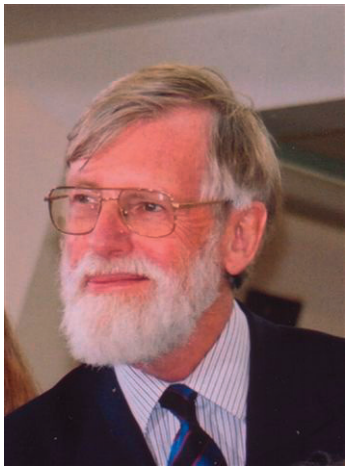
SIBBALDIA GUEST ESSAY



Professor Sir Ghillean Prance was born in Suffolk in 1937 and was educated at Malvern College and Keble College Oxford where he obtained a BA in Botany and a D.Phil. His career began at the New York Botanical Garden in 1963 as a research assistant and subsequently B.A. Krukoff Curator of Amazonian Botany, Director and Vice-President of Research and finally Senior Vice-President for Science. His exploration of Amazonia included 15 expeditions in which he collected over 350 new species of plants. He was Director of the Royal Botanic Gardens, Kew from 1988 to 1999, McBryde Professor at the National Tropical Botanical Garden in Hawaii from 2001 to 2002 and is currently McBryde Senior Fellow there. He is Scientific Director and a Trustee of the Eden Project in Cornwall and Visiting Professor at Reading University. He is the author of 19 books and has published over 520 scientific and general papers in taxonomy, ethnobotany, economic botany, conservation and ecology. He holds 15 honorary doctorates and in 1993 received the International COSMOS Prize and was elected a Fellow of the Royal Society. He was knighted in July 1995 and received the Victoria Medal of Honour from the Royal Horticultural Society in 1999. He received the David Fairchild Medal for plant exploration in 2000 and the Allerton Award in 2005. In 2000 he was made a Commander of the Order of the Southern Cross by the President of Brazil. He continues to be active with research in plant systematics and in conservation of the tropical rainforest. He chairs the Brazilian Atlantic Rainforest Trust, the Mass Extinction Memorial Observatory (MEMO), A Rocha International and the Development Committee of the Eden Project and is a board member of the Amazon Conservation Trust and the Exbury Gardens Trust. He is President of The Wildflower Society, Nature in Art and the International Tree Foundation.

THE INTERNATIONAL YEAR OF BIODIVERSITY

Professor Sir Ghillean Prance[1]

When environmentalist Raymond Dasmann (Dasmann, 1968) from California coined the term biodiversity in a popular book on conservation in 1968 he would have had little idea of what this would lead to. In fact, the word was ignored for some years afterwards until ornithologist and conservationist Thomas Lovejoy used the term in a foreword to a book (Soulé & Wilcox, 1980). However, the term biodiversity really came into use after the National Forum on Biological Diversity in Washington, DC in 1985 when the editor of the proceedings, E.O. Wilson, used it as the title of the resulting book. I

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remember the excitement about this supposedly brand-new term when I attended that Forum. After this the use of the concept of biodiversity really took off, so much so that 2010 has been declared by the UN as the International Year of Biodiversity. Throughout this year there have been countless initiatives planned to disseminate information and to promote the protection of biodiversity, and so it seems an appropriate topic to think about in *Sibbaldia.* More than 200 organisations in the UK, including the Royal Botanic Garden Edinburgh, have signed up to play their part in the global awareness campaign of the International Year of Biodiversity.

The website of the Royal Botanic Garden Edinburgh speaks of this year's programme for the International Year of Biodiversity. "The programme will focus on the abundance of biodiversity here in Scotland and in countries around the world – and is presented in partnership with a wide range of research organisations, artists and environmental charities. We can learn ways in which we can help protect our biodiversity now and for future generations. The Royal Botanic Garden Edinburgh has taken a lead in the study and promotion of biodiversity for three centuries and it is fitting that the new John Hope Gateway should provide a platform for such a wide variety of events during this global celebration of our living planet." (Royal Botanic Garden Edinburgh, 2010)

