

Fire in Mediterranean Macchia: a Case of Study in Southwest Sardinia¹

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Abstract

Degradation of soil and vegetation has been investigated in one burned area with Mediterranean macchia located at Is Olias, in the Rio Santa Lucia catchments in southwestern Sardinia (Italy). The land uses considered are representative of situations commonly found throughout the island. The botanical investigation showed that the renewal of the natural vegetation on abandoned land is only seemingly a slow process, that the burned areas can be restored in quite a short time, especially when undisturbed by grazing which hinders the development of suckers of the evergreen sclerophylls. What is more, growth rates are far too slow to make wood production economically viable. The results of the investigation provide useful indications for steering land management strategies towards policies compatible with sustainable development, and stress the importance of understanding, through the experimental data, the degrading effects that certain choices of land use can produce.

Introduction

The Mediterranean vegetation has been widely studied along general lines (Di Castri, Goodall, Specht, 1981) and in relation to the surveying problems (White, 1985). Within the framework of Medalus, several studies have been carried out on the vegetation in relation to degradation and desertification processes linked with human activities. In the Santa Lucia area the works by Arrigoni (1968), Camarda and others (1993, 1995) and Camarda & Satta (1995) provide a general picture of the setting of the Is Olias Santa Lucia site.

In the Mediterranean basin macchia (= matorral, maquis), together with the aspects of degradation correlated therewith (garrigue, phrygana, batha), is one of the most common kinds of vegetation. It differs in a number of aspects, depending on the climate, the botanical species making up the *macchia*, on its history and human activities, on overgrazing and catastrophic events such as fires, where natural causes and human activities are closely interdependent.

Flora and vegetation provide one of the most immediate responses to degradation and desertification processes. The decline in primary production and the changes in floristic composition represent, at times, the most appreciable sign on the landscape.

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The field site of Santa Lucia

In the Santa Lucia area, a significant part of the monitoring in the experimental plots concerned the evolution of the vegetation in different environmental situations. These plots are representative of abandoned agricultural land, burned land and land reforested with eucalypts, both in Sardinia and in the Mediterranean basin. Vegetation relevés have been carried out in the single plots and nearby areas. Here the analyses are presented as well as the general considerations that emerge there from.

Burned Mediterranean macchia

The Mediterranean *macchia* is a forest ecosystem composed chiefly of evergreen sclerophyllous phanerophytes which have developed in tufts, owing to the recurrent fires, cutting and influence of domestic animals that feed thereon. Thus it is an ecosystem of secondary origin, rejuvenated cyclically and having highly complex biodiversity, biological forms and phenology of the different species. At Is Olias, in particular, the *macchia* is thermoxerophilous and characterized by the strong presence of *Ceratonia siliqua*, whose diffusion also depends on the fact that this species, in the past, was cultivated in areas nearby.

Table 1--Relevé on spontaneous restored vegetation after fire

Relevé area:	80 m ²
Total cover:	100%
Tall shrub layer cover:	45%
Average height:	2 m (1.6-3.10 m)
<i>Ceratonia siliqua</i>	2
<i>Quercus ilex</i>	2
<i>Arbutus unedo</i>	1
<i>Phillyrea latifolia</i>	2
<i>Lavatera olbia</i>	+
<i>Pistacia lentiscus</i>	1
<i>Rhammis alaternus</i>	+
Dwarf shrub layer cover:	55%
Average height:	1.6 m (1.4-1.8 m)
<i>Cistus monspeliensis</i>	3
<i>Cistus incanus</i>	3
<i>Euphorbia dendroides</i>	+
<i>Smilax aspera</i>	+
<i>Asparagus acutifolius</i>	+
<i>Pistacia lentiscus (pl.)</i>	+
Herbaceous plant layer cover:	10%
<i>Pipthatherum miliaceum</i>	1
<i>Trifolium sp. pl.</i>	+
<i>Medicago sp. pl.</i>	+

The relevé of table 1 shows that, after the fire in 1991, ground cover has been completely restored by the natural vegetation in six years. The total destruction by fire of that portion of the woody plants above ground, though on the one hand exposes the soil to erosion and mineralises the organic matter in the top soil, on the other encourages the growth of a grass cover composed of a large number of species.

