



HAL
open science

Livestock grazing and biodiversity in semi-natural grasslands

Bertrand Dumont, A.G. Thorhallsdottir, Anne A. Farruggia, A. Norderhaug

► **To cite this version:**

Bertrand Dumont, A.G. Thorhallsdottir, Anne A. Farruggia, A. Norderhaug. Livestock grazing and biodiversity in semi-natural grasslands. 17. Symposium of the European Grassland Federation (EGF), Jun 2013, Akureyri, Iceland. 38 p. hal-02745695

HAL Id: hal-02745695

<https://hal.inrae.fr/hal-02745695>

Submitted on 3 Jun 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Livestock grazing and biodiversity in semi-natural grasslands

Dumont B., Thórhallsdóttir A.G., Farruggia A., Norderhaug A.

INRA – Agricultural Univ. of Iceland – Norwegian Inst. for Agriculture and Environmental Res.

Grass-dominated ecosystems



Approximately one-third of the Earth's vegetative cover is savannah, grassland and other grass-dominated ecosystems

Grasslands

- Climatically-determined
 - Savannah and shrub steppe
 - Natural grassland
- Successional/agricultural
 - Maintained by grazing and other agronomic practices
 - Semi-natural grassland
- Not as clear division as previously thought
- Natural grasslands often proved to have a more anthropogenic background

A GENERALIZED MODEL OF THE EFFECTS OF GRAZING BY LARGE HERBIVORES ON GRASSLAND COMMUNITY STRUCTURE

D. G. MILCHUNAS, O. E. SALA,* AND W. K. LAUENROTH

Department of Range Science and Natural Resource Ecology Laboratory, Colorado State University, Fort Collins, Colorado 80523

Submitted December 19, 1986; Revised June 8, 1987; Accepted November 18, 1987



European grasslands

- Mainly successional/agricultural grasslands
 - Middle and south Europe
 - Agriculture has conquered most of the landscape for the last 9000 years
 - Northern Europe and Scandinavia
 - Pre-industrial agriculture (6000 yrs) based on animal husbandry and grazing of semi-natural grasslands
 - Iceland
 - Shorter grazing history: settlement during the 9th century
 - A long-held view that sheep grazing is the culprit for land degradation and soil erosion
 - Grazing exclusion & re-seeding for ecosystem restoration
- ➔ Different views on grassland conservation

European grasslands

- Provide a large proportion of animal proteins
- Host a wide diversity of plants, animals and microorganisms of functional or patrimonial interest
- Face new social expectations
 - Support for other agricultural systems (pollination)
 - Landscape production
- How to conciliate production and other ecosystem services, while reducing the environmental footprint of livestock farming systems?



Threats on biodiversity

- Intensification in land use
 - Cultivation and fertilization
- Abandonment of marginal areas
 - Shrub encroachment
- Fragmentation of habitats



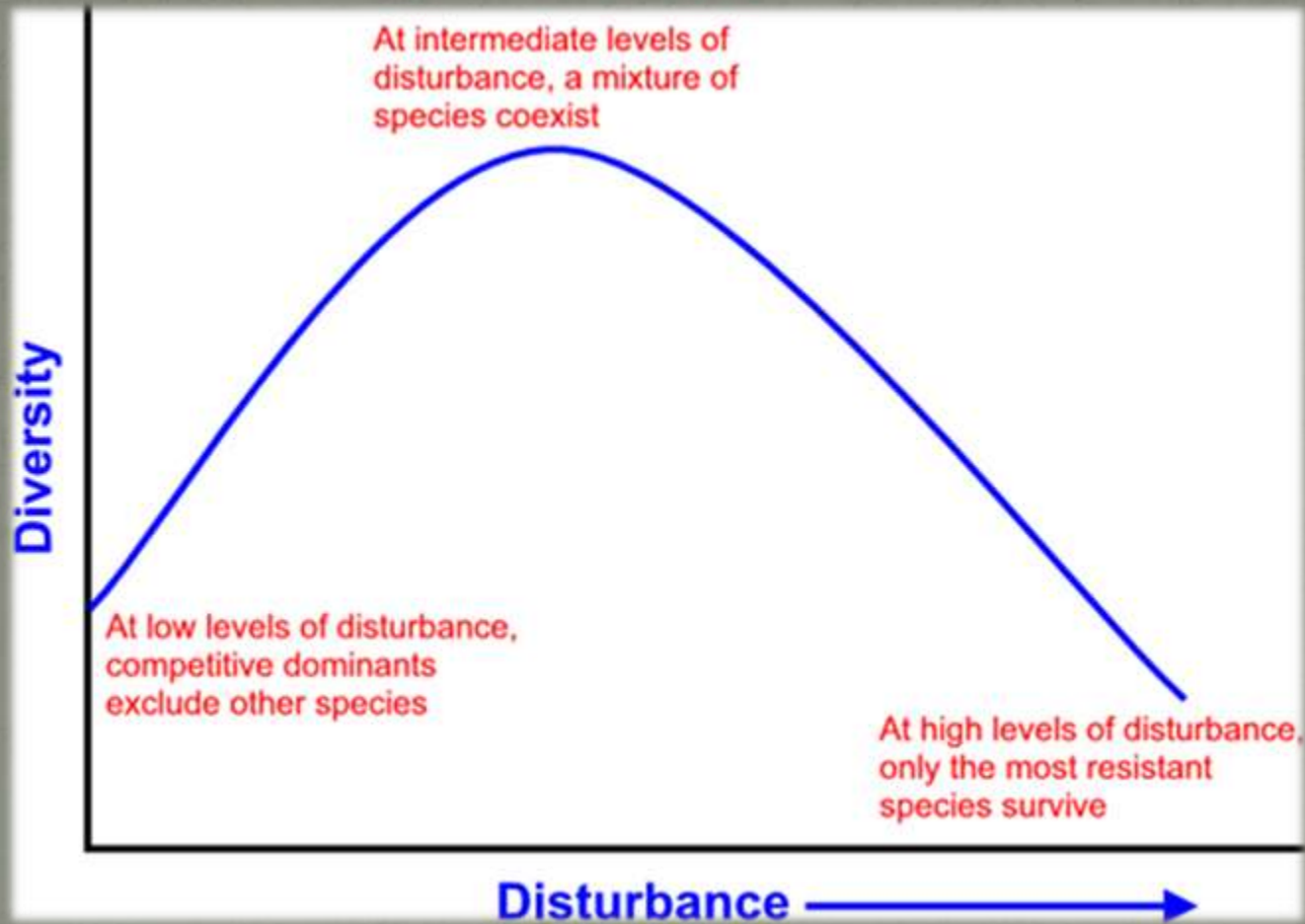
Grazing by livestock can be seen as a conservation tool with positive effects on biodiversity, but the quality of the management regime and grazing history are decisive

