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THE MEANING OF ENDEMISM IN PHYTOGEOGRAPHY

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The definition of endemism is a relative concept, and is relative to the size of the territory and the hierarchical rank of the taxon one is referring to.

The more the territory is small, less you would expect to find in it the whole areal of taxa which ranks are high as a family or an order. Here is the case to cite FAVARGER (1969): "It is the scale that creates the phenomenon."

The criterion for the definition of endemism is therefore the exclusive membership to a certain geographical territory taken as a reference, not the size of the range of taxon.

The fact that a taxon is confined in a small areal can be biogeographically caused by two different reasons:

1. It is an ancient taxon , which occupied some time ago a much greater territory and at this time it is in its phase of regression. This can be caused by many different reasons: inability to compete with younger taxa and ecologically better adapted to the land, climatic changes, destructive geological events, etc.

2. It is a recent taxon, which has not yet had time or opportunity to expand its range. It is therefore in its progressive phase , in which nowadays occupies a small area.

In the first case we will speak about a paleoendemic (ENGLER, 1879) or relict endemic (DRUDE, 1897) or even of endemic for conservation (SCHRÖTER, 1926), in the second case we will talk about neoendemic or endemic for innovation.

There is therefore a strong link between the changes in a distribution area and plant endemism.

The simpliest modification of an areal consists of its expansion (if it still has not occurred we are in front of the distribution range of a neoendemic species or endemic for innovation) followed by a reduction (which is cause of the paleoendemism or relict endemism).

One of the main limiting factors that determine the extent and form of the areal is the climate (temperature and humidity). The temperature in particular is responsible for much of the distribution of organisms in space (ZUNINO, 1995).

A particular case (interesting for the phytogeographic concept of endemism) is what often happens on the borderlines of a certain area, where the environmental conditions stop to be favourable for the species. The peripheral borderline of an area is often an experimental zone, where only the fittest or the most adapted organisms survive these extreme conditions for specie average standards.

In biogeography, classifying an endemic species on the basis of the areal it occupies can be useful but is not enough.

The problem of classification of endemism is among those which the recent acquisitions of biosystematics, and particularly of citotaxonomy, have given an useful contribution.

The classifications prior to 1960 have not been fully satisfactory regarding it. If all botanists agree on this important division between paleoendemism or endemism for conservation and neoendemism or endemism for innovation (WULFF, 1950), is its application to real study cases to be difficult, in particular for the insular endemic flora (FAVARGER & CONTANDRIOPOULOS, 1961).

The reason is that the age of a taxon is, however you might look at it, difficult to estimate correctly. Last but not least, often problems about this topic occur for a purely emotional and sentimental behaviors. For many botanists in fact, an ancient species deserves more respect of a young one (FAVARGER & CONTANDRIOPOULOS, 1961).

In doubt and confusion between these terms, it is tempting to assert (Favarger & CONTANDRIOPOULOS, 1961): an endemic taxon is systematically isolated, then it is also a paleoendemic; or again: a taxon is a subspecies or a variety of a widely distributed species, then it is a neoendemic. But thinking in this way could lead to a great mistake, ignoring or overlooking to the order of evolutionary events.

The age of the taxa, although it is an important fact, can not be the only one to be analyzed to describe the degree of endemism. It is important to understand the way such endemic has formed and its phylogenetic relationships with relatives taxa from neighboring regions. There was a need of a classification which could have solved doubts like this one: the endemic taxa of a territory are the source of wide distributed taxa in proximal regions or, on the contrary, are descendants through an evolutionary phenomenon?

The Swiss botanist C. Favarger (FAVARGER & CONTANDRIOPOULOS, 1961; FAVARGER, 1969) and co-workers showed that the chromosomes of many endemic species and their correspondent "adelfotaxa", i.e. those entities that show undeniable morphological similarities, could be compared. The number, shape, type of chromosomes and especially the ploidy level of the plants allowed him to make objective comparisons between different entities and their systematic, historical and phylogenetic relationships.

