

“Managing Ecosystem Change in the Greater Blue Mountains World  
Heritage Area”

# How could climate change affect plants and what are their dispersal options?

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Prof Richard Kingsford, Dr Dan Ramp, Dr Shiquan Ren, Dr Tony Auld, Dr Angela  
Moles.

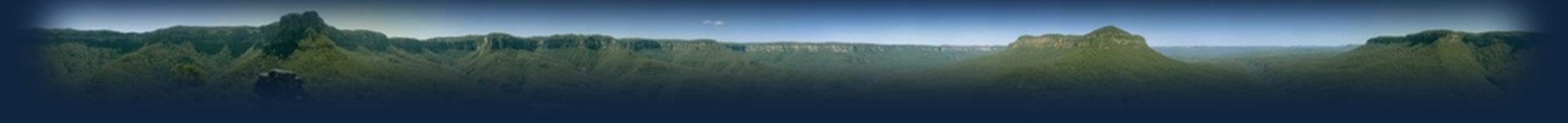


# Why study plant dispersal?



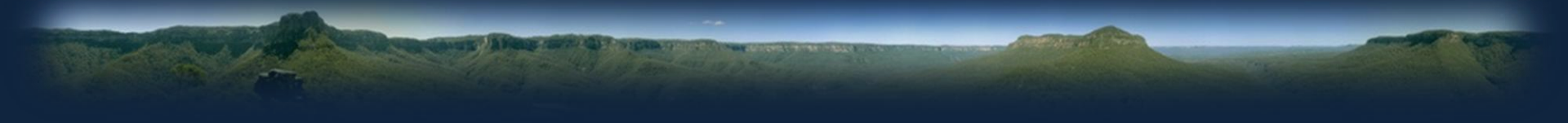
Adapt in situ  
to new climate

Move to  
appropriate  
climate



# Summary of Talk

1. How far can plants disperse?
2. How do plants disperse in the GBMWHA?
  - a) Can we predict unknown mechanisms
3. Does a dispersal system alter in different climates?
4. Landscape connectivity; how does isolation affect plant communities?



