Boletín de la Asociación de Geógrafos Españoles N.º 54 - 2010, págs. 407-412
I.S.S.N.: 0212-9426

ENVIRONMENTAL AND TERRITORIAL PHYTOINDICATION/PHYTOACTION. TEST FOR THE APPLICATION ON URDAIBAI BIOSPHERE RESERVE (BASQUE COUNTRY)

Guillermo Meaza Rodríguez
Departamento de Geografía, Prehistoria y Arqueología. Universidad del País Vasco

María José Cuesta Aguilar
Departamento de Antropología, Geografía e Historia. Universidad de Jaén

The study of vegetation as an attribute to territory, the latter meaning the systemic framework of the relationships between the different elements of which it is composed, leads one to consider its two-fold function: that of revealing and of controlling environmental and territorial character and activity.

From such premise biogeographic-geoecologycal, in the same way that one considers characteristic species to be «phytoindicators» in that they assume a passive role, revealing the properties of their medium, one could also call the dominant species of a plant community «phytoagents». Indeed, these species, due to their abundance, size, morphology, structure and phenology are prevalent in the physiognomic and biotypical characteristics of the community, they lead its structural configuration, determine its productivity and, as a consequence, play an active role in controlling the properties of its environment.

After outlining the phytoindication/phytoaction interactivity within climatic, hydrological, geomorphologic, edaphic, biotic and anthropic parameters, the mesological interest of phytoindicator/phytoagent communities in each of the aforementioned categories is assessed together with their respective graphic representation.

Bearing in mind that all plant communities play this double role, at least to some extent, this attempt to study phytoindication/phytoaction focuses on three communities which, due to their varied typology, landscape, dynamic, environmental and territorial significance carry out very different phytoindicator and phytoagent roles within the territorial area of the Urdaibai Biosphere Reserve (Basque Country).

The plant landscape in the Urdaibai Reserve corresponds to that of the typical basque-cantabrian countryside (oak forest of *Quercus robur*, riverside forests, scrubland, meadows

and grasslands, forest plantations…). As well as this, other unique formations of the utmost interest can be seen, such as the marshes and cantabrian holm oak forests. All these constitute a well-valued biological, natural and cultural heritage, which all contributed in the past to Urdaibai being named a Biosphere Reserve (1984) and to the formal declaration, 5 years later, of the Law of Protection and Planning of the Urdaibai Biosphere Reserve. Three vegetation units of differing typologies and landscape, activity, environmental and territorial significance have been described (cantabrian holm oak forests, birch forests and the marsh complex of *Baccharis halimifolia* and *Cortaderia selloana*). Firstly, each one of these 3 vegetation units is presented with a table of phytoindicator and phytoagent species in the environmental and territorial context belonging to Urdaibai; and, secondly, they are assessed with two-fold information according to the aforementioned model.

The first vegetation unit affects one of the most typical plant communities of the Urdaibai Biosphere Reserve: the cantabrian holm oak forest, tributary to a complex connection between natural and anthropic factors whose genesis and evolution date far back in time.

The cantabrian holm oak forests of *Quercus ilex* constitute one of the most characteristic environmental and landscape elements of the cantabrian region, especially the latter's coasts, where its connection to the humid thermoatlantic/thermocoline terrain is clearly seen, as well as its special fondness for rugged soils and thin ground with little capacity for hydric retention. The richness of species is evident in the cantabrian holm oak forest, which is a consequence of a rather striking divergence of a biogeographic philiation and floristic composition between higher and lower strata. One of the keys to the cohabitation of mediterranean species in the crowns of trees and of atlantic species in the lower part of them is surely that, due to large amounts of rainfall, the hydric reserve of the soil reaches, even in the summer, not only the plants in the higher strata, which can dig in their roots to deeper, more humid levels, but also the plants foresting under bushes and on grass levels, whose roots are closer to the surface.

The holm oak forest has been eliminated from wide areas of its potential jurisdiction. The surviving patches, confined in enclaves whose typology and scarce edaphic development have saved them from otherwise unavoidable extinction, have not been free from human intervention throughout history. The traditional exploitation of the holm oak forest, once communal, covers a wide range of resources such as firewood, the obtaining of logs and wood for domestic needs and construction, the collecting of its fruits for human and animal consumption, winter pruning, the use of lime deposits and hunting activities. The holm oak forests suffered relatively frequently from the scourge of fire. Privatisation processes of land areas eased the proliferation of felling of land patches, which ended up spreading uncontrollably.

