

cultivated plant taxonomy**news**

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Ceci
n'est
pas
une plante

A floristics
for the 21st century

Cultivated plant floristics: a highly necessary study

James Armitage
EDITOR

Cultivated plant floristics has existed as a special branch of floristic study for nearly a century, since the publication in 1924 of L H Bailey's *Manual of the most common or significant species of plants grown in the continental United States and Canada*. The concept of the Horticultural or Garden Flora is now well recognised and some large and impressive examples, often running to several volumes, have been produced for various parts of the world, including Europe, Hawaii, south-eastern Australia, South Africa and Spain. These works are extraordinary efforts in cataloguing and classification often achieved by only a handful of individuals operating with very limited resources.

It might be assumed that Garden Floras are straightforward equivalents of those far more numerous Floras dealing with wild plants, but this isn't quite the case. Garden Floras usually contain keys and descriptions, taxonomic assessment and synonymy but some other elements are generally absent. Ecological considerations are either missing or replaced with cultivation advice or a hardiness rating and there is usually no assessment of abundance or range. This has tended to cast Garden Floras as checklists with associated identification guides rather than

holistic studies of organisms in a defined environment.

The importance of this distinction is that it has created a false separation, in environmental terms, between plants that have arrived of their own accord and those that have been planted. The artificiality of this conceptual division comes most sharply into focus when considering urban ecosystems. Here, the farcical situation arises of the field botanist who records a native species (whatever that may mean in an entirely manmade environment) seeded into a crack in the pavement but in doing so ignores thousands of tons of respiring, functional biomass, providing habitat for who knows how many other living things, simply because it was planted. For the practical purposes of understanding urban environments, the "rules" by which field botanists operate are simply unhelpful.

Taxonomy of all sorts is taken for granted to an extraordinary degree. Without the framework for reference and communication it provides all further biological investigation is impossible. With justification might taxonomists feel they are unappreciated by their fellow scientists who seldom make the effort to understand the discipline upon which their own lines of enquiry depend. But undervalued as taxonomy may be, taxonomists

still have a responsibility to provide the taxonomic data required by their users.

If it is shocking how little regard is paid to taxonomy in general, it is equally shocking how little regard is paid by wild plant taxonomists to the highly necessary study of cultivated plants. In the developed world the greatest gap remaining in botanical knowledge is of plants in cultivation. Given

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that the majority of the world's population now live in urban zones, it is simply astonishing how little we know of the plants that dominate towns and cities.

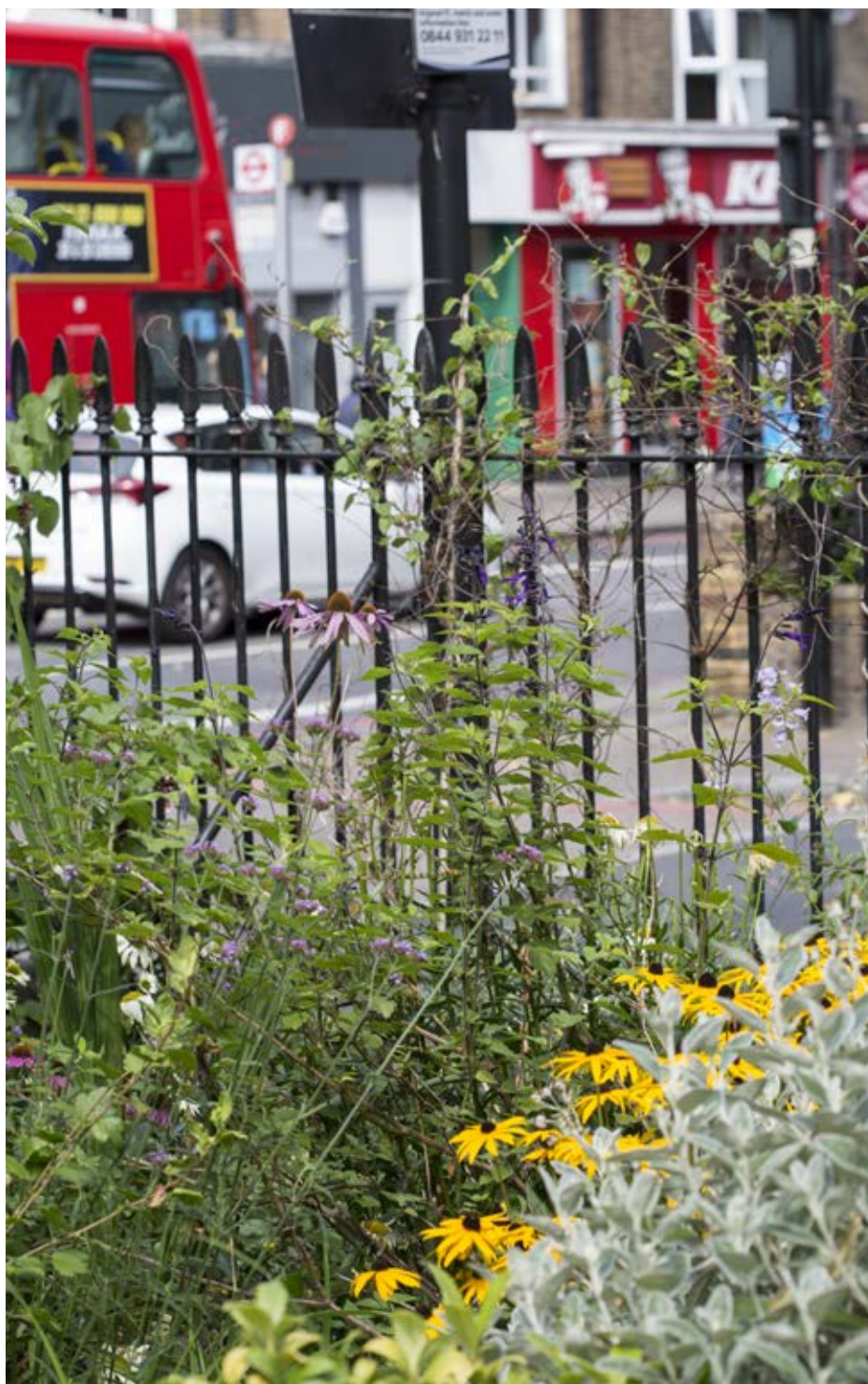
A change in the culture and perceptions of botanists will not occur overnight but I hope this special edition of CPT News will be seen as a call to action. There is so much that can be done now to define, develop and provide infrastructure to the emerging discipline of urban floristics and

the study of cultivated plants in general.

