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

Plant dispersal in relation to a changing climate

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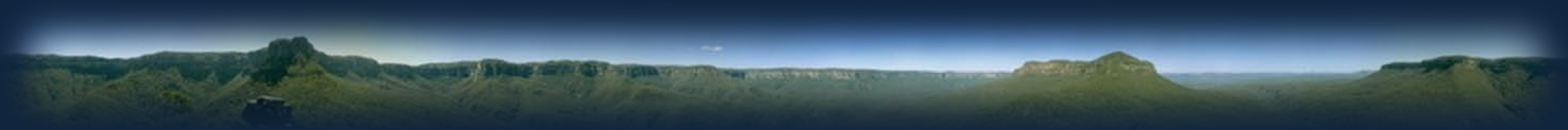
Climate Change

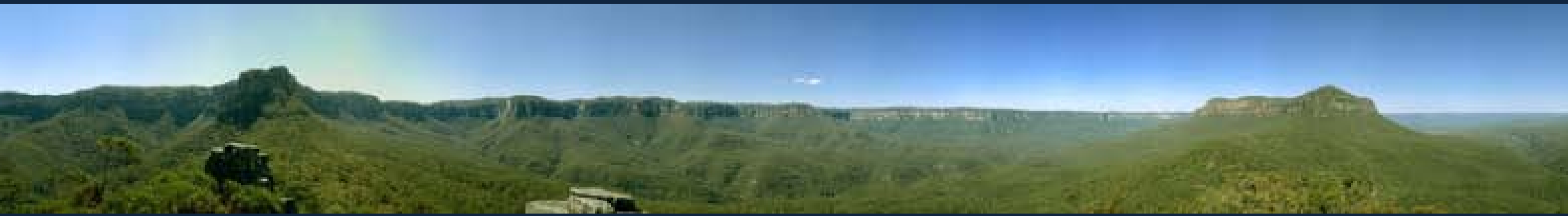
Adapt in situ to new climate

Move to appropriate climate



Aims of Study

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



1. How far can plants disperse?

Few studies on seed dispersal distances across species

- Willson (1993), Vittoz & Engler (2007)

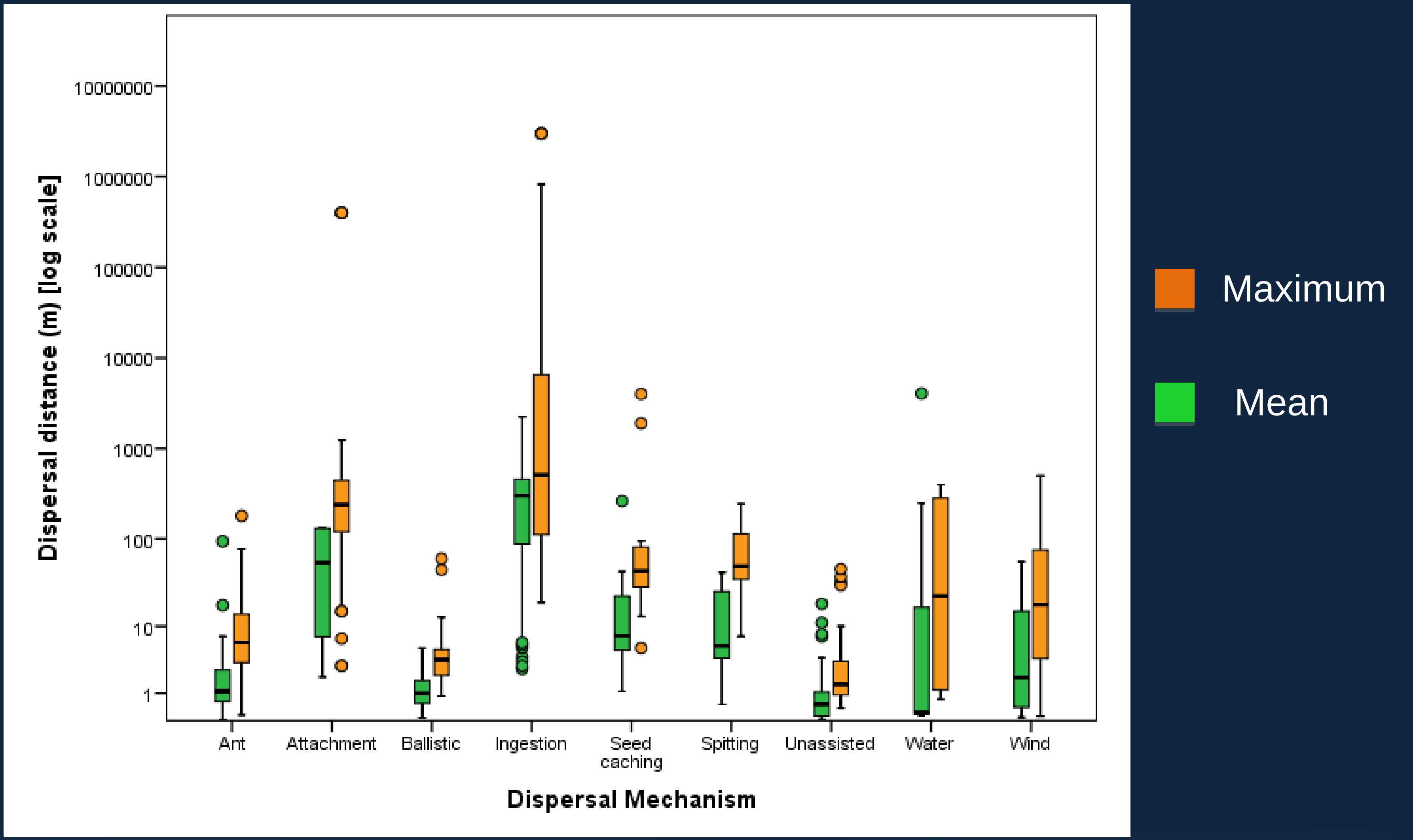
- Global literature review: 1500 articles
- 187 articles with maximum or mean dispersal distances
- 416 species; 101 families

