

Grassland farming and land use management systems in mountainous regions

Grassland biodiversity in a mountainous PDO cheese area in France : do organic and cheese production systems provide higher biodiversity ?

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The BIG-Diva project (2008-2011, French ministry of ecology)

Biodiversity and Geographical Indications : how local actors adopt or not the stake of safeguarding biodiversity, and convey it into actions in Protected Denominated Origin cheese areas

- ◆ Two PDO cheese areas in the Auvergne (French Massif central) based on grassland : Saint Nectaire and Salers
- ◆ A multidisciplinary approach : agronomists, ecologists, economists
- ◆ Different analysis scales : territory, farm, plot, vegetation facies

Grassland biodiversity and its determining factors in the dairy farms of the PDO cheese areas

Impact of farming systems

Two hypothesis :

Organic farming : *higher biodiversity due to less intensive practices and more attention to natural elements*

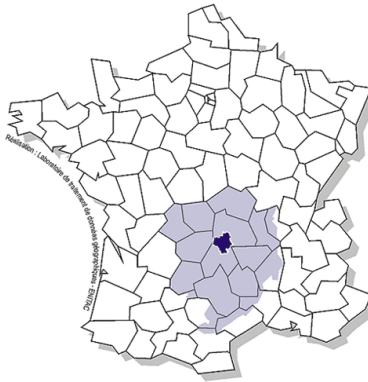
Cheese production : *higher biodiversity due to more attention to the link between flora diversity, forage practices and cheese quality, image of a PDO product*

→ Test on the **Saint-Nectaire** PDO cheese area

The Saint Nectaire PDO area

◆ A mountain area

- 1900km²
- 800 to 1800 m elevation
- Mainly grassland systems



◆ Saint-Nectaire PDO cheese production

- the 5th rank of the 29 French PDO cheeses
- 921 dairy farms :

*84 ha farming area, Montbéliardes and Prim'Holstein
4550 liters /cow/year , 0.9 Livestock Unit /ha*

- about 45% of total tonnage is made in farms by breeders
- few organic farming



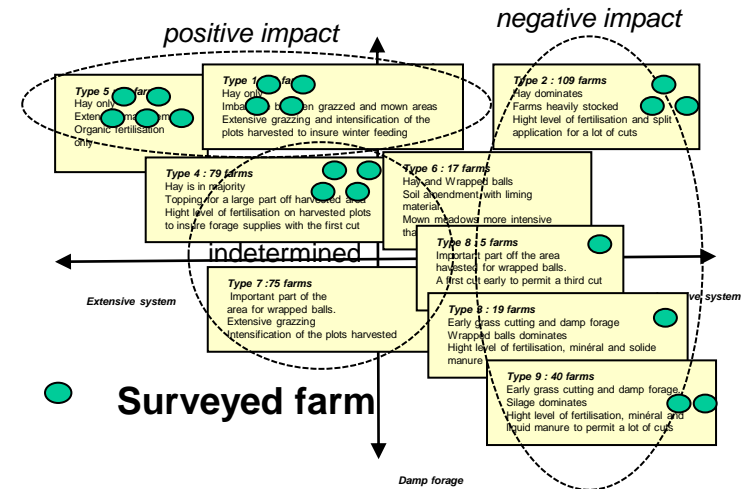
◆ New specifications for the Saint Nectaire PDO (2015-2020)

- no maize, no damp forage
- 90 % permanent pastures, grass diet only from the PDO area
- grassland management : < 130 kg N /ha (<60 mineral N/ha)
- all cows have to be born and bred in the PDO area



Material and methods

- ◆ A forage system typology in the PDO area
 - 18 variables for 455 farms
 - characteristics of the fodder systems as regards their potential impact on biodiversity
- ◆ Surveys in **20 dairy farms**



Number of farms	Organic	Conventional	
Cheese producer	3	5	8
Only milk producer	4	8	12
	7	13	20

- description of the fodder and livestock system and the main practices
- ◆ A simplified assessment of floristic and faunistic grassland diversity