As with so many things, technology has made it possible to tackle subjects which would have been insurmountable even two decades ago. The vast store of information we have amassed about cultivated plants, in journals, books, nursery catalogues, herbaria, registers and so on, hitherto extremely dispersed and to most people largely inaccessible, can now be digitised and brought before the world. With an organised and collective effort so much is possible. How about a web-based portal to access digitised nursery catalogues? or an online herbarium of urban plants? or a database to plot records of cultivated plants and display their global distribution? In the coming years image recognition software is likely to advance to such a state that an army of citizen scientists armed only with an iPhone and a sense of curiosity about their surroundings will be able to provide more data on cultivated plants than can presently be processed or understood. I suggest that an International Conference on Urban Floristics is required to assess resources, identify priorities and set targets.

I hope the articles that follow will offer some idea of what the taxonomic study of cultivated plants can produce, why the work is so necessary and, with collaboration and effort, what might be achieved in the future. ■

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What is cultivated plant floristics?

The identification and enumeration of the cultivated plants of a given area

Cover. *Doronicum* × *excelsum* 'Harpur Crewe'.
RHS / Adam Duckworth.
Above. RHS / Julian Weigall.

Global cultivated plant floristics

Roger Spencer is Horticultural Taxonomist at the Royal Botanic Gardens Victoria and chief editor of the *Horticultural Flora of South-eastern Australia* (now online). With Rob Cross he is an author of the CSIRO publications *Sustainable Gardens* and *Plant Names*.

IT IS EASY to forget how rapidly and dramatically the world's natural landscape has changed over the last 200 or so years, and how so much of this change emanated from Enlightenment Western Europe – most notably imperial Britain. Global landscape change has come about through the human redistribution of plants by means of agriculture, forestry and horticulture.

Plant redistribution is a function of culture. Aborigines have occupied Australia for about 65,000 years, arriving on the continent more than 10,000 years before modern humans migrated into northern Europe. We do not have a single confirmed record of Aboriginal plant introduction from outside Australia.

Apart from a few crop plants, it seems that the first major influx of exotic (foreign) plants to Britain occurred during its occupation by Roman garrisons between about 45 and 410 CE. Archaeological research in

Britain has revealed that during this period there was a rapid introduction of about 50 new plants, mostly Mediterranean fruits, herbs, spices, and vegetables that Romans imported to improve the bland flavours and limited nutrient content of the local foods. It is a telling quirk of history, and globalisation, that of these 50 Roman-introduced plant species about 36 (over 70%) are now naturalised in Australia – a stark indication of the subsequent cultural diffusion of plants across the planet.

One consequence of Western science's concern for stocktaking has been the desire for an inventory of the world's wild plants. At the time of the Roman Empire, about 1,350 different plants had been recorded in the West. By 1613 an attempt by Frenchman Jean Bauhin to calculate the total number of plants in the world put the figure at about 4,000, his son Gaspard increasing this number of published species to 6,000 in 1623. English botanist John Ray's three-volume *Historia*

Plantarum (1686, 1688, 1704) lists some 18,700 different kinds. Carl Linnaeus, Europe's most renowned naturalist of the eighteenth century, in his entire career assembled the names of about 7,700 species of flowering plants. In 1753, less than 40 years before Australian settlement, he believed that the total number of plant species in the world was unlikely to exceed 10,000.

Though this was essentially guesswork, some more extensive data was soon available. Imperial Britain achieved a major step towards a world flora through a census of wild plants growing in its colonies and described in Floras of North America (Hooker 1829–1840), Antarctica (Hooker 1844–1847), New Zealand (Hooker 1852–1855), Tasmania (Hooker 1855–1859), West Indies (Grisebach 1859–1864), Sri Lanka (Ceylon; Thwaites & Hooker 1858–1864), Cape of South Africa (Harvey, Sonder & W. Thistleton-Dyer 1859–1933), Hong Kong (Bentham 1861), Australia (Bentham & Mueller 1863–1878) and British India (Hooker 1872–1897). Today the total number of

botanically described seed plants in the world is estimated to be about 400,000 and the *Global Strategy for Plant Conservation* through the World Flora Online Project has set itself the target of compiling a widely accessible

Our world today is a truly interconnected and interdependent global society.

working list of known plant species as a step towards a complete world flora.

So, from the time of European colonial expansion in the

nineteenth century, plant taxonomy blossomed, the nursery trade gathered momentum, the number of known plant species in the world rocketed. At the same time cultivated plant redistribution began in earnest, as European arable land grabs occurred in North and South America, Africa, Australia and elsewhere. The improved transport systems of the industrial revolution facilitated the spread of the European agricultural system into not only the temperate neo-European colonies but the tropics as well with their commercial plantations of tobacco, cotton, breadfruit, maize, bananas and more as part of a mostly Atlantic market economy.

We have yet to fully digest the horticultural component of this major global transformation, but without doubt horticulture will play a major part in the determination of both cultural and environmental landscapes of the future.

Our world today is a truly interconnected and interdependent global society. One consequence of this

is our collective environmental responsibility as we shake off the history of nations and empires on our way to a common future and a shared fate.

As horticulturists we share an enthusiasm for ornamental plants, for the “beautiful, curious and new”. This fascination goes back to the time of the early spice trade, through the Age of Discovery to the intrepid horticultural plant hunters as they prospected in foreign lands. Then there was the botanophilia of eighteenth century high society as people like Joseph Banks and Joséphine Bonaparte amassed plant trophies from round the world, assembling them into much-admired public and private collections. We have all wanted a share of the world’s botanical beauty and bounty as plant novelties and exotic plant foods have been eagerly passed from country to country.

Though British influence went into rapid decline after the Second World War, Britain has maintained its pre-eminent position on horticulture’s world stage. One indication of all this history can be seen when comparing the number of Britain’s native species – about 1,500 – with its number of different cultivated plants, which is thought to be in the region of 400,000.

