The 2010 Banks Memorial Lecture: Responsibilities in maintaining biodiversity in a changing world

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Introduction

The Banks Memorial Lecture is an important event in the Royal New Zealand Institute of Horticulture calendar. The lecture was instituted about forty years ago at the time of the bicentenary of Cook's first voyage of discovery 1768–1771. Botanist Joseph Banks and his retinue accompanied Cook and visited New Zealand in 1769.

Over the years, many disparate topics have been chosen for the lecture. In this year's lecture, I addressed the question of biodiversity and specifically the importance of plant collections. This seems especially appropriate as the Banks Memorial Lecture was delivered in Gisborne, the home of New Zealand's National Arboretum at Eastwoodhill, which is currently celebrating its hundredth year of existence. Furthermore, the year 2010 has been declared the International Year of Biodiversity.

Fig. 1 Keith Hammett delivering the 2010 Banks Memorial Lecture. Photo: Gil Hanley.

Perspectives

As with any treatise it is important to first define the parameters followed. As a breeder of ornamental plants I feel it a privilege to be able to use naturally occurring species and the hybrids derived from them as a means of artistic expression. However, at the same time I have a real conviction that those parental species should be conserved unsullied for future plant breeders, for people to enjoy, and for the long term preservation of the species itself. Equally, I do not feel that I own the parental species themselves.

I can (and do) claim royalties and assert Plant Variety Rights for some of the plants that I breed, in the same way that it is reasonable for a composer of music to be rewarded for a defined period of time for the specific juxtaposition of notes that he or she arranges. However, I do not think it reasonable that anyone should be able to claim permanent ownership of those notes or genes. In my opinion, no person or group of people should claim ownership of naturally occurring flora or fauna. The disparity between the time it has taken for species to evolve and the time period that specific people have occupied any area negates any notion that man can have made any contribution to the development of those species. Indeed, most often, human activity has led to the demise of species.

Humans should be custodians not owners of those species and I believe that the question of preserving biodiversity is a global responsibility and not just a parochial one.

Historical and global context

It is important to consider the world in which Sir Joseph Banks lived and to contrast it with our world of today, already a decade into the 21st century.

Banks lived between 1743 and 1820. This was an extraordinarily eventful period in many respects. Carl Linnaeus (1707–1778) published *Species Plantarum* in 1753, when Banks was ten years old. European powers were increasingly seeking to explore the rest of the world and to establish colonies.

If we consider the British Empire alone, Bank's lifetime encompassed the transition between the so-called first and second British Empires. The first involved the establishment of colonies in North America and the fringes of Africa approximately between 1583 and 1783. The second was between 1783 and 1815 and involved exploration and colonisation in the Pacific and elsewhere. Indeed Banks played a role in this when he and his entourage accompanied Cook on their first voyage of discovery between 1768 and 1771 which included exploration of New Zealand.

The most obvious monikers left by Joseph Banks is Banks Peninsula in the South Island of New Zealand and the naming of Botany Bay in Australia. Bank's also recommended that Australia would be a good place to set up a penal colony.

When back in England, Banks became very influential and seven years after his return he became President of the Royal Society, a position he held for the next 41 years, until his death.

From 1773 Banks acted as unofficial director of the Royal Gardens at Kew. He was instrumental in sending many collectors to various British colonies and elsewhere and raised Kew to the status of the foremost botanical collection in the world.

It is important to remember that this was a period of enthusiastic exploration, both in terms of geography and science. The natural world was starting to be systematically catalogued.

This time period was later coined the 'Industrial Revolution' because discoveries in pure science were being employed to develop new technologies and expand trading

