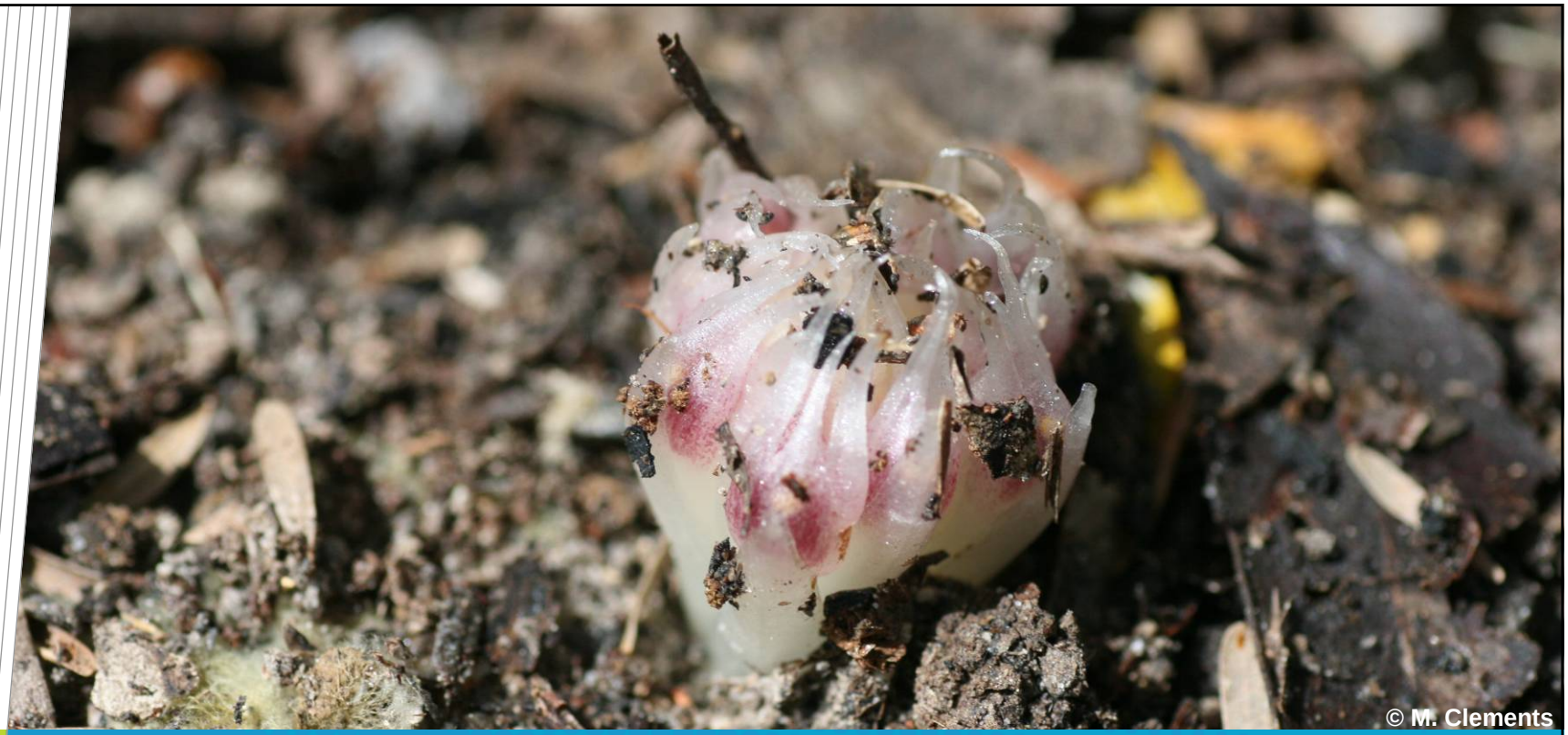


www.csiro.au

Bulahdelah Bypass Orchid Recovery Project

Dr Mark A. Clements & Dr Chris Howard

Centre for Plant Biodiversity Research

RTA

EcoPro
THE ECOLOGICAL PROFESSIONALS

CSIRO

Overall aims of Project

- Due to the Pacific Highway Upgrade on the footslopes of Alum Mountain, several populations of three threatened Orchid species will be affected
- The NSW RTA has contracted the CSIRO to perform research into the survival and translocation of these species
- CSIRO was awarded the research contract through a competitive process
- The CSIRO is to provide the RTA with strategies to address issues for the survival and translocation of these orchid populations