Nowadays, the holm oak forest's state of conservation can be called good and the level of threat low, since the soil on which it thrives has little or no agricultural or livestock value. However, the danger comes from the proliferation of plantations of *Pinus radiata* and *Eucalyptus*, planted both to the detriment of the very holm oak forest and the patches of oak forests which, in the heart of the holm oak forests, cover the most developed soil depression. What is unquestionable is the important phytoagent value of the cantabrian holm oak forests, especially as regards the efficient regenerative and protective role carried out by these lush forests on the emaciated soils which feed them –especially if one bears in mind the land's steepness– as well as the interesting richness of the fauna which finds refuge and sustenance in them.

The second vegetation unit is no doubt striking and is a result of the breaking of the natural balance associated with anthropic intervention which seriously unbalances the stability of the system. This area, covered mainly by oak forests and chestnut trees, was historically maintained by the peoples who communally exploited the livestock and forest resources of the mountainside. Wood was extracted, which served a wide range of purposes (construction, barrel-making, furniture, firewood…) and fallen leaves were collected which, together with the fern and the bilberry, was used as a bed for livestock. In the XIXth century one witnessed the collapse of plantation policies, when a period began in which the mountainside was used as a means of facing the debt provoked by the large sums required to finance endless wars. As a consequence of that, during the second half of the XIXth century and the beginning of the XXth century, Urdaibai's surroundings presented a very deteriorated plant covering on the lower mountainside and its pasture spotted with disperse plant clusters of oak forests and chestnut trees, the latter having been largely destroyed by the cryptogamic disease, horse chestnut bleeding canker.

In the mid XXth century a real forest revolution took place which radically transformed the landscape of the cantabrian lands: there were massive plantations of foreign species, mainly the distinguished Monterrey pine (*Pinus radiata*) and the eucalyptus (*Eucalyptus ssp*). However, the foresting demand from the forest and paper industry gave rise to such an intensive exploitation that the latter consequently led to the rupture of the balance in the natural system, with the added rise of a type of danger which had previously been of little significance to the area: forest fires. In the scorched areas, the initial stage of shrubland gives way to a bush grouping which reveals a more advanced state of the progression: that of the pyrophilous broom, of *Cystisus cantabricus* and *C. Commutatus*, able to colonise burnt areas, including steep slopes, stony and bare territory, eroded furrows plugged with big and small rocks and soils destroyed by aggressive forestry techniques…

In a more advanced successive state, broom acquires a preforestal aspect as the opportune birch (*Betula celtiberica*) sneaks in, leafy and endowed with resources which allow it to prosper in situations even more awkward than that of the broom. With time, the broom-birch forest turns into a birch-broom forest and the latter into a birch forest which plays an all-important role in the phytostabilisation of slopes and the scarring of fire-torn land. The not excessively shady, nemoral environment allows for germination and the development of other tree species, mainly the principle occupant of the territory, the pedunculate oak (*Quercus robur*) which, eventually will join the birch in the closing of the upper covering, making up an appearance of a birch-oak forest, an immediate precursor to the nowadays already foreseeable climax (of an oak forest) in some isolated enclaves: as the natural process follows its course, the birch crowns are being surpassed little by little by the oak ones, whose shade begins to threaten the sun-loving birch, announcing, thus, the increasing recuperation of the potential dominance of the oak forest.

The third vegetation unit is proof of a complex environmental process brought about by extreme –and in recent years one would also say brusque– changes in the anthropic use of the marshy surroundings. The massive draining of the marshes coincided with the phase of agricultural expansion at the end of the XVIIIth century, having much to do with the spirit and innovative instructions of the Basque Illustration: at the same time that cultivated lands became more common, attempts to eradicate the spots where malaria was rife, a

disease which strongly affected the sanitary conditions of these regions. The zenith of this draining activity was reached in the second half of the XIXth century, when the demand for agricultural and livestock products became greater due to the Carlist wars. Work began with the building of dykes or earth ditches –at times reinforced by the planting of tamarisk (*Tamarix gallica*)–, which impeded the entrance of tidal water and, consequently altered the hydric cycle and salt concentration.

In effect, from the mid XXth century, the progressive attraction of agricultural work hands towards the neighbouring urban and industrial nuclei provoked a clear retreat of the area which in days of yore had been retrieved from the marsh, which again began to be covered in halophile communities. In the 1980s the dykes were reconstructed, once again closing off the tidal flow from the area. The patches of land affected once again changed their appearance due to the draining tasks; even one of the most genuine elements of the Atlantic countryside was recuperated: the harvesting plains. However, nowadays the use of the drained and desalted lands for agricultural and livestock is practically nil. True witness to this is the proliferation of grasslands, rushes and reedbeds, a sign of the breakup of the draining of freshwater and, above all, of the aforementioned opportunist non-native species (*Baccharis halimifolia* and *Cortaderia selloana*), which quickly invade the wide areas of agriculturally unattended plots of land.

