

Hemi-epiphytes in New Zealand: a tropical lifeform in a temperate land

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NEW ZEALAND

Te Whare Wānanga o Tāmaki Makaurau

Hemiepiphytes

- Plants that begin life as epiphytes, then grow roots to the ground
- Mostly colonize large trees but occasionally cliffs, or manmade structures.
- Estimated to be 1472 species of hemiepiphyte from 59 genera globally
- Almost all are tropical, e.g. *Ficus* spp. (strangler figs)
- However, life-form also common in temperate New Zealand forests





Hemiepiphytes in New Zealand

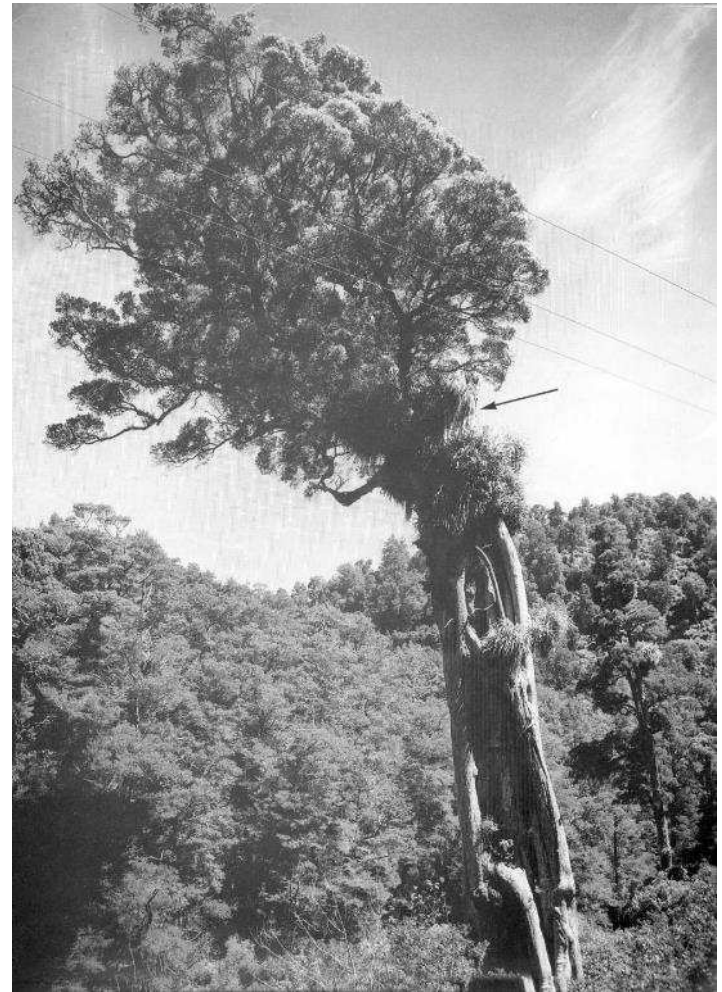
Hemiepiphytes of trees:

- *Metrosideros robusta*, *M. umbellata*, *M. bartlettii*
- *Griselinia lucida*, (*G. littoralis*)
- **Ficus macrophylla*, **F. rubiginosa*

Hemiepiphytes of tree ferns:

- *Weinmannia silvicola*, *W. racemosa*
- *Pseudopanax arboreus*, *P. colensoi*, *P. edgerleyi*
- *Ackama rosifolia*, *A. nubicola*

Metrosideros robusta



Metrosideros bartlettii



IUCN status= critically endangered





Griselinia lucida



Tree fern hemiepiphytes



Pseudopanax arboreus



Weinmannia racemosa

Ackama nubicola



Discovered in 2000 on the Waima Range
Nationally critical

Ecological research questions

1. Epiphytic establishment and host specificity

Are hemiepiphytes non-random in their choice of host and tree position and what mechanisms drive this choice? What is the impact on the host?

2. Life as an epiphyte

How do hemiepiphytes cope with low water and achieve mechanical support as an epiphytic seedling?

3. Metamorphosis

What changes occur in plant physiology and growth rates when arboreal roots reach the ground?