The great and undoubted benefits of horticulture have brought with them some down sides, as cultivated plants have flooded the world, swamping island floras in particular. It is this negative effect that we need to manage. In New Zealand,



Left. *Digitalis purpurea* was introduced by the Romans. Of the 50 plant species introduced to Britain by the Romans, about 36 (over 70%) are now also naturalised in Australia. Photo. RHS / Lee Beel.

My appeal is that we indulge our passion for ornamental plants in full knowledge and consideration of its potential impact on global ecology and sustainability.



Above. Colour engraved plate from Volume 3 of Pierre-Joseph Redouté's *Les Roses*. This work contains a total of 369 plates depicting rose cultivars. Belgian-born Redouté achieved success as a painter working for the French royal court tutoring Marie-Antoinette and from 1798 was appointed to paint the flowers of Malmaison by Joséphine Bonaparte. His published works included *Les Roses* and *Les Liliacées*. © RHS Lindley Collections.

towards half the total flora is naturalised and, as in Australia, a large proportion of naturalised plants were brought into the country for horticulture. Biosecurity programmes are now needed to monitor both new plant introductions as well as existing collections and availability. This story is repeated across the world.

Ideally, as plant scientists, we should provide the global community with the best possible information, quantified where possible, on the origins and distribution of the world's cultivated flora. In an era of globalisation we need to have a debate about the role of horticulture in world plant geography and its influence on the current world distribution of cultivated plants – how it came to be the way it is, and how we would like it to be in the future. Part of this process is the attempt at a frank appraisal of the consequences of past action.

Good management begins with a stocktake. As publication of a wild plant World Flora gathers momentum we are now also embarking on a global phase of cultivated plant inventory – building up national and regional floristic records. To tell the world story of cultivated plants we need the underlying facts and figures that tell us exactly how wild habitats were turned into cultural landscapes.

For countries and regions we need at least comparative numbers of wild and cultivated plants through history; records of plant introduction and use and the historical factors that drove this process;

Right. *Drosera capensis*, an invasive alien in New Zealand. Photo. RHS / Janet Cubey.

the extent of past and current commercial availability; records of plant redistribution to other regions of the world.

This process can be tackled from many angles. Australia, for example, has followed the British lead in having a Garden Plant Conservation Association that consists of heritage private collections, mostly of cultivated plant genera; the historical availability of plants is indicated by databases of old nursery catalogues; cultivar records are maintained by the Australian Cultivar Registration Authority; there is an *Aussie Plant Finder* and there are other databases of cultivated plants, including the stock lists of botanic gardens and a combined list of plants held by major Australian botanic gardens compiled by the Council of Heads of Australian Botanic Gardens. The *Horticultural Flora of South-eastern Australia* will shortly be online.

My appeal is that we indulge our passion for ornamental plants in full knowledge and consideration of its potential impact on global ecology and sustainability. ■



References

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|--|---|
| Bentham, G. (1861). <i>Flora Hongkongensis</i> . London: Lovell Reeve. | Hooker, J.D. (1858–1864). <i>Flora Tasmaniae</i> . London: Lovell Reeve. |
| Bentham, G. & Mueller, F. (1863–1878). <i>Flora Australiensis</i> . London: Lovell Reeve. | Hooker, J.D. (1872–1897). <i>Flora of British India</i> . London: Lovell Reeve. |
| Harvey, H., Sonder, O. & Thistleton-Dyer, W. (1859–1933). <i>Flora Capensis</i> . London: Lovell Reeve. | Hooker, W. (1829–1840). <i>Flora Boreali-Americana</i> . London: London: Treuttel & Wurtz, Treuttel, Jun., & Richter |
| Hooker, J.D. (1844–1847). <i>Flora Antarctica</i> . London: Lovell Reeve. | Grisebach, A.H.R. (1859–1864). <i>Flora of the British West Indian Islands</i> . London: Lovell Reeve. |
| Hooker, J.D. (1852–1855). <i>Flora Novae-Zelandiae</i> . London: Lovell Reeve. | Thwaites, G. & Hooker, J.D. (1858–1864). <i>Enumeratio plantarum Zeylaniae</i> . London: Dalau & Co. |



The ‘In Gardens of Hawaii’ project 1988–2005

GEORGE STAPLES

worked for many years on the taxonomy of cultivated tropical plants. Now he focuses his taxonomic research on the *Convolvulaceae*, a family with considerable agricultural and horticultural importance.

THE BISHOP MUSEUM, Honolulu, Hawaii, began a project in 1983 with the goal of updating and revising Marie C. Neal’s classic manual on plants of the Hawaiian Islands, *In Gardens of Hawaii* (1948, 1965). In 1988 I was hired as Project Leader to replace Horace Clay, the project’s initial author, who had died.

For the next 11 years (1988–1999) I led a team of research assistants and collaborators in Hawaii and abroad in preparing a horticultural flora based on rigorous taxonomic research and documented by voucher specimens, archival and photographic records. Ultimately the book grew into an entirely new reference work, different in scope and coverage from Neal’s 1965 edition of *In*



Cultivars of *Cassia × nealiae* (left) are widespread as flowering street trees throughout the Hawaiian Islands. Photo. Forrest and Kim Starr. Right. **Naupaka (*Scaevola taccada*).** Photo. Gail Hampshire.

Gardens. Thirty-two authors contributed families or chapters to the book and more than 200 taxonomic specialists provided identifications to support the writing done inhouse. A thorough rectification of the scientific plant names used in the new book was fundamental to the information it contains.

Design, formatting, review, editing, and finally publication took six years (1999–2005) and the new book, entitled *A Tropical Garden Flora* (Staples & Herbst 2005) was published by the Bishop Museum Press in 2005. It includes more than 2,100 species of tropical garden plants grown in the Hawaiian Islands and in many tropical places generally. The book is fully illustrated with more than 400 line drawings and a selection of colour photographs; an illustrated glossary explains

the terminology used in the plant descriptions; there is a bibliography of more than 1,600 references cited in the text; and an etymological glossary for the species and varietal names concludes the book.

