Specialist Interactions in Orchids

networking for improved translocation success

Belinda Davis
Kings Park Science, DBCA

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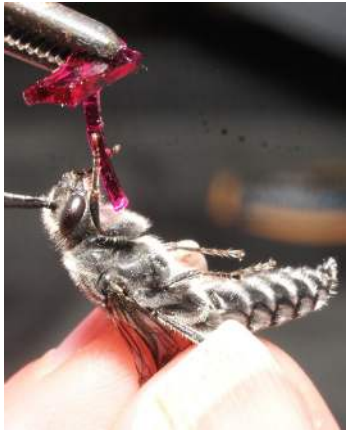
BOTANIC GARDENS & PARKS AUTHORITY



Orchids: networking specialists

Above ground

Highly co-evolved floral morphology to attract/deceive pollinator – visual, pheromones, nectar

Below ground

Obligate mycorrhizal germination – annual re-establishment

Specific or general interaction

Means of nutrition – two way street

Niche exploiters

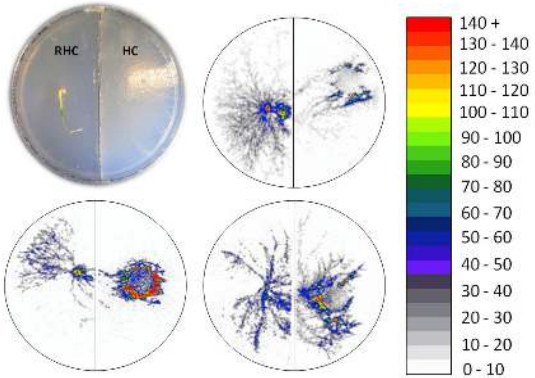
Reproduction

30, 000+ dust like seeds

<1 seed to adults (Batty et al, 2001)

High dispersal

Long lived (10-30+yrs)