Grazing as nature conservation tool

- Grazing
 - One of the main drivers of global vegetation dynamics
- The effect of grazing
 - Grazing history
 - Livestock species and breed
 - Pasture productivity
 - Grazing intensity
 - Grazing period
 -
- The connection between grazing and biodiversity



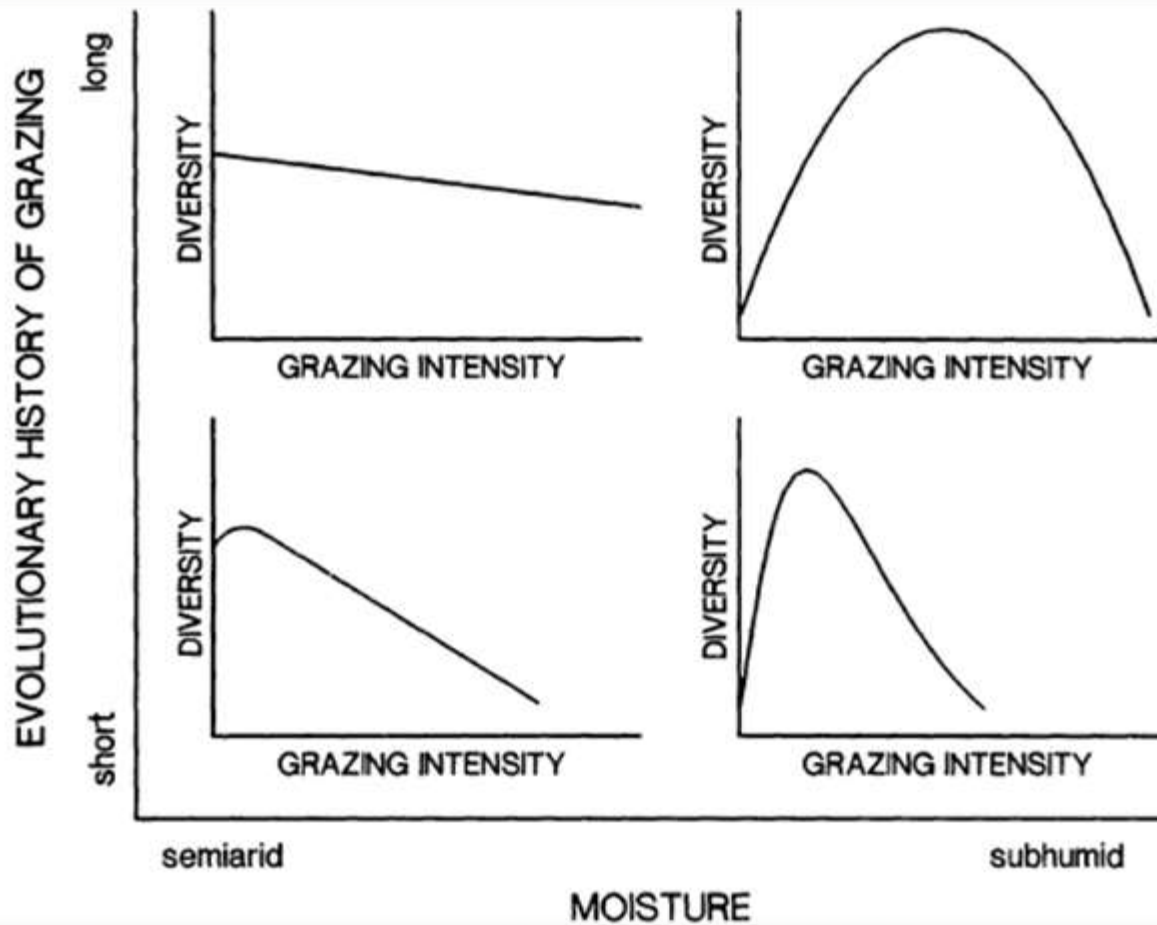
Intermediate disturbance hypothesis



i.e Connell 1978; Wilkinson 1999

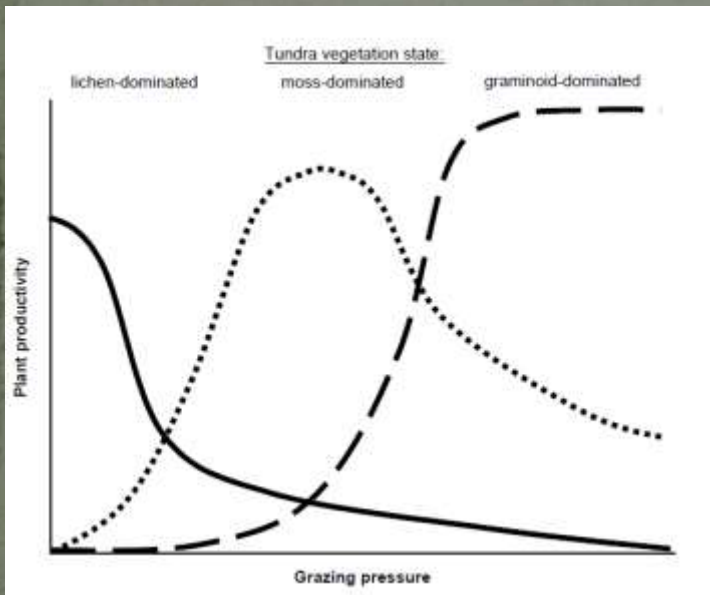
Grazing is disturbance

Relationship between grazing and biodiversity is a function of environment moisture and grazing history