Because there are many thousands of plants grown in Hawaii that could not be included in the book, a companion website was created to provide a more comprehensive listing of garden plants grown in the Islands. The Annotated Checklist of Cultivated Plants of Hawaii is available at this link: <http://www2.bishopmuseum.org/HBS/botany/cultivatedplants/>

The Checklist, circa 2005, included more than 8,000 species of cultivated plants. Unfortunately, it is not being

updated to keep pace with changes in plant nomenclature and the arrival of new plant introductions, which are continuous, dynamic processes. ■

Neal, M.C. (1948). *In Gardens of Hawaii*. Honolulu: Bernice P. Bishop Museum.

Neal, M.C. (1965). *In Gardens of Hawaii*. Honolulu: Bernice P. Bishop Museum.

Staples, G.W. & Herbst, D.R. (2005). *A Tropical Garden Flora: plants cultivated in the Hawaiian Islands and other tropical places*. Honolulu: Bishop Museum Press.

Varieties of plants cultivated in Spain

Daniel Guillot Ortiz is a biologist, botanist and PhD. A member of the editorial board of the scientific magazine *Bouteloua*, he is the author of numerous articles, focusing on the ornamental and invasive Spanish flora and the study and cataloguing of varieties of plants cultivated / commercialised in Spain in the 19th century and the first half of the 20th.

My work on the study and classification of the ornamental and alien flora of Spain was carried out mainly between 2001 and 2016. The results have been used in the publication in scientific journals of numerous articles (more than two hundred and eighty) together with several monographs. I have also participated in the creation, together with other botanists, of *Bouteloua*, a Spanish journal dedicated to the study of ornamental flora from a scientific perspective, the first volume of which was published in 2006.

The results of this line of work have increased knowledge regarding the number of species and cultivars cultivated and / or commercialised in Spain, and also of the presence of these taxa as naturalised plants. Over the



Far right. **Gardens of the Alcazar de los Reyes Cristianos, Cordoba.**

Photo. RHS / Julie Hollobone. Right. ***Nepeta tuberosa*.** Photo. Peganum.





course of this study numerous cultivars not mentioned in recent horticultural literature were discovered. The outputs from this work can be split into two categories, discussed below.

Output 1: scientific articles

Alone or in collaboration with other authors, I have published numerous scientific articles that have increased the number of cultivars known in Spain, and that generally adhere to one of four types:

a. The study of the alien flora of ornamental origin. As a result of this line of inquiry, works have been published where cultivars belonging to different genera have been cited (e.g. *Aeonium*, *Agave*, *Aptenia*, *Centranthus*, *Chlorophytum*, *Crassula*, *Hedera*, *Ipomoea*, *Lantana*, *Opuntia*).

b. Data contributed by historical Spanish botanical works. This has contributed to our knowledge of genera such as *Lactuca*, *Malus*, *Pyrus*, *Rosa*, *Allium*, *Dahlia* and *Daucus* as cultivated plants in Spain. I have also published articles with broader cataloguing works of cultivars marketed in this historical period, for example 'Hacia una base de datos de variedades de plantas cultivadas en España en el siglo XIX primera mitad del XX' ('Towards a

Left. *Ophrys apifera*. Photo. RHS / Tim Sandall. Above right. *Iris xiphium*. Photo. Gail Hampshire.



database of varieties of plants cultivated in Spain in the 19th century and first half of the 20th'; Guillot, 2014) and 'Nuevos datos acerca de cultivares comercializados en España en el XIX y la primera mitad del XX' ('New data about cultivars commercialised in Spain in the XIX and the first half of the XX'; Guillot 2016).

c. The study of the Spanish ornamental flora. I have published alone or in collaboration with other authors numerous articles focusing on the study of the ornamental flora, citing many cultivars grown in Spain. Some of these works focused on the study of the ornamental flora of specific geographical areas or in the cataloguing of cultivars.

d. New species and cultivars. During this period I have described in collaboration with other authors for the first time cultivars and hybrids grown in Spanish gardens as well as new

hybrids observed in the alien flora (e.g. *Agave gonzaloi*, *A. × rossellonensis*, *A. × cavanillesii*, *Lavandula × cavanillesii*, *L. × glaucescens*, *Opuntia* 'L'Horta Nova').

Output 2: larger works

Nine larger works have been published, focusing on various groups of non-native ornamental plants dealt with taxonomically or geographically. Perhaps the most important work is the monograph entitled *Claves Para la Flora Ornamental de la Provincia de Valencia* (*Keys to the Ornamental Flora of the Province of Valencia*; Guillot *et al.*, 2009). The first work of its kind published in Spain, it is a study of ornamental plants at the provincial level, based on extensive fieldwork in the core urban area of each municipality in the province of Valencia, complemented by a comprehensive study

of catalogues of Spanish and foreign nurseries selling their products in this geographic area. Another novel aspect in Spain was the inclusion of a large number of cultivars: 2,166.

Current work

My work at present incorporates several areas of activity:

- ◆ Field work in different parts of the Iberian Peninsula, cataloguing the ornamental flora.
- ◆ The creation of a database of plant varieties cultivated in the 19th century and the first half of the 20th century in Spain.
- ◆ The creation of a database of varieties cultivated and marketed today in Spain.

Guillot, D., Mateo, G. & Roselló, J.A. (2009). *Claves Para la Flora Ornamental de la Provincia de Valencia*. Monografías de Bouteloua 1.

Guillot, D. (2014). Hacia una base de datos de variedades de plantas cultivadas en España en el siglo XIX primera mitad del XX. *Bouteloua* **17**: 16–41.

Guillot, D. (2016). Nuevos datos acerca de cultivares comercializados en España en el XIX y la primera mitad del XX. *Bouteloua* **25**: 85–96.

Beautiful & functional

BEING PRETTY CAN BE a double-edged sword. Sometimes people may not see past your beauty to realise you have other qualities and merits! This could be the dilemma ornamental plants find themselves in.

Ornamental plants are defined here simply as any plant used conventionally in a garden or wider landscape due to their aesthetic appeal (and may include true species, as well as selected forms or hybrids).

Ornamentals may be great in parks and gardens for creating the “Wow” factor, but giving them space in our crowded towns and cities has not been a priority in recent years, especially when every square metre seems to be required for new housing, roads and car parks. We are,

however, beginning to realise this may be a false economy; adding ornamentals to “grey” infrastructure may actually make urban life worth living – by literally bringing more life back to our cities. Although scale may be an important factor here – the more greenspace, the greater the benefits – even providing ornamentals with a limited foothold in our concrete jungles, may pay us great dividends in return.

