# Classification of the Biosphere

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## Background

Building on the work of Good (1947, 1974), Gleason and Cronquist (1964) and others, Takhatjan (1986) divided the world into six floristic kingdoms, 35 floristic regions and just over 150 floristic provinces. These are here described as biokingdoms, bioregions and bioprovinces. At the highest-ranking level, biokingdoms include endemic plant taxa of the highest categories including endemic families and very high levels of endemic genera and species. Each biokingdom is divided into bioregions established on the basis of high levels of generic and species endemism, and in turn each bioregion is divided in bioprovinces characterized mainly on their level of species endemism. If endemic genera exist at the bioprovince level they are usually monotypic (based on just one species) or oligotypic (based on just a few species). At each level these are regarded as natural floristic areas or choria and represent major centres of endemism. The sizes of these bioprovince vary enormously but the smaller they are the more distinctive they must be in terms of their biodiversity and endemism. They are, therefore, based on floral biogeography and biosystematics rather than geographic variations such as climate, topography, geology, or even vegetation. That is not to say that climate and topography, in particular, have not been important factors in their development. The system is largely based on the biogeography of vascular plants rather than lower plants since the global biogeography of lower plants, such as bryophytes, is incomplete, but many are turning out to have cosmopolitan distributions and so would be of little value in defining local biogeographic areas. From experience gained in the development of this website two new bioprovinces have been recognized. These are the Cocos Island BioProvince and the Chocó BioProvince both in the Neotropic BioKingdom.

## Other attempts to divide the biosphere into meaningful units

Early classification systems usually concentrated on the physiognomy and structure of vegetation with little attention paid to species composition (e.g. Warming 1909, Fosberg 1967, UNESCO 1969). These systems tend to be generalized and provide no ‘sense of geographic area’. For example, under Fosberg’s system, Europe was largely classified as winter-deciduous forest.

There have also been attempts to develop systems of faunistic regions. Wallace (1876) divided the world into six zoogeographical realms. On a smaller scale, Hagmeier (1966) described the mammal provinces of North America and Fittkau (1969) the faunal provinces of South America. However, plants have the advantage of being more tightly restricted by abiotic factors such as temperature and rainfall. Consequently areas of plant endemism are more clearly defined by climate or other physical barriers. Many animals are able to overcome certain climatic barriers by physiological and behavioral adaptations (Brown and Lomolino 1998). Most faunistic systems have been based on vertebrates, and rationalizations based on other animal phyla can be markedly different (Udvardy 1975), although the same could be said for vascular plants as compared with bryophytes for example.

Ideally we should be talking in terms of a biotic system of regions and provinces based on both floristics and faunistics, but no satisfactory system on a global scale has been developed. The term biotic province was originally devised by Vestal (1914) and later developed by Dice (1943) in a system to classify North America. However, this was never

extended to other countries. In another system, Clements and Shelford (1939) coined the term 'biome' to describe an area characterized by prevailing regional climax vegetation and its associated animal life. For example, the tundra biome can be clearly identified, but the weakness of this system lies in the fact that much of the natural climax vegetation of the world has now been lost. Nevertheless, it still provides a very useful broad scale classification of the terrestrial biosphere, and was used as a basis for developing a system of biotic provinces by the International Union for Conservation of Nature (IUCN) (Dasmann 1973, IUCN 1974). Each biotic province was defined in terms of its vegetation, flora and fauna, but the system was a rather inelegant using different criterion in different parts of the world. As a result of refinements introduced by Udvardy (1975) the term biotic province was replaced by biogeographic province. In total, 193 biogeographical provinces were recognized, but these are not radically different from Takhatjan's floristic provinces, with many having identical boundaries. Surprisingly, though, in Udvardy's system the British Isles were recognized as a biogeographical province. This may sound appealing to British people, but when other biogeographical provinces included much more clearly defined areas like Borneo and Hawaii, this made a mockery of the whole system, and showed a complete lack of any meaningful biogeographic analysis. One of the merits of a phytogeographic system is that that plant life underpins most of our terrestrial ecosystems, but clearly no single biogeographic framework will be optimal for all taxa (Olson *et al.* 2001).

Generally, there is good concordance between floristic and faunistic schemes at the highest (global) geographic scale (Brown and Gibson 1983). There is also complete correspondence at the lowest (ecological) scale because the distribution of plants and animals is largely determined by the physical structure of the environment (Krasnov and Shenbrot 1998). However, inconsistencies between phytogeographic and zoogeographic regionalization have been reported for intermediate scales (provinces) where both ecological and historical factors are involved (Brown and Gibson 1983), but in other cases a degree of correspondence have been found (Krasnov and Shenbrot 1998). Myers *et al.* (2000) also talks about finding good species congruence insofar as high counts for endemic plants were often matched by high counts for endemic vertebrates especially in tropical areas.

Clearly no classification of the world's biological areas can be perfect and like many ecological classifications there will be a degree of arbitrariness, but Takhatjan's classification is possibly the closest we can expect to achieve in terms of creating near natural boundaries. Also any global system to be of value has to be reasonably understandable. It is very easy to achieve greater resolution. For example, at a level below floristic or bioprovinces the World Wildlife Fund (WWF) has mapped the earth in terms of 867 land-based ecoregions (Olson *et al.* 2001), and below that there are literally thousands of habitats that can be sub-divided into a multitude of communities. Clearly, therefore, to gain a global perspective we have to think in terms of reasonable large units.

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