Silva Carelica 15: 183-190 (1990)

94

STRUCTURE OF A SPATIAL LIMIT COMMUNITY OF JUNIPERUS THURIFERA

Camino Fernández, Reyes Tárrega, Margarita Fernández, Estanislao Luis

Department of Ecology, Faculty of Biology,
University of León, 24071 León (Spain)

ABSTRACT

A Juniperus thurifera community located in Crémenes (Province of León, Northwest Spain) which corresponds to one of the most westerly areas where this species is found has been studied. The perimeter of the trunk, height and cover of the crown have been measured for the structural analysis of the tree and stimating the density using the quadrant method. All the biometric variables are compared using a factorial analysis in principal components.

The herbaceous layer has also been studied using inventories at random situated in places outside the influence of the trees. The influence of the tree on the herbaceous layer is determined using transections between pairs of trees situated at a sufficient distance for it to individualize the effect of each tree. A slight specific diversity of the vegetation nearest the tree is observed with a clear dominance effect which trends to diminish in the inventories farther away from the trees and consequently increasing in diversity.

Key Words: Structure, tree influence, herbaceous layer.

INTRODUCTION

The area of distribution of *Juniperus thurifera* is essentially mediterranean and is limited to Spain and North Africa as well as an area in France close to Grenoble (fig. 1).

The *Juniperus thurifera* forest which this study deals with is located in the Crémenes area which is in the Northwest of León province (Spain). This area has a natural vegetation of *Juniperus thurifera* which has survived here since before the Ice age, which gives it great historic interest. The trees are rooted at the fissures of the rocks and with the greater part of the trees on the southwesterly facing sides. The Crémenes juniper forest has an approximate length of 3.5 km and an average width of 0.75 km, being divided into two subzones, making up a residual community and, for this reason, it is very vulnerable to perturbations both natural and those directly or indirectly caused by man. It is also one of the most westerly references of *Juniperus thurifera*, not only in the Iberian Peninsula but also in the rest of Europe. It is included in the *Juniperetum sabinothuriferae* association and is found on calcareous substrate (Peindado and Rivas, 1987).

Given the particular characteristic of this ecosystem, with the present work we try to add to its knowledge from the structural ecological point of view, determining, on one hand, the characteristics and structure of the juniper population and, on the other, the composition in species of the plant community and the dependent of interdependent relationships between them as well as the effects the tree has on the herbaceous layer structure.