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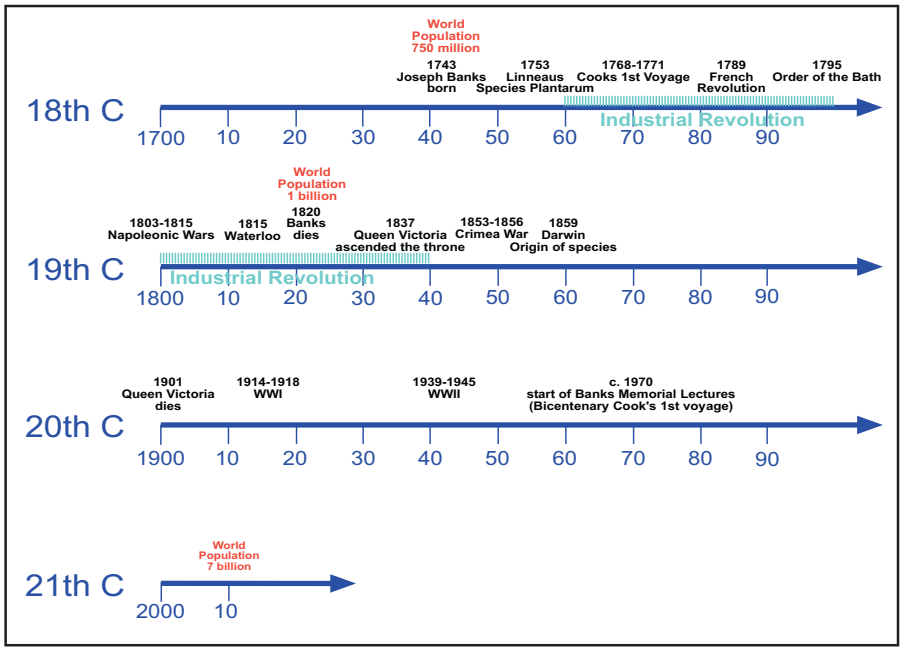

Fig. 2 Timeline of events discussed.

opportunities. The possibility of finding new plants to develop new crops and trade was very much part of the thinking of the day. Remember that largely at the instigation of Banks, Captain Bligh of *The Bounty* fame, was sent to Tahiti between 1787–1789 to collect breadfruit plants (*Artocarpus altilis*) so that they might be grown and used to feed slaves in British colonies in the Caribbean.

Remember also, that some plant transfers have been enormously important. As discussed in Ross Ferguson's (2008) Banks Memorial Lecture, tea was transferred from China to India and Ceylon, coffee from the old world to the new and rubber from South America to Malaya, in this case via Kew Gardens.

Human population, certainly that part considered to be civilised, was relatively low and the undeveloped world must have seemed limitless.

The human world population today (2010) is estimated to be close to 7 billion. During Bank's lifetime it rose from approximately 750 million to one billion. Most population growth occurred in the developed world of Europe and North America where the benefits of improved agriculture (the 'Green Revolution') and medicine were first felt.

Population growth and the environment

While many organisms have still to be described and catalogued, we have for many years been acutely aware that species of plants and animals, certainly some of the larger and more obvious ones, have become extinct in recent centuries, while today others teeter on the brink of oblivion.

Such losses are almost all attributable to human activity and primarily through habitat destruction. Currently perceived changes in climate ('Global Warming') are being attributed to human activity.

Commonly held religious beliefs and political dogma dictate that the human population must continue to increase *ad nauseum*. Indeed the philosophy of Capitalism and world trade is based on the notion of ongoing continuous growth. However, biologists will affirm that any habitat has only limited capacity to sustain finite numbers of individual organisms in the complex ecological web, and that populations cannot continue to grow unimpeded.

Unlike those early colonial days, the Earth is now seen to be an exceedingly small and closed ecosystem. Much of the explosion in human population has been sustained by the exploitation of fossil fuels built up over geological time. Whenever any non-human organism reaches plague proportions, we implement vigorous eradication programmes as we have seen in New Zealand with regard to rabbits, possums and environmental weeds. We take less responsibility managing our own population problems.

Quite apart from the fundamental problem of insufficient essential resources to sustain our population growth, we should also question the quality of our lives. Currently, here in New Zealand we are exceedingly lucky, as population density is low enough to allow a good quality of life. However, even here, in built-up areas such as urban Auckland, increasing social problems are the tell-tale signs of people living in small dwellings packed tightly together. Are our social problems that different to the violence, crimes, and gangs seen in large conurbations overseas? Do we really want to 'progress' to the point of living confined in cells with nutrients, waste removal and information exchange achieved through pipes and cables?

Maintaining biodiversity

Biodiversity can be defined as "the variation of life forms within a given ecosystem, biome, or on the entire Earth" (Wikipedia, 2010) and can be said to encapsulate species diversity, ecosystem diversity, morphological diversity and genetic diversity.

