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Temporary translocation of entire mistletoe plants to understand the mechanistic basis of animal foraging decisions

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Corresponding Author:	David Watson Charles Sturt University - Thurgoona Campus: Charles Sturt University Albury, BNew South Wales AUSTRALIA
Corresponding Author's Institution:	Charles Sturt University - Thurgoona Campus: Charles Sturt University
Corresponding Author E-Mail:	DWatson@csu.edu.au
Order of Authors:	David Watson
	Melinda Cook
	Andy Leigh
Additional Information:	
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TITLE:

Temporary translocation of entire mistletoe plants to understand the mechanistic basis of animal foraging decisions

AUTHORS:

Melinda Cook[1], Andy Leigh[1], David M Watson[2]

[1]University of Technology Sydney, School of Life Sciences, PO Box 123, Broadway, NSW 2007, Australia.

[2]School of Agricultural, Environmental and Veterinary Sciences, P.O. Box 789, Charles Sturt University, NSW 2640, Australia

CORRESPONDING AUTHOR:

David M Watson

dwatson@csu.edu.au

EMAIL ADDRESSES:

melinda.cook01@gmail.com

andrea.leigh@uts.edu

KEYWORDS:

Spatial learning, seed dispersal, mistletoe, plant-animal interactions, canopy, frugivory, endozoochory

SHORT ABSTRACT:

This work outlines a simple experimental procedure to quantify behavioural drivers of foraging decisions in free-living animals, temporarily relocating mistletoe plants to novel locations and measuring visitation rates.

LONG ABSTRACT:

Fruiting mistletoes present a model system for understanding decisions made by foraging animals when locating food. Where, when and how animals find food is central to many ecological questions, relating to the basis of individual foraging decisions and the extent to which these decisions are innate or acquired. Ecologists have paid particular attention to frugivores, quantifying preference for fruits with specific shapes, colours or scents which, over evolutionary time, confer selection for suites of traits in their favoured plants whose seeds they disperse. This work outlines a novel experimental approach to manipulating food plant occurrence and measuring the response of wild, free-living animals, ideally suited to studying the evolutionary origin and ecological maintenance of seed dispersal. The "cut and paste" protocol involves removing an entire fruiting mistletoe plant from its host and either returning it to its original location or moving it to a novel location, affixing it to a

‘pseudo-host’ of the same or different tree species. By counting visits to the mistletoe and noting the duration, species and behaviours, a series of comparisons can discern the most important factors affecting foraging decisions and the consequences for both plant and animal. Here, the protocol is illustrated with a case study to determine between-guild differences in mistletoe frugivory. The experimental approach facilitates an ability to tease apart the mechanistic basis of search image formation and refinement, spatial learning, inter-specific differences in foraging strategies and how these changes modify seed dispersal effectiveness. Finally, potential modifications are considered with respect to addressing other questions on foraging ecology, plant-animal interactions and coevolution.

INTRODUCTION:

How do animals find food? It’s a deceptively simple question, integrating cognition, sensory perception and metabolic demands with habitat structure, inter-specific interactions and variation in resource availability through space and time. Most of the conceptual advances in our understanding of this topic have come from studying captive animals, where resource quality, quantity and accessibility can be manipulated[1,2]. While useful for establishing sensory capabilities, qualitative preferences and nutritional qualities of food, captive methods do not reveal how animals fulfill these demands in the wild.

Early experimental studies on resource use by free-living animals sought to understand the lower bound of food availability an organism will reach before deciding to feed elsewhere (Charnov’s marginal value theorem[3]). Known as “giving up density”, this approach quantifies how much risk an animal is willing to tolerate—e.g., how few acorns per square metre a squirrel is prepared to leave behind when feeding in woodlands of differing densities where predators are variously detectable[4]. While this framework has been applied to a wide range of food resources and ecosystems, the necessarily constructed basis of the approach limits its application and can confound interpretation of reported differences[5]. Further, determinants of giving up density relate more to vigilance, habitat preferences and competition than foraging ecology (known collectively as the ecology of fear[6]). This approach is rarely able to capture the attractiveness of a food resource in the wild to a free-living animal. Hence, studies on frugivory are usually based on observation of wild behaviour with implications to both plant and animal being drawn from the resulting behaviours.