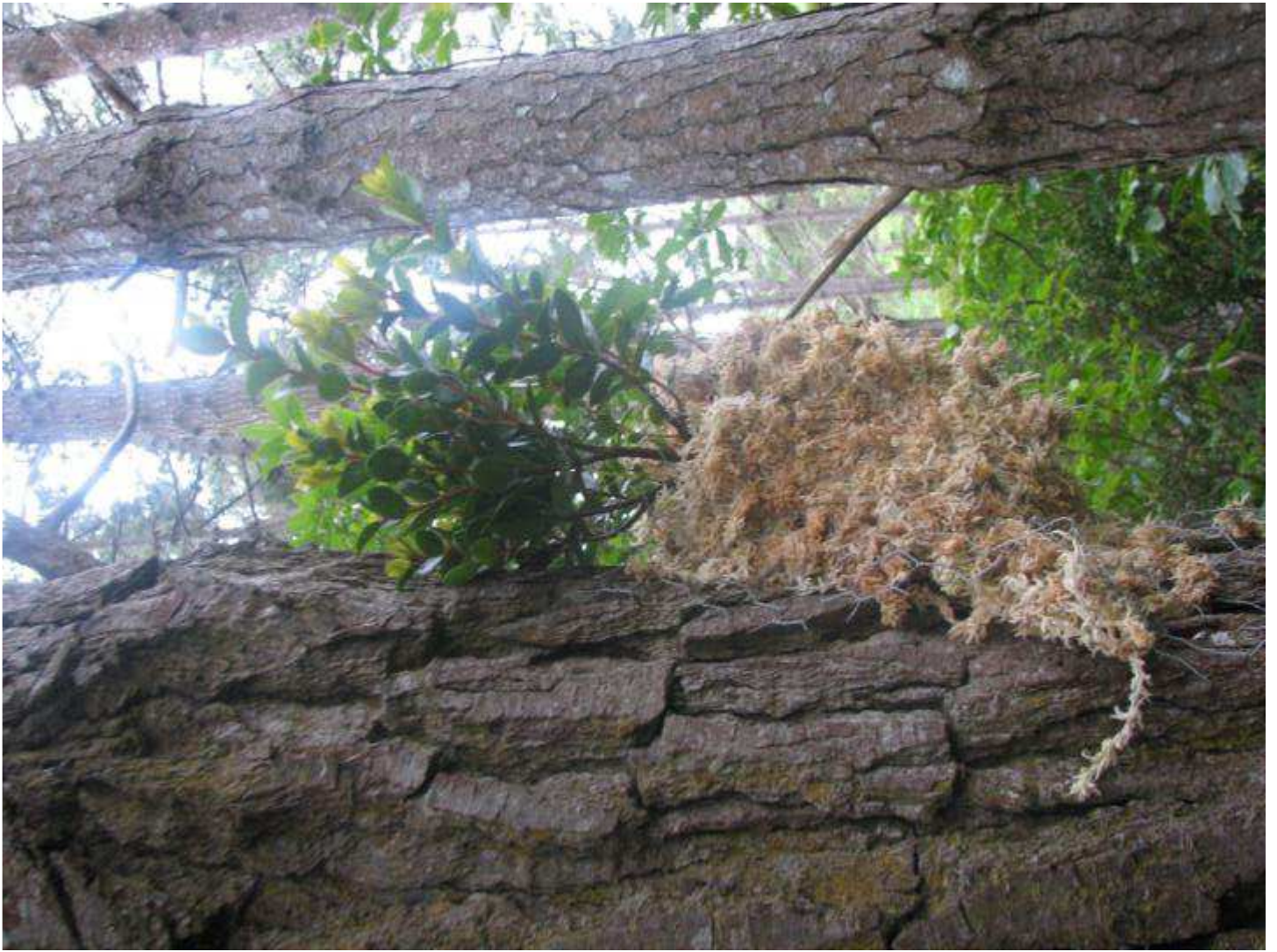
M. robusta restoration experiment

Can hemiepiphytes be reintroduced into mature forest?

1. Does the host species used affect success?
2. How does rooting volume affect success?
3. What light levels are optimal?

