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Characterization and Biogeographic Evaluation through the Lanbioeva Method of the Forests of *Quercus Petraea* of the Basque Country and Navarre (Iberian Peninsula)

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The article characterizes and evaluates *Quercus petraea* forests in the Basque Country and Navarre. Specifically, three locations: south of Vizcaya (Garrastatxu), south of Guipúzcoa (Pikandi) and north of Navarra (Garralda).

In the studied area, *Q. petraea* tends to establish at altitudes above *Q. robur*, which occupies the colino floor. Specifically, in the transit between the colino and the montano (above 500-600 m.), where it has to share territory and ecosystem with *F. sylvatica*. Everything seems to indicate that *F. sylvatica* was originally located in the Carpathians during the last glacial maximum and that, from these shelters, once the influence of the ice mass began to decrease, it colonized new spaces towards the west, until reaching the Iberian Peninsula (Bennet *et al.*, 1991). *F. sylvatica* has reduced the size of *Q. petraea* considerably in the last 4,000 years. It is also possible that human actions have favored these processes of substitution of one species for the other (Gassiot *et al.*, 2014). Therefore, *Q. petraea* can be interpreted as a relict species and in danger of disappearance due to its regressive dynamics.

The present work aims to provide a characterization of the different spots of *Q. petraea* to verify significant differences around issues such as the courtship of each one, its specific diversity, its structures, chorological affiliations of the taxon that integrate them or the status of each one, in addition to diagnosing the value of each one of them. The ambit of study includes the autonomous communities of the Basque Country and Navarre where *Q. petraea* forests are scarce and not well studied. In addition, to analyze biogeographically these forests, has been used the LANBIOEVA (Landscape Biogeographical Evaluation) methodology to



obtain partial data on such interesting variables as phytocenotic, territorial, mesological, structural, patrimonial and cultural values; and, in the same way, determine the degree of threat that is on them. The application of this method can shed light on the status of these specific sites and observe what their threats and strengths are for their correct management and / or conservation, so that it is a good approximation to the risk they present.

10 plots have been inventoried for each location. These are chosen from a random and stratified model that responds to a method which has been tested, contrasted and corrected on successive occasions (Lozano *et al.*, 2020). The species are divided into three major physiographic groups: trees and shrubs, bushes and climbers, and herbaceous. The covers of each taxon are estimated in four strata that go from more than 7 meters to the ground. To do this, the phytosociological sismatist method is used (divided into 6 categories (+ = less than 1%, 1 between 1% and 10%, 2 between 10% and 25%, 3 between 25% and 50%, 4 between 50% and 75% and 5 between 75% and 100%) for each of the strata and the overall plant group. Obtaining data on the chorological distribution and the status of the plants of the courtships of the three study formations has been done by consulting the work of Aizpurua *et al.* (1999).

The LANBIOEVA methodology is divided into Conservation Interest and Conservation Priority. The first is the sum of the qualifications obtained by the Natural Interest and the Cultural Interest. The Natural Interest is made up of four groups of criteria: phytocenotic, territorial, mesological and structural. The phytocenotic interest encompasses intrinsic characteristics of the vegetation and the landscape such as diversity, naturalness, maturity and spontaneous regenerability or resilience. The territorial interest considers the attributes of rarity, endemism, relictism and peripheral character. The mesological interest evaluates the geomorphological, climatic, hydrological, edaphic and faunal functions on a local scale. The structural interest values the richness by stratum, the coverage by stratum, the richness of microhabitats and the connectivity and extension of the vegetal area. Cultural Interest is calculated taking into account two groups of values. The first is patrimony interest, which evaluates three sub-criteria: ethnobotanical value, perceptual value, and didactic value. The second is structural cultural interest, which takes into account structural physiognomic value and structural cultural value.

The Conservation Priority is obtained by multiplying the Conservation Interest by the Threat Factor that weighs on each formation. It is calculated based on three parameters: demographic pressure, accessibility-walkability and alternative threats. The demographic pressure coefficient penalizes situations of high population density. The accessibility-walkability coefficient evaluates the higher or lower ease of reaching the area under study, and the "friction" it shows with the transit of human beings. The coefficient of alternative threats shows other types of risks and dangers (fires, acid rain, xenophyte taxa, hiking, residues...).

The scarcity of this formation is alarming since, based on our research, it has been found that certain publications (Basque Government, 1991; Aramburu, 1996), and with the cartographic layers of the Basque Government or the Government of Navarre (SITNA), give for granted, the existence of different locations with this type of formation that are non-existent because the species appears as individual specimens and, in the best of cases, hybridized with other taxonomically close species such as *Q. pyrenaica* or *Q. robur*. In this sense, the main objective set has been fulfilled.

Despite taking root, in all cases, on steep slopes, petran substrates and acidic and oligotrophic soils, *Q. petraea* forests have many species, especially in the cases of Garralda and Pikandi. However, contrary to what could be inferred from different studies (Aramburu, 1996; Aizpurua *et al.*, 1999) the species can exist perfectly on calcareous substrates, because in the Garralda area, two of the inventories carried out have provided information on a relatively closed formation of *Q. petraea* on this type of substrates.

Talking about the specific diversity, Garralda shows the best numbers followed very closely by Pikandi. Garrastatxu is configured as a relatively poor forest in species, not far from the beech forests studied in this same geographical context.

The most structurally diverse *Q. petraea* formation is Pikandi, followed by Garralda and, finally, Garrastatxu.

Regarding the chorological ascriptions of the taxa, in the three cases dominate the Euro-Siberian / Eurasian, Atlantic components and those of transition between the Atlantic and the Mediterranean. Those with



a wide territorial range show global percentages not exceeding 25%; this testifies to the quality of the taxa, which is increased by the contribution of endemisms and boreal-alpine and alpine-pyrenean orophyte taxa.

The status of the various species shows a single very rare taxon in Garralda, two rare in this locality and Pikandi, and none very rare or rare in Garrastatxu. In all three cases there is an important number of scarce taxa. For this reason, adequate protection and management measures must be carry out.

Continuing with the natural interest within the biogeographic assessment LANBIOEVA: the phytocenotic interest can be classified as outstanding, at the head of all forest groups in the study field (Lozano *et al.*, 2020). This derives from its high degree of diversity and naturalness, a circumstance that extends to the criterion of maturity and, to a lesser extent, to that of resilience. Regarding the territorial interest, the *Q. petraea* forests are not, in general, very lavish in rare, endemic or peripheral elements; but the relictic character compensates for these low scores. The mesological interest reaches high values in all the items that integrate it, clearly highlighting its geomorphological, edaphic and faunal functions. The structural interest shows modest scores, taking into account that this plant group presents good levels of richness and coverage by stratum, low variety of microhabitats and moderate spatial connectivity.

The Cultural Interest criteria maintain the same trend. Both in its patrimonial (ethnobotanical, perceptual and didactic) and structural (physiognomic and cultural) aspects, *Q. petraea* forests are rich in elements and values linked to a certain traditional and ancestral management by human beings. With all this, the Conservation Interest, the sum of the Natural Interest and Cultural Interest, reaches scores that clearly place them at the forefront of the most valuable plant groups in the studied area (Lozano *et al.*, 2020).

The Conservation Priority, however, reaches relatively low records. This is explained by the low Threat Factor to which they are subjected, since they are located in areas relatively far from population centers, have low accessibility and walkability, and have few alternative threats. It is important too, that most of the area of *Q. petraea* settle in protected spaces.

The results show the need to strictly conserve these scarce and not very extensive areas. Measures such as the control of extractive and livestock activities must be applied.