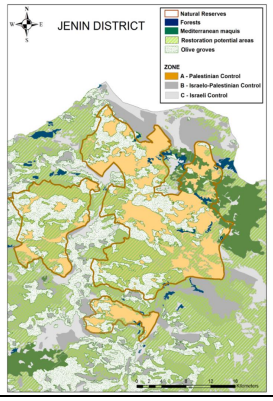

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Parallel disasters: Wars and biodiversity loss in mountain areas

Bartolomeo Schirone[a], Iman Al-Hirsh[a], Nisreen Al-Qaddi[a], Corrado Battisti[b], Federico Vessella[a], Tatiana Marras[a], Maria Raffaella Ortolani[a]✉

[a]Dipartimento di Scienze Agrarie e Forestali (DAFNE), Università della Tuscia, Via San Camillo de Lellis, snc, 01100, Viterbo, Italy; SIRF (Società Italiana di restauro Forestale)
[b]'Torre Flavia' LTER (Long Term Ecological Research), Città metropolitana di Roma, via Tiburtina, 691, 00159 Rome, Italy

✉ raffaellaortolani@libero.it

Abstract

It is widely accepted that the Mediterranean Basin is a prominent hotspot of biodiversity hosting a significant richness of plant lineages and fauna. Projected trends in the context of global change suggest this area will cope with strong increases in temperature and decreases in precipitation with consequent effects on forests and ecosystem services. Upward shifts of species range and/or mass extinction are expected to occur on a broad scale, especially in the Mediterranean. Here, mountain ecosystems would undergo the most severe reduction and fragmentation events. Further human based impacts aggravate the effects of global warming. Among them, wars and civil disorders seriously affect mountain landscapes, marking them over time. Presently, many threats of war are occurring in the Mediterranean and mostly in mountain areas at a high level of biodiversity. Furthermore, these same scenarios are overlapped with global warming, thus exposing many species to an actual risk of extinction.
The aim of this study was to find a solution to the disturbances created in the forest ecosystem by the consequences of war of an identified area in the Mediterranean basin.

Keywords

Mediterranean; Biodiversity; Forest ecosystem disturbance

Contents

1 Introduction

Previous studies (Medail et al. 2009), have identified 52 putative refugia in the Mediterranean region obtained from the analysis of the phylogeographical patterns of 82 plant species. These refugia mainly concern the coastal mountain areas of the Mediterranean basin, due to the fact that the microclimate of these areas protect the plant species from climate changes and other disturbances.

Therefore, it is clear that there is a need to protect the mountain areas of the Mediterranean basin, for the role they have in plant species conservation.

However, the Mediterranean area is going through a period of disorders and civil wars that, in addition to the already present human pressure, risk destabilizing the natural evolution of plant species. In fact, the armed conflicts that daily affect large areas of the Mediterranean basin may result, directly or indirectly, in serious changes to the natural environment. Consequently, we are witnessing a greater susceptibility of soils to degradation, but above all, to a plant biodiversity loss.

As mentioned above, the mountain areas of the Mediterranean play a crucial role as a hot spot of biodiversity but often are the scene of many violent conflicts that have negative impacts on the environment. For example, Mitri et al. (2014) evaluated the effects of the repetitive armed conflicts on land degradation and cover vegetation along the coastal mountain zone of North Lebanon. They have recognized that soil degradation depends on many factors (i.e. climate change), but the armed conflict and the wrong environmental management have adversely affected the cover vegetation of North Lebanon.

Another example of civil disorder impacts on the environment is the Israeli-Palestinian situation. For this work, the study case was the area of Palestine and the negative feedback from local conflicts on the natural heritage, firstly the floristic one. Coupling the most advanced forecasting methods on climate change and the actual vegetation cover or land use, coexisting factors, pressures and threatened species are investigated. We evaluated the effects of new settlements in three areas of the West Bank, where it was evident that there were consequences on environmental defragmentation. Proposals and management plans to conserve biodiversity have been therefore exposed. It is without doubt that every scientific recommendation will be inefficient and unreliable if no political solution will be taken to stabilize and pacify that area.