Foraging decisions made by frugivores when selecting fruit may hinge on many different traits expressed physically by the plant in terms of abundance, quality and seasonal availability. How easy the fruits are to locate, to consume and to pass through the gut also play a role in the selection by frugivores, making it tricky to separate the potentially learnt behaviour from the inherited. The current work introduces a new approach to manipulating resource availability and location to measure the response of wild, free-living animals as they forage in their natural habitat. This method is ideally suited to addressing questions regarding the cues different animals use to locate food—in the case showcased here, the energy-rich fruit of hemiparasitic mistletoe plants. The approach involves removing entire mistletoe plants from their host trees and relocating them to other trees of the same or different species. Note that the case study presented focuses on fruit, frugivores and the interaction between dietary breadth and the implications for seed dispersal. However, for work on nectarivores or folivores the same approach can be applied to flowering mistletoes or non-reproductive mistletoes, respectively. Mistletoes are an ideal model to use for this approach, being found in woodlands and forests worldwide and visited by a wide range of animals[7]. In terms of fruit, although most research has focused on mistletoe fruit specialists that eat little else[8], a large range of generalist frugivores and opportunists with a broader diet regularly consume mistletoe fruit[9]. Finally, their size, growth habit, and physiognomy make them especially amenable to experimental manipulation[10].

Research in a semi-arid woodland system demonstrated that foliage density affected apparency of mistletoes to fruit eating birds[11], but numerous questions remain unanswered. Do birds search for *mistletoes* or *fruiting* mistletoes? For those mistletoe populations dependent on a single host species, do birds preferentially search for the mistletoe or for their principal host? Do groups that forage primarily, occasionally, or opportunistically on mistletoe fruit use divergent cues to find mistletoe fruit?

To answer these questions and uncouple the influence of host identity, spatial context and mistletoe location on bird visitation, a novel relocation protocol was devised and that experiment is used as a case study. The protocol is illustrated with step-by-step instructions to determine how birds locate fruit in a structurally complex woodland. In addition to exploring other questions readily addressed using this technique, consideration is given to how this method could be integrated with other ecological field methods to understand the mechanistic basis of foraging ecology in forest and woodland canopies.

The initial application of this experimental approach was to determine how birds find food in a heterogeneous woodland canopy by relocating entire mistletoe plants. This protocol spans two days—selecting the mistletoe on day 1 to manipulation, then affixing, observing and detaching the mistletoe on day 2. Conduct replicate trials on successive days; select the mistletoe for the next trial on the second day of the first trial. In the illustrative case study, bird visitation to mistletoes was compared among three different host locations, here referred to as treatments. To do this, a single fruiting Grey Mistletoe (*Amyema quandang*) plant was cut from its host plant and attached to one of three locations: 1) its *original host* tree, 2) a *pseudo-host* tree, or 3) a *novel host* tree. The *original host* treatment kept spatial location and host identity constant while controlling for the effects of cutting. The *psuedo-host* treatment involved temporarily affixing the mistletoe to a different individual of the same species as the host (in the case study, Yarran (*Acacia homalophylla*)*,* but with few to no existing mistletoes to discern the roles of spatial memory *versus* host-association. The *novel host,* an individual of a different tree species that does not host mistletoes (for the case study site, White Cypress Pine (*Callitris glaucophylla*)) clarified whether the search image used by mistletoe fruit consumers relates to the mistletoe itself or to the principal host.

ETHICS STATEMENT

This experimental protocol was developed and experimentally proved under the provision of and abiding by the Animal Research Authority guidelines of the University of Technology Sydney (UTS ACEC 2013-745). The protocol does not require handling of animals. Native plants were experimentally manipulated under the permission of a National Parks and Wildlife scientific licence (SL101337).

