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Effect of the abandonment of mountain pastures on the Orthoptera populations in the northwest of Spain

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Abstract

This study deals with the short-term effects on grasshoppers (Orthoptera) of the abandonment of pastures, related to livestock management. This abandonment has inmediate positive results (i.e. an increase in density, diversity and species richness) on grasshoppers living in the plant community of Mesobromion erecti (ME) and no change has been observed in Nardion strictae (NA). The abandonment of pastures affects different species in different ways. The results of this study lead to conclusions on the procedures that should be followed.

Introduction

Grasshoppers (Insecta: Orthoptera) are considered to be important primary consumers of mountain pastures (ISERN-VALLVERDU 1992). Some authors maintain that grazing favours them (HOLMES et al 1979). Others, however, find that grazing had a negative effect on the macrofauna (review in SIEPEL et al 1989) and on Orthoptera in particular (CAPINERA & SECHRIST 1982, BARKER 1982, GUÉGUEN 1990). VAN WINGERDEN et al (1991) point out that the effects depend on the intensity of grazing, while WELCH et al (1991) also refer to the time factor.

The type of habitat affects the presence of species as well as its relative abundance (SÄnger 1977, KEMP et al 1990). on the other hand, the choice of habitat does not depend on feeding preferences (ISERN-VALLVERDU et al in press), but rather on microclimatic conditions (SCHÄLLER & KÖHLER 1981). Furthermore, the population density is regulated by climatic conditions, and by birds -the principal predators (BOCK et al 1992, ISERN-VALLVERDU 1992).

Lately, systems of livestock management have changed in the Iberian Peninsula (FILLAT 1980, CHOCARRO et al 1990). Some mountain pastures have been abandoned or grazed less intensively. This implies a change in the structure of the vegetation which will presumably affect the fauna. In the long-term, if there were no human intervention at all, it would be expected that the forests that once coverde most pastures would reclaim them (CHOCARRO et al 1990). Among Orthoptera, an increase in the density, biomass and structural complexity at intermediate stages has been suggested (ISERN-VALLVERDU 1992).

The short-term effects which must be known in order to correctly manage these areas are, however, unclear, although it has been observed that

grasshoppers react very quickly to changes in their surroundings (see review in GUÉGUEN 1990). On the other hand, pasture is not homogenous and it is not known how the different plant communities will evolve.
In this study, we look at the effect of the recent abandonment of grazing land on the principal herbaceous plant communities and we discuss the results in relation to livestock management.

Study area

This study has been carried out on the mountain pass of San Isidro (Cantabrian Mountains, northwest of Spain) at an altitude of 1500 m (Fig. 1). The climate is typical of mountainous areas near the Atlantic. The average rainfall is 1319.5 mm and the average temperature is 5.5 C. Winters are long and cold with frequent snowfalls. Summers are typified by a low rainfall. The herbaceous vegetation correponds to two plant groups: Mesobromion erecti (ME) and Nardion strictae (NA). In Table 1 dominant species and other characteristics of each community are shown.

