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VEGETATION RESTORATION PATTERNS IN DESERTIFIED AREAS OF SOUTHEASTERN IBERIAN PENINSULA

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Abstract

A study on the development of desert-like plant communities in Southeastern Iberian peninsula is made, pointing out its socioeconomic relations. Some vegetation restoration patterns based on vegetation dynamic and their suitable flora composition are also proposed.

Introduction

In the semi-arid areas of southwestern Europe, such as Andalucia in SE Spain, areas of marginal land cultivation have gradually been abandoned, with the resulting erosion processes creating a desert-like landscape.

Marginal land cultivation areas are unsuitably exploited zones where barely productive agriculture is carried out. From a general socioeconomic point of view, the environmental damage caused by this kind of agriculture far outweighs the economic gains obtained. Furthermore, the impoverishment of soils in such areas leads to severe environmental deterioration of the entire landscape.

The many technological, economic and social changes which have occurred since the 1950s have had a major influence upon regions with a poor agricultural economy (e.g. mountain areas, arid and semi-arid climates, unsuitable soils, etc.) and led to a high level of emigration. This, in turn, creates further problems, as there are fewer and fewer people available or willing to carry on running family smallholdings. As a consequence, in large areas of Spain which were fully cultivated only a few decades ago but have little real agricultural tradition, crops are now being abandoned and replaced with cattle; all that remains is a subsistence economy and an uncertain future.

Since Spain joined the European Community (now the EU), the introduction of the Common Agricultural Policy has had a negative effect on many areas, with even more crops being abandoned (some of which had been first introduced only a few years before) because EU subsidies do not extend to agriculture on land which is so poor in natural resources.

As soon as crops are abandoned, the dynamics of nature come into play (pioneer plants take root, followed by low shrubs, bushy thickets and, finally, trees) and the landscape gradually returns to the state it was in before man intervened.

At least, that is what happens in theory, provided that the ecological conditions remain largely unchanged and the climatology is suitable for regeneration. In practice, however, if the conditions are adverse (e.g. soil erosion and drought), natural regeneration is not only slowed down, but is actually stopped in its tracks. Nitrophytes and other weeds waste no time in colonizing the abandoned soils, and take full advantage of their ability to adapt to environments which are hostile for most other types of plants (e.g. hydric stress, and poor, briny soils, etc.). In effect, although nature has indeed reclaimed the land that man has abandoned, it is the 'wrong' type of nature. The once typical Mediterranean thyme- and rosemary-scrub communities now seem destined to be replaced by sub-desertic vegetation.

The aim of the present paper is to study the plant dynamics of such areas, proposing several operative patterns of ecological regeneration to hold back the advance of desertification. These proposals will be valid not only a western Mediterranean context, but in any region with similar climatology.

Objectives

The final aim of this study is to detain the erosion processes that take place in this semi-arid zones and fight against the desertification advance. This fight may be based on effective tools to restore damaged ecosystems improving our knowledges about functioning and dynamic of the mediterranean plant communities.

Furthermore, we must consider the conservation of plant communities with high naturalness degree and those species and communities endangered with special ecological value.

The restoration patterns we intend to establish in reforestry held in the southeastern Iberian peninsula can be also applied in other areas of the Mediterranean region taking care of the suitable vegetation series that developes in the zone.

Methodology

The study about the vegetation and flora must be based on a previous compilation of data about the ecological factors that will affect directly to plant communities; we have used the following works: Geology (I.G.M.E., 1983); Pedology (AGUILAR & al., 1986); Climatology (ELÍAS & RUIZ BELTRÁN, 1977).

We have obtained the bioclimatic (RIVAS MARTÍNEZ, 1994) and biogeographical data (RIVAS MARTÍNEZ & al., 1994) to identify the vegetation series that developes in each place of the considered area.

The identification of Flora based on data at different levels (European Flora, Iberian Flora and specific works about southeastern Iberian peninsula) allows us to know the plant composition of the vegetation that will be studied later using the phytosociological methodology (BRAUN BLANQUET, 1979; GÉHU & RIVAS MARTÍNEZ, 1981).

The different stages found in each vegetation series and their relation with ecological and human actions are used to elaborate dynamic schemes (VALLE & al., 1987), what will be definetely necessary for the establishment of restoration patterns (VALLE & al., 1990).

Results

Biogeographical location.- The study area is located in the souteastern Iberian peninsula (Andalucia, SE Spain). Biogeographically, it lies in the Alpujarreño-Gadorense sector of the Baetic province in the Mediterranean region, and is adjacent to the Almeriense sector (Murciano-Almeriense province).