CSIRO Research Team Introduction

- Centre for Plant Biodiversity Research, Canberra
  - Joint initiative between CSIRO and the Australian National Herbarium
- Dr Mark Clements
  - Research Scientist
  - Approximately 30 years experience in orchid research
  - Expert in:
    - Cultivation & Propagation
    - Taxonomy
    - Systematics
- Dr Chris Howard
  - Postdoctoral Fellow
  - Training in Molecular Biology & Plant Pathology

Brief History of the Project

- 2000 – 2002
  - Floristic surveys were commissioned by RTA for route selection and for associated Environmental Impact Statement
    - *Cryptostylis hunteriana* was discovered on the site
    - Local family relocated *Rhizanthella slateri* plants, a species previously known from the site
    - Detailed surveys for *Rhizanthella slateri* and *Cryptostylis hunteriana* conducted
- 2003 - 2004
  - Detailed survey for undescribed species (to be *Corybas dowlingii*) with samples sent to CSIRO Canberra for identification and formal naming
- 2003 - 2008
  - Annual surveys for all three threatened species
    - To gain an understanding of the distribution of the three species on the site
- 2008
  - Orchid Management Plan drafted
  - Addresses issues for the survival and translocation of the affected orchid populations

CSIRO's Involvement in the Project

- 2006 - 2007
  - Contacted to observe and record the phenology of the three species
  - Also to perform hand pollinations for *Cryptostylis hunteriana* and *Corybas dowlingii* for seed collection and to enhance natural regeneration
- 2008 – 2011
  - Contracted to research strategies for propagation and translocation of populations of the three orchid species
  - Including additional hand pollinations for seed collection and to enhance natural regeneration

The Orchid Species

Cryptostylis hunteriana
(Leafless tongue orchid)
EPBC Act – vulnerable

Rhizanthella slateri
(Eastern underground orchid)
EPBC Act – endangered

Corybas dowlingii
(Red helmet orchid)
NSW TSC Act
- endangered

Cryptostylis hunteriana

- Perennial / deciduous terrestrial leafless herbs
- Dry habitat preference - Associated with many plant species
- Reproduction – sexual, vegetative forming localised clumps
- Wasp Pollination
- Seed dispersal - wind

