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in

Ferchichi A. (comp.), Ferchichi A. (collab.).
Réhabilitation des pâturages et des parcours en milieux méditerranéens

Zaragoza : CIHEAM
Cahiers Options Méditerranéennes; n. 62

2004
pages 307-310

Article available on line / Article disponible en ligne à l'adresse :

<http://om.ciheam.org/article.php?IDPDF=4600176>

To cite this article / Pour citer cet article

Bartolomé J., Plaixats J. **Perspectives of heathland-pastures in the Montseny Natural Park, Spain.** In : Ferchichi A. (comp.), Ferchichi A. (collab.). *Réhabilitation des pâturages et des parcours en milieux méditerranéens*. Zaragoza : CIHEAM, 2004. p. 307-310 (Cahiers Options Méditerranéennes; n. 62)



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Perspectives of heathland-pastures in the Montseny Natural Park, Spain

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RESUME – “Perspectives des pâturages des landes dans le Parc Naturel de Montseny, Espagne”. Les pâturages des landes du Parc Naturel de Montseny et de la Réserve de la Biosphère représentent une petit îlot (environ 1000 ha) de végétation atlantique à l’intérieur de la région méditerranéenne. Dans ces montagnes, des communautés d’arbrisseaux de *Calluna vulgaris* ont fourni un pâturage continu aux ovins et caprins pendant des siècles. Durant la deuxième moitié du XX^e siècle, des changements de gestion des landes, tels que l’interdiction du feu ou la mise en culture et abandon ultérieur des champs, ont réduit de façon drastique la zone des landes, même en conditions de pâturage. Pour la conservation des landes il est nécessaire de contrôler l’empiètement des buissons et l’invasion des fougères par coupe mécanique ou récupération du cycle traditionnel du feu

Mots-clés: Pâturages, buissons, *Calluna vulgaris*, paysage.

Introduction

The abandonment of grasslands and field crops has led to considerable changes in Mediterranean landscape over recent decades. Many studies have confirmed the predominance of arable fields and pastures up to the middle of the 20th century and their later encroachment by shrubland. Currently, many of our protected areas are attempting to stimulate certain traditional management activities such as grazing, because of their importance for biodiversity conservation. It is evident that a long history of pastoral management has produced a landscape in which habitats and dependent wildlife communities are sustainable only through the continuation of farming.

The Montseny Natural Park and Biosphere Reserve is an example of the global change process, where Mediterranean forests and shrublands have increased their surface area to the detriment of temperate forests, arable land and pastures for about five decades. This paper focuses on the study of the present-day diversity, grass production and nutritive value of semi-natural heathlands and grasslands of La Calma, in the Montseny Natural Park, associated with changes in land use management, such as fire prohibition.

Materials and methods

The study area was situated in the Montseny Biosphere Reserve and Natural Park, in Catalonia, Spain. Currently, La Calma altiplano are covered by grasslands and mainly by shrublands. Its altitude ranges between 1000 m and 1350 m. The parent rock material is siliceous (slates), the soil is a ranker type and the pH is 4.5. The climate is Atlantic with an annual average rainfall around 800 mm and the mean annual temperature is 12°C. One can assume that pastures of La Calma had been grazed during hundreds (or perhaps thousands) of years.

Vegetation types were chosen according physiognomic attributes and following pytosociological criteria when it was possible. The typologies considered were:

- Dry grassland: Herbaceous vegetation without shrub cover, where *Agrostis capillaris* and *Trifolium* sp. used to be dominants (*Thero-Brachypodietea* and *Festuco-Brometea erecti* class).

- Wet grassland: Herbaceous well developed vegetation without shrub cover, where several species are dominants (*Molinio-Arrhenatheretea elatioris* and *Festuco-Brometea erecti* class, Al. *Mesobromion erecti*).

- Closed bracken stands: Herbaceous community with seasonal dense bracken cover (*Pteridium aquilinum*) (*Stellario-Pteridetum* class).

- *Calluna* heathland: Dwarf shrub vegetation with crowns of *Calluna vulgaris*. There is only one stratum (*Calluno-Ulicetea* class, Al. *Calluno-Genistion*).

- *Erica* heathland: Shrub community higher than 1.5 m tall, with *Erica arborea* as the dominant species. *Calluna vulgaris* is also abundant in the lower stratum (*Calluno-Ulicetea* class, Ass. *Centaureo pectinatae-Ericetum arboreae*).

- *Cytisus* scrub: Communities dominated by broom (*Cytisus scoparius*) The herbaceous stratum is discontinued and dominated by graminoid species (*Calluno-Ulicetea* class, Al. *Sarothamnion scoparii*).