Such a definition is all encompassing and represents a vast topic. However, the really important thing to understand is that such diversity represents millions of years of evolution and we have yet to fully catalogue what exists on Earth. For example, it is estimated that 90% of arthropods are not yet classified. It is certain that many species are being eliminated before they have become known to science.

While we now know that there have been previous mass extinctions in Earth's history, followed by restoration of biodiversity (albeit with radically different species compositions), it has to be comprehended that such diversification has taken place over geological time frames. No other mass extinction has been caused by one species becoming rampant.

We might ask "why is it important to maintain such wide biodiversity when agriculture, horticulture and forestry have managed to feed, clothe and house us by using just a tiny fraction of the plants and animals that occur on Earth?"

Well, first and foremost, history suggests that human nature and human wisdom cannot be trusted (and we should not have the right) to decide which organisms are worthy of preservation and those that are not. Indeed, much of mankind does

not see itself as being an animal, let alone part of an interdependent ecosystem.

We all need to show humility and do all we can to preserve maximum biodiversity into the future. Those who believe in a God might reflect that their God knew what he was doing when he created such a diversity of life forms.

Coming back to more prosaic considerations, what are some of the important functions and opportunities offered to us by natural ecosystems? We can list:

1. Air quality
2. Water purification
3. Pollination of crops and plants
4. Prevention of erosion
5. Discovery of useful drugs and other products.

Genetic diversity is essential within agriculture, horticulture and forestry. Quite apart from the possibility of developing crops not yet envisaged, maintaining genetic diversity within existing crops is essential. This may be in terms of enabling adaptation of specific cultivars to specific regions and in the longer term the ability of crops to respond to changes in climate.

It is essential that no crop relies too heavily on just a few genotypes and monocultures. The Irish potato famine and its consequences alone should be adequate warning against such practises.

Some people derive pleasure from visiting relatively unaltered areas of natural beauty and the tourist industry caters in part for those people who seek recreation other than in the artificial environments of casinos, bars and nightclubs.

The use of plants as a means of aesthetic expression is important worldwide, both in terms of the appreciation of individual cultivars and their use as houseplants and components in garden and landscape design. Here a rich palette is essential to meet the ever-changing demands of fashion.

Practical considerations

When I was a university student I believed that botanic gardens could adequately maintain collections of plants into the future. Experience has shown me that such a notion was naïve in the extreme for a plethora of reasons.

The only way to satisfactorily maintain ecosystems and the organisms within them is to set aside large areas of national parks and reserves and to make them sacrosanct. While valiant efforts have been made around the world to this end, the sheer pressure of human populations and the vagaries of war militate against their long-term survival. New Zealand has had a relatively good record establishing national parks but even here attempts are currently being made to erode the sanctity of such areas.

If we resort to establishing living collections of plants in cultivation it is essential we recognise that we will only be able to maintain a relatively small sample of the naturally occurring genetic diversity. Despite concern regarding the dangers of exotic plants going rogue and becoming rampant weeds, the reality is that most often it is difficult or impossible to establish some plants into cultivation. Many ecotypes are so finely adapted to a specific ecological niche that they will not grow elsewhere.

At the other end of the spectrum, some plants are so promiscuous that once brought together in a collection they interbreed prolifically and produce a hybrid swarm. Often, maintenance of a wild collected genotype can only be ensured by careful curation and vegetative propagation and even this can be fraught with difficulty as that genotype senesces.

Plant collections are most often brought together through the efforts of an individual, spurred on by the thrill of the hunt. Sometimes such collections are maintained through the lifetime of the instigator but major problems in perpetuating collections occur when that person dies.

Institutions are notoriously bad at maintaining even important living plant collections. A collection is only as good as its curator and people in institutions tend to hold positions for relatively short periods of time before moving on.

Effective curation requires many skills ranging from taxonomic knowledge, good record keeping ability, keen observation and plantsmanship. Such skills need time to be acquired.

Government policies change and funding sources dry up. A particularly good example of this occurred when science was restructured in New Zealand and Crown Research Institutes (CRIs) were established in the 1980s. Valuable collections of potential new crops were assembled over a period of more than a quarter of a century both in the Ministry of Agriculture and Fisheries/Forestry (MAF) and the former Department of Scientific and Industrial Research (DSIR). Very soon after the formation of the CRIs, driven by short term commercial imperatives, most components in these collections were dissipated.