Cryptostylis hunteriana

Distribution

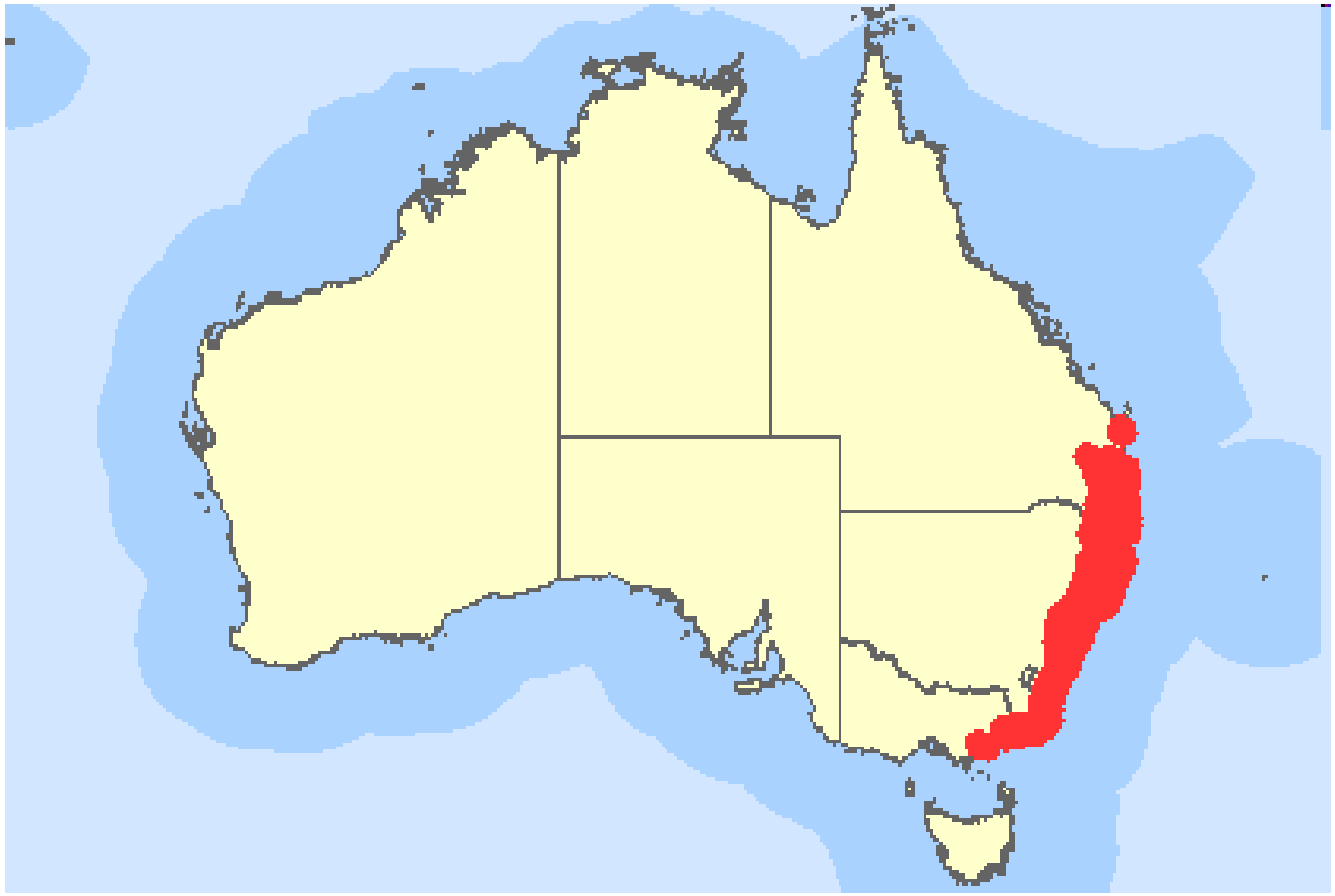
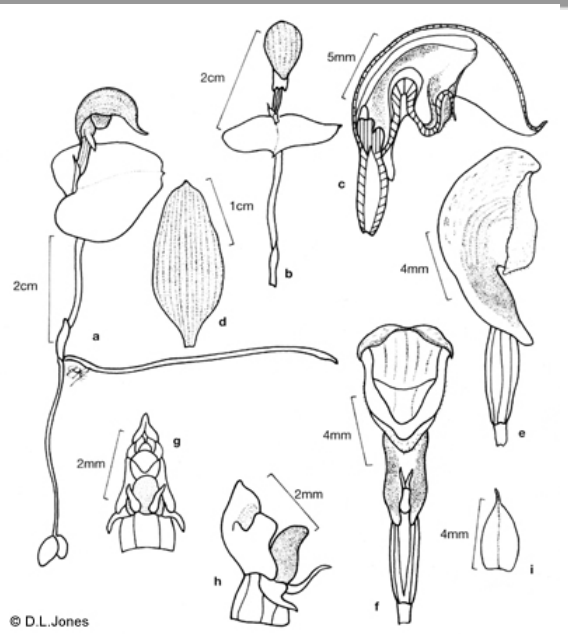


Image source: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=19533

Corybas dowlingii

- Small, colony forming, terrestrial herb
- Habit preference – restricted to wetter gullies
- Cultivation – possible
- Transferable – probably
- Fly Pollination
- Seeds – wind dispersed
- Formally described in 2004 yet possibly known since 1930s



