ONLINE PLANT DATABASES

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Abstract

Landscape architects have a prominent role in designing and specifying plantscapes across a wide range of project scales, from gardens to urban streetscapes and parks to large-scale conservation revegetation. Both scientific and design plant data is essential to facilitate appropriate and creative planting design. At present there is a gap in the availability of comprehensive and up-to-date plant selection data for landscape students and the landscape profession. Each year students research and compile plant selection information from a wide range of sources as part of their course requirements. Each year the research leaves with the students, and is not captured or expanded in its use.

This paper reports on a survey of online plant databases, seeking to answer the question "What does an ideal plant database look like for landscape design purposes?", and secondarily "Can the plant data collected by students be used to grow such a database?". Databases are an effective way of storing plant selection data in an easily retrievable format. The development of on-line resources allow for instant and convenient sharing of information. However databases tend to cater well for the scientific aspects of plant data, but less well for visual / design data. The changing dynamic design characteristics of plants as they grow are also important to represent.

Planting design is fundamental to landscape architecture and landscape architects require an understanding of the values of plants, and knowledge of a wide variety of plant types in order to design appropriate plantings for components of the vegetated urban landscape (Clouston 1994; Robinson 2004). Three frameworks at different scales are useful to consider here. The first is to understand vegetation as part of global systems and biodiversity (Given 1994). The second is vegetation as a form of environmental infrastructure in urban areas (Robinette 1972). The concept of the 'Urban Forest' contributes to this understanding, as described by American authors (Grey 1996). The third framework is to understand plants in design terms, both in spatial and aesthetic terms (Robinson 2004).

The survey seeks creative ways in which plant knowledge and data may be presented by students while they are studying, and then shared as a larger collaborative resource with the profession. A summary of best practice in this field will be presented, with the aim of development of such a resource for Unitec students and practitioners in the future.

Keywords: Landscape Architecture, Online, Plants, Databases.

1   INTRODUCTION

In developing teaching resources for the Landscape Architecture programme at Unitec, we are considering the usefulness of online plant databases. Traditionally there has been an issue for landscape students in the availability of comprehensive and up-to-date plant selection data, and also for landscape professionals. Plant texts are expensive to produce, go out of date due to changes to nomenclature, new variety introductions, trade availability and fashion trends. Opportunities for capturing valuable plant research exist in tertiary institutes, because each year students research and compile plant selection information from a wide range of sources as part of their course requirements. Every year the research leaves with the students, and is not captured or expanded in its use. Databases are clearly an effective way of storing and sharing large amounts of scientific data in an easily retrievable format (Oppel 2004), but capturing and organizing plant design data is more challenging.

1.1   Plant knowledge and concepts

Planting design is fundamental to landscape architecture and landscape architects require an understanding of the values of plants, and knowledge of a wide variety of plant types in order to design appropriate plantings for components of the vegetated urban landscape (Clouston 1994;

Robinson 2004). Three frameworks at different scales are useful to consider here. The first is to understand vegetation as part of global systems and biodiversity (Given 1994). The second is vegetation as a form of environmental infrastructure in urban areas (Robinette 1972). The concept of the 'Urban Forest' contributes to this understanding, as described by American authors (Grey 1996). The third framework is to understand plants in design terms, both in spatial and aesthetic terms, with knowledge of individual plant character essential to site or project scale design (Robinson 2004).

Global Biodiversity scale values

Urban Forest – regional scale green infrastructure

Site or project scale – design compositions and aesthetics

Individual plant scale – design character

Figure 1. Plant Values – four scales of reference

Plants embody many different values ascribed to them by humans (Arnold 1993, Given 1994; Nadel & Oberlander 1977; Phillips 1993; Zube et al 1975). These values include their global biological functions in processes such as the hydrological cycle, gas exchange cycles, biodiversity and food chains / webs (Beckett et al 2000; Carpenter & Walker 1990; Robinette 1972), as well as psychological and physiological benefits to people (Kaplan 1992; Honeyman 1992; Relf 1992; Ulrich 1986; Ulrich & Parsons 1992) and the design values of plants, of which landscape architects take advantage (Booth & Hiss 1991; Clouston 1994; Robinson 2004).