Further development

- Moisture gradient generalized to a productivity gradient
- Incorporation of the state and transition model (Westoby *et al.* 1989) predicts that grazers can create alternative equilibria
- According to grazing pressure, we get different sward composition
- An example of different alternative stable stages in tundra ecosystems: the most productive and resilient grassland is created and maintained by large herbivores



Grazing creates mosaic of habitats

- Defoliation
- Trampling
- Dung deposition

Creating mosaics of short and tall patches, contrasting growth forms and competitive interactions

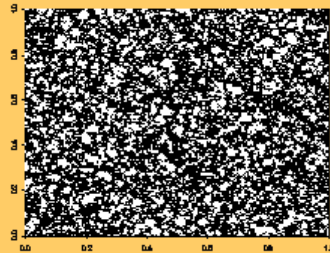
- Animals select for short rather than tall patches (patch grazing, Adler *et al.* 2001)
- Patch stability...



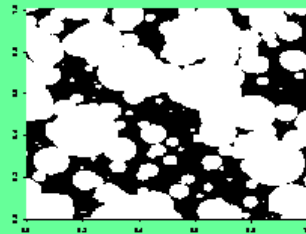
Inter-annual patch stability

Poor grasslands

Fine-scale stability patterns explained by Δ in plant palatability and local abundance



Large-scale stability patterns favour functional divergence



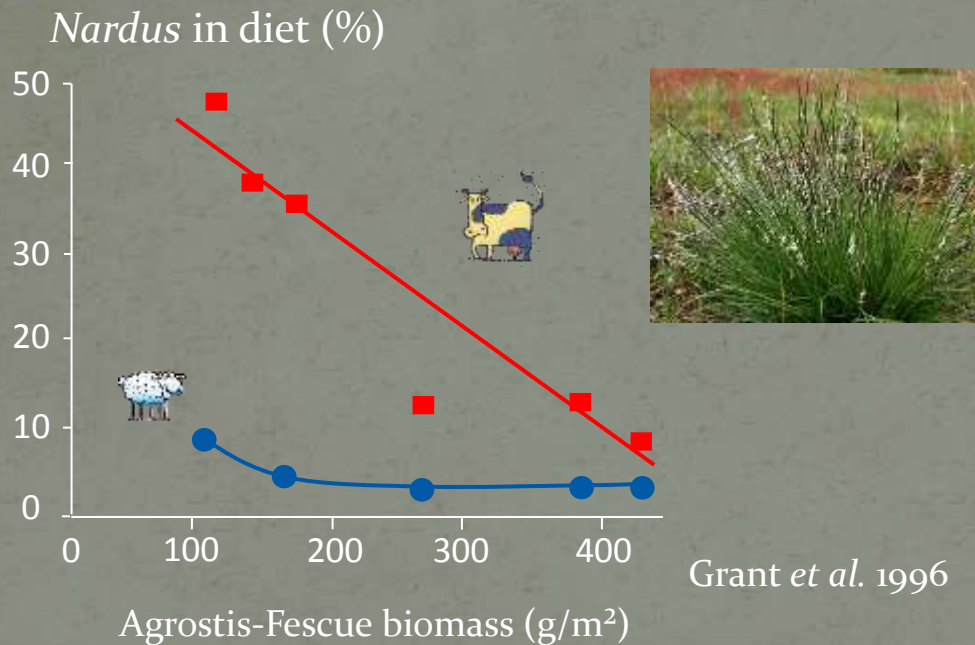
Mesophile grasslands




Large stable patches more frequent in lightly-grazed, productive swards


Livestock species and breed

- Size matters !!!
 - Differences in requirements / gut capacity, in the ability to sort out preferred items and graze short swards, in digestive capacities



After 5 years, *Nardus*:

55-86% 

30-55% 

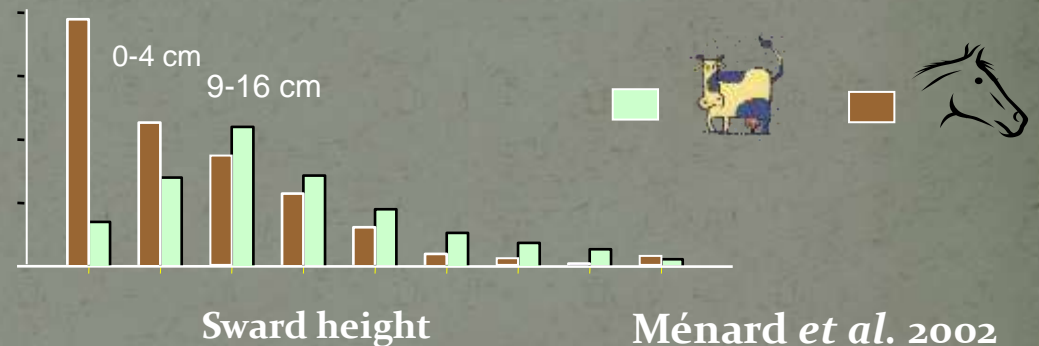
- In temperate grasslands, \neq in size and experience in the young age explain most breed effects; stronger effects in constraining environments (Sæther *et al.*, 2006)

