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THE STRUCTURE OF SMALL MAMMAL COMMUNITIES IN SOME ALPINE HABITATS

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ABSTRACT - We studied the composition of several small mammal communities living in different mountain and forest habitats of the central eastern Italian Alps. The small mammals were then grouped together, by cluster analysis, according to similarities in species and density. From the 22 stations investigated, five groups emerged, each one having also distinct environmental characteristics. We observed that spruce forest communities are grouped separately from those of mixed forests (larch and Swiss stone pine). We must stress the considerable difference existing between the small mammal communities living in different kinds of coniferous forests. The larch and Swiss stone pine forest seem to be able to support a greater density of small mammals, which includes in particular the bank vole (*Clethrionomys glareolus*).

Key *words*: Small mammals. community analysis, cluster analysis, *Clethrionomys glareolus*.

INTRODUCTION

Small mammals play an important part in maintaining the balance of mountain ecosystems and their impact can be quite important (just consider, for example. their influence upon other forms of animal life, especially predators, and seed exploitation). In order to manage the forest ecosystem appropriately. it is very important discover more about the structure and dynamics of small mammal communities.

In this research we tried to identify the composition of different small mammal communities which live in mountain habitats and the differences between them.

MATERIAL AND METHODS

The study was conducted in 1993 in the Cadino Forest. This is a prevalently wooded area of 2000 hectares with an altitude which ranges between 900 m to 2200 m above sea level. It can be found on the left side of the Cadino Valley (central-eastern Alps; coord. UTM 32TPS 84-87 18-22) and is east facing. The most common habitat is spruce (*Picea abies*) forest, which is sometimes mixed with larch (*Larix decidua*). At the timberline the larch and Swiss stone pine (*Pinus cembra*) prevail, while at lower levels, along the Cadino stream, the broadleaved trees (*Sorbus aucuparia, Acer pseudoplatanus, Populus tremula, Betula pendula, Alnus incana*) are more common. Higher up. above the timberline, an alpine meadow can be found. There is scree at the top near the crests, and also in wide clearings inside the forests.

The investigation was carried out by setting up traps in 22 stations (Table 1) that were representative of the many different environmental situations found inside the Cadino Forest.

Thirty snap traps were set up in selected positions in each station, covering an area of approximately 100 m^2. The traps were left on site for three consecutive nights and were checked daily. Fat and "Nutella" (a chocolate cream) were used as bait. Each station

Table 1. Description of the trapping stations. The stations have been listed according to the groups in figure 1.

GROUP 1:

St. 5	Rocky rubble above the tree line with almost no vegetation cover. There are only a few lichens (*Alectoria ochroleuca*) and mosses, and rare shrubs of *Vaccinium uliginosum, Arctostaphylos uva ursi* and *Loiseleuria procumbens*; 2025 m.
St.16	Rocky rubble above the tree line, bordering on moorland, with the presence of *Vaccinum myrtillus*, *V.uliginosus*, *Arctostaphylos uva ursi*, *Juniperus communis*, *Loiseleuria procumbens*, *Rododendron ferrugineum*, *Alectoria ochroleuca*; 2100 m.
St.17	Alpine grassland on stony slope (*Calamagrostis villosa* and *Deschampsia cespitosa*); other species are *Gentiana punctata, Aconitum nepellus, Rododendron ferrugineum, Luzula* spp.; 2125 m.
St.22	Landslide rocky rubble in a spruce forest with an undergrowth of *Sorbus aucuparia, Alnus incana, Salix caprea, Lonicera xilosteum, Sambucus racemosa, Rubus idarus, Rosa pendulina*; grassy layer of *Luzula* spp. and *Oxalis acetosella*; 1550 m.
St.7	Pre-thicket stage of spruce forest with thick grassy undergrowth of *Calamagrostis villosa* and *Deschampsia cespitosa*; rare shrubs of *Betula alba. Lonicera xilosteum* and *Rosa pendulina*; 1600 m.