These concepts describe well the landscape environment in Auckland, New Zealand. Landscape architects may be involved in projects for any one of the 'Urban Forest' components (Grey 1996; Lewis 1991; Meunier et al. 1998, Miller, 1988; Phillips, 1993), making plant selections for streetscapes, residential gardens, revegetation projects for transport corridors, stormwater projects,

motorway plantings, working with both native and exotic plants for both the amenity plants for gardens but also native plants for revegetation projects with a focus on ecological communities, and their functions as well as aesthetics (Robinson 2004).

The plant selection process which a landscape architect undertakes when designing a garden or larger scale landscape, includes an assessment of the **visual character** of the plant. This visual character will contribute to the spatial articulation of outdoor areas, the style or theme of a garden, as well as the visual amenity or beauty of the individual species employed as a specimen, or in a composition with other species (Clouston 1994, Hutchison 1992, Robinson 2004). The unique characteristics of each species of plant, with its array of complex features requires serious and concentrated research by landscape students during their study and then ongoing plant research once in practice. A landscape architect also needs to understand how plants adapted for particular conditions such as water logged soil or steep banks can be used en masse or in mass groupings to provide **ecological services** such as to filter water, stop erosion and provide habitat for native fauna (Robinette 1972).

Students of Landscape Architecture need to learn about plant species to achieve these goals. Plants are their unique point of difference from other design fields. The methods which students are gaining knowledge of plants are being revolutionised by online plant database resources. No longer are students reliant on books, which are expensive and become out of date due to changes in plant names and planting trends such as for ecological services or a particular fashion or style. Interactive online plant databases allow designers to select plants for particular visual characteristics such as size, form, colour etc, as well as for growing conditions tolerances such as wind, soil moisture levels and sun. Our teaching methods must be brought up to date to take advantage of this technology.

2   METHODOLOGY

25 plant databases have been surveyed – 24 online and one CD Rom. The databases are evaluated in terms of their usefulness as a model for the planned database for Unitec, under the following headings:

2.1   Purpose

These databases have been categorised into types based on their intended purpose or use. This categorisation was important in understanding which databases are most closely aligned in purpose to our teaching requirements. However it is recognised that there may be useful elements from any of the categories eg. presentation techniques.

2.2   Scope and richness of data

The next measure is a comparison with the criteria in the brief for the existing paper-based assignment which students are currently asked to complete. There are 25 criteria covering scientific **and** design characteristics of the plants in that brief. These criteria are based on plant selection books such as Botanica (Bryant 1999), Flora (Vogan 2003) and various plant encyclopedias (Bricknell 1996; Reader's Digest 1991).

This comparison gives a measure of the richness of the scientific and design data the provided. Further criteria have been added to this list as found in the databases surveyed. The score is expressed as a percentage of the total number of possible criteria.

Scoring for each criteria is from 0 = absent; 1 = limited; 2 = adequate; 3 = excellent

Observations about the way various databases are structured will be reported under this criteria.

From a design perspective images are very important. The databases are evaluated in terms of the types and quality of the images provided for both botanical and design purposes. Excellent image data shows both the whole plant in situ, detail identification photos and design use settings.

2.3   Searchability of data

The next feature evaluated is the searchability of the data. When selecting plants, it is ideal to set search criteria such as height, colour, tolerance to an environmental condition etc. The evaluation was on how many criteria could be searched for.

Ranking for searchability (and also for imagery and accessibility below) is from 0 = absent; 1 = limited; 2 = adequate; 3 = excellent

Again observations about the structure of the database affecting the search function and its ease of use will be included.

2.4   Accessibility

Accessibility of the data to different audiences was also evaluated, for example open public access from common search engines, subscription based access, in house access only.

2.5   Other features

Features such as plant availability, accessibility, ongoing management and scope of the databases will be commented on under this section.