This debate about urban space has focused the mind on what exactly ornamental plants bring to our urban environments, and can we justify their inclusion. Being pretty does not hold much weight with policy makers, but

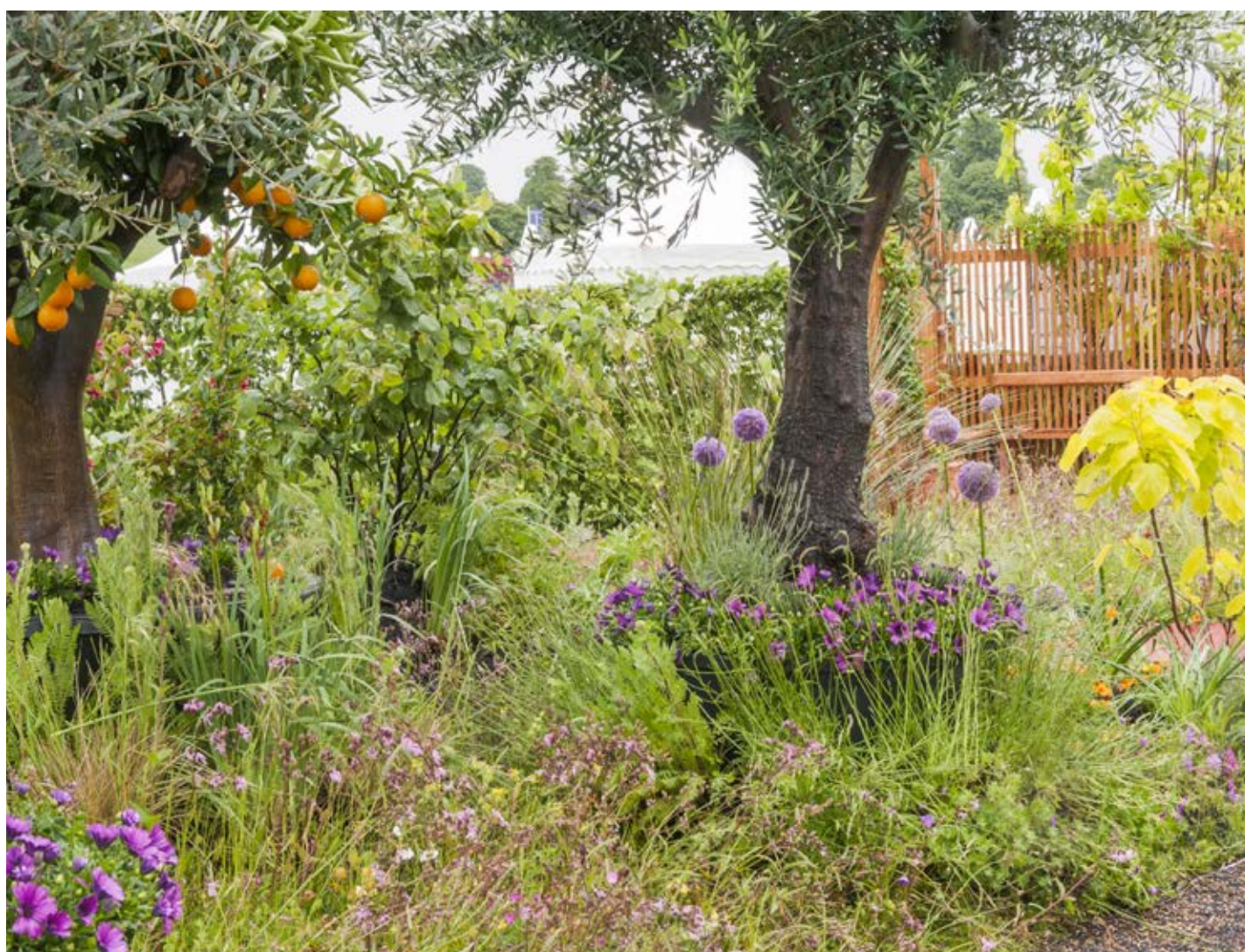
Ornamental plants have been cultivated almost exclusively for their aesthetic appeal.

Ross Cameron from the Department of Landscape, University of Sheffield, however, outlines that ornamentals can provide a range of other benefits (ecosystem services), and that these may merit their wider cultivation in the urban landscapes of the future.

Right. RHS Garden for a Changing Climate, designed by Andy Clayden and Ross Cameron (Sheffield University); RHS Chatsworth Flower Show 2017. Photo. RHS / Joanna Kossak.

being functional might. Over the last few years, researchers have started identifying the benefits parks, gardens and other urban greenspaces provide for human society (urban ecosystem services), and more specifically how different plant taxa contribute to this service provision. Ornamentals play a key role here, largely because they already have the public “on their side” – simply because they look attractive. This public acceptance is further strengthened when people realise the other benefits ornamental plants (and their associated landscapes) offer. So what are these services? They can be divided into:

- ◆ environmental services, with a capacity to:
 - absorb rainwater, and thus reduce the risk of flash flooding within city landscapes;
 - improve air quality;
 - reduce city centre air temperatures (i.e. mitigation of the urban heat island effect);
 - reduce energy loss from nearby offices and houses;
 - abate the effects of noise;
 - stabilise soil and remove / inactivate soil pollutants (phytoremediation);
 - provide habitat for wildlife.
- ◆ services based on health or socio-economic benefits, including:
 - opportunities for physical exercise;
 - the provision of relaxing, restorative environments with benefits for human mental health;
 - improving community relations through a better “sense of place”;
 - reducing certain forms of crime;
 - enhancing human attention span and improving educational achievement;
 - providing financial benefits.





Research has shown that some ornamental plants, such as *Stachys byzantina* (above), provide more than a single ecosystem service. Photo. RHS / Carol Sheppard.