GROUP 2:

St. 11	Spruce forest with larch; scarce undergrowth with *Vaccinium myrtillus, Rododendron ferrugineum, Lycopodium* **sp.;** 1650 m.
St. 18	Young spruce forest with rare trees of *Sorbus aucuparia* and *Betula alba*; the undergrowth, rather scarce, consists of *Oxalis ncetosella, Vaccinium myrtillus, Solidago virgaurea* and a moss layer; 1600 m.
St. 21	Spruce forest at the bottom of the valley with some rare shrubs of *Corylus avellana. Sorbus aucuparia, Lonicera xilosteum*; *Oxalis acetosella*; Y7S m.

GROUP 3:

St. 2	Grassy glades of *Deschampsia cespitosa*, *Calamagrostis villosa, Veratrum album, Gentiana punctata, Rumex alpinus* on turfy soil at the edges of a larch-Swiss stone pine forest, with bushes of *Juniperus coniniunis. Rododendron ferrugineum, Vaccinium myrtillus* and *Vaccinium uliginosum*; 1850 m.
St. 3	Low peat bogs at the edges of a larch-Swiss stone pine forest with *Deschampsia cespitosa, Eriophorum scheuchzeri, Veratrum album, Pseudorchis albida*; 1850 m.
St. 8	Widespread glades originating from a cutting of spruce forest: rich grassy undergrowth of *Calamagrostis villosa* and *Deschampsia cespitosa* with a few shrubs (*Rododendron ferrugineum, Vaccinium myrtillus* and *Juniperus communis)*; 1700 m.
St. 14	Peat bog with *Carex* **spp.,** *Tofieldia calyculata*, *Tofielda pusilla* with *Parnassia palustris, Veratrum album, Gentiana punctata, Rumex alpinus*; 1950 m.

GROUP 4:

St. 9 Woody areas of *Alnus incana* near a stream with undergrowth of *Urtica dioica, Adenostyles alliarie, Deschampsia cespitosa, Peucedaneum ostruthium;* 1700 m.

St. 10 Stream in a forest of spruce, larch, and Swiss stone pine, with *Sorhus aucuparia* and *Alnus incana;* rare undergrowth of *Vaccinium myrtillus* and *Adenostyles alliarie;* 1650 m.

St. 19 Stream in a mixed forest on the bottom of the valley, dominated by *Alnus incana;* undergrowth of *Adenostyles alliarie, Lonicera xilosteum, Peucedaneum ostruthium: 1350* m.

GROUP 5:

St. 1 Mixed spruce, larch and Swiss stone pine forest with thick grassy layer of *Adenostyles alliarie*: 1800 m.

St. 4 Spruce, larch and Swiss stone pine forest with a shrubby undergrowth of *Rododendron ferrugineum, Vaccinium myrtillus, Juniperus communis, Deschampsia cespitosa* and *Calamagrostis villosa*: 1900 m.

St. 6 Mixed forest of spruce, larch and Swiss stone pine with good vegetation cover (*Adenostyles alliarie, Epilobium angustifolium, Senecio fuchsii, Solidago virgaurea, Rubus idaeus, Aconitum paniculatus, Peucedaneus ostruthium. Deschampsia cespitosa, Calamagrostis villosa*); 1875 m.

St. 15 *Rododendron ferrugineum* shrubs at the edge of a forest of larch and Swiss stone pine, with *Vaccinium myrtillus, Vaccinium uliginosum, Juniperus communis*: 2000 m.

NON GROUPED STATIONS:

St. 13 Mature forest of spruce with scarce undergrowth of *Vaccinium myrtillus, Gymnocarpium dryopteris, Oxalis acetosella* and *Lonicera xilosteum*; 1425 m.

St. 20 Stream in a mixed forest at the bottom of the valley, with *Alnus incana, Salix caprea, Sorbus aucuparia*; undergrowth of *Adenostyles alliarie, Rubus idaeus* and *Lonicera xilosteum*; 1225 m.

St. 12 Mixed forest of spruce and broadleaved trees (*Corylus avellana, Alnus incana, Sambucus racemosa, Sorbus aucuparia, Betula alba, Populus tremula, Salix caprea*); 97.5 m.

was monitored for three different periods: the second half of June, August and October. The total trapping time was 5940 trapping nights (n° traps x n° nights). Unfortunately the length of the field work was quite short and could have therefore partially compromised the overall results.

