STUDIES CONCERNING SOME ETHOLOGICAL – PHYSIOLOGICAL PECULIARITIES OF THE SPECIES *Mus spicilegus* PETENYI, 1882

LARION Alina

Abstract. In the paper there are analysed the typological peculiarities of central nervous system (CNS) of the individuals that form the population of *Mus spicilegus* species in different seasons. The orientation – exploratory behaviour, the capacity of individuals to support the emotional stress and to adapt toward new conditions were studied; there were emphasized and described the positions, the movement of individuals, registered the frequency of various behavioural elements. It was pointed out that in spring, as well as in autumn the population of *M. spicilegus* is formed by individuals with CNS of three types: strong, medium and week. Most of the individuals are those with medium CNS, those with strong CNS are the less numerous. The proportion of individuals with strong CNS is lower by comparing to individuals with medium CNS. The winter groups are formed by one male with strong type CNS, while the other males have medium and week CNS. There were emphasized changes in the typological ratio of CNS in winter groups and their role in the maintenance of population stability at the beginning of reproductive period in spring. The dynamics of exploratory behaviour provide data about the value and time period of the emotion reaction caused by facing the stress and by adaptation to the new environment. It was revealed that females adapt more quickly to the dynamic conditions of the environment and overpass easier the stress and fear, no matter the CNS type, while among the males only those with strong CNS are more flexible.

Keywords: *Mus spicilegus*, central nervous system type, emotional stress, orientation and exploratory behaviour.

Rezumat. Cercetări privind unele particularităţi etologo-fiziologice ale speciei *Mus spicilegus* PETENYI, 1882. În lucrare sunt analizate particularităţile tipologice ale sistemului nervos central (SNC) al indivizilor care alcătuiesc populaţia speciei *Mus spicilegus* în diferite anotimpuri, prin studierea comportamentului de orientare şi cercetare, capacitatea indivizilor de a înfrunta stresul emoţional şi de a se adapta la noile condiţii. Au fost de asemenea evidenţiate şi descrise pozele, mişcările indivizilor şi s-a înregistrat frecvenţa diferitor elemente de comportament. S-a constatat, că atât primăvara, cât şi toamna populaţia şoarecelui de mişună *M. spicilegus* este alcătuită din indivizi cu SNC de 3 tipuri: puternic, mediu şi slab. Majoritatea indivizilor sunt cei cu SNC de tip mediu, iar cei mai puţini – cei cu SNC de tip puternic. Indivizii cu SNC de tip puternic sunt mai puţin numeroşi decât cei cu SNC de tip mediu. În grupările de iarnă sunt prezenţi câte un mascul dominant cu SNC de tip puternic, ceilalţi masculi au SNC de tip mediu sau slab. Au fost evidenţiate schimbări în raportul tipologic al SNC în grupurile de iarnă şi rolul lor în menţinerea stabilităţii populaţiei la începutul procesului reproductiv, primăvara. Pe baza dinamicii activităţii de cercetare a indivizilor observaţi se pot face evaluări asupra mărimii şi duratei reacţiei emoţionale, cauzată de înfruntarea stării de stres, cât şi despre posibilitatea adaptării lor la mediul înconjurător. Am constatat, că femelele se adaptează mai uşor la condiţiile dinamice ale mediului şi depăşesc mai uşor stresul, frica indiferent de tipul SNC, pe când la masculi, numai cei cu SNC de tip puternic sunt mai flexibili.

Cuvinte cheie: *Mus spicilegus,* tip de sistem nervos central, stres emoţional, activitatea de orientare şi cercetare.

INTRODUCTION

The harvest mouse *Mus spicilegus* PETENYI inhabit agrocoenoses and adapt to various environment conditions, as well as to the factors induced by anthropogenic activity. The behaviour plasticity in mound-building mouse consist in the capacity of individuals to adapt toward dynamic conditions of the environment that can quickly change for short time periods, as well as in modifications in the sphere of social interaction. The study of animal behaviour is in direct connection with the adaptation, which represents an important element of the evolution and is an essential problem of modern biology.

Typological peculiarities of the central nervous system (CNS) of the individuals, forming the population of *M. spicilegus* in different seasons of the year and of the populational cycle, can serve as fundamental criteria of its functional state, its viability and tendencies in number changes. Since the type of CNS is one of the main factors that determine the individual rank in the hierarchic system of the groups, it determines the capacity of the organism to differently react and adapt toward changing environment conditions. At present, it is well known the fact that the CNS type influence upon the individual behaviour (MUNTEANU et al., 1988; LARION, 2003, 2009).