Further research is required to substantiate some of these claims, but the evidence to date is encouraging. Ornamental plants strategically placed around buildings can reduce the need for artificial air conditioning in summer, and conversely reduce energy loss in winter (perhaps by as much as 20–30% in a UK setting; Cameron *et al.* 2015; Liu & Harris 2008). Moreover, some ornamental plants seem to perform better than others; for example, a green roof planted with *Stachys byzantina* may reduce surface temperatures by 12°C, compared to the performance of the “standard green roof veneer” of *Sedum* spp. (Blanuša *et al.* 2013). Ornamentals with large total surface leaf areas (e.g. long needle pines or ornamental grasses) are most effective at capturing and storing rain water. Even with groundcover species, plants such as *Dianthus* ‘Haytor White’ (intricate fine leaves) hold 25% more water than a similarly sized glossy-leaved subject like *Vinca minor*.

Well-designed landscapes can help reduce stress and tension in those who view them, with naturalistic garden styles cited as being a highly “stress restorative” form of landscape (Ivarsson & Hagerhall 2008); the presence of flowering plants being a significant component in promoting positive responses. Such aspects are not superficial or subtle – neighbourhoods in the USA with well-cared-for green plots and community gardens have been shown to have reduced levels of gun crime (Branas *et al.* 2011). In gross financial terms too, ornamental landscapes hold their own; for example, the garden industry in the UK is worth £5 billion pa, and one in three tourists to the UK will visit a park or garden during their vacation.

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There is growing evidence that the benefits of a given green space are, to some extent, determined by the composition of the plants present (Cameron & Blanuša

2016). As outlined above, not all taxa are uniformly beneficial. Indeed, some species and cultivars may have significant drawbacks (e.g. may need excessively high levels of resource to ensure their survival) or even make some urban problems worse. For example, *Eucalyptus* species are thought to

exacerbate problems of poor air quality through the release of volatile chemicals from the leaves. Thus further research is warranted to determine those ornamentals that are beneficial, and for what particular service, and those that are not. It is hoped that in time urban plant communities may be designed not only for their aesthetic appeal, but also because they optimise the environmental performance of the landscape or provide the greatest social benefits to the citizens that live around them. But to understand urban ecosystems as they are now it is essential to study, quantify and catalogue the plants that currently constitute



Fine-leaved plants such as *Dianthus* (below) hold 25% more water than a similarly sized glossy-leaved plant such as *Vinca minor* (left). Photos. RHS / Tim Sandall (left), RHS / Carol Sheppard.

urban vegetation and it is at this point that cultivated plant taxonomy and ecology meet.

Hopefully, cultivated ornamental plants will always have a place in our society for their fragrance and immense beauty (after all, making people happy is a significant service in its own right). Identifying their other wider functions and benefits, however, may be key to ensuring their full appreciation and potentially helping them move up the political “priority ladder”. ■



Cameron, R.W., Taylor, J. & Emmett, M. (2015). A *Hedera* green façade – energy performance and saving under different maritime-temperate, winter weather conditions. *Building and Environment* **92**: 111–121.

Liu, Y., & Harris, D.J. (2008). Effects of shelterbelt trees on reducing heating-energy consumption of office buildings in Scotland. *Applied Energy* **85**(2): 115–127.

Blanuša, T., Monteiro, M.M.V., Fantozzi, F., Vysini, E., Li, Y. & Cameron, R.W. (2013). Alternatives to *Sedum* on green roofs: can broad leaf perennial plants offer better ‘cooling service’? *Building and Environment* **59**: 99–106.

Ivarsson, C.T. & Hagerhall, C.M. (2008). The perceived restorativeness of gardens – assessing the restorativeness of a mixed built and natural scene type. *Urban Forestry & Urban Greening* **7**: 107–118.

Branas, C.C., Cheney, R.A., MacDonald, J.M., Tam, V.W., Jackson, T.D., & Ten Have, T.R. (2011). A difference-in-differences analysis of health, safety, and greening vacant urban space. *American Journal of Epidemiology* **174**(11): 1296–1306.

Cameron, R.W. & Blanuša, T. (2016). Green infrastructure and ecosystem services – is the devil in the detail? *Annals of Botany* **118**(3): 377–391.



**Recording
New Zealand's
cultivated
flora**

Left. *Metrosideros umbellata*
© Stan Shebs.

Murray Dawson is journal editor, webmaster and member of the national executive of the Royal New Zealand Institute of Horticulture. For his day job, he works as a botanist at Manaaki Whenua – Landcare Research.

Background

In 1958, the Royal New Zealand Institute of Horticulture (RNZIH) was appointed the International Cultivar Registration Authority (ICRA) for New Zealand native plants.

Since then, several associated cultivar checklists / registers have been published, for *Leptospermum* (Metcalf, 1963), *Cordyline* (Heenan, 1991a), *Phormium* (Heenan, 1991b), *Sophora* (Heenan, 1992), hebes (NZ native *Veronica* and allied genera; Metcalf, 2001), and *Metrosideros* (Dawson and Heenan, 2010).

From 2011, the RNZIH have re-embarked on a New Zealand Plant Collections Register project to digitise plant names (species and cultivar names from New Zealand nursery catalogues and other specialised horticultural literature) and record online cultivated plant collections held throughout New Zealand (from private garden collections, botanic gardens, public parks and reserves, and arboreta).

Aims

The collections register aims to resolve several issues surrounding cultivated plants. First and foremost, there is a major lack of knowledge and poor cataloguing of which cultivated plants are present in New Zealand. We don't fully know:

- ◆ What is in this country
- ◆ What it is called, or
- ◆ Where it is growing.

In comparison to the extensive diversity of plants found only in cultivation, perhaps comprising 25,000–40,000 taxa, New Zealand's much smaller flora of native (endemic and indigenous) and naturalised (weedy) species are well known and documented comprehensively. A running total (at <http://www.nzflora.info>) indicates that there are currently 2,482 native New Zealand species compared with about 2,819 fully naturalised species.

Dr Keith Hammett, ornamental plant breeder and President of the RNZIH, summed up the cultivated plants problem by saying "Managing the country without knowing everything in the flora is like managing a supermarket without knowing everything on the shelf" (Hammett in Dawson, 2010).

New Zealand has stringent biosecurity regulations, and importation of species deemed to be "new" is difficult and expensive. Lack of knowledge and ineffective cataloguing of which cultivated plants are already present in New Zealand severely hampers biosecurity management, both pre- and post-border, as well as impairing effective management of living collections, plant exchange, availability of breeding material, and conservation of rare plants and heritage cultivars.

