MILII AND C. NIGRA* (DIPTERA).

J. Scheirs, L. De Bruyn, D. Vandenbussche, P. Verdyck and *K. Jordaens* - University of Antwerp (RUCA).

Chromatomya milii and *C. nigra* are oligophagous leafminers of grasses (Poaceae). We studied the host range of both species in natural conditions. We collected in several habitats samples of grasses, counted the larvae in that sample and reared the pupae until adult flies emerged. The range of host plant species occupied by *Chromatomya milii* was much smaller than the range occupied by *C. nigra*. The larvae of *C. milii* were only found on 3 genera of grasses : *Agrostis*, *Holcus* and *Poa*. The larvae of *C. nigra* were found on most Belgian genera of grasses. No larvae of *C. nigra* were found on *Calamogrostis*, *Digitaria*, *Echinochloa*, *Elymus*, and *Molinea*. Within the host range of both species, large differences in population densities and larval performance, measured as pupal size, were observed.

86 REPORT ON ROTIFERA FROM PAPUA NEW GUINEA.

H. Segers - University of Gent (RUG).

A total of 124 rotifer species was identified from 17 samples collected in Papua New Guinea, representing the first record of rotifers from the Island. Remarks on the taxonomy of *Lepadella biloba* Hauer (new status) are provided, a description of a hitherto unknown species in the genus *Scaridium* is presented. A majority of cosmopolitan or cosmo(sub)tropical, warmstenothermic species is reported. A single local endemic and one Australian species are found. Eleven species, including the new *Scaridium*, occur either exclusively in the freshwater biotopes of the floodplain of the river Sepik and in floodplain lakes in the lower Niger Delta, (Nigeria, 1, 2), or have also been recorded from other, similar habitats in tropical Asia and Australia. Two species, on the other hand, were previously known from either Europe or North America only. The littoral genera *Lecane* (27.4%), *Lepadella* (12.9%) and *Trichocerca* (6.5%) account for the largest fractions of the rotifer coenosis. The most species-rich samples are from habitats in the floodplain of River Sepik. These results confirm the importance of tropical floodplain systems as optimal habitats for Rotifera (2).

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87 INFLUENCE OF MACROFAUNA ON THE VERTICAL DISTRIBUTION OF MEIOBENTHOS IN AN AVICENNIA MANGAL, GAZI BAY, KENYA. *J. Silence, P. Polk** and *F. Fiers*** - *University of Brussels (VUB) and **Royal Belgian Institute for Natural Sciences (IRSNB), Brussels.

The influence was studied in an *Avicennia marina* mangrove in the upper intertidal zone of Gazi Bay (Kenya), over a period of two months. Exclusions were performed in co-operation with the University of Gent. Cube cages with a bottom surface of one square meter were erected, walled with plastic gauze (mesh-width : 1mm). In order to evaluate possible procedure-effects, partial cages (*i.e.* cages with the seaward side left open) were placed in the field. Crabs and gastropods were eliminated out of the cages. The meiofaunal component was measured qualitatively and quantitatively. Samples were taken with a handcore (diameter: 36 mm) and fractioned in slices (0-2 cm, 2-4 cm, 4-10 cm and below). Three replica's were taken from three treatments (cage, partial cage and blanco). The experimental units were placed following a randomized block design. The meiobenthos and some environmental factors (grain size analysis, curtosis, skewness, median particle diameter, porosity, % of organic material, redox potential, temperature, chlorophyl a, fucoxanthine, nutrient analysis, salinity, pH and dissolved oxygen) were sampled before the cages/partial cages were placed in the field, five days and one month after installation. Statistical ANOVA-test was applied to test for significant effects on the environmental factors and the meiobenthos. Only pigments showed a clear increase in the cage in the third sample-period. This was probably due to a bloom of diatoms, and the exclusion of the gastropods can be at the origin of this growth. The meiofauna showed no remarkable exclusion-effects after one month. This can be due to the short sampling period, unknown cage-effects, interactions between the meiobenthos (ex. changes in community species structure) and other non-measured underlying factors or factor-combinations. Three new harpacticoid species (Crustacea, Copepoda, Darcythompsoniidae Lang) from the genus *Leptocaris* T. Scott (1899) were described and discussed in detail.

88 STUDY OF THE ENDOSOMAL COMPARTMENTS IN CHROMAFFIN CELLS.

D. Slembrouck, W. Annaert, I. Llona and *W.P. De Potter* - University of Antwerp (RUCA).

We used primary cultures of chromaffin cells to study the endocytotic component of the exo/endocytotic cycle. These cells have many characteristics in common with adrenergic neurons, can be easily isolated in high purity and have been used extensively as a model of adrenergic neurons. In chromaffin cells the main secretory pathway is represented by chromaffin granules. A second population of vesicles (called synaptic like microvesicles, SLMV) is also present. In contrast to chromaffin granules they originate from an early endosomal compartment after passage through the plasma membrane. In this study we look at the endocytotic pathway of both populations with horseradish peroxidase (HRP) as an extracellular marker. Both types of vesicles can be distinguished based on their distinct membrane composition by immunodetection. The HRP uptake was linear in function of the extracellular concentration and time indicating that the uptake represents fluid phase endocytosis. We compared basal uptake and uptake after stimulation of secretion. In stimulated cells the HRP uptake was increased up to five times compared to basal. After a 5 minute pulse period in basal condition, the recycling of HRP in a subsequent chase period could readily be measured. The recycling activity accounted for approximately 1% internalised HRP per minute. Density gradient centrifugation was used to study the intracellular distribution of HRP. Chromaffin granules were identified by DH-immunoreactivity and SLMV by synaptophysin-immunoreactivity. Both in basal and stimulated cells HRP codistributed with DH immunoreactivity in sucrose gradients. In order to better separate SLMV and chromaffin granule membranes we used an urografin-density gradient. No HRP could be detected in the SLMV enriched fractions. In conclusion, our results indicate that the HRP uptake after stimulation of the cells is mainly done by retrieval of chromaffin granule membranes and SLMV seem not to be involved in the regulated secretory pathway.

89 DYNAMICS OF THE NESTS OF *CUBITERMES SPECIOSUS* (ISOPTERA, TERMITIDAE) : A LONG TERM FIELD STUDY.

K. Soki, G. Josens and *M. Loreau* - Université Libre de Bruxelles (ULB).

As part of a study of an equatorial forest ecosystem, we surveyed a population of *Cubitermes speciosus* nests near Kisangani, Zaïre. The nests were measured annually from June 1985 to January 1993 on an area of 2500 m2. Nests were found to grow in two ways : either they were enlarged sporadically (in this case, leading to a correlation between age and size) or they were no longer enlarged after a 2-year period of initial

growth, which means that large as wel as small nests can be quite old (6 years and more).
The number of living nests was fairly constant : it varied betwen 28 and 38 all along our study and about a quarter of the nests were renewed each year in a regular way. However, a clear tendency was observed over our 7.5-year observation period : the average size of the nests increased regularly and was twice larger in 1993 than in 1985. Using a model of continuous growth, the mean life expectancy of a nest was estimated at 3.5 years.