MATERIAL AND METHODS

As study object it was used the mound building mouse *M. spicilegus* PETENYI. To study the qualitative composition of the population, researches on CNS type identification were accomplished after the method of KAMENOV (1973). Each individual was included in the experiment once a day at the same hour. The experiment represents 10 tests with alternation of light and sound with the interval of 1 minute between the tests. The mandatory additional excitant was the alternating electric current of 30 – 40A intensity and was selected for each individual separately. At individuals with strong type of CNS the conditioned reflex to sound and light has formed during 8 days, at those with medium type of CNS – during 14 days and at those with week type of CNS – during 17 days and more. 130 individuals participated at the experiment.

The study of orientation – exploratory behaviour, the capacity of individuals to confront the emotional stress and to adapt to new conditions was carried out by open field method (HALL, 1934). As a whole 229 individuals were

investigated. In view to emphasize and describe the positions and movement of individuals, to register the frequency of various ethological elements the method of couple interaction on neutral territory (male – male; male – female; female – female) (GOLTSMAN et al., 1977) of individuals from the same mound and from different mounds was used. In the experiment, there were included 189 individuals and 371 couple interactions were accomplished between individuals from different mounds and 322 – between individuals of the same mound.

RESULTS AND DISCUSSIONS

During the analysis of *M. spicilegus* population, it was established that among males, as well as among females there are individuals from 3 CNS types, which were characterized as strong, medium, and week. At the beginning of spring the population is formed only by individuals from last generations of the previous year. The determining of typological peculiarities of CNS type allows establishing that in this period the *M. spicilegus* population is formed by the individuals with strong, medium and week CNS types. The most numerous are the individuals with medium CNS type (50%), followed by those with week CNS type (33%) and the least numerous are those with strong CNS type (17%) (Fig. 1). It can be explained by the fact that in mounds it can be present only one dominant individual, which, according to obtained data, have a strong CNS type.

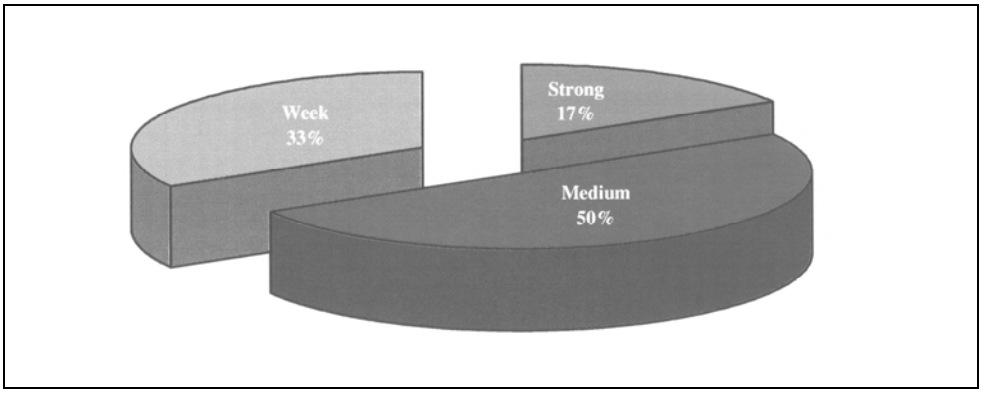

Figure 1. Ratio of CNS types in *M. spicilegus* population in spring.
Figura 1. Raportul tipurilor SNC în populația *M. spicilegus,* primăvara.

According to bibliography data (SHILOV, 1977), the individuals with week CNS type never occupy dominant position in a group hierarchy. Individuals with medium CNS type, which after the CNS type peculiarities are rather similar to those with strong CNS type, are probably under stress in the presence of males with strong CNS type. This fact is explained by the tendency to occupy the dominant position within the group, therefore the males avoid the groups where a male with strong CNS exists. Individuals with medium CNS type often fight for the dominant positions in the group and occupy this position, especially when these individuals have highest body weight (MUNTEANU et al., 1999; LARION, 2003).

Sex structure of *M. spicilegus* populations has seasonal dynamics. At the beginning of spring (depending on climatic conditions), in late autumn and winter, when the reproduction process of individuals ceased the sex ration is 1 : 1, while in reproduction period the female number is higher than that of males 2 : 1 (LARION, 2002). This dynamics of sex ratio is part of the adaptation mechanisms of the population and allows to keep the optimum individual number in the changing environment conditions. By analysing the sex ratio within various CNS types, it was observed that in spring, among individuals with medium and week CNS type the females are more numerous than the males ($p>0.05$) and ($p<0.05$) accordingly. Only among individuals with strong CNS type the males are dominant ($p>0.05$). The majority of the population is formed by females with week CNS type – 64.3%, followed by the females with medium CNS type and the males with strong CNS type – 57.1%. The less numerous are the males with week CNS type – 35.7% (Fig. 2).