The specimens were measured and their sex, reproductive state and presence of parasites were registered. They were then immediately prepared according to the method used by the British Museum (Clevedon et al., 1977) and are now kept in the Natural Science Museum of Trento.

The similarity of the small mammal communities in the several trapping stations were checked by using classification techniques. This method is based on mathematical mod-

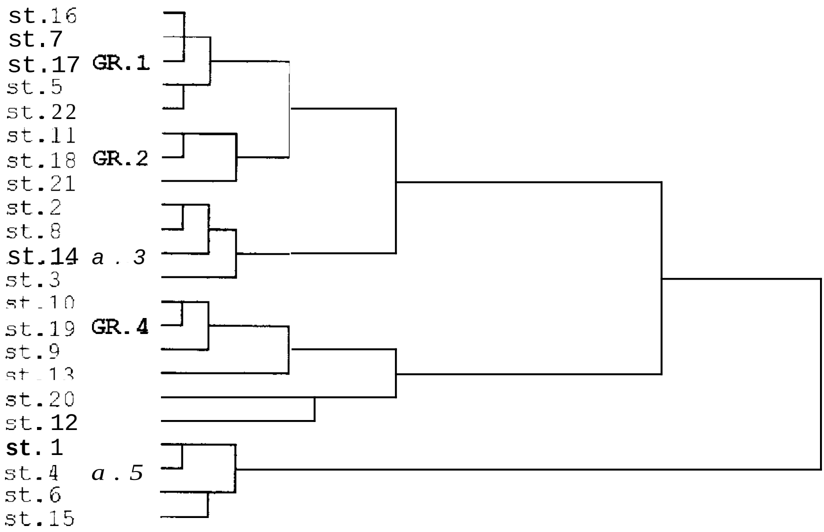

Figure I. Aggregation of small mammal communities from cluster analysis (Ward's method).

els which place communities in a diagram, whereby those most similar to each other, both in terms of the species presence and abundance. are closer to each other. Communities that differ considerably in the relative importance of an overall group of similar species. or that have totally different species, are wide apart (Begon et al., 1989). To determine aggregation Ward's method was used. This method at first sums the squared Euclidean distances between each case and the cluster means. **At** each stage in the cluster analysis the two cases of cluster that merge are those resulting in the smallest increase in the overall sum of the squared within-cluster distances. The variables used to describe the stations correspond to the number of specimens of each species collected during each of the three surveys. Thus, it was possible to classify the small mammal communities in terms of differences in: 1j species composition; 2) relative and absolute abundance (ratio between species); *3)* dynamics of the population during summer and autumn.

Results

In total 586 speciemens were caught. These belonged to the following species: *Sorex alpinus*, *Sores araneus*, *Sorex minutus*, *Neomys fodiens*, *Eliomys quercinus*, *Dryomys* nitcdulu. *Clethrionomys glareolus*, *Microtus agrestis*, *Microtus subterraneus*. *Chionotnys nivalis*, *Apodemus flavicollis*, *Apodemus sylvaticus*. The mole (*Talpa europaea*), the squirrel (*Sciurus vulgaris*), the edible dormouse (*Myoxus glis*) and the common vole (*Microtus arvalis*), even if present, were not considered in this study, because they were seen outside the trapping stations. Figure 1 shows the results of the cluster analysis and the histograms (Fig. *2)* represent the abundance of every species in each one of the five groups that emerged from data analysis. The first histogram refers to rodents, the second one to insectivores. The abundance index was obtained by averaging the total number of specimens captured in the stations belonging to the same group and