90 STUDY ON THE POPULATION-ECOLOGY OF THE RED SQUIRREL (*SCIURUS VULGARIS* L.) IN AN ISOLATED PARK HABITAT.

L. Somers, L. Wauters and *A.A. Dhont* - University of Antwerp (UIA).

In 1987 a reintroduction experiment of red squirrels (*Sciurus vulgaris* L.) in an isolated park near Antwerp was started (1). Of 19 squirrels (9 males, 10 females), taken from 3 different areas, space use and survival after introduction were monitored. On the long-term, the dynamics of the introduced population was followed for 7 years and spacing behaviour was compared for a low density (just after the introduction, 1988 - 1989) an a high density (1992 - 1993) situation. The behaviour immediately after release differed strongly between individuals. Males were more mobile than females. As a result, early male-mortality (many road-victims) was much higher than early female-mortality. In 1990, a mast-year for beech, and spring 1991 population size increased strongly. From the autumn of 1991 onwards the population started to decline. Adult mortality remained high throughout 1992, suggesting that the carrying capacity was exceeded and lies around 30 squirrels (0.89 squirrels/ha woodland) in this park. No differences in survival were found between adults and subadults in the spring - summer period. In autumn - winter adults survived better than subadults. In 1988 (low density) more juveniles were recruited then in 1992 (high density). Males had larger home ranges than females. Both male and female core-areas (70% of all locations) were much smaller than their total range. Home range size, of both sexes, did not decrease significantly when density increased. Social behaviour of females squirrels differed from the intrasexual territoriality found in large continuous woodlands. Females were very tolerant of each other, and had core-areas that overlapped strongly. We suggest that the absence of female intrasexual territoriality is caused by the fact that high quality home ranges are very rare in this park so that the costs of defending a territory outweight the benefits.

(1) C. SWINNEN (1987). I.W.O.N.L. report.

91 STRUCTURAL AND TROPHIC RELATIONSHIPS BETWEEN MEIOBENTHOS AND EPIFAUNA IN *CERIOPS* MANGROVES (GAZI BAY, KENYA).

M. Steyaert and *J. Schrijvers* - University of Gent (RUG).

The specific relationships between the epifauna and the meiofauna were studied by means of a cage experiment in a mangrove swamp with a *Ceriops tagal* vegetation in Gazi Bay (Kenya). The experimental set up consists of three cages, three half cages and three blanco's (surface 1 m^2). All the epifauna was removed in the cages in order to study the effects of epifaunal exclusion. The effect of the cage set up was tested by means of the half cages, open on one side. The blanco's are a test for normal fluctuations in the meiofaunal community. Sampling occurred every five days during one month. The experiment shows that the exclusion of the epifauna is followed by an increase of the total meiofauna density (mainly Nematoda, Turbellaria and Oligochaeta). A distinct influence of exclusion of epifauna was also found for the different feeding types of nematodes. Different migration patterns are visible on the taxon level as well as on the genus level (according with feeding type). The disappearance of epifaunal interactions such as predation, competition for food and bioturbation are thought to be the main causal factors for the observed changes in the meiofauna community. Comparison with the blanco's shows that the cage set up has an impact on sediment deposition, algae growth and density of the Ostracoda. This effect is explained through a larger stagnation of the water in the cages (and half cages) causing a larger deposition rate of particles and hence producing better circumstances for the filterfeeders (*e.g.* Ostracoda).

92 PARTIAL CYCLE SEQUENCING ANALYSIS OF A SECOND FAU LOCUS.

D.J. Stickens and *K. Kas* - Universitaire Instelling Antwerpen (UIA).

FAU (for **F**inkel-Biskis-Reilly **A**ssociated **U**biquitiously expressed gene) was initially identified as an FBR-MuSV transduced gene. This virus transduced along with the fos oncogene also a mutated version of the FAU gene. Within the virus this sequence is called fox (**F**BR **o**steosarcoma **X** sequence) (1). The FAU gene is strongly conserved and expressed in many tissues. The gene encodes a 133 AA Ubiquitin-like protein (Fubi) fused to the ribosomal protein S30, a protein of the small ribosomal subunit (2). Hydrolysis of human genomic DNA with HindIII, followed by hybridization with the human FAU cDNA probe, generates at least four FAU specific fragments. Hybridization with 5' and 3' FAU cDNA subprobes gives the same result, implying that all these fragments contain at least the whole cDNA. Screening of two human cosmidlibraries with the human FAU cDNA probe, always yields the same

6.3 kbp HindIII fragment. This fragment contains the FAU1 gene of which the sequence was already determined (3). Attempts made to clone the additional human FAU genes through preparative enrichment, followed by ligation in a plasmid vector, gave no positive results.
In this work, attempts were made for characterization of the additional human FAU genes through the use of the polymerase chain reaction and cycle sequencing. Therefore, four FAU specific fractions were enriched by preparative gel electrophoresis. One of these fractions contains, based on PCR amplification, a fragment with the same length as the FAU cDNA. The sequence of this fragment was obtained by using cycle sequencing reactions. The gene was called FAU1P. FAU1P has no introns but reveals an open reading frame encoding a protein of 134 AA. However, no stop codon has yet been found, so the protein might be longer. Therefore, the FAU1P gene can be added to the list of retropseudogenes which are potentially capable of encoding a protein. In comparison to the FAU cDNA, the sequence of the FAU1P gene shows an amplification of a p(AAG) repeat. This finding points to the possibility that the amplification of a p(AAG) repeat could also take place in the FAU1 gene. At least six genetic diseases are caused by amplification of a three nucleotide repeat. The amplification described here could be responsible not only for a genetic disease associated with FAU1P, but also for a disease associated with chromosome 11q13 on which FAU1 is located.

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(2) L. MICHIELS, E. VAN DER RAUWELAERT, F. VAN HASSELT, K. KAS and J. MERREGAERT (1993). *Oncogene*, 8: 2537-2546.
(3) K. KAS, L. MICHIELS and J. MERREGAERT (1992). *Biochem. Biophys. Res. Comm.* 187 : 927-933.

93 THE LARVAL ODONATA COMMUNITY OF ACID HEATHLAND FENS. *R. Stoks, M. Santens, S. De Vocht* and *L. De Bruyn* - University of Antwerp (RUCA).

Until now only very few biocenological investigations have been undertaken on larval dragonflies, especially for the species living in acid heathland fens. Therefore we started a study of the Odonata fauna of a large heathland habitat, the "Groot Schietveld" at Brecht and Wuustwezel, northern Belgium. Odonata larvae were collected in 31 pools during the summer of 1993. To explain the presence of the different species we measured abiotic (O_2, NO_3^-, NO_2^-, NH_4^+, pH, total hardness, electric conductivity) and biotic (vegetation density, pool size, ...) habitat characteristics. In addition we also recorded the presence of mating and/or ovipositing adults. In a total of 77 samples, 11 species were found of which 7 appeared in large numbers. Species such as *Libellula*

quadrimaculata, *Enallagma cyathigerum*, *Leucorrhinia dubia* and *Sympetrum danae* were found to be habitat generalists. Other species are more habitat specific. *Lestes sponsa* was only found in sandy pools with a low vegetation density. The *Ceriagrion tenellum* population was closely linked to the presence of *Juncus* vegetation. (*This study was made during a biology students' camp of the University of Antwerp on aquatic macro-invertebrates*).

