Ex Situ Seed Conservation

Flora Management Course
2008

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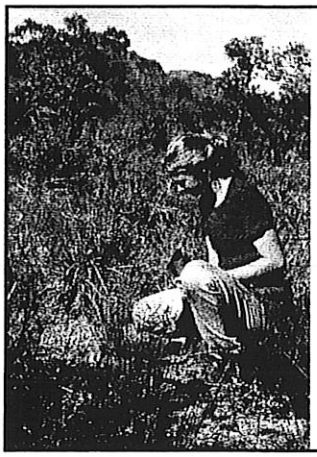
Environment and Conservation

Course Content

Ex situ conservation
- DEC's Threatened Flora Seed Centre
- Millennium Seed Bank Project

Seedbanking strategies
- Provenance, timing of seed collection, fruit ripeness & seed predation
- Documentation
- Seed handling & storage

Assessment (multi-choice)



Course Aim

To provide an understanding of the importance of seed collection for conservation purposes and to provide knowledge of basic seed identification, collection and processing

Ex situ conservation

... maintenance of samples of organisms away from their natural habitat

- seed
- pollen
- vegetative propagules = "germplasm"
- tissue or cell culture
- living plants
- DNA

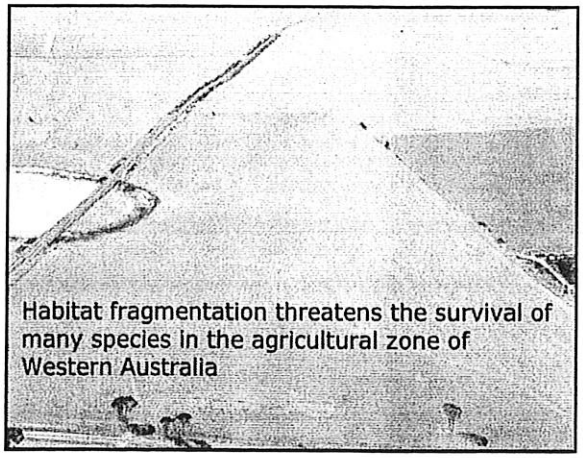
Opposite of *in situ* (on site) conservation

Ex situ conservation

.... used as an interim solution to prevent loss of genetic diversity due to threatening processes such as salinity, disease, weed invasion and habitat loss.

A strategy that can be used as a last resort in preventing the species extinction

Neither a substitute for in situ *conservation nor mandate for destruction of habitat*

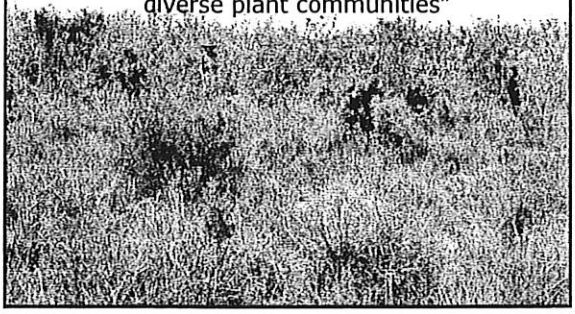


Habitat fragmentation threatens the survival of many species in the agricultural zone of Western Australia

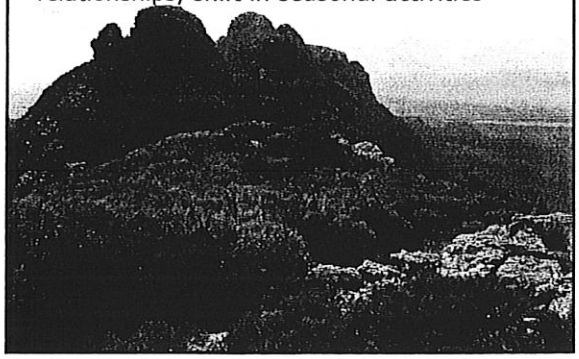
Many species threatened with extinction found only in fresh or naturally saline lowlands, directly threatened by rising ground water and salinity

Phytophthora cinnamomi - dieback

"Unparalleled example of an introduced pathogen with a wide host range causing immense irreversible damage to unique and diverse plant communities"