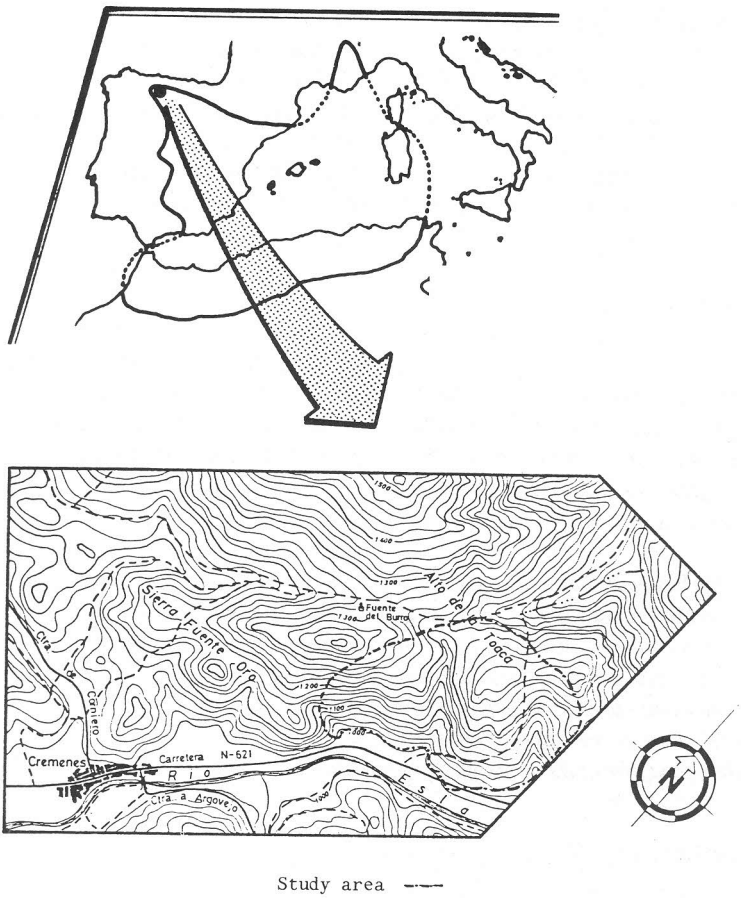

Fig. 1. Geographical location of the study area.

MATERIAL AND METHODS

The biometric study was carried out using the information obtained from 60 juniper specimens chozen at random and distributed throughout the whole area. The perimeter of the trunk, height and cover of the crown for the four principal geographic points and the distance to the nearest tree have been measured for each tree. Density was calculated using the quadrant method (Cotton and Curtis, 1956), placing 36 sampling points in the largest subzone and 12 in the smallest along the two parallel lines cutting through the contour lines.

The values of both absolute and relative dominance and frequency and the value of importance of the tree species found in the area, defined as the sum of the last three parameters, have also been obtained from this sampling method.

A principal components analysis was applied to the whole study of all the biometric variables, disregarding those specimens which they do not have an only trunk.

The herbaceous vegetation was studied setting up 90 inventories randomly distributed at

reasonable distances from the trees, beyond their direct influence. A 50 cm square quadrant was used as a sampling plot and the importance of the species in percentage terms of the cover was assessed. The greater part of the inventories were located facing south-east, with only 19 facing east and 12 facing south. Just as what was done to the information related to the characteristics of the tree population, a principal component analysis was applied to the data related to the herbaceous vegetation.

Seven transections between pairs of juniper trees, chozen at random, but a sufficient distance between them in order to individualize the effect of each tree, were carried out, with the aim of showing the influence the woodland has on the herbaceous layer. Inventories in sequence were carried out using sampling plots of 25 cm square along the transects in numerical order.

The value of importance in percentage terms of the cover was stated for each species present. From these values, the species diversity using the Shannon-Weaver index (1949) was calculated and the inventories were related to an affinity analysis using the index attributed to Steinhaus by Motyka *et al.* (1950) whose results were regrouped using the U.P.G.M.A. method (Sokal and Michener, 1958) and were graphically represented in dendrograme form.

RESULTS AND DISCUSSION

Trees

Not all of the trees had only one trunk, but a fairly high number of them (25 of those taken into account in this study) had two or three main branches or shoots, which on coming out of the ground gave the impression of various trees together.

The large existing variability stands out in both the height and perimeter of the trunk. The maximum and minimum values for the height are 9.35 m and 1.50 m, while the perimeter of the trunk varies between 2.20 and 0.15 m.

As general rule, a reduction in the cover of the crown is observed in the side facing north, while the maximum development corresponds to those facing east and west. With regard to the distribution of the trees, the inequality stands out appearing fairly isolated in some areas and very grouped together in others.

The two subzones studied are clearly differentiated with regard to the values of absolute density, since in the most extensive part there are 314.37 trees per ha and only 136.16 trees per ha in the least extensive. In the latter case, specimens of *Quercus pyrenaica* and *Quercus faginea* appear with *Juniperus thurifera*, this being an oak effect which separates both subzones. However, in either case, the complete dominance and high impotance value of the juniper over the other tree species are evident in both subzones.

Having carried out a principal components analysis on the trees with only one trunk, a variance absorption of 85.1% is obtained for the first three axes. The information, together with the first two components, is summed up in a defined tendency towards a reduction in the vying for light and the provision of nutrients which converges towards the first quadrant of the determined plan for both axes.