94 ELIMINATION OF PCBS FROM CONTAMINATED NATURAL FRESHWATERS: COMPARISON OF THE FIXATION EFFICIENCY ON CHITOSAN AND BIOCONCENTRATION BY *DAPHNIA MAGNA*.

I. Thys, M. Weltrowski*** and *J.P. Thomé** - *University of Liège (ULg) and **Textile Technology Center, St Hyacinthe, Québec.

Chitosan, the deacetylated derivative of chitin, is well known as a chelating agent for binding heavy metals as well as a sorption polymer for pesticides and PCBs. This work deals with the study of the PCB adsorption ability of various lots of chemically modified chitosan in order to develop filter cartridges useful for the purification of contaminated stream waters. The PCB adsorption efficiency of pure chitosan (CHT 200) and of 2 derivatives synthesized by means of a cross-linking procedure with glutaric aldehyde (CHT 201) and terephtaldehyde (CHT 206) have been tested. The adsorption properties of these derivatives have been compared with the elimination of PCBs from contaminated water by two zooplanktonic species (*Daphnia magna* and *Cyclops sp.)*, with chitinous cuticles, according to the bioaccumulation processes. The experiments were performed with six PCB congeners (tri- to heptachlorobiphenyls; 1 µg/l for each PCB). The efficiency of these different chitosan derivatives has been tested by means of a "batch" (closed system) and a "flow-through" chitosan filter cartridge system (opened system). The different chitosan derivatives appeared as very good purifiers, both in "batch" system and in flow-through system. However, the substitution of chitosan by aliphatic or aromatic carbons (CHT 201 and CHT 206 respectively) improves their adsorption properties. It appears that the fixation of PCBs on the different derivatives of chitosan is the result of a combination of two kinds of binding processes: a strong ionic bond, especially for non-modified chitosan (CHT 200) and a weak bond of hydrophobic type which is predominanting in PCB adsor`ption on cross-linked chitosan (CHT 201 and CHT 206). The substitution of chitosan by a non-ionised molecule results in an increase of the hydrophobic interaction. The fixation of the PCBs on crustaceans is rather important but more complex than on chitosan powder and can not be explain by simple chemical interactions with chitinous cuticle. Although the PCB bioconcentration processes in microcrustaceans appear not as efficient as

pure or chemically modified chitosan to remove high amounts of PCBs from contaminated water, the PCB accumulation by these organisms contributes to a large extent to the water purification in natural ecosystems. Chitosan, and its cross-linked derivatives, appear as powerful PCB adsorbents and, as a consequence, constitute promising materials for the purification of PCB polluted stream waters. However, there is still a need to develop a physical form of chitosan filters to perform the epuration of large volume of PCB polluted water.

95 ACID-BASE HOMEOSTASIS IN AQUATIC ANIMALS EXPOSED TO NATURAL AND PERTURBED ENVIRONMENTS. *J.P. Truchot* - CNRS - URA-1126, Université de Bordeaux, France.

Keeping an appropriate acid-base state in the various body compartments of animals is of prime importance for many basic living processes, especially those depending on protein conformation and electric charge, which are in large part determined by the pH. Acid-base homeostasis requires a balance between metabolic production and controlled excretion of two categories of acids and bases : the volatile carbonic acid whose the elimination depends on respiratory regulations, and fixed acids and bases, the excretion of which is usually associated with ion exchanges. In aquatic animals, these functions are heavily challenged by large natural changes of respiratory gases, oxygen and carbon dioxide, as well as of particular ions or total salinity in the environment. The effects of each of these factors in isolation have been well studied in laboratory conditions, but integrated responses to the changes of many factors as it occurs in the natural setting are less well known. Variations of ambient or internal CO_2 are not a strong stimulus to breathing in aquatic crustaceans and fishes, and respiratory regulations are thus of little importance in acid-base homeostasis. On the contrary, aquatic organisms are usually able to quickly get rid of large fixed acid or alkaline loads by coupling their excretion with gillionic exchanges. Such excretory process also serve to compensate acid-base disturbances induced by changes of the respiratory qualities of the water. The well-known impact of various pollutants on gill ionoregulatory mechanisms (heavy metals, ammonia, acid waters...) can also considerably disturb the acid-base balance in aquatic animals. Selected examples will be presented to illustrate and discuss these various aspects of acid-base homeostasis in crustaceans and fishes living in freshwater as well as in seawater.

96 *ACARUS SIRO* (ACARI : ACARIDAE), SEXUAL OR AGGREGATION PHEROMONE ?

L. Van Asselt, A. Arnouts and *P. Grootaert* - Institut Royal des Sciences Naturelles de Belgique (IRSNB), Brussels.

In the present study, the effect of acetone extract of male and female flour mite on the behaviour of male, female and tritonymph *Acarus siro* were investigated. Levinson *et al.* (1) reported the presence of two different sex pheromones in *A. siro* : a pheromone produced by males, attracts and stops virgin females; a female pheromone attracts and stimulates males to mate. In our experiments, we used a black plaster support covered with a filter paper. Three circular areas (diam. : 6 mm) were delimited. Acetone extracts of males or females were added, in different concentrations corresponding to 5 up to 80 individuals, to one of the areas. The other areas received pure acetone and thus served as control. In each replicate, behaviour of five individuals was filmed during 30 minutes. The time spent in the different areas was measured. Similar observations, using another technique, were conducted with tritonymphs. Levinson *et al.* (1) concluded that the male extract contained a male sexual pheromone. It seems that the male acetone extract acts also as an aggregation pheromone at low concentrations (aggregative effect on male and tritonymphs). Furthermore, we can observe mating attempts between males, at high concentrations. The mating attempts suggest the presence in male *A. siro* of the same sexual pheromone as in females. A similar fact was observed by Kuwahara *et al.* (2) which reported the occurence of a female sexual pheromonal substance in both sexes of *Aleuroglyphus ovatus*.

(1) A.R. LEVINSON, H.Z. LEVINSO and U. OELKER (1989). *Naturwissenschaften* 76:176-177.

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97 STUDY OF THE FEEDING ECOLOGY OF BRACKISH-WATER NEMATODES.

