The Smart Collection

The Western Australian Herbarium is no longer simply a plant museum, it is a dynamic scientific resource. By using the latest technology, staff and volunteers have turned historically collected information into a research tool that is ready to speed along the information super highway.

by
Alex Chapman
and
Paul Gioia

Working smart has become a byword of the modern corporation, but it seems at first glance irrelevant to something as steeped in history and archaic charm as a herbarium. After all, this is the place where you can wander up to a shelf and pull out two folders containing what seem to be identical specimens of dried plant material. One was collected by John Drummond in 1839, the other was collected last year by a PhD student. But then you notice a difference. The label on Drummond's specimen is laboriously, albeit beautifully, written by hand in copperplate. The student's has a computer-generated label, the work of WAHERB, a dynamic resident of cyberspace that has been developed by the Western Australian Herbarium and is equipping it for life in the 21st century.

HOW IT WORKS

For many centuries, plant specimens have been collected from the wild, pressed and described in Latin according to the Linnaean system of classification, established by the 18th century Swedish naturalist Linnaeus, that uses two Latin names—the first being the genus and the second the specific name—to arrive at the species name.

Although the practice of collecting has not changed greatly since the days of the earliest botanists, the way in which this information is stored and used has undergone enormous change thanks to technological advances.

Dried specimens are still the basic tools of taxonomists, the scientists who name, describe and classify species. When a plant is collected in the field, information about its locality, latitude and longitude and habitat is recorded in a field book. Specimens for the vascular collection (flowering plants, ferns and their allies and cone-bearing plants) are dried, then frozen, to preserve them and to kill any insects they may harbour. The specimens are then mounted on stiff sheets of cardboard and labelled with all the pertinent habitat information from the collector's field book. The non-vascular collection (mosses and their relatives, algae, fungi and lichens) is usually stored in special packets or boxes.

It is estimated that about one-third of Western Australia's flora has still not been described, despite the fact that the Herbarium has about 350 000 plant specimens in its collection and is adding to it at a rate of about 12 000 per year. The importance of such work is sometimes overlooked, but without this basic building block, the more glamorous fields, such as DNA research and tissue culture, could not exist.

The Herbarium's work is vital to the Department of Conservation and Land Management (CALM). If plants are classified authoritatively, information related to a species can be reliably documented. While this information is obviously important as a basic research tool in botany, it has a number of practicable and commercial applications as well. For example, it is often vital for land managers to know how certain plants cope with fire or salinity; what sort of plants were indigenous to an area due for rehabilitation; and how the State's threatened flora can best be conserved. The core information about different forms of a particular plant is also vital to commercial growers experimenting with the development of new varieties.

PLANTS WITH BAR CODES

The data now managed by the Herbarium fall into four major types: specimen labels, names, descriptions and biogeographic data. Having all this information is no use at all unless it can be accessed quickly and easily; and integrating all four types of data will provide a powerful conservation device.

In an innovative move, the WA Herbarium introduced a bar coding system for its research collection almost a decade ago—when supermarkets were only just starting to toy with the idea. This was a turning point in the management of the vast pool of knowledge contained in the Herbarium collection, as it revolutionised the processing of specimens. It accompanied the development of the database, known as WAHERB, which has proven to be a powerful tool. WAHERB effectively manages the flow of specimens, while providing fast access to invaluable label information and forming a dynamic link to the never-ending

Previous page
Top left: Rhubarb fungus.
Top right: Cauliflower fungus.
Centre: Flowers of the Pindan wattle.
Bottom: Seed pods of the Kurara.
Photos – Babs & Bert Wells/CALM

Below: The WA Herbarium now tightly integrates its specimen databasing operations (*below left*) with its traditional tasks of taxonomy and curation (*below right*). In late 1994, operators finished the initial phase of databasing the specimen collection when the last of the 350 000 record backlog was entered into the WAHERB database.
Photos – Donna Swan

reclassification of the collection.

In 1990, a database administrator was appointed and external funds granted to increase the rate of data input. This led to a doubling of the annual rate at which specimen details were entered, with about 90 000 specimens being put into the database each year. In December 1994, the databasing of label information from the specimens already in the collection was completed. This was the culmination of ten years' sustained effort by many staff and volunteers. Other advances included the automated production of specimen labels, automation of herbarium loan procedures and a major shift towards obtaining data from all new collections.

The aim of the WAHERB system was to make information on a specimen's identity, appearance and location readily accessible, and to link it to other information systems, thereby fulfilling CALM's role for providing information on the State's flora and fauna.

This year, the focus is on refining data quality and standards, and on ensuring the accuracy of location data so that future products are reliable.

WAHERB's companion, HERBIE, is a personal computer program that allows individual collectors, such as CALM staff, volunteers and other related conservation groups, to maintain their own specimen collection details. There are a number of advantages to using HERBIE. For the user, the program helps store, retrieve and print label information for their own use. HERBIE also allows individual collectors to capture data in a compatible format so specimen information can be uploaded directly into WAHERB without retyping.