PROTOCOL:

1. Determine suitable site, species and ethical considerations

- 1.1 Choose the ecosystem type and study location. A suitable site should have abundant mistletoes with one regular mistletoe host and at least one species of tree/shrub that does not normally host mistletoe. The case study was carried out in a semi-arid woodland, New South Wales, Australia. ***{Filming could be case study: pan shot of two different host tree species with one mistletoe, maybe still shots of 1.1.1 – 1.1.3 below}***
- 1.2 Identify the ecologically relevant time of year for the study. For example, pre-determine when mistletoes are fruiting. Consider that this might be different times of year, depending on the seasonal profile of a given area. In this case, mistletoe species fruit for some months over spring-summer.
- 1.3 Choose a patch size that satisfies the research question, e.g., if the species being observed is territorial, choose a patch size that reflects that, if the mistletoe species abundance is

patchy, choose several patches and be prepared to reflect the variance in your statistical analysis.

1.4 Identify the dominant species in your chosen ecosystem and location. At the case study site, the dominant tree canopy species comprised *Callitris glaucophylla* (White Cypress Pine), *Acacia homalophylla* (Yarran) and *Casuarina cristata* (Belah), with sub-dominant stands of *Allocasuarina luehmannii* (Buloke) and *Eucalyptus populneus* (Poplar box). *Amyema quandang* (Grey Mistletoe; Loranthaceae) is the principal mistletoe in the area, growing almost exclusively on *Acacia homalophylla* (Yarran) at the study site ***{Filming could pan around the location, with a voice over describing the habitat (either at Binya State Forest or elsewhere}***

1.5 Identify the target mistletoe and become familiar with the animals that forage on it. For example, in the case study, Grey Mistletoe produces pale-yellow fleshy fruits[12] that are eaten by two mistletoe specialist avian frugivores (Mistletoebird; Dicaeidae, *Dicaeum hirundinaceum* and Painted Honeyeater, Meliphagidae, *Grantiella picta*) and four generalist frugivores (Silvereye, *Zosterops lateralis*, Spiny-cheeked Honeyeater, *Acanthagenys rufogularis* and Singing Honeyeater, *Lichenstomus virescens,* Striped Honeyeater, *Plectorhyncha lanceolata*), with numerous other species opportunistically consuming the fruits and occasionally dispersing seeds[13,12].

1.6 Choose the ideal number of replicates for the study, considering the total number of days required to complete each 2-day replicate trials. In the case study, data for 20 replicates were collected for each of the three relocation treatments (60 individual mistletoes), over the course of 60 days, with one day of observation per replicate, randomised across treatments. To reduce the number of days that the experiment will run, two replicates may be observed by one observer with sufficient distance between the two replicates to minimise interference.

1.7 Conduct a pre-experiment pilot study to prolong the vigour of the mistletoe once cut from the host plant by comparing visitation to mistletoes with and without the cut ends sealed with glue. If there is no difference in terms of either wilting or bird visitation for the 12-hr duration of each trial, then the mistletoe can be deemed as retaining sufficient vigour until the late afternoon. If bird visitation is significantly lower to cut mistletoes, select a different mistletoe species and/or in a more humid environment where evaporation is slower.

1.8 Ensure that all relevant permissions are in place, both to collect native plants and to observe wildlife. Since this protocol involves cutting live mistletoe from the canopy, avoid work in populations of mistletoe of conservation concern. Further, given the reliance of many animals on mistletoe as both a food source and a nesting/roosting location, ensure that the experiment will not cause a lasting disruption to the ecological community under investigation. Obtain appropriate permissions from the relevant government agency and consult animal care and ethics committee of the researcher's institution, balancing any short-term impacts with the scientific merit of the proposed study. Note that no wildlife handling is explicitly required for this method.

2. Identify target individual mistletoe-host pairs

2.1 At least one day prior to conducting the experiment, locate suitable mistletoe plants on the appropriate hosts and, if relevant, appropriate *pseudo-hosts* or *novel hosts*.

2.2.1 When selecting locations to affix the mistletoe, ensure the branch is sufficiently strong to hold the weight of the mistletoe.

