

June 29<sup>th</sup> 2019  
ApiNZ conference  
Rotorua



[www.treesforbeesnz.org](http://www.treesforbeesnz.org)



**The New Zealand  
Trees For Bees Research Trust**

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# **Tree Biology for Bee Nutrition**

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**Sustainable Farming Fund Project 404868**  
*Strategic Planting for Pollination and Honey*

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# Nutrition for One Bee Colony

Pollen →

Nectar →

Water →

Data from Seeley 1995 *The Wisdom of the Hive*

# Nutrition for One Bee Colony

Pollen → **20 kg per year**

Nectar →

Water →

Data from Seeley 1995 *The Wisdom of the Hive*



# Pollen for Protein, Fat, Vitamins

Weeping beech  
*Fagus sylvatica*  
var *pendula*

# Nutrition for One Bee Colony

Pollen → **20 kg per year**

Nectar → **120 kg per year**

Water →

Data from Seeley 1995 *The Wisdom of the Hive*



# Nectar for carbs and micronutrients

Nectar droplets  
in maple flower

*Acer mono mayrii*



# Nutrition for One Bee Colony

Pollen → **20 kg per year**

Nectar → **120 kg per year**

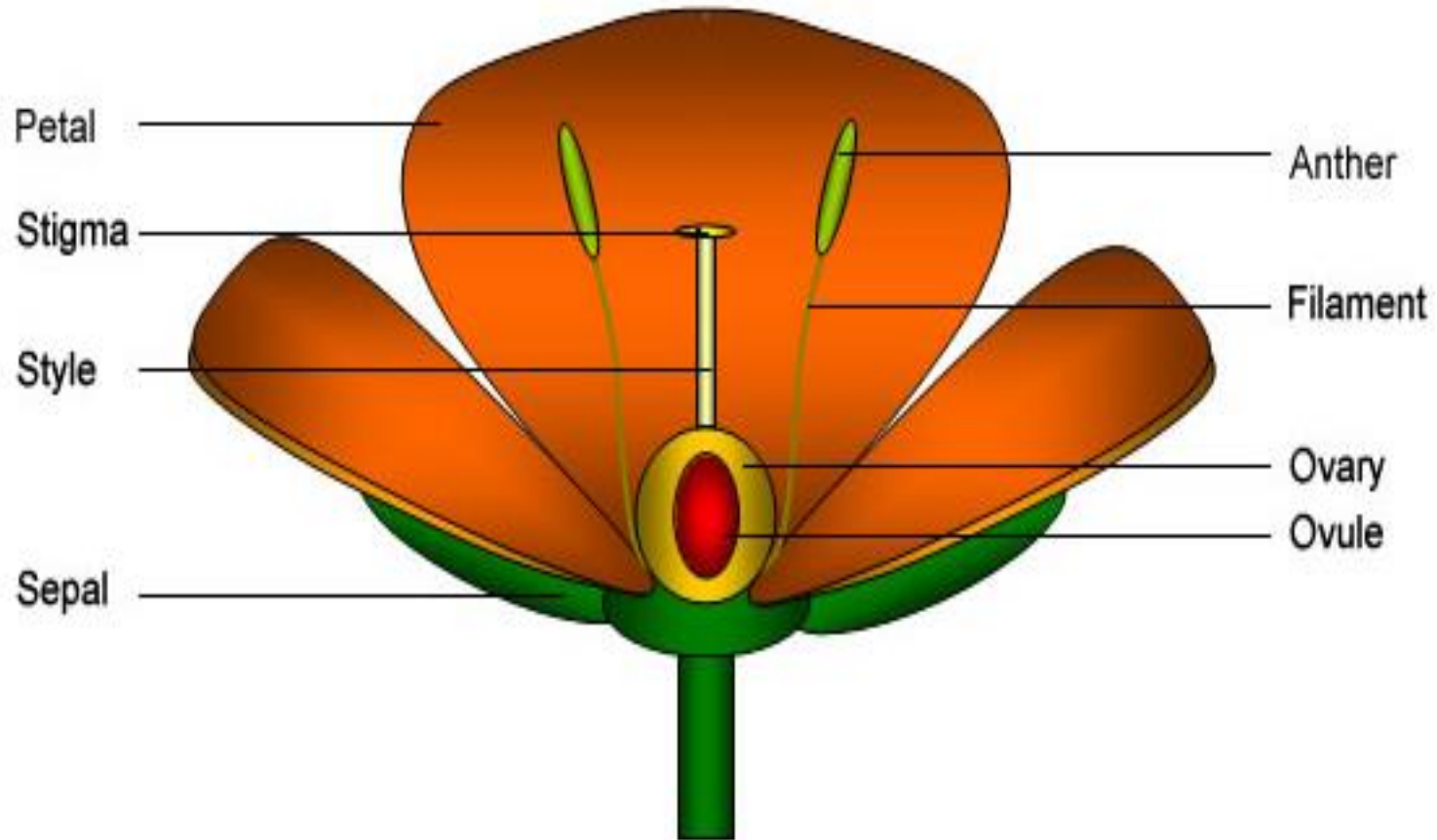