Favarger and coworkers have developed a classification of the various types of endemics based on karyological results that takes expecially into account the process that originated them (see GARBARI, 1989). According to this classification endemic plants are divided into 4 classes:

1. **Paleoendemics (sensu stricto)**
2. **Schizoendemics**
3. **Patroendemics**
4. **Apoendemics**

1: Paleoendemics (sensu stricto)

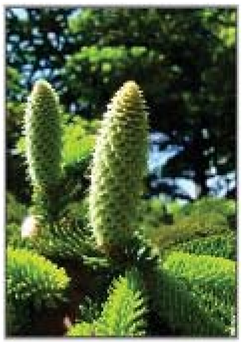
Paleoendemics (sensu stricto) are considered taxa systematically isolated, such as genera represented by a single species, without closed relative taxa. They are in general weak variables, often endangered, whose range is frequently a remnant of a larger territory. Paleoendemic taxa are often diploid, but not less frequently polyploid; in the latter case are paleopoliploids (FAVARGER & CONTANDRIOPOULOS, 1961; FAVARGER, 1969).

Sicily has some magnificent examples of exceptionally rare paleoendemics plants (point source endemics, i.e. they exist only with a small population in an exceptionally restricted area) as *Hieracium lucidum* Guss., *Abies nebrodensis* (Lojac.) Mattei., *Anthemis ismelia* Lojac., *Petagnaea gussonei* (Spreng .) Rauschert or *Zelkova sicula* Di Pasquale, Garfi & Quézel.

In Sicily there is a small population of about 200 specimens of *Zelkova sicula* (Pic. 1) in a small territory of Monte Lauro, Syracuse, subject to significant environmental risks such as grazing or fire (DI PASQUALE *et al.*, 1992).

Abies nebrodensis (Pic. 2) is instead a point source paleoendemic tree of the division Pinophyta. Its range relies on the mountainous regions of northern Sicily (Madonie mountains). Currently there is only one population of 29 individuals.

Pic. 1: Zelkova sicula. (Ph. Prof. S. Romano).



Pic. 2: Strobiles of Abies nebrodensis. Ph. Dott. A. La Rosa

2: Schizoendemics

Under the class of schizoendemics go those taxa that result from slow and progressive differentiation of a primitive taxon in different areas of its range ("gradual speciation" VALENTINE, 1950).

Often the differentiation intervenes in different parts of a continuous territory. The areas of vicariant taxa are adjacent, and each vicariant taxon occupies a small remote area of the territory.

Schizoendemics always present, because of their common origin and the wide genetic similarity, the same chromosome number of taxa that generated them. Their name "Schizo-" doesn't give any reference to the age of the taxa. A comparative analysis of chromosomes, however, it is possible to deduce whether the schizoendemics plants have old or recent origin. In the first case they will be called paleoschizoendemics(oloschizoendemics), in the second instead neoschizoendemics. (FAVARGER & CONTANDRIOPOULOS, 1961; FAVARGER, 1969).

It exists in Sicily a possible case of future speciation, visible example of neoschizoendemism, or rather, of what will be a future neoschizoendemic taxon if the growth trend will remain constant over the next geological periods. It is *Muscari commutatum* Guss. and the now "ex species" *Muscari lafarinae* (Lojac.) Garbari (pic. 3) (it is no more taxonomically accepted as a species).

Pic. 3: Muscari commutatum, Capo Gallo (Sicily, Italy) (Ph. de Simone);

3: Patroendemics

Under the class of patroendemics go those taxa which have remained diploid (and therefore primitive) in a given territory where they are endemic, and that have differentiated into polyploid taxa on the surrounding regions. (FAVARGER & CONTANDRIOPOULOS, 1961; FAVARGER, 1969)

A possible case of patroendemic plant is *Limonium bocconei*, which has a diploid chromosome number 2n = 18 and in the neighboring areas of its range there are 2 species of the same group (the group of *Limonium cosyrense*): *L. flagellare* (tetraploid with 2n = 36) and *L. ponzoi* (triploid with 2n = 27) (BRULLO, 1981): it is possible therefore that it is a patroendemic.

4: Apoendemics

The apoendemism is the opposite concept of patroendemism. It is represented by those entities, which have differentiated into a specific region for polyploidization from a diploid taxon or from one with a lower degree of ploidy level, widespread in the surrounding areas or contiguous (or who have been contigous), or with a more advanced degree of kariotipic differentiation respect of the corresponding taxon, in case of this has the same chromosome number. (FAVARGER & CONTANDRIOPOULOS, 1961; FAVARGER, 1969)

Examples are the above-mentioned kinds of Limonium, *Calendula maritima*, some species of the genus Allium and *Diplotaxis crassifolia*.

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