2.2.2 When selecting a target individual mistletoe, consider the thickness of the host branch and whether the selected mistletoe is growing at the terminal end of the branch or midway along. Host branches above 70mm diameter or mistletoes growing mid-way along a host branch that still bears host foliage should be excluded from selection or pruned above the haustorium to avoid difficulty in cutting the host branch or transporting the host foliage along with the mistletoe. ***{Filming could give an example of a good vs bad target mistletoe/host branch combination}***

2.2.3 Select the new host location that will allow for affixing the mistletoe in the same orientation as it grew e.g., if its branches all droop down in a tear drop shape ensure that they do so at the new location as well (Fig 2). ***{Filming could give a demonstration of appropriate matching of shape}***

2.2.4 Inspect each candidate closely to ensure that no active nests are located within them or near them.

2.2.5 Choose mistletoe plants that can be safely reached and removed from their host before dawn. If ladders are to be used, ensure that the ground beneath each tree is clear of snakes, animal burrows and obstructions.

2.2.6 Note phenology (i.e., presence of ripe fruit or open flowers).

2.2 Record details of experimental plants. Mark the target plant pair unobtrusively to avoid disturbing animals e.g. an inconspicuous fabric tag, a stick or stake in the ground close by or GPS coordinates.

{Filming could show the selection of a mistletoe, a person indicating the thickness of the branch, describing the size of the mistletoe, inspecting the fruits, marking of a tree with a fabric tag or a still of a person standing next to a tree with a GPS}

3. Cutting the mistletoe

3.1 At least one hour before dawn on the day of observations, remove the mistletoe from its host using a clean pruning saw.

3.1.1 Depending on the branching pattern of the mistletoe, this can be achieved by cutting either side of the haustorium ***{filming should visually indicate}*** but cutting proximal (i.e., upstream) to the connection with the host ***{filming should indicate}*** and removing the entire mistletoe is simpler and more effective.

3.1.2 Take care when cutting, undercutting first to minimize damage to the host tree. It is important to be well-positioned and/or have a second person assisting in this process, as the abscised mistletoe may be heavier than anticipated. For larger mistletoe plants, wind a length of rope around the proximal portion of the host branch (between the trunk and haustorium) before tying it securely to the mistletoe prior to abscission, enabling the plant to be lowered safely to the ground without losing branches which are characteristically brittle.

3.1.4 Thoroughly clean the saw with ethanol after each individual mistletoe removal.

4. Attaching (‘pasting’) the mistletoe

4.1 Once the mistletoe is removed, affix it to the final location using black cable-ties. Make sure that the mistletoe will not swing unnaturally in the wind or fall off if a larger animal lands in it. Make the cable ties as inconspicuous as possible, cut off long ends and leave no rubbish behind for curious animals to find. **{Filming should capture this process perhaps using a comparative set of shots of the mistletoe in the original host tree and move on to the process of attaching the mistletoe in close detail then zoom out to show the attached mistletoe}**.

4.2 As per 2.2.3ensure that the relocated plant is secured in an orientation similar to its original growth habit.

5. Collect visitation data.

5.1 In addition to noting species and duration of visit, behavioural data can be useful for distinguishing different kinds of visits, including actively foraging for insects, visiting and probing flowers, taking fruit, agonistic interactions and loafing. This can be conducted using timed watches with binoculars, or with motion-activated cameras mounted the night before.

5.1.1 If using cameras, conduct initial trials using different sensitivity settings and locations to minimise false triggering.

5.1.2 For timed watches, multiple mistletoes can be observed simultaneously from the one vantage point. Our case study used this method, with the observation period of approximately 6.5 hours between 7:30 am and 6:30 pm, in two blocks over the morning and afternoon, avoiding the heat of the day where there was little bird activity while still capturing peak foraging activity [14,15]. During this period, every visit to relocated mistletoes was recorded by direct observation from a distance of 5–10 m, noting the identity of each bird and the duration of each visit (as per[11]). Visiting species were divided into three diet-based functional groups