Corybas dowlingii

Distribution

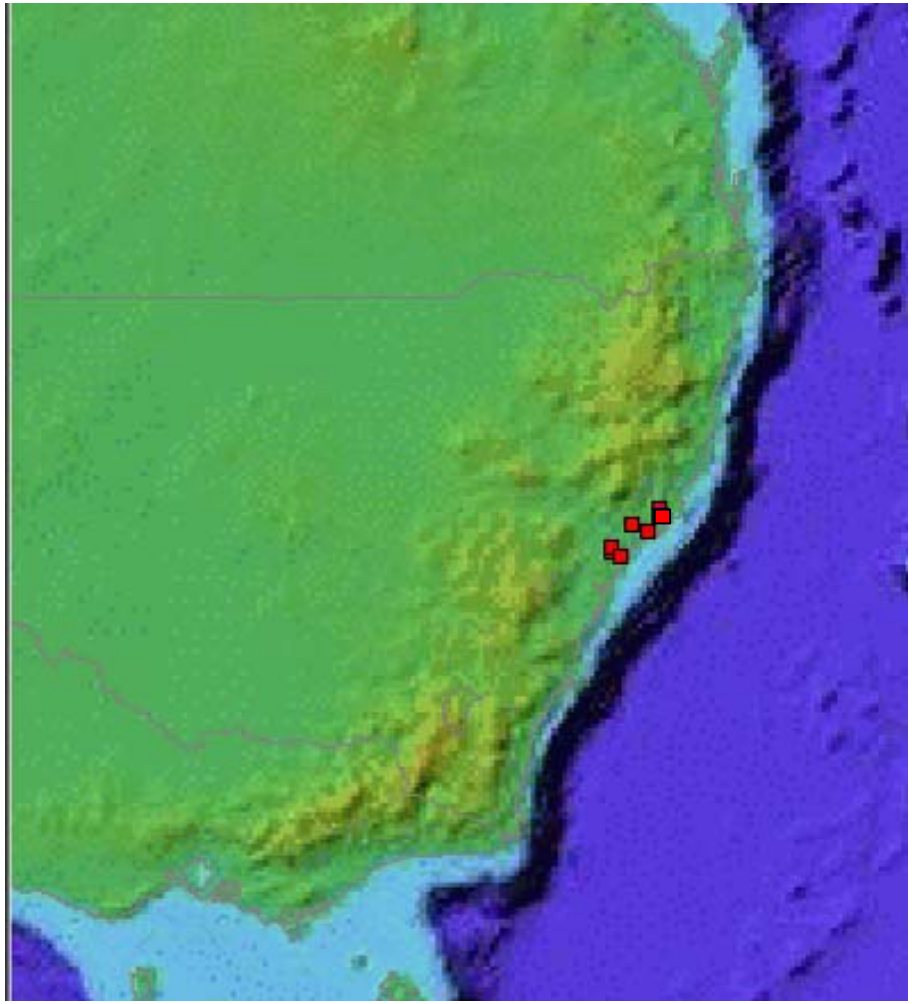


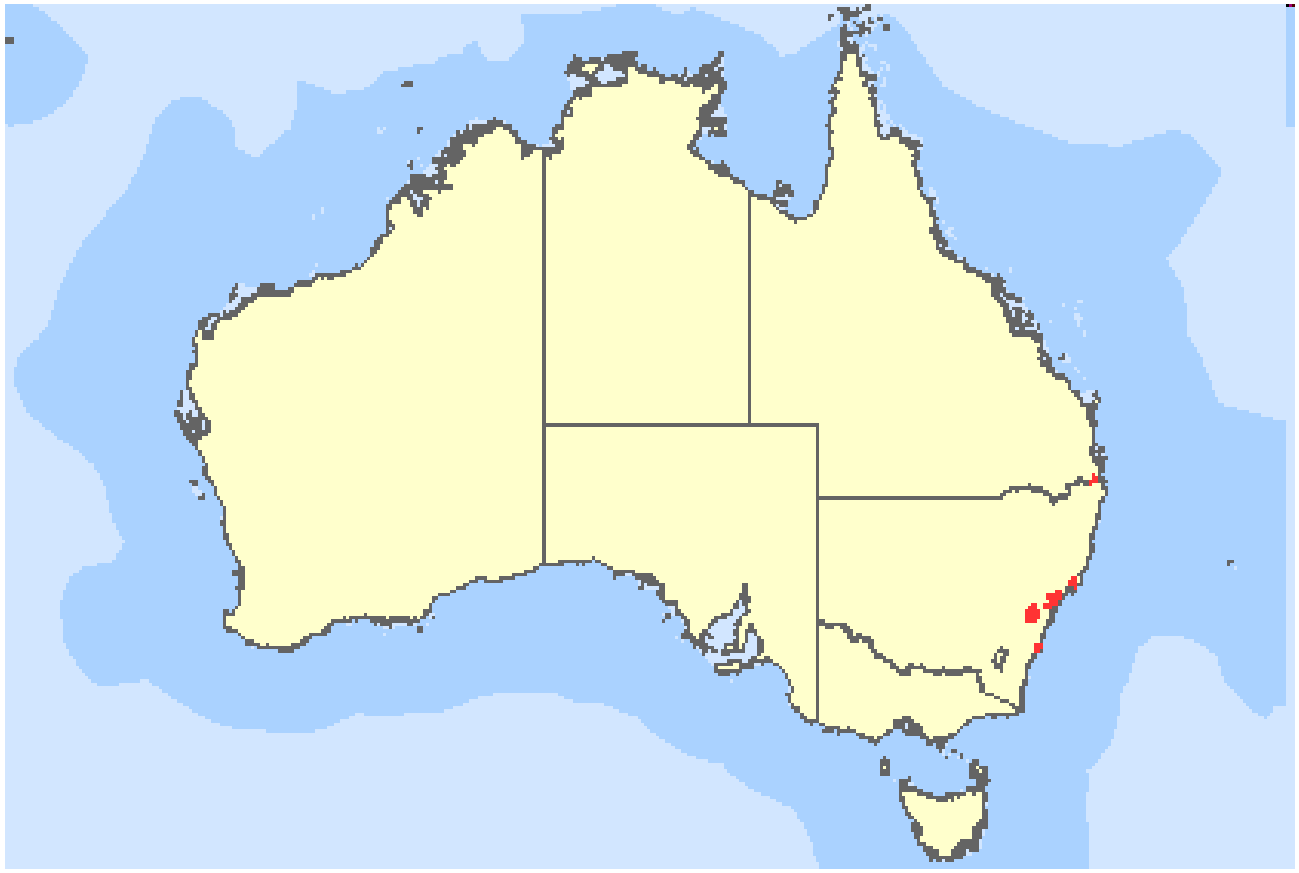
Image source: http://www.rbg.vic.gov.au/cgi-bin/avhpublic/avh.cgi

