

mistletoe

the secret life of a parasitic plant

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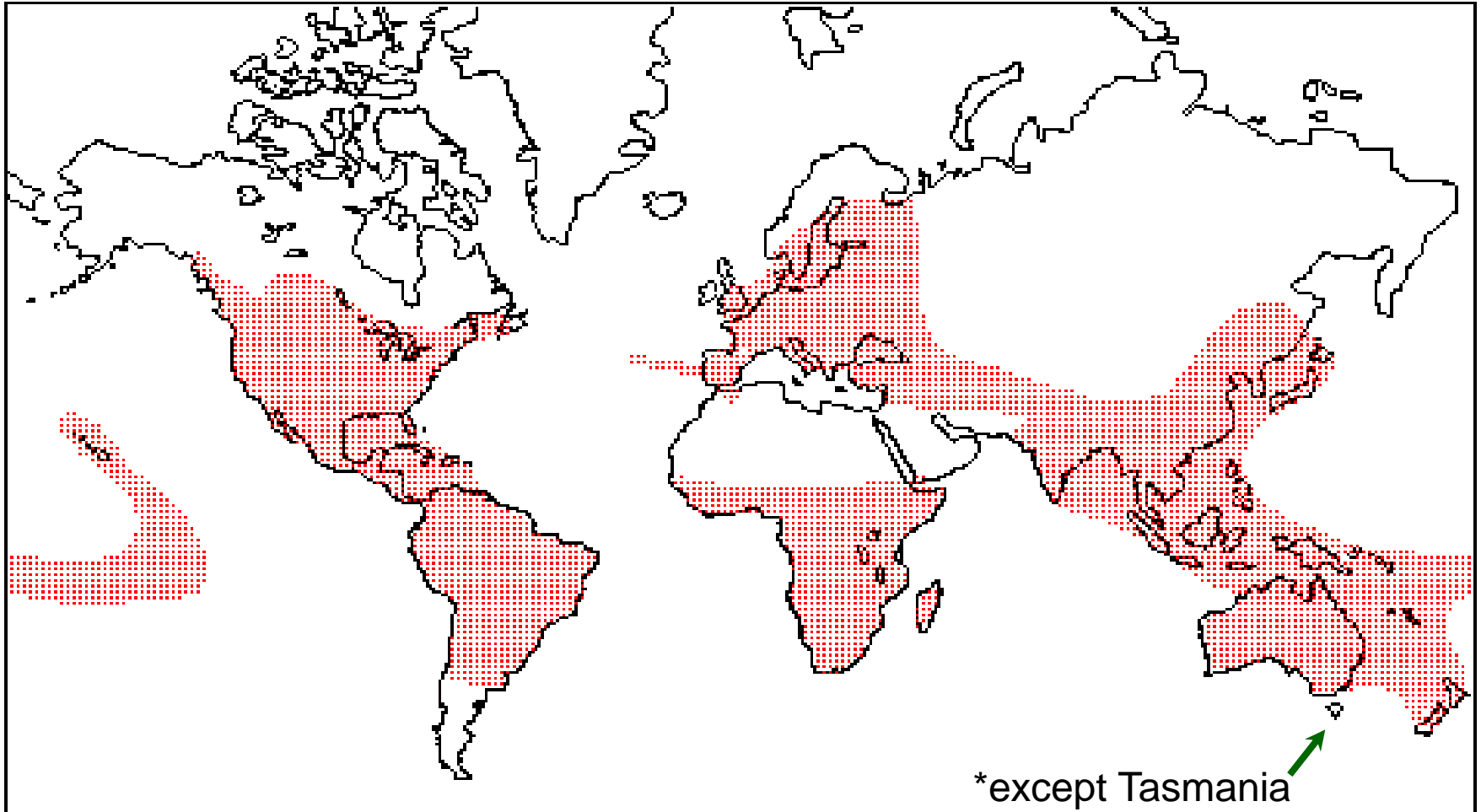
CHARLES STURT UNIVERSITY

David M Watson: “Prof Mistletoe”