Horse grazing

Two rows of teeth → Grazing short lawns



Time spent grazing (%)



→ Stable patches in horse-grazed pastures

Different digestive regulation → Roughage consumption

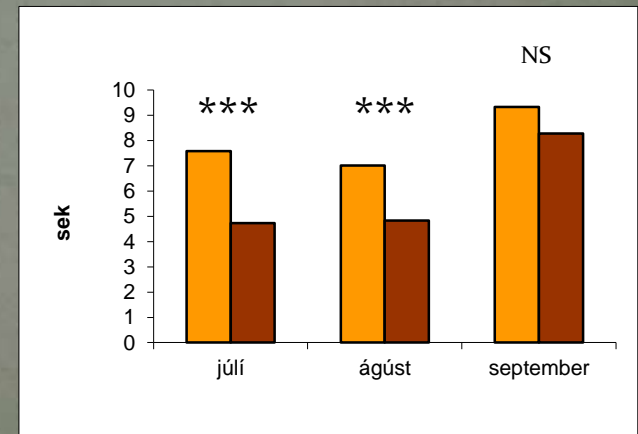
→ Impact on sward composition

Biodiversity affects foraging behaviour

- Grazing horses in W-Iceland
- Two areas
 - High biodiversity - 30 species
 - Low biodiversity - 10 species
- Time at each feeding station (*Marginal Value Theorem* as a reference model)
 - Gain at each station
 - Traveling time between stations
- Stay shorter at each feeding station in high biodiversity
 - More to gain at the next station...

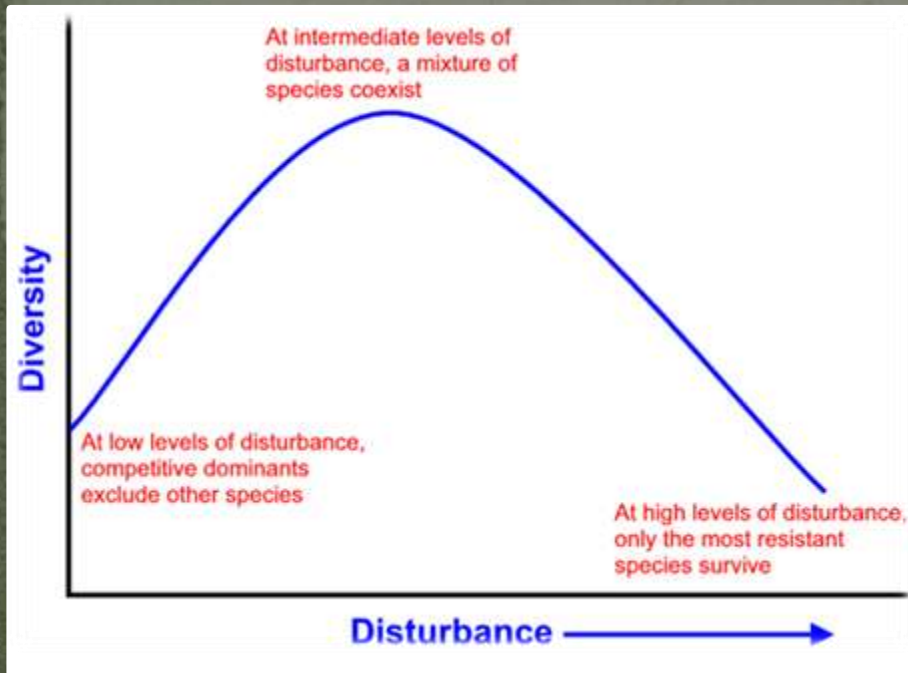


Feeding station

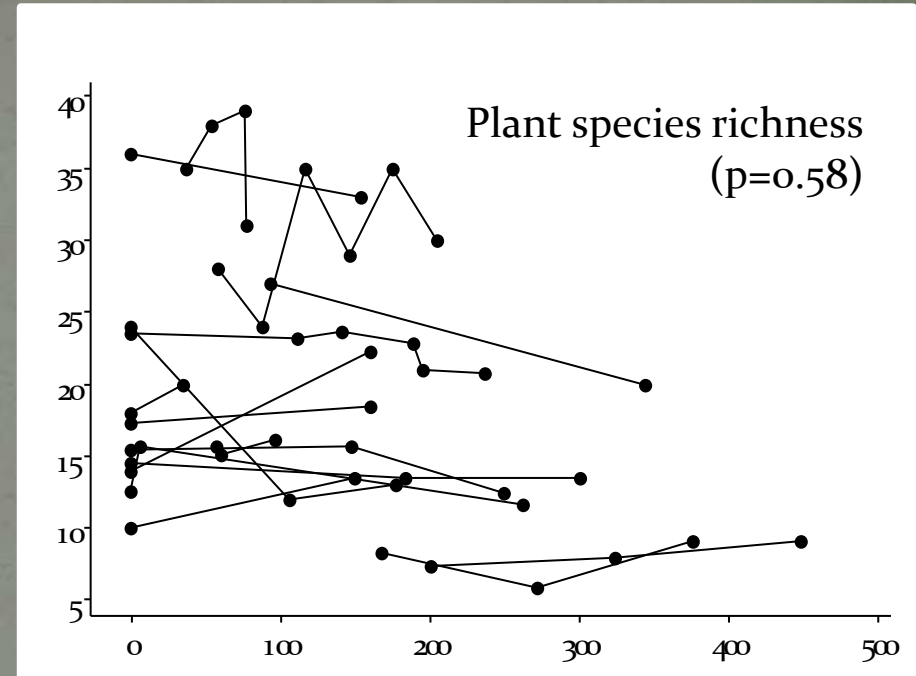


Time at each feeding station

Grazing intensity



Grazing intensity (LU.day/ha)



Grazing intensity (LU.day/ha)

Scohier & Dumont 2012

Observations did not fit predictions of the theoretical model !!!