Rhizanthella slateri

- Subterranean leafless orchid
- Non-photosynthetic
- Fly Pollination
- Seed maturation 11-12 months
- Seed dispersal – animal (bandicoots / birds)
- may be intimately linked to host plant (tree or shrub) by mycorrhizal fungus

Rhizanthella slateri

Distribution



The species is known from several isolated locations from the NSW south to mid-north coast

Image source: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=11768

The Orchids - Life History Strategies

- Three orchids with entirely different life-history strategies
- Representing a diverse set of obstacles to overcome in order to achieve project objectives
- Translocating the orchids from the affected area requires knowledge of:
  - mycorrhizal associations
  - flowering times, regimes and pollinators
  - habitat preference
  - reproductive strategies (vegetative, sexual)
  - seed dispersal/longevity

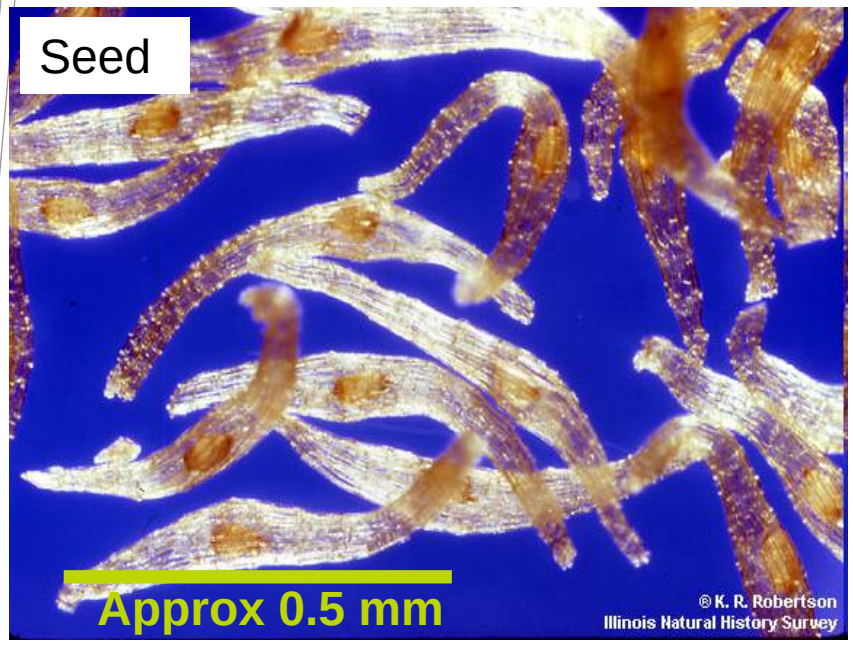
Orchid biology – fungal association

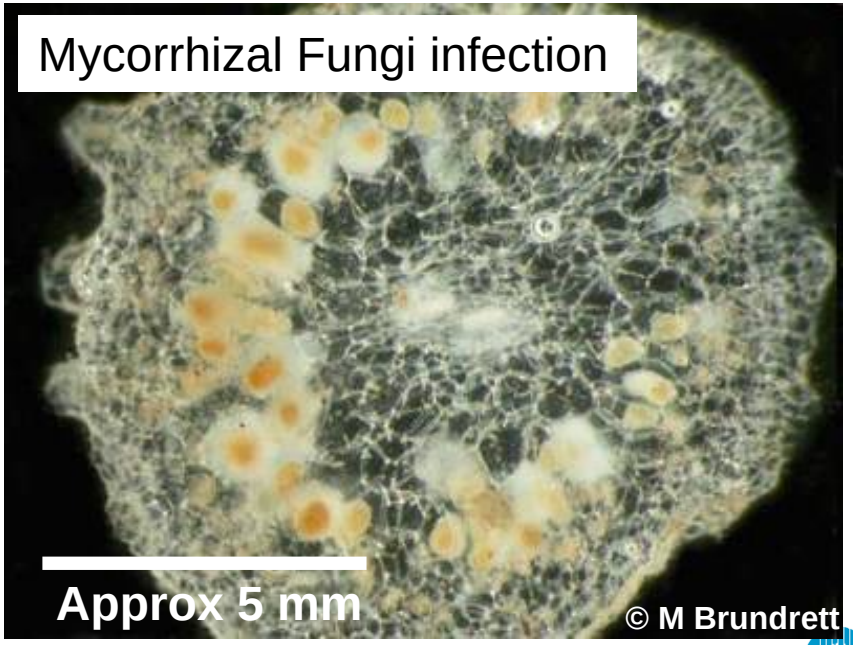
- Reliant on Mycorrhizal Fungi
  - Fungi that interact with and form associations with plant roots
  - Example of a mutualism

Image source: http://www.ipm.iastate.edu/ipm/hortnews/2006/4-5/fungi.html

Orchid biology – fungal association

- Reliant on Mycorrhizal Fungi – Orchids are Heterotrophs
  - Seed germination and Nourishment (myco-heterotrophy)