# 1. How far do plants disperse?



Long Distances

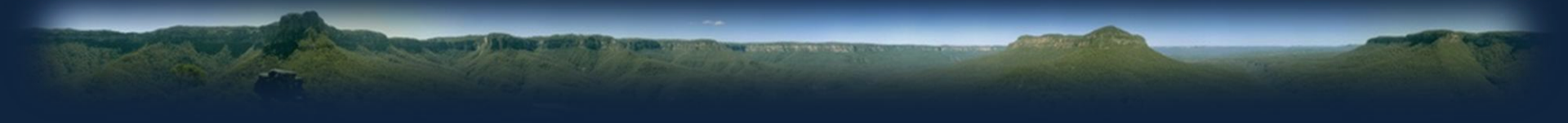


Short Distances

# 1. How far do plants disperse?

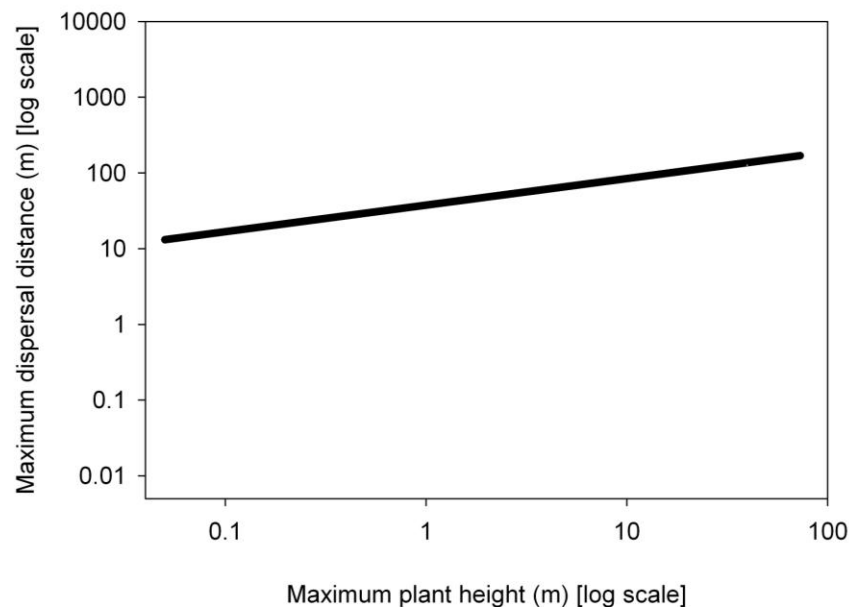
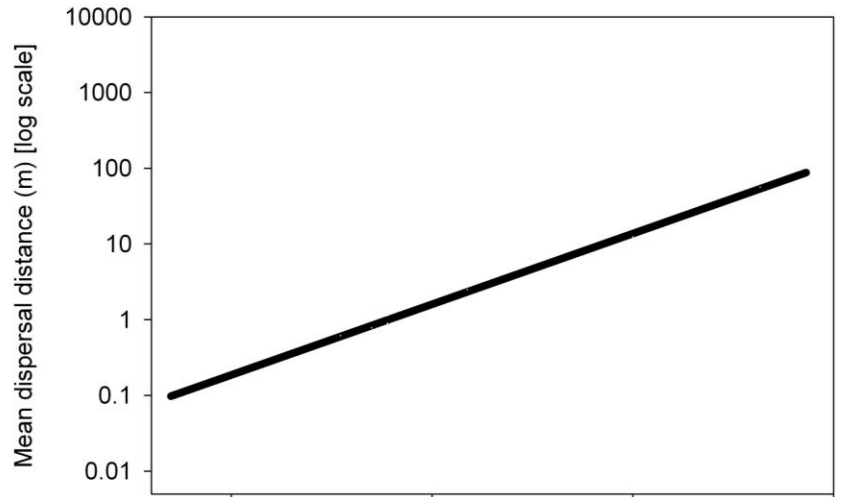
Dispersal Vector	Mean distance (m)	Mean Range (m)
<b>Unassisted</b>	<b>3</b>	1-18
<b>Wind</b>	<b>8</b>	1-54
Water	614	1-4050
<b>Ballistic</b>	<b>1</b>	1-5
Attachment	51	2-128
Ingestion	337	3-1222
Seed caching	23	1-263
<b>Ant</b>	<b>5</b>	1-94

Table: Global compilation of species dispersal distances



# Do taller species go further?

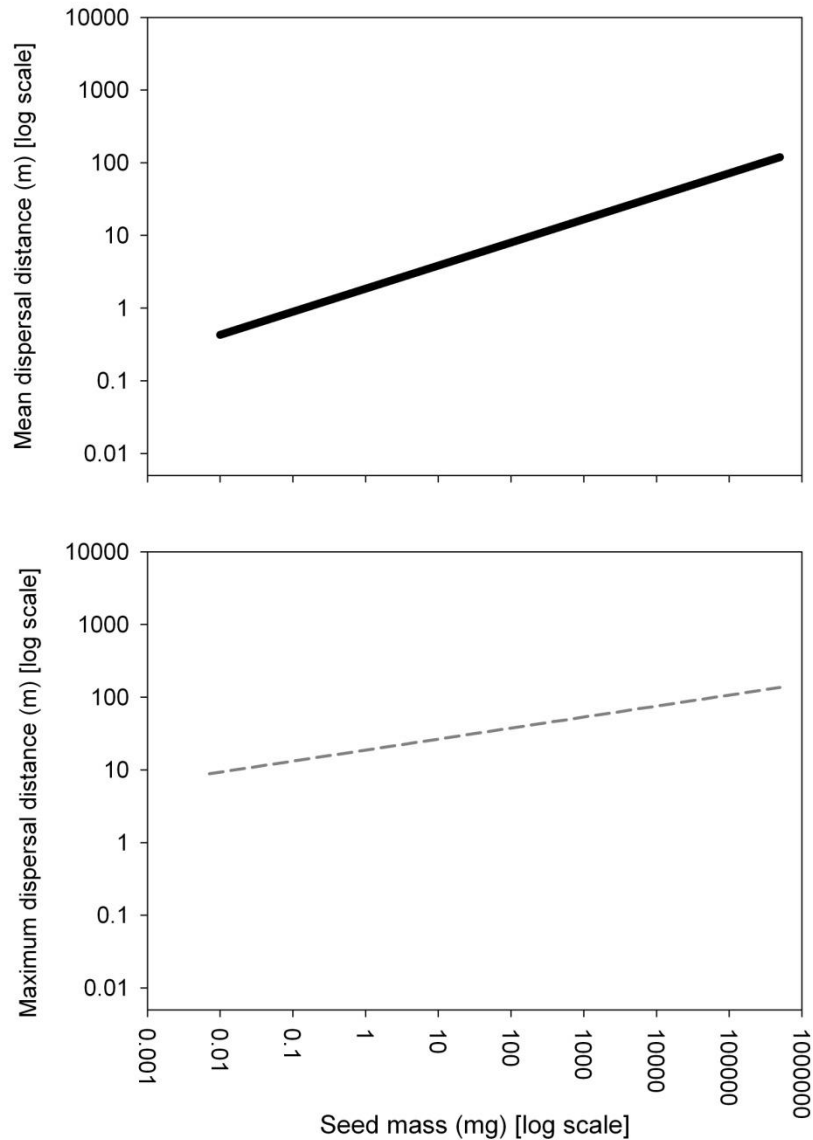
Yes both mean and maximum dispersal distances increase as plant height increases!



