Chapter

# Introductory Chapter: The Role of Education in the Conservation of Endemic Flora Ecosystems

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## 1. Introduction

In order to conserve endemic and rare species, knowledge of the habitats, their mapping, their floristics and the relationship between these and man through educational services is a priority. European policy, through its Directive 92/43/EEC of 1992 on the conservation of fauna, flora and habitats of interest because of their endemic or rare character, establishes this. This European circumstance can be transferred to other places on the planet, especially to those areas with a high rate of plant endemism and a high floristic diversity. This is mainly due to the island effect, such as the islands of the Caribbean, Cuba, Española [1–3] and Madagascar, which act as hotspots on the planet [4], as well as in American areas where the Quaternary glaciations hardly caused extinctions, due to the special north-south disposition of the mountains, which favoured migratory routes, which is why in Mexico approximately 200 species of *Quercus* have been detected, bringing down the genus Pinus of holarctic character to subtropical environments [5]. Another factor that conditions the greater or lesser protection of endemic species is anthropic action; in this case, it is possible to intervene in a positive way to favour the conservation of the flora, which must be done by conserving the habitats; otherwise, the loss of genomes will continue, which in the opinion of Favarger and Contandriopoulos [6] represents genocide. Hence the need to stimulate and motivate the teaching of endemic flora in order to achieve its conservation, a plant diversity that inevitably requires the protection of the habitat in which it is located [7–9], habitats that are sometimes fragile due to their rarity or endemism. The greater or lesser abundance of rare and endemic species has its origin in geological, climatic, historical and edaphic aspects such as edaphisms [10]; of particular importance is the phenomenon of population isolation, which has not allowed genetic flow between individuals over time.

## 2. Results and discussion

### 2.1 Areas of distribution

Plants can be more or less stenotic, so there are plants restricted to small areas, while others have large areas of distribution, and their distribution is linked to the

presence of certain ecological, historical and geographical factors. Among the various factors that condition the distribution of species, it is worth highlighting the ecological aspects, as can be seen in the endemic species of the south of the Iberian Peninsula belonging to the Asteraceae family [11].

Species present certain mechanisms to disperse their seeds, passing them from one place to another by anthropocoria, zoocoria, anemocoria, and if the seeds fall in biotopes suitable for germination, a new nucleus of propagation is generated, which is directly related to the stenotic nature of the plant. The boundaries of the areas have an ecological, geographical or biological component, being closely related to climate and soil. This interpretation is supported by the fact that most of the areas are situated within the floristic zones defined by temperatures (altitudinal floors) and by the degree of oceanicity [12–14]. For these reasons, the following areas of distribution exist.

1. Continuous areas. These are considered to be those which, despite the existing gaps, occupy the entire emerged lands or at least wide latitudinal spaces. In these cases, we speak of cosmopolitan occupation in the first case, and in the second case, depending on the area occupied, we speak of circumpolar, circumboreal, circumaustral and pantropical areas, which are generically included in circumterrestrial. Examples of cosmopolites are the reed *Phragmites* sp., cattail *Typha* sp. and duckweed *Lemna* sp., plants that are confined to marshy environments at almost all latitudes except in polar areas. Such dispersal seems to be attributable to migratory birds. A good example of cosmopolitan plants is the family Gramineae.

2. Disjunct areas. These are local areas without continuity, which is why they are grouped under the generic name of discontinuous areas. A case of discontinuity is when populations related at the species, genus or family level appear in areas sufficiently far apart, so that there can be no genetic flow between them. In this case, the phenomenon of speciation is occurring, since for any species there is the so-called disjunct threshold, which represents the minimum distance that cannot be exceeded by the species, so when we find areas above this threshold we are in the case of disjunct areas.

3. Vicariant areas. These are areas occupied by species that, although they have a common origin, due to a recent territorial separation (appearance of a geological accident), or because it is a very large area of occupation, there is no genetic exchange, and specific differentiations appear. These are cases of recent biological evolution, and generally only reach the subspecies level. This is the case of *Ulex parviflorus* and *Ules parviflorus* subsp. *eriocladus.*

4. Endemic areas. An endemic area is a very localised area which can have a very variable extension; the higher the rank of the taxon considered within the systematic scale, the greater the extent. Thus, species endemism is limited to a restricted area, such as a small mountain massif, *Viola cazorlensis*, *Lithodora nitida* of the Sierras Subbeticas and *Thymus mastichina* of the Iberian Peninsula; whereas genus, family and order endemism can extend to the whole of a continent, for example the American families Cactaceae and Bromeliaceae. Or this phenomenon is confined to islands where the island effect has led to high taxonomic differentiation; hence the high rate of endemic genera on islands such

as Madagascar and the Caribbean islands, for example Hispaniola has a rate of endemic species of more than 30%. Despite the different ways of classifying endemics, the most widely accepted classification is as follows: Paleoendemics, systematically isolated taxa, such as monotypic genera, as is the case of Tortuga Island, of calcareous nature, located to the north of Haiti, at a maximum altitude of 378 m. Despite its small size, the presence of the monotypic genus *Tortuella abietifolia* Urb. & Ekman and 15 exclusive endemic species justify Cano-Ortiz et al. to consider this small island as a district biogeographic unit [15]. These are ancient taxa, sometimes on the verge of extinction, making it a conservation endemism or relict endemism. Schizendemic, taxa that result from the slow and progressive differentiation (gradual speciation) of a primitive taxon in the different parts of its range by means of small mutations or recombinations. Schizendemic taxa have a common origin, since their formation is simultaneous and, being formed by gradual speciation, they have the same chromosome number. Patroendemics are taxa that have remained diploid in a given territory, while in neighbouring areas, they have given rise to corresponding polyploid taxa, the area of the latter being larger. Apoendemics are taxa that have originated in a given region by polyploidisation (sudden speciation) from a taxon of more or less large area and diploid or in any case of lower ploidy level.

### 2.2 Educational aspects

In the current situation, with a changing world and with great social and cultural challenges, it is necessary to move into a phase of action to protect endemic and rare species, and although most organisations in their resolutions talk about promoting environmental educational aspects, the reality is that these aspects always take second place. Consequently, it is a priority to raise awareness of the meaning of endemism in educational centres, as established by Noguera-Urbano [16]. Scientific literacy is a priority so that students and society can understand the value of species; otherwise, a large-scale destruction of species is foreseeable due to factors such as climate change, which is becoming more pressing every day, and the strong anthropic action that depletes plant resources. To promote botanical literacy, among other considerations, it is necessary to increase the cultural and educational level of the population with the learning of botanical-geobotanical concepts such as those set out by Cano-Ortiz et al. [17]; to this end, the few environmental contents taught in educational centres must be modified and increased, using teaching methodologies that have a greater impact on the acquisition of knowledge by students, either through enquiry [18–20], in any case the didactic proposal of practical classes outside the classroom by Álvarez and Antolin Rodriguez [21] is preferable, the latter method being essential as it arouses curiosity and develops the student's capacity for observation.

## 3. Conclusions

Although research on the knowledge of species has progressed in recent years, this is not the case at the sociocultural level of the population. It is therefore necessary to promote botanical studies in schools, educational centres and universities in order to raise public awareness, which is only possible with the involvement of public and private institutions.

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