  - Orchid seed is minute – no endosperm (or food source)
  - Mostly wind dispersed
  - Rely on fungal infection and subsequent symbiosis





Orchid biology - pollination

Pollination by sexual deception

Propagation and Translocation

- Primary aim is to propagate the orchids from seed and replant in an undisturbed area
  - Some physical translocation may be necessary

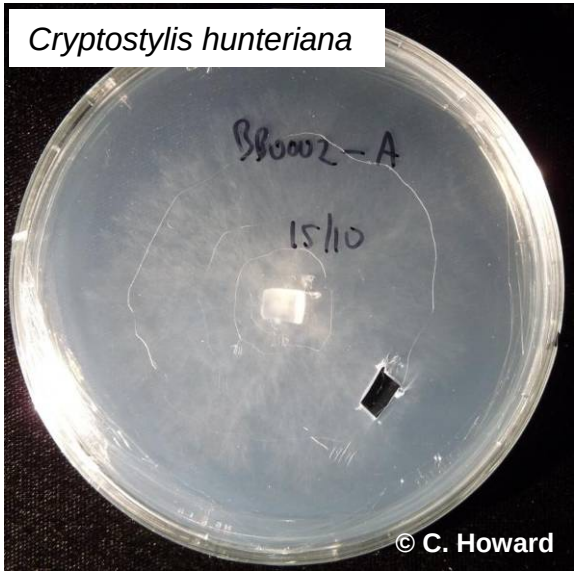
- Requires knowledge of:
  - Habitat Preference
    - Floristic surveys at the location of each orchid species will establish what habitat the orchids prefer
  - Mycorrhizal fungi presence
    - Surveys for fungi will reveal likely places to reintroduce the orchids
  - Flowering times
    - Work over the last 2 years has established precise flowering times
  - Reproductive strategies
    - Each species of orchid utilises different strategies for survival when flowering is limited

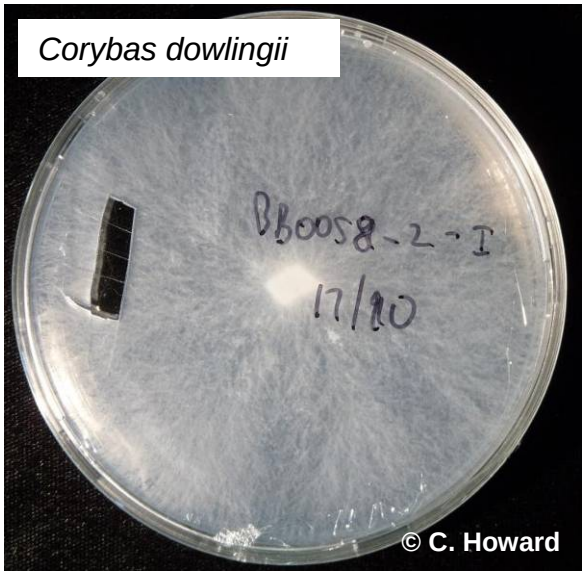
What we have achieved

- Now have clearer understanding of the biology of each species
  - Flowering times, seed dispersal mechanisms, reproductive strategies
- Have performed 100s of hand pollinations
  - Resulting in tens of thousands of seed released over the site – including adjacent to the road corridor
  - Seed samples have been collected for germination experiments

