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BIOGEOGRAPHIC STUDY OF THE FORESTS OF CHILE'S MEDITERRANEAN AREA: INVENTORY AND CHARACTERIZATION

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The mediterranean region of Chile extends from 32°45' to 37°30' South, covering a distance of approximately 850 km. It is framed by two tall and extensive mountain ranges in a north-south direction (the Andes Range and the Coastal Range), leaving wide central valleys between them. As to geomorphology, there is an inner mountain complex in the northern end of the region, while further south there are fluvial, glacial and volcanic sedimentation basins and plains. The influence of Cenozoic vulcanism has left its imprint in the agricultural quality of the soils of the central plains of Chile (Borgel, 1983).

The southern mediterranean climate is characterized, in general, by low temperatures during autumn and winter and by their increase during the rest of the year, while precipitation is concentrated mostly in those seasons and increases with latitude toward the south (from 400 to 900 mm per year). In response to this kind of climate, the predominant autoctonous vegetation corresponds to sclerophyllous forests and young forests of sclerophyllous brush in the hills and slopes of the mountain ranges, while in the middle hills of the Coastal Range there is a predominance of savannas and steppes of *Acacia caven* in granitic overburden with deep drainage.

From the nonzonal standpoint, there are hygromorphic and high Andean vegetation enclaves in both chains: sclerophyllous wet forests (a paradoxical name that is explained because in the more humid part of ravines and small valleys there are no well differentiated riparian forests, but rather hygrofilous faciation of the sclerophyllous forest that dominates the area); communities of endemic palm tree groves in prelitoral low relief areas; forest groups of deciduous oaks in the high mountain; and conifer forests in the high Mediterranean Andes, sharing the land with high altitude steppe (Quintanilla, 1987). Considering the richness of these enclaves, with a character of priority sites to be conserved, a study is made of some of them, following a north-to-south geographic sequence in which some forest lots

of the Mediterranean area of Chile were chosen, from the Metropolitan Region, the V Region of Valparaiso, and the VI Region of Libertador General Bernardo O'Higgins. By regions and scope, the concrete work zones and sectors were the following:

- Fifth Region of Valparaiso:
  1. La Campana National Park. Las Minas and Granizo sector.
  2. El Salto Palm Grove-Quebrada del Quiteño, Viña del Mar.
- Metropolitan Region:
  3. Río Clarillo Forest Reserve. Camino Jorquera.
  4. Altos de Cantillana Forest Reserve, Melipilla. Lo Lisboa sector.
- Sixth Region of Libertador General Bernardo O'Higgins:
  5. Private Forest Reserve of Alto Huemul. Las Cruces sector and Las Gordas sector.

The main objective of the present work is to provide basic information on the composition and structure of some types of biogeographic units of the mediterranean area of Chile. The aim is to set the basis for the study derived from FONDECYT research project 1095048 for the protection and management of the native vegetation of Chile. In that relation there is a certain lack of information and systematic inventories of those units, so the work attempts to clarify their composition, structure and state, for their later arrangement and management.

On the other hand, inventorying and evaluation method of landscape and biogeographic quality widely used in Europe will be applied, and in that way its scientific robustness can be tested for other territories.

The first phase of this research, which is the one presented in this article, involved collecting data on the land, and it meant preparing the biogeographic inventories of the lots chosen to represent each of the types of forests to be studied. The inventory model is specific and has been designed, tested and corrected by some of the authors of this article in successive contributions (Cadiñanos and Meaza, 2000; Cadiñanos, Meaza and Lozano, 2002; Meaza, Cadiñanos and Lozano, 2006; Cadiñanos, Lozano and Quintanilla, *in press*) in order to collect all the geographic and environmental data needed for the later biogeographic assessment of the plant community in question. In the first place, as required, data on the location and identification of the site are taken (UTM coordinates, toponyms, etc.), general geographic and environmental aspects and traits (topographic, lithological, geomorphological, edaphic, hydrological, etc.), photographs of the lot, etc.

In the second place, each of the identified and classified species is noted. Insofar as possible, the classification of vascular plants is made in the field, but also samples and photographs were taken for their later identification, which in this case and due to unfamiliarity with the flora that was being studied, has meant an additional effort and an exhaustive job for the confirmation of the determination of the taxa. All the species in the inventories are included, with their current scientific names, in Table 3 of the annex.

