Impact of physical soil disturbance on the vertical distribution of seed banks and the above ground plant community composition in a Mediterranean temporary pond (Western Morocco): preliminary results

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Abstract:

Moroccan temporary ponds are regularly visited by cattle and wild boars, causing strong disturbance of the surface soil. We experimentally studied the impact of this disturbance on the vertical distribution of the seed bank and the above ground plant community composition in a temporary pond (Benslimane Forest) in Western Morocco in 2006-2007.

*From the edge to the centre of the pond we created 8 undisturbed and 8 disturbed (man-made ploughing) plots (120 cm*120 cm). In each plot, we took 4 soil samples (cylinders of 4 cm diameter and 4 cm depth). Each sample was then divided into 4 slices of 1 cm (64 samples in total) and incubated in the laboratory for germination. The vegetation cover on the entire parcel was measured at 3 dates (March, April, May) and the total seed bank density was calculated for each soil sample.*

The results show that soil disturbance (1) has a significant impact on the vertical distribution of the seed bank, which no longer showed stratification between surface sediment and depth compared to witness (2) reduces the vegetation coverage, but does not significantly affect its total species richness (3) changes the community composition, promoting typical temporary ponds species, including perennials.

Introduction:

In Morocco, temporary pools are wetlands with a high conservation value, and an original flora (Grillas et al 2004). They are regularly used for pasture (cattle, sheep) and by large wild herbivores (wild boars) witch lead to the mixing of soil surface. The impacts of these disturbance on the species richness, the species composition of plant communities and the vertical distribution of the seed banks is not known. This work aims to:

1-Study the seed bank vertical stratification after one soil disturbance.

2-Study the effects of disturbance of superficial soil on species richness and plant cover of temporary pool (edge and centre).

Materials and methods:

In one Moroccan temporary pool in Benslimane forest (Western Morocco) we created 16 plots (1m20*1m20) in December 2006, respectively 8 at the centre of the pool, and 8 at the edge. In each zone, the superficial soil (0.1m) was mixed (man-mad plough) (=disturbed plots) and 4 were maintained undisturbed(= control). From each plots we cored one soil sample (cylinder of 4cm diameter and depth) each sample was then divided into 4 slices of 1cm (64 samples in total).

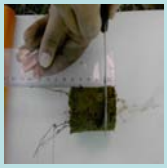
At the laboratory, samples were weighted, then spread into a layer about 1cm thick in a perforated dish on a layer of synthetic absorbent tissue on a top of a 1 cm layer of previously washed and sterilised sand. The samples were arranged at random and watered daily (until 27 Jun). The seedlings that germinated were counted and were removed after identification.

The cover of species coverage was measured at 3 dates (Mars, April, May 2007) using a quadrat system (0..3*0.3m). The impact of disturbance and topography (zone) on species richness and land cover was tested using ANOVA test and multiple regression models.

Soil seed density/gr was calculated for each of the 4 layers(1cm, 2cm, 3cm, 4cm) The differences in soil seed density was compared between treatment and topography with ANOVA test (data square root transformation). Additionally, the effects of disturbance, topography and their interaction on plant cover, species richness and seed bank density were analysed using multiple regressions.







Results:

*Seed bank vertical stratification:

The density of the seed bank density was significantly different between the topographic zones (F= 19.6 ; dF= 1 ; P<0,0001), but did not differ between the disturbed plots and the control (P>0.05). Furthermore there was no significant effect on their interaction (Topography*disturbance) (P>0.05).

The seed bank was higher in the centre of the pool than at the edge (F=14.9 ; dF=1 ; P=0.0006).This is probably the result of the large seed production by aquatics and amphibious species that dominate at the centre of the pool. On undisturbed plots, seed bank density decreases significantly between soil layers (F=3.44 ; dF=3 ; P=0.03, Fig. 1)

On disturbed plots, the density of the seed bank did not differ significantly between soil layers (Fig. 2).

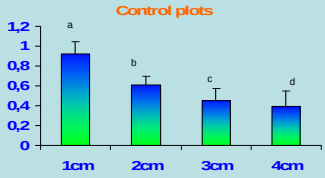


Figure 1: Seed bank vertical distribution on control plots.

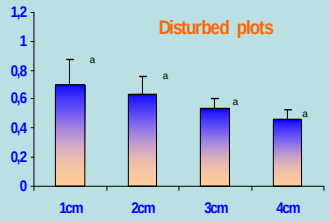


Figure 2: Seed bank vertical distribution on disturbed plots.

*Community richness:

Multiple regressions (F= 4.21; dF= 3; p=0.02) used to explain vegetation specific richness, shows a significant effect of topography (F=8.32 ; dF=1 ; p= 0.006), but disturbance had only a marginal effect (P=0.06) with no significant interaction between disturbance and topography (p>0.05) .

-On the cover of vegetation, was found a significant effect of topography (F=11.04 ; dF=1 ; p= 0.003), and disturbance (F= 12.4 ; dF= 1 ; P= 0.003) (Fig 3) but there was no significant effect of the interaction between these variables (p>0.05).

- Multiple regressions used to explain disturbance effect on annuals richness and recovery show a significant effect on richness and coverage (F=6.62; dF=1;P=0.02& F=6.21;dF=1; P=0.02) but no significant one on perennials richness and coverage (p>0.05). ANOVA test show a significant annuals richness and coverage reduction between disturbed and control plots (P=0.05) (Fig 4)

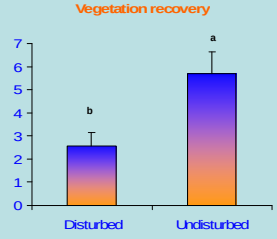


Figure 3: Disturbance effect on vegetation recovery on disturbed and control plots.

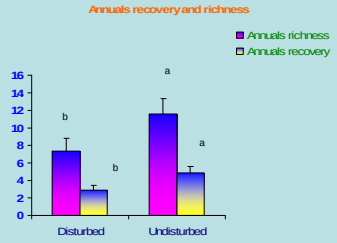


Figure 4 : Disturbence effect on vegetation richness and recovery of annuals on disturbed and undisturbed plots.

Discussion:

The first results of this work suggest that the disturbance of surface soil in Mediterranean temporary pools leads to a reduction of the cover of vegetation particularly on a annuals . The lower effect on perennials is explained by a fast vegetative colonisation by edges (runners, rhizomes).This impact results probably from the burial of seeds which is shown by the change in seed bank distribution where seed density in surface soil declined from 0.92 in the Control treatment to 0.70 in the disturbed treatment. However, the first year of this experiment was very dry which could have affected the effects of the treatments by a weak development of vegetation.