J. Vanaverbeke - University of Gent (RUG).

In the first part of this work, vertical profiles of nematodes in a brackish-water mudflat were correlated with the environmental variables. Three stations in the Westerschelde were sampled. In the second part of this study, tracer experiments on agar were carried out to measure grazing of nematodes on diatoms and bacteria. The highest number of nematodes were found between 0.5 and 1 cm depth. Individual biomass was maximal between 1 and 1.5 cm in one station, in another one between 3 and 4 cm depth. Density of nematodes were positively correlated with the concentration of chlorophyl a (except one station) and fucoxanthine and

with the number of bacteria in the sediment. In two stations, a significant correlation with the median grain size was found. In each station densities were significantly correlated with the redox potential. No correlations were found between the individual biomass and any other variable. The vertical profiles of the nematodes are most influenced by the food supply : bacteria and diatoms. The most important chemical variable seems to be the redox potential. In the experimental part of the thesis was studied if grazing of nematodes on bacteria and diatoms in agar plates could be measured. Therefore, food was labeled and radioactivity in grazing nematodes was measured. Control-experiments were carried out as described by Montagna (1). When diatoms were used as food, the uptake of radioactivity by nematodes was as described by Montagna (2). In experiments were bacteria were used as food, the model of Montagna (2) could not be found. The reason is that working with bacteria on agar plates is very difficult. Abiotic uptake of label by nematodes was measured in formalin-poisoned experiments. Abiotic uptake was very low. Uptake of label due to non-grazing activity was measured in dark-controls and non-grazing experiments. Non-grazing experiments seem to be the best experiments to control for non-grazing uptake.

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(2) P.A. MONTAGNA (1984). *Mar. Ecol. Prog. Ser.*18:119-130.

98 FUNCTIONAL-MORPHOLOGICAL STUDY OF THE UPPER JAW AND ITS PROTRUSION MECHANISM IN GOBIIDAE (TELEOSTEI).

B. Vancoppenolle, D. Decleyre and *W. Verraes* - University of Gent (RUG).

The study deals with the morphology and some functional aspects of the upper jaw in Gobiidae. Special attention has been paid to interspecific differences in the protrusion capacity of the premaxillary bone. Therefore, an atempt was made to set up a protrusion model in which the force transmission to the premaxillary bone is described. The movements of the premaxillary bone are influenced by the mandibula and the maxillary bone. The ligaments connected to the maxillary and the premaxillary bone partly determine the movements of both elements and thereby direct the protrusion. Some ligaments conduct the rotation of the maxillary bone, others regulate the downward sliding of the premaxillary bone. The resulting movement is a forward displacement of the most anterior point of the premaxillary bone while the processus ascendens glides downwards. Within the investigated Gobiidae, some variation occurs in the upper jaw, regarding both the shape of the skeletal elements and the length of the associated ligaments. These anatomical differences influence the movements of the maxillary and the premaxillary bones. The mobility of these elements in turn will partially determine the biting and the sucking capacity of the fish, and in that way determine which prey items

can easily be consumed and which ones can not. In this respect, *Gobius niger* with its short ligaments and its well-developed upper jaw bones seems to be a "biting species". This is confirmed by stomach analysis. *Deltentosteus quadrimaculatus* appears to be a species that can forcefully bite on the one hand, but on the other hand also disposes of (and uses, as appears from stomach analysis) a remarkable suction capacity. *Pomatoschistus minuus* and *Lesueurigobius friesii* appear to be two species which have morphological adaptations for both sucking and biting. Stomach analysis reveals that *Pomatoschistus minutus* is a "sucker", *Lesueurigobius friesii* appears to be a "biter".

99 KINEMATICAL CHARACTERISTICS OF NECK MOVEMENTS IN THE AUSTRALIAN SNAKE NECKED TURTLE *CHELODINA LONGICOLLIS*.

J. Van Damme, P. Aerts and *F. De Vree* - University of Antwerp (UIA).

Cervical movements in the side necked turtle *Chelodina longicollis* were studied by means of X-ray cinematography. On the basis of radio-opaque markers, inserted near the cervical joints, changes in joint angles between the eight successive vertebrae were calculated and expressed in function of time and in function of the degree of head retraction. A key feature in the kinematics is the observation of a S-shaped initial configuration of the neck. Major bending points are located at the level of the joint between V7 and V8 (=V8-7) and around the biconvex fifth vertebra (=joints V5-4 and V6-5). The major bending points in the neck when the head is fully retracted (=fast head retraction) are reflected in this initial cervical configuration. In order to grasp a prey item, a distinction can be made between frontal and lateral movements of the head and neck. Each movement consists of a protraction and a retraction phase. No conspicuous differences are found between the changes in joint angle between both phases, especially in the proximal joints. These strike cycles are characterized by the stretching of all cervical joints. Joint V6-5 never stretches completely during all registered neck movements. Ventroflexion of the neck system is also obtained by stretching all joints in the vertical plane. Dorsiflexion, which is more pronounced than ventroflexion, occurs in the distal part of the neck (V2-V5). The presence of initial joint angles can be related with the steering of this complex multilinked system. To retract the head at any time very fast underneath the shell these initial angles avoid erroneous folding of the neck. This also implicates the use of only a few large retraction muscles and a simple motoractivity. *Supported by IWONL-grant 910091 and FKFO-grant 2.9005.90.*

100 ULTRASTRUCTURAL STUDY OF HUMAN RESTING T LYMPHOCYTES AND SERTOLI CELLS; MORPHOMETRIC AND IMMUNOCYTOCHEMICAL ANALYSIS.

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Contradictory results about the precise location of rDNA in the nucleolus were obtained by ultrastructrural *in situ* hybridization technique. In Ehrlich tumor cells (1, 2), HeLa cells and mouse T cells (3, 4), rDNA have been detected exclusively in fibrillar centers. On the contrary, on human lymphocytes (5) and Sertoli cells (6), these genes have been located preferentially in the dense fibrillar component. It is self evident that any structural component in which any rDNA is found must include DNA. However, while the presence of rDNA in the fibrillar center is compatible with the nucleolar distribution of DNA in a wide variety of cells, its presence in the dense fibrillar component has never been clearly proven (7).Thus, is the nucleolar organization of human lymphocytes and Sertoli cells different from that of others cell types ? To answer, we have investigated the nucleoli of these two cells by means of a morphometric analysis and a new immunocytochemical method : the Terminal deoxynucleotidyl Transferase-immunogold procedure for precisely detecting DNA. These studies have been performed on sections of acetylated cells, a condition which improves the distinction between the nucleolar compartments (8). Our results emphasize two points. First, in human lymphocytes, about one third of the fibrillar center surface is essentially occupied by condensed chromatin. Secondly, DNA is only detected in the fibrillar center and the condensed chromatin, whereas no significant labeling is detected over the dense fibrillar component and over the granular component both in these two human cells.Thus, these results argue against different nucleolar organization. They pinpoint the fact that condensed chromatin is frequently included in nucleolar interstices near the dense fibrillar component. Finally, they show that it is important to know the fine DNA distribution within the nucleolus before investigating the distribution of more specific DNA nucleolus-associated segments.

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101 APPLICATION OF HIGH RESOLUTION MRI IN DIAGNOSIS OF SEX IN QUAIL EMBRYOS.