Taking into account that the order of the trees in relation to the third component is carried out based on the perimeter of the trunk, it is possible to follow a sequence with regard to the age of the tree. However, a definite modification is introduced into this process by the second component and is concentrated in the form of exploitation which has favoured a better development of the surviving trees (fig. 2).

On combining axes II and III, the clear tendencies are previously summed up, since, on one hand, the existance of a normal process from young trees to old trees is identified and, on the other hand, a process of exploitation, which

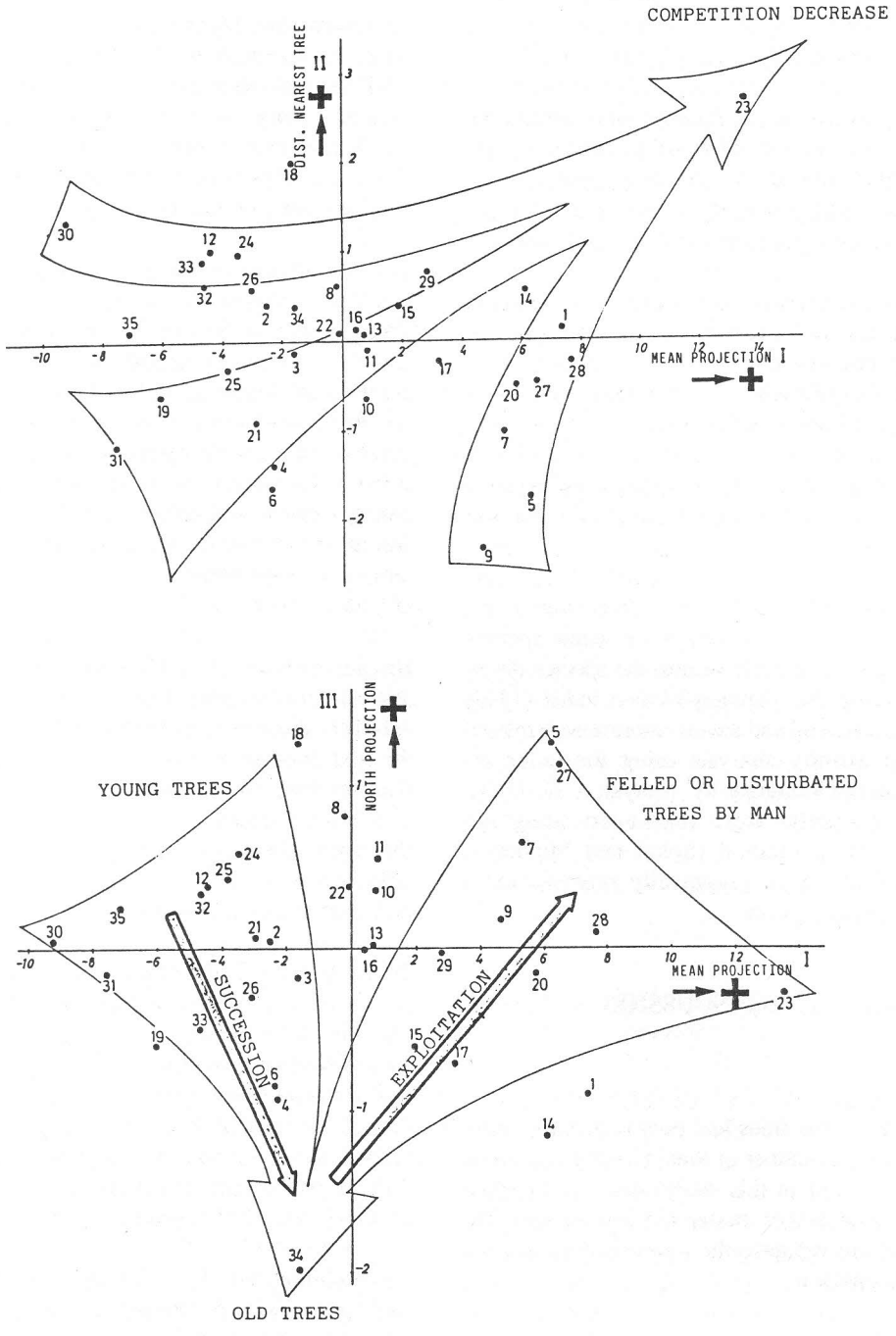

Fig. 2. Distribution of the trees in the planes defined by I-II and I-III components.

has an identical significance to that already mentioned, is established.