Today, both these foreign species constitute one of the worst environmental plagues facing the Cantabrian estuaries as they drastically reduce the original biodiversity and they have a serious impact on the landscape. At the moment, together with the native species of the salt marsh, halophile phytoindicators, typical of the genuinely marshy strip, nitrophile phytoindicators which have survived old livestock usage and freshwater phytoindicators common in higher marshy lands make up, if only for a time, a heterogeneous puzzle, rich in microhabitats and their species which cohabit. If there is no further human intervention, both non-native species in a short period of time will end up taking over the marsh, usurping the autochthonous occupants of the land until they make a virtually bispecific agrupation.

From this comparative study of these 3 cases, one deduces the following conclusions:

A. Phytoindication

- Climatic phytoindication: it is unquestionably the protagonist in the case of the holm oak forest and the birch forest, which is coherent with its climatic character in the former and preclimatic in the latter; this is not so in the case of the marsh complex, paradigm of a «permanent community».
- Hydrological phytoindication: the terms are inverted as regards the previous paragraph as it is in the area of the marsh where the corresponding phytoindicators overtake the leadership in line with its condition as a wetland; in the holm oak forest and the birch forest its presence is only modest.
- Geomorphological phytoindication: it is hardly of any relevance in the case of the holm oak forest; however, it is highly significant in the other two cases: in the birch forest because it reveals the high increase in the dynamics of slopes as a result of the

break-up of the natural balance by repeated deforestation, and in the marsh due to the inconsistency of the land subjected to tidal currents when there is episodical slackness in the maintenance work of the polders.

- Edaphic phytoindication: edaphisms are noteworthy in all three vegetation units, but with a different significance in each one: in the holm oak forest they come mainly from the calcicolous and eutrophic context; the birch forest due to a silice litology and, above all, to the resulting oligotrophy with a quantitative and qualitative degradation of the land due to reiterated felling and burning; in the salt marsh due to the gleycification, salinisation and eutrophization brought about by old practices used for agriculture and livestock.
- Biotic phytoindication: it is significant in the holm oak forest and the birch forest where interspecific plant relations prosper as well as the pollinating and propagating work of the fauna; it is however, limited in marshy lands, above all due to the progressive and biotically impoverishing presence of invasive non-native species.
- Anthropic phytoindication: it is scarce in the holm oak forest, which experiences little anthropic intervention; it is noteworthy in the salt marsh due to the periods of draining and agricultural and livestock use and, nowadays, in the proliferation of neophytes brought about by human intervention; especially striking in the birch forest, brought about by the breaking of the natural balance by the deforestation of the natural vegetation, fire and intensive silviculture through aggressive and destabilising techniques.

B. Phytoaction:

- Climatic phytoaction: the varied climatic role of the phytoagents in the 3 situations is worthy of highlighting: it is considerable in the tangle of the holm oak forest where an internal microclimate is generated which favours the installation of sciaphilics, termophiles and hygrophytes; its presence is discreet in the birch forest as these trees have relatively uncrowded tops; it is incipient, although foresting, in the marsh complex as far as the non-native species' dominion becomes denser in the higher level of the bushes.
- Hydrological phytoaction: the hydroregulating role carried out by the corresponding phytoagents undoubtedly proves vital in the marsh environment; however, they play a less noteworthy role, although still prominent, in the case of the birch forest and the holm oak forest.
- Geomorphologic phytoaction: what is striking is the important geomorphological role played by the plant covering in all three cases: in the cantabrian holm oak forest due to generally foresting on steep slopes; in the birch forest due to coming together quickly after setting fire to and felling the bare land exposed to erosion; and in the marsh complex for strengthening the inconsistent soils exposed to tidal action.
- Edaphic phytoaction: the three environments contain very efficient phytoagents in the genesis, maintenance and protection of the ground: in the case of the holm oak forest for covering cracks and limestone hollows with an edaphic film; in that of the birch forest for regenerating the impoverished soils after felling, fire and destructurisation

inflicted by aggressive silvicultural techniques; and in the marsh for retaining the nutrients and strengthening quick sands.

- Biotic phytoaction: paradigmatic in the forest complex of the holm oak forest, where plants and animals interrelate narrowly at all levels; something similar happens in the salt marsh, although the foresting threat of the invading neophytes endangers the integrity –and even the continuity– of the vital forms which are typical of marshes; the birch forest presents more moderate values, which is inherent in its preclimatic ubication in the succession.
- Anthropic phytoaction: bearing in mind that the anthropic function is restricted to the species which, presenting an abundance-dominance index superior to 1, are or have been an object of interest and of past and present anthropic use, what is striking is its quantitative and qualitative importance in the heart of the holm oak forest, which is lower in the case of the marsh estuary and the birch forest.