Water → **25 litres per year**

Data from Seeley 1995 *The Wisdom of the Hive*





# Parts of a Flower





# Types of flowers

- Super bowl
- Open dish
- Tubular
- Complex (flag)
- Catkins



# Super Bowl Flower Herbaceous Peonies



Photo by Newstrom-Lloyd



**Super  
Bowl  
Flower**

**Camellia sp.**

# Open dish and Closed (flag)

*Acer mono mayrii*



*Cercis sp.*



# Tubular flower in flax (*Phormium*)



Photo by Finn Scheele



# Catkins in Willow (*Salix* sp)

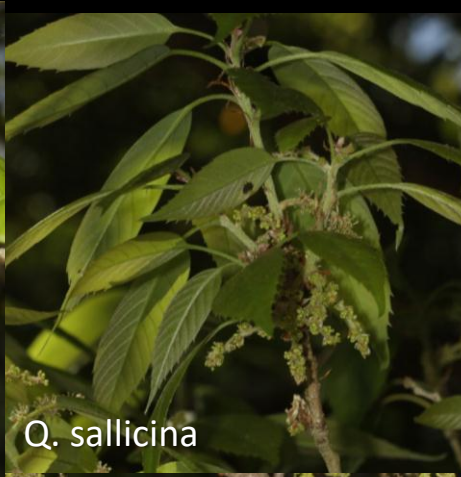


Photo : Jean-Noël Galliot

# Oaks (*Quercus* spp.) - Range **18%** to **22%** protein



*Q. robur*



*Q. salicina*



*Q. laeta*



*Q. canariensis*



*Q. mongolica*



*Q. crassifolia*





# Why Trees?

## More pollen & nectar

- vertical dimension huge
- flowers per sq. m. of ground
- low to no maintenance
- long-lived



# Why Trees?

## More pollen & nectar

- vertical dimension huge
- flowers per sq. m. of ground
- low to no maintenance
- long-lived e.g. 100 yrs





# Types of Trees

## Wind Pollinated trees

- wind pollinated catkins
- pollen/ovule ratio large
- deciduous drops all leaves
- flower in early spring

# Mexican Oak

(*Quercus candicans*)