Need to be tested with other species

Shifts in functional group abundance more rapid than changes in sp. richness

Grazing intensity



Butterfly dynamics matches that of flowering plants → Trophic hypothesis
(Loertscher *et al.* 1995; Collinge *et al.* 2003; Öckinger *et al.* 2006)

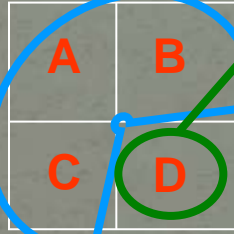
Sward heterogeneity provides more diverse habitats and microclimate → Habitat heterogeneity hypothesis (Dennis *et al.* 1998; Wallis De Vries *et al.* 2007)

Less risk of negative direct effects (Lenoir & Lennarston 2010)



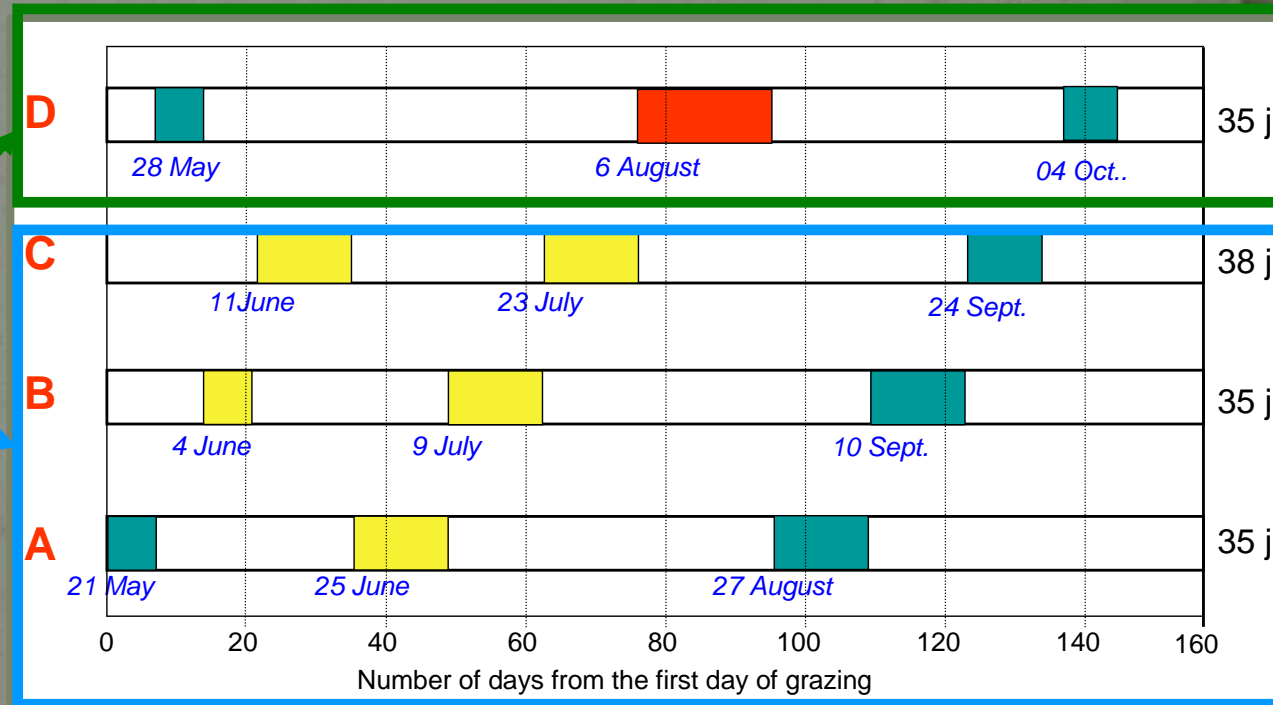
Grazing period

Continuous grazing



7  / plot (3,6 ha)

