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## Poster Session 1 – Form and Function

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### **1 Comparative analysis of some weight and structural parameters for determination of sexual dimorphism in adrenal function of the Libyan jird, *Meriones libycus* (Lichtenstein, 1823)**

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The existence of sexual dimorphism in the activity of some endocrine-metabolic functions has been well established in several animal species. Furthermore, very little work has been done on small Saharan mammals. In this concept, we compared in *Meriones libycus*, a nocturne Saharan species belonging to *Gerbillinae* subfamily, some metabolic functions by weight explorations including kidneys, adrenals, and pancreas, as well as by histomorphometric analysis of the adrenal cortex. The results show that the organs weights are in favor of the male compared to the female even though the differences are not statistically significant. Moreover, in the histomorphometric profile, it appears that the adrenal cortex is more developed in the female particularly in the fasciculata and reticularis zonae. In addition, cellular and nuclear analyzes confirm this sexual dimorphism in favor of the female of the adrenocortical activity since this development is essentially due to cellular hypertrophy in the cells of all adrenal cortex zones. These results indicate the existence of sexual dimorphism in favor of the female *Meriones libycus* in adrenocortical activity suggesting the involvement of sex hormones in the regulation of adrenocortical activity probably inhibited by androgens and stimulated by estrogens.

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### 2 Family-specified direction of selection in underground rodents

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Up to now the majority of studies of the analysis of genetic diversity within species and populations was carried out using a small number of molecular markers. However, this approach does not account for the molecular basis of adaptive variation, it remains unclear how many genes are involved in a particular adaptation, what is the origin of genetic diversity responsible for formation of adaptation. The comparison of genomes of phylogenetically close taxa but contrast in adaptations and phylogenetically distant but with similar adaptive traits may help in recovering convergence and parallelisms at the molecular level. This allows testing the hypothesis of the origin of mutations leading to similar phenotype effects and reveal the velocity at which mutation in the DNA may cause a phenotypic effect. In our study, we used annotated genomes of terrestrial and underground rodents from the Ensembl genome browser (ensembl.org). Seven species with well assembled genomes were used: *Cavia porcellus*, *Chinchilla lanigera*, *Rattus norvegicus*, *Mus musculus*, *Fukomys damarensis*, *Nannospalax galii*, *Heterocephalus glaber*. Of these species three are underground rodents, belonging to two phylogenetically distant families – *Spalacidae* and *Bathyergidae*. Ortholog genes were identified with protheintho program and dN/dS values were determined in PAML codeml program for each orthogroup. GO enrichment analysis was performed with Webgestalt software (<http://www.webgestalt.org/option.php>). First of all we identified ortholog genes that have the same direction of selection in all underground species. These genes are enriched with several GO terms, connected with many essential processes: "RNA binding", "metabolic processes", "regulation" and "transcription activity" etc. After that, we identified family-specified genes that belong to the immune response and defence to the stimulus. This study was conducted in Zoological Institute RAS under the research theme N №AAAA-A17-117042410167-2 and partially supported by the grant from RFBR N18-04-00730.

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### **3 Testicular luteinizing hormone receptor (Lhcgr) mRNA expression correlated to testis and seminal vesicles activities in the Libyan jird (*Meriones libycus*) in breeding season compared to non breeding season**

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The Libyan jird (*Meriones libycus*) is a wild desert rodent and a seasonal breeder species that adapted to breed when the environment conditions are able to satisfy the energy and hydrous request of pregnant and nursing females that to ensure the birth at the most favorable time of the year. We assessed gene expression of testicular Lhcgr by QRT-PCR and testis activity by a histological method in adult male Libyan jirds during the resting and the breeding seasons. Our results showed that Lhcgr mRNA expression was increased in autumn during the non breeding season and decreased in spring during the breeding season. This expression varied in opposite manner with testicular structure or function and plasma testosterone levels. These results provided important information for understanding the seasonal sexual activity of this desert rodent correlated to the central regulation.

