Title:

Managing Plant Collections Using GPS/GIS in the Royal Botanic Gardens Melbourne (RBGM)

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Paper Abstract

As we were finalising our 20 year Master Plan in 1997, we could see the advantages of GPS/GIS mapping of our plants and structures for all sorts of management values, especially monitoring change. Whether it was an icon like the famous Separation Tree, which featured in celebrations of Victoria's parting from New South Wales in 1851, or the surviving quaint Colonial shelters, which seem part of our collective memories, the potential was enormous. In 1997 the capture of more than 50,000 plants of 12,000 different species started using a differential GPS. We were able to upgrade to ArcView 9 this year after we obtained an ESRI conservation grant.

The GPS/GIS initiative started from scratch, and we were trendsetters among plant collections in Botanic Gardens in Australia. It’s now an absolutely fundamental tool to save us time and generally ease much decision-making.

Introduction

The Royal Botanic Gardens Melbourne has greatly benefited from geospatial initiatives introduced into the Gardens in the last 10 years. Technology and heritage go hand in hand on this 159-year-old site with its ever-evolving small landscapes set in 38 hectares of sylvan beauty. Beloved by generations of Victorians and visited by over two million visitors every year the Gardens need to be managed well to deal with heritage demands and changing needs of these visitors while at the same time carefully managing its living plant collections.

Managing living plant collections is not easy due to the underlying complexity of plant nomenclature and the frequent changes to spatial and attributes data. The RBGM uses MS Access to manage its plant collection information using the International Transfer Format as its standard.

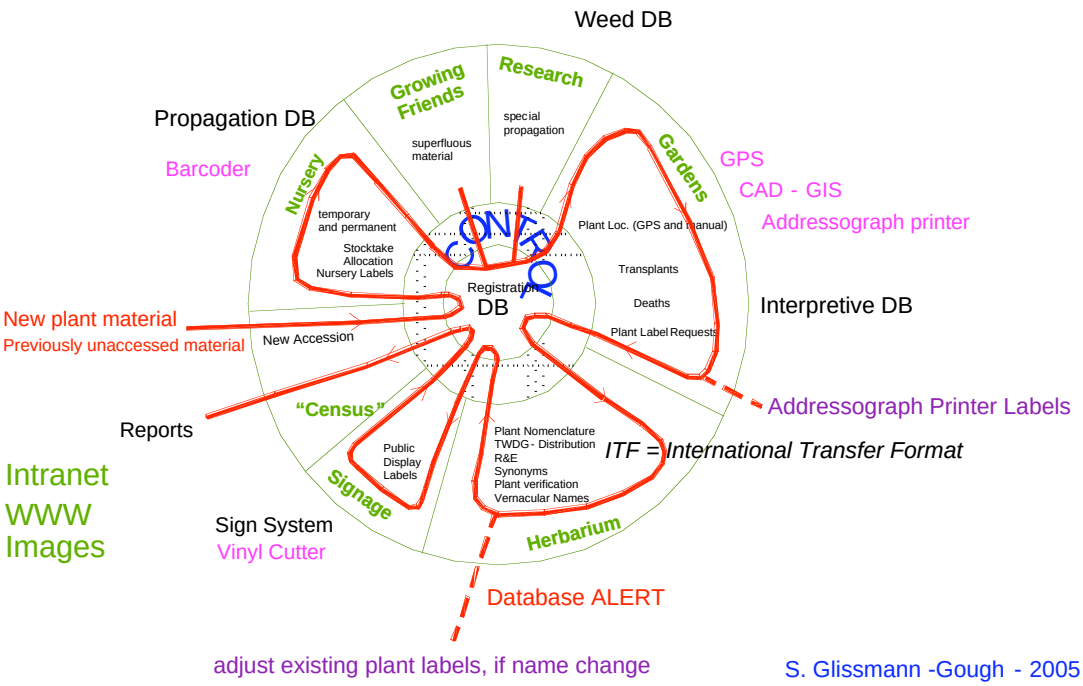
Our GPS/ GIS drive started from scratch and was taken step by step as funding and resources allowed and we set trends in using geospatial technologies for living plant collections in Australian botanic gardens. It has become absolutely fundamental in shortening the decision making process, while at the same time retrieving more up to date and reliable information.

Collections management using GPS and GIS

In 1997 the Friends of the Royal Botanic Gardens bought a differential global positioning system for the Gardens, which was able to record with sub meter accuracy and perform well under tree canopy. This was the start of capturing all data into a comprehensive digital mapping system, first into a CAD system and then completely into a GIS system. This was facilitated when we purchased two ArcView licenses under ESRI's conservation program. Being a government statutory organization obtaining the licenses has been invaluable for the Gardens. This is because resources are limited and expectations are always high. The RBG Melbourne does not charge an entrance fee and has only a comparatively small operational budget.