2 Material and Methods

The quantitative effects of war and civil disorders on the West Bank environment was evaluated by comparison of land cover in the 21st century. Three areas were chosen: two of them placed in the Jenin District, north east of West Bank, the former around the Um-Rehan Natural Reserve, the latter in the surroundings of Jenin City; the third example is situated in the Hebron Governorate, south west of the West Bank, close to the administrative border with Israel. Land cover changes, such as in urban expansion and forest surfaces were monitored across several time periods, from 2002 to 2015, by photointerpretation of aerial images retrieved from Google Earth. Hence, main differences on the landscape were identified and marked.

Given the peculiar administrative control exerted in West Bank by Israeli and Palestinian Authorities, a shapefile map of subzones was retrieved from the Applied Research Institute of Jerusalem (ARIJ). This information was useful to detect which

one of the abovementioned examples would be worthy of further investigation with the objective in approaching a forest restoration plan. In view of this, we selected the area around the Jenin City, fully controlled by the Palestinian Authority.

Here, land cover was defined by integrating data from local Corine Land Cover, provided by ARIJ, photointerpretation of Google images of 2013, and field surveys done in May 2013 (Figure 1). Detailed perimeters of natural areas were made in GIS environment using ArcMap 9.3 software, further clustered in four classes: natural Mediterranean maquis dominated by *Quercus coccifera* L., reforested areas with *Pinus halepensis* Mill. plantations, olive groves and potential restoration areas (including bare lands, abandoned cultivations, grass covered fields and surfaces with scattered natural vegetation) (Figure 2).

Connections among the present forest patches were tracked taking into account the distribution of the mentioned surfaces available for building ecological corridors by defragmentation programs.

The spatial detection of restoring areas was coupled with a phytosociological study of the local natural environments in order to select the appropriate species to adopt in case of forest restoration actions. This leads to the identification of five arboreal or shrubby species (i.e. *Cupressus sempervirens* L., *Pistacia palaestina* L., *Ceratonia siliqua* L., *Rhus coriaria* L., *Prunus dulcis* Mill.) to be used in association with *Quercus coccifera* L. and *Olea europaea* L. already occurring on sites.

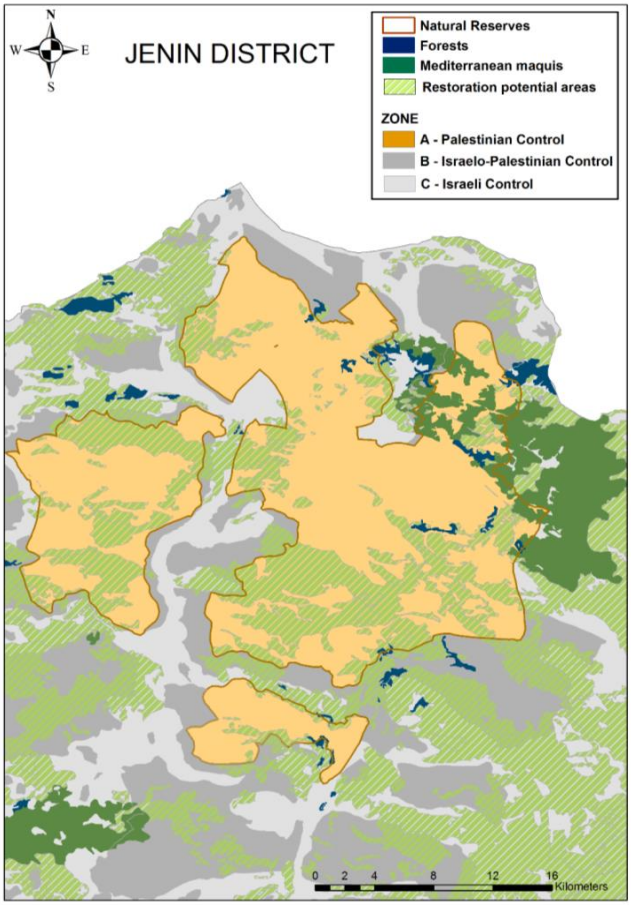

Figure 1. Land cover of Jenin District.