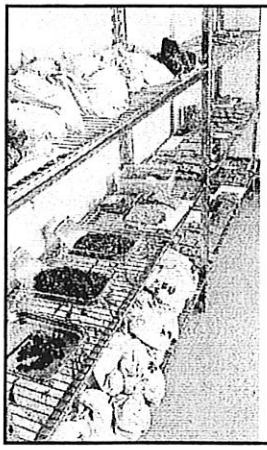
Climate Change - geographic range shifts, drought, more fire, decoupling of biotic relationships, shift in seasonal activities



Seed Conservation

- Plants can produce seed in quantity
- Seeds are small & naturally dispersed
- Seeds are mostly desiccant tolerant
- Potentially long storage life
- Useful for propagation in the future
- Wide species applicability
- Technology is easy & cost effective

Seed banking is a cheap insurance policy



Seed Longevity

Seeds of many flowering plants can be stored under low temperature and low moisture conditions for long periods of time without significantly reducing viability

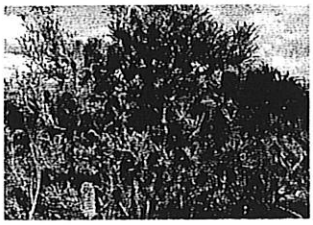
Seed Conservation

Allows access to biodiversity material for recovery and research both in- and out of-season, removing pressure off wild populations.

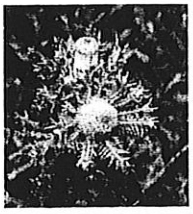
Seed Conservation

.. may represent the only option available if the remaining natural populations are to be conserved in the face of destruction of their habitat

In some cases material may be held in storage from now extinct populations .....

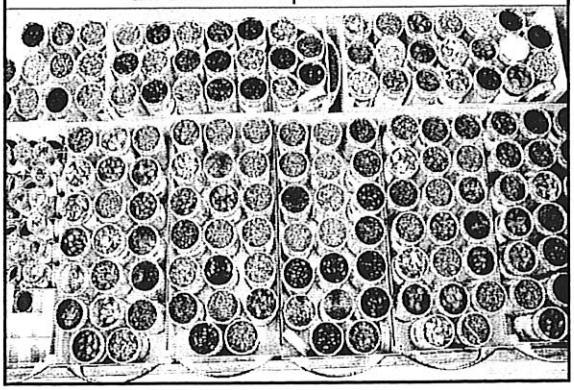


Banksia brownii (at least 3 pops)



Banksia anatona (1 pop)

...is this the last option for conservation of threatened species.....?



Alternative methods

If plants do not produce viable seed

Vegetative propagation

1. Cuttings
2. Tissue culture

– More expensive, technology

Drawback *- use of clonal material requires many individuals to conserve diversity*

Threatened Flora Seed Centre (TFSC)

- Established at CALM in 1992
- Initial commonwealth funding (ANCA)
- *Phytophthora* susceptible rare and threatened species
- Principle long term seed storage facility in Western Australia
- Additional funding – state, commonwealth & international

Objective

....to ensure the maintenance of genetically representative seed collections of Western Australian threatened flora under long term storage conditions as an interim solution to the prevention of genetic degradation or local extinction of threatened flora populations.....

Natural Resource Management in Western Australia – The Salinity Strategy (2000)

Section 4.4.1 *Seed collection, storage and databasing*

...CALM will establish and maintain a long term storage facility for seed of rare and threatened plant species located in saline environments...

National Strategy for the Conservation of Australia's Biological Diversity (1996)

Objective 1.9: *Ex-Situ Conservation*

...to complement *in situ* measures, establish and maintain facilities for *ex situ* research into and conservation of plants, animals and micro-organisms...

Global Strategy for Plant Conservation (2002)

Target: *Conserving Plant Diversity*

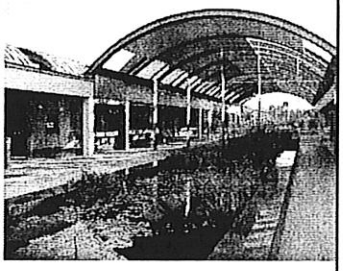
... 60 per cent of threatened plant species in accessible *ex situ* collections, preferably in the country of origin, and 10 % of them included in recovery and restoration programmes...