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In most avian embryos the degeneration of the right female gonad and Müllerian tube would constitute an excellent criterion in the sexing of individuals. Most techniques, however, are of limited value since they may interfere seriously with normal embryonic development. In this respect MR imaging might prove to be a promising approach, since up till now no harmfull effects on living tissues have been reported. In this study series of embryos of the chinese dwarf quail, *Coturnix excalfactoria* chinensis, were examined in a Varian Unity 400 spectrometer at 9.4 Tesla to determine if sufficient resolution and contrast can be obtained to allow reliable diagnosis of sex. To facilitate appropriate orientation, the embryos were removed from the egg shells and mounted in an imaging probe of 25 mm inner diameter. MR images obtained by multislice spin-warp technique, were checked by dissection or light microscopic studies of serial sections of the specimens. At nine days of incubation most organs are readily identified, most important being gonad, meso- and metanephros. Size and asymmetry of the gonads at that time are conclusive criteria to allow correct diagnosis of sex, both in transversal and coronal orientations. Wolffian and Müllerian ducts are far less conspicuous and may serve as additional characteristics only. Interpretation of sagittal oriented MR images remains doubtfull. From day seven till day nine of incubation identification of the gonad is possible, but we doubt if diagnosis is reliable in all cases. From this study it may be concluded that MR imaging techniques can be developed to procedures in routine sexing of bird eggs and may substantially contribute to morphological studies of avian embryology.

102 BROOD SEX RATIOS OF SOLITARY PARASITOID WASPS OF THE LEAFMINING FLY *AGROMYZA PHRAGMITIDIS*.

D. Vandenbussche, L. De Bruyn, J. Scheirs, P. Verdyck and *K. Jordaens* - University of Antwerp (RUCA).

Hymenoptera possess a haplo-diploid reproductive system where fertilised eggs produce female and unfertilised eggs produce male wasps. In this way ovipositing females are able to control the sex ratio of their offspring. In the present study we analysed the sex ratio of the solitary hymenopterous parasitoids of *Agromyza phragmitidis* (Diptera, Agromyzidae) in view of the host size model and the Local Mate Competiton theory. *A. phragmitidis* is a monophagous parasite of the common reed, *Phragmites australis* (Poaceae). The larvae feed on the inner tissues of the leaves and form typical blotch mines. Mines were collected in the field and brouhgt to the laboratory. Here the content of each mine was reared and the emerging adults were identified. Two species of parasitoids were found in high numbers: viz. *Opius rex* and *Opius polyzonius* (Hymenoptera: Braconidae). Both species are larval parasites of *A. Phragmitidis*. *O. rex* had a 1:1 sex ratio while the sex ratio of *O. polyzonius* was strongly female biased (1:3.25). Larger host pupae produced larger male and female parasitoids but for neither of the two species the size of the host influenced the sex of the emerging parasitoids. Measurements of the thorax and abdomen showed that there was no size difference between males and females of both species. Females of *O. rex* however had significantly larger wings. Analogous to other hymenopteran parasitoids we therefore can assume that these females have a greater dispersal ability. This results in a greater number of females which mate outside the oviposition patch. In turn this gives rise to a random mating system. *O. polyzonius* has a female biased sex ratio as predicted by the assumptions of the Local Mate Competition theory.

103 POSTEMBRYONIC DEVELOPMENT OF HEAD OSSIFICATIONS IN *CHRYSICHTHYS AURATUS* (PISCES, BAGRIDAE).

P.Vandewalle *, *Ph. Laleye* ** and *B. Focant* * . *University of Liège (ULg) and **Université nationale du Bénin.

The inception and development of the bony cephalic skeleton of *Chrysichthys auratus* is described from hatching to 28 days. The larval development is divided, for practical reasons, into mophological levels rather than following days after hatching or fry length. Fry are cleared by trypsin and stained with alizarine. The bony cephalic development passes through periods of fast and slow growth. These rates are not the same in different parts of the skull. The operculum, dentary and two

branchiostegal rays are present at hatching. The first bone appearing in the braincase is the parasphenoid; a lot of other bones develop subsequently and in the same time: the interoperculum, maxilla, lacrimal and upper pharyngeal jaw. After, the splanchnocranium continues to develop at a relatively fast rate while the neurocranium grows slowly. The braincase begins to close when the bucco-pharyngeal apparatus is almost complete. The apparition of the other structures seems to be linked with the mechanical demands of biological functions such as breathing and feeding. *P.V.and B.F. are Research Associates of the Belgian Fonds National de la Recherche Scientifique.*

104 MOBILITY AND PHENOTYPIC VARIATION IN THE SPECKLED WOOD BUTTERFLY *PARARGE AEGERIA* L. (LEPIDOPTERA: SATYRIDAE). *H. Van Dyck, E. Matthysen* and *A.A. Dhont* - University of Antwerp (RUCA).

We try to understand the observed variation in mobility within populations of the bivoltine butterfly *Pararge aegeria* by studying the variation in wing morphology (colour, eyespot pattern, size) in relation to behavioural variation. Phenotype and behaviour of adult Speckled woods were studied in a set of small woodland fragments. Field data were collected by using a Mark-Release-Recapture method and by following individuals. Individuals with a clear fourth submarginal eye spot on the upperside of the hindwings, were in average darker and larger than three-spot-individuals. The relative frequency of individuals with 3 eye spots decreased progressively with time in both the first and second generation. Darker individuals were more often seen in longer flights (patrolling), while paler ones engaged more in short flights within a sunspot at the forest floor (perching). At the same ambient temperature paler individuals spent more time at dorsal basking, while darker ones spent more time at flight and resting with closed wings. The few recorded males that moved from one woodland fragment to another were all dark and large individuals. These results suggest a link between behaviour (mobility) and phenotype : darker, larger individuals are more mobile. Coloration and size could affect the activity, and thus mobility, in a direct way because they are relevant to thermoregulation. Darker individuals could reach more rapidly an optimal body temperature for activity, so that they could spend more time flying. The meaning of the link between mobility and the number of eye spot is less obvious. The expression of a fourth eye spot could be a secundary effect of an intenser melanization.

105 INTERTWINING OF THEORETICAL AND APPLIED APPROACHES AS ILLUSTRATED BY AN INTEGRATED ZOO-RESEARCH PROGRAM. *L. Van Elsacker*, V. Walraven**, H. Vervaecke*** and *R.F. Verheyen*** - *Royal Zoological Society of Antwerp (RZSA) and ** University of Antwerp (RUCA).

Historically, the goals put forward in behavioural research in zoos have been twofold in that there was a need for "basic" as well as "applied" research. In some cases the approaches could be intertwined. An example of such integrated zoo research is presented. A longitudinal visual evaluation of the external appearance of the genital swellings of adult female bonobos (*Pan paniscus*), living in a social group at Planckendael (Belgium), is carried out. This evaluation is complemented by ethological information concerning the sexual activities of the animals and also endocrinological data relating to the profiles of sex hormones present in the urine and faeces of the females. We will illustrate how findings in the research on sociobiological questions can be applied to the management of the social group, which in its turn favours the possibilities for further research.