Study of the herbaceous layer

The position on the plan which is defined by the components I (4.9% of the total variance) and II (3.8%) of the 165 registered species is shown on Figure 3. The variation along axis I is interpreted as an acidity gradient in the soil which is defined at the positive end, which is of greater acidity, by the species *Alopecurus pratensis, Sesamoides canescens, Andryala integrifolia, Arnoseris minima, Avenula marginata* subsp. *sulcata* and *Cytisus scoparius*, which are characteristic of preferably siliceous soils and have dependency coefficients above 0.6. With regard to the first factor, the polarity is not very high. However, at the negative end species such as *Festuca rubra* subsp. *trichophylla*, which are normally lime areas, are located (Table I).

The second variation tendency, expressed by axis II, refers to the fairly stoney nature of the study area and is shown in the existing contraposition between species characteristics of pasture lands, such as *Lotus corniculatus, Sanguisorba minor* and *Plantago lanceolata*, and those of rocky areas, such as *Teesdalia* nudicaulis, *Argyrolobium zanonii, Epipactis atrorubens...*

Influence of the trees on the herbaceous layer

The results obtained in one of the transects are included as examples. A slight diversity (fig. 4a) is observed in the inventories closest to each one of the two trees, partly because of the low specific richness and also because of the strong dominance effect by only one species, in this case *Bromus erectus*. In other transections, it may be this same one or another grass, *Brachypodium pinnatum* subsp. *rupestre*; both of which are very abundant in the tree proximities and diminish in the open areas. The

Table I.- List of species most closely related to the first two principal components.

1. Daucus carota
3. Hieracium pilosella
5. Trifolium campestre
7. Poa trivialis
8. Plantago lanceolata
12. Airea caryophyllea
14. Sanguisorba minor
20. Phleum pratense
21. Ononis spinosa
24. Lotus corniculatus
25. Galium divaricatum
28. Brachypodium distachyon
30. Festuca rubra
31. Bromus erectus
33. Pethrorhagia prolifera
35. Trifolium arvense
36. Alopecurus pratensis
37. Myosotis arvensis
38. Eryngium tenue
39. Senamoides canescens
41. Bromus squarrosus
46. Aphyllantes monspelliensis
60. Pimpinella tragium subsp. lithophila
64. Anthyllis vulneraria subsp. iberica
69. Helichrysum stoechas
72. Helianthemum canum
79. Avena pratensis
90. Leontodon sp.
95. Cytisus scoparius
101. Andryala integrifolia
102. Arnoseris minima
103. Plantago holosteum
104. Avenula marginata subsp. sulcata
107. Geum sylvaticum
111. Minuartia hybrida
112. Arenaria serpyllifolia
113. Campanula rotundifolia
139. Centaurea scabiosa
140. Teesdalia nudicaulis
144. Argyrolobium zanonii
145. Herniaria hirsuta
146. Poa bulbosa
147. Taraxacum officinale
148. Epipactis atronubens
149. Iberis amara
154. Iberis sempervirens