389 *M. robusta* seedlings 'planted' to mimic epiphytic establishment at Karori Sanctuary (2007/2008)

– varied host species, rooting volume, canopy cover above seedlings



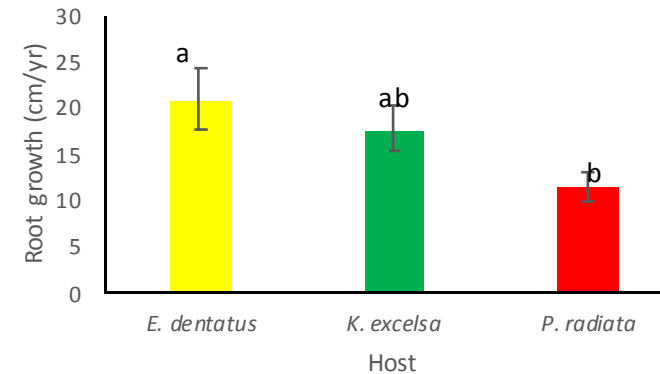
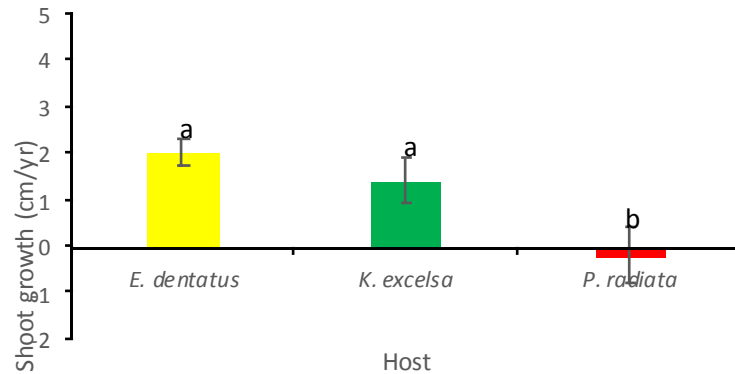
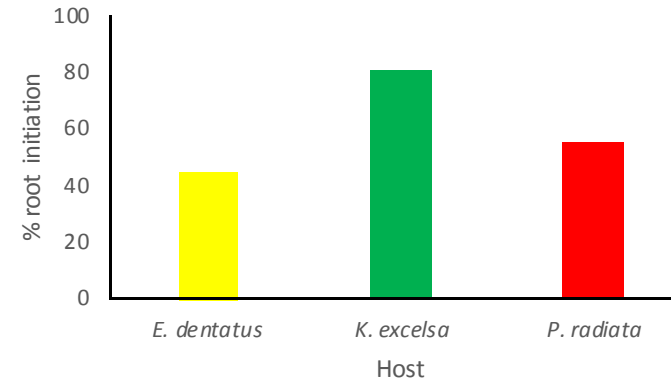
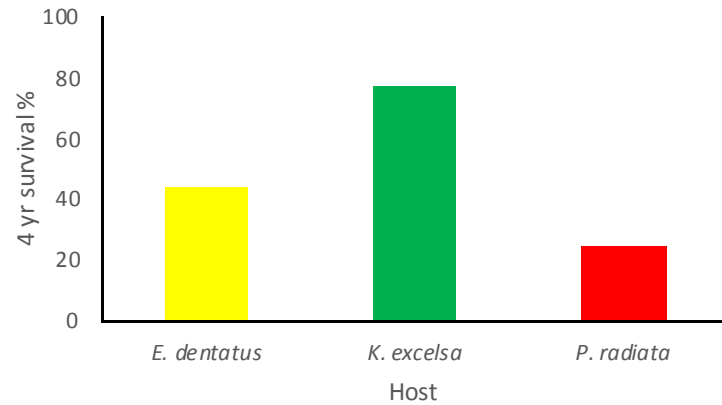


Overall results

- Survivorship: 42% over 4 years
- Shoot growth: 1.25 ± 0.26 cm/year
- Aerial root initiation = 59% of survivors
- Root growth = 17.3 ± 1.6 cm/year
(maximum = 68.5 cm/year)