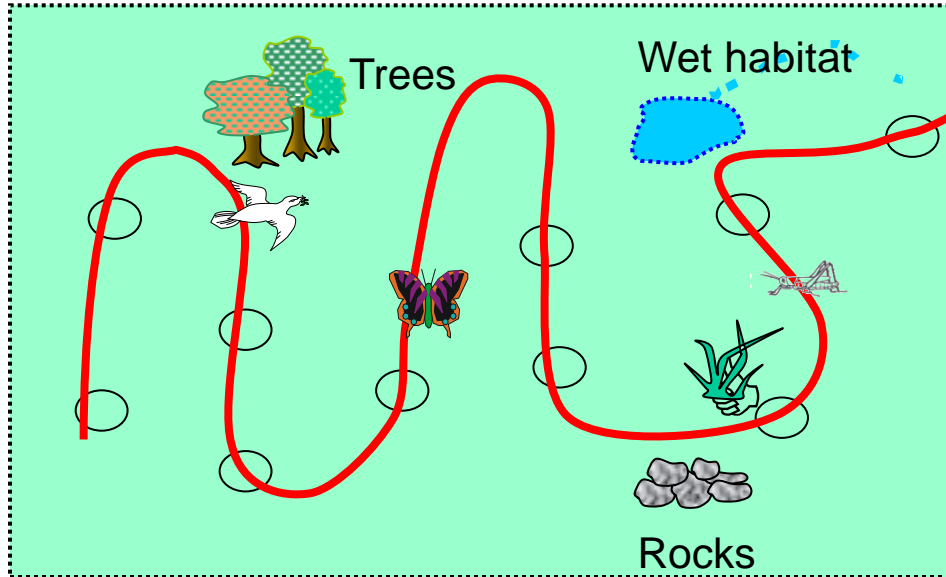
Three plots for each surveyed farm :

- two typical plots of the farming system :
one only grazed, one mown
- the most diversified one according to the farmer

58 plots (1 to 20 ha)
→ 75 vegetation facies
(42 mown, 33 grazed)

Biodiversity assessment

A method based on **simplified field observations** :



- **Landscape elements**

- **Fauna countings** : size, colour, individuals...

- **Flora countings** : colours, flowers, physiognomy...

Indicators ⇒ **assessment grids**

⇒ **Five diversity components** :

- fauna : **birds, butterflies, orthopterans** *plot scale*

- flora : **herbaceous vegetation, landscape elements** *vegetation facies scale*

⇒ **Five diversity levels** : 1 (low) to 5 (high) in reference to regional values for different kind of meadows (*grazed / mown*)

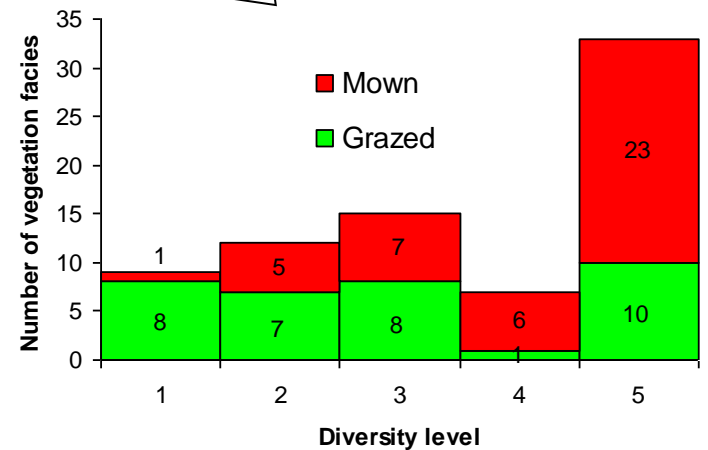
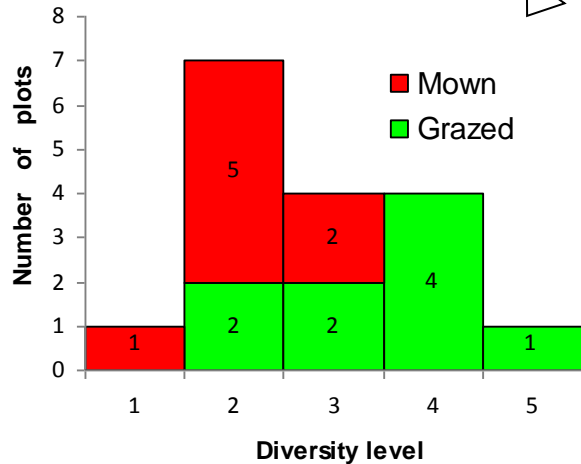
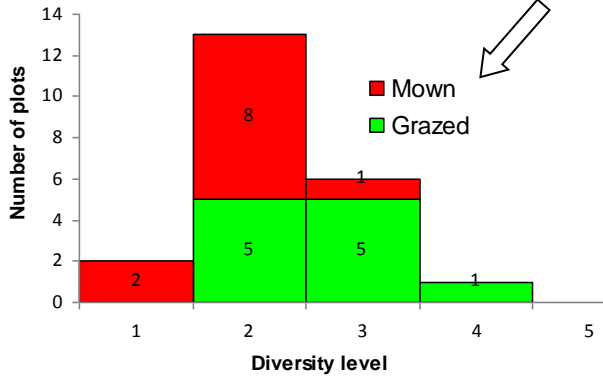
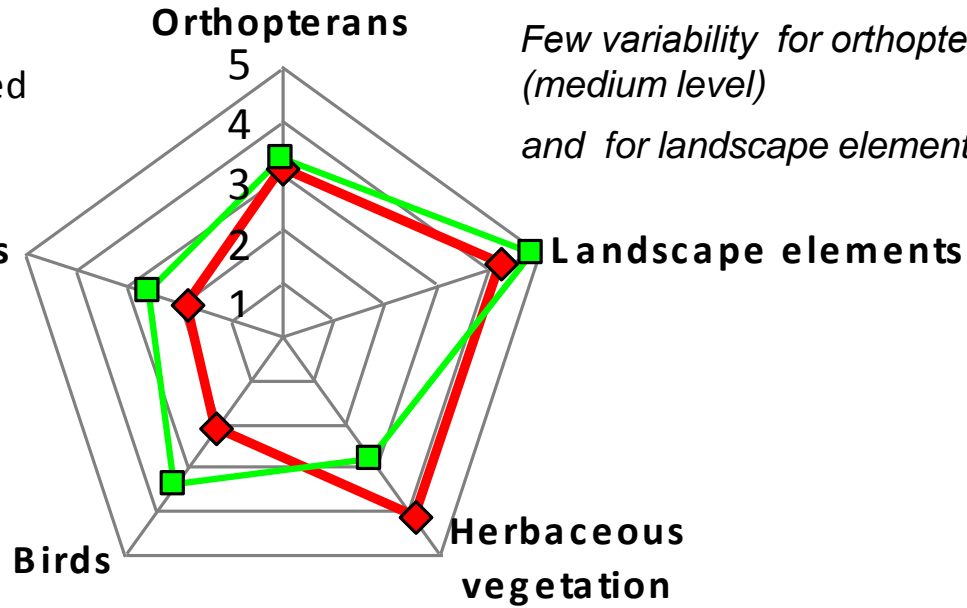
Grassland biodiversity in the Saint Nectaire PDO area