# Do large-seeded species go further?

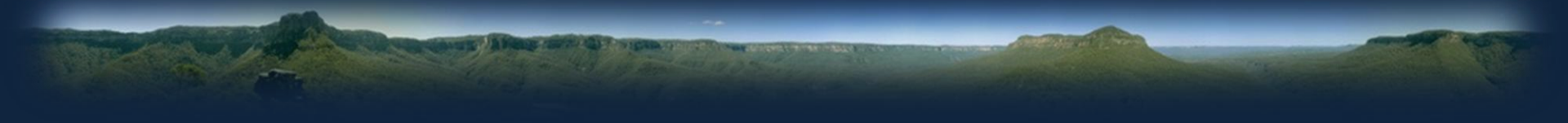
Yes both mean and maximum dispersal distances increase as seed mass increases!

BUT .....



# 1. How far do plants disperse?

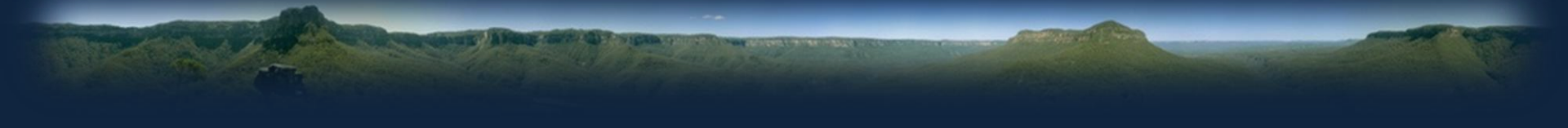
- Ant, unassisted and ballistic short distance dispersal mechanisms (wind?)
- Ingestion & attachment long distance dispersal mechanisms
- Across all dispersal mechanisms
  - Taller plant species have greater mean and maximum dispersal distances



# Management implications

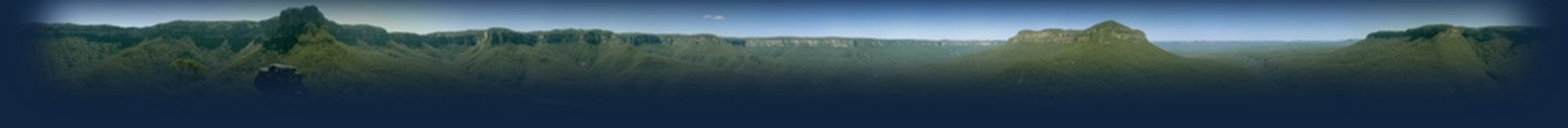
Species of concern under climate change

- Short species
- Species that use short dispersal distance vectors
  - Ballistic, ant, unassisted, wind?
- Management of biotic interactions (dispersal)

