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AGE STRUCTURE OF YELLOW-NECKED MOUSE (*APODEMUS FLAVICOLLIS* MELCHIOR, 1834) IN TWO SAMPLES OBTAINED FROM LIVE TRAPS AND OWL PELLETS

OLIVERA VUKIĆEVIĆ-RADIĆ, TATJANA B. JOVANOVIĆ, RADA MATIĆ and D. KATARANOVSKI

Siniša Stanković Institute for Biological Research, Ecology Department,
Bulevar Despota Stefana 142, 11000 Belgrade, Serbia and Montenegro

Abstract - The age structure of yellow-necked mouse (*Apodemus flavicollis* Melchior, 1834) has been analyzed in individuals obtained by two methods: trapping with Sherman live traps and obtainment of skulls from long-eared owl (*Asio otus* Linnaeus, 1758) pellets (predator diet analysis). One hundred and forty-four mice were analyzed for the degree of wear of the surface of molar crowns, and an additional 74 measurements were performed on captive-born *Apodemus flavicollis* individuals. We used a refined model of comparison that included seven classes of mouse age, rather than four classes, as suggested by other authors.

Key words: *Apodemus flavicollis*, *Asio otus*, age structure, molar, diet, prey, Serbia

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Sampling methods for small mammals are various, and each of them has its drawbacks (Chelowska, 1967; Anderson, 1976; Andrews, 1990). Combined techniques give the best results in investigating the small mammal fauna in a region under study. Analysis of the diet of the long-eared owl (*Asio otus* Linnaeus, 1758) reveals many data of great interest for investigation of the small mammal fauna (Mikkola, 1983; König *et al.* 1999; Jovanović, 2002). The number of prey items taken by owls exceeds that obtained by any trapping method yielding the same results, and predator diet analysis does not harm the micromammalian community of the investigated region. On the other hand, small mammal remains obtained from pellets lack many valuable features that can be obtained using trapping methods. In the present article, we compare these two techniques of obtaining and recording yellow-necked mouse individuals in studied areas to gain a better understanding of the predator-prey relationship and to find out if the data are valid in cases where pellet analysis was used as the screening method to estimate population structure in a given habitat (Jovanović, 2002).

Trapped yellow-necked mouse individuals were obtained during research on *Apodemus flavicollis* and *Apodemus agrarius* population ecology in an *Orno-Quercetum petraeae* (Bor, 1955). Mišić, 1972 forest community on Mt. Avala performed as the main task of a PhD thesis in the period November 1996 - October 1999 (Vukićević, 2002). Baits used in Sherman traps were made with a mixture of fried bacon, onion, and bread, and the study plot was 1 ha, with 100 traps in each 10-m^2 square. In addition to this, 12 pairs of yellow-necked mouse were successfully bred in captivity, producing one to three broods with three to five cubs each (Vukićević *et al.* 2004). At intervals of 20 days one animal was sacrificed in order to compare it with animals taken from their habitat for determination of age structure of the population.

The pellets that provided us with *Apodemus flavicollis* skulls for this investigation were collected in March of 2003 at the long-eared owl communal roosting site at the Čukarica locality in Belgrade (Jovanović *et al.* 2003). Identification of prey remains from pellets was carried out following criteria established by to Schmidt (1967), Niethamer and Krap (1978, 1980), März (1987), and Turni (1999). The most valid were cranial elements such as maxillary tooth rows and mandibles. Most of the prey items were identified to the species level. Problems were encountered in identifying remains of species of the subgenus *Sylvaemus*:

Apodemus sylvaticus (Linnaeus, 1758) and *A. flavicollis* (Melchior, 1834) remains were difficult to distinguish in some cases (Ruprecht, 1979). None of those remains had a preserved intact skull, making it impossible to perform measurements of the neurocranium that could be useful for identification and further analysis. Rodent species undergo different damage during digestion in the owl's stomach. Due to the rather large number of identified prey items (36970; Jovanović, 2002), mice are rarely preserved with intact skulls, and this is true even in the case of insufficiently digested prey. For the present work, we used 66 *Apodemus flavicollis* maxillaries that were determined with certainty as such. The most precise method for estimation of a rodent's age is the one based on changes in lens weight (Kataranovski *et al.* 1999). However, this method is impossible to use on prey remains derived from owl pellets, so only the molar wear method was used for age estimation of individuals.

