

*From Here
to Eternity*
Western Australia's
Great Botanical Challenge

Beneath
the modern uses
of botanical specimen
collection—land
conservation strategies,
bio-prospecting, genetic
engineering—its ancient
principles remain largely
unchanged. Now, the computer
and the internet are here, and
at Western Australia's State
Herbarium, botanists are
coming 'on-line' to meet the
challenges of the future.

By Neville Marchant

Western Australia is renowned the world over for the richness of its plant life. The State's flora represents almost half of Australia's estimated 25 000 plant species. Yet until recently, some 20 per cent of the species in this botanists' paradise had gone largely undescribed. With the ever-expanding resources of the Department of Conservation and Land Management's Western Australian Herbarium, botanists are intensifying the challenge of classifying and naming our wealth of native flora, in the service of scientific endeavour as well as natural heritage.

Although recently computerised, CALM's WA Herbarium maintains traditional principles and practices handed down over hundreds of years. As biological specimens go, plants have always lent themselves particularly well to preservation and study. The technique of plant pressing dates back to the middle ages, when it was first discovered that a plant specimen pressed firmly between soft absorbent surfaces dried quickly, did not shrivel, and could be preserved indefinitely. It was on this basis that the first herbaria were developed. These early collections



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WA is renowned for its high number of sundews. Many, like this *Drosera miniata*, live on winter-moist soil and survive the summer as balls of white, protecting leaf parts.

Photo – Babs & Bert Wells/CALM

Left: A dried, mounted and labelled herbarium specimen is a single sample of a population of plants, and can reveal much about a species.

Photo – Neville Marchant

Below: WA has a huge variety of wildflowers. We see here spider orchid (*Caladenia multiclavia*), and many everlastings, with wattle and sheoak trees.

Photo – Babs & Bert Wells/CALM

became virtual libraries of specimens carefully pressed and stored, along with simple field observations, such as the time and place of collection or any noteworthy features of the environment.

Nowadays, herbaria have been transformed from quaint early museums of plant specimens to modern scientific resources. Each specimen is a databank of information, representing a species whose significance may vary, from its geographic region, to its

phytochemistry, to its insect damage or disease resistance, to any combination of features. DNA samples, leaf or wood anatomy, or chemical characters can be observed, and such information can assist with naming the species and identifying its relationship to other species. Today's herbaria persist as the main tool of the modern botanist, whose science has survived and evolved with the times to be as important as any other to modern human endeavour.



For example, botanical knowledge holds the key to advances in land conservation and in bio-prospecting, the growing technology of finding and putting to use the natural chemical and pharmaceutical properties of the plant world. Economic botanists and ethnobotanists, who collate knowledge from indigenous people, still search the world for economic plants or active pharmaceutical compounds to combat antibiotic resistance or emergent diseases such as AIDS.

HERBARIA THROUGH HISTORY

Herbaria have not just achieved this political and economic significance recently. Botanical collections were at the cutting edge of the age of exploration and political expansion. From the 1700s herbarium botanists and their herbaria played a major role in documenting the world's economic plants and their characteristics. Botanists such as Joseph Banks held high scientific and political status as important members of European exploration voyages for their contribution to the expanding empires. The discovery of the anti-malarial properties of quinine, a substance found in plants of the American genus *Cinchona*, is a prime example. It led to a concerted effort by chemists, working with specimens collected by exploration botanists from the information provided by Kew herbarium taxonomists, to find the highest yielders of the substance. This enabled the quinine-rich species to be propagated and the seed to be taken to British India. Eventually the refinement of quinine enabled the expansion of European empires to other parts of the world where malaria was endemic.

The development of many natural products such as jute, rubber, cotton, tobacco and sisal also depended heavily on herbaria, as did the enhancement of food crops such as wheat, rice and potatoes, and a huge variety of medicinal plants. Information about where and under what condition the species grew, the variation, how they could be propagated, how they were pollinated, and their potential or actual use, was stored in herbarium specimen labels, in files, and in books.