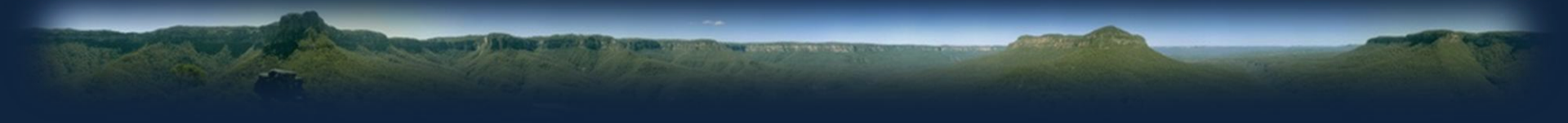
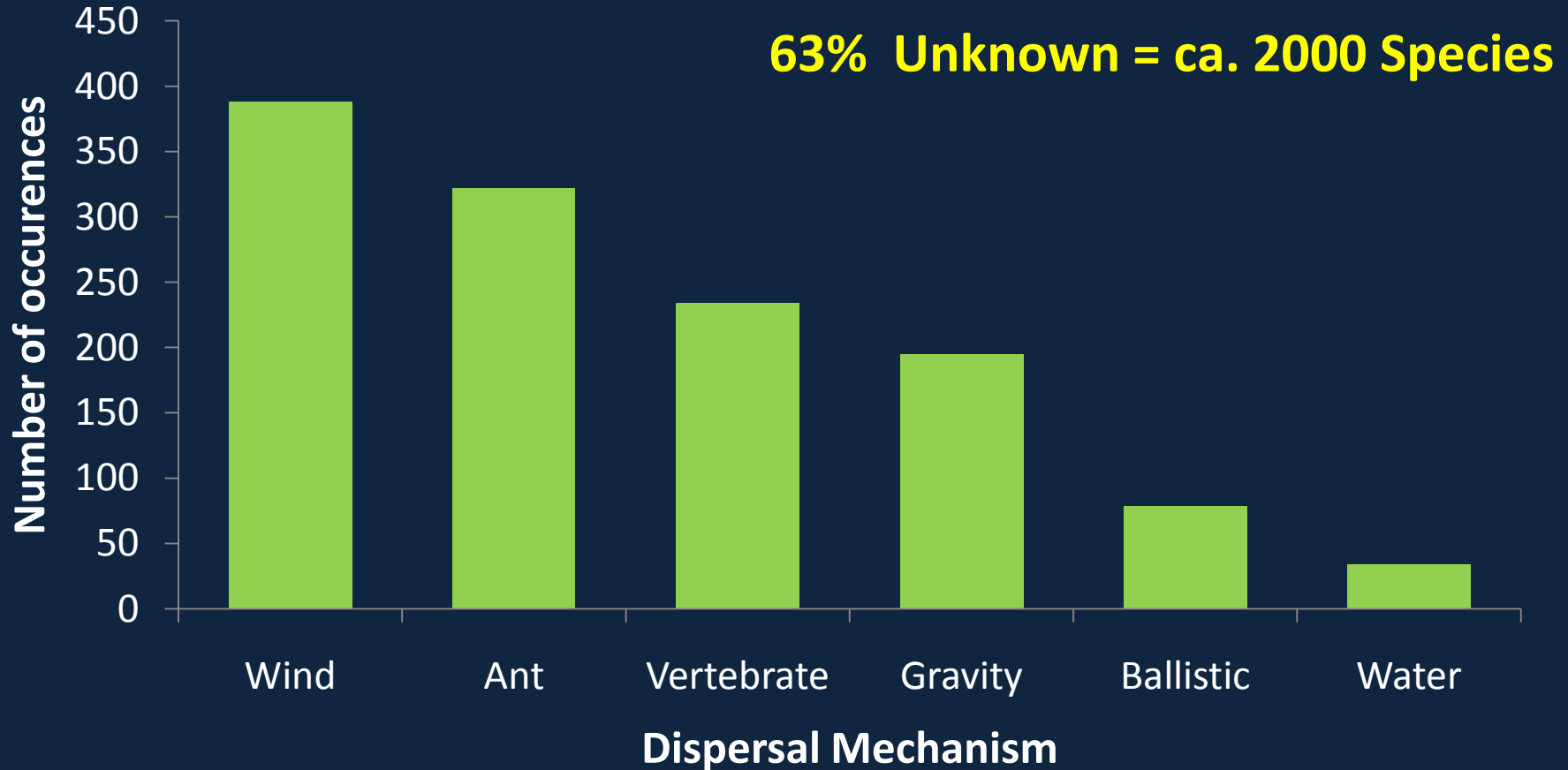


## 2. How do plants disperse in the GBMWHA?

- Study Region: Greater Sydney area
  - 4.1 million hectares
  - 3,143 plant species, 198 families
- Data Collection on dispersal mechanisms
  - Unpublished/published databases & literature
  - 1,162 species = 37%