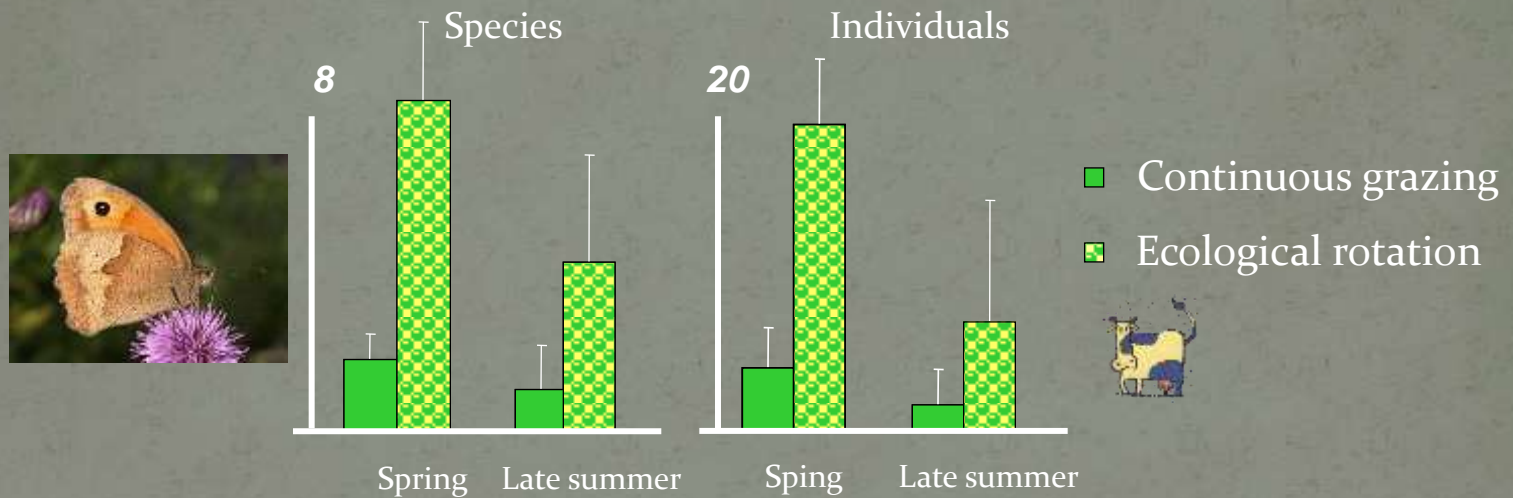
Ecological rotation



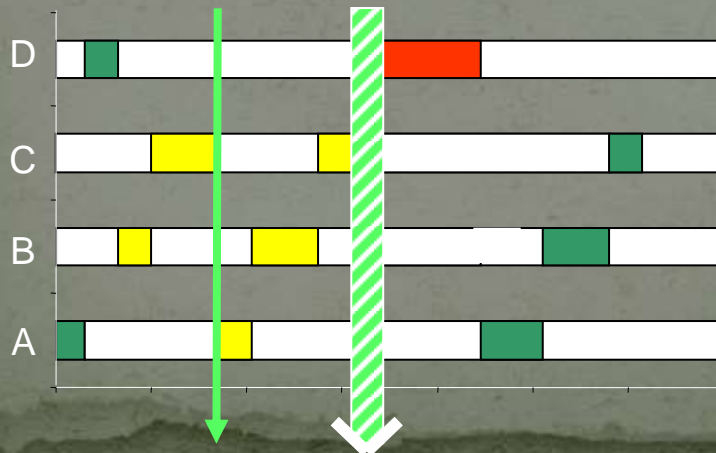
Preserving flowering intensity and sward heterogeneity is assumed to benefit nectar-feeding insects

Grazing period

Ecological rotation increased flowering intensity and sward heterogeneity



Farruggia *et al.* 2012



-19% grazing d. a year of poor spring growth

Grazing period

Benefit was lesser in sheep-grazed pastures



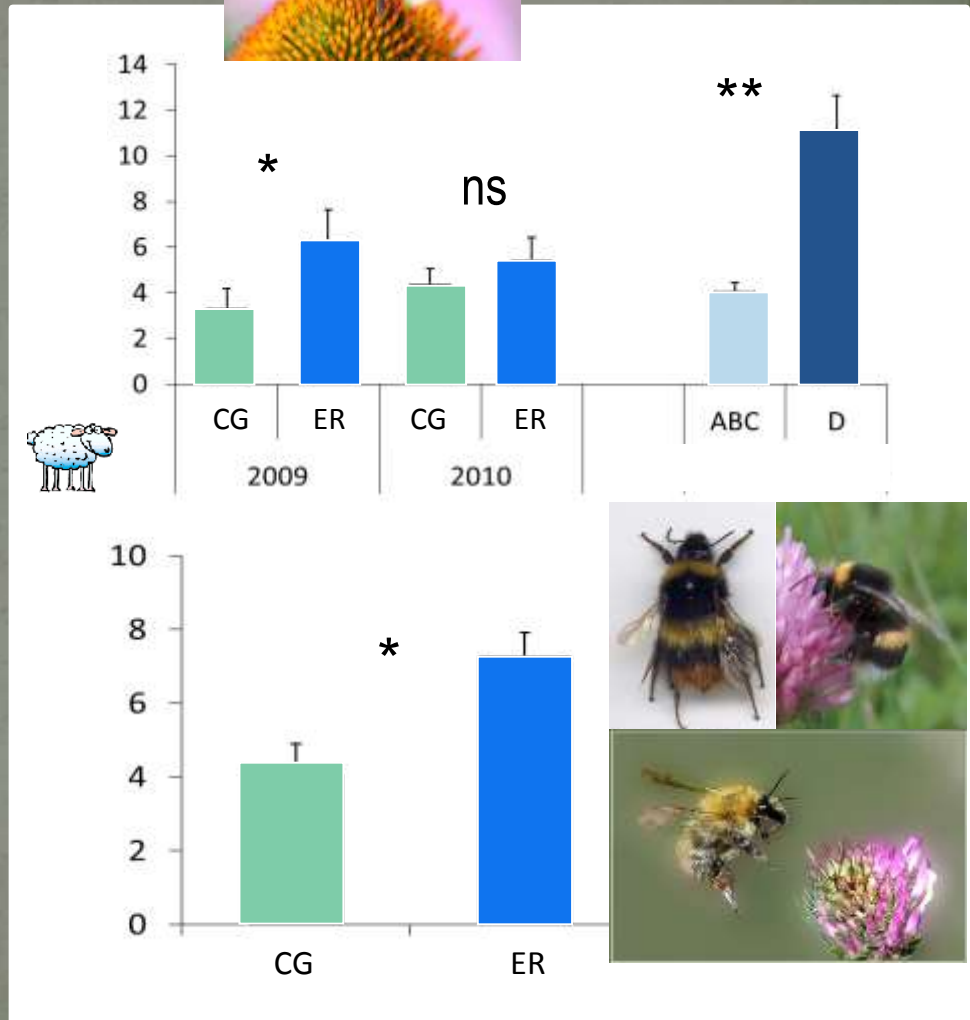
CG = ER

Same daily liveweight gain

Context affects the success of grazing practices!

