ORIENTATION – EXPLORATORY BEHAVIOUR OF THE MAIN SMALL RODENT SPECIES INHABITING THE AGROECOSYSTEMS

ANDREI MUNTEANU, NELLI CEMIRTAN, ANATOL SAVIN, VICTORIA NISTREANU

Abstract. *The orientation-exploratory behaviour of the most spread four species of small rodent inhabiting the agroecosystems of Moldova was studied by open field method. These species have a significant economic importance and their populations' social-ethological structure is different. The sex and species differences of the studied indexes were emphasized.*

Keywords: *small rodents, orientation-exploratory behaviour, agroecosystems.*

Rezumat. Comportamentul de orientare-cercetare a speciilor de fondal de rozătoare mici din agrocenoze. *Prin metoda "câmpului deschis" a fost studiat comportamentul de orientare-cercetare a celor mai răspândite patru specii de rozătoare mici care populează agrocenozele Moldovei. Aceste specii au o importanţă economică semnificativă, iar structura social-etologică a populaţiilor lor este diferită. Au fost evidenţiate diferenţe de sex şi de specie ale indicilor studiaţi.*

Cuvinte cheie: rozătoare *mici, comportament de orientare-cercetare, agrocenoze.*

INTRODUCTION

In the life of every animal the capacity of orientation in time and space is of great importance. It is based on the orientation reflex, which after Pavlov's words is the reflex "what is it?" that allows to quickly react to the environment modifications, to adapt, to duly avoid the danger etc. Therefore we decided to study out if there are some sex and species related differences in exploratory behaviour of the animals with different social-ethological structure of the populations. As research objects individuals of both sexes of four small mammal species inhabiting the Moldova agrocoenoses were selected: *Apodemus uralensis* (PALLAS, 1811), *Microtus arvalis* (PALLAS, 1879), *Mus spicilegus* (PETENYI, 1882) and *Mus musculus* (LINNAEUS, 1758). The first species is widely spread in agro- and zoocoenoses, has a dynamic social structure: before the beginning of reproduction it has a solitary way of life, in the reproduction period it forms family groups with various social structure (MUNTEANU & CEMIRTAN, 2001; MUNTEANU, 2006). In summer, the new born individuals migrate on new territories for reproduction and restoring the species number after the winter period, while in autumn the species form numerous groups for more successful surviving during the winter. *M. arvalis* is a colonial species that inhabits the biotopes with abundant vegetation (alfalfa fields, abandoned gardens with tall herbaceous vegetation etc.) in separate colonies. The population social structure of this species is more static: the animals reproduce and survive the unfavourable winter conditions in colonies.

The next study objects are two representative of the house mouse that are closely related species with various degree of synanthropy: the true synanthrope *M. musculus* (after the classification of KOTENKOVA & MUNTEANU, 2007), inhabiting the human buildings, and *M. spicilegus*-typical inhabitant of agrocoenoses. The population structure of the last two species is also different. *M. spicilegus* have a solitary-family way of life during the vegetation period, while at the end of summer-beginning of autumn, the representatives of this species start to build mounds from stalks and seeds of cereal. The mounds have a raised above ground part that contains the food reserves and a complex levelled underground architecture of galleries and nests, where the animals survive during the unfavourable winter conditions and where the first generation of new vegetative year is forming. The social-ethological structure of *M. musculus* population is different: the house mouse forms the so called "demes", which represent relatively stable family groups with complex hierarchic structure (ZORINA et al., 2002). Therefore, it was interesting to compare the characteristics of the above mentioned animal species exploratory behaviour.

MATERIAL AND METHODS

The studies were accomplished in summer and autumn period. The field vole was caught in alfalfa fields (20 males and 20 females), *A. uralensis* (17 males and 18 females) and *M. spicilegus* (15 males and 15 females) - in forest shelter belts around these fields, and *M. musculus* (11 males and 12 females)-in human buildings.

The exploratory behaviour of the adult individuals from both sexes of the four analysed species was studied in open field (HUGHES, 1978). The animals were placed for 15 min in the open field device and during every 3 minutes the following indexes were noted: *the horizontal activity* (e.g. the number of crossed squares that characterize the locomotor activity and is formed by two components: the proper exploratory behaviour and the emotional reaction to new environment and wish to escape from it), *the vertical activity* (the number of vertical stands that characterize the exploratory behaviour) and the latent period of exit from the portable cage into the open field chamber (seconds).

