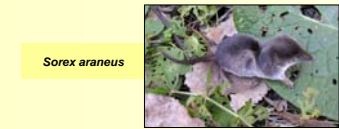
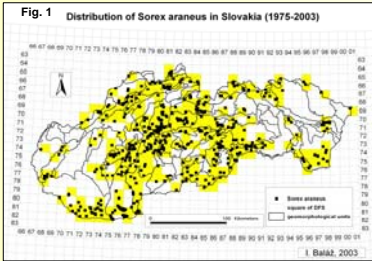


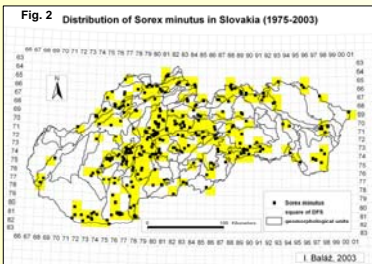
EXPANSION OF SORICIDAE IN SLOVAKIA AND THEIR DEPENDENCY ON ALTITUDE GRADIENT

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Sorex araneus



Sorex minutus

SYNUSIAS OF SMALL TERRESTRIAL MAMMALS

Lowland level (P-1) – in synusias of small terrestrial mammals we approved 16 species: *A. agrarius*, *A. flavicollis*, *A. microps*, *A. sylvaticus*, *Ar. terrestris*, *C. glareolus*, *C. leucodon*, *C. suaveolens*, *M. minutus*, *M. arvalis*, *M. oeconomus*, *N. anomalus*, *N. fodiens*, *P. subterraneus*, *S. araneus*, *S. minutus*. In lowland level, the mean dominance of species Soricidae in synusias was 22.5%.

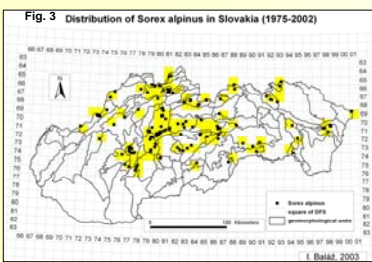
Hillock level (K-2) – in synusias of small terrestrial mammals were detected 16 species: *A. agrarius*, *A. flavicollis*, *A. microps*, *A. sylvaticus*, *Ar. terrestris*, *C. glareolus*, *C. leucodon*, *C. suaveolens*, *M. minutus*, *M. arvalis*, *N. anomalus*, *N. fodiens*, *P. subterraneus*, *S. alpinus*, *S. araneus* a *S. minutus*. In hillock level was the mean dominance of species Soricidae in synusias 24.6%.

Submountainous level (SM-3) – in synusias of small terrestrial mammals were ascertained 18 species: *A. agrarius*, *A. flavicollis*, *A. microps*, *A. sylvaticus*, *Ar. terrestris*, *C. glareolus*, *C. leucodon*, *C. suaveolens*, *M. minutus*, *M. arvalis*, *M. oeconomus*, *N. anomalus*, *N. fodiens*, *P. subterraneus*, *P. taticus*, *S. alpinus*, *S. araneus*, *S. minutus*. In submountainous level the mean dominance of species Soricidae in synusias was 28.8%.

Mountainous level (M-4) – in synusias of small terrestrial mammals were approved 17 species: *A. agrarius*, *A. flavicollis*, *A. microps*, *A. sylvaticus*, *Ar. terrestris*, *C. glareolus*, *M. minutus*, *M. arvalis*, *M. oeconomus*, *N. anomalus*, *N. fodiens*, *P. subterraneus*, *P. taticus*, *S. betulina*, *S. alpinus*, *S. araneus*, *S. minutus*. In mountainous level, the mean dominance of species Soricidae in synusias was 27.1%.

Oreal level (O-5) – in synusias of small terrestrial mammals were ascertained 18 species: *A. agrarius*, *A. flavicollis*, *A. microps*, *A. sylvaticus*, *Ar. terrestris*, *C. glareolus*, *M. minutus*, *M. arvalis*, *M. oeconomus*, *N. anomalus*, *N. fodiens*, *P. subterraneus*, *P. taticus*, *S. betulina*, *S. alpinus*, *S. araneus*, *S. minutus*. In orreal level was the mean dominance of species Soricidae in synusias 35.4%.

Subalpine level (SA-6) – in synusias of small terrestrial mammals were approved 12 species: *A. flavicollis*, *Ar. terrestris*, *C. glareolus*, *M. arvalis*, *M. nivalis*, *P. subterraneus*, *P. taticus*, *S. betulina*, *S. alpinus*, *S. araneus*, *S. minutus*. In subalpine level, the mean dominance of species Soricidae in synusias was 24.2%.