Photo : Jean-Noël Galliot  
© Landcare Research







*Quercus  
candicans*



Photo : Jean-Noël Galliot



# Box elder (*Acer negundo*)



Photo: Jean-Noël Galliot



# Box elder (*Acer negundo*)



Photo : Jean-Noël Galliot

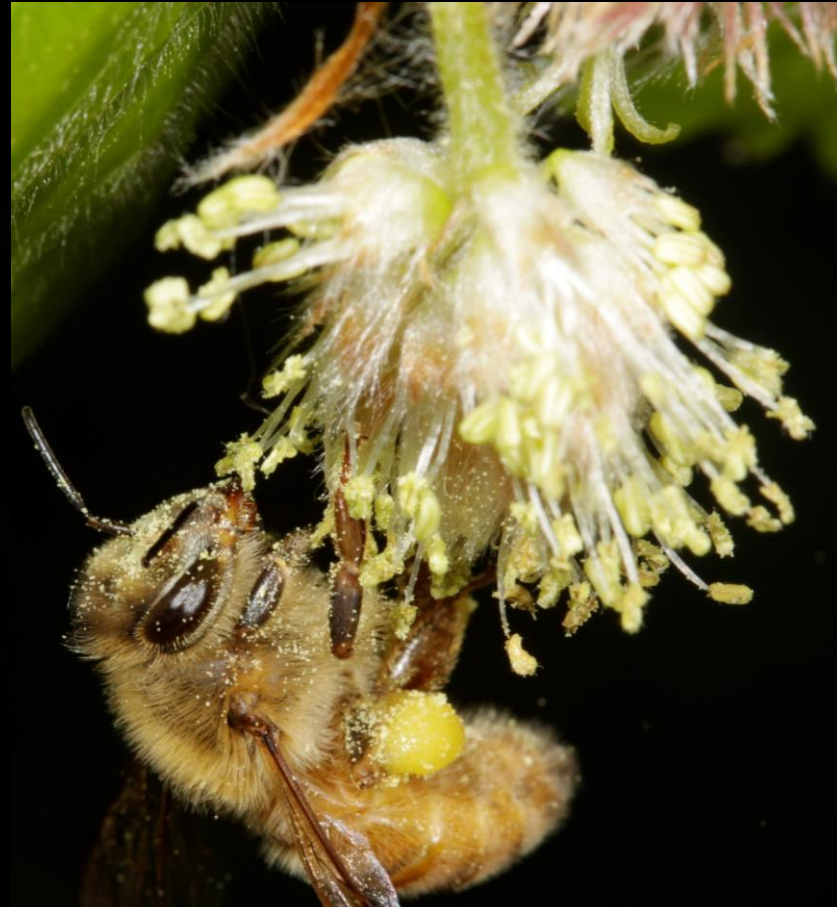
***Fagus sylvatica*  
var *pendula***  
**Weeping beech**

- Flowers profusely
- But not every year





# Anthers on long filaments and no petals



Weeping Beech Tree



# Types of Trees

## Insect pollinated trees

- blossom trees
- open dish small flowers
- dense flowers over whole tree
- good foraging platform
- total nectar and pollen high