(58 plots, 75 vegetation facies)

Diversity levels

- 1 low
- 2 medium low
- 3 medium
- 4 medium high
- 5 high

- ◆ Mown
- Grazed



Grassland biodiversity in conventional and organic systems

Comparison : One way variance analysis with 4 combinations (use×system)
Multiple comparison test (LSD)

Average diversity level for conventional and organic plots

Biodiversity component	Mown		Grazed		P-Value
	Conventional	Organic	Conventional	Organic	
Flora-Landscape elements	4.6 ^{ab}	4.3 ^a	4.8 ^{ab}	5.0 ^b	0,20
Flora-Herbaceous vegetation	3.8 ^b	4.7 ^c	2.3 ^a	3.7 ^b	0***
Fauna-Birds	2.6 ^a	2.0 ^a	4.0 ^b	2.8 ^{ab}	0,03*
Fauna-Butterflies	1.6 ^a	2.3 ^{ab}	2.5 ^b	2.8 ^b	0,03*
Fauna-Orthopterans	3.7 ^a	3.7 ^a	4.2 ^a	4.2 ^a	0,55

Diversity level from 1 (low level) to 5 (high level),

P value of the variance analysis : *** : $P < 0.001$, ** : $P < 0.01$, * : $P < 0.05$

a, b, ab : results of the LSD test for each diversity component, a same letter (in a line) means that there is no statistical difference between data

- ◆ No difference for landscape elements and Orthopterans
- ◆ Birds and Butterflies diversity : difference due to use (mown or grazed)
- ◆ Herbaceous vegetation : one diversity level higher for organic farming

Herbaceous vegetation indicators for conventional and organic facies

Herbaceous vegetation indicators	Mown		Grazed		P value
	Conventional	Organic	Conventional	Organic	
Total species number	37.9 ^a	42 ^{ab}	39.1 ^a	47.3 ^b	0.08
Mean species number	14.2 ^a	17.4 ^b	12.6 ^a	16.7 ^b	0.0001***
Flower shapes number	12.7 ^{ab}	14.0 ^b	11.5 ^a	14.3 ^b	0.0122*
Total colour number	8.1 ^{ab}	9.1 ^c	7.3 ^a	8.6 ^{bc}	0.003**
Mean colour number	4.2 ^b	5.3 ^c	3.3 ^a	4.5 ^b	0.0000****
Pink, blue, violet colours	7.5 ^b	8.9 ^b	5.6 ^a	7.4 ^b	0.0016**
Butterflies types			2.6 ^a	3.0 ^a	0.4697

◆ **Always higher indicator value for organic vegetation facies and significant difference for five indicators**

◆ Same proportion of « most diversified » plots in organic and conventional systems (mown : 40 % , grazed : 20%)

⇒ **Positive impact of organic farming on herbaceous vegetation diversity**

◆ **Less intensive organic grassland management** : no chemical fertilizer (but same total NPK as conventional) , more late harvesting (58% against 35% for conventional), lower stocking rate on pasture (0.79 LU/ha against 0.97)

Grassland biodiversity in only milk and cheese production systems

Average diversity level of the plots for milk and cheese producers

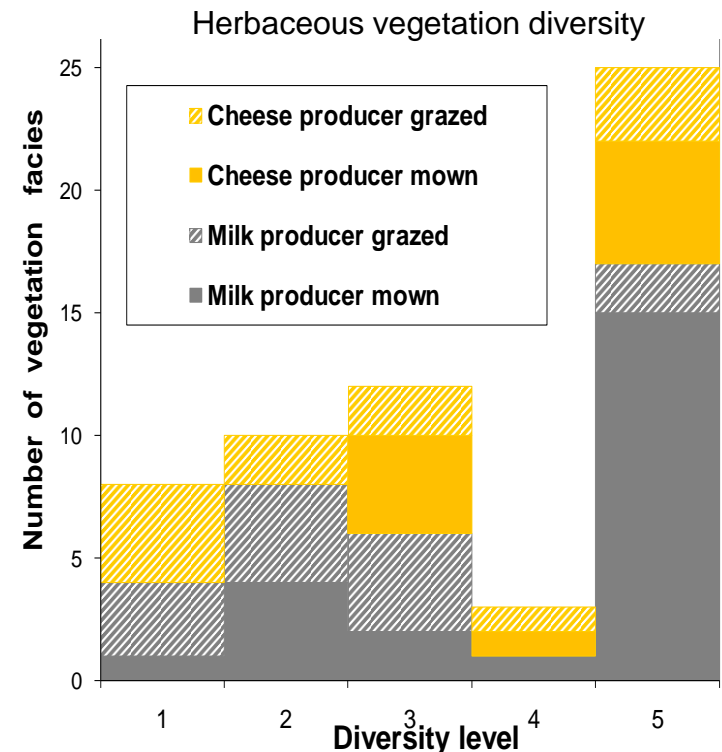
Biodiversity component	Mown		Grazed		P-Value
	Milk	Cheese	Milk	Cheese	
Flora-Landscape elements	4.5 ^a	4.4 ^a	4.9 ^a	4.8 ^a	0.397
Flora-Herbaceous vegetation	4.1 ^b	4.2 ^b	2.5 ^a	3.1 ^a	0.0005***
Fauna-Birds	2.2 ^a	2.5 ^{ab}	4.0 ^b	3.0 ^{ab}	0.110
Fauna-Butterflies	1.9 ^a	2.5 ^{ab}	2.6 ^{ab}	2.7 ^b	0.109
Fauna-Orthopterans	3.7 ^a	3.7 ^a	4.1 ^a	4.3 ^a	0.513

Diversity level, P value, and a, b, ab : see explanations table 1

◆ **Difference only for herbaceous vegetation but due to use (mown > grazed)**

Cheese production system : no diversity level under 3 (medium) for mown grassland

- ◆ Same proportion in each system of :
 - organic farming (1/3)
 - Extensive and intensive practices (1/2)



Discussion and Conclusion

- ◆ **High landscape diversity** (within a grassland plot) **for all systems**
- ◆ **Surprising low fauna diversity**
less data for fauna : plot scale, surface limitation (*under 5 ha for butterflies and orthopterans, over 5 ha for birds*), climate conditions in 2008
- ◆ **Herbaceous vegetation : hypothesis of higher diversity verified for organic farming but not for cheese production systems**

- Organic farming : positive impact on **species number, colour, flower**

Supposed effect of organic management on grassland biodiversity :

no chemical N ⇒ later growth of the grass

less competition, delayed harvesting or grazing

➔ **Dairy organic farming and organic cheese production should be more supported by the PDO organization**

Future : the new Saint Nectaire PDO specifications will limit grassland intensification
= a first step for biodiversity conservation



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