

Impact of grazing on the richness and biomass of plant communities in Mediterranean temporary ponds (Morocco)

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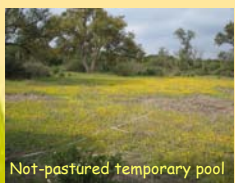
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Introduction

Because of increasing anthropogenic disturbances, the conservation of plant communities is becoming a priority for scientists (Hobbs et al., 1992). In Morocco, natural ecosystems in general and wetlands in particular are severely threatened. Among them, temporary ponds constitute important reservoirs for endangered biodiversity (Rhazi, 2001). The uncontrolled human activities (grazing, agriculture, urbanism ...) were shown to induce profound changes of their vegetation structure and composition, and to lead to a decrease in their species richness. In Mediterranean wetlands, characterized by high productivities, grazing is often used as a tool for managing the maintenance or restoration of biodiversity (Gordon et al., 1990; Mesleard et al., 1991). However, the impact of human's activity, and especially of cattle grazing, on the plant communities of vernal ponds, is still largely unknown.



The presented study aims to provide insights in order to highlight the influence of grazing, which represents the main disturbance of vernal pools in the Benslimane region (west Morocco). We will evaluate the respective influences of:

- 1- Grazing and environmental factors (mainly hydrology) on the structure of plant communities;
- 2- Grazing and topography on species richness and productivity;
- 3- Grazing and climate on the abundance of not-grazed plants in temporary ponds.

Materials and methods

In order to study the impact of grazing on plant diversity, six temporary ponds located in western Morocco (forests of Benslimane) were selected: three not-grazed ones (hunting reserves) and three grazed ones (cattle and sheep).

Water depths were measured and vegetation surveys were performed at 3 dates in 2006-2007 (March, May, June) on quadrats (0,3 x 0,3 m divided into 9 squares of 0,1 x 0,1 m) distributed along 2 perpendicular permanent transects crossing the deepest zones of the ponds.

The species abundances were measured on each quadrat as the number of squares occupied. In addition, to study the productivity of these habitats, 9 plots were established under different water depths in each grazed and not-grazed pond, and 9 supplementary control plots were installed in each not-grazed pond. Within each plot (1m²), divided into 4 squares, the vegetation was taken, separated by species and dried in an oven, at 60 °C during 2 days.

The plants present in the plots were classified into 4 ecological categories: grasses, forage plants, not-grazed plants, and legumes. Moreover, they were characterized as annual/perennial and hydrophilous/terrestrial. The biomass measures were treated with the non-parametric test of Kruskal-Wallis, and the vegetation dynamics was analysed using a correspondence analysis (CA).

Results and discussion

1-Biomass production

The use of vernal ponds (grazed or none) and the topographic level have significant impacts on the biomass productivity ($F=52.7$, $ddl=1$, $p<0.0001$; $F=8.7$, $ddl=2$, $p<0.0006$, respectively), as well as their interaction ($F=5.5$, $ddl=2$, $p<0.0072$). The biomass of the not-grazed ponds is almost twice the one of the grazed ponds ($p<0.05$), with respectively 25.7 g/m² and 13.8 g/m².

During the study, the biomass significantly decreased ($p<0.0001$): high in March, it regressed in June to disappear in September (Figure 1A).

The analysis of plants based on the ecological categories suggests that the biomass of grazed and not-grazed ponds is dominated by forage plants, followed by not-grazed plants, grasses and legumes (Figure 1B). All categories disappear during the dry season (summer), highlighting the control of climate (hydrology) on the abundance of the not-grazed vegetation of the temporary ponds.

The produced biomass varies significantly with the topographic gradient for both grazed and not-grazed ponds ($F=6.90$, $p<0.01$; $F=13.70$, $p<0.01$, respectively).