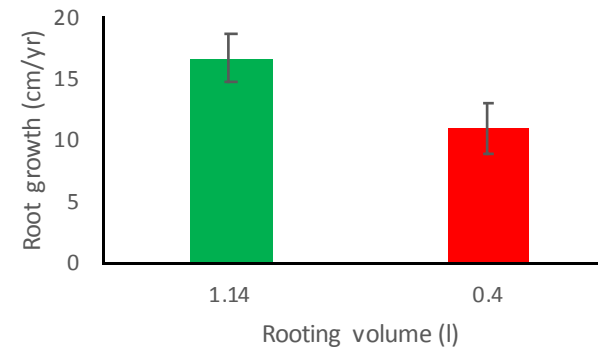
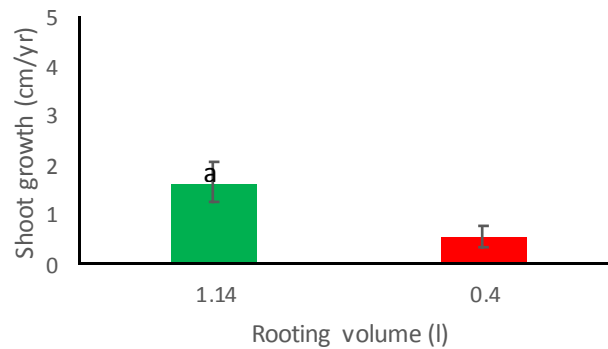
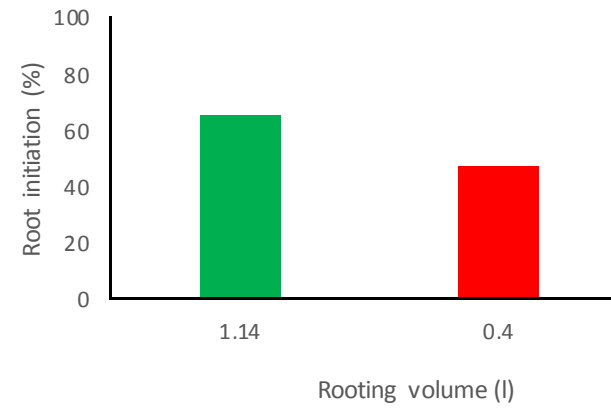
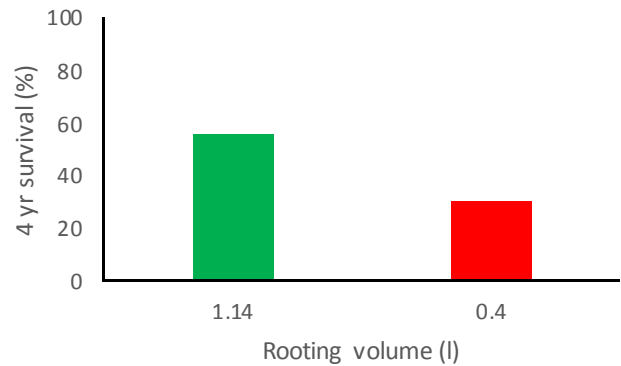
1. Host effect?



Yes

K. excelsa > *E. dentatus* > *P. radiata*

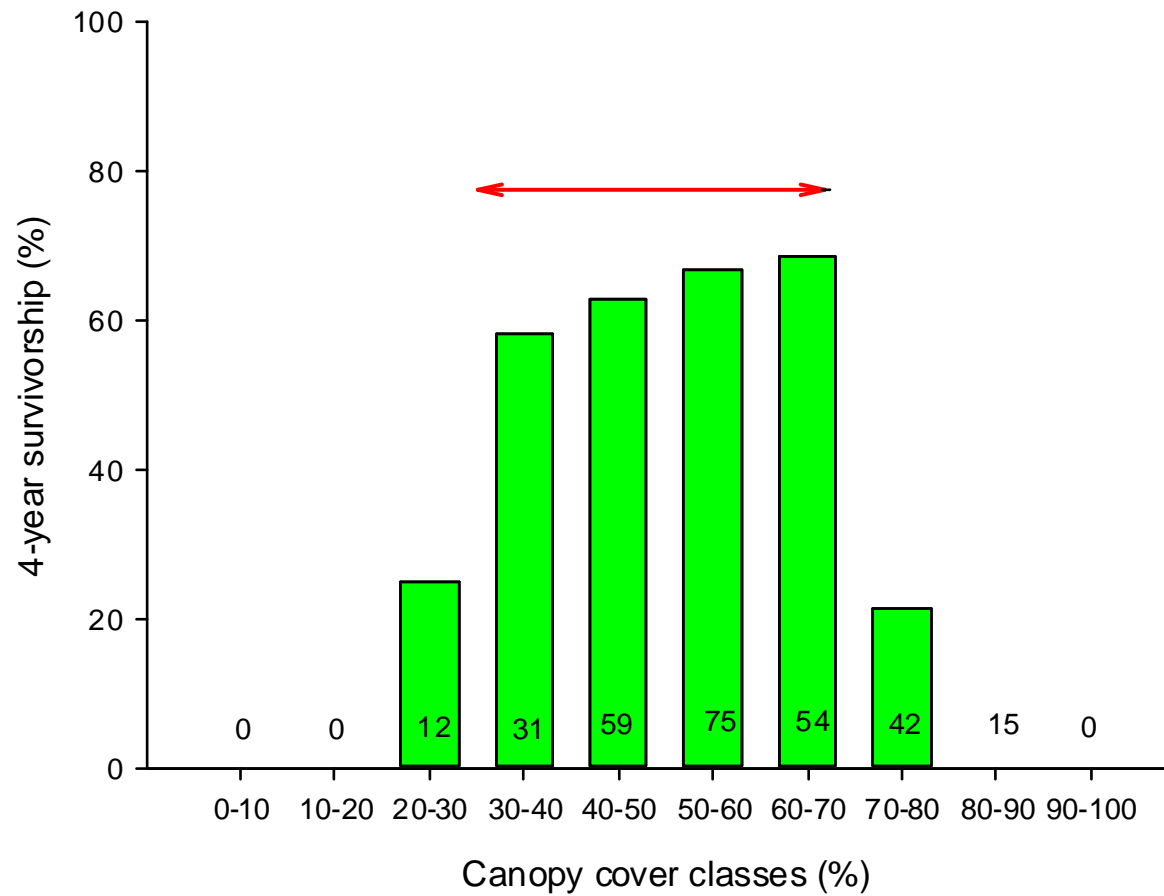
2. Planting volume effect?