Yellow-necked mouse age was determined from the degree of wear of the surface of molar crowns according to an improved version of the method suggested by Adamczevska-Andrzejewska (1967). The original method suggested by her included four classes of molar age: up to one month (I), 2-5 months (II), 5-9 months (III) and more than 9 months of age (class IV). This method allows biases that are a result of individual feeding habits and other environmental factors (Adamczewska, 1959). Since we had captive individuals for comparison, we used seven classes to provide a more refined picture of age structure. Table 1 presents the range of values for body length, tail length, and body mass as clarifies for seven age classes of measured individuals. Those classes had distinctive molar wear patterns that we used for further determination of age classes in material obtained from pellets. However, in this comparison, we have to take into account that tooth wear depends on what kind of food was available to the mice we examined. It has been suggested that food in the natural habitat causes rather more extensive tooth wear than when food is supplied in the form of brickets for captive animals in the laboratory (Andrzejewski and Liro, 1977). The yellow-necked mice we bred in laboratory conditions were fed *ad libitum* with food as similar as possible to what would be found in their natural habitat, which included: oak acorns; wheat, oat, barley and sunflower seeds; and *Carabus* insects occasionally (Vukićević *et al.* 2004).

Table 1. Measurements performed on captive yellow-necked mouse individuals: age in days, HBL - body length (mm), TL - tail length (mm), BW - body weight (g).

Days	HBL (mm)	TL (mm)	BW (g)	Class
14 - 37	40 - 80	20 - 81	2 - 14	I
42 - 57	75 - 87	72 - 97	12 - 22	II
64 - 80	89 - 95	89 - 100	19 - 26	III
132 - 144	95 - 102	91 - 102	25.5 - 28.5	IV
164 - 194	98 - 106	97 - 108	23.5 - 34	V
209 - 260	98 - 115	97 - 113	22 - 35	VI
289 - 620	98 - 120	100 - 116	21 - 40	VII

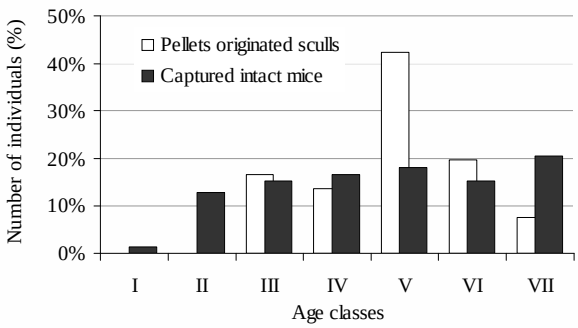

Fig. 1. Distribution of *Apodemus flavicollis* individuals in two samples sorted according to molar wear-defined age classes.

As Fig. 1 indicates, age classes I and II were not found in pellet residues, whereas they were present among captured specimens. One of the reasons for their absence in pellets certainly is the rather tender bone structure of mouse skulls in general, at least compared to other rodents, such as voles (Andrews, 1990; Jovanović, 2002). Thus it often happens that after a subadult mouse has been eaten, it is impossible to recover its residues from the pellets even in experimental laboratory conditions. On the other hand, traps were spread out rather densely, around active holes of yellow-necked mouse on the studied plot, making probable the capture of a wide age range of individuals.

The most abundant age class in pellets is V, *i.e.*, with estimated age in the range of 164-194 days. Skulls extracted from pellet residues reflect the most active age of *Apodemus flavicollis* in wild populations (Vukićević, 2002). The difference in percentage of

each class in trapped animals is also a result of the fact that those animals were not taken at random (Jensen, 1975), as they would be by a predator (Jedrzejewski *et al.* 1993), and some were found dead in traps for unknown reasons. The most dead mice were found in 1997 (54 individuals) throughout the year, even though there were two peaks: in March and September (17 and 10, respectively). In 1996 there were 18 mice found dead in traps, while in 1998 there were only six (Vukićević, 2002). In the light of these facts, we can conclude that the two methods of obtaining insight into yellow-necked mouse populations are consistent with each other. We therefore suggest that pellet analysis be used as a screening method to obtain data on the possible presence of rodents, in this case *Apodemus flavicollis*, before any serious population study is set in an area needing to be examined. Pellet studies may also provide valuable resource data that can reveal new records of scientific interest (Petrov, 1992; Jovanović *et al.* 2001).

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УЗРАСНА СТРУКТУРА *APODEMUS FLAVICOLLIS* (MELCHIOR, 1834) ИЗ ДВА УЗОРКА ИЗ КЛОПКИ И СОВИНИХ ГВАЛИЦА

ОЛИВЕРА ВУКИЋЕВИЋ, ТАТЈАНА Б. РАДИЋ, РАДА МАТИЋ и Д. КАТАРАНОВСКИ

Институт за биолошка истраживања "Синиша Станковић", Булевар деспота Стефана 142, *11000 Београд*, Србија и Црна Гора

Узрасна структура *Apodemus flavicollis* (Melchior, 1834) анализирана је на узорку прибављеном применом две методе: изловљавањем Шермановим клопкама и прикупљањем лобања мишева из гвалица сове *Asio otus* Linnaeus. Код укупно 144 јединке студиран је степен израбљености моларних круница; извршена су и 74 додатна мерења код јединки гајених у лабораторијским условима. Током истраживања коришћен је редефинисани модел комбинације седам узрасних класа мишева (а не четири, како су раније сугерисали поједини стручњаци).