Millennium Seed Bank Project

Conceived, developed and managed by the Seed Conservation Department of the Royal Botanic Gardens Kew United Kingdom

Aim is to collect and conserve 10% of the world's dryland flora by 2010 as part of Global Strategy for Plant Conservation

Western Australian seed banking efforts have been facilitated through generous MSB financial and technological inputs



DEC's Threatened Flora Seed Centre has been in partnership with the MSB since 2001

Seed Collection Strategy

- What species will be collected?
- How many populations sampled?
- How many plants sampled?
- How much seed to collect per plant?
- Multi-year sampling may be required

Seed Collection Strategy

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What Species?

- Degree of threat
- Geographic range of the species
- Number of individuals and populations
- Conservation status of the species
- Intended purpose of the collection

TFSC Collecting Priorities

- Declared Rare & Priority Flora
- Species associated with Threatened Ecological Communities & Recovery Catchments
- Biodiversity Hotspots

Purpose of Collection

- Reintroduction and restoration
- Long term storage (insurance policy)
- Research - Disease susceptibility
  - Salinity tolerance
  - Seed biology
  - Genetic
- Display and Education
  - Botanic Gardens
  - Schools

Seed Collection Strategy

- What species will be collected?
- How many populations sampled?
- How many plants sampled?
- How much seed to collect per plant?
- Multi-year sampling may be required

Sampling Populations

- Sample all populations if possible to maximise diversity of collection
- Variation between pops may reflect reproductive & physiological differences
- Keep seed from different pops separate
- Local pops possibly most suitable for site rehab (long term survival & ecological processes) due to evolution & adaptation to local conditions

Seed Collection Strategy

- What species will be collected?
- How many populations sampled?
- How many plants sampled?
- How much seed to collect per plant?
- Multi-year sampling may be required

Sampling Plants

- Sample ≥50 plants per population to increase genetic variation
- Random stratified sampling with equal proportions of seed from each plant
- Sample from range of sizes, shapes etc including from range of ecotypes
- Ideally, keep seed from separate plants in separate bags

Seed Collection Strategy

- What species will be collected?
- How many populations sampled?
- How many plants sampled?
- How much seed to collect per plant?
- Multi-year sampling may be required

- Take no more than 10-20 % of seed from each plant unless that plant & immediate habitat to be destroyed eg clearing, road maintenance etc.
- Remaining seed will allow natural regeneration to occur & provide material for the soil seed bank

Objective: *collect genetically representative sample of the population without damaging any plants prospects for survival in the wild.*

Seed Collection Strategy

- What species will be collected?
- How many populations sampled?
- How many plants sampled?
- How much seed to collect per plant?
- Multi-year sampling may be required

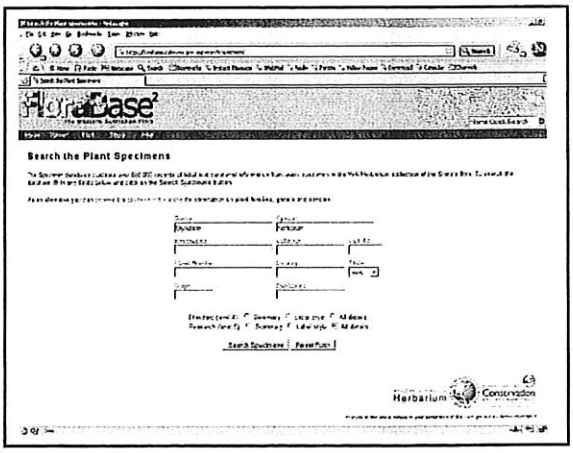
Repeat Sampling

It is not always possible to collect sufficient seed for the desired purpose all in one go without affecting the demography and/or reproductive capacity of the population.

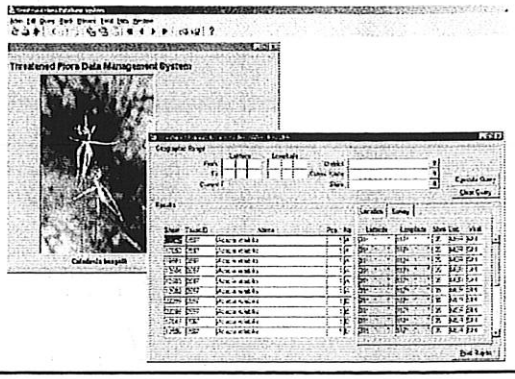
Multi-season or multi-year sampling may be required.