RESULTS AND DISCUSSIONS

Latent period. At the comparison of latent period values in the four studied small mammal species some sex and species differences were registered. The more significant oscillations were observed in females: from 37.5±3.53 sec in *M. musculus* to 180.0±37.0 in *A. uralensis*, in *M. spicilegus* the latent period was 106.0±18.0 sec and 85.9±18.9 sec in *M. arvalis*. In males the index fluctuation was lower: from 84.31±1.45 sec in *M. musculus* to 160.0±31.8 sec in *M. spicilegus* and 146.24±28.41 sec in *A. uralensis*. In field vole the latent period was 116.0±22.4 sec. Thus, except the herb field mouse, the latent period values of the females are lower than those of the males, while the increasing of the latent period values was recorded in the following succession: *M. musculus, M. arvalis, M. spicilegus, A. uralensis*, furthermore, at the last species the female latent period index was slightly higher than that of the males (Fig. 1).

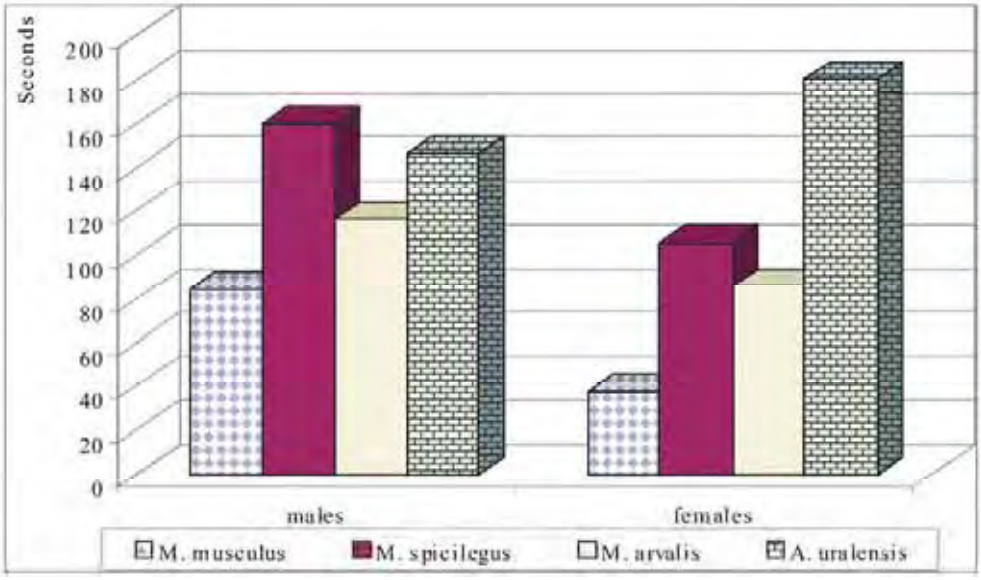

Figure 1. Latent period of males and females in the studied species.
Figura 1. Perioada de latență la masculii şi femelele speciilor studiate.

Horizontal activity. The total horizontal activity (number of crossed squares during 15 min as a whole) and the index dynamics every 3 minutes of the individual activity in open field chamber were studied. In males the values of the total horizontal activity varied from 233.84±19.3 (in *A. uralensis*) to 453.0±66.1 (in *M. musculus*, Fig. 2), while in females-from 300.3±27.8 (in *M. spicilegus*) to 429.4±33.4 (in *M. musculus*). We have to mention that the absolute values of female and male total horizontal activity of the same species showed practically no differences, except *A. uralensis*, where in the females this index was 1.5 times higher than in males (362.25±49.86 and 233.84±19.3 respectively).

