



ГОДИНИ
МАКЕДОНСКО
ЕКОЛОШКО ДРУШТВО
YEARS
MACEDONIAN
ECOLOGICAL SOCIETY

**6th CONGRESS OF ECOLOGISTS
OF THE REPUBLIC OF NORTH MACEDONIA,
WITH INTERNATIONAL PARTICIPATION**

ABSTRACT BOOK

October 15th-18th 2022, Ohrid

Publisher:

Macedonian Ecological Society
Blvd. Boris Trajkovski, street 7, No 9A, 1000 Skopje,
North Macedonia

Citation:

Abstract book, 6th Congress of Ecologists of the Republic of North Macedonia,
with International Participation.
October 15th-18th 2022, Ohrid,
Macedonian Ecological Society, Skopje, 2022

Editor:

Metodija Velevski

Printed by:

Grafoden, Skopje

Printing run:

250 copies

CIP – Каталогизација во публикација

Национална и универзитетска библиотека "Св. Климент Охридски", Скопје

502/504(062)(048.3)

CONGRESS of ecologists of the Republic of Macedonia with international participation (6 ; 2022 ;
Ohrid)

Abstract book / 6th Congress of ecologists of the Republic of North Macedonia, with
international participation, October 15th-18th 2022, Ohrid ; [editor Metodija Velevski]. - Skopje :
Macedonian Ecological Society, 2022. - 236 стр. ; 25 см

Регистар

ISBN 978-9989-648-44-1

а) Екологија -- Собири -- Апстрактни

COBISS.MK-ID 58348293

The effects of urban habitats on morphological variations of a skull in populations of yellow-necked mice *Apodemus flavicollis*

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The global process of urbanization largely affects the natural environment and its wildlife. The main effects of that process are the fragmentation of habitats and their mutual isolation. Urban infrastructure surrounds preserved forest areas in the cities and prevents the migration of small mammals between them. Yellow-necked mice *Apodemus flavicollis* is a widespread species in Palearctic forests. Due to extensive urbanization processes in Belgrade city, we wanted to explore its effects on morphometric variation using skulls of this species as convenient objects. We chose two urban and two natural forest populations. One of the chosen locations in Belgrade has been isolated for a long time, while the highway relatively recently separated the other. The main goal of this study was to understand how habitat alteration influence populations of *A. flavicollis* by determining differences in morphological variation among studied populations. A total of 95 skulls of *A. flavicollis* adult and subadult animals were analysed from four locations in Serbia, two urban (Košutnjak 29; Stepin gaj 22) and two natural (Avala 30; Senokos 15). Animals were collected from 2015 to 2020, sacrificed, and their skulls were cleaned using dermestid beetles. Images of the mandibles and skulls, together with the scale in millimeters, were obtained with a digital camera. We digitized 14 mandible and 30 cranium landmarks using tpsDig software. The size (Centroid size) and shape (Procrustes distances) variations of the left mandibles and cranium's ventral side were compared between populations and sexes using landmark-based geometric morphometry in MorphoJ software. Skull and mandible shape variations differed significantly among the central urban population on Košutnjak and the other three analyzed populations and between the population of Stepin gaj and the most distant location from Belgrade, Senokos. The same pattern of variations between analyzed populations was observed for the mandible and the cranium regarding the size. Differences between sexes were not observed in terms of locations or the size of the mandible and cranium. Two natural populations did not morphologically differ from each other. Obtained results indicate that the urban populations of *A. flavicollis* are morphologically affected by urbanization. The urban environment produces a decrease in migration rate between forest patches and thus decreases gene flow. In theory, small populations, highly isolated, are becoming exposed to the strong effect of genetic drift. The most isolated population from Košutnjak shows limited phenotypic variability, otherwise characteristic of the island population. The other urban population, Stepin gaj differs from the closely located Košutnjak but not from the natural population from Avala, which is also closely located but relatively recently separated by highway and regional roads. Using landmark-based geometric morphometry, we obtained that natural and urban (Belgrade) populations of yellow-necked mouse *A. flavicollis* are divergent in skull traits. We suggest that phenotypic divergence is associated with human activity that leads to the isolation of natural habitats and their conversion into urban forests.

Key words: *Apodemus flavicollis*, skull, morphometry, urban environment