- Core research within 3 themes:
 - Conservation and management of biodiversity in production landscapes
 - Biological consequences of habitat fragmentation
 - Ecology of parasitic plants
- 19 recent projects, 15 ongoing with 21 collaborators
- Supervise 7 PhD students
- Field-based studies:
 - Billabong Creek
 - Sturt NP
 - Pacific Northwest of USA
 - Central America

Mistletoes of the world



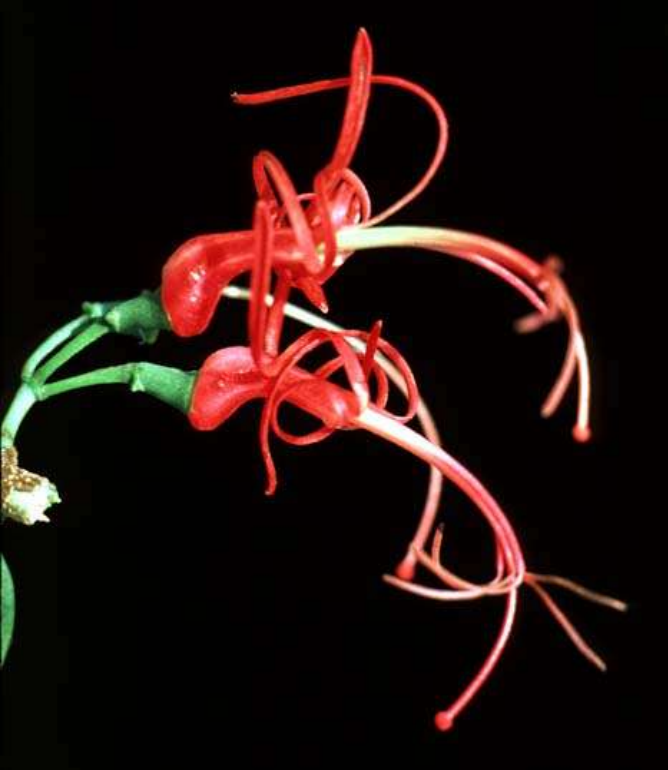
- 1500 species, found on all continents except Antarctica & most oceanic islands*