3   THE SURVEY RESULTS

An investigation into a range of online plant databases demonstrates a wide variety of purposes, formats and plant information data categories. The databases surveyed can be categorised into three main types based on their intended purpose or use – see **Table 1.** below:

- Scientific information (both for conservation / botanical purposes) – 12 databases

- Landscape design / Gardening databases – 7 databases

- Nursery catalogues – 6 databases

Table 1. Databases by type

Databases by type	Website URLs:
Scientific (conservation / botanical): 12	
United States Department of Agriculture (US)	www.plants.usda.gov
Plants For A Future (Resource centre for rare and unusual plants, UK)	http://www.pfaf.org
Global Invasive Species Database	www.issg.org/database
NZ Plant Conservation Network	http://www.nzpcn.org.nz
Auckland Regional Council	www.arc.govt.nz
University of Texas Plant Resources Centre	www.lib.utexas.edu
The Noble Foundation Plant image gallery	www.noble.org/WebApps/PlantImageGallery
Plant Information Online – University of Minnesota	http://plantinfo.umn.edu/
International Plant Names Index – combined US, UK and Australian data	http://ipni.org/
Index Kewensis - Royal Botanical Gardens Kew	http://epic.kew.org/
The Green Toolbox – Landcare Research NZ	www.landcareresearch.co.nz/services/greentoolbox/gtbweb/default.asp, also http://floraseries.landcareresearch.co.nz
Urban Forest Ecosystems Institute	http://selectree.calpoly.edu
Landscape design / Gardening databases 7	
Royal Horticultural Society Plant Selector (UK)	www.rhs.org.uk/rhsplantselector
My Garden Guide (Environmental News Network – US)	mygardenguide.com

Dave's Garden	http://davesgarden.com
Flora CD Rom	c2008 Global Boook Publishing
Plantfile online (Australia)	http://www.plantfileonline.net/
Vectorworks CAD programme plant database	Landmark Plant database – http://www.nemetschek.net/
Project Landscape – Waikako landscape students	http://www.projectlandscape.co.nz
Nursery catalogues - 5	
Taupo Native Plant Nursery	www.tauponativeplant.co.nz
Landsendt Tropical Plants	http://www.landsendt.co.nz
Oratia Native Plants	http//:oratianatives.co.nz
Wairere Nursery	www.wairere.co.nz
Kaipara Coast Plant Centre	www.plantsnz.co.nz

Analysis of this data is grouped under three main headings – the richness or scope of botanical plant data, scope and quality of the design data, and ease of searching for suitable plants (termed searchability). The full Excel analysis spreadsheet is available from the author on request

Further considerations include whether the database is managed to remain up to date, reflecting botanical nomenclature changes and new varieties, the scope or range of species included, its accessibility to a range of potential users, and whether it provides information as to the plants' availability.

3.1 Scope of plant data

Common plant data categories included in plant selection literature included nomenclature (botanical and common), visual characteristics, environmental tolerances, ecological habitat and / or distribution, landscape and other uses. The databases surveyed ranged from 10 – 20 categories of plant data entries. Clearly the more categories of data, the more information available to the designer, but the **hierarchy of information** or the way these categories of data were presented was also important, for easy access to key data, such as botanical name and size specifications.

Nomenclature – botanical, common and family names were all included in all but two databases, both of which omitted the family name.

Environmental tolerances /ecological habitat – 'right plant for the right place'. Designers need to select plants for specific site conditions. Examples of this set of data include natural habitat which indicates tolerances to different light, water, soil, wind and conditions eg. selecting a plant which must tolerate high light conditions versus one for a full shade condition. The new Green Tool Box database from Landcare Research provides a clear and simple search function for these categories of data.

Plant Size - height and spread data is very important for planting designers. The height and spread dimensions enable design of appropriate combinations of plants of particular sizes (as well as other visual characteristics) to form desired compositions. Based on data found in hard copy books, best practice is to provide sizes at both 10 year and mature size to indicate long term growth patterns, of trees in particular. However none of the databases surveyed provided this full range of size data, but most provided mature height and spread data consistently.

Images - visual information contained in photographs of a plant, described here for identification purposes, and in section 2.2 for visual design character.