# *Malus sieboldii* – Apple



***Malus sieboldii* – Apple**





# Photinia (*Photinia beauverdiana*)



Photo : Jean-Noël Galliot

# Photinia (*Photinia beauverdiana*)



Photo : Jean-Noël Galliot



# *Acer coriaceifolium*    Yunnan Maple



# *Acer coriaceifolium* Yunnan Maple





# Flowering Ash (*Fraxinus ornus*)



Photo : Jean-Noël Galliot

# Flowering Ash (*Fraxinus ornus*)



Photo : Jean-Noël Galliot



# Deciduous holly (*Ilex macrocarpa*)



Photo : Jean-Noël Galliot  
© Landcare Research



Photo: Jean-Noël Galliot  
© Landcare Research



# Deciduous holly (*Ilex macrocarpa*)



Photo: Jean-Noël Galliot

# Shadbush (*Amelanchier canadensis*)



Photo : Jean-Noël Galliot



# Shadbush (*Amelanchier canadensis*)

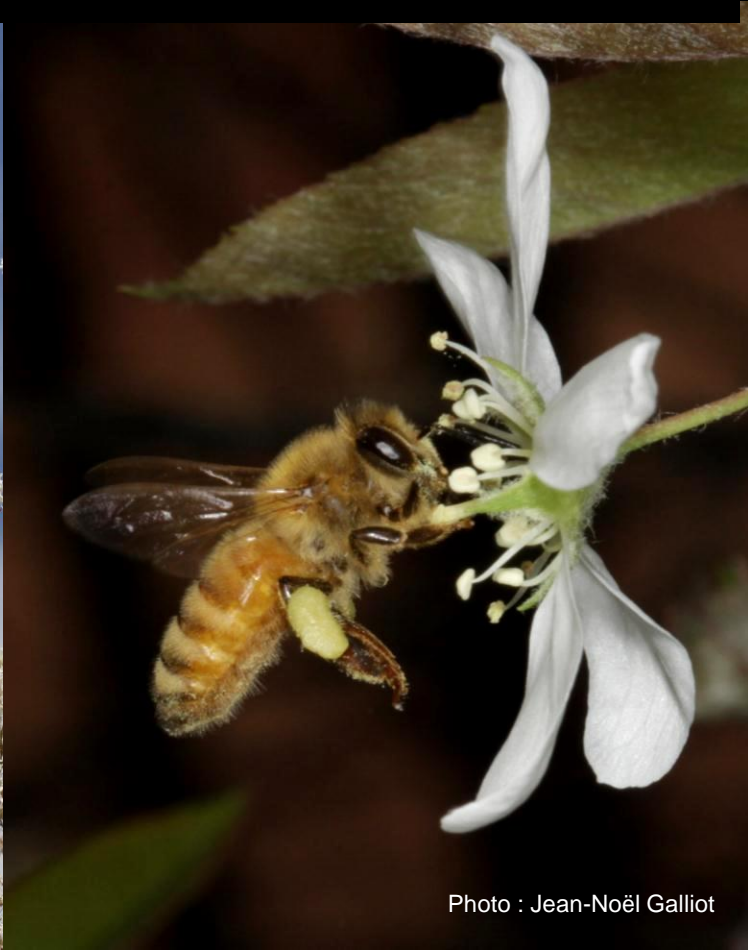


Photo : Jean-Noël Galliot





# Types of Trees

## **Animal pollinated trees**

- copious nectar production
- huge pollen production
- Australasian trees
- some flower autumn, early spring

# Animal Pollinated Trees

Pohutakawa

Grevillea



# Banksia integrifolia







# How many trees?

## Per hive need xx?

- measure?
- count?
- estimate?

# How many flowers to feed one bee?

Flax averages 5 mg pollen/flower (need 125 to 145 mg)

25 to 30 flowers for 1 bee from egg to adult





# Cockspur hawthorn (*Crataegus crus-galli*)



Photo : Jean-Noël Galliot





# Answer is ...

## Limits to planting

- space for planting
- budget for plants and labour
- maintenance time
- too much → swarming?



# How many trees?

## Per hive add xx?

- Wild Cape -- Bill Savage
- Tawari Apiaries – Barry Foster
- Kintail – James & Mary-Anne Ward



# Strategic Planting

- multi-purpose plants
- balanced – no gaps
- targeted – no competition
- low maintenance
- long-lived