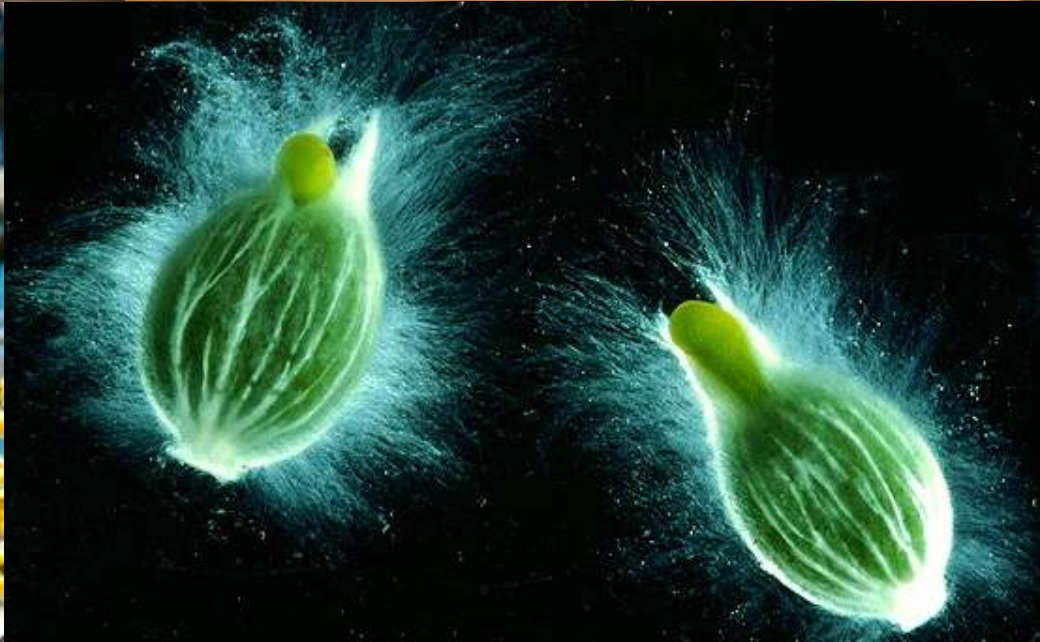


Mistletoe life cycle

- Yellow / red flowers with lots of nectar
 - Pollinated primarily by birds
- Abundant fruit rich in protein, fat, carbs & water
 - Dispersed primarily by birds
 - Provide abundant, high quality fruit, nectar, leaves
- Sticky seeds “planted” by fruit-eating birds
- Require well lit position on thin, living branch of host

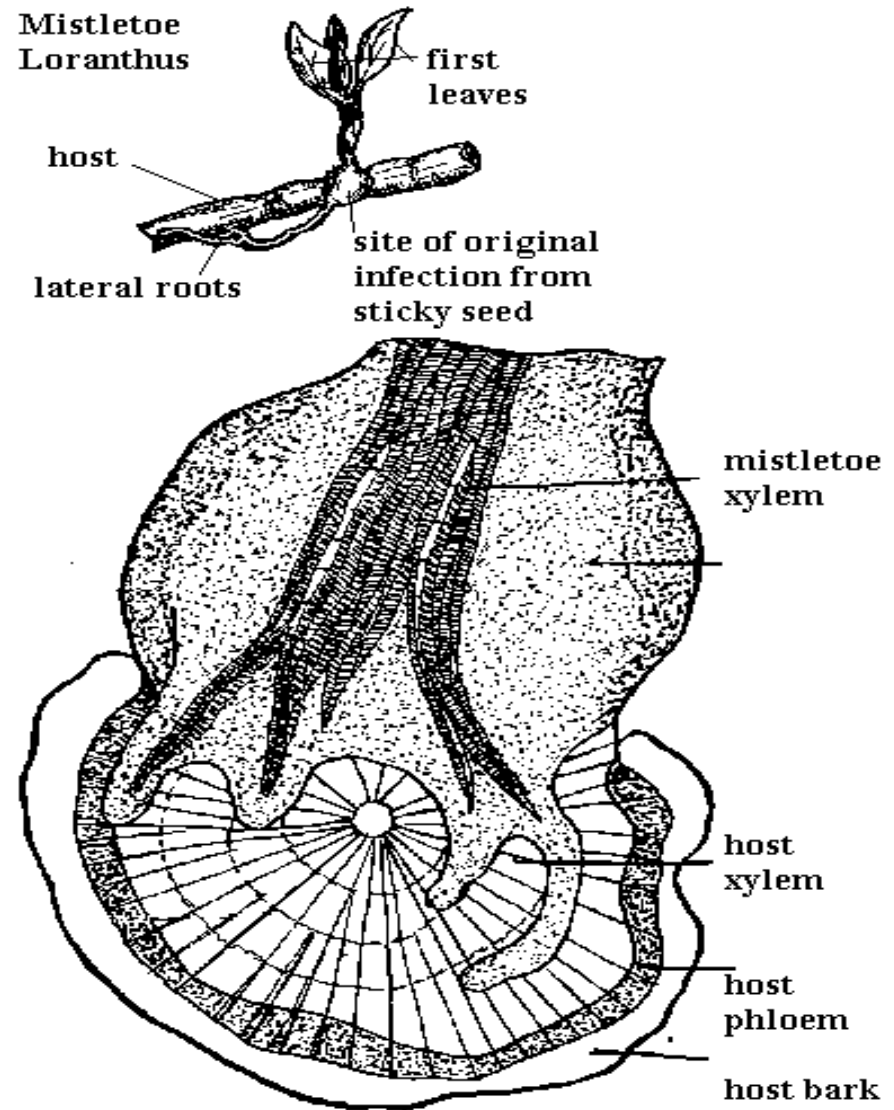






Mistletoe establishment

- Modified root system = haustorium for taking up water, nutrients and some amount of sugars from the host
- Formation of rosewood structure at the point of attachment
- Direct connection with the host wood (xylem)
- Lateral roots used for subsequent infections of the same host
- Multitude of suitable hosts, rarely parasitize a single host species