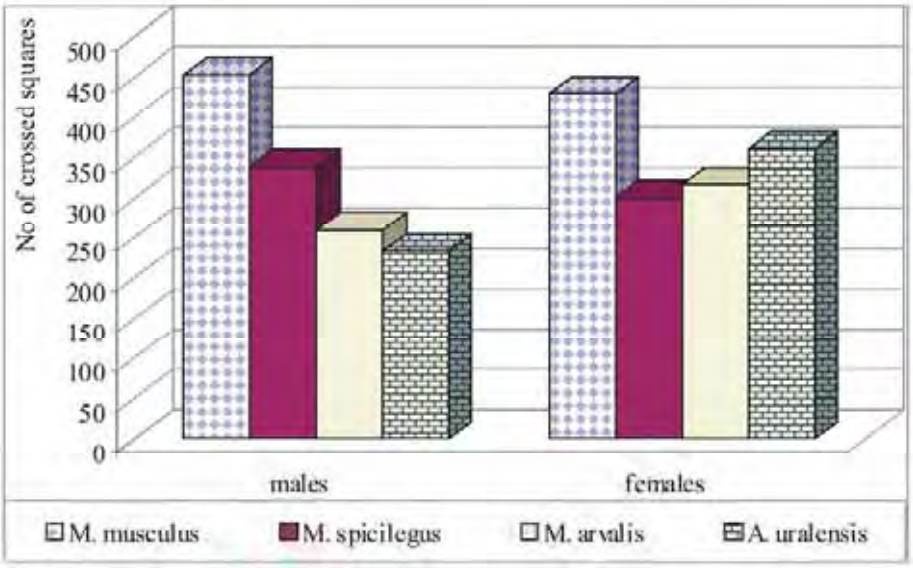

Figure 2. Total horizontal activity of the studied species.
Figura 2. Activitatea orizontală sumară la speciile studiate.

The open field behaviour strategy of both sexes of the studied species was similar, e.g. the highest values of the motor activity index was registered in the first minutes of the experiment, then smooth or sharp decreasing of the indexes occurred and reached minimum values at the end of the experiment (Fig. 4-7, A). Also, species and sex differences in horizontal activity dynamics were recorded.

Hence, in *M. arvalis* and *M. spicilegus* the curves of male and female indexes of the same species and the interspecific indexes were as a whole similar after their configuration, as well as after the absolute values (Fig. 5-6, A).

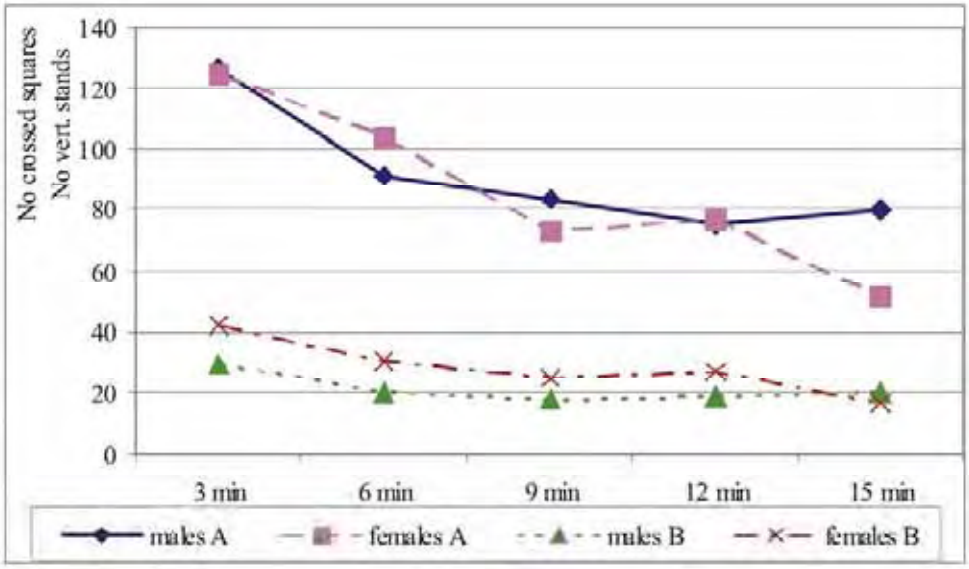

Figure 3. Dynamics of horizontal (A) and vertical (B) activity in *M. musculus.*
Figura 3. Dinamica activităţii orizontale (A) şi verticale (B) la *M. musculus.*

In *A. uralensis*, although the index dynamics had the analogical configuration with the above mentioned species, the absolute values of female horizontal activity were significantly higher then those of the males (Fig. 7, A), which, at it turn, correlated with the mentioned above peculiarities of total locomotor activity of the species. The females were more emotive and more curios then the males (the first one was confirmed by the higher indexes of locomotor activity and the second one-by the last minutes of open field activity).