Planning a Collecting Trip

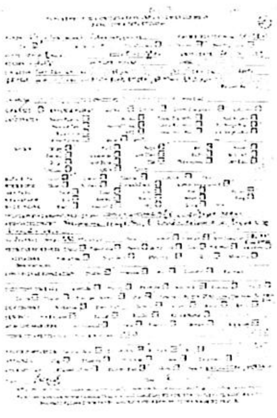
- Florabase records
- DEFL Records
- RFRF
- Mud maps
- Species information
- Herbarium specimens
- Topographic maps
- ARCVIEW tool to collate



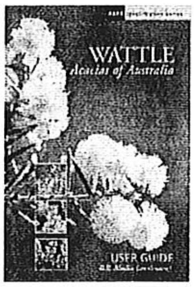
DEFL database

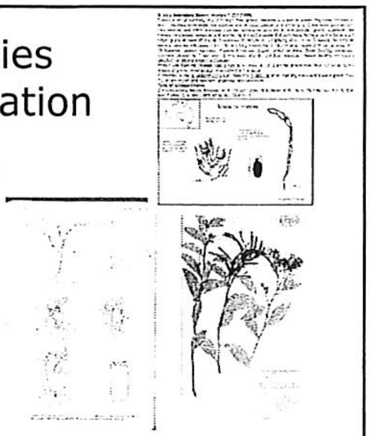


Paper Files (RFRF & mud maps)



Species Information





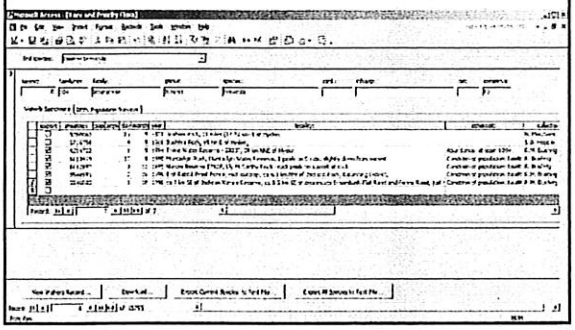
Data Gathering

- Good location information
- Recent record
- Good site/habitat description
- Information on plant numbers

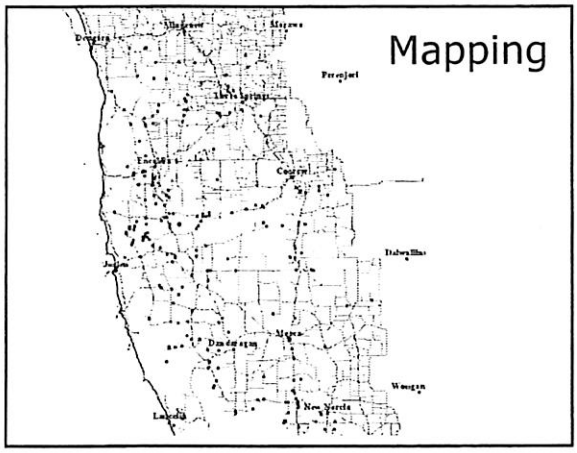
PERTH 05044417

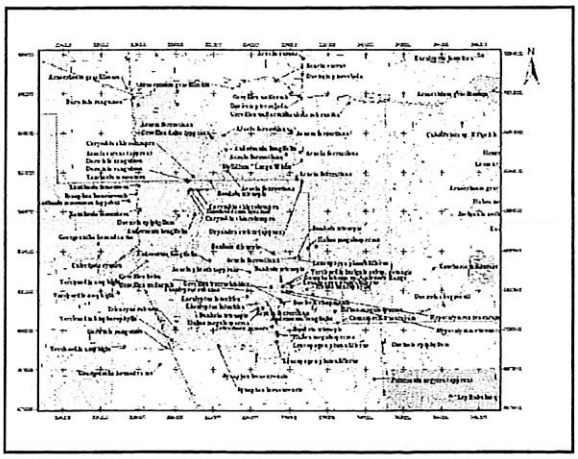
Collection Date:

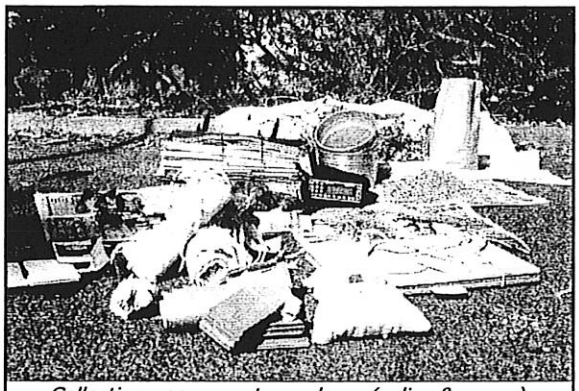
Collating Information
(TFSC collecting database)



Mapping



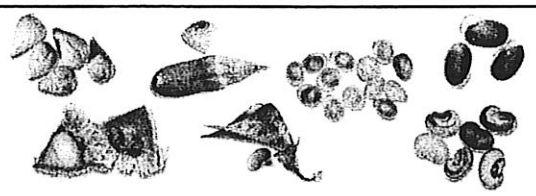




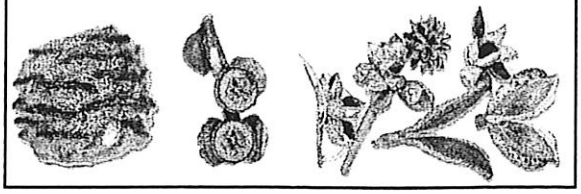
Collecting gear: secateurs, bags (calico & paper), notebook, plant press, maps, GPS.....

Seed Collection Considerations

- Fruit/seed comes various shapes & sizes
- Seed storage & dispersal mechanisms vary
- Seed collection techniques vary depending on fruit/seed type & storage/dispersal
- Timing of seed collection vary according to species & environmental conditions

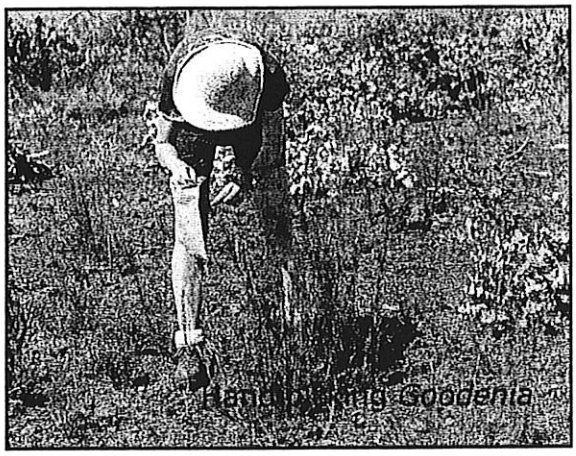


Fruit/seed comes in all shapes & sizes



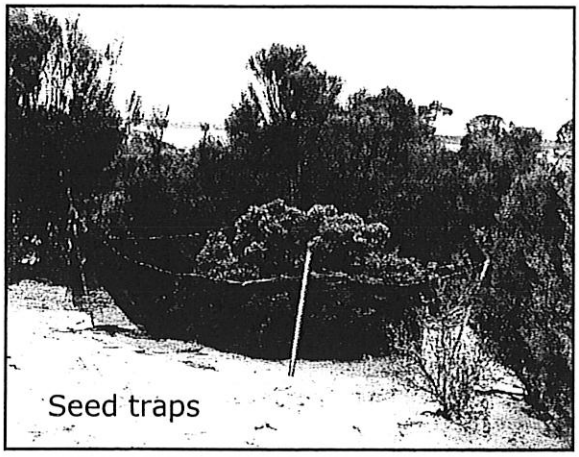
Seed Collection Techniques

- Hand picking (individual seed/ fruits)
- Pruning with secateurs
- Bags (eg stockings/ muslin)
- Extended pole pruners
- Stripping
- Shaking branches
- Collecting from ground
- Seed traps