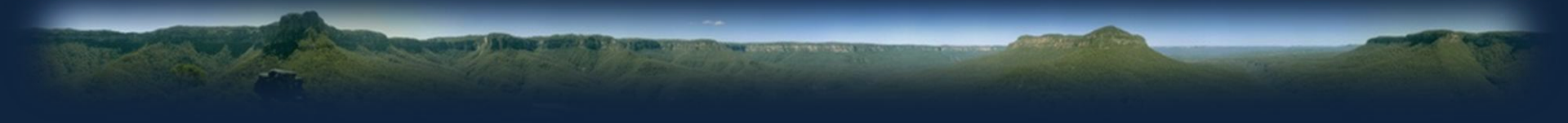
# Known Dispersal Mechanisms in the Greater Sydney Region



# What do we know?

Family	Total Species	% with known Dispersal Vectors
Proteaceae	133	80%
Rutaceae	91	65%
Myrtaceae	260	55%
<b>Asteraceae</b>	<b>188</b>	<b>48%</b>
<b>Ericaceae</b>	<b>88</b>	<b>39%</b>
<b>Fabaceae</b>	<b>308</b>	<b>38%</b>
<b>Poaceae</b>	<b>247</b>	<b>15%</b>
<b>Orchidaceae</b>	<b>275</b>	<b>13%</b>
<b>Cyperaceae</b>	<b>165</b>	<b>12%</b>
<b>Lamiaceae</b>	<b>64</b>	<b>9%</b>

Table: 10 most diverse families in Greater Sydney Region



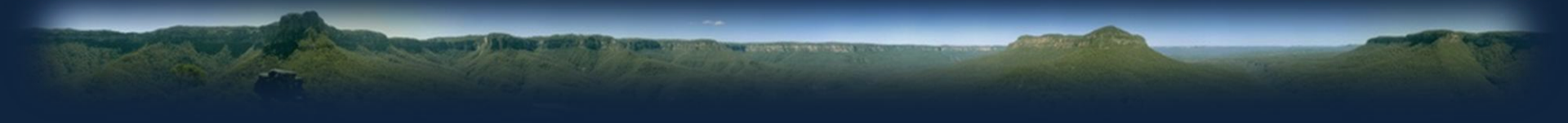
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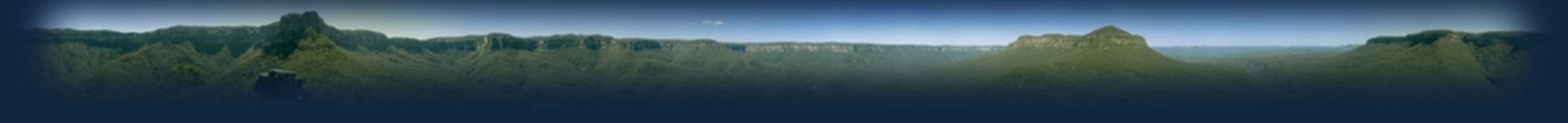
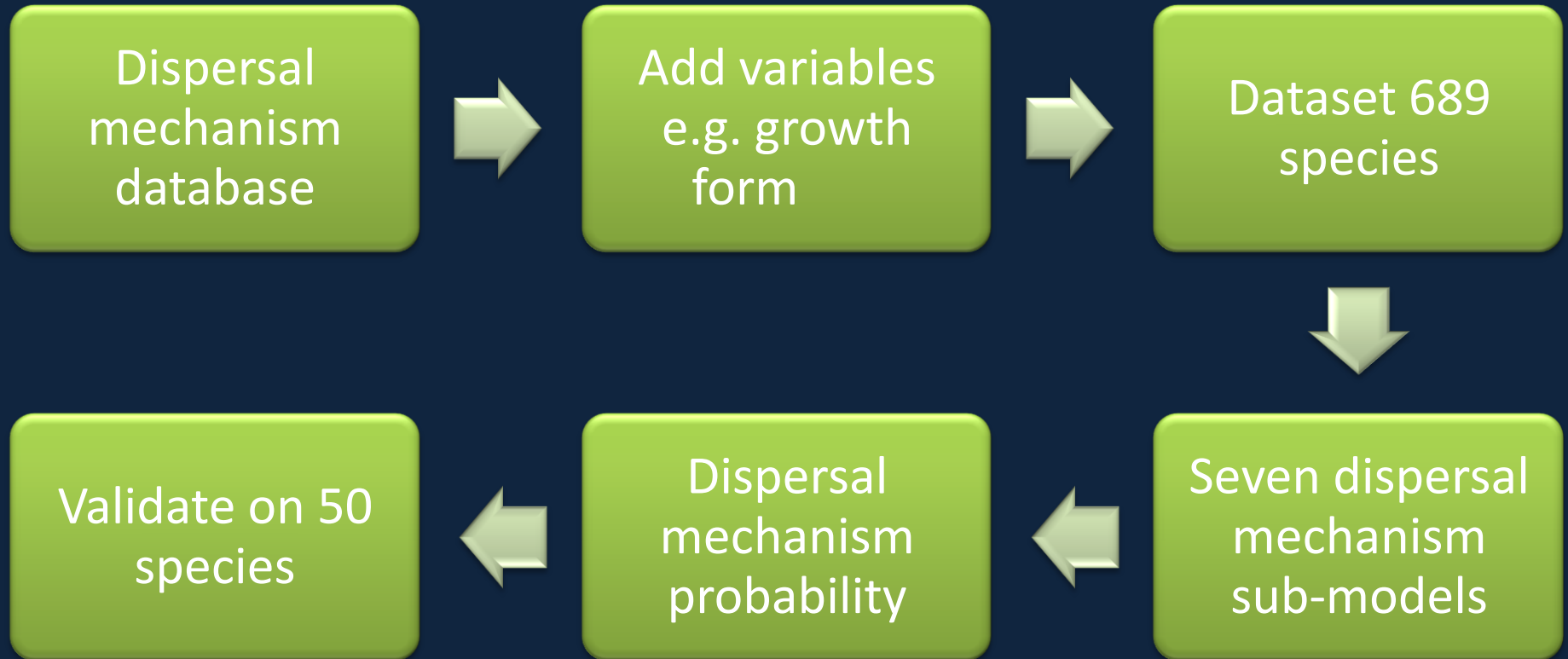
Can we fill the gap?