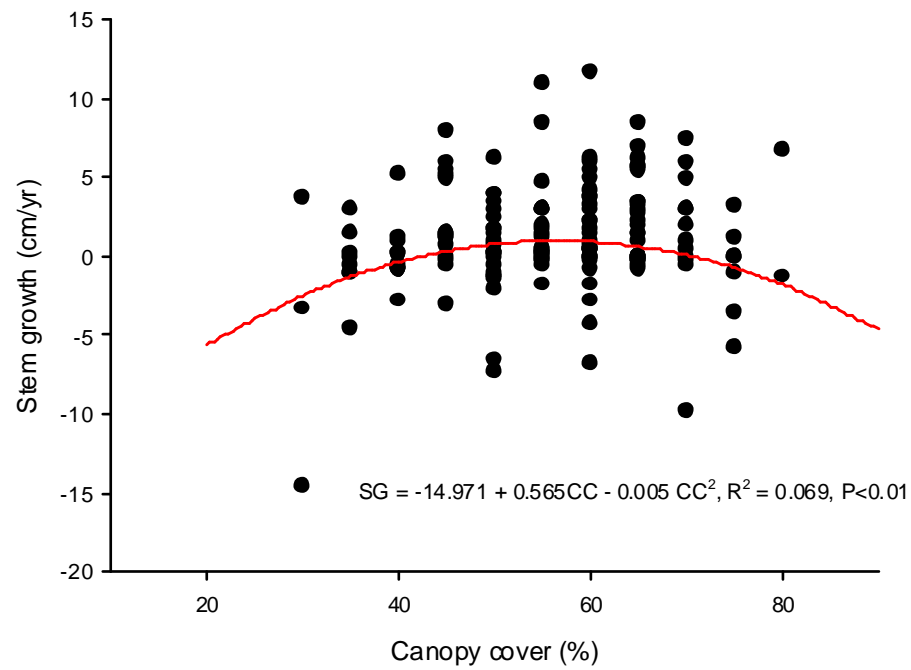


Yes

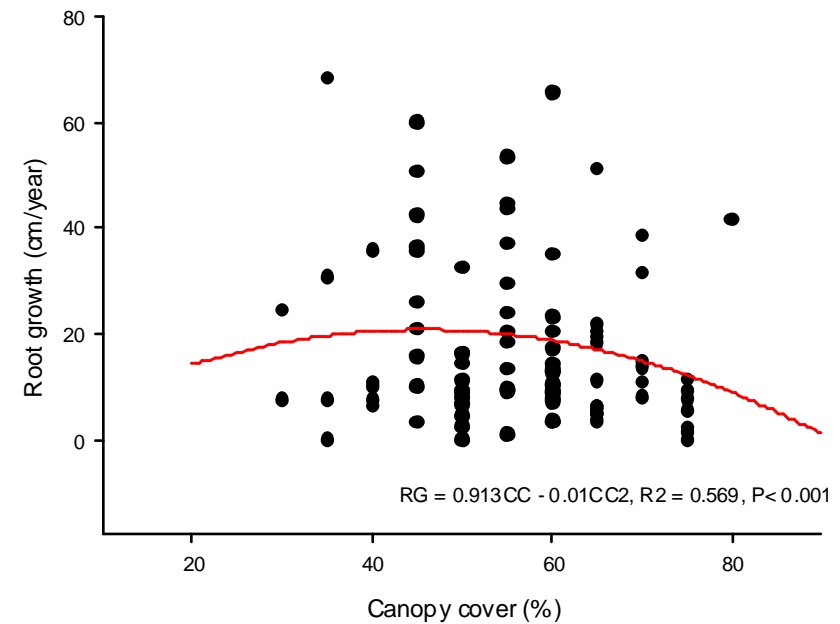
Seedlings with larger volumes more successful

3. Light effect?





Higher stem and root growth
at moderate canopy cover





Similar technique currently being
Used for *M. bartlettii* restoration

Source: Janeen Collins

Invasive figs in New Zealand

- Moreton Bay fig (*Ficus macrophylla*) and Port Jackson fig (*Ficus rubiginosa*) planted as ornamentals in New Zealand starting in the mid-1800's
- Not palatable to possums
- Pollinator wasps arrived from Australia in 1960's-1970's for *F. rubiginosa* and 1990's for *F. macrophylla*







Invasion in Auckland?

- 244 seedlings found within 50 m of 67 Moreton Bag fig trees (2.44 per tree)
- 10 seedlings had roots to the ground
- Found on 32 different host species