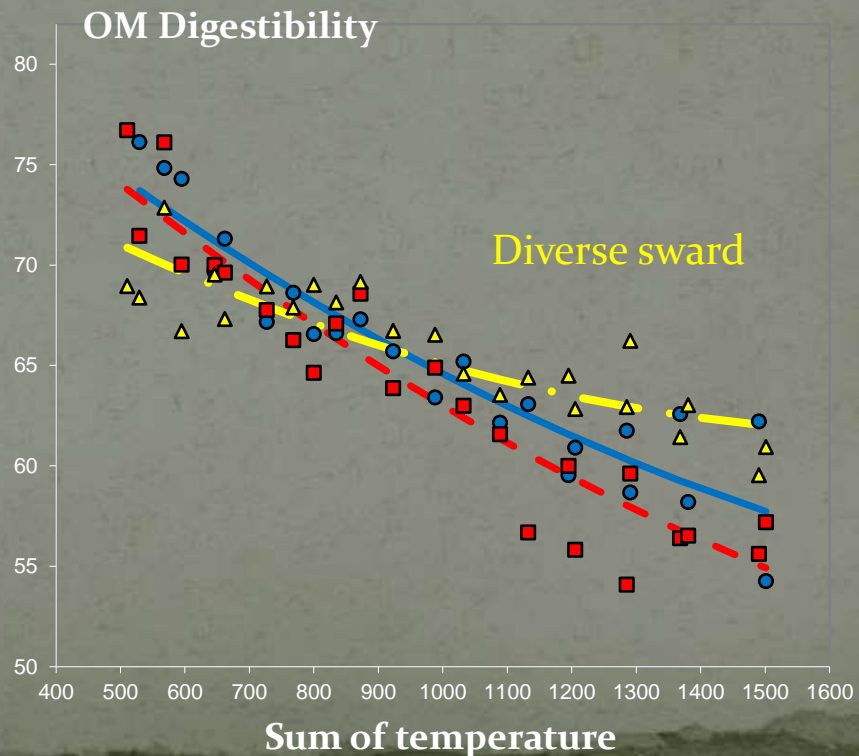


Density



Biomass, dynamics of sward production

- Greater stability of biomass production in diversified grasslands due to variability in plant species response to abiotic conditions, and asynchronicity of these responses (Yachi & Loreau 1999; Tilman *et al.* 2006)
- Greater stability in the digestibility of diverse swards (Michaud *et al.* 2011)



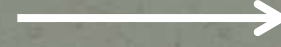
Milk from diverse pastures is richer in fatty acids (benefit to human health)



Maize silage



Lowland pastures



Diverse upland pastures

C18:3n-3 (omega 3) +1,0

CLA-c9t11 +0,6

(Ferlay *et al.* 2006, 2008)

+0,8 (g/100 g AGT)

+1,3

(Lucas *et al.* 2006; Chilliard *et al.* 2007)



The abundance and diversity of dicotyledonous plants reduce ruminal biohydrogenation, which leads to a weaker transformation of omega 3 and CLA in the rumen

A simple way to express services provided by each sward type

Provisioning services

❖ Yield



❖ Production seasonality

At 400 °C 60% of grass are vegetative

At 800 °C 80% of grass culms above 10 cm soil level

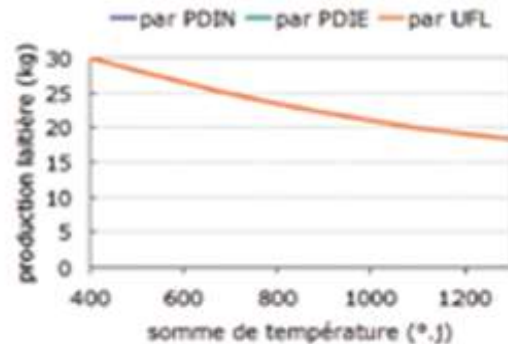
❖ Forage nutritive value



❖ Management flexibility



❖ Allowed milk production



A simple way to express services provided by each sward type

Provisioning services

❖ Yield



❖ Production seasonality

At 400 °C 60% of grass are vegetative

At 800 °C 80% of grass culms above 10 cm soil level

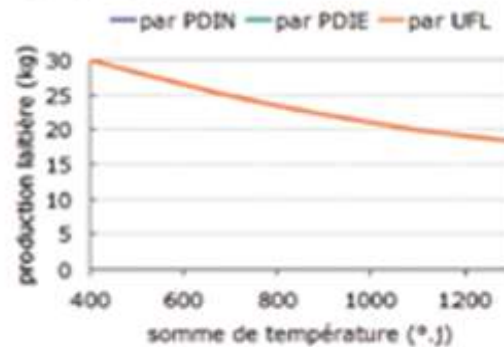
❖ Forage nutritive value



❖ Management flexibility



❖ Allowed milk production



Cheese quality



❖ Organoleptic potential

Colour

4/4

Flavour

1/4

❖ Nutritional potential

Antioxydes

3/4

Insaturated fatty acids

3/4



A simple way to express services provided by each sward type

Provisioning services

❖ Yield



❖ Production seasonality

At 400 °C 60% of grass are vegetative

At 800 °C 80% of grass culms above 10 cm soil level

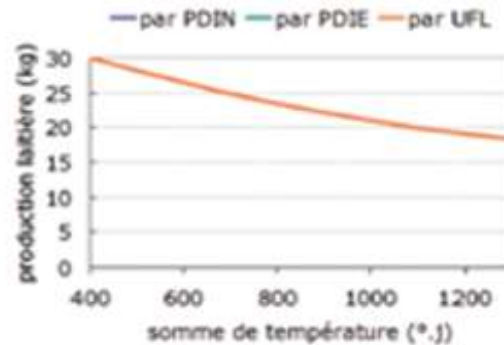
❖ Forage nutritive value



❖ Management flexibility



❖ Allowed milk production



Regulating/cultural services

❖ Carbon sequestration



❖ Botanical patrimonial interest



❖ Colour diversity



❖ Pollinisation impact



❖ Fauna



Cheese quality



❖ Organoleptic potential

Colour

4/4

Flavour

1/4

❖ Nutritional potential

Antioxydes

3/4

Insaturated fatty acids

3/4



Basis for a multifunctional diagnosis tool to characterise services at farm scale