Now, under New Zealand's current biosecurity legislation, plants cannot be reimported to form comparable collections, even if source material is still available overseas.

For some plants cryopreservation, the storage of seeds at low temperatures and controlled humidity is a useful tool. I have used this method for more than forty years for my collection of *Lathyrus* species and cultivars. However, while such techniques are well suited to annual plants, schemes like the Millennium Project in the UK and the Svalband Global Seed vault in Norway seem more in tune with a Doomsday scenario. It takes a long time from a tree seed to a mature tree.

Conclusion

Recognition that preservation of maximum biodiversity is important is in reality a Western notion made from a position of privilege. Someone living in an underdeveloped country will regard their own survival as more important.

For the reasons already discussed, the pressure of human population, even without further projected increases, is too high to stop further losses of species.

Equally, if one accepts the concept of evolution, *ipso facto* we must accept that, like climate, it is a dynamic system in a state of constant flux. It is therefore unreasonable to attempt to freeze the components of any ecosystem at some arbitrary point in time. Usually, the supposed Nirvana

is before the coming of man, or more narrowly, the white man.

Such a concept embodies the notion that human beings are not an integral component of the natural world. With mankind's ability to bring together plants, which, for millions of years have been separated by geographical barriers, it is reasonable to expect that the components of ecosystems will change with the introduction of exotic species.

Why is it acceptable for *Homo sapiens*, arguably the most successful animal species, to run rampant, but at the same time to demonise other highly successful animal and plant species as undesirable pests?

If we wish to facilitate a planet that affords wide biodiversity and at the same time leave a good quality of life for our successors, some very fundamental choices will have to be made.

The big question is "does our species have the wisdom and foresight to do this?"

References

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2010 Royal New Zealand Institute of Horticulture Awards

Award in Garden History

Eleanor Kay Baxter

Kay Baxter at the award ceremony. Photo: Gil Hanly.

The Award in Garden History promotes public interest in horticultural history and the conservation of cultivated plants. Old cultivars or 'heirloom' plants are a form of living history. They link us back to the past, they remind us of the early days of European horticulture in New Zealand, they remind many of us of the gardens of our parents and of our grandparents in less complicated times and, more importantly, they are often still excellent garden plants to be treasured in their own right.

When Kay Baxter moved to Kaiwaka in the 1980s to live on the family farm of her husband, Bob Corker, she soon learnt of the wealth of local vegetables and fruit trees in the Far North. Many of these plants had been there since the first days of colonial settlement. She built up a wonderful collection of the old vegetables with such romantic names as the Dalmatian runner bean, the King George bean, the Borlotti Stoppa bean, the white Belgian carrot, the Port Albert cucumber; and a whole variety of different tomatoes, varying in shape, colour, flavour and potential use.

Within her collection there are vegetables, herbs and old-fashioned flowers. There are also fruit trees, particularly apples, peaches, plums and pears, many of them cultivars no longer in commerce, with sometimes only very old and declining individual trees remaining. Often she was just in time to save bud-wood for grafting. She was assisted in this work when enthusiastic gardeners from all over New Zealand began sending her seed and plant material.

Although much of her initial efforts were devoted to building up her plant collections her eventual aim was to make this wealth of fruit trees and vegetables available to the discriminating public. A quick browse through the Koanga Institute website (www.koanga.org.nz) and catalogues reveals just how successful her pioneering work has been.

Many of the plants offered for sale may have characteristics that make them unlikely to be chosen for large-scale commercial cultivation, but they can be ideal for the home gardener. The recent interest in sustainable living and the resurgence of home vegetable and fruit gardening make her resources that much more valuable. Although she no longer lives in the Far North, she remains the CEO of the Koanga Institute which is still actively working to save heritage food plants around New Zealand. Kay was a co-founder of the Koanga Institute along with her husband, and this now holds a national collection of well over 600 New Zealand heritage vegetable cultivars and more than 200 fruit trees well suited to the climatic conditions of northern New Zealand. The Koanga Institute is supported by a strong membership base and a national network of growers who support the seed collection started by her and the team at Koanga.

In presenting the 2010 Award in Garden History to Kay Baxter, the Royal New Zealand Institute of Horticulture acknowledges and honours her work for the preservation of our national heritage of traditional food plants.

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