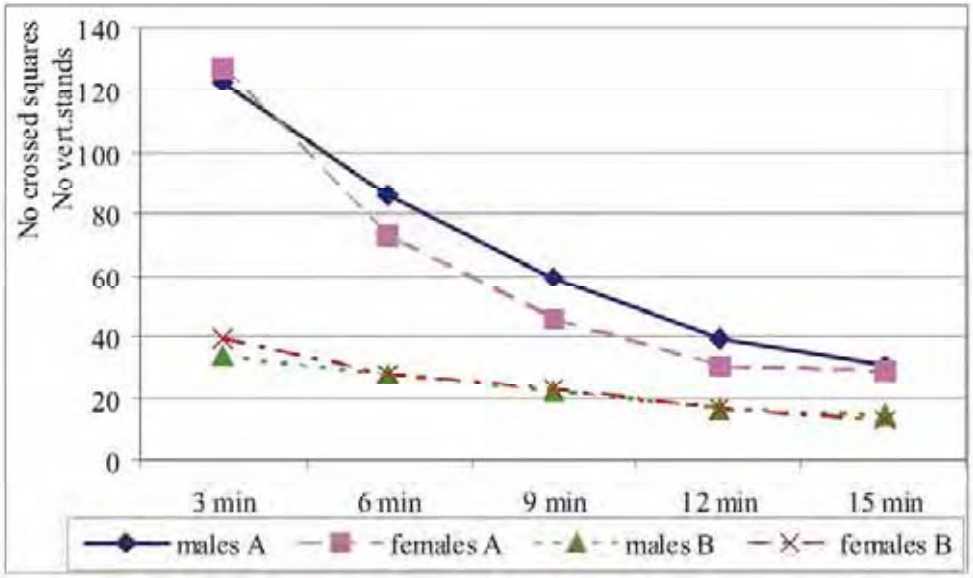

Figure 4. Dynamics of horizontal (A) and vertical (B) activity in *M. spicilegus.*
Figura 4. Dinamica activităţii orizontale (A) şi verticale (B) la *M. spicilegus.*

The open field behaviour of *M. musculus* was different from that of other studied species. Although the values of horizontal activity in the first minutes of the experiment were practically similar to the above species, the index dynamics is different: in males at the 6th minute the decreasing of the horizontal activity was recorded, after that its value practically did not change until the end of the experiment. In females up to the 12th minute gradual decreasing of locomotor activity was registered, but after that its value remained to the analogous one of the males, and only on the

15th minute more significant decreasing of the horizontal occurred, although its absolute value still was high and significantly exceeded the similar index of the other three studied species (Fig. 4, A). The higher levels of horizontal activity dynamics revealed in *M. musculus* males and females match with the previously registered maximum indexes of total locomotor activity of this species.

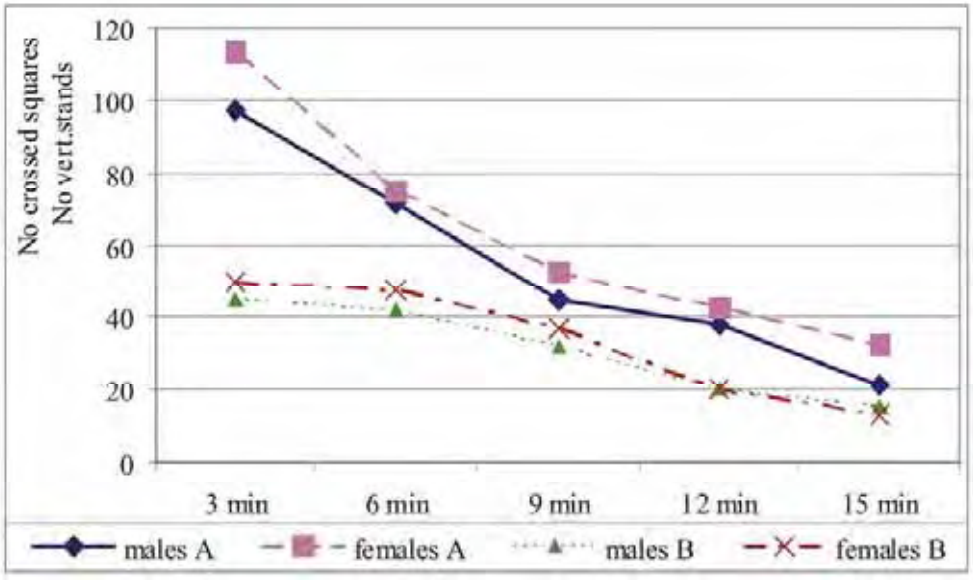

Figure 5. Dynamics of horizontal (A) and vertical (B) activity in *M. arvalis.*
Figura 5. Dinamica activității orizontale (A) şi verticale (B) la *M. arvalis.*