Designed for farmers and extension services



System description

Farm plots

Diversity of vegetation types, practices, grazing intensity

Herd

Animal requirements, milk yield, calving dates, concentrate



Analysis

(4 aggregated criteria)

Forage system 'consistency'

Forage autonomy (PDO rules)

Ecosystem services

Quality of dairy product (cheese)



Take-home messages

- Grazing history led to different views of the role of livestock grazing with regard to grassland biodiversity
- Cows, sheep and horses have a role to play
- Taking account of fertility, grazing intensity, grazing period allows to define proper management
- Highlight the benefits of sward diversity and heterogeneity
- Diverse swards provide a wide range of ecosystem services
- New tools need to be developed to assess sward and forage system multifunctionality

Thanks for your attention



24-26 June 2014, Clermont-Ferrand, France

Forage resources and ecosystem services provided by Mountain and Mediterranean grasslands and rangelands

Joint meeting of "Mountain Pastures, Mediterranean Forage Resources and Mountain Cheese" networks

Field trip on Wednesday 25



Topics

- Forage diversity, production and tiller recruitment capacity, assessment of risk
- Efficiency: from soil to plate and bowl
- Management of forage and livestock resources
- Forage performance of grassland systems in a context of global change



- Meeting web site: www.jmfao2014.com
- Contact: contact@jmfao2014.com

Meeting venue

Workshop floor
100 rue de Clermont
63000 Clermont-Ferrand - 04 77 12 12 12

2014 conference: 04 77 12 12 12
http://www.sudagro.org/2014/mediterranean-forage-resources-and-rangelands

JOINT MEETING OF THE "MOUNTAIN PASTURES, MEDITERRANEAN FORAGE RESOURCES - CHEAM) AND MOUNTAIN CHEESE" NETWORKS

24-26 June 2014
Clermont-Ferrand, France

Forage resources and ecosystem services provided by Mountain and Mediterranean grasslands and rangelands



PARALLELIZATION OF THE MEETING

Thanks to the financial support of the "Mediterranean Forage Resources and Mountain Cheese" networks

The meeting concerns the sustainable utilization of forage resources by livestock, livestock in conventional environments (pastureland and Mediterranean areas), in semi-arid and/or arid environments (low to medium production, persistence of high environmental value and high quality), the sustainability of small production units of their dairy, in recently eroded performance based on the value, value of high quality animal products, and ecological performance based on the preservation of biological diversity relying on high value for animal and driving components systems.

The Mediterranean meeting aims at identifying key aspects, methods and tools of specialized systems working in arid and semi-arid conditions and allowing in a context of climate change and environmental changes, livestock farming systems in Mediterranean and surrounding areas their focus centered in forage production, which can be used with its own unique resources and Mediterranean farm units (cultivated or spontaneous vegetation, herbaceous or leguminous species, arid forage resources, shrubs or succulent forage), or non-plantary based, contributing to the multiple performance of farm food systems.

The meeting will deal with questions related to forage production, resource use, efficiency, use of forage resources in livestock, and disease risk control. The spatial public-consultation from plate and to publicly used livestock farming systems and landscape. The meeting will explore these various systems in the Mediterranean and we focus on doing which these pathways will be used.



	Mountain IOP area	Mediterranean IOP area	Mediterranean IOP area
Morning	08:00 Registration 08:30 Opening session 09:00-10:00 Coffee break	08:30-10:00 - Mediterranean IOP Forage resources and ecosystem services Breakfast and self-communication	08:00-08:30: The mountain environment Presented by local research teams 10:00-10:30: Coffee break 10:30-11:00: Mediterranean IOP Forage resources and ecosystem services Breakfast and self-communication
	11:00-12:00 Lunch		11:00-12:00: Mediterranean IOP Forage resources and ecosystem services Breakfast and self-communication
Afternoon	13:00-14:00 Lunch	13:00-14:00: Mediterranean IOP Forage resources and ecosystem services Breakfast and self-communication	13:00-14:00: Mediterranean IOP Forage resources and ecosystem services Breakfast and self-communication
Evening	18:00-19:00 Dinner and self-communication	18:00-19:00: Mediterranean IOP Forage resources and ecosystem services Breakfast and self-communication	18:00-19:00: Mediterranean IOP Forage resources and ecosystem services Breakfast and self-communication

MAIN DATES

- 14 September 2013: Opening of the call for abstract submission
- 10th October 2013: Deadline for abstract submission for abstract presentation
- 11 February 2014: Deadline for the abstract to send the online version of abstract submission
- 14th April 2014: Deadline for registration payment by email from all participants
- 15-16 June 2014: Meeting in Clermont-Ferrand
- 15 September 2014: Submission of abstracts (self-communication) and abstracts for the meeting website

Open questions

The proceedings of the Joint Meeting (JMFAO) concerning the mountain and Mediterranean forage resources and ecosystem services will be published in the form of a book, which will be distributed to the participants. The volume will be published in the form of the abstracts of the congress and in 2015 (2014).

2nd Mediterranean Forage Resources

The idea will be proposed to the participants. Following the 1st and 2nd Mediterranean Forage Resources, system management, analysis and products.

3 other reasons to come to Clermont

- Nice landscapes and the only other place in Europe where you can find andosols (Helgadóttir *et al.*, 2013)
- Akureyri is the most beautiful town in the World and where you can eat the best lamb...

... but Clermont-Fd is the second most beautiful town in the World and where you can eat the best cheese!

- « Clermont-Ferrand has the best rugby team in Europe, second best is Munster » (J.D. Murphy, pers. comm.)