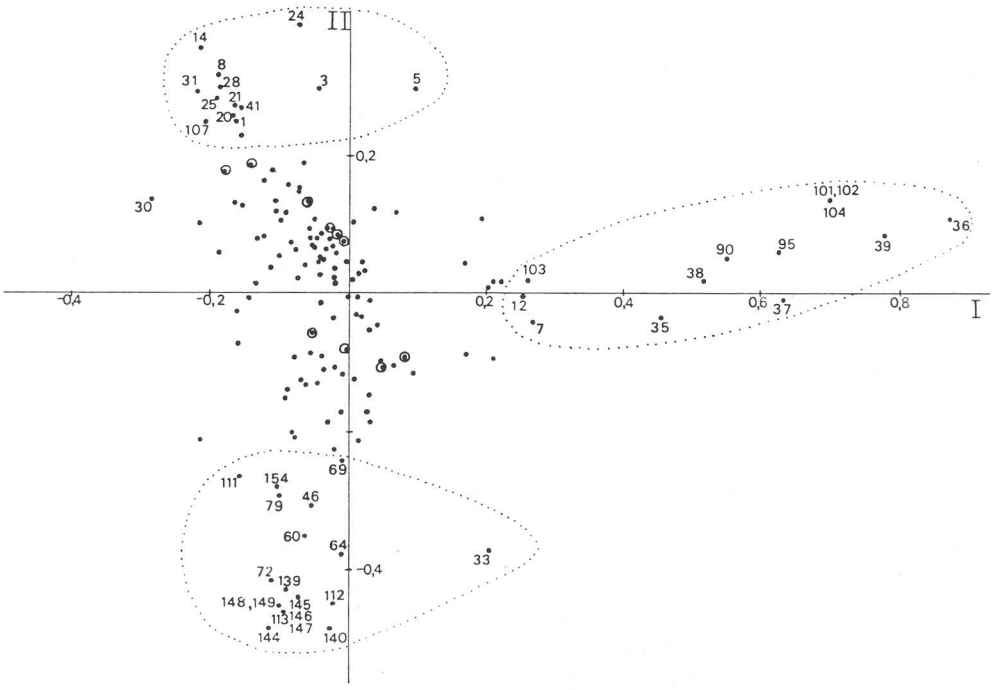

Fig. 3. Distribution of the species in the plane defined by the components I and II.

diversity in the central part of the transection, in harmony with the diminising of the dominance effect and the greater richness, tends to increase. González-Bernáldez *et al.* (1975) in evergreen oak "dehesas" and Luis *et al.* (1987) in oak forests also observed highest diversity values among the inventories least influenced by the woodland.

Three inventory groups, in general, which correspond to three areas in which the influence of the trees is manifiested with different intensity, can be distinguished in the affinity dendrogramme (fig. 4b). A first area, defined by the inventories closest to each one of the two junipers and characterized by the great abundance of *Bromus erectus*; another area, which in this case has only one inventory, where the influence of the tree is less, a greater number of species stands out here (*Plantago lanceolata, Potentilla reptans, Festuca ovina, Daucus carota, Bellis perennis, Eryngium campestre, Pimpinella tragium, Prunella laciniata* and so on), and lastly, a transitional area of intermediate characteristics between both areas. A great likeness in the floral composition among the inventories closest to the trees is observed, which indicates that very few strongly dominant species are able to adapt to the microclimatic conditions of these areas.

The extension of the area in which the influece of the tree is show depends on the cover of the crown and the orientation, a northerly direction being the most intense, which shows the particular importance the effect of the shade has. Thus, in the dendrogram, only the two inventories closest to the first tree are included in the area of greater influence, inspite of its larger cover of the crown, and the three closest to the second of smaller size, which is due to the fact the former ones are found to SE and the latter ones to the NW with respect to the nearest tree. These results are confirmed in broader studies on the subject (Tárrega, 1980) and coincide with those obtained by Alonso (1978) in his