How far do plants disperse?

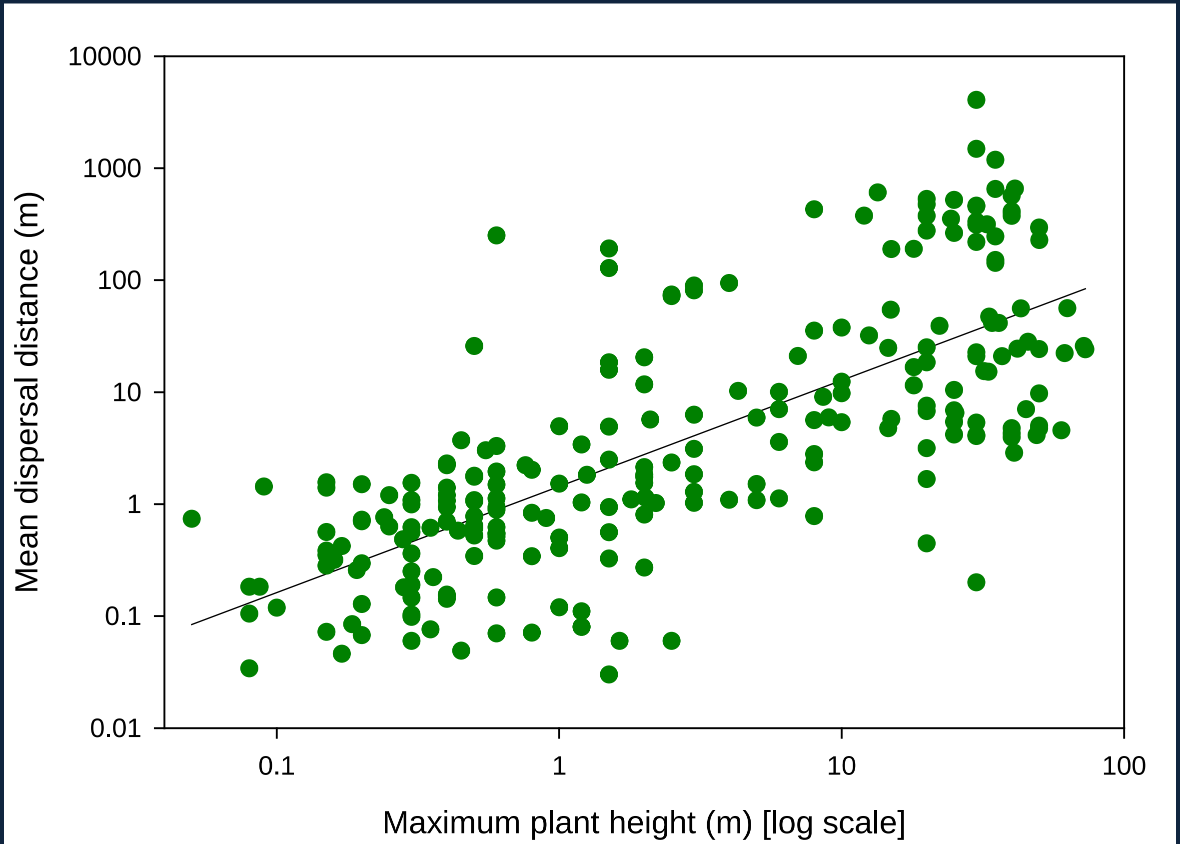
Long Distances

Short Distances

Dispersal distances across species



Taller plants go further?



Mean distance

Adjusted R^2=0.52

$P < 0.001$

N = 217 species

Maximum distance

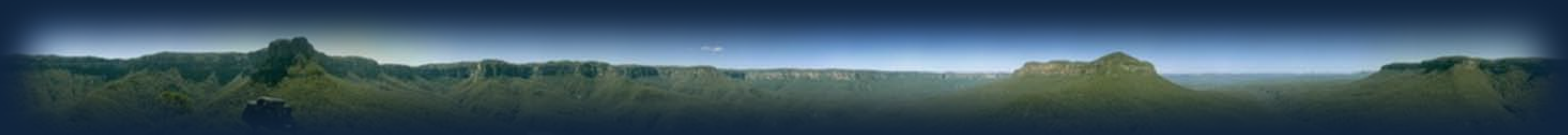
Adjusted R^2=0.03

$P = 0.003$

N = 261 species

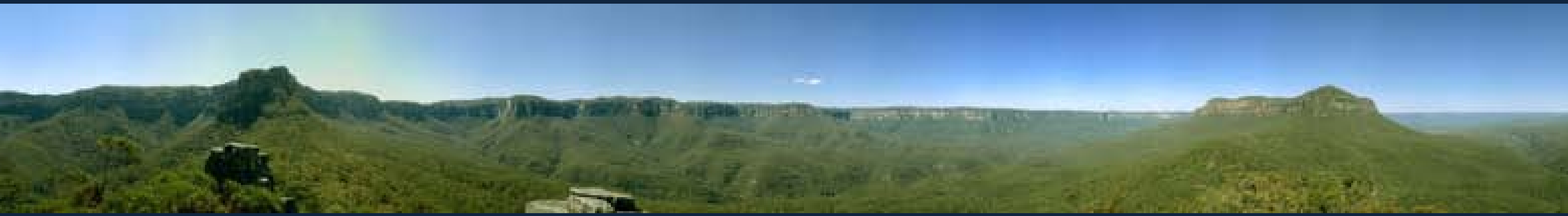
1. Conclusions

- Ant, unassisted and ballistic short distance dispersal mechanisms
- Ingestion & attachment long distance dispersal mechanisms
- Across all dispersal mechanisms
  - Taller plant species and smaller seeded species have greater mean dispersal distances