The coverage index of the taxa of the vascular flora is also indicated, following the common notation system of phytosociology, but also including on the one hand their basic biological physiognomy divided into three groups: trees and shrubs, bushes and climbers (quite varied and conspicuous in the Chilean flora), and herbs, and on the other hand their presence is described within four vertical strata, namely an upper stratum above 5 m (> 5), an intermediate high stratum (5-1), an intermediate low stratum (1-0.5), and a bottom stratum

(below 0.5 m: < 0.5), which have also been shown to be perfectly valid and satisfactory in the Chilean communities studied.

The presence and density of bryophytes (mossy stratum), lichens and fungi according to the growth substrate, simplified into epiphytes (corticolous and lignicolous, trunks and branches) and terricolous-saxicolous (soil and rocks) are also indicated using the common coverage scale. These data will be indispensible to calculate the complementary indices that explain the richness in habitats of the corresponding formation. Save for very concrete exceptions, and in contrast with what is usually done in the inventories made in the Iberian Peninsula, we have not gone into the determination of the concrete taxa that make up these tallophyte communities.

Finally, a number of data necessary for the complementary evaluation of the forest communities have been taken according to the system of Cadiñanos and Meaza (2000): global coverage and richness by strata (needed to calculate the COBEST and RIQUEST), diversity of habitats not cartographically divisible (FORHAB), the area of the homogeneous spot (FORESP), the typological variety of the trees (FORFIS), and the added cultural and ethnographic values (FORCUL).

It is easily seen that these inventories are more laborius and require more time than phytosociological or similar ones, but once made, the information obtained is much more and it also allows its further use not only for the geobotanical characterization of the zone in question, but also to reflect its structural and biogeographical arrangement as well as, in the last analysis, for the evaluation and management of the vegetation, the fauna, and the landscape.

A total of 17 biogeographic inventories were made, which are attached, summarized, in synoptic Table 2, which are assumed to be a good representation and characterization of the forest or fruitescent vegetation of the mediterranean area of Chile. It is also the first time that biogeographic inventories are made in this region meant for the evaluation of the vegetation, the fauna, and the landscape. However, the inventorying method and system, designed for the communities of the Iberian Peninsula, have been shown to be fully functional in these new areas, which was one of the main concerns of this project.

The basic data of all the inventories are collected in Table 2, and for greater details on all the vascular taxa determined and arranged according to simplified biological type and the coverage or abundance of mosses, lichens and fungi we refer to Table 3 in the annex.

In brief, the main kinds of arboreal or arborescent vegetation in the mediterranean area of Chile were studied and inventoried for their evaluation, namely:

- Sclerophyllous forest or brush:
  - Dry mediterranean sclerophyllous forest: Three inventories in R.F. Río Clarillo.
  - Wet mediterranean sclerophyllous forest: Three inventories, one in R.F. Río Clarillo, two in P.N. de La Campana.
  - Mediterranean sclerophyllous forest with Chilean palm trees: one inventory in El Salto-Quebrada El Quiteño.
  - Mediterranean sclerophyllous brush: three inventories in R.F. La Cantillana.
- Mesophytic forest:
  - *Nothofagus macrocarpa* oak forest: three inventories in P.N La Campana.
  - *Nothofagus obliqua* oak forest: three inventories in R.F.P. of Alto Huemul.

- Resinous Andean forest:
  - Open forest of Chilean cedar: two inventories in R.F.P. of Alto Huemul.

Although it is the first time that the inventory system developed by Cadiñanos, Lozano & Quintanilla (*in press*) is applied to the Mediterranean area of Chile, it has been shown that the method in general, and the concret techniques in particular, are fully efficient and usable outside Europe, which is the only geographic setting in which they had been applied so far, especially in the Basque Country and the north of the Peninsula.

We also estimate that approximately up to 90% of the vascular flora characteristic of the studied nemoral or fruitescent communities have been recorded, representing a far from negligible contribution to the knowledge of the flora and vegetation of Chile's Mediterranean zone, vegetation whose structure and composition are not always well known, particularly those formations of more remote natural or residual distribution.

Both the inventories as well as their corresponding evaluations, which will bve presented in successive articles, will serve for the achievement of the objectives stated by FONDECYT project 1095048 for the protection and management of the native vegetation of Chile, because they represent the indispensable basis for the follow-up and knowledge of their response to fire, of to what extent the units studied have more or less accelerated dynamics for recovery and regeneration aftyer the frequent fires which unfortunately ravage the natural communities of Mediterranean Chile.