WHAT'S IN A NAME?

The name identifying a plant is the foundation upon which all other information about it is built. In 1985, the WA Herbarium published a revised second edition of the *Census of the Vascular Plants of Western Australia*, which includes species names of most plants in the State. However, there was no way of ensuring that the Herbarium contained a valid representative of those names.

In 1991, the WACENSUS database was initiated in order to automate, where possible, the tasks involved in keeping an up-to-date list of published names, to build on the foundation of the previous census and to broaden its scope to include non-vascular plants as well as unpublished names that were in use.

Above: A cone-bearing plant from the genus *Cycas*.
Photo – Kevin Kenneally

Right (top to bottom): Jelly fungus, beard lichen, scarlet bracket fungus, the earthball and club moss.
Information about the names of cryptogamic plants such as these is included for the first time in the new publication of the *Census of WA Plants*.
Photos – Babs & Bert Wells/CALM

Plant taxonomy is not a static field. Names sometimes change, plants are reclassified or species are divided. WACENSUS was designed to track relationships between names. For example, it could indicate not only that a name was no longer current, but also which other names needed to be considered in finding the most appropriate current name. WACENSUS provides name data linked to WAHERB and individual users' databases, and also automates the production of the new *Census of Western Australian Plants*.

In the same way that HERBIE is a small version of WAHERB, a companion to WACENSUS, called SEDIT, exists for personal or project use. SEDIT allows users to enter species names, which can be validated against the names supplied by WACENSUS. This helps ensure that species names in users' databases remain consistent with WACENSUS and retain their integrity and value.

THE KEY TO IDENTITY

Plants are commonly identified by the use of a 'key'—a sequence of statements about their physical characteristics. A key consists of a series of 'either/or' choices ('Is the flower blue or pink?'), each choice leading to another. Through the process of elimination, the reader is guided to the correct plant name.

Designing a useful key is a challenge, a task that computers can make easier. The Descriptive Language for Taxonomy (DELTA) is an international standard developed over the last twenty years. It allows those involved with classifying and describing organisms to capture their base data in such a way that it can be automatically transformed into a number of different products, including keys. Once the data is fully entered in this manner, it may be automatically converted into descriptions, either printed or interactive keys, or output for further scientific analysis of relationships. It is the plain descriptive text and the interactive keys that are the most used features of the DELTA system.

MAPPING THE FLORA

The main purpose of checking location accuracy for WAHERB specimen records is to provide reliable maps at a specified accuracy level to CALM staff. Perhaps the greatest demand in this area

Left (top to bottom): Holly-leaf banksia, honey-suckle grevillea, nodding banksia and pink pokers. Descriptive database projects compiling DELTA data on the genera of WA flowering plants (initially those in Proteaceae), Australian *Acacias* and the genus *Olearia* will result in a comprehensive set of interactive keys.
Photos – Babs & Bert Wells/CALM

Below: Interactive mapping applications can help visualise species distributions and display descriptions, drawings and images of the plant derived from a range of DELTA projects.
Photo – Leonie O'Halloran

Left: The Sturt pea was one of the first Australian plants collected by an Englishman (William Dampier in 1699) and was one of the first to be described, albeit using the pre-Linnaean system, in 1703. It was formally named in 1832 and given its most well-known name, *Clianthus formosus*, in 1950. It was reclassified as *Swainsona formosa* in 1990.
Photo – Babs & Bert Wells/CALM

Right: Dancing orchid. The *Descriptive Catalogue of WA Plants* is a joint project between the WA Herbarium, the Wildflower Society of WA and Kings Park to produce a book and interactive key briefly describing every plant species in the State. To date, all monocots have been described.
Photo – Babs & Bert Wells/CALM

is for simplified but informative maps of where species occur. Geographic Information Systems software is used to manipulate and view this information.

Another of the WA Herbarium's innovative software applications allows users to prepare and place existing species distribution data from WAHERB onto a scalable map of the State. Predefined additional information such as roadways, hydrology, conservation reserves and place names, as well as scale and title information, can also be added. The resulting map can then be printed, if required, or used for further interrogation of the data. For example, when the user enters the name of the species to be mapped, the application retrieves the locations directly from WAHERB and displays them as points on the map. Selecting any point will then display the related specimen data and, optionally, bring up a standard species description, illustration or image prepared from one of the DELTA projects. This illustrates the application's ability to integrate all four major types of Herbarium data (specimen labels, names, descriptions and biogeography).

HERBARIUM IN CYBERSPACE

With the establishment of CALM communications networks and access to the Internet worldwide network, the possibilities for distributing information are enormous. A site on the Internet is aready being established by CALM, with access to selected herbarium data being one of the features. Specimen data (with only generalised localities to protect the native flora) and census information can be made available for query, and collaboration with CSIRO scientists will result in the ability to transform DELTA descriptive data directly for presentation on the Internet.