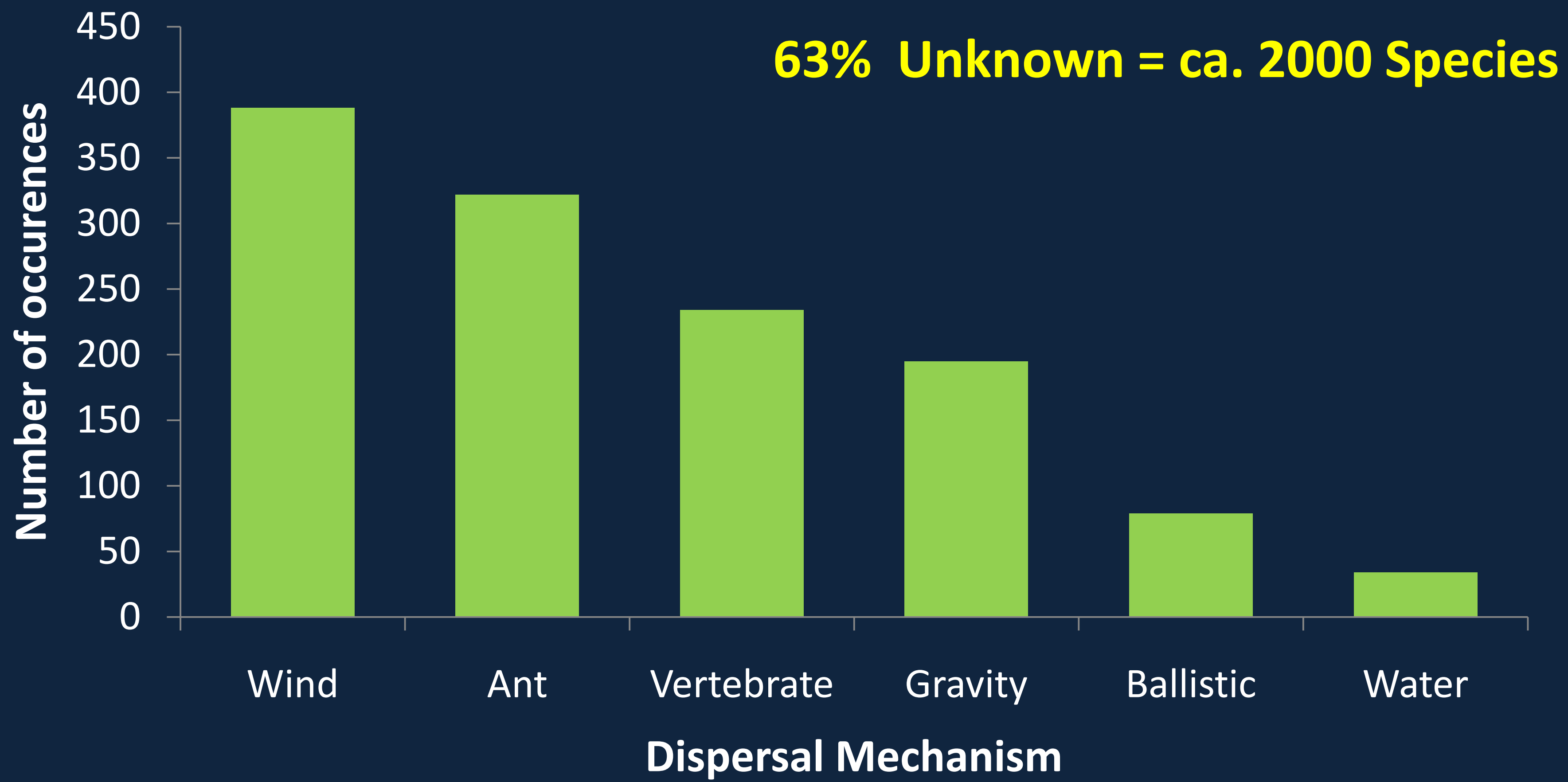


2. How do plants disperse in the GBMWHA?

- 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%
Asteraceae	188	48%
Ericaceae	88	39%
Fabaceae	308	38%
Poaceae	247	15%
Orchidaceae	275	13%
Cyperaceae	165	12%
Lamiaceae	64	9%

Table: 10 most diverse families in Greater Sydney Region

What do we know?

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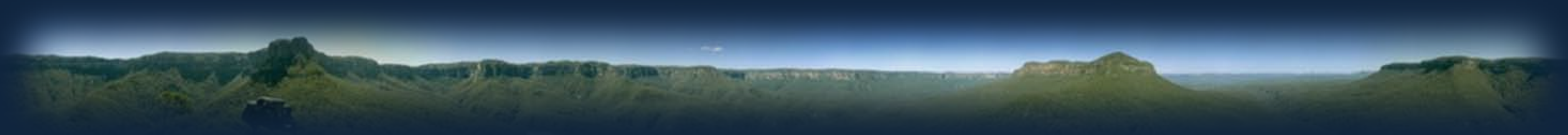
Can we fill the gap?

Table: 10 most diverse families in Greater Sydney Region

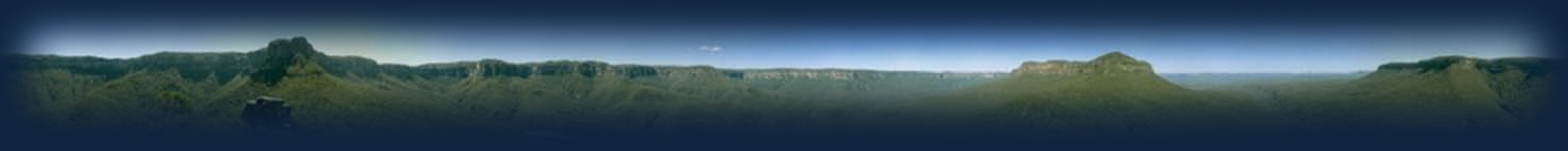
Predict Dispersal Mechanisms

1. Dispersal mechanism database
2. Add variables e.g. growth form
3. Dataset 689 species
4. Seven dispersal mechanism sub-models
5. Dispersal mechanism probability
6. Validate on 50 species