Mistletoe dispersal



- As parasites, seeds must be actively transported to hosts
- Narrow window of seed viability: hours—days
- Successful dispersal = movement of seed to new host
- But, higher parasite loads can affect health of host
- Optimal dispersal = movement to suitable & uninfected host
- Farther not necessarily better: often adapted to local hosts





Mistletoe as food

- Pollinators and dispersers = tiny fraction of consumers
- Provide abundant, high quality fruit, nectar, leaves
- Diverse range of opportunistic foragers
- Feeding records from 98 bird & mammal families
- Indirect food source: insects → birds











Mistletoe as shelter

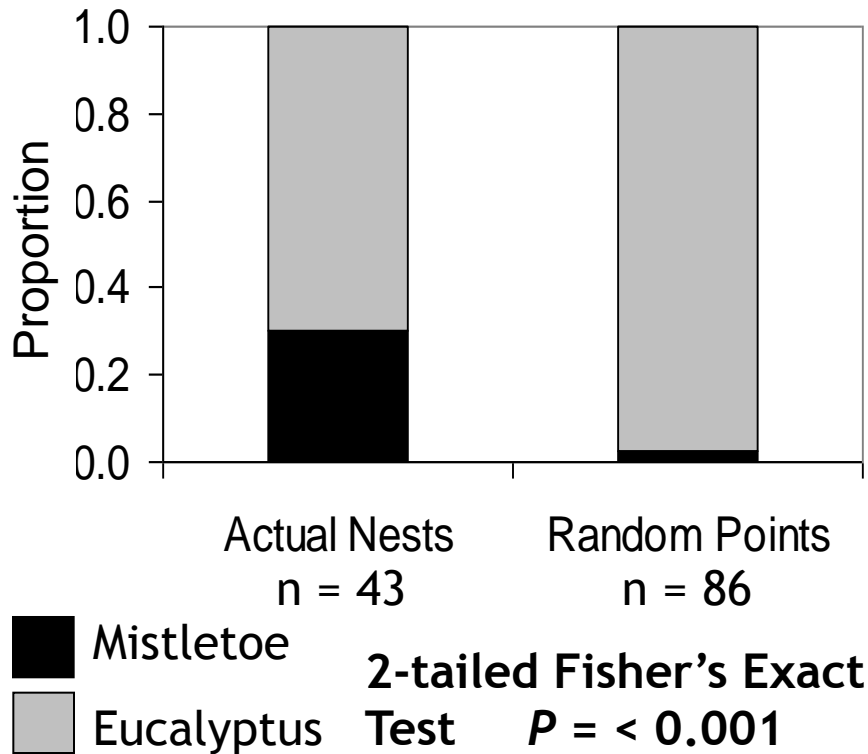


- Widely used for escaping heat, cold, nesting & roosting
- Prominent in some groups: raptors, turacos, mousebirds
- Spp. from 66+ mammal and bird families worldwide
- 244 Aust bird spp.* (73%)
- Structural, climatic and chemical factors involved
- Structure: coarse woody debris, snags, hollows





Is mistletoe a preferred nest site?



➤ Diamond Firetails nest in mistletoe more often than would occur by chance alone



Why nest in mistletoe?



- Artificial nest trial based on Noisy Friarbirds
- 270 nests placed in mistletoe or eucalypts
- Baited with quail eggs
- Mistletoe nests predated significantly less often
- Concealment had no effect
- Microclimate differed, but only slightly (temp & humidity)
- More likely to confer advantages in arid areas

Hypothesis

Mistletoe functions as a **keystone** resource in forests and woodlands worldwide



Determinant of biodiversity?

- Only source of fleshy fruit in many habitats
- High quality fruit and nectar when little else available
- Determinant of bird diversity in several systems
- Mistletoe density predicts occurrence of several species
- Data all consistent with positive effect on biodiversity



A landscape photograph showing a wide, flat field of dry, golden-brown vegetation in the foreground. The horizon is low and straight, with a vast, dramatic sky above. The sky is filled with large, dark, grey clouds, some of which are illuminated from below by a low sun, creating a warm, golden glow on the undersides of the clouds and a soft light on the horizon. The overall mood is somber and contemplative.

