Different Reactions of Plants and Insect Taxa to Reduction of Stocking Rate: A Concrete Reason to Promote Habitat Heterogeneity in Grazing Systems

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The 21st International Grassland Congress / 8th International Rangeland Congress took place in Hohhot, China from June 29 through July 5, 2008.

Proceedings edited by Organizing Committee of 2008 IGC/IRC Conference

Published by Guangdong People's Publishing House

Different reactions of plants and insect taxa to reduction of stocking rate : a concrete reason to promote habitat heterogeneity in grazing systems

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Key words : cattle ,stocking rate ,biodiversity ,shopping-basket approach ,habitat heterogeneity

Introduction Preservation of habitat heterogeneity is an empirical rule that has been frequently proposed as a key for restoring and sustaining biodiversity in temperate agricultural systems . However , only few targeted experiments allow to support this hypothesis and to make practical management implications on the basis of reliable data . During five years , we measured biodiversity in a species-rich mountain pasture grazed by cattle under three different stocking rates . We opted for recording taxa with different ecological characteristics (shopping-basket approach) to test for more general and applicable patterns of diversity in relation to a reduction of stocking rate .

Materials and methods We recorded the abundance and diversity of plants (a majority of oligotrophic species due to the low soil nutrient status) , butterflies , grasshoppers and ground-dwelling arthropods in 3 .6-ha plots continuously grazed by heifers at three different stocking rates : 0 .6 , 1 .0 and 1 .4 LU/ha (1 LU = 600 kg liveweight) . Percentage cover of all plant species was estimated in ten fixed 1 m2 quadrats per plot . Butterflies and grasshoppers were recorded along fixed transects . Ground-dwelling arthropods were sampled by pitfall trapping . Each stocking rate treatment was repeated three times according to a randomized block design . In addition to a fixed stocking rate factor , the mixed ANOVA model included a year factor , a random block factor , and the interaction between stocking rate and year .

Results and discussion A reduction of stocking rate favoured forbs , grasses with a low leaf turnover (S and S-C types , Grime *et al* . , 1998) , butterflies , grasshoppers , and detritivore insects like Collembola (Table 1) . The lowest stocking rate was however detrimental to grasshoppers associated with short grasslands . Conversely , the positive effect of a reduction of stocking rate was also found for butterfly species associated with short grasslands , which could reveal the benefit of increased structural heterogeneity through patchiness . The highest stocking rate favoured legumes , competitive grasses (C-S-R and C types , Grime *et al* . , 1998) and coprophagous beetles (Coleoptera : Scarabidae and Hydrophilidae) . Finally , some taxa like carabids , most of which are omnivorous and polyphagous , did not vary along this stocking rate gradient . In conclusion , each stocking rate treatment selected a different biodiversity pattern , which is a concrete reason to promote habitat heterogeneity as the result of different pasture management practices in livestock farming systems .

Table 1 *Response of vascular plants , butterflies , grasshoppers and ground-dwelling arthropods to a reduction of stocking rate (all data at the plot level) .*

	1 .4 LU/ha	1 .0 LU/ha	0 .6 LU/ha	s .e .	*P*
Plant species richness	55 .4	55 .6	53 .3	2 .9	N .S .
C-S-R , C grasses (abundance in %)	34 .5*a*	31 .1*a*	26 .9*b*	3 .2	***
S and S-C grasses (%)	11 .8*a*	16 .1*b*	18 .1*b*	1 .3	***
Forbs (%)	27 .9*a*	31 .1*ab*	35 .1*b*	2 .1	**
Legumes (%)	12 .4*a*	10 .0*a*	6 .3*b*	0 .9	***
Butterfly species richness	7 .7*a*	12 .5*b*	11 .3*b*	0 .7	***
Butterfly abundance	28 .2*a*	43 .3*b*	63 .0*c*	3 .8	***
-from tall vegetation	22 .7*a*	32 .2*a*	51 .8*b*	3 .3	***
-of short grasslands	2 .9	5 .1	4 .6	0 .8	0 .06
Grasshooper species richness	6 .1*a*	6 .8*a*	8 .4*b*	0 .6	**
Grasshooper abundance	90 .7*a*	134 .7*b*	122 .1*ab*	30 .1	*
-from tall vegetation	49 .1	64 .7	73 .3	12 .3	0 .16
-of short grasslands	41 .6*a*	70 .0*b*	48 .8*a*	21 .3	**
Ground-dwelling arthropods (abundance)					
Coleoptera : Carabidae	113 .4	111 .1	146 .1	17 .2	N .S .
Coleo . : Scarabidae , Hydrophilidae	3 .9	2 .1	0 .3	1 .2	0 .14
Collembola	6 .1*a*	10 .9*ab*	17 .0*b*	2 .9	*

For each line , means with different suberscripts differ ($P < 0.05$) ; *** : $P < 0.001$; ** : $P < 0.01$; * : $P < 0.05$

Reference

Grime , J .P . , Hodgson , J .G . , Hunt , R . , 1998 . Comparative Plant Ecology—A functional approach to common British species . *Unwin Hyman , London* , 742 pp .