What we have achieved

- Physical translocation trials have been undertaken
  - *Corybas dowlingii* and *Cryptostylis hunteriana*
- Mycorrhizal fungi for each species have been isolated, identified, and are in culture in Canberra
  - DNA sequence comparison reveal distinct species of fungi are involved with all three orchid species





Fungal culture morphology

Ongoing Work

- Characterisation of each mycorrhizal fungal isolate
  - DNA and growth studies

- DNA analysis of Soil samples from across the site to map the distribution of mycorrhizal fungi on the site to identify reintroduction sites

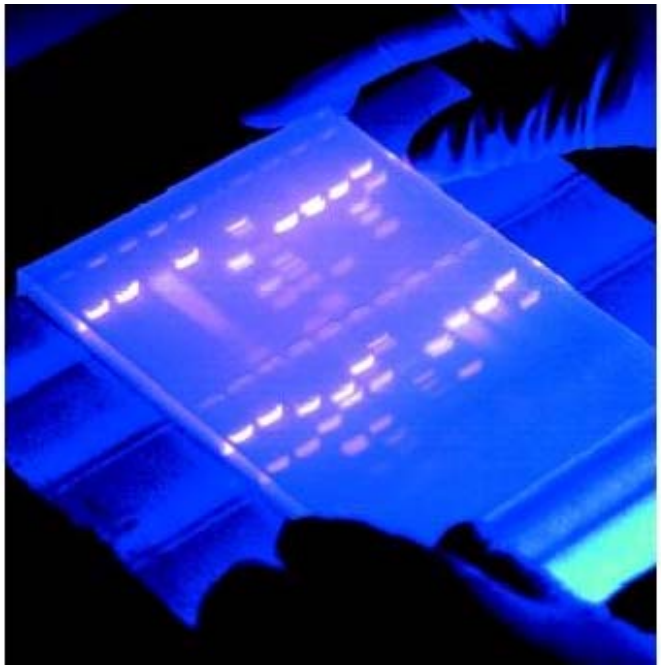


Image source: http://www.biologyreference.com/Dn-Ep/Electrophoresis.html

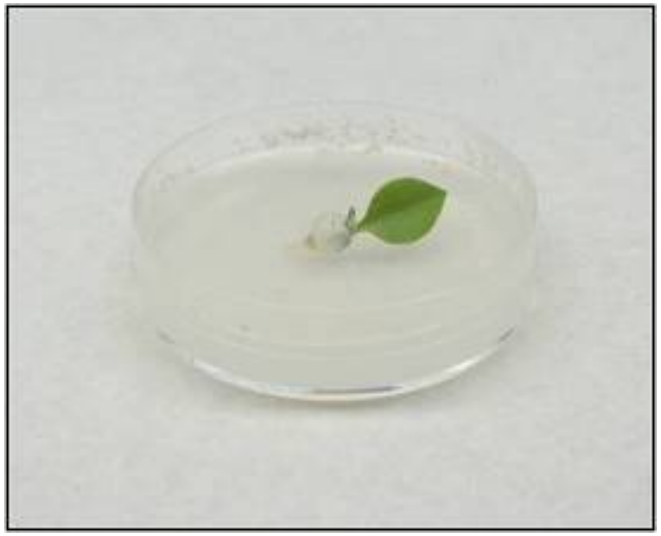
Ongoing Work

- Seed germination trials for *Cryptostylis hunteriana, Corybas dowlingii* and *Rhizanthella slateri*

- Monitor trials of translocated *Cryptostylis hunteriana* and *Corybas dowlingii* during their respective growing periods

Ongoing Work

- With knowledge of fungi and growth requirements, we aim to propagate populations of each orchid species for re-introduction
- Continue orchid propagations for future re-introductions
- Cryogenically store seed and mycorrhizal fungi for long term management
- Specific orchid plants that will be affected will be translocated prior to construction