Nutrition

'Farm' free living saprotrophs

C in return for soil P, N

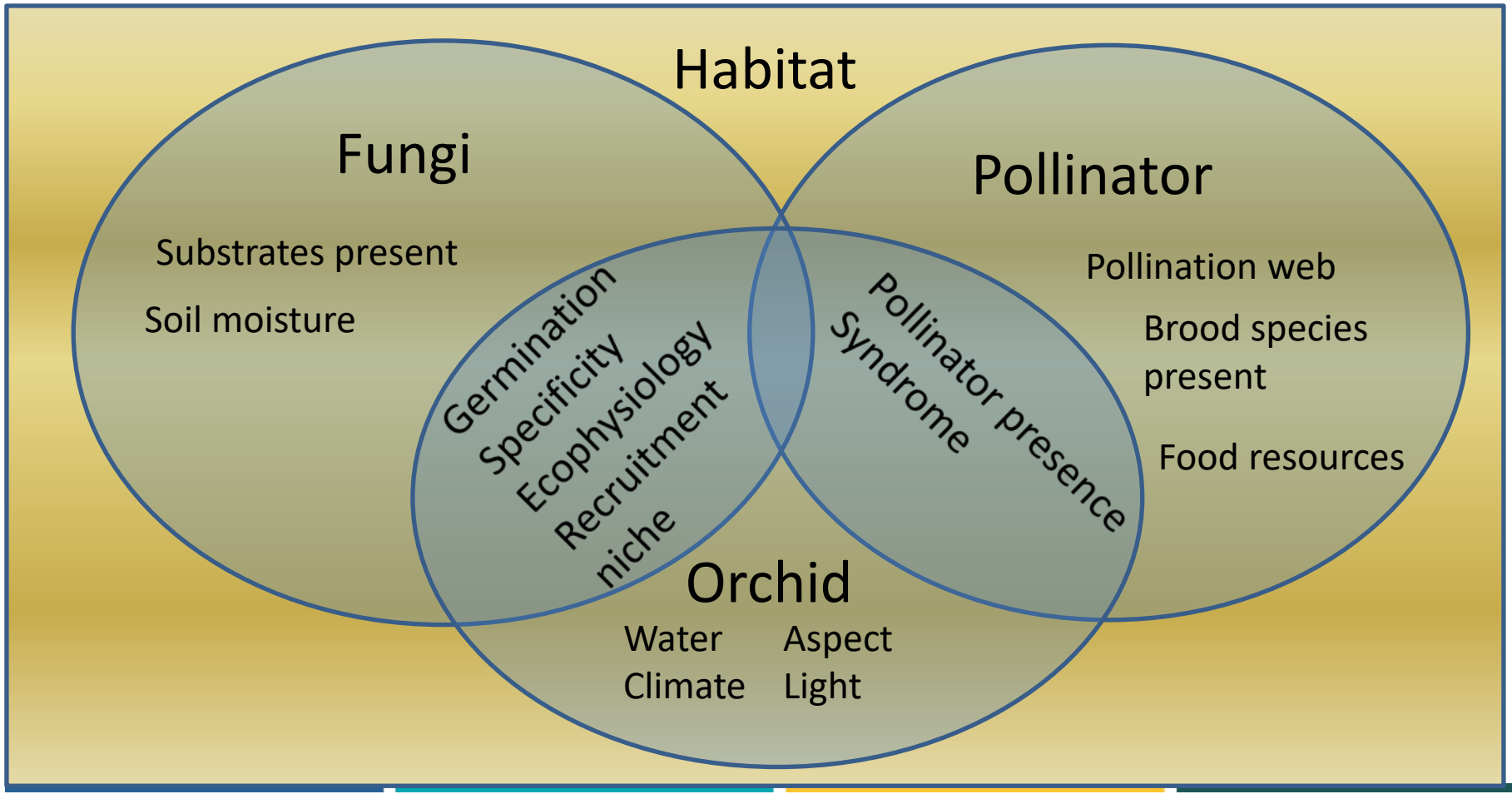
Exploit nutrition niche

Life history

Summer dormancy

Clonal

Habitat SRE to generalists


Habitat
Fungi
Substrates present
Soil moisture
Pollinator
Pollination web
Brood species present
Food resources
Germination
Specificity
Ecophysiology
Recruitment
niche
Pollinator presence
Syndrome
Orchid
Water
Aspect
Climate
Light

T- >20 to 3 years

Ex situ

T-2 to 5 years

Pollinator studies

T-1 year

Approvals

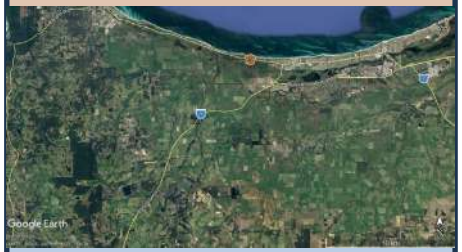
Time zero

Planting day

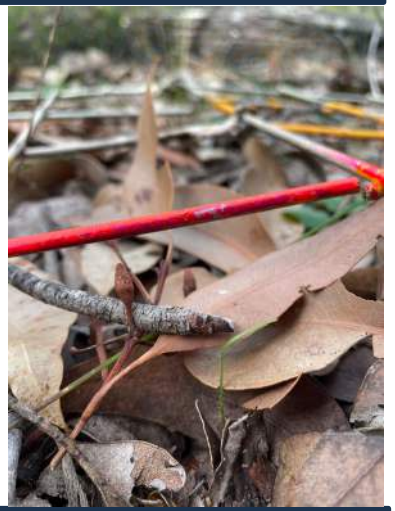
T-7 to 3 years

Propagation

T-2 to 1 years



Site selection

Time post planting	Short term 1-3 yrs	Mid term 3-7 yrs	Long term 8+ yrs
			
Success Criteria	Survival	Reproductive function	Self Sustainability
Key Interactions	• Mycorrhizal	• Mycorrhizal • Pollinators	• Mycorrhizal • Pollinators • Site selection

Long term success = significant pre planting investment

Translocations

- First step in translocating with interactions is understanding how to reproduce/manage/mitigate interaction
- Translocating with mycorrhiza (symbiotic propagation) increases survival from 50% to 61%.
- Ensuring pollinator presence increases fruit set from 25% to 63%

Two key interactions in translocation success

Orchid re-introductions: an evaluation of success and ecological considerations using key comparative studies from Australia

Noushka Reiter, Julie Whitfield, Gail Pollard, Wendy Bedggood, Mary Argall, Kingsley Dixon, Belinda Davis & Nigel Swarts

Plant Ecology **217**, 81–95 (2016) | Cite this article

JOURNAL ARTICLE

Orchid conservation: from theory to practice

Ryan D Phillips, Noushka Reiter, Rod Peakall

Annals of Botany, Volume 126, Issue 3, 1 September 2020, Pages 345–362,
https://doi.org/10.1093/aob/mcaa093

Published: 14 May 2020 **Article history**

Plant Ecology (2023) 224:715–727
https://doi.org/10.1007/s11258-023-01334-0

Improving conservation and translocation success of an endangered orchid, *Caladenia xanthochila* (Orchidaceae), through understanding pollination

Noushka Reiter[1,2,3] · Mike Wicks[1] · Gail Pollard[1] · Graham Brown[4,5,6] · Myles Menz[7,8] · Björn Bohman[2,9,10]