WA Herbarium - FloraBase Records - Metacapp
File Edit View Go Communicator Help

NatureBase Science Matters
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Home: Science Matters: FloraBase Home: FloraBase Search: Name Records

FloraBase
NAMES

This document contains information sourced from the Census of Western Australian Plants, A.R. Chapman, P. Gioia and P.G. Wilson (1998, in prep.), Western Australian Herbarium (WA Department of Conservation and Land Management). Common names are sourced from Eleanor Bennett, courtesy of Kings Park and Botanic Gardens.

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Family	Plant name, author and reference	Specimen	Map	Image	Description	Protolog
273	<i>Darwinia acerosa</i> W Fitzg. J. W. Austral. Nat. Hist. Soc. 2 (1):17 (1904) Taxon 5304 is current. Conservation Status R Common name: Fine-leaved Darwinia	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
273	<i>Darwinia apiculata</i> N G Marchant <i>Nuytsia</i> 5:63-65, Fig J (1984) Taxon 5305 is current. Conservation Status R Common name: Scarp Darwinia	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
273	<i>Darwinia calothamnoides</i> N G Marchant & Keighery ms Taxon 14369 is current. Conservation Status P1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
273	<i>Darwinia capitellata</i> Rye <i>Nuytsia</i> 4:423-426 (1983) Taxon 5306 is current.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
273	<i>Darwinia carnea</i> C. A. Gardner <i>J. Roy. Soc. Western Australia</i> 14:80 (1928) Taxon 5307 is current. Conservation Status R Common name: Mogumber Bell	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
273	<i>Darwinia chapmaniana</i> N G Marchant ms Taxon 14263 is current. Conservation Status R	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Document Done

THE EVOLUTION OF CALM'S WA HERBARIUM

In international terms, the Western Australian Herbarium was a late starter. Although the earliest surviving specimen was collected in 1801, more than twenty years before European settlement, it was not until the 1920s that formal documentation of the State's flora began. The State Collection was formed out of three existing collections: an economic collection of WA weeds and plants used by pastoralists, and poison plants to be avoided; a forestry collection; and a general museum collection.

Top (left and right): Look-alike bell 'flowers' Qualup bell (*Pimelea physodes*) and tulip bell (*Darwinia macrostegia*) from the Stirling Range belong to different plant families and have very different individual flowers within the bell. Photos - Babs & Bert Wells/CALM

Above: The Herbarium databases are accessed on one page of the web page 'FloraBase'. The current scientific name, synonyms and details of the original publication of the name are given.

Following World War II, the field of taxonomic botany declined, and herbaria the world over languished along with it. Most of the flora of the technologically



advanced countries was well known and advancing biotechnology appeared to be eclipsing the role of botanical science. However, its importance began to resurge in the 1970s with the recognition of the conservation value and pharmaceutical potential of plants in tropical and subtropical countries.

Today, the vast amounts of information stored in CALM's WA Herbarium have been recorded in an electronic database and are readily accessible to conservation scientists and planners (see *LANDSCOPE*, Winter 1995). The main database, WACENSUS, is a world-class information system

where there has been value-adding to an electronic list of names. Users can cross-refer to the actual specimen records, a map of where the species occurs and, where they are available, full colour images of the whole plant and a close-up of the leaves and flowers. This system is currently available to CALM researchers and is soon to be made accessible to subscribers over the Internet.

As well as sophisticated storage and retrieval systems, CALM botanists are now producing electronic guides to the flora of WA. A network of regional field herbaria are now linked to the State collection in a program to ensure that

information about the rich flora of WA can be accessed by Landcare and a number of other regional conservation groups. The main herbarium in south Perth has a parallel resource, a separate reference collection for the use of outside botanists. Each of the 11000 specimens in the reference collection is a duplicate of a fully labelled specimen in the main collection. In addition to the main reference collection, which is managed by volunteers, there are reference collections in Albany, Manjimup and Karratha, as well as almost 50 other smaller herbaria in centres ranging from Broome to Esperance.

A JOB NEVER FINISHED

Just as the process itself is timeless, the techniques of collecting and examining specimens remain largely unchanged from the past. Herbarium specimens are mounted on special thick paper and, after naming and labelling with field details, are stored in special cupboards. Each sample can be studied simply by examining the character of the leaves, or even the dry flowers, as well as the detailed notes on each label. When correctly prepared, even the specimen's flower colour can usually be maintained. Certainly, the features of leaves, stems, and flower parts—be they hairy, prickly or otherwise textured—are retained forever. For detailed study, an individual flower can be carefully removed and soaked in a little ordinary washing-up liquid, which will cause it to swell to the same size and shape as it was when it was fresh. Even though they are non-living, the minute parts can be measured, photographed or drawn, and the whole flower can be re-dried and placed back onto the herbarium sheet.

Above left and right: Specimens at CALM's WA Herbarium are stored in insect-free vaults. Related species are stored together and are readily accessible to researchers.

Photos – Neville Marchant

Left: The extensive heaths of low shrubs of WA are world-famous for their incredible diversity. Small areas have as many species as similar areas of the rich tropical rainforest of other countries.

Photo – Jiri Lochman





UNCHARTED BOTANICAL TERRITORY

CALM's WA Herbarium boasts hundreds of thousands of 'voucher' specimens, covering the plant kingdom from the lowly algae, fungi and lichens to the highly evolved and intricate orchids, triggerplants and everlastings. But the collection is only the beginning. Despite the renowned abundance of plant species in Western Australia—the south-west alone is one of the world's richest botanical areas, with an estimated 9000 species—it remains the only State without a published account of its flora. The flora of the Kimberley and metropolitan areas have been documented, but a vast amount of work remains. Botanists in WA have barely started to document organisms other than the flowering plants. Even though there are extensive collections of mosses, liverworts, algae and microfungi and their allies, an enormous task lies ahead in classifying them. The vascular plant flora, which includes the ferns, fern allies, pines, cycads and flowering plants, is still being documented and, judging by the number of new species being discovered, it will be many years before there is a representative list of species of WA.

FISH OR FLESH?

Taxonomy is the science of assigning a biological specimen to a series of ordinal classifications based on its observed characteristics. To begin with it may belong, for example, to either the plant or animal kingdom. As the observations become more detailed, the specimen is assigned to a phylum, class, order, family and, finally, to a genus and a species. So it is that taxonomists may end up describing a new species, and giving it a name.

The fact that WA is such a special place for native plants, widely



acclaimed for its abundance of species, particularly woody shrubs, makes classifying its botanical species particularly tricky. This flora has evolved in a harsh climate and many species of different families look superficially similar. Hundreds of shrubby species all have small needle-like leaves, any many others have similar looking flowers. This parallel evolution in harsh climatic conditions has created many types of plants, which, at a glance, appear to be the same, or closely related. To a trained eye, however, these look-alikes may have significant structural differences that set them far apart, and these differences may extend a long way up the taxonomic ranks. Such distinctions, which may seem minor on the surface, become extremely important in the face of the issues of conservation, land rehabilitation, and bio-prospecting.

Top left: A 'broth' of decomposing insect victims supplies nourishment to pitcher plants. These can grow in dense thickets without need for many roots to compete for space in the surface soil.

Top: Many of WA's species are unique and only distantly related to plants of other regions. The pitcher plant (*Cephalotus follicularis*) ranges from near Yallingup to east of Albany.

Above: CALM's WA Herbarium now has a comprehensive preserved collection of mosses and their allies. Fungi are widespread in WA and are increasingly becoming known as studies and collections increase.

Photos – Babs & Bert Wells/CALM

NAMING TROUBLES

A plant inventory is like a jigsaw puzzle with an infinite number of pieces. Any herbarium, ancient or modern, is part of a process of continual evolution and change, as more pieces of the puzzle—knowledge—becomes available.

KEEPING THE STATE COVERED

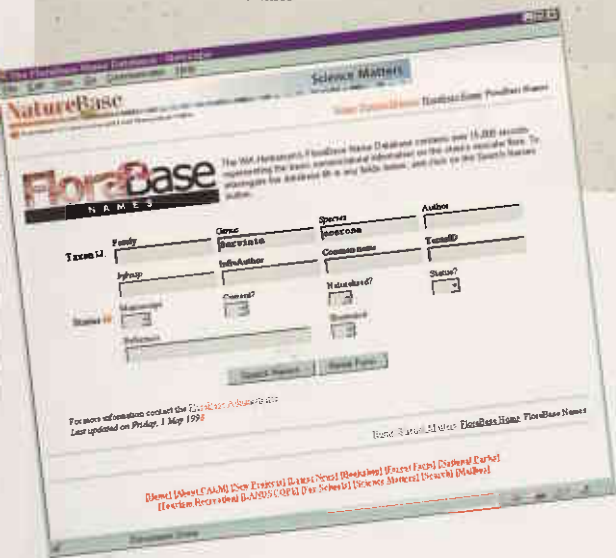
CALM's WA Herbarium receives duplicates from volunteer regional group plant collectors who have been trained to collect and label specimens. The label information includes the height and growth form of the plant, soil type, surrounding vegetation and any available observations on pollinators, salinity level of the site, logging history or fire history. Some regional groups send details on a computer disk and these are loaded into the appropriate herbarium databases. Once a specimen has been identified correctly by herbarium botanists, a printed label is returned to the country based group, labelled with a barcode identical to that on the parent specimen in the State collection. Through this system, affiliated country groups can keep abreast of any corrections to the original identification, and can also gain access to any name changes a particular species may have undergone.



Regional herbaria act as a local interactive resource. Landcare groups, for example, may use their local reference collection to find plant species that can grow in saline soils. Those concerned with managing remnant vegetation are documenting the species of reserves and roadsides. People interested in developing nature trails can collect the commonly seen, interesting species along the proposed route, and consult the collection to produce guided walks with botanical information. The potential uses of CALM's WA Herbarium and its allied regional resources are limitless.

Above: Taping specimens to special cards, affixing the correct label, and ensuring that fruits or seeds are added to the correct sheet, require painstaking effort. About 30 000 specimens are added to the collections each year. Photo - Neville Marchant

Below left: The FloraBase search screen is the starting point for searching for plant information.



specimen, and there are too many species in Western Australia for common names to be used with confidence.

Errors of identification and difficulties with the determination of the limits of genera and species can frequently result in name changes. Knowledge of the names of the WA flora

is rapidly advancing, and the accompanying rapid changes can make it difficult for researchers to keep up. Nomenclature, the branch of systematic botany concerned with naming procedures, is a precise and well-ordered discipline with strict internationally agreed rules. Name changes are not made frivolously. One of the biggest

challenges facing the taxonomist is the development of a classification system that groups related plants together. The WA Herbarium's computer systems enable users to keep up to date with name changes and additions to the inventory of the State's flora.

INTO THE FUTURE

The first botanists of the Middle Ages, with their pressings, were building a legacy for the generation to follow, and at CALM's WA Herbarium the tradition continues. The value of any herbarium is cumulative, through the ages, and the definitions and names and associations of different species change over time. Beneath the layers of state-of-the-art computer technology, which now makes the botanists' job easier, are two timeless scientific methods that will extend into perpetuity as far as they extend back into history: the gentle technique of specimen gathering and plant pressing, and the rigorous intellectual exercise of classification and nomenclature.

An important part of the WA Herbarium's recent resurrection is the recovery of early specimens sent abroad. Even in the first few decades of European settlement, thousands of specimens were sent to botanists and horticulturists overseas. Plans to repatriate numbers of these early samples are taking shape. A recent agreement between the WA Herbarium and those of Paris and Geneva will result in the exchange of valuable specimens collected by early French expeditions to WA as well as duplicates of the collections of colonial botanist James Drummond. Arrangements such as these mark the coming of age of CALM's WA Herbarium and the bright future for documenting our unique flora.

There are still many species yet to be discovered in Western Australia. In many cases, even where there are specimens of an unknown species available, botanists have insufficient information about its relationships and often only a superficial knowledge of variation. This sort of uncertainty makes it difficult to assign a reliable scientific name to a new

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LANDSCOPE

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'Conserving the western ringtail possum' tells a story of rehabilitation, release and repopulation.



Discover the fascinating world of 'Starfish, Urchins and their Relatives' on page 10.



'The Art of Interpretation' on page 36 discusses how interpreters use a variety of techniques to enrich our experiences.



What have rabbits done to our land and what have we done about them? Find out in 'Run, Rabbit' on page 49.



Learn about a study of life in the tropical mudflats of Roebuck Bay on page 16.

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