6. Collect contextual data on the location of mistletoe plants.

6.1. In addition to noting whether each plant is a control (i.e., cut and returned to its original location) or a relocated plant, record attributes of the host (species, height, diameter), mistletoe (size, foliage density, phenology, height, aspect, number of fruits) and context (distance to nearest mistletoe, distance to other fruiting / flowering plants). ***{Filming could include a still of a data sheet with either more still shots or moving film of one or two people measuring and recording the data}***

6.2 Photo-point monitoring of both mistletoe and pseudo-host can be an effective complement to conventional quantitative data collection, with image analysis software readily able to generate estimates of canopy closure and other physiognomic attributes. ***{Filming could include a still shot of the data collection sheet and either still or moving shots with a couple of people measuring the trees distances, heights, diameter etc}***

7. End of observation tasks

7.1. For seed dispersal studies, estimate the number of fruits removed by counting the total number of ripe fruits before and after the experimental period. Check the ground for fruit caps or fallen fruits before removing the mistletoe.

7.2 At the end of every data collection day, once visitation data have been collected, remove the relocated mistletoe and collect all cable ties and any flagging tape or tags. **{Filming should capture counting fruit caps on the ground below the mistletoe then the cutting down of the mistletoe and the removal of any rubbish}**

REPRESENTATIVE RESULTS

A total of 392 hours of observation was collected across the 60 replicates, with 26 of the replicate mistletoes receiving visits from 15 species of bird. To determine if the visiting birds preferred one treatment over another, visitation data were analysed using generalised linear models (GzLMs)[17] with negative binomial distributions (after [18, 19]). Four variables were included as covariates: host height, host canopy cover, number of mistletoes on the host and number of fruits on the treatment mistletoe. When only treatment was included in the model, there was a significant difference in the number of visits by birds to each of the mistletoe relocation treatments. The number of visits to the *original host* mistletoes was significantly higher than to either mistletoes relocated to *pseudo-host*s or *novel hosts* (Table 1A). When the covariates, host canopy cover and the number of fruits were included, the difference remained significant, but the habitat characteristics did not influence visitation (Table 1B). Thus, across all birds, spatial cues were more important than resource density, accessibility or apparency, consistent with the inference that prior experience is more influential than proximate sensory cues in finding ripe fruit.

Insert Tables 1 and 2 here

To determine whether the dietary breadth of birds influenced their search strategy to locate fruiting mistletoe, dietary functional group (mistletoe specialist, generalist frugivore and opportunist) were included as a second predictor alongside treatment. A median test was conducted to determine if the three dietary guilds differed in the number of visits made to the treatment mistletoes. Further analyses were then conducted separately for each functional group using a Poisson GzLM with a loglinear link. Models for the three groups were created initially including the four selected covariates to find the best model using the same information theoretic approach as described above. The resultant guild models were then compared for overall fit to determine the set of covariates that were most influential for each different dietary group.

The specialist dietary guild included one species: Mistletoebird. The generalist frugivore guild included four species: Spiny-cheeked Honeyeater, Silvereye, Singing Honeyeater and Striped Honeyeater. The opportunist guild included nine species: Splendid Fairy Wren, Inland Thornbill, Yellow Thornbill, Rufous Whistler, Australian (Mallee) Ringneck, Double-barred Finch, Grey Shrike-thrush, Noisy Miner and Red-capped Robin. The mistletoe specialist visited treatment mistletoes on 19 occasions, there were 19 visits by generalist frugivores and 34 by opportunists. Visitation by the three guilds differed significantly after accounting for visits to treatment mistletoes, and there was a significant interaction between guild and treatment (Table 2A). The generalists visited the *original host* mistletoes significantly more than the *pseudo-host* or *novel host* mistletoes.

Specialist visitation did not significantly differ among treatments; however, the number of fruits was positively related to visitation ($P = 0.001$; Table 2B). The number of fruits on treatment mistletoes was not significantly different across treatments (one-way ANOVA: $F_{(2, 56)} = 0.266$, $P = 0.768$).