106 CELLULAR MECHANISMS AND REGULATION OF SALT AND WATER TRANSPORT IN MALPIGHIAN TUBULES IN INSECTS. *E. Van Kerkhove* - Limburgs Universitair Centrum (LUC).

Malpighian tubules secrete primary urine and the hindgut and rectum fine regulate its composition. The system plays an important role in the regulation of the salt and water content in insects: after metamorphosis and before flight some insects must lose a lot of water in order to reduce their weight; or after a bloodmeal, increasing its body weight by a factor of more than ten, the blood sucking bug *Rhodnius* needs to eliminate a high load of NaCl and water; the mealworm *Tenebrio molitor* on the other hand uses a cryptonephric system, built by the Malpighian tubules and the rectum, to reabsorb practically 100 % of the water present in the excreta.
The cellular mechanisms of salt and water secretion in Malpighian tubules have been extensively studied in the last ten years. The prime mover for salt secretion in the tubule is a V-type H^+ATPase in the luminal membrane in parallel with a Na^+/H^+ or K^+/H^+ antiporter. Uptake mechanisms for K^+ and/or Na^+ at the haemolymphal side may differ according to the species: *e.g.* uptake of K^+ through high conductance channels occurs in the presence of a high K^+ concentration in tubules of *Formica*. At lower K^+ concentrations a K^+/Cl^- and a $Na^+/K^+/2Cl^-$ cotransporter may also be functional in these tubules. In some species an appreciable Na^+conductance

is present (*e.g. Aedes aegypti*) or a Na^+/K^+-ATPase may play a role (*e.g. Rhodnius*). The pathway followed by the accompanying anion (mostly Cl^-) is still controversial. The study of the regulation of the primary urine formation by the Malpighian tubules is also a rapidly developing field. In many species endogenous peptide factors have been characterized that regulate fluid secretion by the tubules. Via second messengers like cAMP, cGMP and/or Ca^{++} they affect the different transport mechanisms functional in the tubules of the species under study.

107 FOOD-ELICITED CALLS IN CAPTIVE BONOBOS (*PAN PANISCUS*): EFFECTS OF RANK AND FOOD QUANTITY. *E. Van Krunkelsven*, J. Dupain*, L. Van Elsacker*** and *R.F. Verheyen** - * Universitaire Instelling Antwerpen (UIA) and **Koninklijke Museum voor Midden-Afrika (KMDA).

The vocal repertoire of the bonobos or pygmee chimpanzees in Planckendael (8 individuals) contains two calls uttered when they are fed: "high hoots" en "food peeps". In the present study we want to analyse the specific function of both calls. We will focus on 3 questions: 1) Are food calls uttered when food is found and are the other bonobos informed food has been found ? 2) Does the quantity of food found affects the occurence and/or the number of food calls ? 3) Do submissive individuals, which find a food patch, suppress these vocalisations more than dominant individuals to avoid competition for food ?
To answer these questions, food items were hidden as clusters in the accomodation of the animals (=social context). In order to find out whether food calls are suppressed in the presence of other group members, food was also given to each bonobo sitting alone in a cage (=control). In each experiment the vocalisations and behaviour was recorded. The food calls were uttered when food was found and, when vocalised, group members were attracted significantly more. So, mentioned vocalisations give information on the presence of food. The quantity of food did not affect the occurence of food calls but the number of "food peeps" uttered increases when finding a larger quantity of food. In that manner, the number of food peeps can give information on the quantity of food found. Food vocalisation is suppressed more in group situations than in isolated situations suggesting food competition may play a role. In the bonobo society, females are dominant over males. Some males were significantly more chased away and ate significant less when vocalizing, however they called when they found food. As an explanation we propose the "sex for food exchange" hypothesis. By vocalising, a male finder attracts a female to copulate with her before leaving the food patch.

108 IN VITRO STUDY OF POTASSIUM-INDUCED CONTRACTIONS OF THE PRE-OVULATORY FOLLICLE IN THE QUAIL. *L. Van Nassauw, S.U. Sys, F. Harrisson* and *M. Callebaut* - Universitair Centrum Antwerpen (RUCA).

The aim of the present work was to study the mechanical activity of the wall of the pre-ovulatory follicle in mature Japanese quails (*Coturnix coturnix japonica*). In isolated parts of the wall, we examined in vitro the contractions induced by potassium under controlled conditions of length and load, using an electromagnetic force-length transducer system. We studied longitudinal and transverse strips of the whole follicular wall, of the theca, and of the outer layer (tunica albuginea and surface epithelium) of the wall. It was observed that during isotonic and isometric contractions, the patterns of force development and shortening of strips of the whole wall and those of the theca are similar. Statistical analysis, employing a two-factor ANOVA with multiple comparisons according to Student-Newman-Keuls, of maximal isometric force, peak shortening length, and percentage of reduction of follicular volume showed that the orientation of strips is without importance. This result allowed us to extrapolate the values of shortening to the dimensions of a sphere. The results from different orientations were pooled, and the different layers were compared statistically. The general result of this analysis was that the contractile activity of the outer layer was significantly lower than the performance of either the whole wall or the theca. We concluded that the contractile activity of the wall of the pre-ovulatory follicle is mainly dependent on the contractile performance of the smooth muscle cells of the theca externa. This thecal contractile system is comparable to that of mammals. We suggest that the main function of the theca externa during ovulation is to maintain a constant intrafollicular pressure against the enzymatically weakened stigma.

109 GENETIC DIFFERENCES BETWEEN SIX SIBLING SPECIES OF THE GENUS *PHYLLOTRETA* (COLEOPTERA: CHRYSOMELIDAE). *P. Verdyck,* T. Backeljau,** W. De Belder*, S. Simokovic* *and *J. Hulselmans* * - *University of Antwerp (RUCA) and **Royal Belgian Institute of Natural Sciences (KBIN), Brussels.

The *Phyllotreta cruciferae*-complex groups six closely related species, all feeding on cruciferous plants. Vertical Polyacrylamide Gel electrophoresis was used to study allozyme variability within this species complex. 23 populations (from Belgium, France, Germany and Denmark) were studied for 7 variable loci (ACO-1, AMY-1, GPD-1, ICD-1, MPI-1,

MPI-2, PGM-1). Three genetic similarity measures were calculated. Nei Genetic Identity and Rogers Genetic Similarity were used to construct UPGMA dendrograms. Prevosti Distance was used to construct a Distance Wagner tree. Between different populations of one species Nei Genetic Identity varies between 0.881 and 1.000. Between populations of different species Nei Genetic Identity is very variable. For most comparisons values are between 0.200 and 0.600. Between some populations of *P. nigripes* and *P. aerea* or *P. nigripes* and *P. consobrina* Nei Genetic Identity is 0.000. Between *P. atra* and *P. cruciferae* Nei Genetic Identity varies between 0.796 and 0.962. Both UPGMA trees give the same result. In the Distance Wagner tree, cluster positions have slightly changed. All dendograms show a very close relationship between populations of *P. atra* and *P. crucifera*. The exact position of *P. diademata* and the two former species is not clear. *P aerea* and *P. consobrina* are always clustered together. The relationship of *P. nigripes* and the other species is not clear.