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### **4 Huddling conserves energy, decreases core body temperature, but increases activity in Brandt's voles (*Lasiopodomys brandtii*)**

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Behavioral adjustments are primary means for the adaptation to cold in many animals. Our study aimed to determine the effect of huddling behavior on energy conservation, thermogenesis, core body temperature ( $T_b$ ) regulation and body composition in Brandt's voles (*Lasiopodomys brandtii*). Adult captive-bred female Brandt's voles ( $n=124$ ) (~50 g) in 31 cages with 4 individuals each were exposed to warm ( $23\pm 1^\circ\text{C}$ ) and cold ( $4\pm 1^\circ\text{C}$ ) ambient temperatures ( $T_a$ ) and were allowed to huddle or were separated single individuals. The cold huddling (CH) groups significantly reduced food intake by 29 % or saved digestible energy 156.99 kJ/day per day compared with cold separated single individuals (CS); in warm huddling groups (WH) the reduction was 26 % or saved digestible energy 105.19 kJ/day per day in comparison to the separated single individuals (WS). Resting metabolic rate (RMR) of huddling voles was 37% lower than in separated single individuals at each  $T_a$ . Non-shivering thermogenesis (NST) of huddling voles was not affected by  $T_a$ , but in CS voles it was significantly increased in comparison to WS. Unexpectedly, huddling voles significantly decreased  $T_b$  by 0.25-0.50°C at each  $T_a$ . The decreased  $T_b$  was not only a direct result of the reduced metabolic rate during huddling, but also possibly caused by heat exchange between huddle mates through increased vasodilation in contact zones as well as relaxed temperature control. Nevertheless, activity of CH voles was higher than in CS voles. Thus, huddling is energetically highly effective because of reduced metabolic rate, thermogenic capacity and relaxed  $T_b$  regulation despite the increase of activity. Therefore, Brandt's voles can remain active and maintain their body condition without increased energetic costs during cold exposure. This study highlights the ecological significance of huddling behavior for maintenance of individual fitness at low costs, and thus survival of population during severe winter in small mammals.

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### 5 Stomach anatomy of *Praomys taitae*

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The genus *Praomys* (*Muridae: Murinae*) circumscribes a small radiation of rodents indigenous to sub-Saharan Africa. Of these, Carleton and Stanley (2012) identified three groups differing in external and cranial morphology, but the third designated species, *Praomys taitae* was left paraphyletic as it was later shown to contain individuals from two genetically and geographically distinct groups (Bryja et al. 2014). Among the morphological differences detected, the authors demonstrated subtle shape differences involving features related to mastication, which could be related to local differences in diet. Little is known however, on the diet or gastrointestinal anatomy of the *Praomys* species. In this paper, the gross and histological anatomy of stomachs of four *Praomys taitae* caught in two cloud forest fragments within the Dawida massif, Kenya were studied. All stomachs contained similar flower blooms and other pieces of plants. In all four specimens, also legs or other small pieces of insects were detected. A well-developed folded edge (margo plicatus) was prominent dividing the stomach into a large non-glandular region (2/3 of the stomach surface) and glandular region. Two low mucosal folds separated this non-glandular part into three compartments. Histological examination confirmed the typical proper (fundic) gastric glands on one side of the plicate border and non-glandular tissue on the other side. An ongoing dental analysis may provide additional insights into the diet of this little known rodent species.

Bryja, J., Mikula, O., Patzenhauerova, H., Oguge, N.O., Šumbera, R. & Verheyen, E. 2014. The role of dispersal and variance in the Pleistocene history of an East African mountain rodent, *Praomys delectorum*. *Journal of Biogeography* 41: 196-208. Carleton, M.D. & Stanley, W.T. 2012. Species limits within the *Praomys delectorum* group (*Rodentia: Muridae: Murinae*) of East Africa: a morphometric reassessment and biogeographical implications. *Zoological Journal of the Linnean Society* 165: 420-469.