Orchidaceae	275	13%
Cyperaceae	165	12%
Lamiaceae	64	9%

Table: 10 most diverse families in Greater Sydney Region

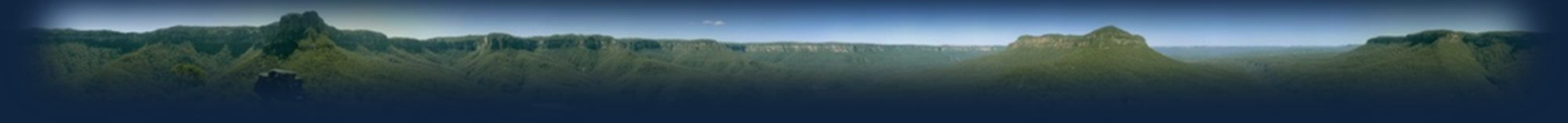


# Predict Dispersal Mechanisms



Variable	Wind	Water	Ant	Ingest	Attach	Gravity
Climber			--	+		
Herb		+	--	---		+++
Shrub	---					
Tree	+++		--	+++		--
Canopy Seed	+++					
Forest		---				
Grass or Swamp			---		++	+
Rainforest			---	+++		
Seed > 100mg		+		+++		
Seed < 0.1mg				-		++

+0.05 -0.01 ++ 0.01-0.001 +++ <0.001



# Predicting Dispersal Mechanisms



*Brunoniella australis*



Dispersal Mechanism	Probability of dispersal mechanism
Wind	32%
Water	2%
Ant	9%
Ingestion	0%
Attachment	0%
Gravity	72%

# Predicting Dispersal Mechanisms



*Notelaea longifolia*

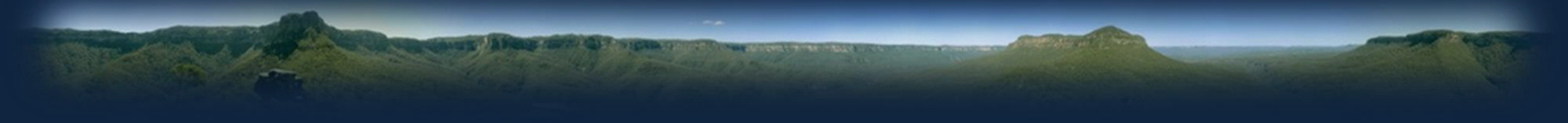
Dispersal mechanism	Probability of dispersal mechanism
Wind	10%
Water	0%
Ant	2%
Ingestion	85%
Attachment	0%
Gravity	1%

# Can we fill the gaps?

YES...