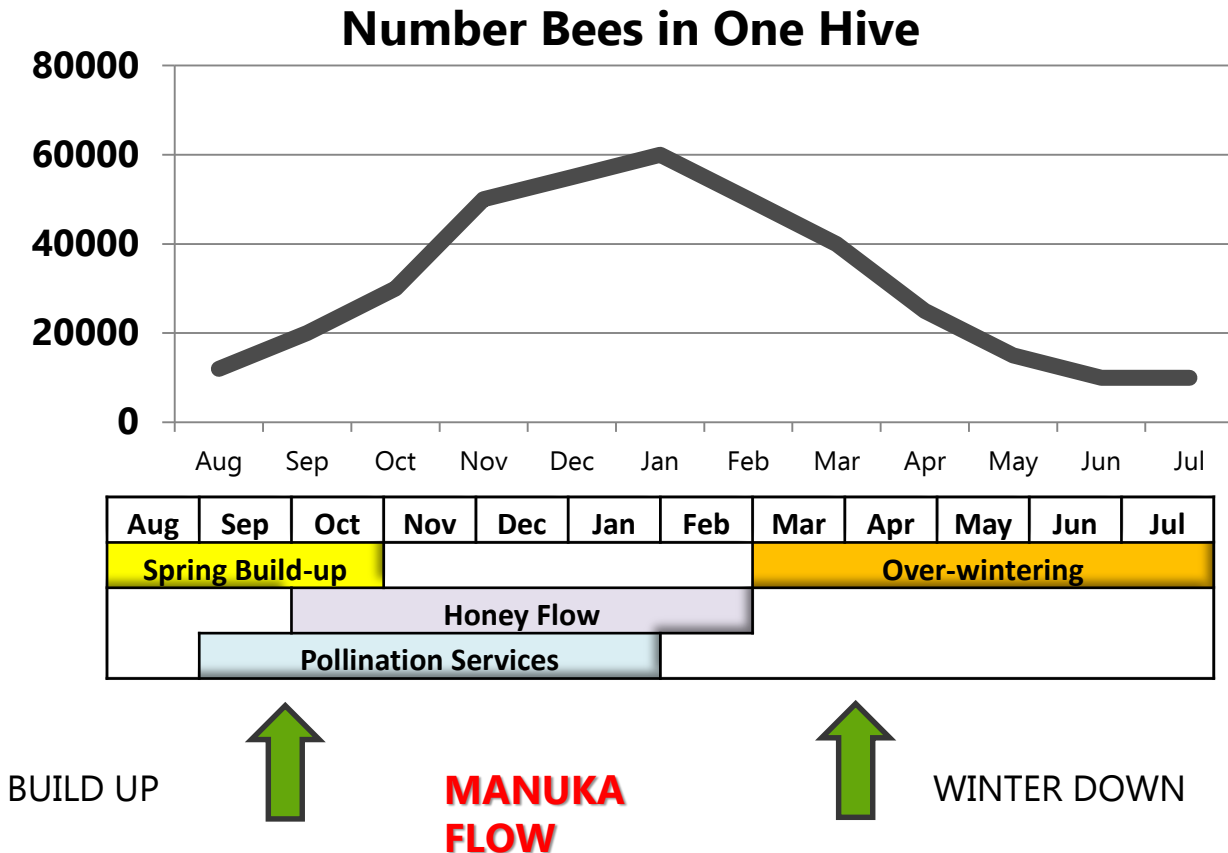




# Tools for planning

- plant lists (*e.g. Riparian*)
- flowering calendar
- species diversity chart
- bee forage profile chart
- annual bee forage budget

# STRATEGIC = Fill gaps & ID Target Activity



# Spring to Summer Flowering

Biostatus	Botanical Name	Common Name	Winter/Early Spring				Spring/Early Summer		Summer				Early Winter	
			June	July	August	September	October	November	December	January	February	March	April	May
Native	<i>Fuchsia excorticata</i>	Tree fuchsia	1	1	1	1	1	1	1	1				
Native	<i>Melicytus lanceolatus</i>	Narrow-leaved mahoe	1	1	1	1	1	1	1					
Native	<i>Pseudopanax arboreus</i>	Five-finger	1	1	1									
Native	<i>Metrosideros carminea</i>	Crimson rata			1	1	1							
Native	<i>Leptospermum</i>	Manuka				1	1	1	1	1	1	1		
Native	<i>Kunzea ericoides</i>	Kānuka				1	1	1	1	1	1			
Native	<i>Pittosporum umbellatum</i>	Haekaro				1	1	1	1	1				
Native	<i>Pittosporum ralphii</i>	Ralph's Kohuhu	x			1	1	1	1	x	x	x	x	x
Native	<i>Pittosporum crassifolium</i>	Karo				1	1	1	1					
Native	<i>Weinmannia silvicola</i>	Kāmahi				1	1	1	1					
Native	<i>Metrosideros diffusa</i>	Rata vines					1	1	1	1				
Native	<i>Olearia furfuracea</i>	Tanguru					1	1	1	1				
Native	<i>Pittosporum eugenioides</i>	Lemonwood					1	1	1					
Native	<i>Knightia excelsa</i>	Rewarewa					1	1	1					
Native	<i>Cordyline australis</i>	Cabbage tree					1	1	1					
Native	<i>Carpodetus serratus</i>	Marble leaf						1	1	1	1	1		
Native	<i>Pennantia corymbosa</i>	Kahikōmako						1	1	1	1			
Native	<i>Melicytus ramiflorus</i>	Whiteywood						1	1	1	1			
Native	<i>Metrosideros umbellata</i>	Southern rata						1	1	1	x	x		
Native	<i>Ixerba brexioides</i>	Tāwari						1	1	1				
Native	<i>Metrosideros robusta</i>	Northern rata						1	1	1				
Native	<i>Phormium tenax</i>	NZ flax						1	1					