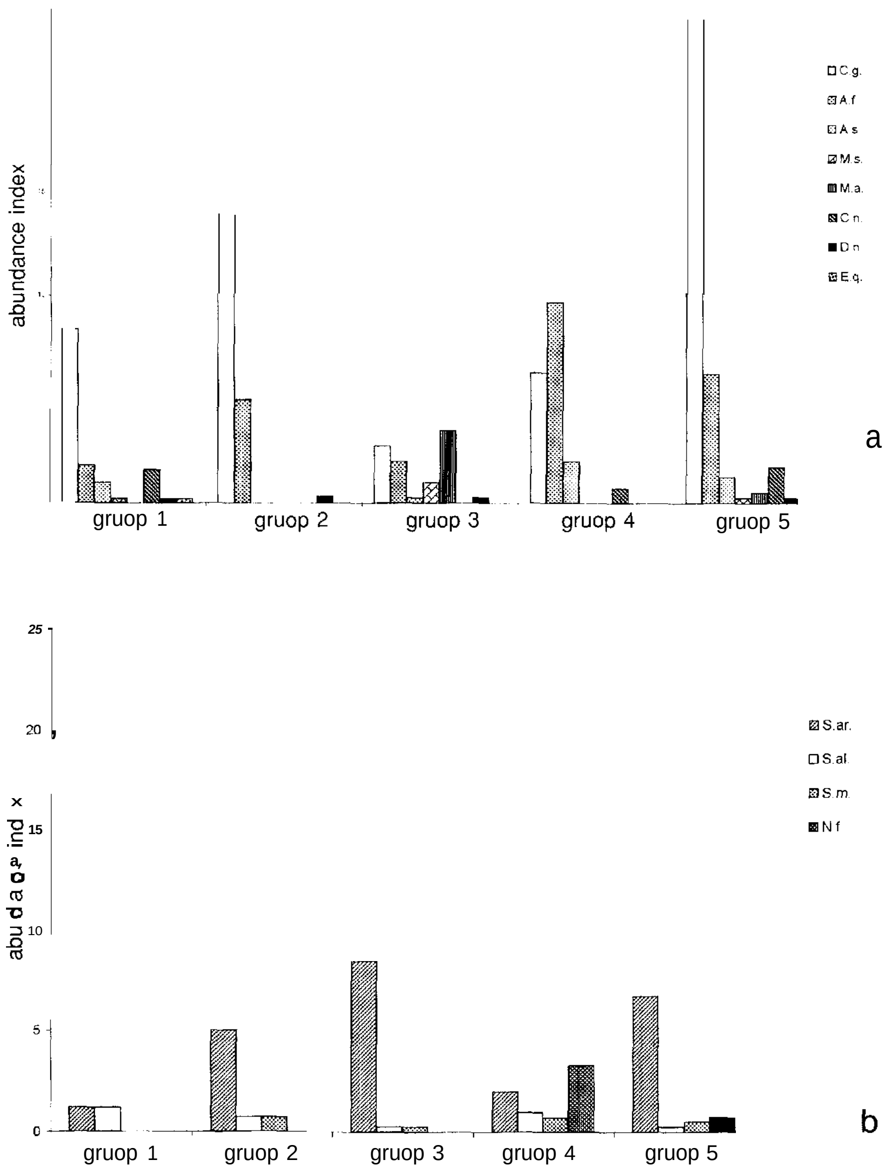

Figure 2. a b. Abundance index for each group (A.s.: *Apodemus sylvaticus*; A.f.: *A.flavicollis*; C.g.: *Clethrionomys glareolus*; M.s.: *Microtus subterraneus*; M.a.: *Microtus agrestis*; C.n.: *Chionomys nivalis*; D.n.: *Dryomys nitedula*; E.q.: *Eliomys quercinus*; S.ar.: *Sorex araneus*; S.al.: *Sorex alpinus*; S.m.: *Sorex minutus*; N.f.: *Neomys fodiens*).

$$\text{Abundance index} = \frac{(\text{n° of captures in June} + \text{n° of captures in August} + \text{n° of captures in October})\ i}{\Sigma i}$$

i = stations belonging to the group.