The individual model for generalist frugivores excluded the *novel host* treatment mistletoes as no visits by generalists were recorded at those mistletoes by this dietary group (Table 2B). The best model included host canopy cover and the number of mistletoes on the host tree as covariates. Generalist frugivores visited the *original host* mistletoes significantly more than they visited the *pseudo-host* mistletoes (Table 2C). The percentage of host canopy cover and the number of mistletoes on the host tree significantly influenced the visiting generalists as main effects (Table 2C).

The best individual model for opportunists included host height and host canopy cover as covariates. Opportunists visited the *original host* mistletoes significantly more than they visited the *pseudo-host* or *novel host* mistletoes and were significantly influenced by the height and canopy cover of the host tree (Table 2D).

DISCUSSION

Our novel method represents a cost-effective means of understanding the mechanistic basis of foraging differences among species and feeding guilds, revealing the critical role of prior learning and spatial awareness in determining how birds find ripe fruit in structurally complex environments. By uncoupling spatial location from other proximate cues, it was possible to demonstrate that generalist frugivores visit plants in known locations, rather than relying on associations with particular habitats, whereas specialists used more proximate cues of resource availability regardless of spatial context.

These findings lead to the next question of how and when do foraging birds develop this memory and how much of a role does it play in the pattern of seed dispersal that drives the spatial pattern of mistletoe occurrence in the landscape? Although our case study used direct observation to collect visitation data, the protocol described herein could be readily applied using motion-triggered cameras[20,21], allowing simultaneous monitoring of multiple sets of mistletoes and yielding new insights into between-species, -guild, -habitat and -biome differences.

Several refinements are worth considering to maximise data quality, comparability and ease of application. First, recognize that wild animals can respond both positively and negatively to novelty, so be careful to minimise any extraneous changes to their environment both in establishing the experiment and during data collection. By conducting mistletoe relocation pre-dawn, any disturbance to diurnal animals will be minimized. Although logistically more challenging, it appeared that birds were more likely to visit plants if they had been affixed in the dark, presumably due to disturbance from movement. Second, minor details can be surprisingly important. Trim off the ends of the zip ties, wear dull clothing and keep all movements to a minimum, especially during data collection. For studies on fruit removal and seed dispersal, ripe fruits are readily knocked off the peduncle, so count fruits after mistletoes are relocated. Also, check the ground after each period of collecting visitation data for fruit caps on the ground, indicative of fruit removal.

Although these representative results and overarching question related to fruit removal, this protocol could be readily applied to address questions regarding nectarivores and pollination or folivores and arboreal herbivory. In addition to manipulating mistletoe locations (e.g., high versus low to quantify herbivory from ground-based versus arboreal herbivores; *in situ* versus translocated mistletoes to quantify the influence of resident and transient nectarivores in effecting short- and long-distance pollen transport), resource density can also be manipulated. Thus, by making high and low resource density patches by manipulating mistletoe densities and/or flower/fruit/leaf numbers, different resource use strategies can be discriminated. By integrating these experiments with before and after measurements of the relevant resource, giving up densities can also be estimated, enabling resultant inferences regarding foraging ecology to be contextualized within the broader framework of habitat preferences and predator vigilance.

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DISCLOSURE STATEMENT

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Figure 1. Grey Mistletoe (*Amyema quandang*) in different stages of removal. (A) A mistletoe being removed from its host by cutting below the haustorium with a cleaned pruning saw; and (B) detail of the same mistletoe removed from the host complete with the distal end of the host branch. (C) The three main branches of another, larger mistletoe clump removed from the haustorium; (D) Detail of the three branches showing the cable ties affixing them to one another.