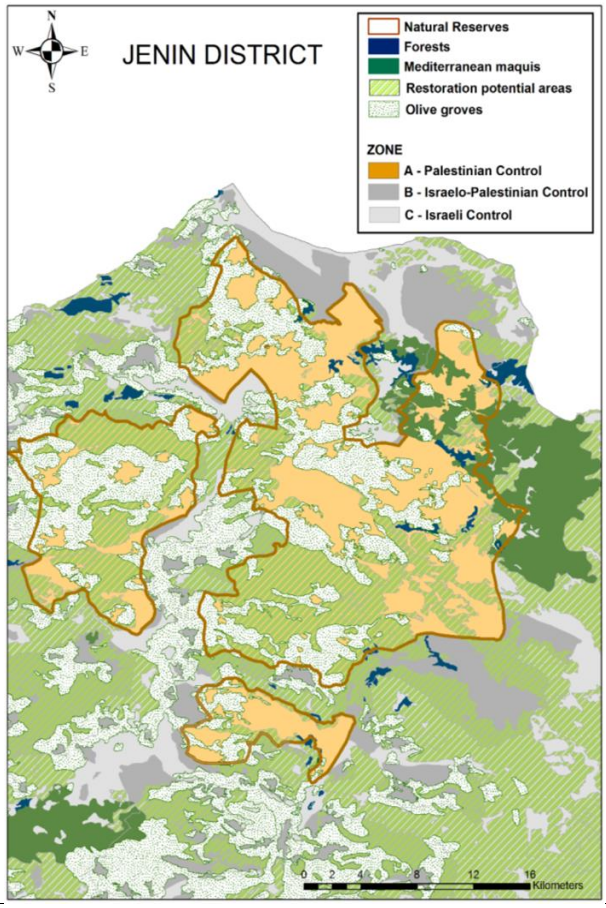

Figure 2. Detailed perimeters of Jenin District natural areas further clustered in four classes.

3 Results and discussion

The analysis of the studied areas indicated the possibility to create the ecological corridors to recover the defragmentation created by the new settlements (AlHeresh 2016, Al-qaddi N. 2016). In fact, the present vegetation of degraded forest and abandoned olive groves that may be connected by *Ceratonia siliqua* L., *Quercus coccifera* L. e *Pistacia Palestina* L. Furthermore, the vegetation of bare lands, rocky soils and uncultivated terrains. In this case, the species for the ecological corridor could be *Quercus coccifera* L., *Cupressus sempervirens* L., *Rhus coriaria* L., *Olea europaea* L. and *Prunus dulcis* Mill. Another hypothesis is to use the olive groves to complete the ecological corridors because these offer a mixture of parameters for the development of shrubby species (i.e. *Cupressus sempervirens* L., *Pistacia palaestina* L., *Ceratonia siliqua* L.).

However, the problem in these areas is the production of seedlings for forest restoration actions. Therefore, we need to propose an alternative for this problem. For example, automated systems for seedling production is a valid alternative. The Zephyr Project developed a highly automated production unit for forest regeneration material recycling water, fertilizers and avoiding pesticides, through a combined action of the optimal environmental conditions, internal movement and LED lamps, as already demonstrated in previous experiments. The unit uses miniaturized wireless sensors and advanced optical analysis for growth control. No pollutants are released

into the environment. A noticeable reduction of emissions is achieved through a low energy consumption, reduced by up to 70% in respect to the traditional nursery pre-cultivations. The whole production system is in a TEU container, fully powered by solar panels.

4 Conclusions

Armed conflicts, but also other factors such as the wrong environmental policies, climate change, and lack of application of the law, can lead to land degradation and vegetation fragmentation. In this work, we emphasized the need and the possibility to create the ecological corridors to restore the natural connections. Furthermore, to support forest restoration and to accelerate the natural defragmentation operations, it is necessary to use new techniques for seedling production. This is how it is possible to obtain the high quality and high quantity of seedling materials to guarantee the success of planned forest operations. However, there are not many studies on this problem and this paper is the first time an analysis has been conducted on the effects of civil disorders and wars on the vegetation network.

5 Acknowledgments

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