- Mixed heathland: This is a community where two or more shrub species are common (*Erica arborea*, *Erica scoparia*, *Cytisus scoparius* and *Juniperus communis*) and is characterised by a dense canopy. The herbaceous level is dominated by graminoids and there is an important part of bare ground.

Orto-rectificated aerial photos and field trips were used in order to produce an actual vegetation map and calculate the vegetational types surfaces.

The presence of species in each vegetation type was recorded in two random replicate line point tracks, each 30 m long, and frequency values were used as the final expression of species abundance. The Shannon-Wiener diversity index [$H' = - \sum (p_i \cdot \ln p_i)$] was calculated in order to characterise species diversity in each vegetational types. Two-way indicator species analysis was applied to the point track data in the classifying of the seven vegetational types.

Grass production and nutritive value were estimated from 2 sampling plots (3 x 3 m²) of each vegetational type in the spring over the years 1999 and 2000. An area of 1m² was cut in order to determine dry matter content (DM) at 105°C, mineral content (MM) and organic matter (OM) at 550°C and crude protein by Kjeldhal procedure (N x 6.25). Neutral-detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) were determined by the method of Van Soest *et al.* (1991). Organic matter digestibility (OMD) and UFL were predicted by the equation of Andrieu *et al.* (1981).

Results and discussion

The current landscape of La Calma altiplano is a mosaic of shrublands and a small area of grasslands. Actually the area of La Calma currently represents only the 56% of the pastureland surface estimated for 1940s from the work of Llobet (1947). Open vegetation types, such grassland and *Calluna* heathland, represents only 30% of the total area (Table 1). Wet grassland have the highest value of plant diversity, although its surface is only 11% of the area. In the past, these were probably amply distributed as burning and grazing maintained *Calluna vulgaris* in its young phase and suppressed the growth of shrubs and bracken stands.

Table 1. Superficies in hectares, plant diversity (H') and dry matter production of each vegetational type studied in La Calma altiplano (Montseny Biosphere Reserve, Spain)

	Wet grassland	Dry grassland	Bracken stands	Calluna heathland	Erica heathland	Cytisu s scrub	Mixed heathland	Forest	Bare ground	Total
Ha	106	101	127	86	182	144	176	21	31	974
H'	3.0	1.8	2.1	2.2	1.8	2.6	2.1	-	-	-
Kg/ ha	2597.8	348.5	1154.7	88.8	1743.9	1104.5	715.8	-	-	-

Succession processes (pastureland to woodland) have occurred in La Calma over recent decades as a result of several changes in land use and management; these include fire prohibition when the Reserve was officially stabilised in 1977.

Current vegetation types have been classified according to the similarities and differences in their botanical composition (Fig. 1).

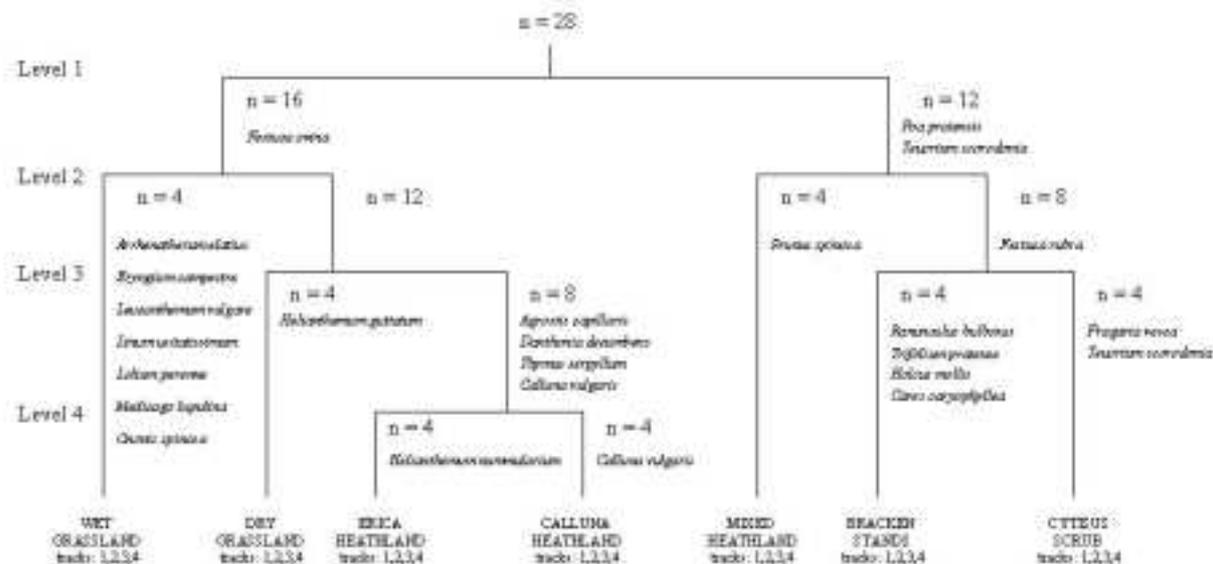


Fig. 1. Results of the TWINSPLAN analysis expressed as a dendrogram showing hierarchical subdivisions of the tracks x species data set to level 4 (n= number of tracks per group).