But...

**All these data are indirect—
could be due entirely to other factors**

Upper Billabong Creek Catchment

Holbrook

**RESOURCES
IN
FRAGMENTED
LANDSCAPES
EXPERIMENT**



RIFLE overview



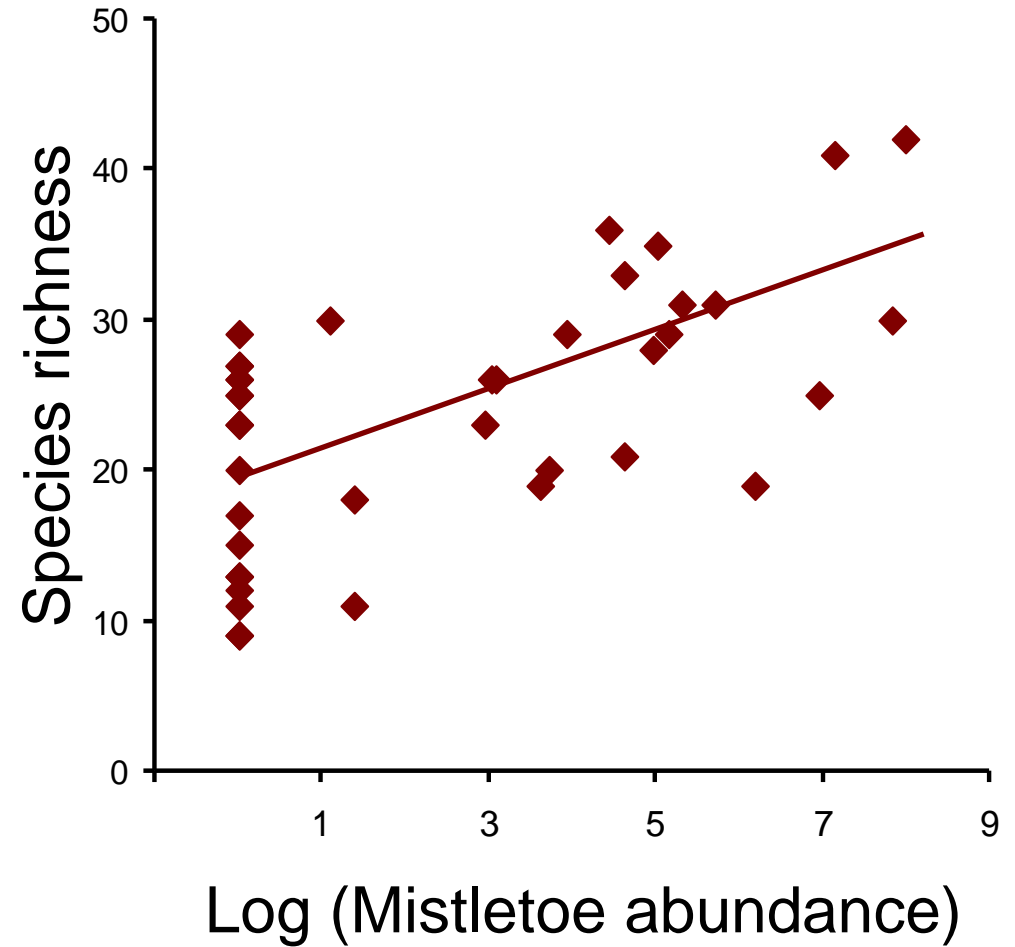
- Explicit resource-based study of habitat fragmentation
- 20 year study of 40 woodland fragments (5–30 ha)
- Patch-scale inventories (birds, reptiles, mammals)
- 12,900 trap nights for small mammals
- Standardized search used for birds (80% completeness)

Mistletoe removal

- All mistletoe plants removed from 20 treatment remnants
- > 5,400 plants; 40 tonnes
- Trailer mounted cherry-picker and hand tools used
- GPS fix, host, height and dimensions recorded
- Sham removals conducted in control sites