- Most preferred hosts were:
 - *Phoenix* sp. (42%), *Quercus* spp. (10%), *Vitex lucens* (8.6%), *Olea europaea* (5.9%), *Metrosideros excelsa* (5.6%), *Cupressus* spp. (3.7%)

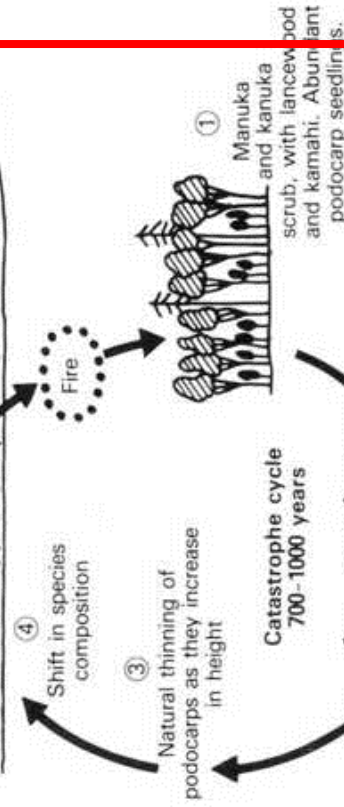
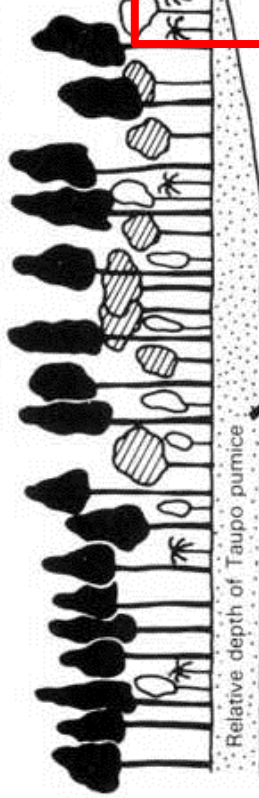
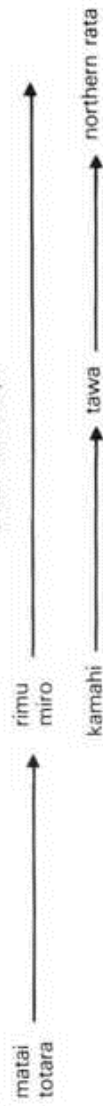


Epiphytes and hemiepiphytes on tree ferns

- Tree fern trunks provide a high-quality establishment site for seedlings and other epiphytes
 - Tree fern mantle is deep (approx. 5-10 cm) with high potential water content and high water retention capacity
- Colonised by wide range of species but only a few are hemiepiphytic
- Part of regeneration strategy for *Weinmannia silvicola* and *W. racemosa*
- *Weinmannia racemosa* may be the most abundant New Zealand tree (Wardle and MacRae 1966)