110 GENIC SIMILARITIES BETWEEN SIX SIBLING SPECIES OF THE GENUS *PHYLLOTRETA* (COLEOPTERA: CHRYSOMELIDAE), BASED ON ISOELECTRIC FOCUSING OF GENERAL PROTEINS.

P. Verdyck, L. De Bruyn, J. Scheirs, K. Jordaens and *J. Hulselmans* - University of Antwerp (RUCA).

In this study we use Isoelectric focusing (IEF) of general proteins to calculate genic similarities between six closely related beetle species. For each species, animals of several populations were used. Focusing was carried out with IEF gels of pH range 4-6.5. After a 500 Volthour run (approximatively 25 minutes) silver staining was performed. Gels were interpreted quantitatively using the band counting technique of Ferguson (1). Differences between intra- and interspecific similarities were tested using ANOVA and Duncan Multiple Range test. Results were visualised using an UPGMA-dendrogram. In total 72 gels were run. In this analysis 234 comparisons (intra-/interspecific) are used. Mean intraspecific similarities vary between 0.694 and 0.841. Mean interspecific similarities vary between 0.316 and 0.580. In the UPGMA dendrogram *Phyllotreta aerea - P. consobrina* and *P. atra - P. cruciferae* are clustered together.

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111 A PHYLOGENY OF THE PHYLLOTRETA CRUCIFERAE-COMPLEX (COLEOPTERA: CHRYSOMELIDAE) BASED ON MORPHOLOGICAL CHARACTERS. *P. Verdyck, L. De Bruyn, J. Scheirs, J.P. Timmermans* and *J. Hulselmans* - University of Antwerp (RUCA).

The six species of the *Phyllotreta cruciferae* complex are morphologically very similar, and difficult to distinguish. This study is the first to use characteristics of both external and genital morphology to construct a phylogeny of the group. The different characters are illustrated using Electron Microscopic pictures. Wagner Parsimony method was used to construct a dendrogram. In the dendrogram *P. aerea* is separated first. *P. nigripes* and *P. consobrina* are clustered together. This does not agree with the results of trees we found using allozyme data. In the latter case *P. nigripes* is always the first to be separated, and *P. aerea* and *P. consobrina* are always clustered together. *P atra, P. diadernata* and *P. cruciferae* are also closely separated. This agrees with the allozyme data.

112 MORPHOMETRIC CHARACTERISATION OF CLOSELY RELATED *PHYLLOTRETA*-SPECIES (COLEOPTERA: CHRYSOMELIDAE). *P. Verdyck, L. De Bruyn, J. Scheirs, D. Vandenbussche* and *J. Hulselmans* - University of Antwerp (RUCA).

The *Phyllotreta cruciferae*-complex groups six morphologically very similar species. In this study we examined the external morphology of these species. For each species one population was included in the study. Fifteen measurements were taken from 158 animals. Differences between species were assessed with MANOVA and Duncan Multiple Range Test as post hoc test. To find the discriminating measurements we performed a stepwise discriminant analysis, the results were visualised using a scatterplot of the first two canonical roots. All species can be separated from each other by at least one morphological measure. Each species is characterised by a different set of morphological measures. Before drawing definitive conclusions it will be necessary to incorporate more populations in the study to obtain an idea of the interpopulation variability within each species.

113 DUAL LOCATION OF NEUROPEPTIDE F IN THE CENTRAL NERVOUS SYSTEM AND MIDGUT OF THE FRUIT-FLY *DROSOPHILA MELANOGASTER.*

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Neuropeptide F (NPF) is an invertebrate neuropeptide structurally related to vertebrate neuropeptide Y (NPY). NPF was originally identified in a cestode (1), but has since then also been sequenced from a turbellarian flatworm (2)and various mollusks (3,4). We are studying NPF-like substances in insects. In the dictyopteran *Periplaneta americana* (the American cockroach), material could be demonstrated with immunochemical and chromatographic characteristics in common with NPF, on the basis of which an isolation strategy for insect NPF has been worked out using liquid chromatography combined with radioimmunoassay (5). Here we report the demonstration and histological distribution of NPF-like peptides in the dipteran, *Drosophila melanogaster*. This is interesting in the light of a recent report on the molecular cloning of a NPY-like receptor in this fruitfly species (4). It is not unlikely that NPF-like peptides represent potential ligands for this newly discovered receptor type. A highly specific NPF-antiserum (code 792) was employed in immunoperoxidase histochemistry of whole mount preparations of fruitfly tissues (fixed in Bouin Hollande's sublimate solution). Intense immunoreactivity was detected in the adult central nervous system (CNS) and midgut. Among the most prominently stained structures are one median neurosecretory cell (NSC), two paramedian cells and two lateral protocerebral cells in each half of the cephalic ganglia. In the ventral ganglia two and four ventrally located immunopositive cells are obvious along the midline of respectively the first and the two following thoracic neuromeres. Moreover, the third thoracic neuromere contains one extra pair of lateral perikarya with relatively strong NPF immunoreactivity. Immunopositive nerve processes associated with these various somata run through all major parts of the fly CNS. The immunostaining pattern in larvae is similar (although the overall number of immunopositive cells is less). A few median and lateral NSCs exhibit clear immunolabelling as well as one ventrolateral soma in each half thoracic neuromere. Staining within the embryo is less obvious but may not be totally absent. In the adult gut, many NPF-immunopositive paraneurons (endocrine-type cells) are detected in the mesenteric region.

Because of practical limitations inherent to neuropeptide extractions from tiny fruitflies, we have now started the purification of dipteran NPF from a nearly one hundred times bigger species, *Neobellieria bullata,* which exhibits a similar dual NPF-like distribution, centrally (CNS) and peripherally (midgut). *The British Council is gratefully acknowledged for encouraging the Leuven-Belfast collaboration.*

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114 JUVENILE DISPERSAL IN WOOD MICE. *R. Verhagen, S. Verkem, H. Leirs* and *A. Lemouche* - University of Antwerp (RUCA).