Initial response



Ongoing research



➤ Seasonal cross-taxa surveys (2005–22) and concurrent resource monitoring

➤ Associated projects:

- Mistletoe litter/soil fertility
- Nest-site selection
- Butterfly distribution
- Basis of edge effects (birds)
- Reptile occurrence and logs
- Spatial ecology of dispersers
- Arthropod community composition
- Possum mistletoe control



Ongoing research



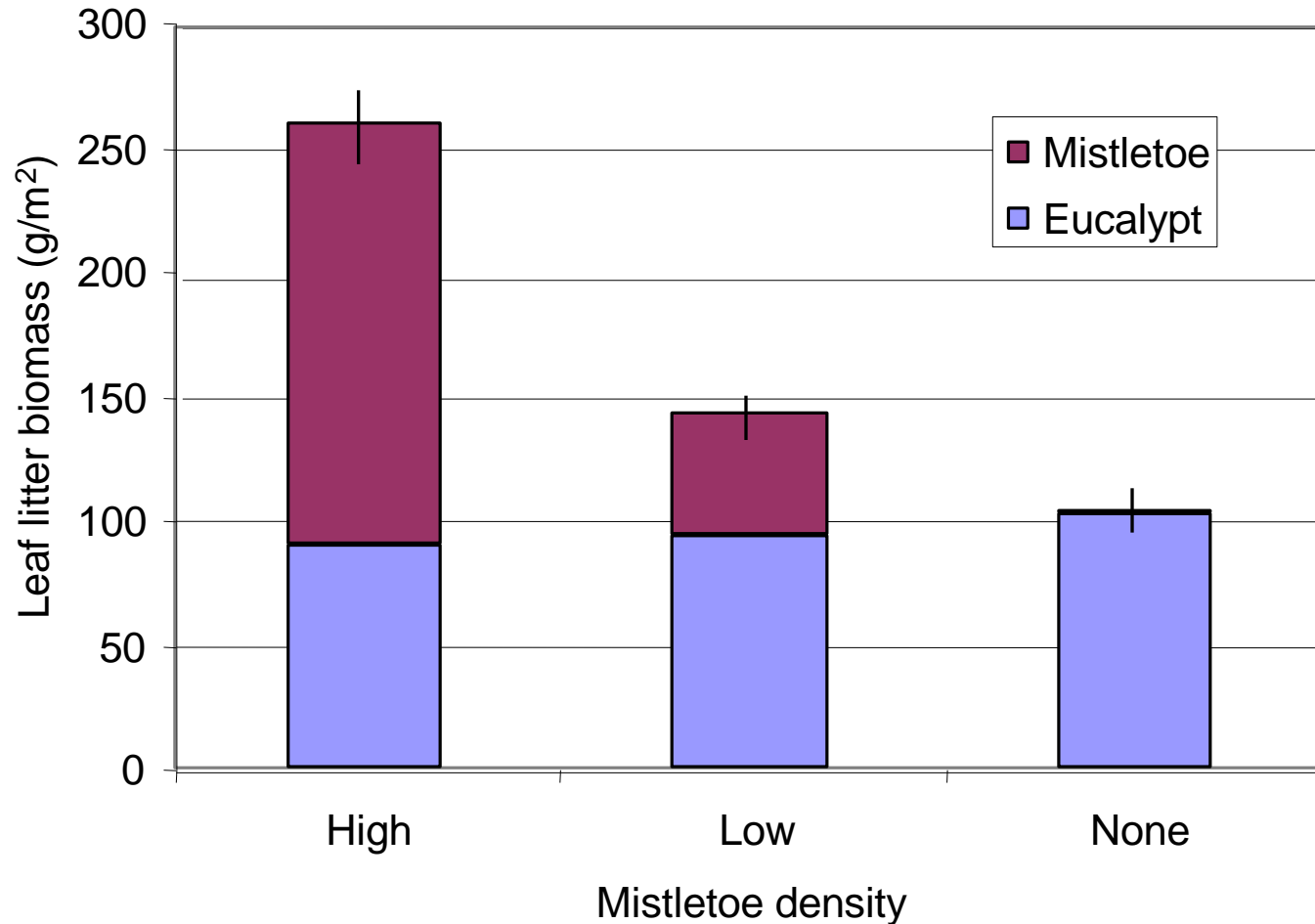
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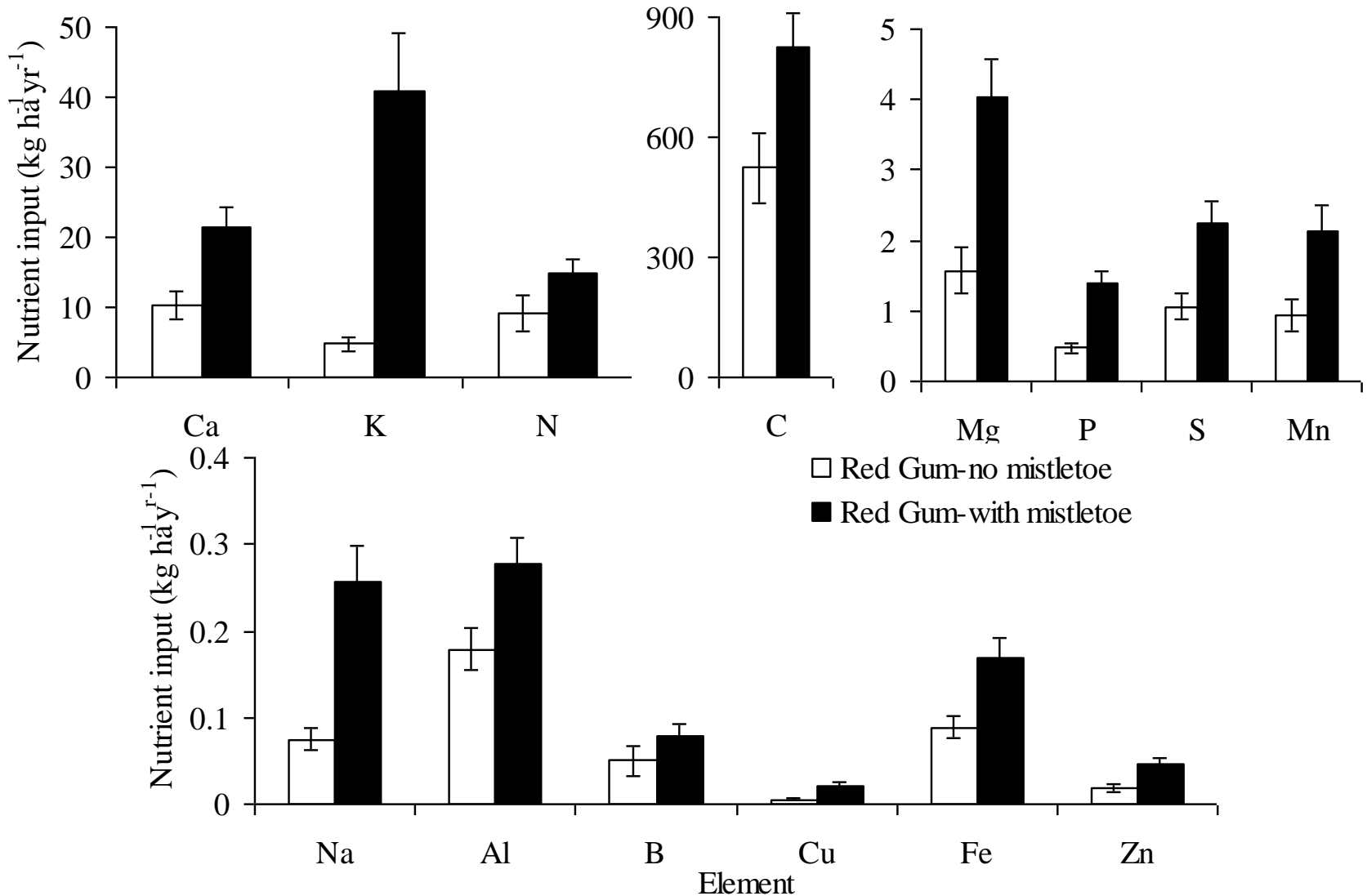
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Contribution of mistletoe to litter