The high indexes of locomotor activity in the first minutes of presence in a new environment prove high emotional reaction of the animals toward new conditions, while the decreasing of the index proves the gradual accustoming to it and the low values in the last minutes of the experiment prove the adaptation to the new conditions. That is the behaviour strategy of three of the studied species, except the house mouse. The high indexes of horizontal activity during practically the whole experiment and, especially, toward its end allow to conclude that to adapt to new conditions *M. musculus* needs significantly more time than other species, fact that is probably justified from evolutionary point of view, taking into account the life way of the animal and its proximity to human beings.

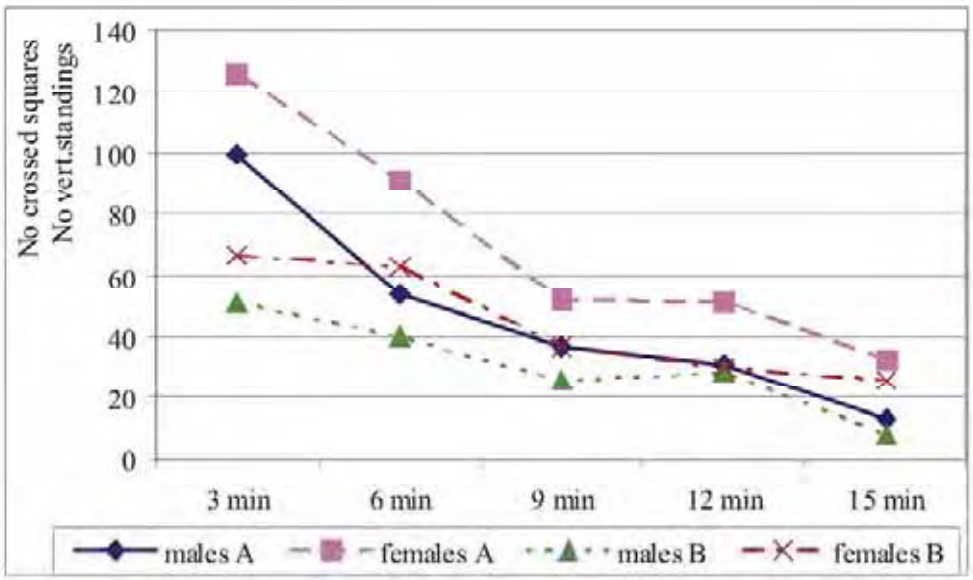

Figure 6. Dynamics of horizontal (A) and vertical (B) activity in *A. uralensis.*
Figura 6. Dinamica activității orizontale (A) şi verticale (B) la *A. uralensis.*

Vertical activity. If the horizontal activity is a summarized index, the vertical activity characterizes the proper exploratory behaviour of the animals in open field conditions. Fig. 7 reflects the total vertical activity of the studied species. The minimum indexes of exploratory activity were revealed at the representatives of genus *Mus* in males, as well as in females, the higher ones-in field vole and in males of herb field mouse and the maximum indexes-in females

of herb field mouse. At the comparison of total vertical activity values with the similar values of horizontal activity (Fig. 2) it was obviously revealed the high emotionality of *M. musculus* representatives (the highest among the studied species), followed by *M. spicilegus* males and females. The males of *M. arvalis* and *A. uralensis* showed low levels of emotional reaction and high values of exploratory activity, while the females of these species showed high degree of emotional reaction toward new environment, as well as high level of exploratory activity. Furthermore, the females of the last species proved to be the most curious among the studied animals.