According to the obtained data, after the animals have left the mounds, the wintering groups divide and form "families", composed by a male with strong CNS type and 2 – 3 females, which confirm the results obtained by Muntyanu (MUNTEANU, 1990). After the individuals move into the mounds, they do not reproduce anymore. After analysing the mound building mouse populations, it was emphasized that the ratio of CNS types in the population in autumn period is slightly different from that existing in spring period. The most of the individuals have medium CNS type and the least have strong CNS type (Fig. 3).

In autumn, as well as in spring, the females dominate. In October the female number is 1.6 times higher than that of the males and in November the sex ration is already 1 : 1. Analysing the sex ratio within various CNS types, it can be observed that despite of CNS type the females are more numerous than the males and the majority of the males have medium and week CNS type (Fig. 4). Specifically these individuals form the majority of population in autumn, because in this period the grouping of individuals occurs, the mound construction continue and in mounds, as it was mentioned before, only one male is dominant and has strong CNS type. Among individuals with strong CNS type the female number is 2 times higher than that of the males ($p<0.01$).

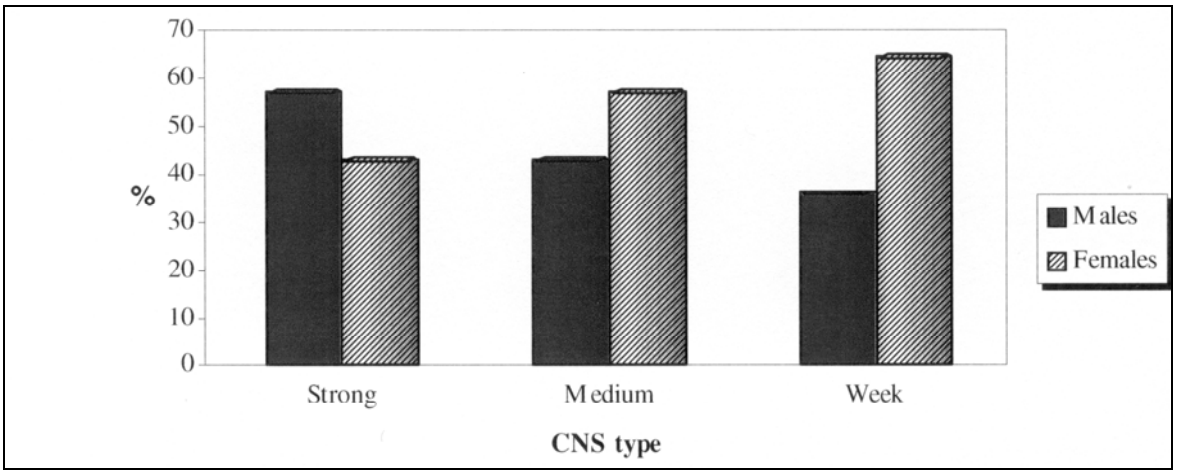

Figure 2. Sex ratio (%) in *M. spicilegus* with different CNS type in spring.
Figura. 2. Raportul de sex la *M. spicilegus* cu tip diferit de SNC, primăvara.

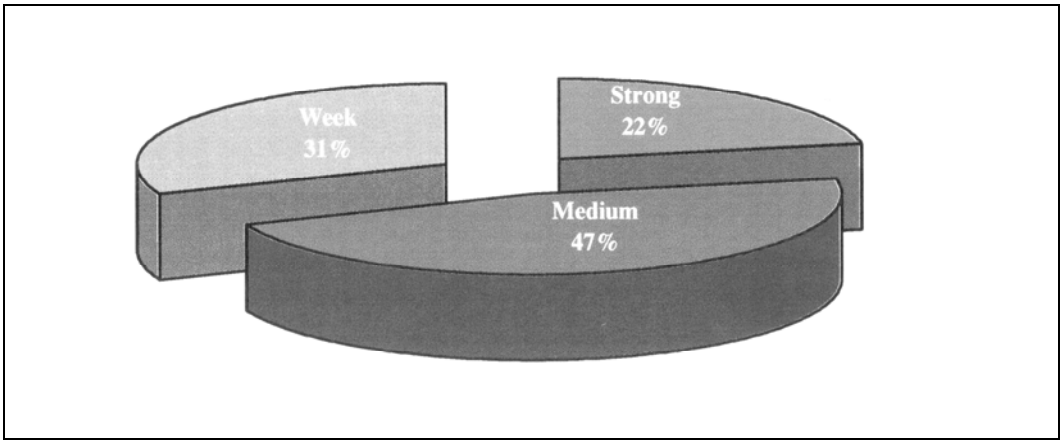

Figure 3. Ratio of CNS types in *M. spicilegus* population in autumn.
Figura 3. Raportul de sex la *M. spicilegus* cu tip diferit de SNC, toamna.