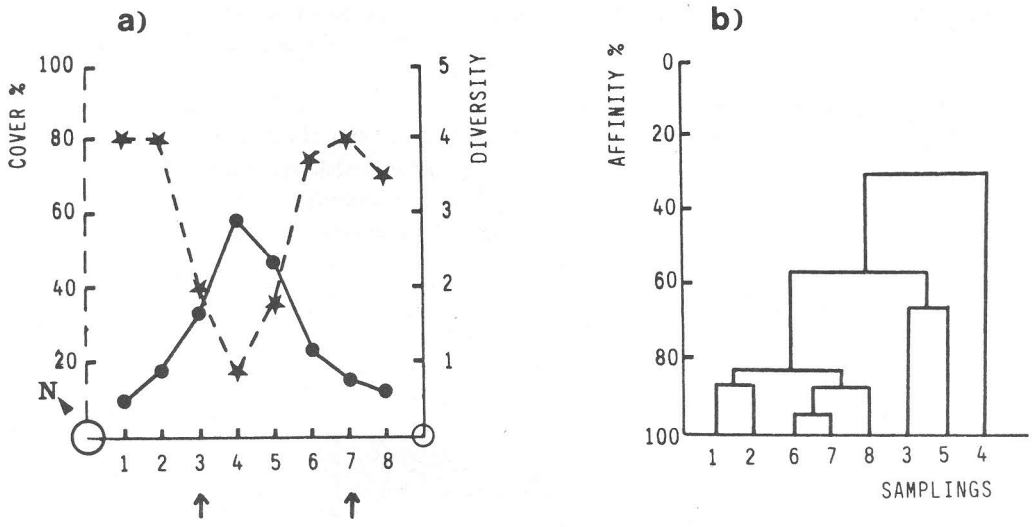

Fig. 4. Transects between nearest trees. a) Species diversity and dominant species cover evolution. The arrows show the end of the vertical projection of the crown of both trees. b) Affinity analysis.

study of the effect the evergreen oak has on vegetation.

In studies carried out on the Sistema Ibérico Meridional (Costa *et al.*, 1986), it is shown that in the formations of "dehesas" of *Juniperus thurifera*, the grass which develops under the protection of the crown of the juniper is richer in biomass than the surrounding pasture being due to the microclimatic effect related to a greater protection against frost and extreme heat, a greater amount of nutrients and an improvement in the soil characteristics. Biomass studies were not carried out on the Crémenes juniper forest, however, a greater cover and abundance close to the trees would seem to be observed, though not generally.

REFERENCES

Alnoso, H., 1978. Efectos de la encina (*Quercus rotundifolia* Lam.) sobre la vegetación en diversas comunidades de pastizal. Memoria de Licenciatura. Universidad de Salamanca.

Costa, M., Morla, C., Sainz, H., 1986. Estudio fitoecológico de los sabinares albares (*Juniperus thurifera* L.) de la provincia de Teruel. Ed. Excma. Diputación Provincial de Teruel.

Cottam, G. and Curtis, J.T., 1956. The use of distance measures phytososiological sampling. Ecology 37:459-460.

Gonzalez-Bernaldez, F., Morey, M., Velasco, F., 1975. Efectos de la encina sobre el pasto. Excma. Diputación Provincial de Badajoz.

Luis, E., Diez, C., Tarrega, R. 1987. Estudio comparativo de especies herbáceas en bosques de roble y sus claros. Pastos, XVII (1-2):310-319.

Motyka, J., Dobranski, B. Zawadzki, S., 1950. Preliminary studies in the southeast of the province Lublin. Ann. Univ. Mariae Curie-Sklodwska Sect. E: Agricultura 5, 367-447.

Peinado, M. and Rivas, S., 1987. La vegetación de Espana. Univ. de Alcalá de Henares.

Shannon, C.E. and Weaver, W., 1949. The mathematical theory of communication. Univ. Illinois Press. Urbana.

Sokal, R.R. and Michener, C.D., 1958. A statistical method for evaluating systematic relationships. Univ. Kansas Sci. Bull., 38, 1409-1438.

Tarrega, R., 1980. Gradiente de diversidad en la vegetación herbácea por efecto de la sabina (*Juniperus thurifera* L.). Memoria de Licenciatura. Universidad de León.