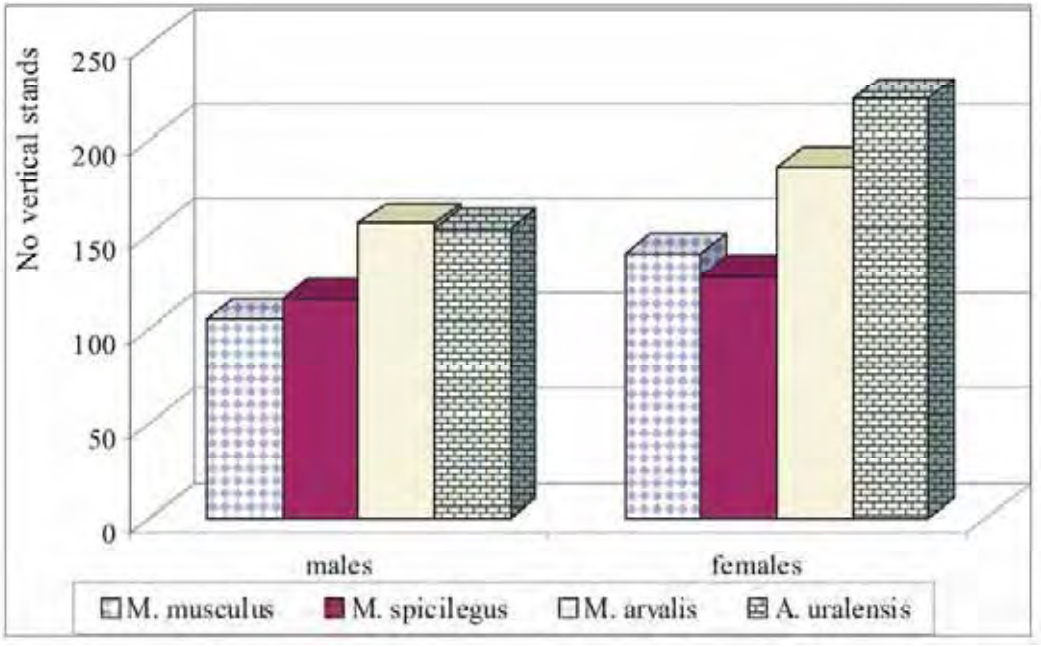

Figure 7. Total vertical activity of the studied species.
Figura 7. Activitatea verticală sumară a speciilor studiate.

The curves of vertical activity dynamics of the studied animal species (Figs. 4-7, B) correspond to the logic of summarized activity. Thus, in *Mus* representatives the lowest exploratory behaviour values were registered by comparing them with other species. The low values of exploratory behaviour at the beginning of the experiment even decreased toward the 6th and 9th minutes then remained practically at the same level up to the end of the experiment (Figs. 4 B, 5 B). In *M. spicilegus* there were no sexual differences in vertical activity dynamics, while in house mouse females its indexes were slightly higher than in males up to the 12th minute of animal activity in the experimental chamber. In the first 9 minutes in *M. arvalis* and the first 12 minutes in *A. uralensis* the levels of exploratory activity in open field were significantly higher than in *Mus* representatives, furthermore in *A. uralensis* the sexual differences of the index are obvious.

CONCLUSIONS

Taking into account the above results we can conclude that in spite of the universality of orientation-exploratory reflex, each studied species has its own qualitative and quantitative characteristics.

1. Latent period

As a whole the latent period in the females was lower than in the males of all the studied species except *A. uralensis*. The species differences of the index consisted in the increasing of its value in the following sequence: *M. musculus, M. arvalis, M. spicilegus, A. uralensis*.

2. Horizontal activity

The maximum indexes of total horizontal activity were emphasized in *M. musculus* males and females, the minimum ones-in *A. uralensis* males.

The absolute values of this index in representatives of different sexes of the same species were practically similar, except *A. uralensis* which registered a 1.5 times higher index in females than in males.

The strategy of individuals from both sexes in open field was similar (high emotional reaction toward new conditions in the first minutes of the experiment, gradual habituation and complete adaptation at the end of the experiment), although it had species (*M. musculus*) and sex (*A. uralensis*) differences.

3. Vertical activity

Minimum indexes of total exploratory activity were revealed in *M. musculus* and *M. spicilegus* at the representatives of both sexes and the maximum ones-in *A. uralensis* females.

The dynamics of vertical activity in the studied animals corresponded to the summarized one: in *Mus* individuals the lowest values of exploratory behaviour were registered, in other two species-higher values and in *A. uralensis* males -the highest ones. In the last species the sexual dimorphism of the index was also recorded.

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Munteanu Andrei, Cemirtan Nelli, Savin Anatol, Nistreanu Victoria
The Zoology Institute of ASM
Str. Academiei 1, Chisinau, MD-2028.
E-mail: vicnistreanu@gmail.com

Received: May 26, 2009
Accepted: July 16, 2009