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INTRODUCTION

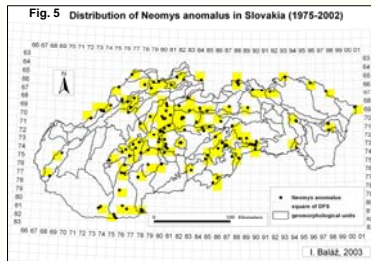
In Slovakia, family Soricidae is represented by species: common shrew – *Sorex araneus* Linnaeus, 1758; pigmy shrew - *Sorex minutus* Linnaeus, 1766; alpine shrew – *Sorex alpinus* Schinz, 1837; water shrew – *Neomys fodiens* (Pennant, 1771); Miller's water shrew – *Neomys anomalus* Cabrera, 1907; bi-coloured white-toothed shrew – *Crocicidura leucodon* (Hermann, 1780) and lesser white-toothed shrew – *Crocicidura suaveolens* (Pallas, 1811).

Occurrence of species in accordance with altitude gradient allow us to find out preferred altitude levels. Expansion of species, vertically or horizontally, can not be taken strictly only according to the altitude or latitude, but more important is vegetation belt conditioned by local attributes of substratum and climate.

Synusias are similar communities of organisms belonging among the same living forms, that settle uniform part of space and mostly have similar functions (Losos et al. 1984). Term synusia is used by zoologists in the meaning of taxocenosis, i.e. population of certain taxonomic unite.



Neomys anomalus



OCCURRENCE OF SPECIES SORICIDAE IN SLOVAKIA

We confirmed occurrence of *Sorex araneus* on 532 localities of Slovakia in 208 squares of DFS (49.3%) and in 77 geomorphological unites, from 100 up to 1800 m a. s. l. (fig.1).

Sorex minutus was found out on 318 localities, from 100 up to 1450 m a. s. l. Pigmy shrew was confirmed on 157 squares of DFS (37.2%) and on 70 geomorphological unites (fig.2).

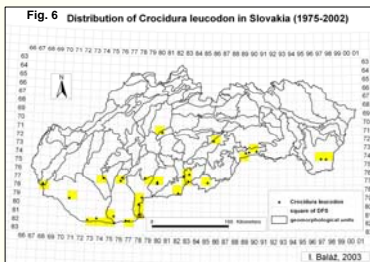
Sorex alpinus was trapped on 128 localities of Slovakia, from 350 up to 1750 m a. s. l. Occurrence of alpine shrew was proved on 77 squares of DFS (18.2%) and on 41 geomorphological unites (fig.3).

Occurrence of *Neomys fodiens* is confirmed on 200 localities, on 105 squares of DFS and on 55 geomorphological unites, from 110 up to 1700 m a. s. l. (fig.4).

Neomys anomalus was found out on 153 localities, on 94 squares of DFS and on 57 geomorphological unites, from 110 up to 1100 m a. s. l. (fig.5).

Occurrence of *Crocicidura leucodon* is confirmed on 32 localities of Slovakia, on 24 squares of DFS and on 15 geomorphological unites, from 100 up to 550 m a. s. l. (fig.6).

Crocicidura suaveolens is confirmed on 36 localities, on 27 squares of DFS and on 23 geomorphological unites, from 100 up to 650 m a. s. l. (fig.7).



WESTERN CARPATHIAN MTS. EXPANSION OF SORICIDAE IN DEPENDENCY ON ALTITUDE GRADIENT

Species *Sorex araneus* and *Sorex minutus* as the euryvalent species are occurred in all 6 hypsographic levels. Using RDA analysis, we found the lowest dependency on altitude by *Sorex minutus*. *Sorex araneus* prefers lowlands and *Sorex minutus* valleys (fig.8).

Sorex alpinus does not appear in lowland level, slightly abundance is in hillock level and from submountainous level is its occurrence common. Using RDA analysis we found, that expansion of *Sorex alpinus* depends on altitude, its abundance is increasing with growing altitude (fig.8).

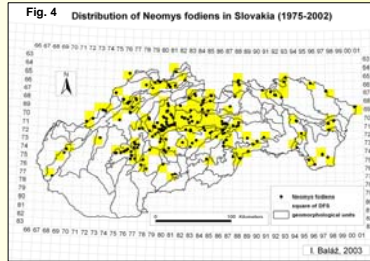
Neomys anomalus appears from 110 up to 1100 m a. s. l. (from lowland to orreal level), RDA analysis confirmed juncture to hillock and submountainous level (fig.8).

Neomys fodiens appears from 110 up to 1700 m a. s. l. (so in all altitude levels) with maximum on mountainous level (as *Sorex alpinus*, fig.8).

Crocicidura suaveolens was found from 100 up to 650 m a. s. l. (from lowland to submountainous level). By RDA analysis prefers hillock level (fig.8). ANDĚRA & HURKA (1984) mention expansion of *Crocicidura suaveolens* from 100 up to 1603 m a. s. l., with maximum finds from 100 up to 600 m a. s. l.