The exploratory and orientation activity is the basis of adaptive behaviour of the animals toward certain environment conditions, which is more distinct in the species with colonial or group way of life. (MUNTEANU & CEMIRTAN, 1997). For the species *M. spicilegus* the adaptation is very important, because they are forced to migrate from one biotope to another after the agrotechnical activities in the fields, which involve the necessity to assimilate new territories. By analysing the individual behaviour in new situations, we tried to emphasize the ethological peculiarities specific for this species. The level of exploration activity is characterized by vertical activity of the individuals in open field test. According to mean values of the vertical activity in *M. spicilegus* species during 15 minutes, the most curious are the males with medium CNS type – 183.56±20.23 and the females with week CNS type – 150.3±15.96 ($p>0.05$). Less curious are the females with strong CNS type – 110.0±24.76. The mean values of the horizontal activity indexes during 15 minutes show that the highest level of horizontal activity have the males with medium CNS type – 382.22±47.3 and the females with strong CNS type – 355.0±36.07. Between males and females with week CNS type the differences of horizontal activity level are insignificant ($p>0.05$): in males – 339.0±26.66, in females – 302.4±23.48. At the beginning of the open field test the horizontal activity can be motivated as exploratory reaction, as well as by the fear towards new conditions, and after the fear disappears, the motoric reaction express only the value of exploratory activity of the individuals. As the interest towards the new environment decreases and the individuals adapt, the decreasing of exploratory activity indexes is registered.

By comparing the level of horizontal, vertical activities and grooming periods, it can be mentioned that the higher level of vertical and horizontal activities, the lower grooming period, and vice-versa. At the individuals with medium CNS type it was observed that the level of vertical and horizontal activities is higher in males, thus the grooming period is shorter. On the contrary, to the females the level of vertical and horizontal activities is lower and the grooming period is longer. According to the obtained data the females of *M. spicilegus* species are easier adapting to the dynamic conditions of the environment and they faster surpassed the stress regardless of CNS type, while among males only the individuals with strong CNS type are more flexible.

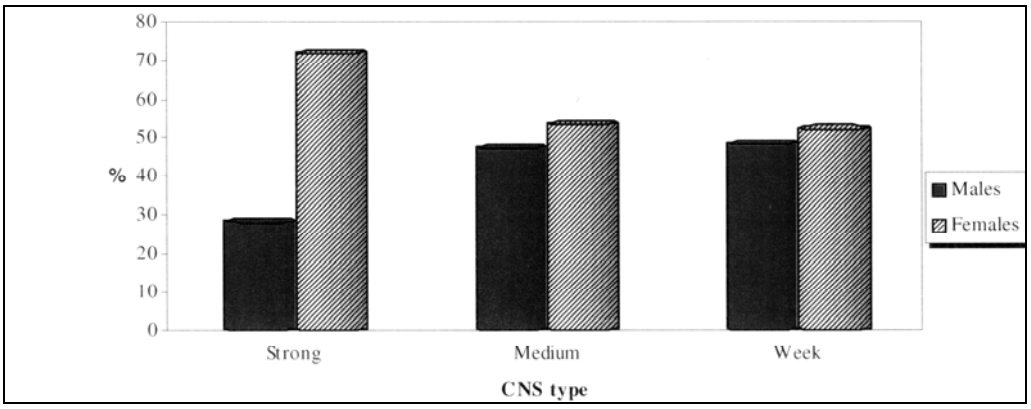

Figure 4. Sex ratio (%) in *M. spicilegus* with different CNS type in autumn.
Figura 4. Raportul de sex (%) la *M. spicilegus* cu tip diferit de SNC, toamna.

CONCLUSIONS

The determination of typological peculiarities of CNS type allows us to establish that in spring as well as in autumn in *M. spicilegus* population there are present individuals with strong, medium and week CNS types. In the population the individuals with medium CNS type dominate (47% - 50%), followed by those with week CNS type (31% - 33%) and by those with strong CNS type (17% - 22%). The exploratory activity is higher at the males with medium CNS type. In individuals with medium and strong CNS type the level of vertical activity is higher in males than in females, while in those with week CNS type the level of vertical activity is lower in males than in females ($p>0.05$). By comparing the level of horizontal, vertical activities and grooming periods, it can be mentioned that the higher level of vertical and horizontal activities, the lower grooming period, and vice-versa. Therefore, according to the dynamics of motoric activity it can be revealed the value and time period of emotional reaction caused by facing stress, as well as by the adaptation to the new environment.

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Larion Alina
Institute of Zoology of ASM
Str. Academiei 1, Chisinau, MD-2028.
E-mail: larion_alina@yahoo.com

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