The ability to pull out detailed information with a few keystrokes has shortened the planning process and allowed us to implement most of the recommendations of our 20-year Landscape Masterplan. The Masterplan safeguards icons like the famous Separation Tree, featuring in celebrations of the State of Victoria's parting from the State of New South Wales in 1851, and the surviving colonial pavilions of the 19th century. These icons form part of the collective memories and feature in nearly every old Melbourne family album. Recommendations on the remodeling of the living plant collections are listed in the Masterplan together with the objectives of each individual plant collection. The objectives address scientific, conservation and horticultural requirements as well as aesthetic and interpretive needs.

There was a lot of information to capture: more than 50 000 plants of about 12 000 different species, both exotic and native in a high maintenance garden setting amidst sprawling lawn areas and water bodies. Data collection menus were defined in the Global Positioning Software. These menus had to be able to easily collect plant names, plant accession numbers referring to plant origin and plant identification status. The attributes are vital so that plants can be labeled correctly for public reference. A large amount of information was also digitized from paper based maps.
(*Appendix I.* shows a typical example of a mapped garden bed)



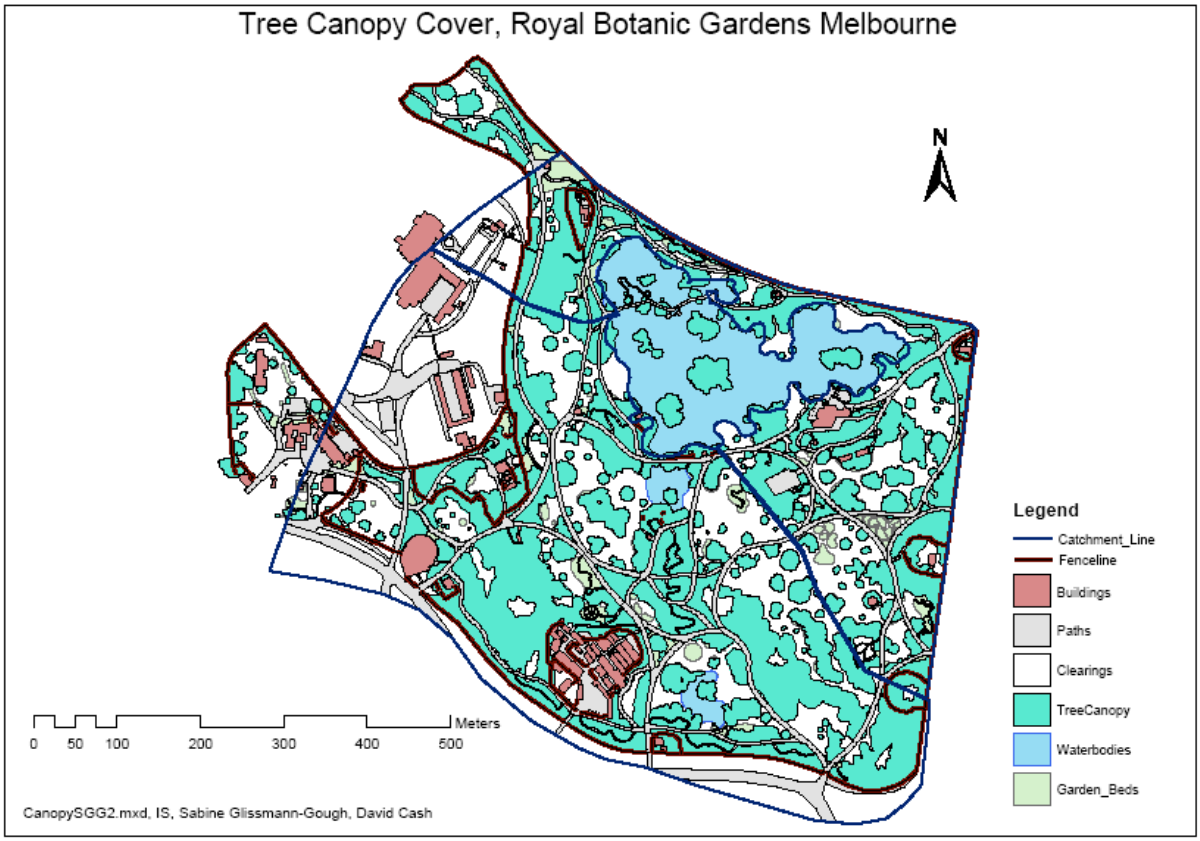
This diagram shows how various stakeholders in the RBGM process plant information. The nursery gives each incoming plant a unique accession number. The horticulturists put the plant in the ground with an addressograph tag and record the location. Before the plant can get a public display label it needs to positively identified and named, which is done by botanists. The sign and print technician is then able to pull the record out of the database for label production. Each stakeholder has specific access rights in the database.