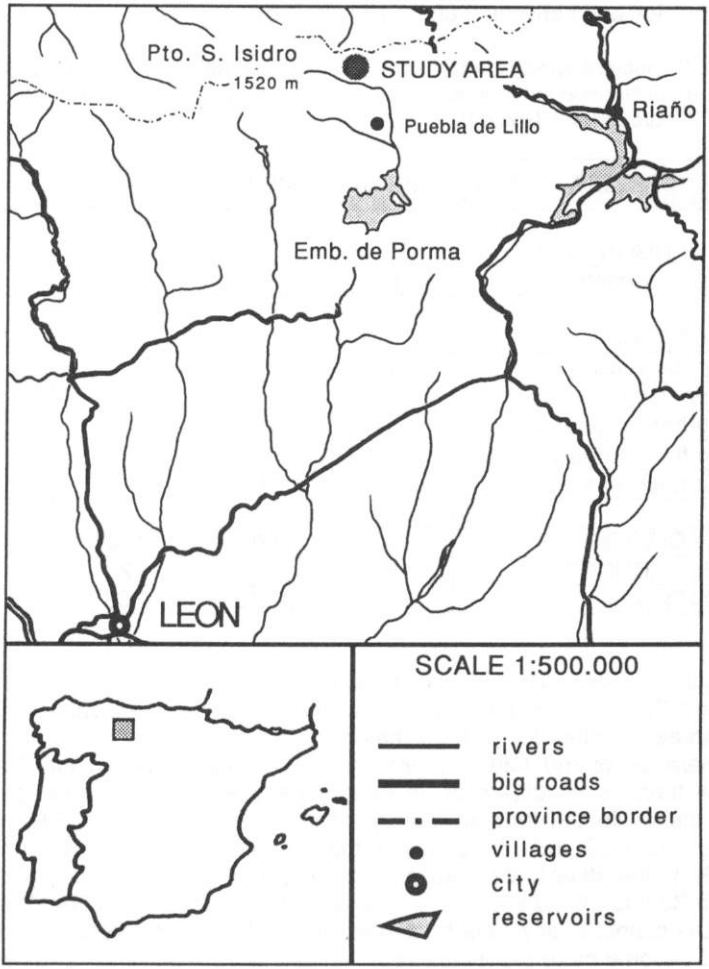
TAB. 1: Floral distribution in the different communities (data from A. GARCÍA and F. BERMÚDEZ, Agricultural Research Station (CSIC), León). NA= Nardion strictae; ME: Mesobromion erecti; P= Production.

	DOMINANT SPECIES	GRASSES	LEGUMINOUS	OTHER	P(Kg/Ha)
NA	*Nardus stricta*	30	6	65	3124
	Festuca rubra				
	Hieracium pilosella				
ME	*Bromus erectus*	10	5	82	922
	Festuca ovina				
	Koeleria vallesiana				

Material and Methods

Two plots are studied in each plant group: one grazed by cattle (G) and another ungrazed and protected by a chicken-wire fence measuring 90 m by 5 m (U) erected the previous year.
A quantitative sampling of Orthoptera was carried out every two weeks during a complete life-cycle (from June to September, 1991), using biocenometers of one square metre, and taking five units for each sample and plot (see a detailed description of methods in ISERN-VALLVERDÚ 1992).
Density and other parameters are compared in grazed and ungrazed areas and in both plant types. Diversity is expressed using the Shannon index. For sample comparisons Mann-Withman's test is carried out (SIEGEL 1990).

FIG. 1: Location of the study area, in León province (Cantabrian Mountains, Spain).



Results

Table 2 shows the distribution of species, species richness and the diversity of adult Orthoptera.

Five of the six species found belong to the Acrididae family and make up 99% of total adults. *Stenobothrus stigmaticus* is the most abundant species of all the areas (from 94.5 to 100%). *Stenobothrus lineatus* appears in ungrazed areas. Moreover it is only in ME-U that *Chorthippus* species and the only species of Tettigoniidae (*Platycleis tessellata*) are to be found. On the other hand, *Myrmeleotettix maculatus* is only found in ME-G.

Species richness and diversity are always very low. These are greatest in ME-U, with five species and 0.244 bits/ind. In other areas values are very low (one or two species and between 0 and 0.198 bits/ind).

TAB. 2: Orthoptera species in two plant communities (ME: Mesobromion erecti; NA= Nardion strictae) and two different management practices (U= Ungrazed, G= Grazed).

SPECIES	ME-U	ME-G	NA-U	NA-G
FAM. TETTIGONIIDAE				
Platycleis tessellata	6			
FAM. ACRIDIDAE				
Chorthippus yersini	1			
Chorthippus parallelus	2			
Stenobothrus stigmaticus	172	76	165	142
Stenobothrus lineatus	1		1	
Myrmeleotettix maculatus		4		
TOTAL ADULTS	182	80	166	142
SPECIES RICHNESS	5	2	2	1
DIVERSITY (H')	0.244	0.198	0.03	0

Figures 2 show variation in density throughout the life-cycle in each of the plot examined. The duration of the cycle is similar in the four areas studied, that is, about three months long, from hatching in the middle of June to the disappearance of the adults in the middle of September. In the first two samples there is no difference in density between the four plots ($p>0.05$). During the cycle the highest density of all the areas is in ME-U (with a maximum of 42.2 ind/m^2), although the difference is not very significant ($p=0.09$). In the other three areas the values are very similar (with maxima of between 20 and 30 ind/m^2). The similarity in densities between NA (G and U) and ME-G cannot in any case be denied ($p>>0.05$). The differences in density in ME-U become more significant from the third sample onwards ($p=0.06$).

FIG. 2: Average density of grasshoppers (Orthoptera) throughout the life-cycle. Density measured in numbers of individuals per squared metre. Frequency of samples: every two weeks from June (VI) to September (IX). Standard deviation is shown.

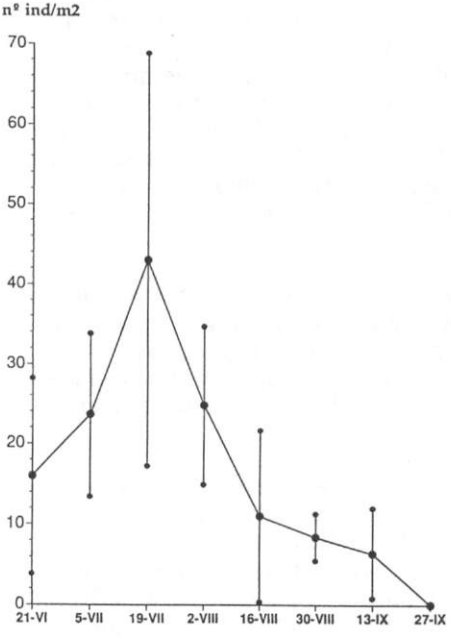


Fig. 2.1: Mesobromion erecti ungrazed (ME-U).

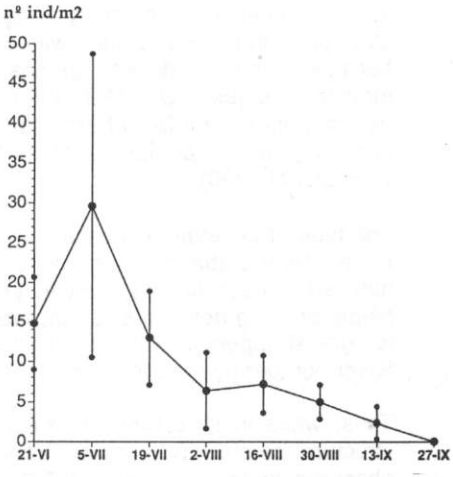
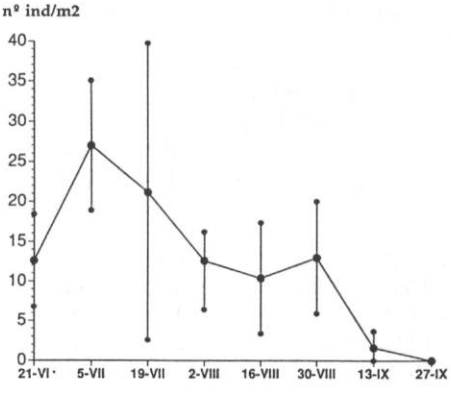
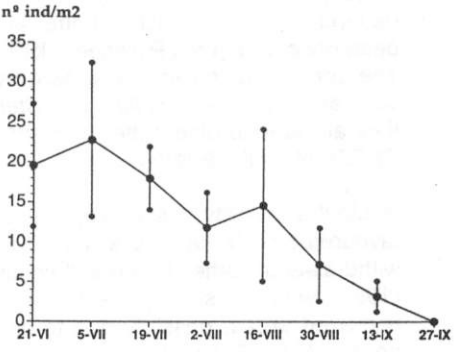


Fig. 2.2: Mesobromion erecti grazed (ME-G).