SETBACKS AND SURPRISES

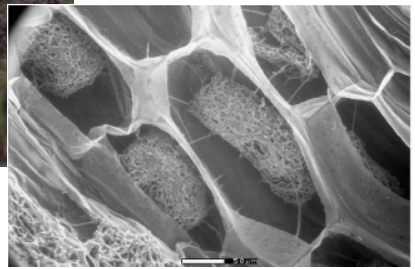
Translocation of threatened terrestrial orchids into non-mined and post-mined lands in the Hunter Valley of New South Wales, Australia

Stephen A.J. Bell

First published: 19 June 2020 | https://doi.org/10.1111/rec.13224 | Citations: 4

Mycorrhizal interactions

- Ex situ collections, screening and establishing germination protocols play critical role in future success – bank knowledge and material for future
- *Pterostylis sinuata* – of 17 isolates, only 2 efficacious. Initial efforts failed due to low collection
- Limited understanding of long-term fungal longevity in storage across genera

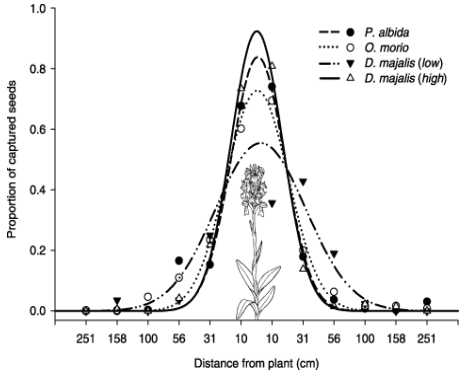


Mycorrhiza in translocations

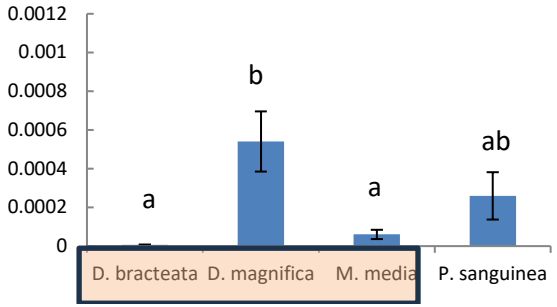
- Good news – using symbiotic propagation we can jump the germination hurdle (<1% to 65-95% germ).
- Delivers mycorrhiza to site as inoculation source.
- Soil core planting delivers symbiosis intact - better survival.

What next?

- Can use common ‘donor’ orchids to harvest fungal species, beyond germination unclear.
- Fungal physiology studies suggest differential nutrition between isolates. Survival post planting?
- Planting density optimization for recruitment – harness parental nurture network



Jersakova & Malinova, 2007



Davis et al., 2022

Pollinator interactions

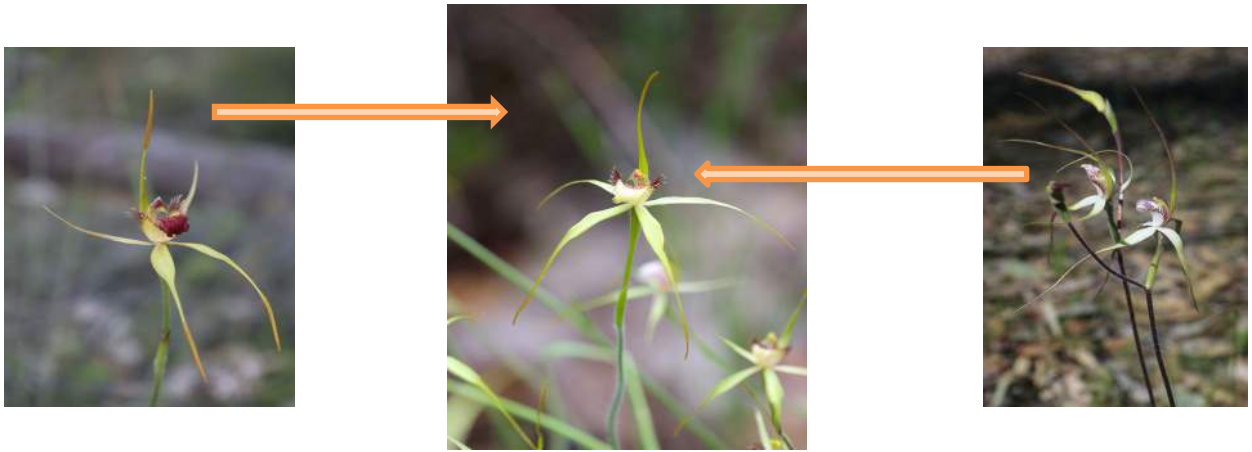
- Understanding pollination ecology for an orchid species
  - Who? One or multiple pollinators?
  - How? Syndrome can dictate how well pollination will happen/can be restored
  - When? How often is natural seed set happening

- Do potential planting sites have pollinators?

- Need to wait for flowers?