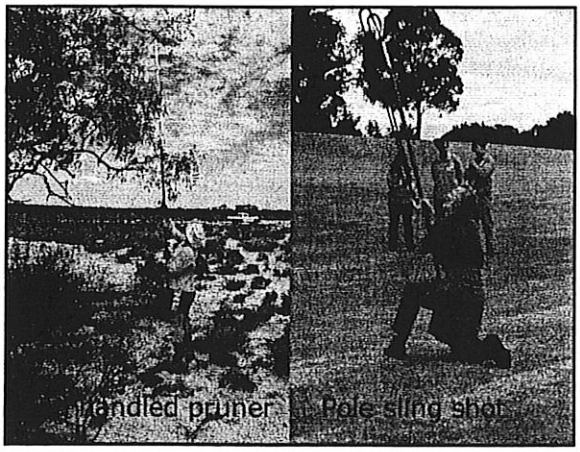


Hand picking *Goodenia*

Using stocking / muslin bags over *Grevillea* fruits



Seed traps



Handled pruner

Pole sling shot

Hand cutting using secateurs

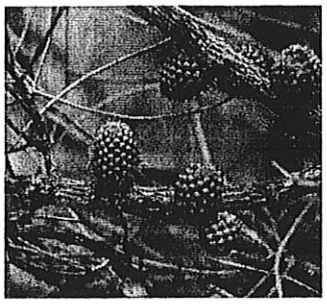
Grovelling!.....

Timing of Collections

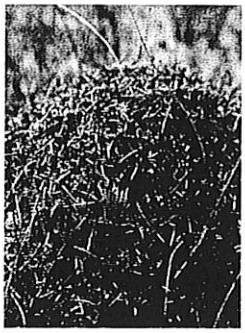
- Take into account natural seed storage and dispersal mechanisms
- Sample at point of natural dispersal when fruits/seed are mature
- Time to maturity varies from species to species, from site to site and is dependant on environmental factors
- Recollect over several weeks if necessary

Info on reproductive biology helps decide collection time

Serotiny or canopy seed storage



Seed dispersal: wind, animal, passive (gravity), water…

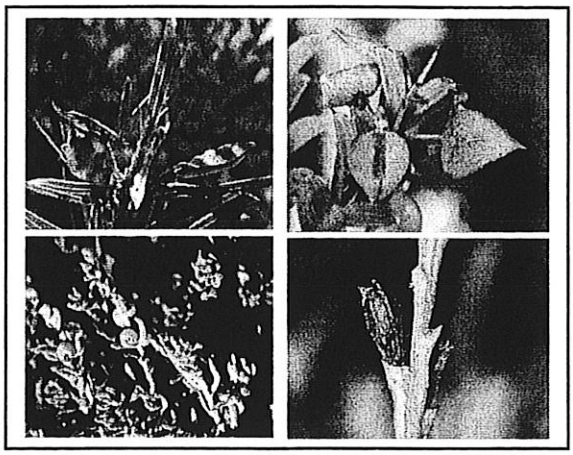


There is very little known about the interval between flowering and fruiting

Fruit Ripeness

- changes in fruit colour
- changes in seed coat colour
- fruit splitting or breaking open
- fruit that are hard and dry
- seed rattling
- some seed already dispersed
- fleshy fruits going soft

There are always exceptions!

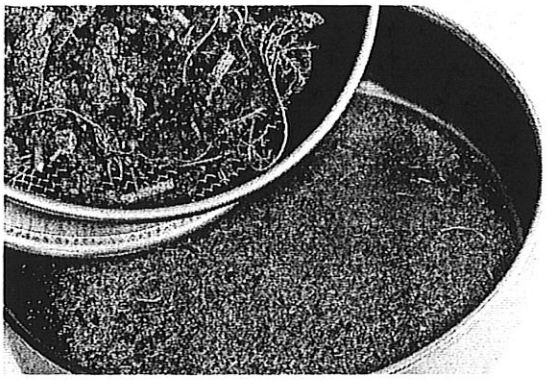


Some plants fruit and flower over a long period of time. Be careful to only collect mature fruits.

Some plants flower in response to fire & some may only seed 1-2 years post-fire

Check valves or capsules are closed & seed not released

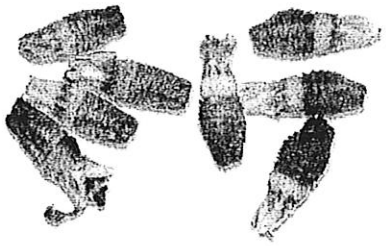
Seeds releasing from dry woody capsules



Check fruits/seeds are not damaged by insects

Sure signs of insect activity-
- frass (looks like sawdust)
- holes
- webbing

Check that fruit you are collecting are filled.