Progress

For this project, many thousands of names – including botanical names (e.g. genera, species, subspecies, varieties and cultivars), synonyms and common names – have been digitised.



So far, the most notable of these resources uploaded by the RNZIH is the Duncan and Davies nursery catalogue collection. Founded in the late 1800s, Duncan and Davies was New Zealand's most prominent plant nursery. More than 10,000 pages have been scanned from 184 catalogues dated from 1925 to 1994. These are accessible on the RNZIH website for non-commercial use (at www.rnzih.org.nz/pages/nurserycatalogues.html), and help document when cultivars and species were first recorded in cultivation and how rare or common they became. These online PDFs currently lack text layers, with Optical Character Recognition (OCR) text layers yet to be added.

A working list of some of the cultivated plant collections held throughout New Zealand is aggregated on the RNZIH website (at www.rnzih.org.nz/pages/plantcollections.html). This is

driven off iNaturalist NZ (<https://inaturalist.nz>) and its USA-derived parent platform iNaturalist (www.inaturalist.org). Functionality is rich, and includes project creation, image upload, custom fields, geolocation, community feedback and identification, and import and export options. The iNat smartphone app effectively turns portable devices into field data recorders for logging plant collections *in situ*.

Current work

Current work on the New Zealand Plant Collections Register project is twofold. Firstly, the RNZIH need to fully mobilise the wealth of cultivated plant names generated from the horticultural literature. Secondly,

Above. *Cordyline australis* 'Sunrise', bred in New Zealand in the 1990s. It is the result of a cross between 'Purple Tower' and 'Torbay Dazzler'. Photo. RHS / Carol Sheppard.

we wish to extend the range and number of living plant collections recorded.

The RNZIH are also exploring options to integrate their cultivated plant names resources into a taxonomic database platform. EDIT Taxonomic Editor (<https://cybertaxonomy.eu/taxeditor/>) is the only open source solution that we know of, but it has not been updated for several years. This powers several database driven taxonomic websites, with Palmweb – Palms of the World Online (www.palmweb.org) providing an excellent example.

Is the EDIT Taxonomic Editor, or a platform like it, one that other ICRAAs could support and adopt? There must surely be a common need for a tool that manages all of our respective cultivar registers.

Ideally, the NZ cultivated names resources should also be federated through the New Zealand Organisms Register (www.nzor.org.nz) initiative. NZOR is an online taxonomic names database that aims “to create an accurate, authoritative, comprehensive and continuously updated catalogue of taxonomic names of all New Zealand biota and other taxa of importance to New Zealand.” The New Zealand horticultural community are currently exploring the best ways to make these plant names available.

To expand the working list of cultivated plant collections, we are prioritising the New Zealand Gardens Trust listings (<https://www.gardens.org.nz>), which feature gardens to visit.

Useful digitisation tools

During the course of this project, the RNZIH have used a range of useful software and online tools. These should prove useful for other plant name digitisation projects.

Foxit PDF Editor (now discontinued) and Adobe Acrobat Pro were used for cleaning and optimising the scanned PDFs. ABBYY FineReader was used for OCR, and remains the industry standard.

The Global Names Recognition and Discovery tool (<http://gnrd.globalnames.org/>) extracts

scientific names contained within PDFs and other documents. The Chrome browser NameSpotter extension usefully harvests names from webpages.

Once you have generated a list of botanical names for checking, the Taxonomic Name Resolution Service (<http://tnrs.iplantcollaborative.org/>) corrects and standardises plant names by matching your list (up to 5,000 names at a time) simultaneously against several international databases (including The Plant List and Tropicos) and generates family names and author authorities. ■

References

- Dawson, M.I.** (ed.) (2010). Documenting New Zealand's cultivated flora: “A supermarket with no stock inventory”. Report from a TFBIS-funded workshop held in Wellington, New Zealand on 9th September 2009 (Available at https://www.landcareresearch.co.nz/publications/researchpubs/Report-documenting_New_Zealands_cultivated_flora.pdf)
- Dawson, M.I. & Heenan, P.B.** (2010). Checklist of *Metrosideros* cultivars. *New Zealand Garden Journal* **13**(2): 24–27. ([www.rnzih.org.nz/RNZIH_Journal/Pages/24-27 from 2010 Vol13_No2.pdf](http://www.rnzih.org.nz/RNZIH_Journal/Pages/24-27%20from%202010_Vol13_No2.pdf))
- Heenan, P.B.** (1991a). A cultivar checklist for the New Zealand species of *Cordylina* (*Asphodelaceae*). *Horticulture in New Zealand* **2**(1): 8–12
- Heenan, P.B.** (1991b). Checklist of *Phormium* cultivars. Lincoln, New Zealand: Royal New Zealand Institute of Horticulture.
- Heenan, P.B.** (1992). Appendix 1: Checklist of *Sophora* cultivars. In: The origin of *Sophora* ‘Gnome’ and the growth habit of *Sophora* ‘Earlygold’. *Horticulture in New Zealand* **3**(1): 2–6.
- Metcalf, L.J.** (1963). Checklist of *Leptospermum* cultivars. Royal New Zealand Institute of Horticulture (RNZIH) *Journal* **5**: 224–230.
- Metcalf, L.J.** (2001). *International register of hebe cultivars*. Lincoln, New Zealand: Royal New Zealand Institute of Horticulture.

Cataloguing cultivated plants in SOUTHERN AFRICA

Where are we, and what still
needs to be done?

AMONG THE EARLIEST surviving specimens of specifically cultivated plants in southern Africa is a small collection made by Dr Ludwig Pappe in the Cape Town garden of Baron Carl F.H. von Ludwig in the 1830s (Glen & Germishuizen 2010). The specimens are still to be found in the Compton Herbarium

at Kirstenbosch; the garden is but a memory, and the site has for many years been occupied by a school. The actual plants the good Baron grew may be seen as a bit of a disaster: he evidently introduced no less than eight of the ten worst weeds in the Cape through his garden.