Case study: The hustle for Bussell's

- Pollination syndromes – a spectrum
- Generalist good, specialist hard, mix of syndromes has consequences
- Management commitment to hand pollination



Sexual deception

Bit of both ???

Food deception

Lots of visitors! But who is important?

Thynnid wasps, landed, 50% fed (in copula), removed pollen

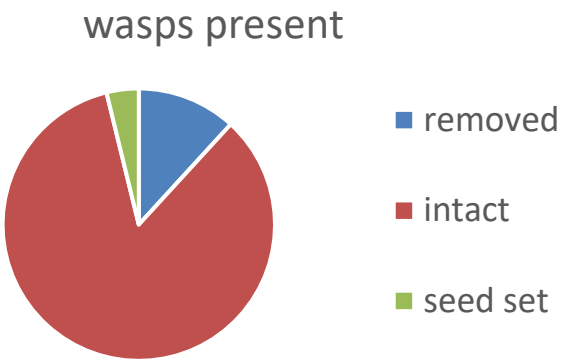
Bombylid sp. approach, no landing

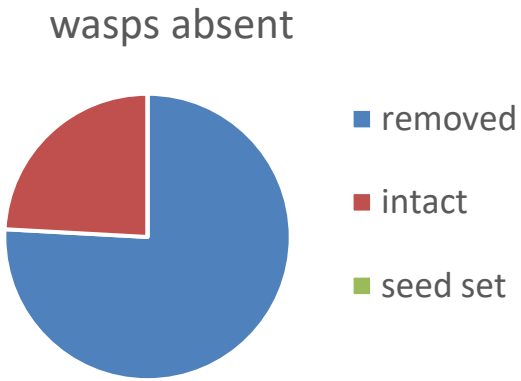
Syrphid flies landed, 75% fed

Apis mellifera landed, 100% fed, pollen removed

2022 intensive regional surveys confirmed the wasp as the main pollinator, and 3 sites

Pollen fates in a mixed syndrome



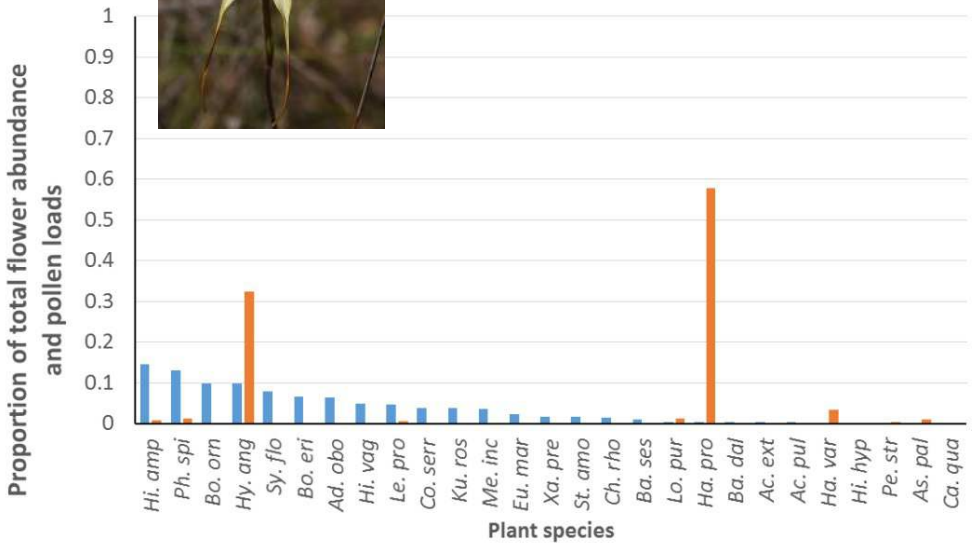


61% of pollen is being lost from system!

Translocation Implications

- Active management of seed set in wild and translocated plants a possible commitment
- Planting density/spatial placement optimization for wasp attraction and secondary pollinators

What next?



Not yet at restoring pollinators – research gap

Orchid pollinators visit a small number of nectar producing plants

Co-planting food plants to support pollinator abundance at translocation sites

Need to ensure not introducing hybrid risk zones in translocations

Human interactions

Bring conservation actions to fruition

LANCO

Department of Biodiversity, Conservation and Attractions

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AUSTRALIAN SEEDBANK PARTNERSHIP

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ATH Australian Tropical Herbarium

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30 YEARS of Friend

WWF AUSTRALIA

Beyond orchids

- Understanding of ecological networks means we can also exploit them to improve translocation success
- Mycorrhizal interactions when not obligate- do they improve translocation success? 80% of plants have mycorrhizal associations!
- Achieving self sustainability goals of translocations by considering pollinator interactions and intactness of pollinator networks or co-release.
- What level of management intervention/research investment are we comfortable deploying to avoid extinction?

Thank you!

Any questions?