Best practice is to provide a range of images to show the plant both as a whole plant in situ and then close up to show botanical details, which are very useful for identification purposes. Additional features found include linkage to separate, related websites, and including images of herbarium samples, which can be interesting historically as well as displaying very specific plant features eg.Cal Poly images shown in **Fig. 2**. below. When visiting University of Texas Plant Resources Centre last year I was shown the scanner developed by Kew Gardens, which has enable their huge bank of

herbaria samples dating back to 19th century explorers to become useful internationally as part of their online database. Databases vary in their capacity to store, display and group images, and link to other websites. The broader the capacity of the database in this data field, the more likely the designer will be able to identify a plant accurately. Wikipedia is worth mentioning here, in its broad scope of botanical data and images, and its example of a multi data input model.

The US Department of Agriculture and RHS Plant Selector databases scored very highly in the overall scope of plant data they present. This is because they include a large number of plant data categories and plant images, a wide range of plants and also the data is arranged in a **hierarchy of importance** which aids the viewer find particular data categories easily. Examples of layouts which provide a clear hierarchy of information are the Green Tool Box shown in **Fig. 2** below and PlantFiles Online shown in **Fig. 3** overleaf, which both provide a list of plants to explore and a search function right on the front page of the database site.
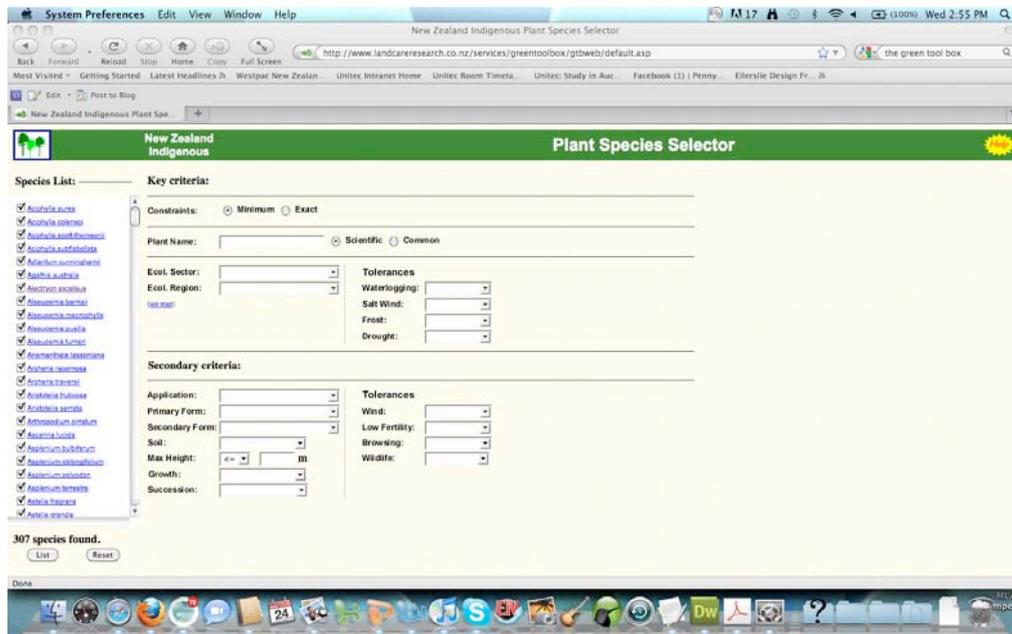