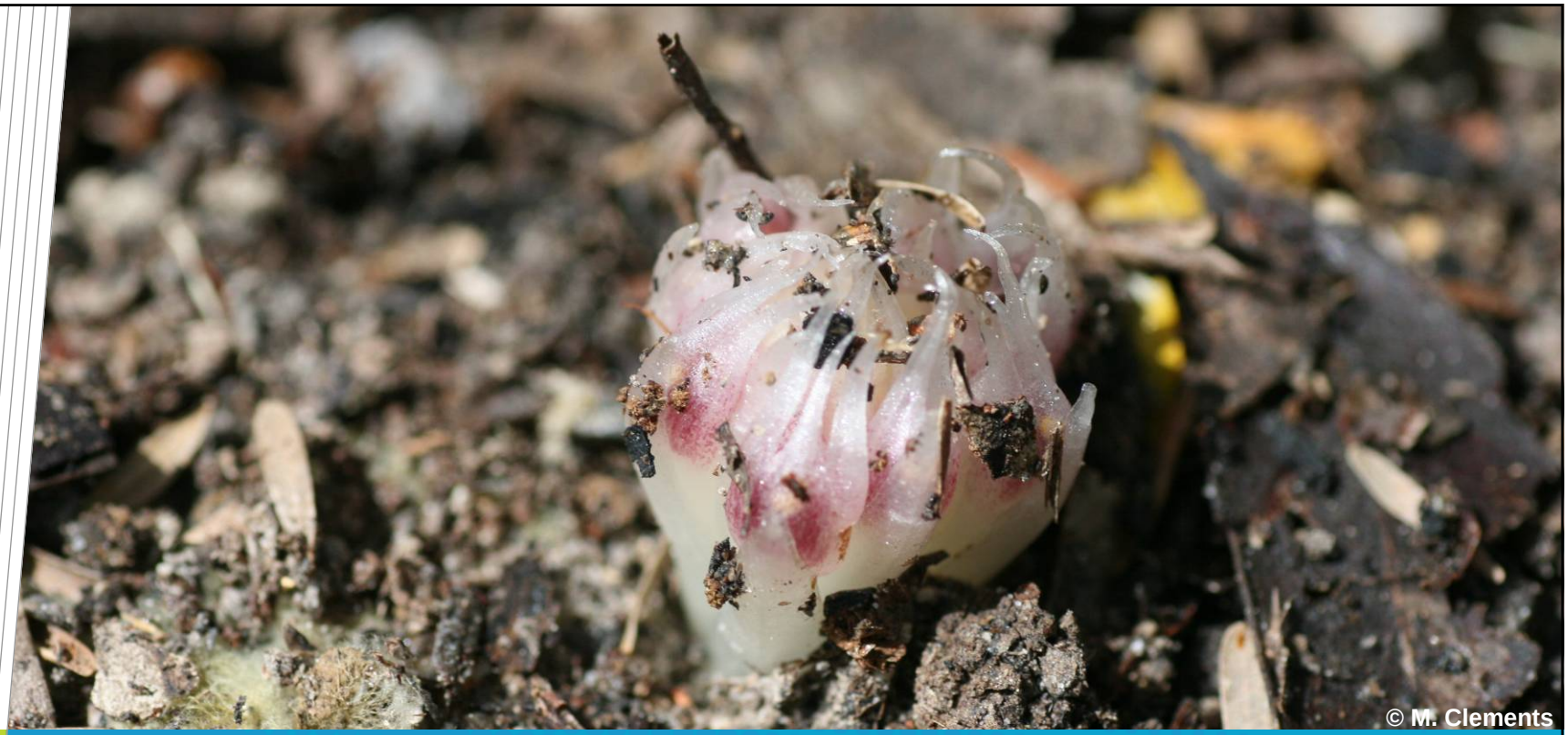
Source of images: Sommerville, K.D., Siemon, J.P., Wood, C.B. and Offord, C.A. (2008) Simultaneous encapsulation of seed and mycorrhizal fungi for long-term storage and propagation of terrestrial orchids. Australian Journal of Botany, 56: 609 - 615

CSIRO

Ongoing Work

- The RTA will continue to facilitate and coordinate quarterly meetings with CSIRO, EcoPro, & relevant NSW and Federal Govt Departments

- Orchid management plan – stipulates continual monitoring of the site for a minimum 10 year period
  - Surveys of translocation sites and unaffected populations
  - Weed control
  - Additional hand pollinations
  - Supplementary plantings if required
  - Continual public information sessions
  - Control of fire regime for the site



www.csiro.au

Bulahdelah Bypass Orchid Recovery Project

Dr Mark A. Clements & Dr Chris Howard

Centre for Plant Biodiversity Research

RTA

EcoPro
THE ECOLOGICAL PROFESSIONALS

CSIRO