Hardly anything that contributed to horticultural taxonomy

HUGH GLEN grew up in a family of keen gardeners and nature enthusiasts in Johannesburg. He completed his PhD at University of Cape Town, with a thesis on a group of *Mesembryanthemaceae*, after which he joined the Botanical Research Institute (now SANBI) in Pretoria. A spell as South African Botanical Liaison Officer at Kew did his appreciation of the variety of cultivated plants the world of good. After returning to Pretoria he worked on *Aloe* for the Flora of Southern Africa, and then took over the National Herbarium's collection of cultivated plant specimens. He has served on two committees of the International Code of Botanical Nomenclature (now International Code of Nomenclature for Plants...) and the IUCN Commission for the Nomenclature of Cultivated Plants. He retired in 2013 and lives in Durban, where he divides his time between "recreational botany" and railway history. He still enjoys working on cultivated plant taxonomy, especially enjoying plants that are "bigger than me".

survives, until we come to the last quarter of the 19th century, when both the Cape and Natal colonies produced useful material. In Natal, John Medley Wood was appointed Curator of the Durban Botanic Garden in 1882, and produced a long series of annual reports, as well as three guides, listing the plants in the Garden (Wood 1883, 1889, 1897) and a checklist (Wood 1915). Wood also founded the Natal (now KwaZulu-Natal) Herbarium, which then as now includes a small collection of cultivated plants.

In the previous year, the Cape Colony established a Department of Forestry under Count Médéric de Vasselot de Régné and Joseph Storr Lister. The latter established an arboretum at Tokai on the Cape Peninsula (Immelman *et al.* 1973); his specimens from here are among the earliest in the former Forestry Herbarium (PRF, now incorporated in the National Herbarium, Pretoria (PRE)). After Union, the Forestry





Department established arboreta in many parts of the country where numerous tree species were grown experimentally. Specimens of there were duly sent to the Forestry Herbarium, which became a major repository for knowledge of cultivated trees. At the same time, the National Herbarium and its offshoots in Durban, Grahamstown, Stellenbosch and Windhoek (before Namibian independence) acquired – usually without any specific effort – collections of smaller cultivated plants. Similarly,

Left. Bronze bust of John Medley Wood (1827–1915). Above. A pathway in the Durban Botanic Garden, the oldest surviving botanical garden in Africa. Photos. Hugh Glen.

university herbaria also acquired material of cultivated plants, usually brought in by members of the public for identification.

Although efforts were made to document the indigenous flora throughout the 20th century, precious little was done about garden, crop and forestry plants. Ken Cunliff produced a long series of studies of individual species in the Tree Society's journal *Trees in South Africa*, and there are garden manuals by Pienaar (1987) and others. The only checklist of this period was Von Breitenbach's (1984) tree list. This is still widely used, but the present author has a problem with the number of "ghosts" (trees listed with no evidence of their having been grown here,

and others quite common in cultivation but absent from the list) in this publication.

When the present author assumed responsibility for the collection of cultivated material in PRE, soon joined by the material in PRF, it was self-evident to him that a listing of the specimens in the collection was a vital management tool. Accordingly, a simple database was designed to be compatible with the main herbarium database and set up. This has now been incorporated in the main SANBI specimen database. The first product of this was in the form of a progress report (Glen, 1999). This was followed by a checklist of taxa represented by material seen for the database, to which was





added, for each family and genus, a list of references to literature in the PRE collection (Glen 2003). A second progress report, on a proposed electronic key to cultivated trees, followed (Glen 2008). The most recent product is a “field” guide to introduced trees (Glen & Van Wyk 2016).

Ideally, these products would be supplemented with comprehensive datagathering to determine what plants are grown where and why, and the publications would then form the basis of a southern African garden flora. However, with no staff in the country tasked with anything resembling this, the chance of this happening in the foreseeable future. Apparently, the best approximations to this on the horizon are a new

checklist being prepared of the trees in Durban Botanic Garden, and a key being prepared to “all” trees in southern Africa, both indigenous and introduced, by a team including both Prof. Van Wyk and the present author.

After many years of hearing all exotic plants decried as “invasive aliens” (in fact, only just over 2% of all exotics are declared invaders), it is good to note anecdotal evidence that at least some exotics are recognised as essential sources of firewood and bee fodder. Maybe one day it will be possible to convince the powers that be that, apart from watermelons and some niche fruits, all our vegetable food and clothing is of exotic origin, and therefore cultivated plants are worthy of study. ■

Above. **Fruits of *Bixa orellana* (annatto) in the author’s garden in the suburbs of Durban. The seeds may be used in cookery.** Left. ***Dracaena draco* (dragon tree) in Grahamstown Botanic Garden.** Photos. **Hugh Glen.**

References

- Glen, H.F.** (1999). The State of Horticultural Taxonomy in South Africa, in S. Andrews, A.C. Leslie & C. Alexander (eds.) *Taxonomy of Cultivated Plants: Third International Symposium*: 469–470. Royal Botanic Gardens, Kew.
- Glen, H.F.** (2003). *Cultivated Plants of southern Africa*. Johannesburg: Jacana.
- Glen, H.F.** (2008). What is this Tree? Towards an electronic Key to Trees cultivated in southern Africa. *Proceedings of the 5th International Symposium on the Taxonomy of Cultivated Plants* 121–125.
- Glen, H.F. & Germishuizen, G., eds.** (2010). *Botanical Exploration of southern Africa*, edn 2. Pretoria: SANBI.
- Glen, H.F. & Van Wyk, A.E.** (2016). *Guide to Trees introduced into southern Africa*. Cape Town: Struik Nature.
- Immelman, W.F.E., Wicht, C.L. & Ackerman, D.P.** (1973). *Our Green Heritage: The South African book of Trees*. Cape Town: Tafelberg.
- Pienaar, K.** (1987). *The A–Z of Garden Flowers in South Africa*. Cape Town: Struik.
- Von Breitenbach, F.** (1984). *National List of introduced Trees*. Pretoria: Dendrological Foundation.
- Wood, J.M.** (1883, 1889, 1897). *A Guide to the Durban Botanic Gardens*. Durban: Ellinger.
- Wood, J.M.** (1915). *List of Trees, Shrubs and a Selection of Herbaceous Plants growing in the Durban Municipal Botanic Gardens*. Durban: Bennett & Davis.