Fig. 2.3: Nardion strictae ungrazed (NA-U).

Fig. 2.4: Nardion strictae grazed (NA-G).





Discussion

As expected, in the first year after grazing is abandoned there is a very rapid reaction among Orthoptera (GUÉGUEN 1990). In general, density increases along with diversity and species richness. In this way foundations are laid down for the recovery of the Orthoptera populations.
The pressures imposed by grazing therefore seem to simplify the groups of Orthoptera in these pastures, with a corresponding reduction in diversity, number of species and density, as has been observed in the Pyrenees and other mountain ranges (GUÉGUEN 1990, ISERN-VALLVERDU 1992). Thus we may detect a negative effect of grazing on the populations of Orthoptera, as recorded by previous authors (CAPINERA & SECHRIST 1982, BARKER 1982, GUÉGUEN 1990).

The type of vegetation is essential in any prediction of the evolution of Orthoptera after the abandonment of grazing. A similar number of grasshoppers are hatched in each area. However, from mid-July onwards, the increase in the height of the grass in ME-U (ungrazed Mesobromion erecti) provides a refuge for grasshoppers (VAN WINGERDEN et al 1991), which are consumed in fewer number by predators (BOCK et al 1992).

Thus, while in Mesobromion erecti (ME) there is an inmediate increase in structural complexity (species richness, diversity) and in density as has been observed in the Pyrenees (ISERN-VALLVERDU 1992), in Nardion strictae (NA) there is only a slight and insignificant increase in these parameters. This community is habitually grazed by cattle (GARCIA-GONZALEZ & MONTSERRAT 1986). Therefore, immediately following the abandonment of grazing there would be very little change in the structure and composition of this plant community. however, the abandonment of ME would mean a rapid increase in the structural complexity of the vegetation. Due to this there would be a different and slower evolution in NA and there would probably be different intermediate stages.
Equally, the effect is not the same for all species, as has been pointed out by GUÉGUEN (1990). The more intensivily grazed areas are inhabited almost exclusively by *Stenobothrus stigmaticus*, the species with fewer ecological requirements, and which is better at enduring the pressures of grazing, as has been observed in the Pyrenees (ISERN-VALLVERDU 1992).
The species which are most sensitive to grazing seem to be the larger ones such as *Platycleis tessellata* and *Stenobothrus lineatus*. This could be because they are able to hide better from predators in areas of taller grass (VAN WINGERDEN et al. 1991).

While the majority of species, including the most resistant (*S. stigmaticus*), are favoured by a let up in grazing, *Myrmeleotettix maculatus* disappears with the withdrawal of cattle. This result coincides with that of VAN WINGERDEN et al. (1991), who find slightly greater densities of this species in grazed rather than ungrazed areas, possibly due to its preference for bare soil where it lays its eggs (SÄNGER 1977).

Nowadays, with the reduction in cattle numbers, less productive fields (NA) are being abandoned while grazing continues on the better pastures (ME). On the other hand, the recovery of the forest is prevented and pastures are dedicated to other uses, such as tourism.
Therefore, in the short-term, it is possible to predict that the recovery of the Orthoptera population will be very slow. It is likely that many species will disappear or take a long time to recover. It is also expected that the population of the dominant species (*Stenobothrus stigmaticus*) will increase and tend to take over the function previously carried out by cattle in the maintenance of pastures, as this species consumes *Nardus stricta* when this plant is abundant (ISERN-VALLVERDU et al., in press), as in the case of NA.
The conservation of grazed and ungrazed areas of both plant communities is suggested in order to encourage a more rapid recovery of the Orthoptera populations, and thus improve the maintenance of pastures.

However, the effects of other intrusions such as summer tourism and the building of ski slopes must be considered, although these are unforseeable at present until the results of specific studies are available. The actual increase in these mountain activities and the speed with which changes in the Orthoptera population are taking place suggest that new studies are required on this subject.

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