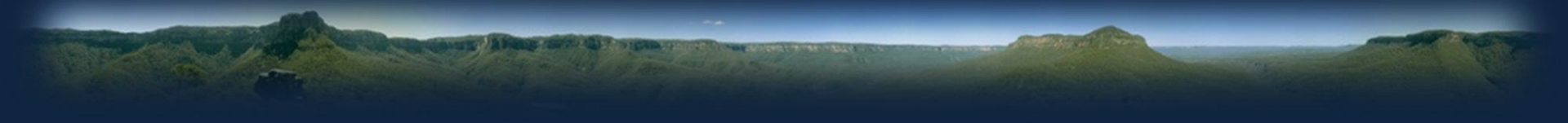
- Models make biological sense!

Probability value of top model	Predicted ( <i>n</i> )	Correct
> 50%	42	71%
Top model	50	66%

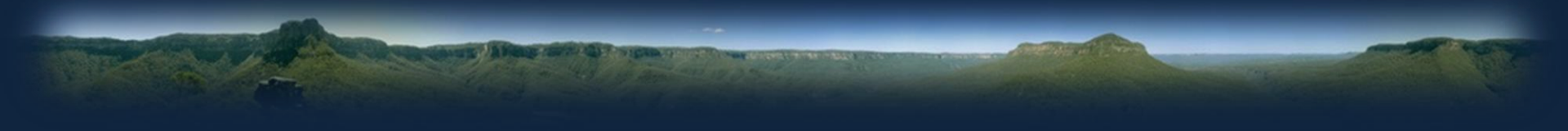
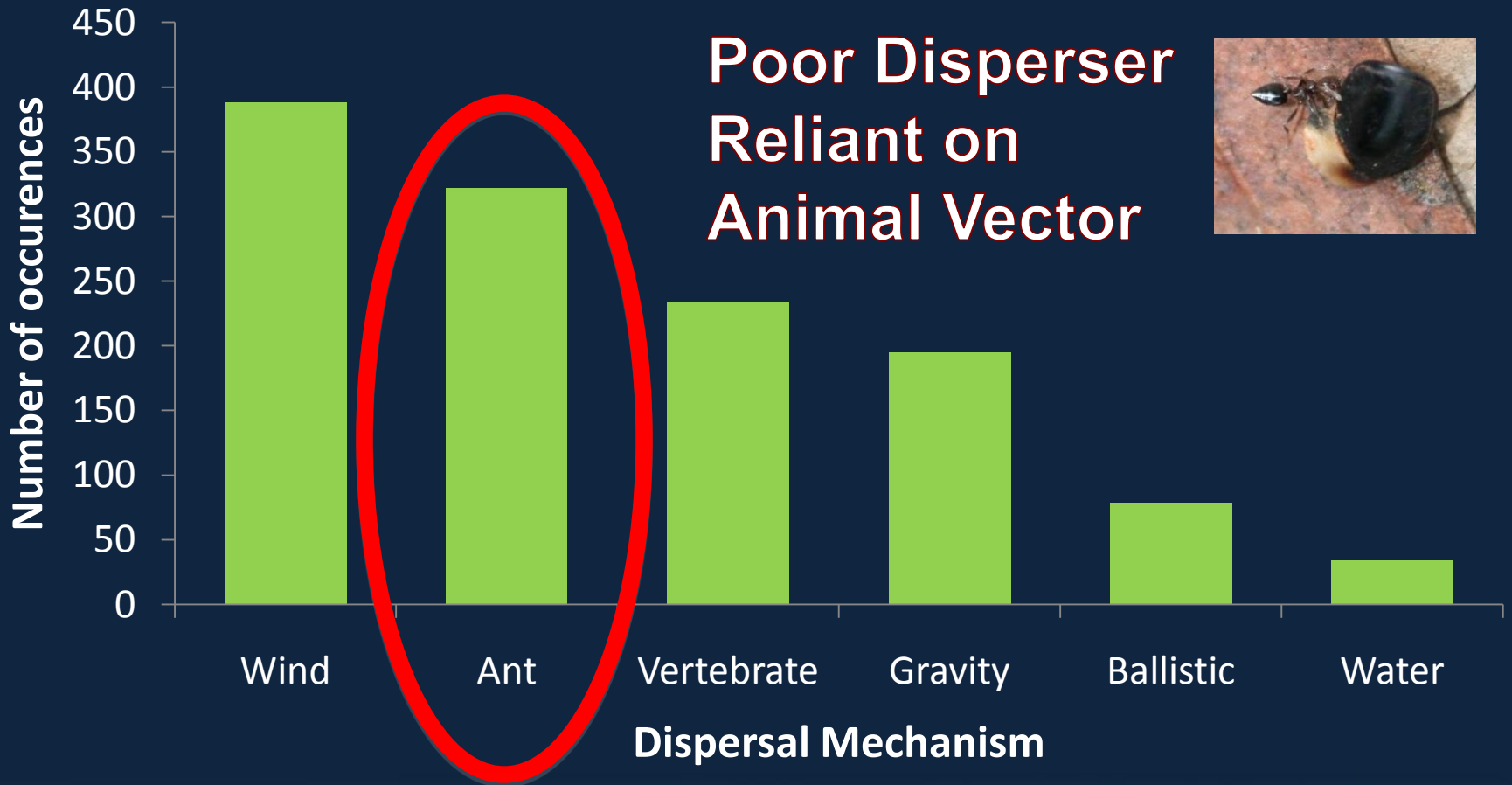