Hypsographic validity of *Crocicidura leucodon* is from 100 up to 550 m a. s. l. (from lowland to submountainous level), using RDA analysis, *Crocicidura leucodon* prefers lowland (fig.8). ANDĚRA & HURKA (1984) mention hypsographic range from 99 up to 1100, with maximum finds to 400 m a. s. l.

Differences between our results and results of authors (ANDĚRA & HURKA 1984) can be followed by relatively insufficient material. State of expansion natural range and hypsographic range of both species requires receiving of further faunistic information.



Neomys fodiens

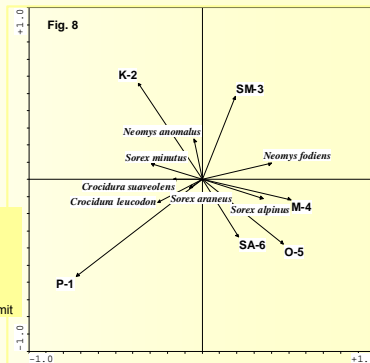
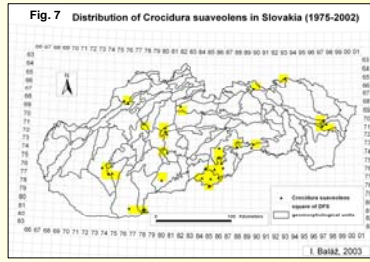
MATERIAL AND METHODS

Evaluated data relate to a collection of 8045 specimens of shrews (*S. araneus* – 5763 ex., *S. minutus* – 1898 ex. and *S. alpinus* – 384 ex.), 1131 specimens of water shrews (*N. fodiens* – 748 ex., *N. anomalus* – 383 ex.) and 147 specimens of white-toothed shrews (*C. leucodon* – 79 ex., *C. suaveolens* – 68 ex.).

Evaluated material comes from 77 geomorphological unites of Western Carpathian Mts. and 288 squares of Fauna Databank of Slovakia (DFS). Specimens of Soricidae were obtained during terrain trapping in the period of years 1974-2003. Majority of the material (89%) were collected by the staff of the Research station Starý hory, the Institute of experimental biology and ecology of the Slovak Academy of Science (SAS) in the years 1974-1996. Results of species expansion are evaluated according to mapping squares of standard mapping net of the DFS in relation to geomorphological units of Slovakia.

Representation of the Soricidae in synusias were evaluated in 6 hypsographic levels according to MAZUR (1980): lowland (P-1, to 200 m a. s. l.), hillock (K-2, 200 – 400 m a. s. l.), submountainous (SM-3, 400 – 600 m a. s. l.), mountainous (M-4, 600 – 900 m a. s. l.), orreal (O-5, 900 – 1200 m a. s. l.), subalpine (SA-6, 1200 m a. s. l. – upper forest limit). Synusias of small terrestrial mammals were formed by 21 species: *Apodemus agrarius*, *A. flavicollis*, *A. microps*, *A. sylvaticus*, *Arvicola terrestris*, *Clethrionomys glareolus*, *Crocicidura leucodon*, *C. suaveolens*, *Micromys minutus*, *Microtus nivalis*, *M. agrestis*, *M. arvalis*, *M. oeconomus*, *Neomys anomalus*, *N. fodiens*, *Pitymys subterraneus*, *P. taticus*, *Sicista betulina*, *Sorex alpinus*, *S. araneus*, *S. minutus*.

In the CANOCO programme (TER BRAAK & ŠMILAUER 1998), using direct linear analysis RDA (redundancy analysis) we ordinated species, localities and hypsographic levels (environmental variable). We discovered preferred hypsographic levels of Soricidae.



SUMMARY

Synusias of small terrestrial mammals, in which Soricidae comprise certain qualitative and quantitative part, are composed from 21 species (in lowland level we approved 16, in hillock level 16 species, in submountainous level 18, in mountainous level 17, in orreal level 18 and in subalpine 12 species).

Genus *Sorex* is present in all hypsographic levels. *Sorex araneus* has the major representation in lowland synusias (38.1%) and minor in hillock level (24.2%), it prefers lowlands. *Sorex minutus* takes the major portion in lowland quarry (31.3%) and minor in mountain level (18.6%), despite of its correlation towards hillock level. *Sorex alpinus* is up from submountainous level, on suitable biotopes, a common species. Its presence correlates with increasing altitude and its mean dominance in a quarry is from 9% (in subalpine level) to 17.2% (in orreal level).

Neomys anomalus appears from lowland to orreal level, but prefers hillock up to submountainous level. *Neomys fodiens* was ascertained in all hypsographic levels, correlating to mountain level.

Crocicidura suaveolens was detected from lowland up to submountainous and partially up to mountainous level, prefers hillock level. *Crocicidura leucodon* was approved from lowland up to submountainous level with preference to lowland level.

Some results and advances were arisen within the VEGA-project 1/127/04.