Dispersal is an important factor in the life history of most rodent species and has become one of the central problems in small mammal population ecology today. Nowadays, it is believed that dispersal has profound consequences for the demography and social structure of rodent populations as well as for individual fitness and evolution. The major problem in the study of dispersal among rodents is to identify dispersing individuals. This is certainly true for juvenile dispersal as most individuals in life trapping studies are caught for the first time after they have left their unknown nest site. To overcome these problems, pregnant non-lactating female wood mice (*Apodemus sylvaticus*) were placed individually in prolypropylene rain protected cages, provided with nest boxes, food and water, on their place of capture and allowed to give birth to their young. Nests were inspected every three to four days. After parturition, the number of neonates in the litter were counted and marked by toe-clipping at an age of 15-18 days. Two days after marking the cover of the cages was removed allowing the animals to leave. The advantages in using this technique are obvious because insight can be gained in processes like natal dispersal, inbreeding avoidance, juvenile survival, space sharing, reproductive success a.o., which would otherwise be difficult or impossible to evaluate. In total 357 juveniles originating from 78 litters were released over a period of 3 years. Nearly half (48%) of the released juveniles were recaptured at least once in the field and only 20% became sexually active. Dispersal distances of juvenile wood mice are generally small. Most of the juvenile settle within or near the edge of their mother's home range. There are however important differences according to habitat type. In large homogeneneous habitats the number of juvenile females and males that became sexually active within or outside their mother's home range was nearly equal. In habitat fragments almost all of the juvenile females (89%) became sexually active within or very close to their natal site whereas most of the juvenile males (69%) became sexually active outside their natal site.

115 CONTRIBUTION TO THE SYSTEMATIC REVISION OF THE SPINY-EELS OF WEST- AND WEST-CENTRAL AFRICA (SYNBRANCHIFORMES, MASTACEMBELIDAE).

E. Vreven, G.G. Teugels*** and *D.F.E. Thys van den Audenaerde** & ** - *Catholic University of Leuven (KUL) and **Koninklijk Museum voor Midden Africa (KMDA).

The Mastacembelidae or spiny-eels belong to the Synbranchiformes. The family is divided into two subfamilies : the Mastacembelinae occurring in South-East Asia and the Afromastacembelinae known from Africa. The study only deals with the African subfamily. The Afromastacembelinae are divided into two genera : the genus *Caecomastacembelus* (type species *C.brichardi*) and the genus *Aethiomastacembelus* (type species *Mastacembelus marchei*).
The aim of this study was to adjust the generic definitions and to improve the existing keys for the genera and especially the species. Whilst performing this research, however, the definition of the genera showed to be inaccurate. Moreover *C. brichardi* does not present three important osteological characteristics considered as generic. Our research revealed important evidence indicating that the type species of both genera should be classified in the same genus. According to the rules of the International Code of Zoological Nomenclature, this implicates that both genera should be synonymised. For the time being, however, we have not introduced these important changes, as we did not have a total view of the diversity of all the species in the family. Moreover we were not able to study the osteology of the head which might have provided useful informations on the relationships between the different species. The most important result from the species revision is the discovery of two new species in the "*Aethiomastacembelus*" *liberiensis* complex from West Africa. Our study is the first contribution to the improvement of the systematics of the spiny-eels. Further research, both on the generic and the species level is absolutely necessary.

116 THE MATING BEHAVIOUR OF *DUGESIA GONOCEPHALA*, A SIMULTANEOUS HERMAPHRODITIC FLATWORM (TRICLADIDA, PALUDICOLA).

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The reproductive behaviour of planarians is poorly understood. All observations made thus far are anecdotical and focus on the copulatory behaviour itself. By using video-tapes we investigated the mating behaviour of the stream-dwelling flatworm *D. gonocephala* in all its

aspects. A clear and consistent asymmetry exists in the behaviour of both individuals before, during and after copulation (attempt) (N= 15). In the precopula phase, one individual **A** glides around normally, while the other makes active searching movements with the head. Then the "active" searcher comes to a sudden halt and the "passive" individual **A** glides on top of it. When **B** does not respond by flattening its body, the "climber" looses interest and leaves. When **B** however does flatten its body, **A** flattens its body too. Copulation only follows when **B** raises the distal part of its body, thus exposing its gonopore. When so, both individuals move their tails to make genital contact. Copulation duration varies from 10 to 410 min (N= 10). A copulation always ends when individual **A** starts gliding away from individual **B**. When a pair breaks up before a proper copulation (defined as genital contact for more than 10 min), the sequence is to be seen as an unsuccessful copulation attempt. Two individuals can run to this behavioural sequence up to 30 times, before a proper copulation occurs. Within a sequence, each role **A** and **B** is fixed, but individuals can switch roles from one sequence to the next.

117 BONOBOS (*PAN PANISCUS*), THE NEGLECTED MANIPULATORS. *V. Walraven*, L. Van Elsacker*** and *R. Verheyen** - *University of Antwerp (UIA) and **Royal Zoological Society of Antwerp (RZSA).

Object manipulation and tool use by nonhuman primates have held scientific interest for many years. Especially the technological skills of Common chimpanzees (*Pan troglodytes*) have been extensively studied. Chimpanzees are considered to be the most proficient nonhuman species in manufactoring and using tools. It is therefore surprising that in primatological research the instrumental capacities of the closely related Pygmy chimpanzee or Bonobo have been neglected. We will demonstrate that captive bonobos are as manipulative as are Common chimpanzees and Orang utans (*Pongo pygmaeus*) in captivity. Further, the technological skills of the four great ape species will be briefly compared.

118 18S RIBOSOMAL RNA SEQUENCES AND METAZOAN RELATIONSHIPS. *B. Winnepenninckx*, T. Backeljau*** and *R. De Wachter* - * Universitaire Instelling Antwerpen (UIA) and ** Koninklijk Belgisch Instituut voor Natuurwetenschappen (KBIN), Brussels.

It is shown that not all of the conclusions of a published phylogenetic distance analysis (1) based on partial 18S rRNA sequences, are supported by their data. Since part of their results were conflicting with traditional views, the data set of Field *et al.* (4) has already been re-

analysed by several other authors (1, 2, 3). Yet their results were controversial and depended on the tree construction method used. We re-evaluated the data of Field *et al.*(4) by optimalizing the sequence alignment, applying alternative tree construction methods and testing the stability of the obtained trees. This thorough analysis showed that the following conclusions of Field *et al.*(4) are not warranted: 1) Metazoa is polyphyletic; 2) Acoelomata is a sistergroup to Eucoelomata; 3) Arthropoda and Chordata are monophyletic. Furthermore, we added to the data set taxa for which 18S rRNA sequences were produced since the paper of Field *et al.* (4). A neighbour-joining analysis of this extended data set followed by bootstrapping yielded, amongst others, the following preliminary conclusions on metazoan phylogeny: 1) Chordata is monophyletic; 2) Platyhelminthes is a sistergroup to Eucoelomata; 3) Brachiopoda and Ectoprocta (Lophophorata) have protostomian affinities; 4) Pogonophora and Vestimentifera is a monophyletic group but there is no evidence for a close relationship with the Annelida; (5) all molluscs belong to the coelomate cluster but there is no evidence for the monophyly of the phylum!; 6) Gastropoda and Polyplacophora are monophyletic but bivalvian monophyly is not supported. From this contribution it can be concluded that 1) it is important to have a good sampling of taxa; 2) a thorough analysis using different tree construction methods and tests is required to reliably infer phylogeny; 3) the phylogenetic information content of partial 18S rRNA sequences is not sufficient to resolve all branching points within the Metazoa.

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KEYWORD INDEX

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