Figure 2. Green Tool Box database structure – plant list and search function

3.2   Visual characteristics (design) data

Complex visual character data including colour, form and texture features, seasonal changes and growth pattern of plants are well demonstrated by **high quality photographic images**, and so these are a key way to represent visual design characteristics of a plant. The best databases provide a range of images of each plant species. Both the overall plant in situ and the close up details of its leaves and flowers etc. are useful in the designer's decision making, but also images showing the plant being used for different **design uses** eg. as a screen of particular character, a dense groundcover useful for erosion control on a steep bank or a fine textured climber suitable for growing on a sculptural form. A wide range of small **thumbnail** sized images is efficient in allowing the designer to scan the images on offer for the one most to show the feature being searched for, while also allowing an enlarged version of the image to be viewed when selected – see **Fig. 3** below. Images of plants growing alongside other species can also be useful in selecting plant compositions and demonstrating plant selections to clients and colleagues.
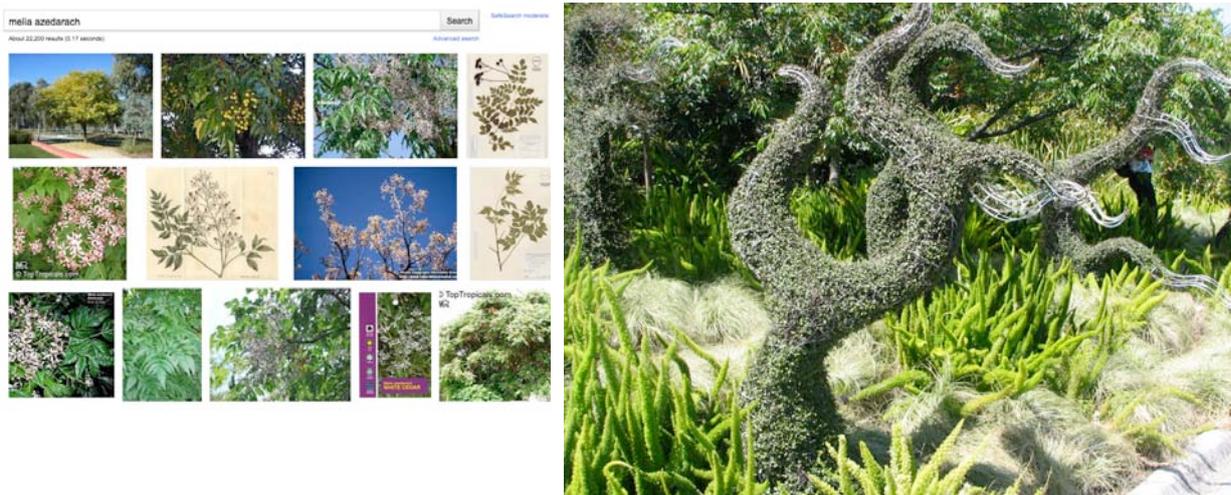
Thumbnail image gallery including herbarium samples   Plant use and species combinations.

Figure 3. Image presentation and use

In personal communication with designers J. Rice and J. Muir report the use of internet searches to provide images of plants for demonstrating planting designs to clients in a similar manner to other designers such as architects or interior designers presenting **swatches** of materials such as fabric, flooring or paint colours. The designer's report preparing these plant material image swatches of proposed plant selection combinations for clients, particularly for garden scale projects. See **Fig. 4**. below.

Figure 4. PlantFile Online swatch layout and search options

Vectorworks CAD software combines photos and plan view **graphic symbols** which enables designers to generate planting plans and schedules. Carefully selected elevational images of species enable the generation of sectional and **3 dimensional** views of the plant within a landscape design.

Not many database attempted to demonstrate temporal factors. Representation of a plant in different seasons was shown in many plant images and is a useful design consideration, particularly for flowering and deciduous species. Flora has a **time sequence** function, which shows how a range of plants, change and grow over a four -season year.

3.3   Searchablity

This function is difficult to be objective about. People with different thinking and learning styles will appreciate different ways of accessing plant data. One clear access option is to present all the plant names available on the database as an alphabetical list. Another is to provide a range search box options for all the categories of plant data available eg. botanical name, common name, plant size, environmental tolerances such as sun, wind, soil etc. Some of these options can be seen in the examples shown in **Fig. 2. & 4.** above.

3.4   Other features

Plant nursery databases have the added advantage of being the only databases which indicate information about plant **availability**. Levels of **accessibility** ranged from completely open public access from a search engine such as 'Google', to requiring registration with a log-in, through to paid subscription access only. Ongoing management arrangements of the databases proved difficult to assess, but none of the databases was identified as 'out of date' in terms of botanical nomenclature. The scope or number of species included in each database was also compared. A recent innovation in music databases such as ITunes is known as the '**Genius'** concept. This was not found in any of the plant databases surveyed, but could be useful for plant selection purposes also. It allows users to search for music similar in character to something they have already selected, in that the user could be invited to view plants based on 'I you liked this plant, you may well like these ones also'.