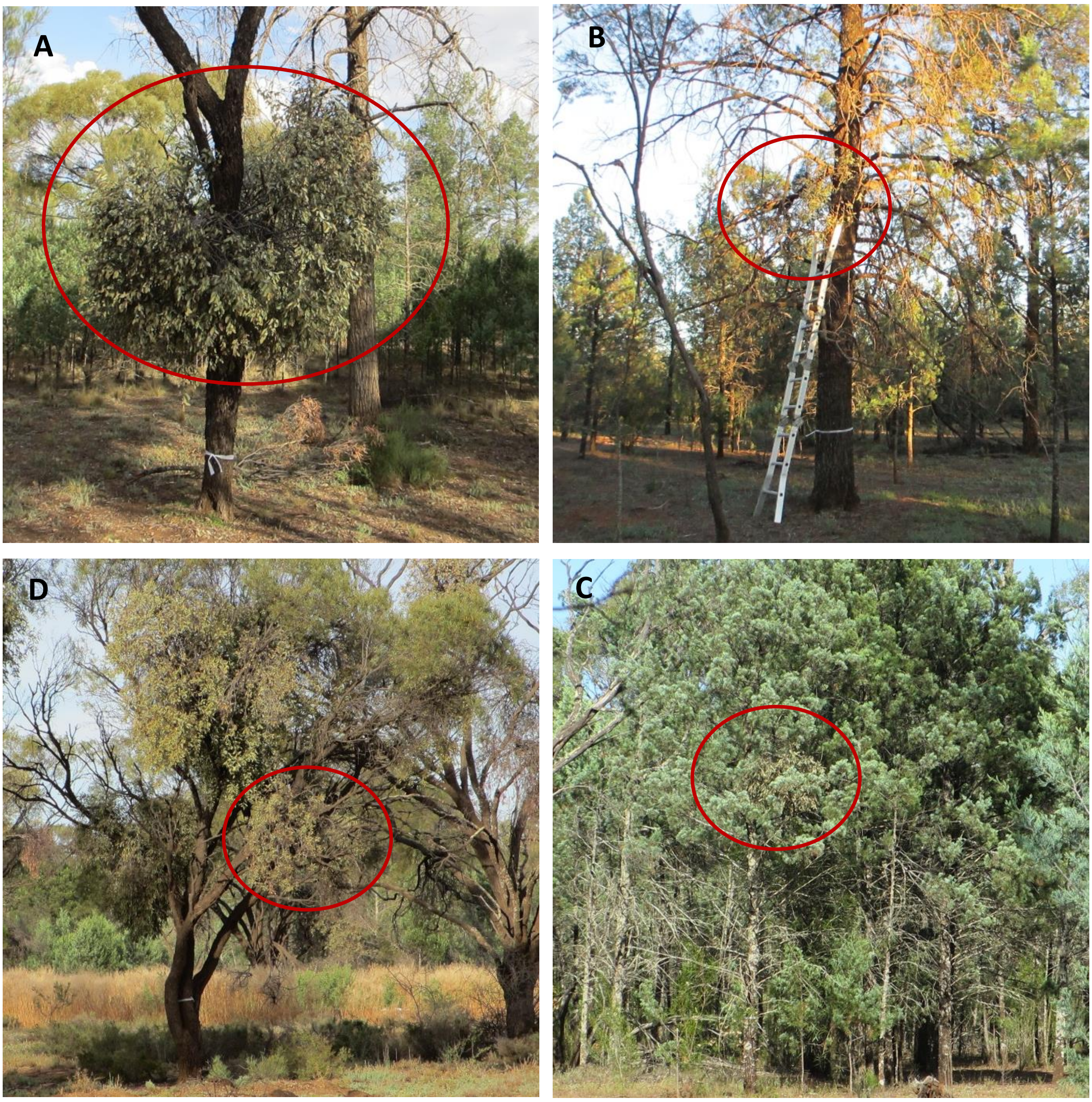

Figure 2. Grey Mistletoe (*Amyema quandang*) in the three different treatments. (A) *In situ* mistletoe before being removal from its Yarran (*Acacia homalophylla*) host and then replaced in its original location; (B and C) *Different Species* treatment mistletoe after being removed from its original host and relocated in this White Cypress tree (*Callitris glaucophylla*). (D) *Same Species* mistletoe after being removed from its original host and relocated to a new Yarran tree already hosting other mistletoes. Treatment mistletoes circled.