Water management in the RBGM

One of our main challenges in the last ten years was the need to save water. As Australia's population increases, along with limited water resources, wise water management becomes more and more critical. Australia's native flora is adapted to the frequent and irregular drought cycles, but the exotic plants that European settlers brought with them and which is part of their heritage are not. It is part of the RBGM's role to make visitors aware of this dilemma and find recommendations and solutions to choose plants wisely and manage them in a responsible way. Since 1994 the organization was able to cut the annual water consumption in half, which means savings of about $US 75 000.- at current water costs. This is significant for the RBG because the water bill had to be paid out of the organization's budget since 2001.
Apart from best horticultural practices like mulching and grouping plants with similar water requirements together, the installation of an automated watering system throughout the gardens allowed us to monitor and manage the water needs of the individual plant collections. There are currently 17 water sensors

throughout the gardens that monitor soil saturation and tell us which of the 500 solenoids in lawns and beds need to be activated to run certain sprinklers. The sprinklers are connected to over 100 kilometers of lateral pipes and seven kilometers of water mains. The efforts that went into accurate mapping support the efficient irrigation maintenance programs, which significantly contribute to effective water conservation.

Ten years ago, when the irrigation system was installed over a three-year period many important in ground services, installed in the last 150 years, were discovered and mapped. Old and largely defunct agricultural terracotta drains, old water reticulation systems, vertical pits to century old sewer lines and mysterious bluestone foundations are now all on the GIS. The information can be retrieved together with the modern installations of three phase power lines, gas pipes, optical fibre and other communication cables, when plant collections need to be replanted or new services need to be installed.



This map shows the extensive tree canopy cover, which has an impact on infrastructure. The plant collections and lawns are irrigated with an automated watering system, which is controlled through over five hundred solenoids. Each solenoid controls a certain amount of sprinklers, which can be programmed.

In the last decade about 5 per cent of the Garden's content changed every year as many of the old trees had to be removed and other recommendations made in the Landscape Masterplan were realized. Those century old trees were either planted by the energetic scientist Baron Ferdinand von Mueller who established his design on swampy marsh and rocky outcrops from 1857 or by William Guilfoyle who altered the site into the current charming English landscape garden style from 1873.

With the implementation of the landscape master plan recommendations from 1997 the Gardens redesigned the Old Melbourne Observatory site. This site is now our main entrance to the Gardens displaying old observatory houses and a new visitor centre.
In 2002 Geoscience Australia chose this site to set up a regional GPS station as part of greater Australian-Pacific GPS network on the roof of the heritage listed Observatory building. This is of benefit to the Gardens, because we can post process all our GPS data at no extra cost, while being part of research that measures the movement of the Australian plate to the North (the plate that caused the 2004 tsunami in Indonesia).

Data Collection is performed by the Plant Records Officer with occasional help from a volunteer or the curator of the plant collection. The Plant Records Officer also maintains and develops the living plant database and the information in this database can be linked to the GIS. Spatial information is retrieved regularly and accurate record keeping and mapping has enabled popular interpretive trails like the Aboriginal Heritage Trail or the Chocolate and Spice Walk. The most recent project completed is the Ian Potter Foundation Children's Garden, which displays many interesting and unusual plants. This Garden is so popular that we have to limit the numbers in the future.

Another big project is currently under construction in our annex in Cranbourne, which is about 50 km to the Southeast of Melbourne's CBD. The site comprises 363 hectares of native bush on undulating land with bogs, wet- and woodlands. Twelve hectares of the 28 hectares big Australian Garden at Cranbourne will open to the public in 2006 and the Gardens are currently seeking sponsorship for Stage II of this project. The Australian Garden will display Australian landscapes with the kaleidoscope of textures, colors and characters of plants in their native environment. Their will be gorges, waterways, dry riverbeds, landscape sculptures, interpretive shelters and a state of the art visitor centre.
Needless to say that GIS will play a big part in the future of the Australian Garden as well. The data is already captured with the GPS and digital orthophotos.

References:

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Interactive 3D model of the Royal Botanic Gardens:
http://www.rbg.vic.gov.au/rbg_melbourne/mapping/3d_model

Appendix I: