A story of data won, data lost and data re-found: the realities of ecological data preservation

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AUSTRALIA

with collaborators

Matt Bolton, Corymbia Ecospatial Consultants,

Lee Belbin, Atlas of Living Australia.

The story…

- In the beginning…
  - the advent of the big computer age: heralding new possibilities and vision for data manipulation
- Potential disaster! Risk of imminent data loss
- But rescue was in sight! someone cared…
  - A program of retrieval and recovery commenced
- This talk: what we learnt…how might this help others?

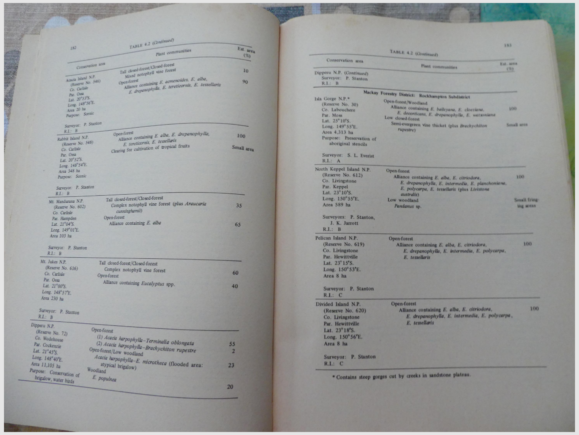

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TABLE 4.2 (*Continued*)

Conservation area	Plant communities	Est. area (%)
Acacia Island N.P. (Reserve No. 546) Co. Carlisle Par. Ossa Lat. 20°53′S. Long. 148°56′E. Area 20 ha Purpose: Scenic Surveyor: P. Stanton R.I.: B	Tall closed-forest/Closed-forest Mixed notophyll vine forest Open-forest Alliance containing *E. acmenoides, E. alba, E. drepanophylla, E. tereticornis, E. tessellaris*	 10 90
Rabbit Island N.P. (Reserve No. 548) Co. Carlisle Par. Ossa Lat. 20°52′S. Long. 148°54′E. Area 348 ha Purpose: Scenic Surveyor: P. Stanton R.I.: B	Open-forest Alliance containing *E. alba, E. drepanophylla, E. tereticornis, E. tessellaris* Clearing for cultivation of tropical fruits	 100 Small area
Mt. Mandurana N.P. (Reserve No. 602) Co. Carlisle Par. Hampden Lat. 21°04′S. Long. 149°01′E. Area 103 ha Surveyor: P. Stanton R.I.: B	Tall closed-forest/Closed-forest Complex notophyll vine forest (plus *Araucaria cunninghamii*) Open-forest Alliance containing *E. alba*	 35 65
Mt. Jukes N.P. (Reserve No. 616) Co. Carlisle Par. Ossa Lat. 21°00′S. Long. 148°57′E. Area 230 ha Surveyor: P. Stanton R.I.: B	Tall closed-forest/Closed-forest Complex notophyll vine forest Open-forest Alliance containing *Eucalyptus* spp.	 60 40
Dipperu N.P. (Reserve No. 72) Co. Wodehouse Par. Cockenzie Lat. 21°45′S. Long. 148°40′E. Area 11,105 ha Purpose: Conservation of brigalow, water birds	Open-forest (1) *Acacia harpophylla–Terminalia oblongata* (2) *Acacia harpophylla–Brachychiton rupestre* Open-forest/Low woodland *Acacia harpophylla–E. microtheca* (flooded area: atypical brigalow) Woodland *E. populnea*	 55 2 23 20

183

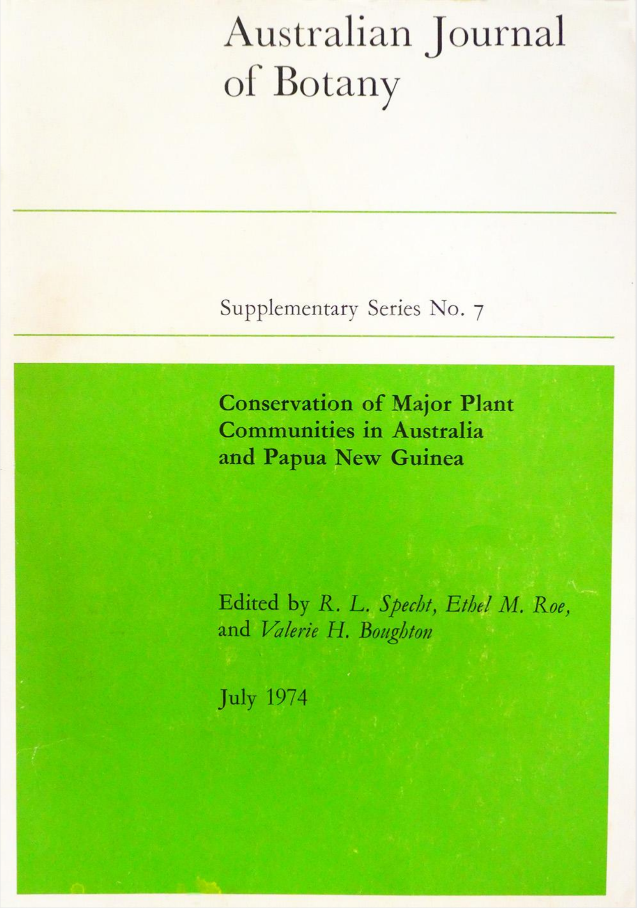
TABLE 4.2 (*Continued*)

Conservation area	Plant communities	Est. area (%)
Dipperu N.P. (*Continued*) Surveyor: P. Stanton R.I.: B		
	Mackay Forestry District: Rockhampton Subdistrict	
Isla Gorge N.P.* (Reserve No. 30) Co. Labouchere Par. Moss Lat. 25°10′S. Long. 149°55′E. Area 4,313 ha Purpose: Preservation of aboriginal stencils Surveyor: S. L. Everist R.I.: A	Open-forest/Woodland Alliance containing *E. baileyana, E. cloeziana, E. decorticans, E. drepanophylla, E. watsoniana* Low closed-forest Semi-evergreen vine thicket (plus *Brachychiton rupestre*)	 100 Small area
North Keppel Island N.P. (Reserve No. 612) Co. Livingstone Par. Keppel Lat. 23°10′S. Long. 150°55′E. Area 589 ha Surveyors: P. Stanton, J. K. Jarrott R.I.: B	Open-forest Alliance containing *E. alba, E. citriodora, E. drepanophylla, E. intermedia, E. planchoniana, E. polycarpa, E. tessellaris* (plus *Livistona australis*) Low woodland *Pandanus* sp.	 100 Small fringing areas
Pelican Island N.P. (Reserve No. 619) Co. Livingstone Par. Hewittville Lat. 23°15′S. Long. 150°53′E. Area 8 ha Surveyor: P. Stanton R.I.: C	Open-forest Alliance containing *E. alba, E. citriodora, E. drepanophylla, E. intermedia, E. polycarpa, E. tessellaris*	 100
Divided Island N.P. (Reserve No. 620) Co. Livingstone Par. Hewittville Lat. 23°18′S. Long. 150°56′E. Area 8 ha Surveyor: P. Stanton R.I.: C	Open-forest Alliance containing *E. alba, E. citriodora, E. drepanophylla, E. intermedia, E. polycarpa, E. tessellaris*	 100

* Contains steep gorges cut by creeks in sandstone plateau.

In the beginning – Phase 1

- Conservation of ecosystems and their biota demands knowledge: what are they composed of, how unique are they, where are they?
- In 1974 a conservation survey of Australian plant communities was published. This was based on expert opinion and although comprehensive and innovative, it was imbalanced as expertise varied across systems.



Australian Journal of Botany

Supplementary Series No. 7

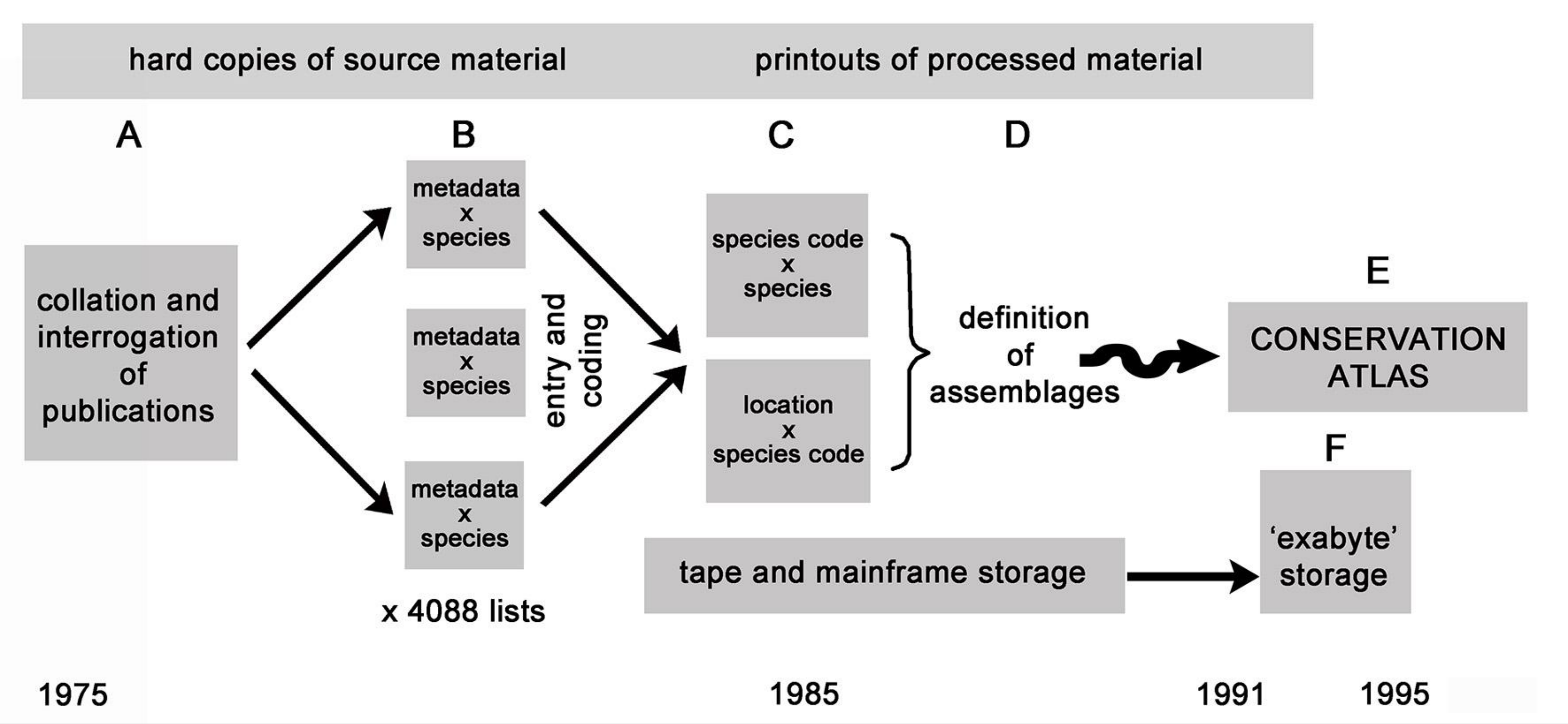
Conservation of Major Plant Communities in Australia and Papua New Guinea

Edited by *R. L. Specht, Ethel M. Roe,* and *Valerie H. Boughton*

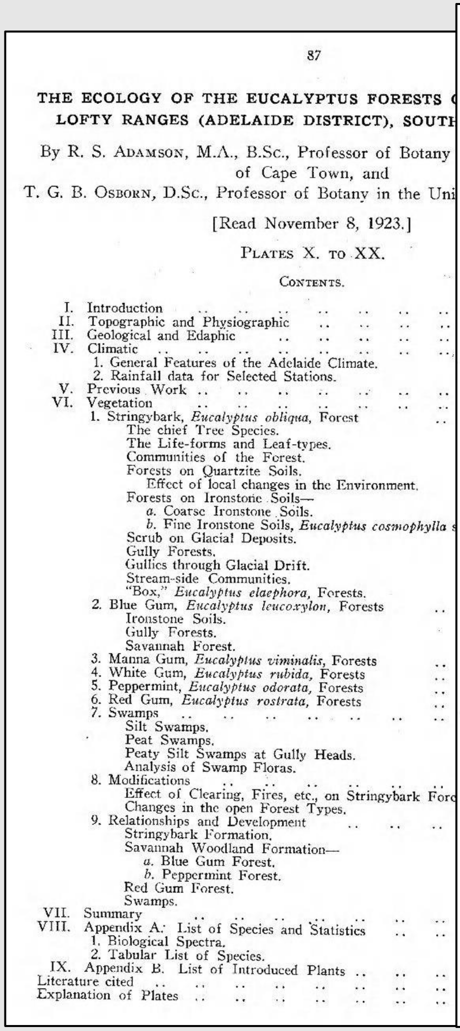
July 1974

In the beginning – Phase 2

- The advent of big computing meant an objective assessment could be made.
- Research project started, led by R.L. Specht



Collation and extraction of information from publications (A, B) for entry into computers



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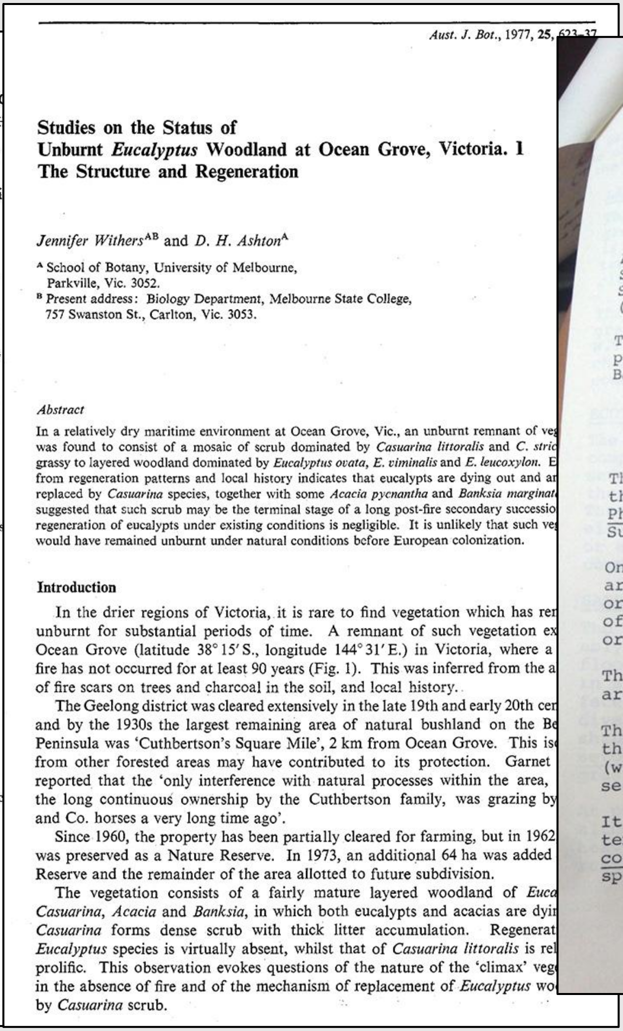
THE ECOLOGY OF THE EUCALYPTUS FORESTS O
LOFTY RANGES (ADELAIDE DISTRICT), SOUTH

By R. S. Adamson, M.A., B.Sc., Professor of Botany
of Cape Town, and
T. G. B. Osborn, D.Sc., Professor of Botany in the Uni

[Read November 8, 1923.]

Plates X. to XX.

Contents.



Aust. J. Bot., 1977, **25**, 623–37

Studies on the Status of Unburnt *Eucalyptus* Woodland at Ocean Grove, Victoria. 1 The Structure and Regeneration

Jennifer Withers[A B] and *D. H. Ashton*[A]

[A] School of Botany, University of Melbourne, Parkville, Vic. 3052.
[B] Present address: Biology Department, Melbourne State College, 757 Swanston St., Carlton, Vic. 3053.

Abstract

In a relatively dry maritime environment at Ocean Grove, Vic., an unburnt remnant of veg was found to consist of a mosaic of scrub dominated by *Casuarina littoralis* and *C. stric* grassy to layered woodland dominated by *Eucalyptus ovata*, *E. viminalis* and *E. leucoxylon*. E from regeneration patterns and local history indicates that eucalypts are dying out and ar replaced by *Casuarina* species, together with some *Acacia pycnantha* and *Banksia marginata* suggested that such scrub may be the terminal stage of a long post-fire secondary successio regeneration of eucalypts under existing conditions is negligible. It is unlikely that such veg would have remained unburnt under natural conditions before European colonization.

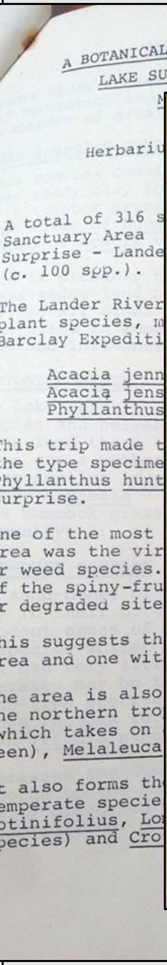
Introduction

In the drier regions of Victoria, it is rare to find vegetation which has rem unburnt for substantial periods of time. A remnant of such vegetation ex Ocean Grove (latitude 38° 15′ S., longitude 144° 31′ E.) in Victoria, where a fire has not occurred for at least 90 years (Fig. 1). This was inferred from the a of fire scars on trees and charcoal in the soil, and local history.

The Geelong district was cleared extensively in the late 19th and early 20th cen and by the 1930s the largest remaining area of natural bushland on the Be Peninsula was 'Cuthbertson's Square Mile', 2 km from Ocean Grove. This is from other forested areas may have contributed to its protection. Garnet reported that the 'only interference with natural processes within the area, the long continuous ownership by the Cuthbertson family, was grazing by and Co. horses a very long time ago'.

Since 1960, the property has been partially cleared for farming, but in 1962 was preserved as a Nature Reserve. In 1973, an additional 64 ha was added Reserve and the remainder of the area allotted to future subdivision.

The vegetation consists of a fairly mature layered woodland of *Euca Casuarina*, *Acacia* and *Banksia*, in which both eucalypts and acacias are dyin *Casuarina* forms dense scrub with thick litter accumulation. Regenerat *Eucalyptus* species is virtually absent, whilst that of *Casuarina littoralis* is rel prolific. This observation evokes questions of the nature of the 'climax' veg in the absence of fire and of the mechanism of replacement of *Eucalyptus* wo by *Casuarina* scrub.



A BOTANICAL SURVEY OF THE LANDER RIVER -
LAKE SURPRISE AREA, TANAMI DESERT

Herbariu

A total of 316 s
Sanctuary Area
Surprise - Lande
(c. 100 spp.).

The Lander River
plant species, m
Barclay Expediti

Acacia jenn
Acacia jens
Phyllanthus

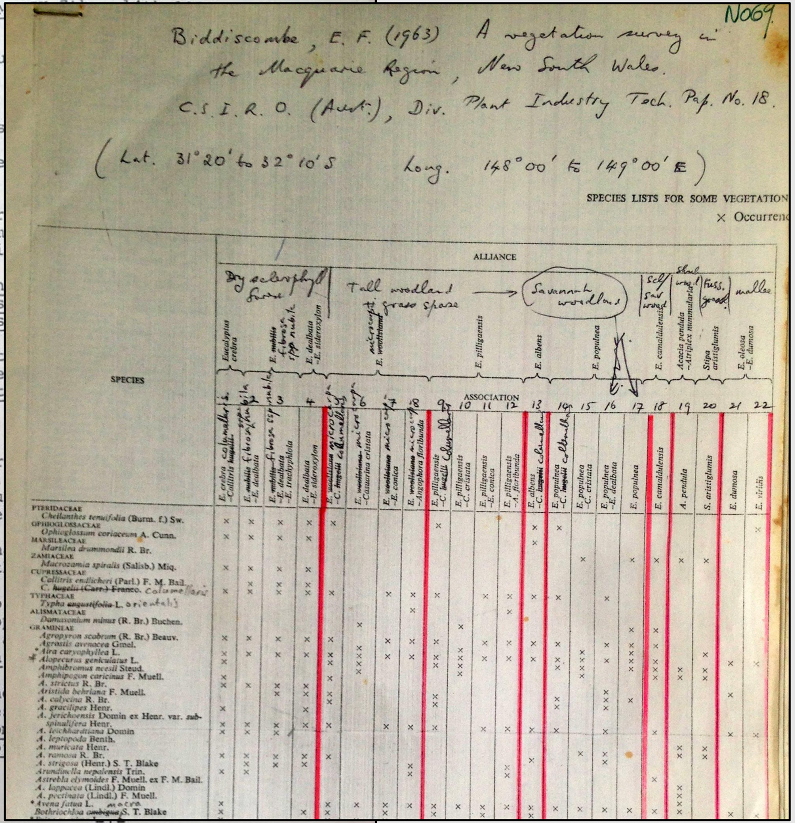
This trip made t
the type specime
Phyllanthus hunt
Surprise.

One of the most
area was the vir
or weed species.
of the spiny-fru
or degraded site

This suggests th
area and one wit

The area is also
the northern tro
(which takes on
seen), Melaleuca

It also forms th
temperate specie
cotinifolius, Lo
species) and Cro



No69

Biddiscombe, E. F. (1963) A vegetation survey in the Macquarie Region, New South Wales.
C.S.I.R.O. (Aust.), Div. Plant Industry Tech. Pap. No. 18.

(Lat. 31°20′ to 32°10′S Long. 148°00′ to 149°00′E)

SPECIES LISTS FOR SOME VEGETATION

× Occurrenc

ALLIANCE

Dry sclerophyll forest | Tall woodland → grass sparse | Savannah woodland | Scl/Sav wood | Shrub wood | Fuss. grass | mallee

Eucalyptus crebra; E. ~~nubilis~~ fibrosa spp nubila; E. dealbata –E. sideroxylon; microcarpa E. ~~woollsiana~~; E. pilligaensis; E. albens; E. populnea; E. camaldulensis; Acacia pendula –Atriplex nummularia; Stipa aristiglumis; E. oleosa –E. dumosa

SPECIES

ASSOCIATION

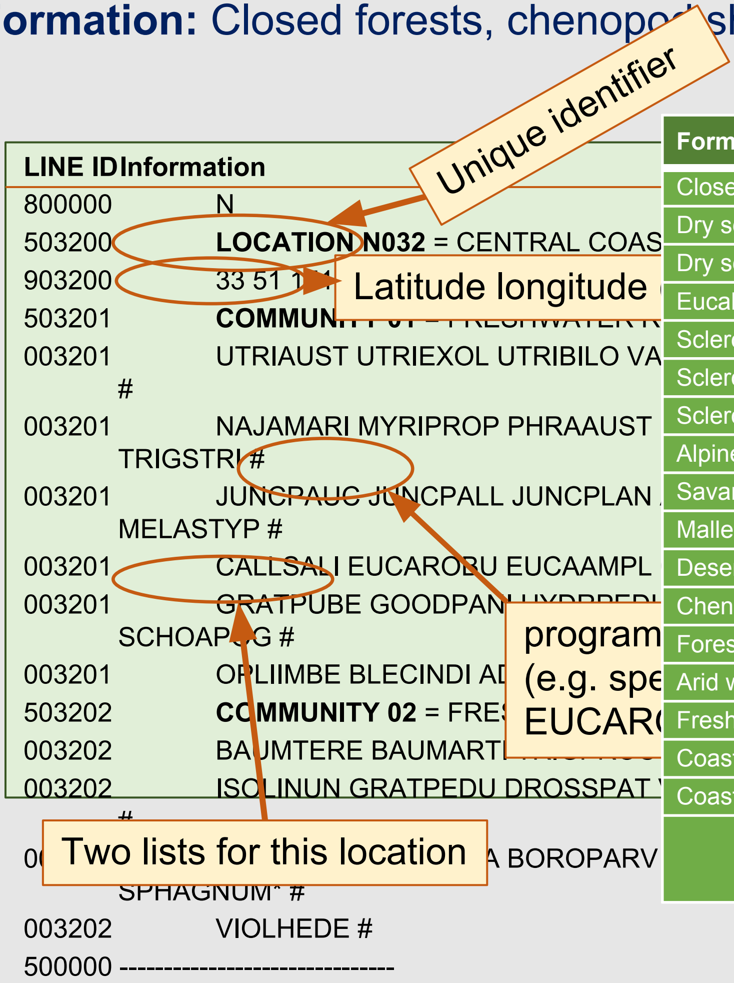
1 E. crebra –Callitris ~~hugelii~~ columellaris; 2 E. ~~nubilis~~ fibrosa spp. nubila –E. dealbata; 3 E. ~~nubilis~~ fibrosa ssp nubila –E. dealbata –E. trachyphlola; 4 E. dealbata –E. sideroxylon; 5 E. ~~woollsiana~~ microcarpa –C. ~~hugelii~~ columellaris; 6 E. ~~woollsiana~~ microcarpa –Casuarina cristata; 7 E. ~~woollsiana~~ microcarpa –E. conica; 8 E. ~~woollsiana~~ microcarpa –Angophora floribunda; 9 E. pilligaensis –C. ~~hugelii~~ columellaris; 10 E. pilligaensis –C. cristata; 11 E. pilligaensis –E. conica; 12 E. pilligaensis –A. floribunda; 13 E. albens –C. ~~hugelii~~ columellaris; 14 E. populnea –C. ~~hugelii~~ columellaris; 15 E. populnea –C. cristata; 16 E. populnea –E. dealbata; 17 E. populnea; 18 E. camaldulensis; 19 A. pendula; 20 S. aristiglumis; 21 E. dumosa; 22 E. viridis

PTERIDACEAE
Cheilanthes tenuifolia (Burm. f.) Sw.
OPHIOGLOSSACEAE
Ophioglossum coriaceum A. Cunn.
MARSILEACEAE
Marsilea drummondii R. Br.
ZAMIACEAE
Macrozamia spiralis (Salisb.) Miq.
CUPRESSACEAE
Callitris endlicheri (Parl.) F. M. Bail.
C. ~~*hugelii* (Carr.) Franco.~~ columellaris
TYPHACEAE
Typha ~~*angustifolia*~~ L. orientalis
ALISMATACEAE
Damasonium minus (R. Br.) Buchen.
GRAMINEAE
Agropyron scabrum (R. Br.) Beauv.
Agrostis avenacea Gmel.
* *Aira caryophyllea* L.
* *Alopecurus geniculatus* L.
Amphibromus neesii Steud.
Amphipogon caricinus F. Muell.
A. strictus R. Br.
Aristida behriana F. Muell.
A. calycina R. Br.
A. gracilipes Henr.
A. jerichoensis Domin ex Henr. var. *subspinulifera* Henr.
A. leichhardtiana Domin
A. leptopoda Benth.
A. muricata Henr.
A. ramosa R. Br.
A. strigosa (Henr.) S. T. Blake
Arundinella nepalensis Trin.
Astrebla elymoides F. Muell. ex F. M. Bail.
A. lappacea (Lindl.) Domin
A. pectinata (Lindl.) F. Muell.
* *Avena fatua* L. macro
Bothriochloa ~~*ambigua*~~ S. T. Blake

Data organization and entry (B & C)

Due to computing capacity, the data were organized into state x formation datasets to be read by FORTRAN programmes.

State: N = New South Wales, V = Victoria, T = Tasmania etc.
Formation: Closed forests, chenopod shrubland, desert acacia etc.



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LINE IDInformation
800000          N
503200          LOCATION N032 = CENTRAL COAS
903200          33 51 1
503201          COMMUN
003201          UTRIAUST UTRIEXOL UTRIBILO VA
        #
003201          NAJAMARI MYRIPROP PHRAAUST
        TRIGSTRI #
003201          JUNCPAUC JUNCPALL JUNCPLAN
        MELASTYP #
003201          CALLSALI EUCAROBU EUCAAMPL
003201          GRATPUBE GOODPAN
        SCHOAP G #
003201          OPLIIMBE BLECINDI AD
503202          COMMUNITY 02 = FRES
003202          BAUMTERE BAUMART
003202          ISOLINUN GRATPEDU DROSSPAT
        #
00                                 A BOROPARV
        SPHAGNUM* #
003202          VIOLHEDE #
500000 --------------------------------
```

Unique identifier

Latitude longitude

program
(e.g. spe
EUCAR

Two lists for this location

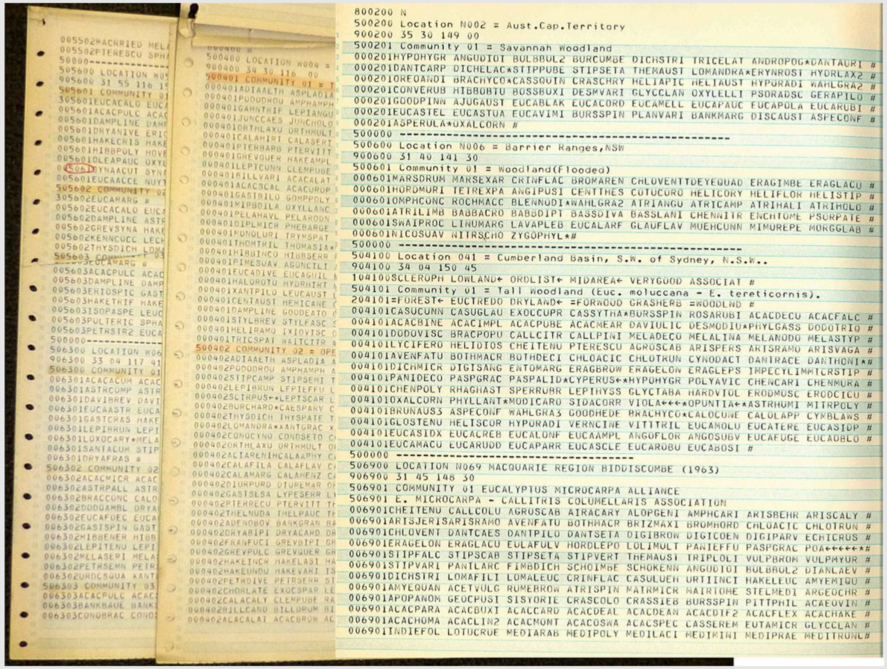
Formation	Locations	Communities	Species*
Closed forests	n/a	644	1,418
Dry scrubs – SE Queensland	232	232	475
Dry scrubs – Northern Territory	n/a	1,219	559
Eucalypt open-forests and woodlands (tree species)	201	1,275	276
Sclerophyll vegetation SW Western Australia	64	172	1,761
Sclerophyll vegetation Central and Eastern Australia	188	549	2,581**
Sclerophyll vegetation – heathland and tall shrubland	136	312	2,071**
Alpine vegetation	73	61	556
Savanna understorey	56	198	1,313
Mallee open-scrub	28	41	395
Desert Acacia	54	148	1,229
Chenopod shrubland	30	68	410
Forested wetlands (including brigalow)	31	36	193
Arid wetlands	20	42	642
Freshwater swamp vegetation	80	80	139
Coastal dune vegetation	45	56	315
Coastal wetland vegetation (mangroves and saltmarshes)	n/a	15	74

* Not including introduced species or singletons within the formation.
** Not including tree species > 10m tall

Data

- **Entry and storage**
  - Punch cards then desktop computers were used for data entry to UQ’s PDP-10. 9-track magnetic tapes used as regular backup.

- **For analysis**
  - Analysis on CSIRONET mainframe computer (TAXON & TWINSPAN).
  - Hard copies (as in print-outs for proofing and run outputs) obtained throughout.



```
800200 N
500200 Location N002 = Aust.Cap.Territory
900200 35 30 149 00
500201 Community 01 = Savannah Woodland
000201HYPOHYGR ANGUDIOI BULBBUL2 BURCUMBE DICHSTRI TRICELAT ANDROPOG*DANTAURI #
000201DANTCARP DICHELAC*STIPPUBE STIPSETA THEMAUST LOMANDRA*ERYNROST HYDRLAX2 #
000201OREOANDI BRACHYCO*CASSQUIN CRASCHRY HELIAPIC HELIAUST HYPORADI WAHLGRA2 #
000201CONVERUB HIBBOBTU BOSSBUXI DESMVARI GLYCCLAN OXYLELLI PSORADSC GERAPILO #
000201GOODPINN AJUGAUST EUCABLAK EUCACORD EUCAMELL EUCAPAUC EUCAPOLA EUCARUBI #
000201EUCASTEL EUCASTUA EUCAVIMI BURSSPIN PLANVARI BANKMARG DISCAUST ASPECONF #
000201ASPERULA*OXALCORN #
500000 ------------------------------------------------------------
500600 Location N006 = Barrier Ranges,NSW
900600 31 40 141 30
500601 Community 01 = Woodland(Flooded)
000601MARSDRUM MARSEXAR CRINFLAC BROMAREN CHLOVENTTDEYEQUAD ERAGIMBE ERAGLACU #
000601HORDMURI TETREXPA ANGIPUSI CENTTHES COTUCORO HELICORY HELIFLOR HELISTIP #
000601OMPHCONC ROCHMACC BLENNODI*WAHLGRA2 ATRIANGU ATRICAMP ATRIHALI ATRIHOLO #
000601ATRILIMB BABBACRO BABBDIPT BASSDIVA BASSLANI CHENNITR ENCHTOME PSORPATE #
000601SWAIPROC LINUMARG LAVAPLEB EUCALARF GLAUFLAV MUEHCUNN MIMUREPE MORGGLAB #
000601NICOSUAV NITRSCHO ZYGOPHYL*#
500000 -------------------------------------------------------------
504100 Location 041 = Cumberland Basin, S.W. of Sydney, N.S.W..
904100 34 04 150 45
104100SCLEROPH LOWLAND← ORDLIST← MIDAREA← VERYGOOD ASSOCIAT #
504101 Community 01 = Tall Woodland (Euc. moluccana - E. tereticornis).
204101=FOREST← EUCTREDO DRYLAND← =FORWOOD GRASHERB =WOODLND #
004101CASUCUNN CASUGLAU EXOCCUPR CASSYTHA*BURSSPIN ROSARUBI ACACDECU ACACFALC #
004101ACACBINE ACACIMPL ACACPUBE ACACMEAR DAVIULIC DESMODIU*PHYLGASS DODOTRIQ #
004101DODOVISC BRACPOPU CALLCITR CALLPINI MELADECO MELALINA MELANODO MELASTYP #
004101LYCIFERO HELIDIOS CHEITENU PTERESCU AGROSCAB ARISPERS ARISRAMO ARISVAGA #
004101AVENFATU BOTHMACR BOTHDECI CHLOACIC CHLOTRUN CYNODACT DANIRACE DANTHONI*#
004101DICHMICR DIGISANG ENTOMARG ERAGBROW ERAGELON ERAGLEPS IMPECYLIMMICRSTIP #
004101PANIDECO PASPGRAC PASPALID*CYPERUS←*HYPOHYGR POLYAVIC CHENCARI CHENMURA #
004101CHENPOLY RHAGHAST SPERRUBR LEPIHYSS GLYCTABA HARDVIOL ERODMUSC ERODCICU #
004101OXALCORN PHYLLANT*MODICARO SIDACORR VIOLA←←←*OPUNTIA←*ASTRHUMI MITRPOLY #
004101BRUNAUS3 ASPECONF WAHLGRA3 GOODHEDE BRACHYCO*CALOCUNE CALOLAPP CYMBLAWS #
004101GLOSTENU HELISCOR HYPORADI VERNCINE VITITRIL EUCAMOLU EUCATERE EUCASIDP #
004101EUCASIDX EUCACREB EUCALONF EUCAAMPL ANGOFLOR ANGOSUBV EUCAFUGE EUCADBLO #
004101EUCAMACU EUCARUDD EUCAPARR EUCASCLE EUCAROBU EUCABOSI #
500000 ---------------------------------------
506900 LOCATION N069 MACQUARIE REGION BIDDISCOMBE (1963)
906900 31 45 148 30
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506901 E. MICROCARPA - CALLITRIS COLUMELLARIS ASSOCIATION
006901CHEITENU CALLCOLU AGROSCAB AIRACARY ALOPGENI AMPHCARI ARISBEHR ARISCALY #
006901ARISJERISARISRAMO AVENFATU BOTHMACR BRIZMAXI BROMHORD CHLOACIC CHLOTRUN #
006901CHLOVENT DANTCAES DANTPILO DANTSETA DIGIBROW DIGICOEN DIGIPARV ECHICRUS #
006901ERAGELON ERAGLACU EULAFULV HORDLEPO LOLIMULT PANIEFFU PASPGRAC POA←←←←←*#
006901STIPFALC STIPSCAB STIPSETA STIPVERT THEMAUST TRIPLOLI VULPBROM VULPMYUR #
006901STIPVARI PANILARC FIMBDICH SCHOIMBE SCHOKENN ANGUDIOI BULBBUL2 DIANLAEV #
006901DICHSTRI LOMAFILI LOMALEUC CRINFLAC CASULUEH URTIINCI HAKELEUC AMYEMIQU #
006901AMYEQUAN ACETVULG RUMEBROW ATRISPIN MAIRMICR MAIRTOME STELMEDI ARGEOCHR #
006901APOPANOM GEOCPUSI SISYORIE CRASCOLO CRASSIEB BURSSPIN PITTPHIL ACAEOVIN #
006901ACACPARA ACACBUXI ACACCARD ACACDEAL ACACDEAN ACACDIF2 ACACFLEX ACACHAKE #
006901ACACHOMA ACACLIN2 ACACMONT ACACOSWA ACACSPEC CASSEREM EUTAMICR GLYCCLAN #
006901INDIEFOL LOTUCRUE MEDIARAB MEDIPOLY MEDILACI MEDIMINI MEDIPRAE MEDITRUNL#
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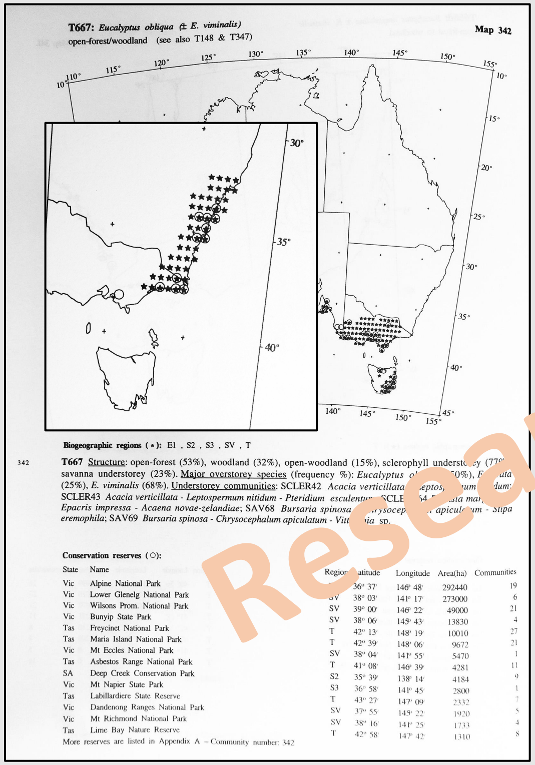
- **Data processing**
  - Described in a procedures manual (CAVE: Bolton)

Product (D & E): 911 objectively-defined plant communities, mapped, keys for their identification, their conservation status, and biogeographic regionalization…

Research project achieved



T667: *Eucalyptus obliqua* (± *E. viminalis*)
open-forest/woodland (see also T148 & T347)

Map 342

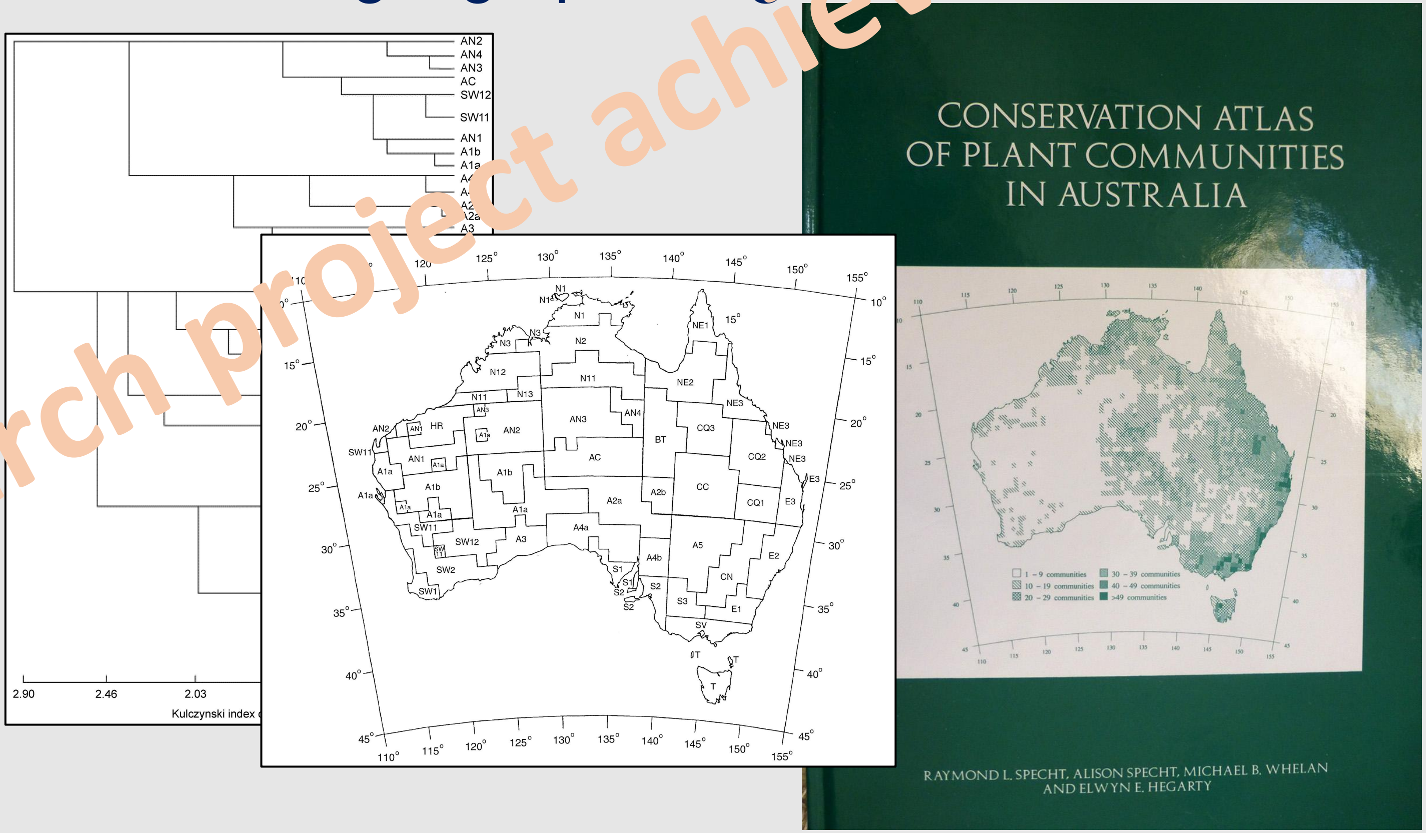
Biogeographic regions (⋆): E1 , S2 , S3 , SV , T

342 **T667** Structure: open-forest (53%), woodland (32%), open-woodland (15%), sclerophyll understo[illegible]ey (77[illegible] savanna understorey (23%). Major overstorey species (frequency %): *Eucalyptus o*[illegible]50%), *E*[illegible]*ata* (25%), *E. viminalis* (68%). Understorey communities: SCLER42 *Acacia verticillata* [illegible]*eptos*[illegible]*um* [illegible]*dum*: SCLER43 *Acacia verticillata - Leptospermum nitidum - Pteridium esculentu*[illegible] SCLE[illegible]64 [illegible]*sia mar*[illegible] *Epacris impressa - Acaena novae-zelandiae*; SAV68 *Bursaria spinosa* [illegible]*rysocep*[illegible] *apicul*[illegible]*um - Stipa eremophila*; SAV69 *Bursaria spinosa - Chrysocephalum apiculatum - Vitt*[illegible]*ia* sp.

Conservation reserves (○):

State	Name	Region	Latitude	Longitude	Area(ha)	Communities
Vic	Alpine National Park	[illegible]	36° 37′	146° 48′	292440	19
Vic	Lower Glenelg National Park	SV	38° 03′	141° 17′	273000	6
Vic	Wilsons Prom. National Park	SV	39° 00′	146° 22′	49000	21
Vic	Bunyip State Park	SV	38° 06′	145° 43′	13830	4
Tas	Freycinet National Park	T	42° 13′	148° 19′	10010	27
Tas	Maria Island National Park	T	42° 39′	148° 06′	9672	21
Vic	Mt Eccles National Park	SV	38° 04′	141° 55′	5470	1
Tas	Asbestos Range National Park	T	41° 08′	146° 39′	4281	11
SA	Deep Creek Conservation Park	S2	35° 39′	138° 14′	4184	9
Vic	Mt Napier State Park	S3	36° 58′	141° 45′	2800	1
Tas	Labillardiere State Reserve	T	43° 27′	147° 09′	2332	7
Vic	Dandenong Ranges National Park	SV	37° 55′	145° 22′	1920	5
Vic	Mt Richmond National Park	SV	38° 16′	141° 25′	1733	4
Tas	Lime Bay Nature Reserve	T	42° 58′	147° 42′	1310	8

More reserves are listed in Appendix A – Community number: 342



Specht R.L.. and Specht A. (2013) Australia: Biodiversity of Ecosystems. In, *The Encyclopedia of Biodiversity* Vol. 1 (ed. B. Levin, et al.) pp 291-306. Waltham, MA: Academic Press.

Specht R.L. and Specht A. (2002) Objective classification of plant communities in tropical and subtropical Australia. *Proceedings of the Royal Society of Queensland* 110: 65-82.

But what about the data?

- The primary objective of phase 2 was the research, secondarily to find a home for public access.
- In 1995 there was no ‘home’, so the data were ‘saved’ on the magnetic tapes and subsequently exabyte tapes when the main frame reader was de-commissioned. The print-outs were conserved.
- High-level data for biogeographical analysis (by PATN) was saved on excel
- *So there they sat…until someone cared…*

Why should we care?

Value proposition

These are heritage data. They were collected on field trips from 1879-1989, and provide unique records for comparison.

Repeating initial project work would be painful, if not impossible

Opportunities in the 2010s

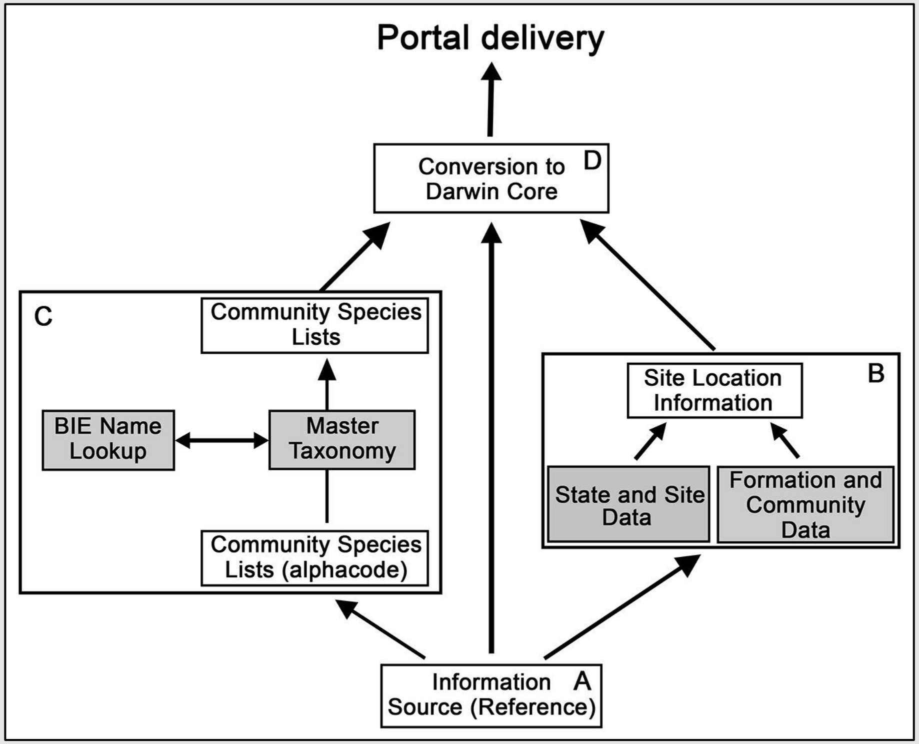
new data repositories were emerging; the Terrestrial Ecosystem Research Network (TERN) and the Atlas of Living Australia (ALA) linked globally to DataONE, GBIF, KNB etc

AND, key members of the team were still alive, personally invested and new team members identified.

□ ***Can we save the data and finally make it available?***

Retrieval – with support from TERN and the ALA

- Recover available data
- Design an appropriate structure
- Update the species codes/names to current nomenclature
- Update georeferencing and check errors
- Map the fields used in the Conservation Atlas project to the Darwin Core standard
- Deliver the data in an open repository

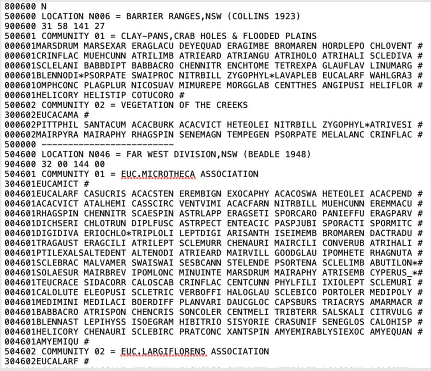

Portal delivery
Conversion to Darwin Core
D
C
Community Species Lists
BIE Name Lookup
Master Taxonomy
Community Species Lists (alphacode)
Site Location Information
B
State and Site Data
Formation and Community Data
Information Source (Reference)
A

Terrestrial Ecosystem Research Network

Recover available data

- As mentioned, the data were moved from mag. tapes to exabyte tapes in 1991
- **Challenge: (a)** find exabyte tapes, and **(b)** an exabyte tape reader.

- Started on the print-outs:
  - Master sites file (location, formation & community data)
  - Reference file (source data)



```
800600 N
500600 LOCATION N006 = BARRIER RANGES,NSW (COLLINS 1923)
900600 31 58 141 27
500601 COMMUNITY 01 = CLAY-PANS,CRAB HOLES & FLOODED PLAINS
000601MARSDRUM MARSEXAR ERAGLACU DEYEQUAD ERAGIMBE BROMAREN HORDLEPO CHLOVENT #
000601CRINFLAC MUEHCUNN ATRILIMB ATRIEARD ATRIANGU ATRIHOLO ATRIHALI SCLEDIVA #
000601SCLELANI BABBDIPT BABBACRO CHENNITR ENCHTOME TETREXPA GLAUFLAV LINUMARG #
000601BLENNODI*PSORPATE SWAIPROC NITRBILL ZYGOPHYL*LAVAPLEB EUCALARF WAHLGRA3 #
000601OMPHCONC PLAGPLUR NICOSUAV MIMUREPE MORGGLAB CENTTHES ANGIPUSI HELIFLOR #
000601HELICORY HELISTIP COTUCORO #
500602 COMMUNITY 02 = VEGETATION OF THE CREEKS
300602EUCACAMA #
000602PITTPHIL SANTACUM ACACBURK ACACVICT HETEOLEI NITRBILL ZYGOPHYL*ATRIVESI #
000602MAIRPYRA MAIRAPHY RHAGSPIN SENEMAGN TEMPEGEN PSORPATE MELALANC CRINFLAC #
500000 ------------------------
504600 LOCATION N046 = FAR WEST DIVISION,NSW (BEADLE 1948)
904600 32 00 144 00
504601 COMMUNITY 01 = EUC.MICROTHECA ASSOCIATION
304601EUCAMICT #
004601EUCALARF CASUCRIS ACACSTEN EREMBIGN EXOCAPHY ACACOSWA HETEOLEI ACACPEND #
004601ACACVICT ATALHEMI CASSCIRC VENTVIMI ACACFARN NITRBILL MUEHCUNN EREMMACU #
004601RHAGSPIN CHENNITR SCAESPIN ASTRLAPP ERAGSETI SPORCARO PANIEFFU ERAGPARV #
004601DICHSERI CHLOTRUN DIPLFUSC ASTRPECT ENTEACIC PASPJUBI SPORACTI SPORMITC #
004601DIGIDIVA ERIOCHLO*TRIPLOLI LEPTDIGI ARISANTH ISEIMEMB BROMAREN DACTRADU #
004601TRAGAUST ERAGCILI ATRILEPT SCLEMURR CHENAURI MAIRCILI CONVERUB ATRIHALI #
004601PTILEXALSALTEDENT ALTENODI ATRIEARD MAIRVILL GOODGLAU IPOMHETE RHAGNUTA #
004601SCLEBRAC MALVAMER SWAISWAI SESBCANN STELENDE PSORTENA SCLELIMB ABUTILON*#
004601SOLAESUR MAIRBREV IPOMLONC MINUINTE MARSDRUM MAIRAPHY ATRISEMB CYPERUS_*#
004601TEUCRACE SIDACORR CALOSCAB CRINFLAC CENTCUNN PHYLFILI IXIOLEPT SCLEMURI #
004601CALOLUTE ELEOPUSI SCLETRIC VERBOFFI HALOGLAU SCLEBICO PORTOLER MEDIPOLY #
004601MEDIMINI MEDILACI BOERDIFF PLANVARI DAUCGLOC CAPSBURS TRIACRYS AMARMACR #
004601BABBACRO ATRISPON CHENCRIS SONCOLER CENTMELI TRIBTERR SALSKALI CITRVULG #
004601BLENNAST LEPIHYSS ISOEGRAM HIBITRIO SISYORIE CRASUNIF SENEGLOS CALOHISP #
004601HELICORY CHENAURI SCLEBIRC PRATCONC XANTSPIN AMYEMIRABLYSIEXOC AMYEQUAN #
004601AMYEMIQU #
504602 COMMUNITY 02 = EUC.LARGIFLORENS ASSOCIATION
304602EUCALARF #
```

- Finally, the last exabyte tape reader in captivity was found (and about to be de-commissioned)!
- Two major challenges remained: updating georeferences and species names

Master sites file

From original printouts (slightly updated)

1. The formation, location and community number (1,2 etc)
2. Locality: general description (soil type, landscape etc)
3. The source reference (link to reference file)
4. Latitude and longitude (degrees minutes)
5. Broad community description
6. Additional information such as dominant species or association
7. Notes

From retrieval team

8. Decimal latitude and longitude
9. Coordinate uncertainty in metres
10. Comments (using a consistent vocabulary)

Reference file

ID	Author(s)	Date	Title	Journal etc.	Volume No.	Page numbers
1	Abbott, J.	1977	Species richness, turnover and equilibrium in insular floras near Perth, Western Australia.	Aust. J. Bot.	25	193-208
8	Adams, L. D. & Craven, L. A.	1976	Checklist of vascular plants in a study area of the South Coast of N.S.W.	C.S.I.R.O. Land Use Res. Tech. Mem.	76/16	
387	McMahon, A.R.G., Carr, G.W., Todd, J.A. & Race, G.J.	1990	The Conservation Status of Major Plant Communities in Australia: Victoria.	Ecological Horticulture Pty Ltd, Clifton Hill, Vic.		
474	Pye, K.	1982	Morphology and sediments of the Ramsay Bay sand dunes, Hinchinbrook Island, North Queensland.	Proc. R. Soc. Qld	93	31-47
560	Tate, R.	1880	On the geological and botanical features of southern Yorke Peninsula, South Australia.	Trans. R. Soc. S. Aust.	13	112-120
705	Willis, J.H.	1967	Systematic arrangement of vascular plants noted on the slopes and summit of the peak: The Rocks Nature Reserve, New South Wales.	Nat. Pks & Wildl. Serv., N.S.W.	705	

Georeferences

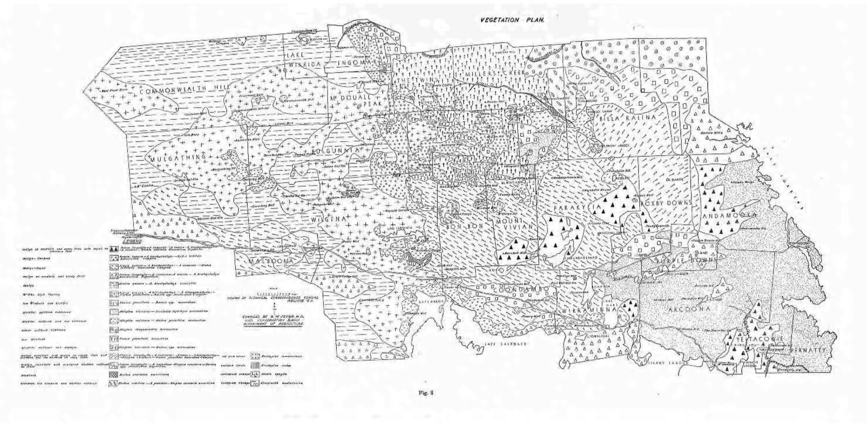
Original locations were accurate to half a degree which was unacceptable in the present day so the team did four things:

- Reviewed original documents and where possible contacted authors to update locations
- Checked locations on google maps
- Checked locations on the ALA's Spatial Portal so vegetation and soil type could be displayed for checking
- Mapped data repeatedly on the ALA sandbox site.

Co-ordinate precision was then estimated to reflect confidence in the range of the community.

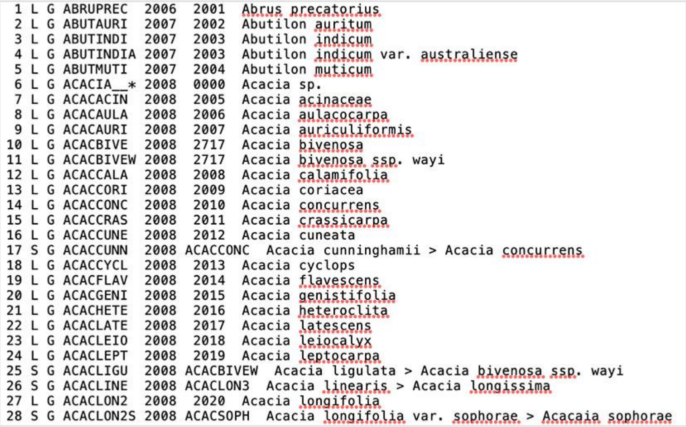
On-line resources such as the Biodiversity Heritage Library, the National Library of Australia

Original articles



Maps in Appendices often not scanned in digital copies of old journals

Species names



```
 1 L G ABRUPREC  2006  2001  Abrus precatorius
 2 L G ABUTAURI  2007  2002  Abutilon auritum
 3 L G ABUTINDI  2007  2003  Abutilon indicum
 4 L G ABUTINDIA 2007  2003  Abutilon indicum var. australiense
 5 L G ABUTMUTI  2007  2004  Abutilon muticum
 6 L G ACACIA__* 2008  0000  Acacia sp.
 7 L G ACACACIN  2008  2005  Acacia acinaceae
 8 L G ACACAULA  2008  2006  Acacia aulacocarpa
 9 L G ACACAURI  2008  2007  Acacia auriculiformis
10 L G ACACBIVE  2008  2717  Acacia bivenosa
11 L G ACACBIVEW 2008  2717  Acacia bivenosa ssp. wayi
12 L G ACACCALA  2008  2008  Acacia calamifolia
13 L G ACACCORI  2008  2009  Acacia coriacea
14 L G ACACCONC  2008  2010  Acacia concurrens
15 L G ACACCRAS  2008  2011  Acacia crassicarpa
16 L G ACACCUNE  2008  2012  Acacia cuneata
17 S G ACACCUNN  2008 ACACCONC  Acacia cunninghamii > Acacia concurrens
18 L G ACACCYCL  2008  2013  Acacia cyclops
19 L G ACACFLAV  2008  2014  Acacia flavescens
20 L G ACACGENI  2008  2015  Acacia genistifolia
21 L G ACACHETE  2008  2016  Acacia heteroclita
22 L G ACACLATE  2008  2017  Acacia latescens
23 L G ACACLEIO  2008  2018  Acacia leiocalyx
24 L G ACACLEPT  2008  2019  Acacia leptocarpa
25 S G ACACLIGU  2008 ACACBIVEW  Acacia ligulata > Acacia bivenosa ssp. wayi
26 S G ACACLINE  2008 ACACLON3  Acacia linearis > Acacia longissima
27 L G ACACLON2  2008  2020  Acacia longifolia
28 S G ACACLON2S 2008 ACACSOPH  Acacia longifolia var. sophorae > Acacaia sophorae
```

1. CODES to NAMES

- apply master species conversion file
- blend across formations (with caution as some species names are location- and formation-specific)

Sequential row number	Validity and Growth habit flag	species code	Original scientific name	Scientific names updated during Conservation Atlas project
2	L G	ABELMOSC	Abelmoschus moschatus	
19	LMG	ACACARGY	Acacia argyrodendron	
20	SZG	ACACARMA -> ACACPARA	Acacia armata	Acacia paradoxa
21	MLG	ACACASHA -> ACACOSHA	Acacia ashanesii	Acacia oshanesii
174	S G	ACAKEMP	Acacia sp. aff. A. sibirica	Acacia sp. aff. A. kempeana
466	S G	BORRCARP/ -> SPERSTEN/	Borreria sp. aff. carpentariae	Spermacoce sp. aff. stenophylla
704	S G	CARPAEQU -> CARPMODE	Carpobrotus aequilaterus	Carpobrotus modestus
705	L G	CARPMODE	Carpobrotus modestus	

Update to current nomenclature

Stage 1. Current name check

Due to the size of the data set, the Atlas of Living Australia web service lookup (BIE) was employed, with codes allocated for follow-up (or not).

Stage 2. Validation

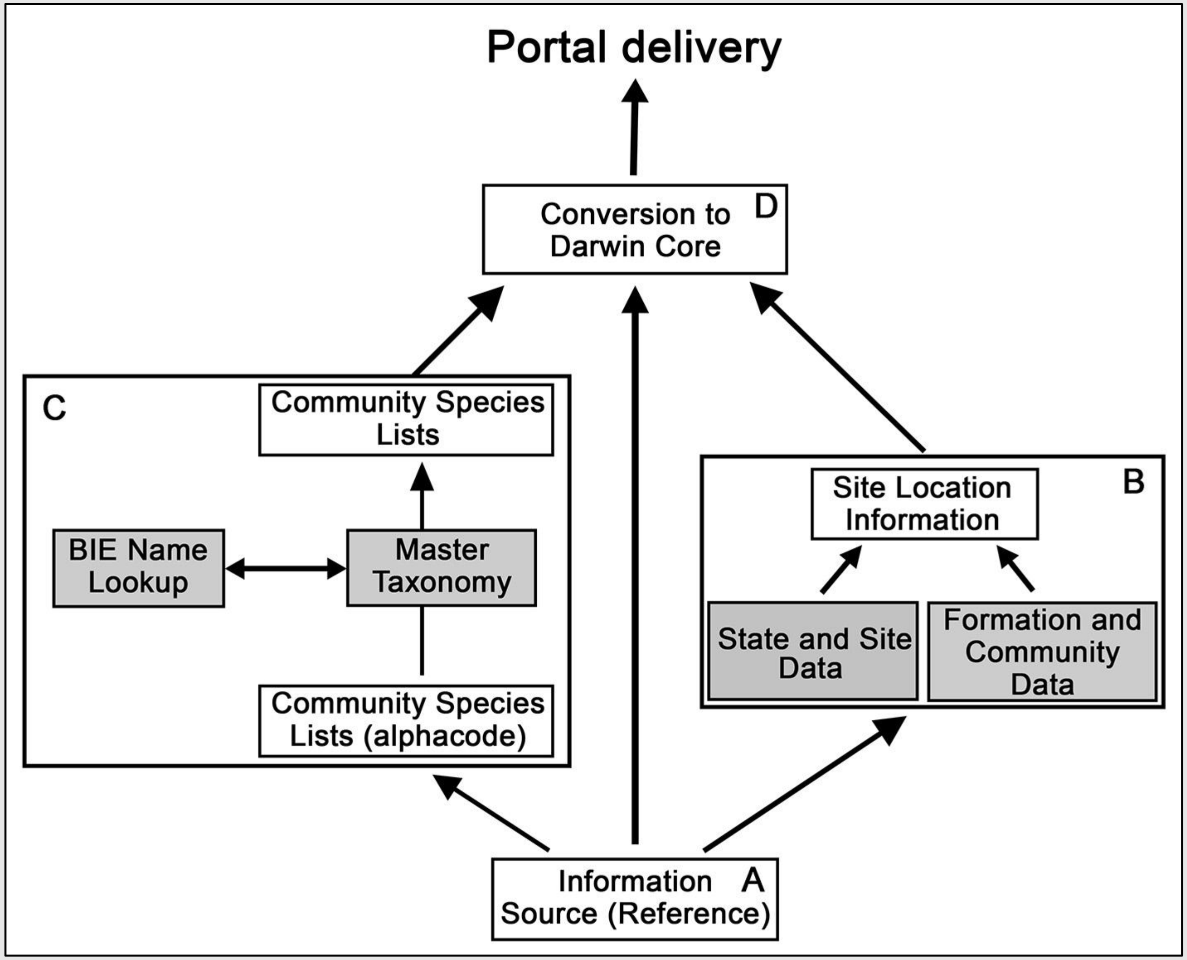
Stage 3. Reference to an expert

Resources used included:

1. On-line national species records
2. State species records
3. Books and papers
4. Experts

CODE	Meaning	action
MATCH	Near-exact match or better	accept
PARTIAL-L and PARTIAL-R	A significant substring match	manual check
FUZZY	Fuzzy matching algorithm built on the score from the web service using a 'letter-pair similarity' score	manual check
WEAK	A weak match falling below thresholds; the best match is retained	manual check
TAXM	No match or major problem with original or subsequent species name	refer to expert

Map the fields used to the Darwin Core standard


Portal delivery
Conversion to Darwin Core
D
C
Community Species Lists
BIE Name Lookup
Master Taxonomy
Community Species Lists (alphacode)
Site Location Information
B
State and Site Data
Formation and Community Data
Information Source (Reference)
A

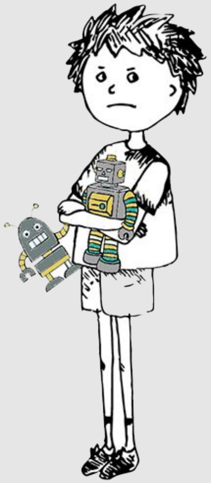
row #	Target DwC Field	ALA field	Source of Field Contents	Remarks
1	datasetID	DataResource	ALA-generated	
3	catalogNumber	Catalog number	Concatenation of CAVE data: formation dataset-location number-community number-line number-position in the line	Allowable values for position in the line are 1-8, inclusive.
4	occurrenceID	Occurrence ID	Concatenation of CAVE data: species alphacode-formation dataset-line number-position in the line (allowable values 1-8)	Allowable values for position in the line are 1-8, inclusive.
23	scientificName	Scientific name	Scientific name as CAVE data matched to current name by ALA BIE facility. (Unless the name match was overridden manualy.)	Overrides, where present, were made by authors MB and/or RLS. See also identificationFlag.
24	taxonRank	Taxon rank	Generated from scientificName by ALA, unless overriden by taxon master file in cases of genus-level taxa.	
39	habitat	Habitat	Derived from Vegetation_Type in master sites file and CAVE data prefixed with 1, 2 or 3 and expanded via lookup tables.	
43	locationRemarks	Location remarks	Field Veg2Association from master sites file plus text from CAVE comment lines for relevant location and vegetation community.	
44	coordinatePrecision	Coordinate precision	"0.000278" (nearest second), "0.01667" (nearest minute)	
45	coordinateUncertaintyInMeters	Coordinate uncertainty in meters	from master sites file	Estimated manually, mostly by AS.
46	georeferenceVerificationStatus	Georeference verification status	from field: "comments - all locations verified using google maps." in master sites file	

Data delivery

- Ingested into the Atlas of Living Australia as a collection, discoverable through species records with associated metadata:
  - https://collections.ala.org.au/public/show/dr8212
- Delivered as excel with associated code for replication of the process in the Knowledge Network for Biocomplexity:
  - http://doi.org/10.5063/F1QC01QK
- In the future, discoverable as plot information on other sites (e.g. TERN).

How did we do?

- ✓ Data saved, updated and deposited for future use in two stable repositories.
- ✓ 9450 taxa found in 1390 communities at 461 locations across the continent of Australia, between 1879 and 1989. This is a lot!



But this represents only around half of the original resource. Why?

The primary cause was loss of data on transfer from magnetic tape to exabyte tape back in 1991. And it appears in some instances those data cannot be found elsewhere.

So what?

Challenges

Lots of talk but too little action – I propose

- We neglect our valuable and hard-won data because of the dominant research imperative and lack of funding and rewards for data management
- Technological change
- Metadata (what are those rows and columns, the units the dates etc.)
- Curated, stable and accessible repositories

Lessons learnt

- we need to deposit data and metadata for future re-use as soon as possible after creation,
- We need to have repositories that are open but secure, and are properly managed for technological change in the long term
- For data archiving, don't work individually or at the small scale, team with others

Without this more data will be lost than were ever gathered and analysed.

Thankyou!

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School of Earth and Environmental Sciences
The University of Queensland, Australia

Biodiversity Data Journal https://bdj.pensoft.net/article/28073/
Knowledge Network for Biocomplexity https://knb.ecoinformatics.org/#view/doi:10.5063/F1QC01QK
Atlas of Living Australia https://collections.ala.org.au/public/show/dr8212

TERN

ATLAS OF LIVING AUSTRALIA
sharing biodiversity knowledge