Source of variation	**Wald chi-square**	**Degrees of freedom**	**Main effects**	**Direction of relationship**
A. Number of visits to three treatment mistletoes				
Treatment	11.246	2	**0.004**	IS > SS; IS > DS
B. Number of visits to three treatment mistletoes including habitat covariates				
Treatment	9.086	2	**0.011**	IS > SS; IS > DS
Host canopy cover	1.759	1	0.185	-
Number of fruits	0.189	1	0.664	-

Table 1. Generalized linear models exploring the influence of treatment on the number of visits to t

reatment mistletoes (A). Model (B) includes host canopy cover and the number of fruits on the treatment t mistletoes as covariates. Treatment mistletoes were one of three treatments: In-situ (IS), cut from the c riginal host tree and reattached exactly where it was, Same Species (SS), moved to another tree of the sa ıme species as the original host and Different Species (DS), moved to a species that never hosts Grey Mist tletoe. Significance is shown in bold.

Source of variation	**Wald chi-square**	**Degrees of freedom**	**Main effects**	**Interaction**
A. Number of visits to treatment mistletoes across guilds (specialist, generalist and				
Dietary guild	6.469	2	**0.039**	-
Treatment	11.685	1	**0.001**	-
Treatment x dietary guild	8.301	1	-	**0.016**
B. Specialist visits to treatment mistletoes influenced by the number of f				
Treatment	2.743	2	0.254	-
Number of fruits	11.086	1	**0.001**	-
C. Generalist visits to treatment mistletoes influenced by mistletoe density and c				
Treatment	13.764	1	**0**	-
Host canopy cover	5.883	1	**0.015**	-
Number of mistletoes on the host tree	9.679	1	**0.002**	-
D. Opportunist visits to treatment mistletoes influenced by host height and car				
Treatment	9.719	2	**0.008**	-
Host height	4.203	1	**0.04**	-
Host canopy cover	5.212	1	**0.022**	-

* negative binomial with log link

Table 2. Generalized linear models for models comparing the number of visits to treatment

Direction of relationship
opportunist)*
-
IS > SS; IS > DS
Gen DS < Gen IS, SS
ruits
-
-
anopy cover
IS > SS
-
-
opy cover
IS > SS; IS > DS
-
-

mistletoes across dietary guilds including various covariates. (A) overall dietary guild; (B) Specialist; (C) G ieneralists; (D) Opportunists. Treatment mistletoes were cut from their original host tree and either re-p placed in-situ (*In-situ* , IS), placed in a host of the same species as the original host (*Same Species* , SS) or, placed in a species that does not host mistletoe (*Different Species* , DS). Models used a Poisson error di stribution with a log-linear link, unless otherwise indicated. Significance is shown in bold.

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Table of Materials

JOVE_MC_DMW_Materials.xlsx

Charles Sturt University

FACULTY OF SCIENCE
School of Environmental Sciences

Elizabeth Mitchell Drive, Thurgoona NSW
PO Box 789, Albury NSW 2640

Tel: (02) 6051 9850 Int: +61 2 60519850
Fax: (02) 6051 9897 Int: +61 2 60519897

www.csu.edu.au/ses/
ABN: 83 878 708 551

David M Watson
Professor in Ecology

14 March 2022

Re: Major revision of JOVE manuscript

On behalf of my coauthors and with their express consent, I am submitting a thorough revision of our manuscript entitled “Temporary translocation of entire mistletoe plants to understand the mechanistic basis of animal foraging decisions”, to be considered for publication in the special issue of JOVE “Methods and applications in parasitic plant research”.

In further revising submission, we adhered closely to the instructions to authors and restructured the entire text to conform to the journal guidelines. In addition to clarifying the context and broader relevance of our approach, we explain the method in clear step-by-step instructions, including suggestions regarding production of the associated video. All substantive comments from all three reviewers were addressed, explanations of our approach expanded to emphasise both the novelty and simplicity of our approach, shortening the representative results section and distilling down our key findings to two short paragraphs. Further, all text was reworded to conform to the editorial style, minimizing notes and using imperative tense throughout.

The revised manuscript and eventual video will be of great interest to ecologists, environmental scientists, behavioural ecologists and evolutionary empiricists, our method complimenting existing experimental approaches in the evolutionary biology / foraging ecology space.

I look forward to hearing from the editorial office in due course

Cordially,

dwatson@csu.edu.au