## 2. How do plants disperse in the GBMWHA?

- Idea of dispersal mechanisms and distances for species where there are no data
- Dispersal mechanism information
  - Indicate species that are dispersal limited
  - Added to species distribution models
- Model needs improvement, but promising results

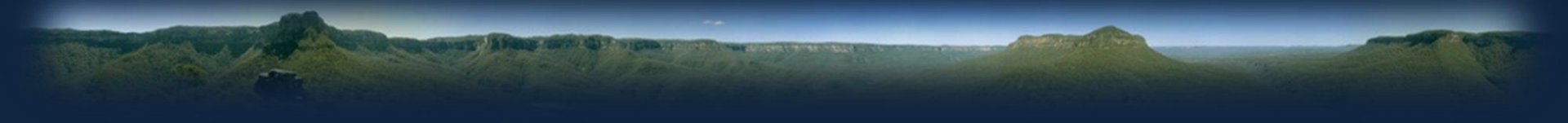


### 3. Does a dispersal system alter in different climates?



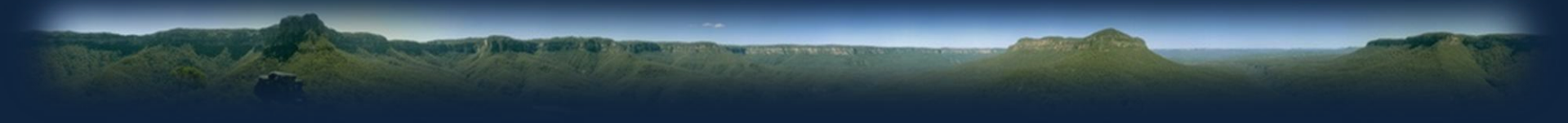
# 3. Does a dispersal system alter in different climates?

- YES...
  - Low elevation (warmer) seeds dispersed primarily by ants
  - Higher elevations (cooler) other vector or seed predator
- More effective seed disperser at low elevations
- GOOD NEWS: Expect ant dispersal system to be retained, but be different



## 4. Landscape connectivity; how does isolation affect plant communities?

- So far... Collected seeds of some hanging swamp species
- Does species composition change with isolation in hanging swamps?
- If anyone knows of vegetation surveys carried out in hanging swamps please come talk to me.



# Final Summary

- How far can plants disperse?
  - Dependent on mechanisms, mean and maximum
  - Species of concern; short using ballistic, ant or unassisted dispersal (wind?)
- How do plants disperse in the GBMWHA?
  - Known for 37%; Mainly ant and wind
  - Can predict for unknown species ca. 70% accuracy



# Final Summary

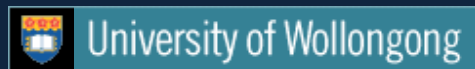
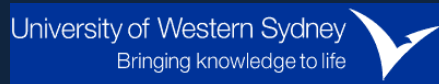
- Does a dispersal system alter in different climates?
  - Yes, but may ‘improve’ ant dispersal
- Landscape connectivity; how does isolation affect plant communities?
  - Working on it!!



# Thank you

Many people that gave data including Mark Westoby, Barbara Rice, Sydney Royal Botanic Gardens Staff (Doug Benson), Mt Annan Botanic Gardens Staff.

List too long but thanks to all that have given advice, and support in one way or another!



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