Prior to the adoption of the term biodiversity, biologists and conservationists were primarily concerned with species diversity. Biodiversity is a much more all-embracing concept because it covers the total variation in organisms and their environment. It covers species diversity, genetic diversity within species and the ecological diversity in which they live. This holistic approach is vital for conservation science. Initially much conservation focused on species diversity and rarity. This resulted in a range of Red Data books that listed the threatened and endangered species of different places. An early one was Lucas & Synge (1978) that listed 250 selected worldwide species of plants that were under threat of extinction. The current IUCN list (IUCN, 2010) lists more than 16,000 species of animals, plants and fungi that are threatened, and this is probably a gross underestimate. Today most countries have some sort of Red Data lists. These are useful and draw attention to the species most in need of protection, and there is no doubt that red lists are still useful tools for conservation and for legislation. However, organisms are dynamic, and their genetic diversity and adaptations to different habitats that are encompassed in a biodiversity approach are also essential tools for conservation.

The emergence of biodiversity as a concept has arisen at an interesting and appropriate time. First, because it is in recent years that the destruction of species and their habitats has accelerated greatly and has reached crisis level. We now live in a time of mass extinction of species that is between 100 and 1,000 times greater than the natural level. Many scientists predict that by 2050 we will have lost about 30 per cent of the species on our planet. Second, biodiversity as a concept is timely because of the emergence of molecular genetics, which enables us to examine the genetic diversity of the species that we study or seek to conserve. The molecular work done by scientists at the botanic gardens of Edinburgh and Kew and elsewhere is not only producing better evolutionary classifications of plants but is also showing much clearer relationships.

When a conservationist is faced with a choice between conserving various species, the evolutionary relationship is a vital piece of information. It is much more important to preserve two genetically very different species than two that have only small genetic differences. I am writing this in Hawaii, the extinction capital of the USA. Here there are many native species that have been reduced to populations of only a few individuals. When one is left with just a few plants of a species and is trying to multiply them to re-establish them, one of the essential tools today is a genetic map of the species. It is obviously wise to make as wide crosses as possible between genetically different individuals to make use of whatever genetic diversity remains in order to produce healthy offspring. A good example of this is *Hibiscus clayi* Degener & I. Degener from the island of Kauai in Hawaii in which there were only four closely related individuals left in the wild. Cultivation from this stock led to weak individuals that produced few seeds (David Burney, pers. comm.). It was discovered that this species was cultivated at Kew from the collections of Joseph Rock from Kauai in the 1950s. When material from Kew was taken back to Kauai the rescue programme for *Hibiscus clayi* took off because it added genetic diversity back into the small population. This story also shows the importance of collections in botanic gardens that have been maintained over many years, often with little knowledge of the status of a species in its natural habitat.

Apart from conservation of wild species, genetic diversity is a vital part of the ability to feed the ever-increasing human population. There are many instances where the use of a small sample of the available biodiversity has led to crop failure. An example is the Irish potato famine that led to the deaths of about a million people. This was because the crop was based on only two varieties of potato, neither of which was resistant to the *Phytophora* fungus that attacked it. In an Andean market, in the potato's country of origin, there are always countless different varieties on sale, showing that their system is based on diversity and not on single varieties of the crop. I remember well the panic in Brazil when coffee rust attacked coffee plantations. This would have been devastating to the country if it had not been for the discovery of a rust-resistant variety from Ethiopia. There are many other examples of agricultural disasters caused by the current tendency to use little genetic diversity for breeding crops. Our crops continue to depend on the wild relatives that contain greater biodiversity. This is a good reason for the research carried out by botanic gardens to understand all aspects of biodiversity about wild species and especially crop relatives.