A comparison of the databases was undertaken in terms of the criteria described in the methodology section above. A numerical ranking was attempted, but proved problematic in terms of relative merits, however the process of comparison has promoted a range of reflections on various features.

4   CONCLUSIONS

This survey of 25 plant databases has clearly shown that databases are a powerful tool for enabling the appropriate identification, selection and design of plant material for landscape design projects. The following conclusions are reflections on the analysis and surrounding research on the original research question of what does an ideal plant database for landscape design purposes look like, and how can student research contribute to that.

4.1   Scope of Botanical data and Design data

There are many existing databases providing excellent botanical plant information and plant environmental tolerances. However not many databases provide comprehensive visual design data. Best practice consisted of multiple images of the plant, for use in both the plant selection phase and in the design communication phase with clients. Photos of both the overall plant en situ and the close up details of its leaves and flowers etc. are important for a designer's decision making for plant compositions and also demonstrating plant selections to clients. Applications which allow for assembly of plant material image swatches of proposed plant selection combinations would be valuable innovation. In this aspect, the survey of plant databases relates to material sourcing techniques from other disciplines such as interior design and architecture. There is a lot of potential to utilise this mode of presentation of plant choice options to clients and colleagues.

4.1.1 Hierarchy of information

A key aspect of presenting botanical and design data is the way the information is arranged. A clear hierarchy of information with headings and subheadings enables easy access to key pieces of information such as botanical name and plant size data.

4.2   Accessibility

Best practice for ease of access suggests some ideas for a Unitec Plant Database, including making the database linked not only from main Unitec webpage, but also from generic search engines. Having an alphabetical list of plants visible from the homepage (both botanical and common name options) gave users an immediate access to the plant data, and a search function for design data and growing conditions added to this accessibility. Linking the database to industry websites provides for externally managed availability searches.

4.2.1 Wiki model for student contributions

A precedent for contributions of plant data from students exists in the Wiki model, where members of the public can contribute material, under an editor's watch.

4.3   Currency management

Ongoing updating of plant databases is clearly important for designers to remain current in terms of plant nomenclature, new variety development and trends, and plant availability. The annual nature of student plant research assignments lends itself to a constant updating process. However plant availability sourcing is a very fast and constantly changing situation, which is best served by the nurseries themselves. Links to nursery websites would therefore be useful.

4.4   Implications for a Unitec database

This survey has revealed a wide range of plant data resources available online at present. All have their specific client base in mind, whether they are conservation botanists, gardeners, or the general public. There is certainly a case for the development of a Unitec plant database designed for New Zealand landscape architecture students and professionals. Software development of features found in this survey, combined with a Wiki style monitored data entry structure with student input has great potential.

Best practice revealed in this survey included open access, intuitive searchability, wide scope of data arranged with a hierarchy of information, capacity for multiple images and linkage to other websites, thumbnail, genius and swatch presentation applications, covering the mix of plants required by landscape architects in New Zealand, which must include natives and exotics suitable for a wide range of projects in New Zealand conditions.

Ideally this database could be linked to computer aided design programmes such as Vectorworks and ArchiCAD commonly used in landscape practices to enable further graphic representation of the plants in plan and 3 dimensional views. Links to nursery sites would also be valuable for up-to-date availability data. The ongoing data management required would be significant, but could be offset with subscriptions from graduate students and practitioners, such as those charged by the Australian PlantFiles Online database. Another option would be to form a relationship with an existing database provider, and contribute edited student plant data to expand their database scope to suit our own requirements, particularly design focussed plant imagery. A database with a Wiki set up which allowed for open but edited contributions would be ideal. The next stage of this research will be canvassing landscape architectural firms for sponsorship of, and involvement in the design of such a database.

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