As we move into the 21st century, conservation will remain the key role of the WA Herbarium. And it is well equipped for the job, having embraced the notion of electronic databasing 10 years ago. Now wasn't that a smart move?

DELTA AT WORK: THE INTERACTIVE KEY

The traditional printed key requires the user to have considerable taxonomic knowledge. An interactive key prompts users to answer appropriate questions about the plant they are trying to identify. As well as selecting the questions based on a user's previous answer, it can also display notes or images to illustrate the terminology. The program can then display photos and line drawings of the resulting species to confirm the identification.

CALM's Science and Information Division is developing a method of using DELTA (Descriptive Language for Taxonomy) that will ultimately lead to the availability of interactive keys for all the State's flora. Although this is a very long-term goal, various groups, such as the 282 threatened flora species, can be prioritised for this treatment. Choosing from a range of 120 characters coded for each species, a user can key out a specimen to find out if they have a threatened species and display the images and map of known distribution to confirm the identification. Once the project is finalised and the appropriate images gathered, this set of data can be published as a CD-ROM providing a very informative and easily distributable source of reliable data on these important species. The data can be updated and released at the same time as the yearly gazettal of threatened flora prepared by CALM's Wildlife Branch.

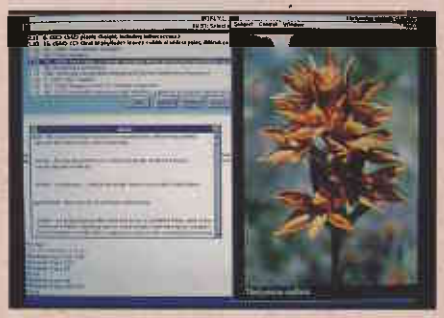


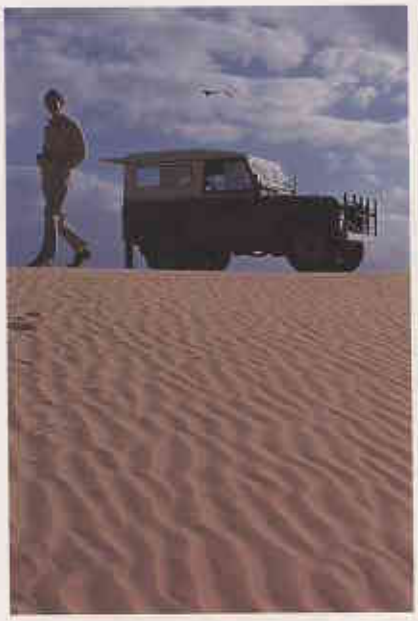
Photo — Leonie O'Halloran

Alex Chapman is a research scientist with CALM and has a research interest in presenting DELTA descriptive data on the Internet. He can be contacted at CALM's WA Herbarium on (09) 334 0500.

Paul Gioia is a research scientist with CALM and has a particular interest in designing computer systems for biological data. He can be contacted at CALM's Wildlife Research Centre (Woodvale) on (09) 405 5140.

LANDSCOPE

VOLUME TEN NO. 4 WINTER ISSUE 1995



Cooperation between 4WD clubs and CALM is helping to protect WA's special recreation spots through a program of education. See 'Go Lightly' on page 17.

The noisy scrub-bird is one species that is responding well to its recovery plan. 'Recovering from the Brink' (page 10) discusses how such plans are drawn up.

Mt Augustus is the biggest rock in the world; yet few people know it exists. Find out more about this natural wonder on page 28.

There is a great deal written and talked about our forests. But what are the facts? 'Looking Beyond the Obvious' (page 22) dispells some of the myths.

Specially developed computer software is helping speed the identification of plant species in 'The Smart Collection' (page 49).

FEATURES

REGULARS

COVER

The rainbow bee-eater is a common bird found throughout most parts of the State, including Mt Augustus National Park.

Illustration by Philippa Nikulinsky.

Managing Editor: Ron Kawalilak
Editor: David Gough
Contributing Editors: Verna Costello, Penny Walsh, Mandy Clews, Amanda Curtin, Deborah Mayrhofer
Scientific/technical advice: Andrew Burbidge, Ian Abbott, Paul Jones, Tony Start
Design and production: Maria Duthie, Sue Marais
Finished art: Maria Duthie, Sue Marais
Illustration: Gooitzen van der Meer, Ian Dickinson
Cartography: Promaco Geodraft
Marketing: Estelle de San Miguel ☎ (09) 334 0296 Fax: 334 0489
Subscription enquiries: ☎ (09) 334 0481
Colour Separation by Prepress Services
Printed in Western Australia by Lamb Print

Published by Dr S Shea, Executive Director
Department of Conservation and Land Management,
50 Hayman Road, Como, Western Australia 6152.