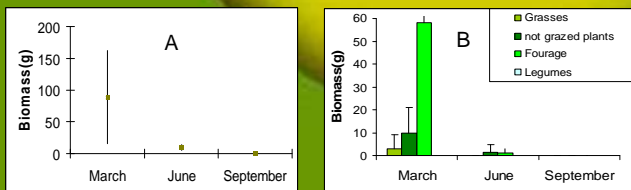
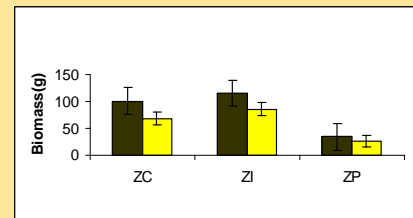


Figure 1. Variation of the total biomass in time (A) and in function of ecological categories (B)

The biomass is important in the central and intermediate belts, in comparison with the periphery (Figure 2). This could be related to longer inundation periods or to higher water depths, which favour the dominance of perennial hydrophilous plants (*Bolboschoenus maritimus*, *Eleocharis palustris*) in the central and intermediate belts of the ponds.

Figure 2. Biomass production in not-grazed (green) and grazed (yellow) ponds, in function of the topographical gradient (central, intermediate and peripheral zones)



2- Structuring of vegetation

The two first axes of the AC (Figure 3) explained 34.42% and 25.84% of the total variance, respectively. The axis F1 opposes hydrophilous species (*Ranunculus peltatus*, *Bolboschoenus maritimus*, *Myriophyllum alterniflorum*...) to terrestrial ones (*Cistus salvifolius*, *Asphodelus cerasifer*...). The axis F2 opposes the most common species of grazed ponds (*Glycyrrhiza foetida*, *Medicago polymorpha*...) to the most common ones of not-grazed ponds (*Plantago coronopus*, *Carex divisa*...).

The first axis thus represents the hydrological gradient structuring the plant communities in temporary ponds, while the second one correspond to a gradient of disturbance by grazing.

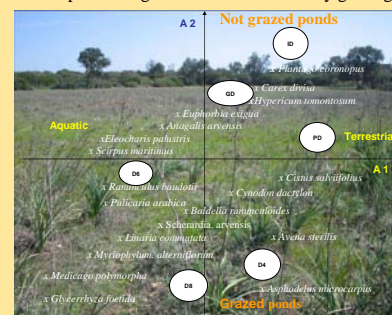


Figure 3. Plot of the CA performed on the vegetation composition in grazed ponds (D4, D6 et D8) and not-grazed ponds (D4, ID, PD).

3- Richness of plant communities

The relative richness in hydrophilous plants and in annual hydrophilous species is significantly higher ($p<0.0001$) for grazed ponds than for not-grazed ones (Figure 4).

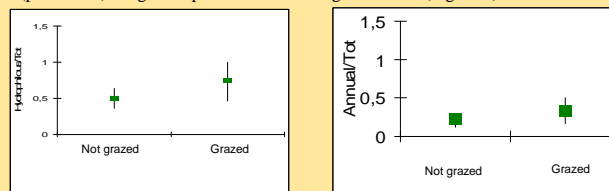


Figure 4. Influence of grazing on the proportion of hydrophilous species (left) and of annual hydrophilous species (right).

This is the contrary for terrestrial and annual terrestrial plants, which are significantly ($p<0.0001$) more abundant in not-grazed ponds than in grazed ones (Figure 5).

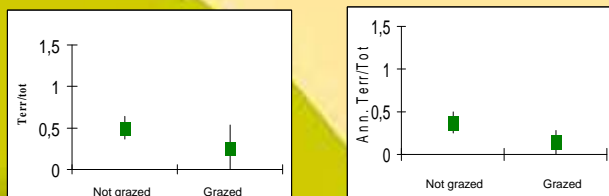


Figure 5. Influence of grazing on the proportion of terrestrial (left) and annual terrestrial species (right).

These results show that grazing in temporary ponds favors the expression of preferential pond species by creating openings and by controlling the expansion of competitive species, and particularly of perennial terrestrial ones.

Conclusion

Despite our results are preliminary, they allow a first estimation of the importance of grazing in the temporary ponds of western Morocco.

First, they confirm the major influence exerted by hydrology on the structure and composition of plant communities (Rhazi, 2001). Second, extensive grazing of ponds seems to allow preservation of plant richness, including preferential pond species, which constitute key elements for conservation purpose. Finally, the lack of grazing could be responsible of changes of vegetation structures, and to induce the decrease in species richness along with the closing of vernal ponds.

This suggests that grazing of temporary ponds could maintain the species richness and favor pioneer species by limiting the competition. Therefore, grazing could be used as a practice for sustainable management of temporary ponds and their biodiversity.