(a) LINEAR SUCCESSION THEORY

(After Mckelvey)



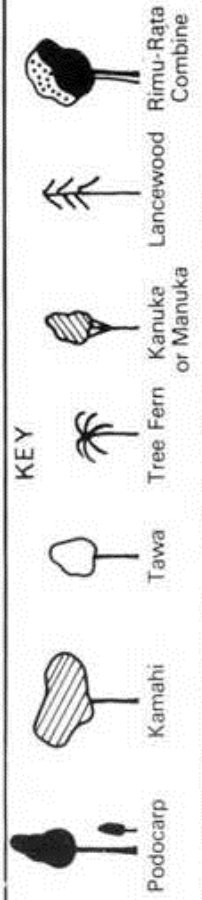
(b) LARGER SCALE SYNCHRONOUS PODOCARP REGENERATION FOLLOWING FIRE

(After Cameron)

(c) GAP REGENERATION CYCLE

(After Beveridge)

KEY



Tree fern lower plant epiphytic flora

- Characteristic fern, fern ally and bryophyte flora exists on tree fern trunks
 - *Tmesipteris* spp.
 - Filmy ferns – 12+ species, 3 almost exclusively on tree ferns (e.g., *Trichomanes venosum*)
 - 35 moss species recorded on 3 species of tree fern (Beever 1984 J.Hat. Bot Lab 56: 89-95).
 - Three species are tree fern specialists
 - Different moss communities occur on different tree fern species



Area available for epiphytes

Altitude (m asl)	Tree fern density (stems/ha)	Surface area per hectare (m ² /ha)	Percent additional surface area
200	1250	707.96	7%
300	1050	2104.30	21%
400	1300	1452.67	15%
500	1250	1476.71	15%
600	900	736.55	7%
700	1750	607.74	6%

Epiphyte density

- 60 *Cyathea smithii* (600 m altitude)
117 epiphytes on 114.3 m² trunk area
= **1.02** epiphytes/m² trunk
- 50 *Cyathea dealbata* (350 m altitude)
55 epiphytes on 81.2 m² trunk area
= **0.68** epiphytes/m² trunk
- 50 *Dicksonia squarrosa* (350 m altitude)
68 epiphytes on 110.58 m² trunk area
= **0.61** epiphytes/m² trunk



Approximately **500-1400** epiphytes/ha of forest

Tree fern epiphyte flora

Species of Epiphyte	% on Cs	% on Cd	% on Ds	% of total epiphytes
<i>Geniostoma rupestre</i>	42.0	91.0	88.0	71.2
<i>Weinmannia racemosa</i>	28.0	2.0	0.0	17.4
<i>Freycinetia baueriana</i>	0.0	2.0	6.0	2.1
<i>Melicytus ramiflorus</i>	3.0	0.0	0.0	2.1
<i>Knightia excelsa</i>	1.0	0.0	2.0	1.3
<i>Laurelia novae-zelandiae</i>	0.0	2.0	3.0	1.3
<i>Coprosma grandifolia</i>	1.0	0.0	0.0	0.8
<i>Hedycarya arborea</i>	0.0	4.0	0.0	0.8
<i>Schefflera digitata</i>	0.0	0.0	3.0	0.8
<i>Beilschmiedia tawa</i>	0.0	0.0	2.0	0.4
<i>Elaeocarpus dentatus</i>	1.0	0.0	0.0	0.4
<i>Pseudopanax crassifolius</i>	0.0	2.0	0.0	0.4
<i>Quintina serrata</i>	1.0	0.0	0.0	0.4
Total species	7.0	6.0	6.0	13.0

95.4%

Only approximately 50% of woody species present occur as epiphytes on tree ferns.

Small seeded, wind dispersed species highly represented



Hemiepiphytes are significant components of New Zealand forests

Host species and establishment sites

Knightbridge and Ogden (1998)

- surveyed 58 ha over 7 sites for *M. robusta*
- occurred more commonly on large host trees (>50 cm diameter) than expected
- 21 tree species acted as hosts but some preferred
- Establishment sites
 - Horizontal branches 44%
 - Primary branch forks 31%
 - Sides of trunks 27%

Host preference Waipoua