The first division (level 1) of the dendrogram produces two groups: open and closed vegetational communities. *Festuca ovina* appears as indicator species for the open vegetational group. In this group, division at level 2 separates wet grassland from the rest, with *Arrhenatherum elatius* as one of the indicator species. At level 3, dry grassland, characterised by *Helianthemum guttatum*, are well separated from the heathland. Finally, *Calluna* and *Erica* heathland are also clearly separated at level 4. *Calluna vulgaris* are consumed throughout the year by sheep and goats (Bartolomé *et al.*, 1998). Furthermore, *Calluna* heathland in the La Calma upland is vegetation through which it is easy to pass.

Erica heathland can be considered as an ecotone community between *Calluna* heathland and *Quercus ilex* woodland. The environmental interest of these communities, both dominated by *Calluna vulgaris* and *Festuca ovina*, lies in their southern distribution in Europe.

The second division (level 2) of closed vegetational group (more dense canopy tracks) separates mixed heathland from the other two. This heathland contains *Prunus spinosa* as indicator species in the herbaceous stratum, which usually appear in previous forest communities. The last division (level 3) separates *Cytisus* scrub from the bracken stands (deep soil). *Cytisus* scrub may be catalogued as an undesirable formation because of their impenetrability and because they are a high fire hazard (due to the high number of dead branches in old individuals). Bracken stands are similar to that formation and, in addition, are toxic and unpalatable.

The grass production of each vegetational type is showed in Table 1. The results obtained indicate a low pasture production in general terms. Wet grassland, *Erica* heathland, bracken stands and *Cytisus* scrub are the most herbage productive plant formation.

The chemical composition and nutritive value of grass are given in Table 2. The CP concentration of herbage ranged from 8.0% in *Erica* heathland to 14.6% in Weet grassland. The crude protein content of grass growing under *Cytisus* was 9.30% that under bracken being 9.15%. Fibre constituents ranged from 50% FND in Weet heathland to 65% in Mixed heathland and from 9.5% LAD to 18.4% respectively. Digestible organic matter content ranged from 526.0 g/kg of MS in bracken stands to 561.5 in *Erica* heathland. Nutritive value measured as UFL/kg of MS was around 0.70 in all vegetational types.

Table 2. Chemical composition and nutritive value of grass from each vegetational type. Results are expressed as kg/ha.

	Ash	C. Protein	Hemicelulose	Celulose	Lignin	OMD	UFL
Calluna heathland	9.7 ± 5.9	7.5 ± 2.3	18.8 ± 7.2	14.4 ± 2.81	20.67 ± 5.9	2.5 ± 5.3	3.4 ± 80.1
Dry grassland	53.8 ± 31.0	31.1 ± 7.9	82.3 ± 26.2	44.7 ± 21.7	66.01 ± 23.8	4.6 ± 73.0	1.5 ± 38.8
Cytisus scrub	72.2 ± 28.3	108.1 ± 63.0	268.0 ± 122.1	286.5 ± 135.4	139.6 ± 69.2	7.5 ± 16.6	2.8 ± 234.2
Bracken stands	101.7 ± 135.4	106.0 ± 26.9	232.7 ± 55.7	288.8 ± 54.7	143.9 ± 28.0	6.7 ± 7.1	1.4 ± 253.2
Erica heathland	104.9 ± 67.7	134.6 ± 72.8	348.4 ± 169.2	353.0 ± 190.3	280.7 ± 220.9	5.3 ± 1.0	1.6 ± 1075.1
Mixed heathland	50.8 ± 47.6	58.3 ± 49.6	180.4 ± 154.7	200.2 ± 177.5	149.9 ± 149.0	6.7 ± 44.4	1.4 ± 508.0
Wet grassland	242.6 ± 200.5	44.4 ± 275.5	423.0 ± 349.2	503.9 ± 502.68	229.3 ± 197.3	7.3 ± 1.8	4.5 ± 940.1

Data expressed as yield (kg/ha) indicates that the best grass are produced in Wet grassland followed by *Erica* heathland. *Cytisus* scrub and bracken stands herbaceous stratum in agreement with their botanical composition quality. This may be important in order to optimise flocks management in the pastureland studied. In designated conservation areas, where traditional human activities are still maintained, promoting or restoring a mosaic of extensively used heathland and grassland is an urgent issue that needs to be addressed in order to preserve the diverse and partly open landscape.

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