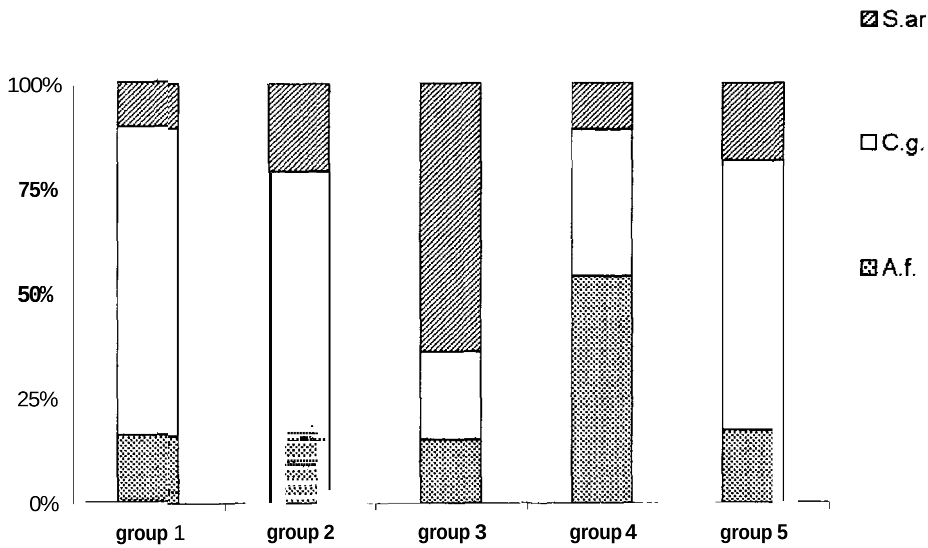

Figure 3. Dominance ratio of the three most common species: *Apodemus flavicollis* (A.f.), *Clethrionomys glareolus* (C.g.) and *Sorex araneus* (S.ar.).

corresponds, therefore. to a trapping effort of 270 trapping nights (30 traps x 3 nights x 3 surveys). Another graph (Fig.3) shows the dominance ratio between the three most common species: *C. glareolus*, *A. flavicollis* and *S. araneus*.

Discussion

The aggregation reflects the ecological characteristics of the different species. The rocky rubble environments which host typical species, such as the snow vole (*C. nivalis*) arc grouped together (group 1; Figs. 1, 2). This is true also for all the stations with water courses where the water shrew (*N. fodiens*) was found (group 4; Figs. 1, 2), as well as meadows and peat bogs where voles such as *M. agrestis* and *M. subterraneus* live (group 3; Figs. I, 2). The communities are identified not just according to the presence of one or more typical species but also according to the relative and absolute density of all species. For this reason, an extremely poor environment. such as an area of dense spruce forest at pre-thicket stage, where very few individuals of the most common species live (*A. sylvaticus*, *A. flavicollis*, *C. glareolus* and *S. araneus*), has been grouped together with the rocky rubble environments. These are extreme habitats where small mammals can be found only at low densities.

It is also interesting to note that there is a considerable difference in aggregation between small mammal communities in spruce forests and those in mixed forests of Swiss stone pine, larch and spruce. The latter has a greater species richness and a higher density (compare groups 2 and 5; Fig.2). This may be due to differences in undergrowth, which is much denser in the mixed coniferous woods we examined. Other authors (Pucek, 1983; Gurnell, 1985; Mazurkiewicz, 1994) stressed the importance of this factor for small mammals, especially for the bank vole. It can also be assumed that the high density of bank vole in the woods with Swiss stone pines is also partly linked to the