Bioclimatology.- The main bioclimate of the territory is dry/semi-arid thermo-Mediterranean. A higher zone (the meso-Mediterranean) is also represented.

Geology.- The geological substrata are composed of alpujarride materials of the inner zones of the Baetic ranges, with siliceous rocks as schists, filites and soft clay and limestone derivates.

Vegetation.- The following vegetation series (consecutive stages of vegetation) are represented in the area: *Ziziphus lotus* communities (*Ziziphetо loti* S.); thermophilous shrub communities (*Bupleuro verticale-Pistacieto lentisci* S.); and three types of holm-oak communities, i.e. thermophilous (*Smilaco-Querceto rotundifoliae* S.), basophilous (*Paeonio-Querceto rotundifoliae* S.); and acidophilous (*Adenocarpo-Querceto rotundifoliae* S.)

Vegetation dynamics.- Figure 1 shows the dynamics of the vegetation. Interrelations among the different communities (with Latin phytosociolical names) are given alongside the ecological or human factors responsible in each case.

Vegetation restoration.- Some of the elaborated vegetation restoration patterns are shown in Tables 1 and 2. In these patterns, the starting point is the present vegetation, which will change following different reforestry actions to obtain halfway and final stages based in the natural vegetation dynamic and taking care of the proper flora composition.

Conclusions

1, Desertification is now a serious problem in southwestern Europe, as it is advancing rapidly in areas such as the southeastern Iberian Peninsula.

2, The main causes of this problem are tree-felling and the ploughing up of natural vegetation, followed by the introduction of crops, which are abandoned shortly afterwards.

3, Based on the LUCDEME project (ICONA, 1977) and the Andalucian Forest Management Plan (ANONIMOUS, 1989), the following objectives for the territory can be identified: 1, Agriculture on land currently devoted to profitable crop production; 2, Fight against erosion and desertification; 3, Protection of communities of ecological interest; 4, Natural evolution of plant communities in no danger of degradation; 5, Restoration of non-productive marginal crop lands or seriously damaged communities that could be enhanced. 6, Protection against fires and pests. 7, Use of renewable natural resources, particularly cattle-raising and forestry. 8, With a view towards the future restoration of the study area, we propose the following species as being suitable to such a project, given the current ecological conditions: *Whitania futescens, Lycium*