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### 6 The effects of population bottlenecks on dental variation in arvicoline rodents

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The study aims to investigate dental variation in arvicoline rodent populations passing through natural or artificial bottlenecks. Phenotypic diversity arising from a limited number of founders is studied in 1) populations of invasive species that have passed through recent bottlenecks related to human-mediated introduction, either intended (*Ondatra zibethicus*) or non-intended (*Microtus rossiaemeridionalis*); 2) populations of native north-Eurasian species showing periodic depressions and outbreaks (*Myopus schisticolor*, *Microtus arvalis obscurus*); 3) captive colonies of arvicoline rodents reared through 3-11 generations (*Dicrostonyx torquatus*, *Microtus arvalis obscurus*). To study dental variation, we use interval and ordinal morphological variables that describe occlusal patterns of left and right m1, m2, m3, and M1, M2, M3 of each individual in the dataset (over 5,000 non-juveniles), with the exception of *Ondatra zibethicus*, which is represented by m1s from 513 individuals). We identify the groups of characters that vary independently of one another and those which reflect the variability of the dentition as a whole, and consider those groups with respect to the present-day knowledge of evolution, development, and function of arvicoline dentition. The results are summarized to answer the following questions. Which dental characters are the best to detect sharp reductions in population size and what kind of shifts are the most common? How many individuals does it take for a group to exhibit different types of phenotypic shifts? How soon can a founder effect and/or phenotypic distortion due to inbreeding be detected in isolated groups of animals? How do the periodic reductions in population size affect phenotypic variation in the absence of complete isolation? Based on comparisons among species, we identify general and species-specific phenotypic patterns that could be used to hypothesize the existence of a bottleneck in arvicoline rodent populations, living or extinct. Supported by Russian Foundation for Basic Research (grant 16-04-01486).

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### **7 Assessment of the activity of Neural Stem Cells in the postnatal brain of *Microtus thomasi***

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Different pools of Neural Stem Cells (NSCs) remain active in the postnatal mouse and rat brain. Multipotent NSCs are clustered in niches such as the Subependymal Zone (SEZ) of the lateral walls of the lateral ventricles and the Subgranular Zone of the dentate gyrus, while oligodendrogenic progenitors are widely distributed throughout the parenchyma. Here we extend the study of NSC function in the adult rodent brain by investigating the presence and activity of NSCs in the brain of Thomas' pine voles (*Microtus thomasi*), fossorial and burrowing rodents captured in the NW Peloponnese area of Greece. Because cytotogenesis in the SEZ mainly contributes to olfaction, by furnishing the olfactory bulbs with new neurons, we aim at exploring if adaptation to fossorial life involves adjustments in the activity of NSCs in the SEZ. NSCs and their progeny are identified using immunohistochemical analysis on coronal brain sections, with proliferating cells being immunopositive for PCNA, newborn neurons for Doublecortin, cells of the oligodendroglial lineage for Olig2 and astrocytes for glial fibrillary acidic protein. The density of mitotic cells, of neuroblasts and of oligodendroblasts is quantified within the *Microtus* SEZ and compared to that of the mouse and of the rat SEZ while the same comparison is performed for the mitotic activity of oligodendrogenic progenitors of the corpus callosum, an olfaction-independent system.

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### **8 A study of behavioral and biochemical indicators in brain regions of the vole *Microtus thomasi* (Rodentia, Arvicolinae), following the induction of epileptic seizures**

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The aim of the present study was to investigate the effect of pentylenetetrazole (PTZ), an epileptic seizure-inducing agent, in anxiety/fear behavior and the activity of the G1 and G4 isoforms of acetylcholinesterase (AChE), in selected brain regions of the Thomas' pine vole (*Microtus thomasi*: Rodentia, Arvicolinae). Initially, the voles, captured from natural populations of NW Peloponnese, Greece, were divided into a control and a PTZ group (administration of 60 mg PTZ/kg of body weight). Twenty-four hours after PTZ administration, vole anxiety/fear behavior was checked, through the performance of an open field test, aiming at the measurement of the thigmotaxis time (rate of anxiety/fear). Afterwards, the voles were sacrificed and specific brain regions were isolated (central hemispheres, cerebellum and midbrain), in order to determine the activity of G1 and G4 {mostly found in the SS fraction (Salt- Soluble) and DS fraction (Detergent-soluble), respectively} isoforms of acetylcholinesterase (AChE), with Ellman's colorimetric method. Following PTZ administration, our results revealed: a) that thigmotaxis time did not differ significantly between the two groups b) a statistically significant reduction of the activity of the G4 isoform of AChE in all tested brain regions of animals under PTZ effect. With this opportunity, a comparison was also conducted between the control group of voles and a group of laboratory mice (Balb-c), and the significant differences that were detected, regarding both the thigmotaxis time and the activity of G1 and G4 isoforms of AChE, are commented.