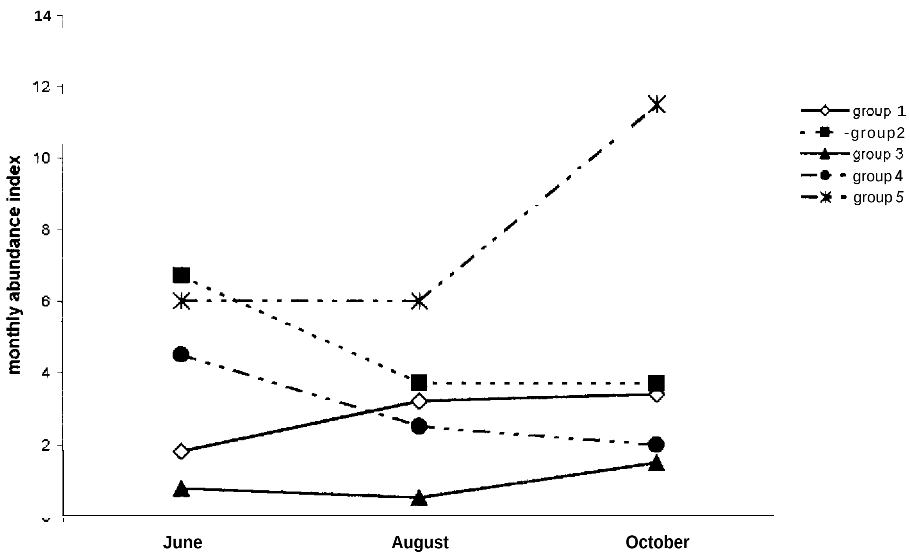

Figure 4. Monthly abundance index of the bank vole (*Clethrionomys glareolus*) population in the different groups of stations.

$$\text{Monthly abundance index} = \frac{(\text{n° of captures during month x})\ i]}{\Sigma i}$$

i = stations belonging to the group.

greater availability of food sources, such as seeds. This could explain the slightly prolonged growth of the population in autumn that was registered in these environments with respect to the forests at the valley bottom and in spruce forests (Fig.4).

Despite the great density diversity, the coniferous forests maintain the same dominance ratio between the most common species: C. *glareolus*, **A.** *flavicollis*, *S. araneus* (Fig.3).

Among rodents, the yellow necked mouse and the bank vole are the most common rodents in mountain forests. However, the yellow necked mouse, although also present in coniferous forests, seems to be more widespread in deciduous forests, as pointed out by other authors (Wolk and Wolk, 1982; Gurnell, 1985). The bank vole is, on the other hand, the dominant species only in coniferous forests? even though it is widespread throughout central and southern Europe, especially in broadleaved woods (Pucek, 1983; Amori et al., 1986). Pucek (1983) has shown that this species is present in all forest environments, but has noted that there is a considerable variability in its choice of habitat within its distribution range: in eastern and northern parts the species is widespread in taiga and in spruce forests; in the central areas it is more commonly found in mixed and deciduous forests and in shady clearings; in the south it prefers a shady and damp habitat. **A** distribution similarity therefore seems to exist between the eastern and northern zones of the Alpine chain. This has already been pointed out by other authors (Niethammer and Krapp, 1982), who say that spruce forests are the typical environment of this species in northern regions and in the mountains.

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REFERENCES

Amori, G., Cristaldi M. and Contoli L.. 1986. Sui Roditori (Gliridae, Arvicolidae, Muridae) dell'Italia peninsulare ed insulare in rapporto all'ambiente bioclimatico mediterraneo. Animalia, 11(1-3): 217-269.

Begon, M., Harper, J.L. and Townsend C.R., 1989. Ecologia. Individui, popolazioni, comunita. Zanichelli, Bologna, 854 **pp.**

Clevedon Brown, J. and Stoddart D.M., 1977. Killing mammals and general post-mortem methods. Mammal Review, 7 (2): 64-94.

Gurnell, J., 1985. Woodland rodent communities. In: J.R. Flowerdew, J. Gurnell and J.H.W. Gipps (eds.) The ecology of woodland rodents. Rank voles and mice. The Zoological Society of London. London: 377- 411.

Mazurkiewicz, M.. 1994. Factors influencing the distribution of the bank vole in forest habitats. Acta Theriol., 39 (2): 113-126.

Niethammer, J. and Krapp, F., 1982. Handbuch der Saugetiere Europas. Band 2/1 Rodentia II. Akademische Verlagsgesellshaft. Wiesbaden.

Pucek, M., 1983. Habitat preferences. In: K. Petrusewicz (ed.) Ecology **of** the Bank Vole. Acta Theriol., 28 (1a): 31-40.

Wolk, E. and Wolk, K., 1982 Response of small mammals to the forest management in the Bialowieza Primeval Forest. Acta Theriol., 27: 45-59.