The Mediterranean *macchia* existing prior to the fire, namely *Pistacia lentiscus*, *Arbutus unedo*, *Ceratonia siliqua*, *Quercus ilex*, *Erica arborea*, *Calycotome villosa*, *Cistus monspeliensis* and *C. incanus*, have proven capable of re-establishing the original conditions within the space of six years. Only *Phillyrea latifolia* has not grown back to the height it had attained before the fire (165 cm against 215 cm). All the woody species flower regularly and produce a good number of seeds. One last observation, in the overall phytomass the herbaceous component only plays a marginal role.

The natural evolutionary process of the vegetation, following the fire in 1991, can be divided into the following stages:

1. Evolved Mediterranean *macchia*.

2. Fire and destruction of original plant cover.

3. Populations of herbaceous plants, chiefly therophytes (*Vulpia sp. pl.*, *Bromus sp. pl.*, *Trifolium sp. pl.*, *Medicago sp. pl.*; flowering of *Asphodelus microcarpus*; propagation by seed of *Cistus monspeliensis*, *C. salvifolius*, *C. incanus*, *Euphorbia dendroides*; development of suckers of evergreen sclerophylls.

4. Garrigue of *Cistus salvifolius*, *C. monspeliensis* e *C. incanus* and evergreen sclerophylls with numerous annual and perennial herbaceous species (*Vulpia sp. pl.*, *Bromus sp. pl.*, *Trifolium sp. pl.*, *Medicago sp. pl.*, *Asphodelus microcarpus*, *Carlina corymbosa*, *Dactylis hispanicapanica*, *Orchis sp.pl.*, *Foeni lum vulgaris*, *Piptatherum miliaceum*, *Leontodon tuberosus*).

5. Mosaic of *garrigue* and *macchia* with strong decrease in herbaceous species and *Cistus salvifolius*.

6. *Macchia* consisting of evergreen sclerophylls, the role of *Cistus monspeliensis* and *C. incanus* diminishing, and further reduction of the herbaceous component. *Pistacia lentiscus*, *Quercus ilex*, *Ceratonia siliqua*, *Arbutus unedo*, *Erica arborea* provide the physiognomy of the vegetation, while the strictly heliophilous species take on a less important part.

The process of renewal at Is Olias has not however proceeded at the same pace everywhere and the area as a whole resembles a mosaic where, depending on the microtopography, different species dominate. In particular, among the plants that reproduce by seed, *Calicotome villosa* has been observed to be the most active species, with regard both to diffusion and duration of the formations that develop after the fire. Vegetation in the burned area (hillslope 2) has taken six years to regain its initial state, much less time than hillslope 1 on abandoned land, and in keeping with what happens in many other areas covered by Mediterranean *macchia* of the evergreen sclerophylls climax stage that have been burned.

Conclusions

After a fire, an essential part in ground cover and soil protection is played by annual

and perennial herbaceous plants, thus by *Cistus* sp.pl. and lastly by the development of sprouts of evergreen sclerophylls.

In many areas, encouraging the development of Mediterranean *macchia* is the most effective way of restoring plant cover in short times, of maintaining biodiversity and of sustaining certain economic activities (cattle fanning, mushroom growing, hunting, beekeeping, products for handicrafts, firewood) and reversing desertification processes.

Of the species completely destroyed by fire, *Euphorbia dendroides*, *Calycolonle villosa*, *Ruta chalepensis*, *Helichrysum microphyllum*, *Phagnalon saxatile* diffuse to a greater extent and more rapidly by seed and this depends essentially on the closeness and quality of the seed bank.

Quercus suber is damaged to a greater extent by the presence of eucalypts than by fire.

The burned areas can be restored in quite a short time, especially when undisturbed by grazing which hinders the development of suckers of the evergreen sclerophylls. Grazing animals are also capable of altering the floristic composition of the vegetation selecting the more appetizable species (*Arbutus unedo*, *Cistus salvifolius*, *Phillyrea latifolia* etc.) rather than the toxic (*Euphorbia dendroides*, *Anagyrisfoetida*), thorny (*Calycotome villosa*, *Genista corsica*) or, in any case, less sought after plants (*Cistus monspeliensis*, *Phillyrea angustifolia*, *Rhammis alaternus* etc.)

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