Darwinia acerosa
fruit on left empty; fruit on right full

Seed Quality
is partly determined by:

- the stage at which seeds were collected
- how seeds were handled after collection

Seed quality affects seed longevity & germination

Collection Information

- Genus, species, subspecies
- Exact location (GPS if possible)
- Collector, date & collecting number
- Number of plants sampled
- Additional information (eg pollinators, health, ecology, associated species, soils, phenology)

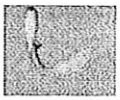
Information is almost as important as the seed itself

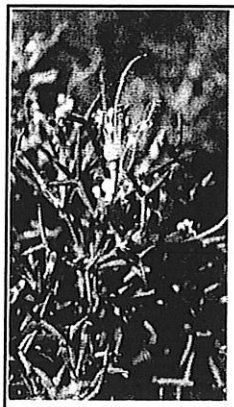
Herbarium specimens

Gastrolobium congestum

Eremophila flower, fruit, seed and germinant

Eremophila nivea





Adenanthos flower, fruit and seed

Good seed

Aborted seed

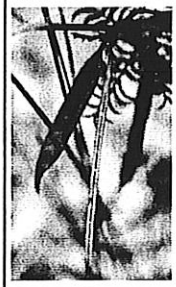
Verticordia albida flower, fruit with seed and germinant

Darwinia flower and fruit with seed

Darwinia lejostyla

Darwinia chapmanniana

Acacia fruits, seed and germinant



Hints for Seed Collection

- Know your species
- Examine pop. Is there a mixture of species?
- Examine seed carefully - collect ripe seed only
- Random & equal sampling
- Clean equipment - **don't introduce disease**
- Collect sufficient seed but don't over collect
- Collect herbarium specimen(s)
- Collect in dry weather if possible
- Reduce risk of herbivory/fungal growth
- Use breathable containers - paper & calico bags
- Label containers and do not damage seed

Remember!

Illustration from Bonney, N. B. 1994. *What Seed is That?* Adelaide, S.A., Greening Australia

It is illegal to collect any plant material (seed, herbarium specimens, cuttings etc) in Western Australia without a licence.

What makes a good collection?

- Priority species, accurately identified
- Single species – no hybrids or mixed pops
- Good quality seed
- Genetically representative of species/pop
- Plants & pops not damaged or over collected
- Sufficient size for needs (consider predation, low seed set, aborted & immature seed)
- Adequate data (incl herb spec)

Remember!

- Plants may not seed all year round so allow time to plan & execute collections
- More than one visit may be required to collect sufficient seed for intended use
- Consider costs associated with collections – eg vehicle, time in field...

Seed handling & storage

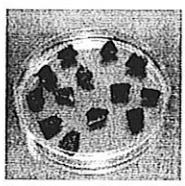
- Handle seed gently
- Keep seed cool & dry
- Store seed in calico/paper not plastic
- Well sealed & labelled bags

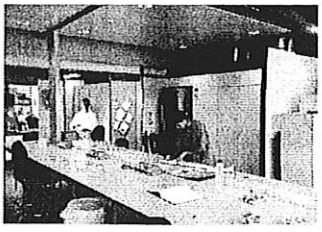
Store seed temporarily under conditions which will maintain maximum viability until incorporation into long term storage facilities.

Don't let time in the field be wasted

After the field work....

1. Seed cleaning
2. Seed quality assessment
3. Seed quantification
4. Seed germination



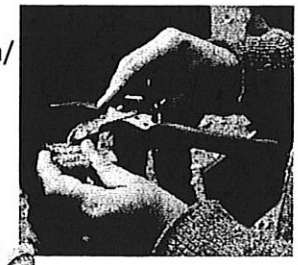


Then seed is ready for packing, storage & viability monitoring

Good seed can last 50+ years in storage

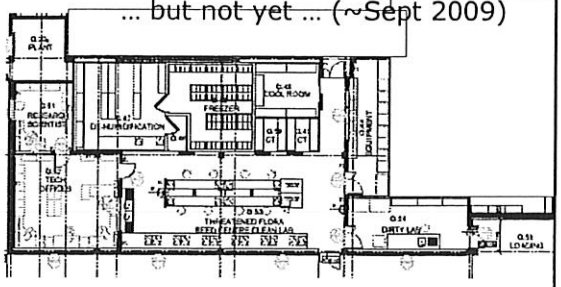
We can provide advice on:

- Seed collection
- Seed germination/ viability testing
- Seed storage

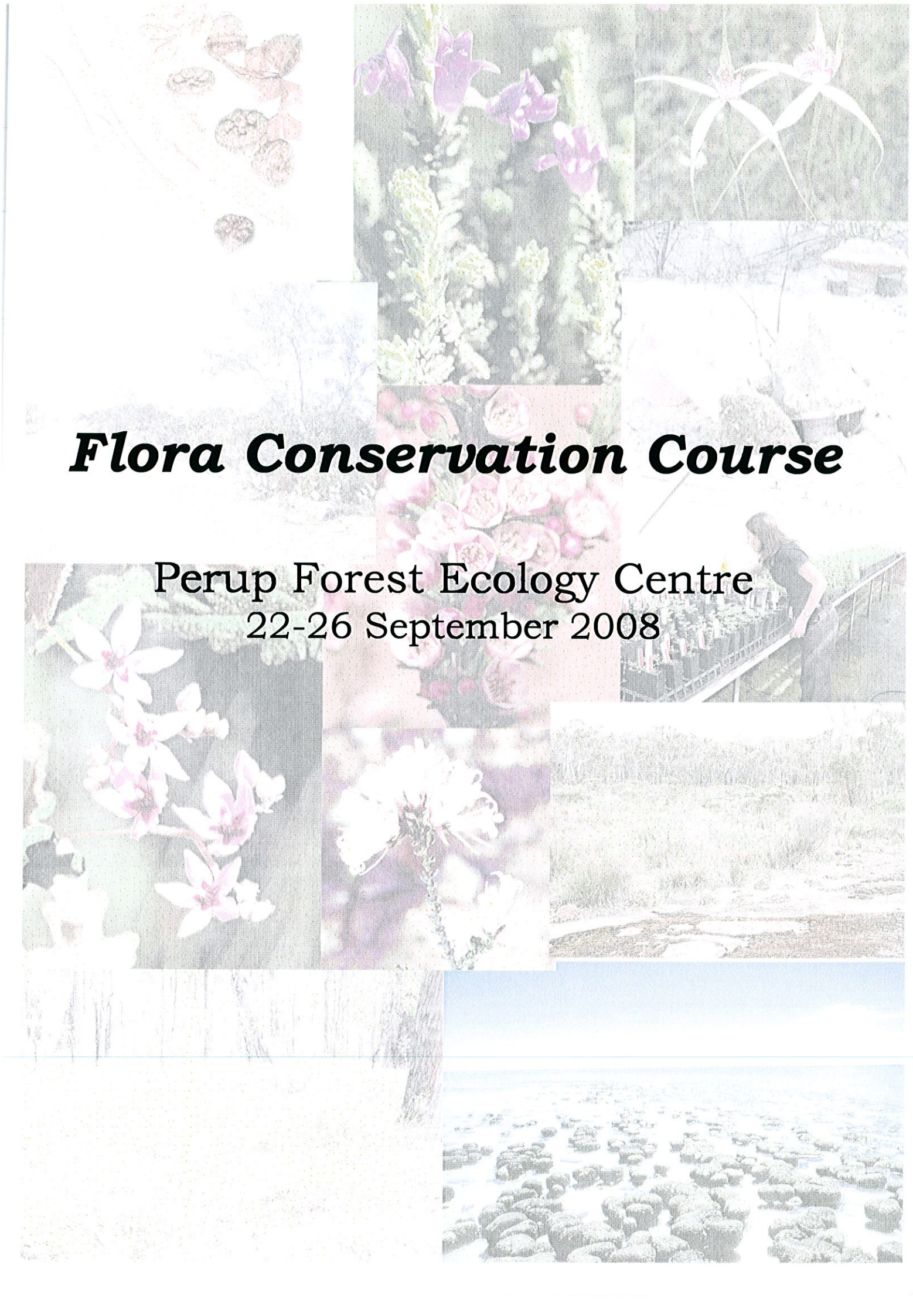


Come visit us in our new seed store

... ~~but not yet ...~~ (~Sept 2009)



Threatened Flora Seed Centre



Flora Conservation Course

Perup Forest Ecology Centre
22-26 September 2008