Contribution to nutrient cycling



Common brushtail possums and mistletoes

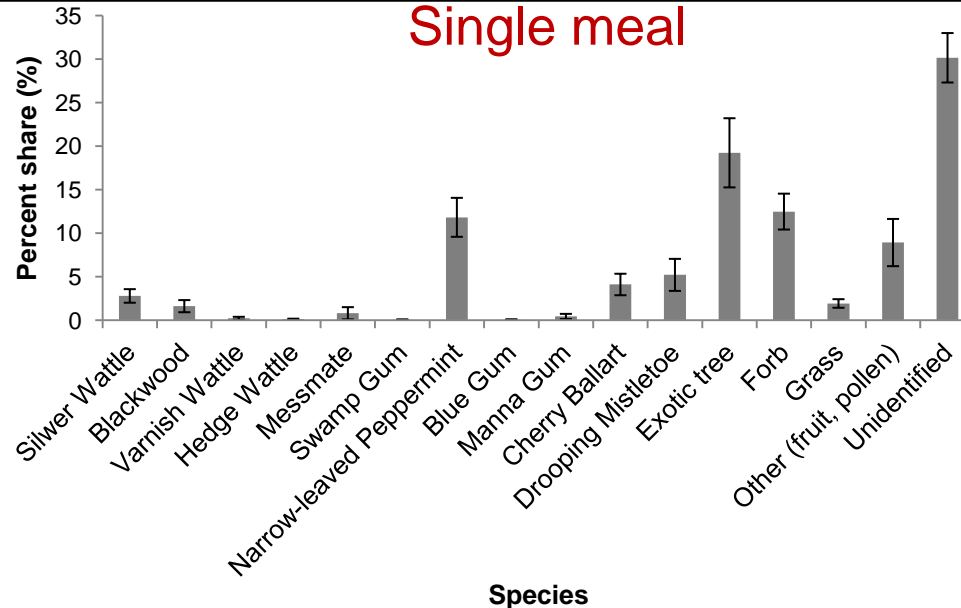
Landscape

Tree type	Frequency of available trees	Percent share of available trees	Possum frequency of tree occupancy	Possum percent share of tree occupancy
Tree with mistletoe	68	11.8	6	11.3
Tree without mistletoe	509	88.2	47	88.7
TOTAL	577	100	53	100

Home-range

Tree type	Frequency of available trees	Percent share of available trees	Possum frequency of tree occupancy	Possum percent share of tree occupancy
Tree with mistletoe	43	10.8	36	25.4
Tree without mistletoe	357	89.2	106	74.6
TOTAL	400	100	142	100

Single meal



Mistletoe occurrence



- Reflects interplay between dispersal, establishment, herbivory and senescence
- Sudden changes in mistletoe density often reported
- May coincide with loss of herbivores
- Common brushtail: main herbivore in SE Australia
- Rabbit baiting programmes triggered local extinctions (?)
- Focus of current PhD project: Karolina Petrovic near Euroa

Effects on host



- Necessarily incurs cost to host: loss of water & nutrients
- May lead to increased water stress, lower growth rates
- Associated with changes in tree survival / mortality
- Negative effects increase with higher mistletoe loads
- Indicates normal controls on mistletoe aren't operating
- Some positive effects associated with infection
 - Increased fertility beneath trees

Mistletoe management

- Natural controlling factors have been removed / changed
- Fewer bushfires
- Fewer possums, other browsers
- Woodland fragmented: more light, trees more stressed
- Changing mistletoe numbers = symptom NOT cause
- Mistletoe: actually a sensitive environmental indicator



Consequences & priorities



- Mistletoe—can have direct positive effect on local richness
- Potential influence of mistletoe on productivity and succession
- Optimal density: balance between short-term biodiversity gains & long-term habitat effects
- Targeted removal / inoculation
- Beyond mistletoe—effects of resources on biodiversity

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