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…

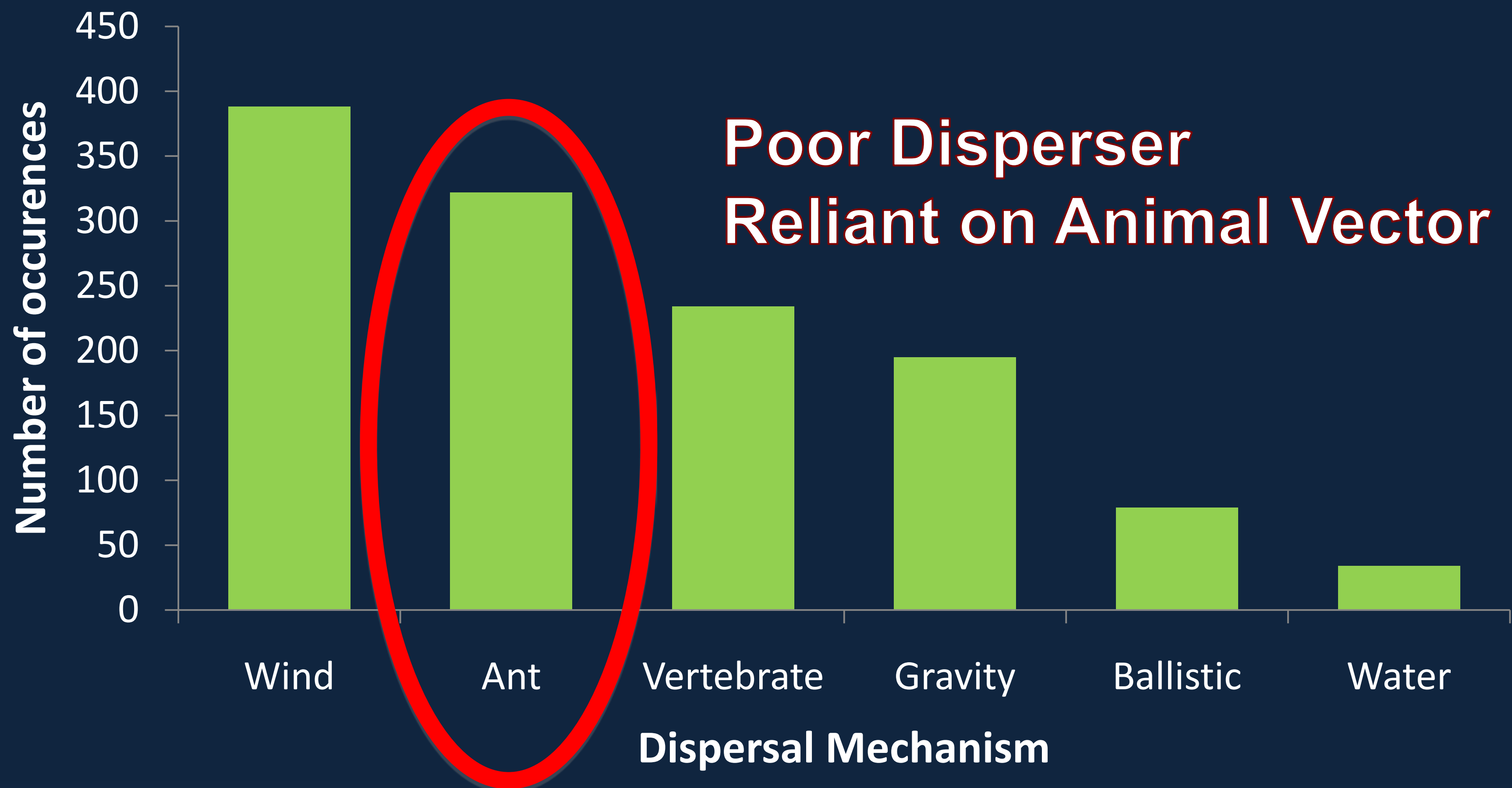
- Models make biological sense!