An important result of the concept of biodiversity was the establishment of the Convention on Biological Diversity (CBD), drafted for the Earth Summit of 1992 in Rio de Janeiro, Brazil and now ratified by most countries (although not yet by the USA). The CBD gives sovereign rights over the biodiversity of a country and commits the signatory countries to conserve biodiversity and develop their resources in a sustainable fashion. It also commits to an equitable sharing of any benefits arising from the use of biodiversity. The CBD requires prior informed consent between a country and a collector of species from it, together with an agreement for benefit-sharing should any financial profits result. The CBD has sometimes led to hasty legislation that has impeded

scientific research, but it has also encouraged many countries to upgrade their conservation efforts. With the focus of the CBD on sustainable use of biological resources, conservation now has to be a balance between pure conservation and the sustainable use of species and the ecosystems in which they grow. An important role of the CBD office has been to promote the International Year of Biodiversity. It was at the World Summit of Sustainable Development, held in Johannesburg, South Africa in 2002 and which followed up the Rio Conference, that a target was set to halt the decline of biodiversity by the end of 2010. A worthy and important goal, but my experience from travelling around the world is that this goal is far from being met. The Amazon forests and the peat forests of Sumatra continue to burn, and many other habitats, temperate and tropical, are still losing their species. The idea was good, but the implementation has been weak.

Botanic gardens will play a vital role in the promotion of the International Year of Biodiversity in ensuring follow-up and continuity and in furthering the goal to halt species loss. Most botanic gardens, including that of Edinburgh, are located within urban areas. They are visited by urban populations who have little exposure to nature and so little idea about the importance of the rural and wilderness biodiversity that supports their very existence. The challenge is to ensure that visitors to our botanic gardens receive information about the importance of biodiversity, whether through interpretive signage or lectures and formal courses. I hope that the focus on biodiversity in 2010 will lead to an increase in methods to demonstrate biodiversity to those who have little contact with it. It is not endless conferences and political fora that will halt the decline in species loss, but rather the practical scientific and educational work of botanic gardens and other scientific institutions around the world. In October of this year world leaders met in Nagoya, Japan to set new targets and steps that are needed to address biodiversity loss. If these are to succeed then botanic gardens must play their part. What is needed is action rather than more political discussions.

Today plant species of the world are facing a new threat, that of climate change. The wild species that will be particularly threatened are those whose genetic diversity has been depleted by reduction to small, genetically similar populations. These species will be less equipped to adapt to new climates. Biodiversity is what will help them to survive. The third aspect of biodiversity, ecosystem diversity, has become vitally important here. Plants that are adapted to a wide range of habitats are more likely to withstand climate change. It is good that conservation is now thinking more in terms of biodiversity than the listing of individual threatened species. The integrated biodiversity approach is showing us how serious climate change is. Species are already moving, as is demonstrated by the upward migration of the alpine flora of our Scottish mountains. Species are also changing the timing of their phenology. This is leading to a lack of synchrony of previously close links, such as where one part of a link is cued by day length and the other by temperature. The breeding times of some UK song birds are now out of synchrony with the maximum availability of insects to feed their chicks. The point is not merely to save species; today an integrated approach is needed that addresses all aspects of biodiversity and of the climate that is controlled to a large extent by the

biodiverse forests of the world. The year 2009 closed with a failed climate conference in Copenhagen. Can we make 2010 a better year because of the focus on biodiversity brought through the International Year of Biodiversity or will it be another Copenhagen?

CONCLUSIONS

The main goal of the International Year of Biodiversity is to raise awareness of the importance of conserving biodiversity and to enhance public knowledge of the threats to biodiversity and the means to conserve it. There is still a lot to do. A survey conducted at the Natural History Museum in London showed that only 15 per cent of visitors were aware of the term biodiversity. We have a huge focus on biodiversity in 2010 through the declaration of the International Year and I have no doubt that this is doing much to promote the conservation of biodiversity and to get the word into the vocabulary of the general public, but my fear is that after such momentum there will be a lull. The challenge to botanic gardens and other institutions involved with conservation will be to keep up the pressure to save the other species with which we share this planet. This will involve the maximum use of biodiversity information in our research and in our interpretation to the many audiences of our gardens. The understanding of species diversity, their genetics and the ecology of the habitats in which they grow is a focus of the scientific and horticultural expertise of the Royal Botanic Garden Edinburgh. This can be a major contributor to keeping the preservation of plant biodiversity at the forefront and to stimulating more action for biodiversity. The future of human life depends on biodiversity; the more biodiversity that remains in the world, the more likely it is that our own species will survive.

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