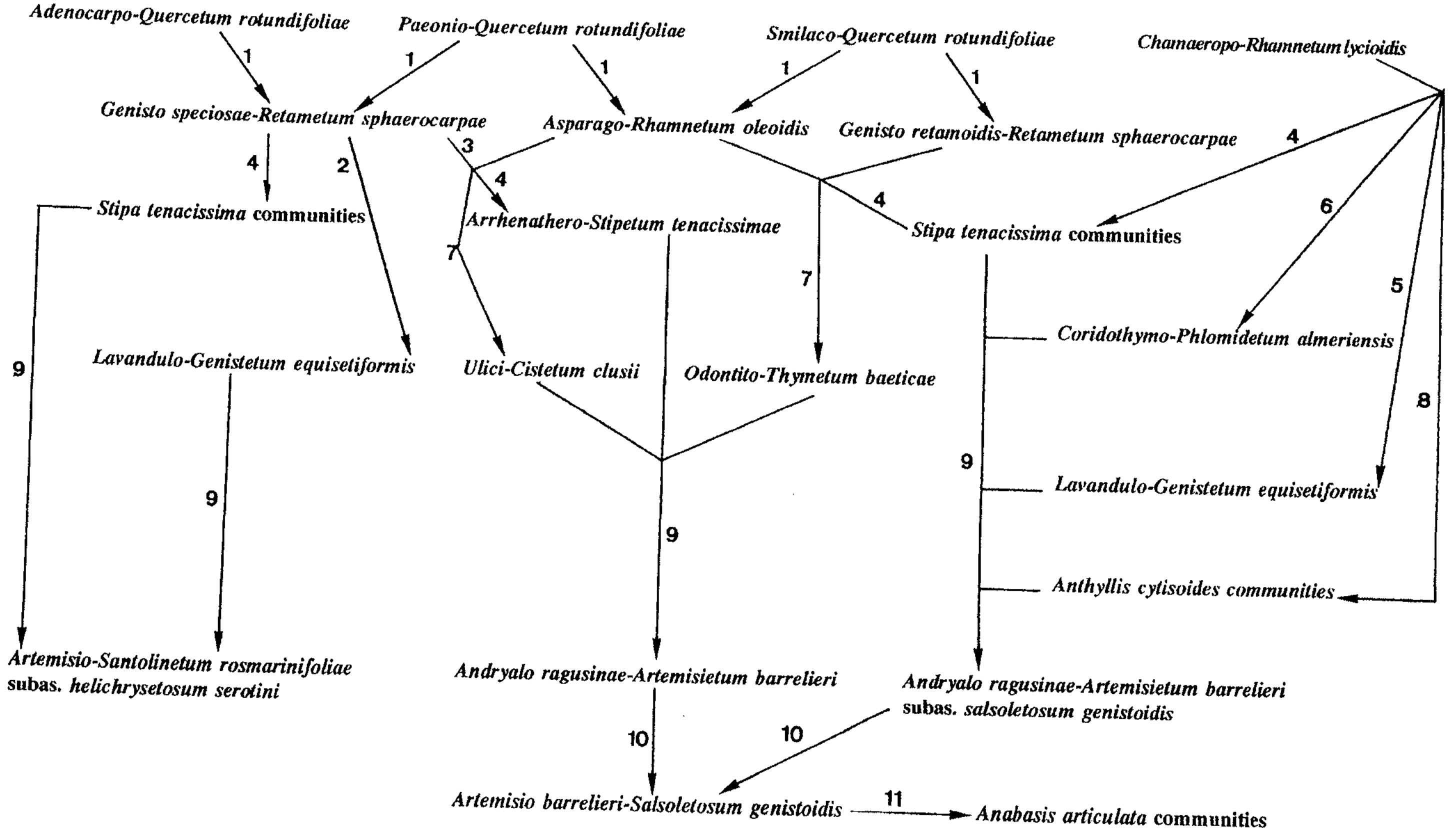

Fig. 1. Vegetation dynamics. The different stages of the vegetation series are interrelationed in this scheme by several ecological and human action factors. 1, Degradation; 2, Acid solis; 3, Basic soils; 4, Marls; 5, Quartzites and Michaschists; 6, Limestones; 7, Stony soils; 8, Filites; 9, Altered soils by human actions, higher oxygenation and mineralization; 10, Greater soil alteration, increasing of dryness; 11, Very erosioned soils high halonitrophilous character.

Starting stages	Types of management	Actions	Halfway stages	Final stage
Low coverage communities	Reforestry	Thinning out of small shrubs. Introduction and/or increasing of higher shrubs communities.	**Thickets** (A)	
(A) **Thickets**	Reforestry and Transformation.	Selective thinning out in thickets. Enhancing of shrubs communities. Shrubs and trees planting. Thinning out of small thickets.	**Mixed thickets and shrubs** (B)	
(B) **Mixed thickets and shrubs**		Regeneration of damaged trees. Selection of shoots. Trees planting. Shrubs enhancing.		**Shrubs communities with evergreen oaks**

Table 1. Starting out from low coverage communities stages (subdesertic plants in abandoned marginal crops) and following several actions to make a planned reforestry, the vegetation developes to a halfway stage (A) that can be enhanced following a new part of the restoration pattern that will get a second halfway vegetation (B). Finally, this stage is transformed using new actions to a final state most mature the place can support).

Starting stages	Types of management	Actions	Halfway stages	Final stage
Thickets	Transformation Thickenning Regeneration	Planting of pines. Introduction or enhancing of small shrubs. Thinning out of weeds.	**Pine-wood with thickets** (A)	
(A) **Pine-wood with thickets**	Transformation	Thinning out of pines. Cutting for enhancing and/or repairing. Sowing of herbaceous plants. Introduction of high shrubs.		**Thickets with shrubs and pines.**

Table 2. Transformation of thickets by planting of pines (*Pinus halepensis*) and enhancing of small shrubs to get a pine-wood mixed with thickets in a short period of time. The existence of this pine-wood (Halfway stage) will help the shrubs to develope and will avoid erosion processes. The second part of this pattern will make a new transformation of this stage by thinning out pines to obtain thickets of higher coverage power with a few pines.

intricatum, Rhamnus angustifolius, Salsola webbii, Salsola verticillata, Carthamus arborescens, Lavatera oblongifolia, Mesembryanthemum nodiflorum, Aizoon hispanicum and *Lotononis lupinifolia.*

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