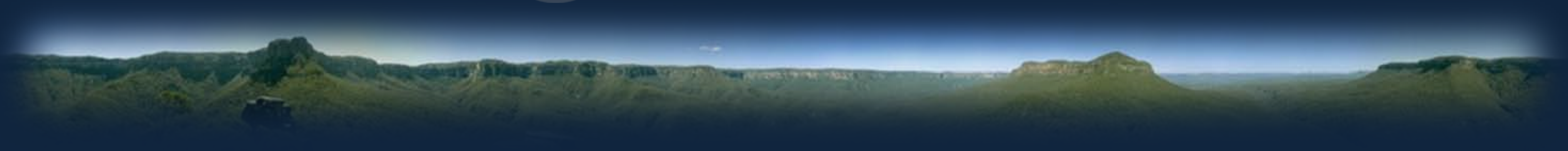
Probability value of top model	**Predicted *(n)***	**Correct**
>75%	23	83%
> 50%	42	71%
Top model	50	66%

2. Conclusions

- 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
- Additional variables or traits
  - Create a ballistic model

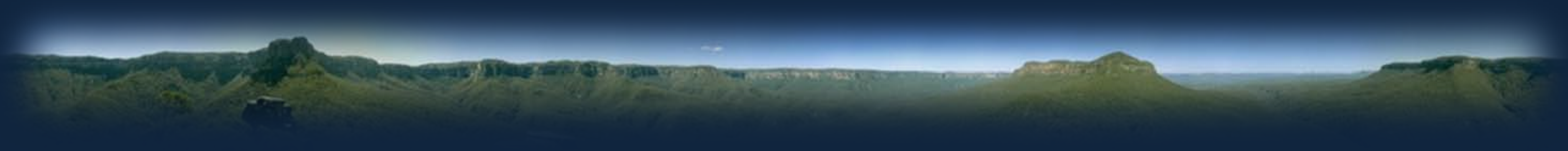
3. Poor dispersers: Does dispersal alter in different climates?





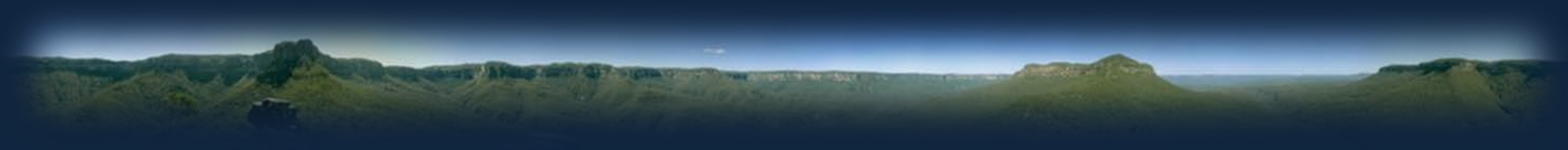
3. Conclusions

- Low elevation (warmer) was primarily ant dispersal
- Higher elevations (cooler), other vector or predator
- More effective seed disperser at low elevations
- GOOD NEWS: Plants should be able to establish at higher elevations



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.

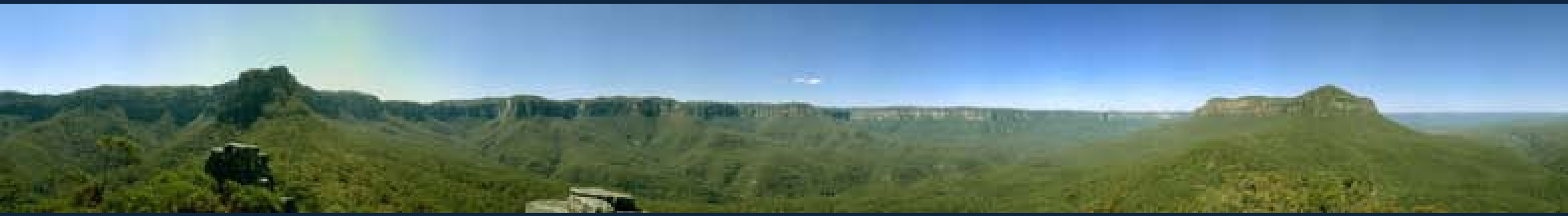


Final Summary

- How far can plants disperse?
  - Dependent on mechanisms, mean and maximum
  - Taller species go further!
- How do plants disperse in the GBMWHA?
  - Known for 37%; Mainly ant and wind
  - Can predict for unknown species ca. 70% accuracy

Final Summary

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



Thank you

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Thanks to the fieldwork helpers!

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