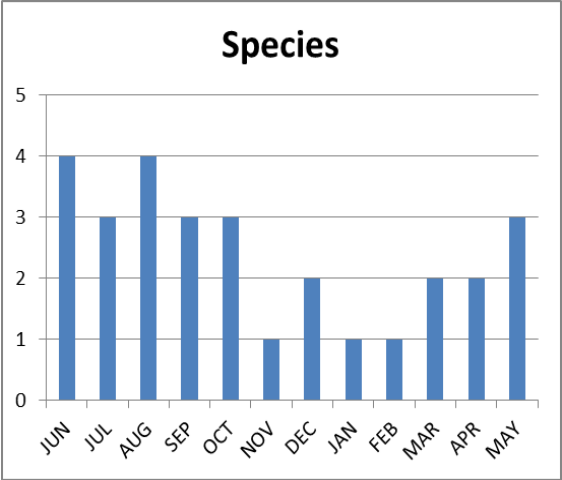
# Summer to Autumn Flowering

Biostatus	Botanical Name	Common Name	Winter/Early Spring				Spring/Early Summer		Summer				Early Winter	
			June	July	August	September	October	November	December	January	February	March	April	May
Native	<i>Carpodetus serratus</i>	Marble leaf						1	1	1	1	1		
Native	<i>Pennantia corymbosa</i>	Kahikōmako						1	1	1	1			
Native	<i>Melicytus ramiflorus</i>	Whiteywood						1	1	1	1			
Native	<i>Metrosideros umbellata</i>	Southern rata						1	1	1	x	x		
Native	<i>Ixerba brexioides</i>	Tāwari						1	1	1				
Native	<i>Metrosideros robusta</i>	Northern rata						1	1	1				
Native	<i>Phormium tenax</i>	NZ flax						1	1					
Native	<i>Hoheria angustifolia</i>	Narrow-leaved lacebark							1	1	1	1		
Native	<i>Metrosideros albiflora</i>	Large white rata							1	1	1	1		
Native	<i>Metrosideros excelsa</i>	Pōhutukawa							1	1				
Native	<i>Weinmannia racemosa</i>	Kāmahi							1	1				
Native	<i>Pseudopanax crassifolius</i>	Hoheka								1	1	1	1	
Native	<i>Metrosideros perforata</i>	Small white rata								1	1	1		
Native	<i>Hebe salicifolia</i>	Koromiko								1	1	x	x	
Native	<i>Metrosideros fulgens</i>	Scarlet rata	1								1	1	1	1
Native	<i>Schefflera digitata</i>	Seven-finger									1	1		
Native	<i>Dysoxylum spectabile</i>	Kohekohe	1									1	1	1
Native	<i>Olearia paniculata</i>	Akepiro										1	1	1
Native	<i>Hoheria populnea</i>	Lacebark	x									1	1	x
	Total species flowering each month		5	3	4	9	14	20	24	19	12	11	5	3

# Species Diversity Chart

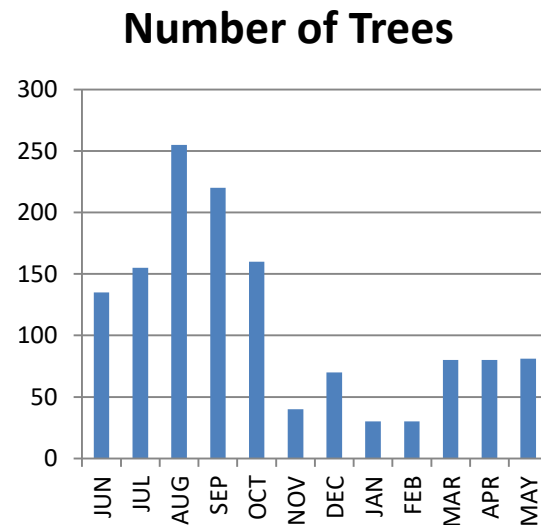
Target Plant

Number of Species		JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
	<i>Leptospermum scoparium</i> Mānuka												
1	<i>Pittosporum eugenioides</i> Tarata					1	1	1					
2	<i>Pseudopanax arboreus</i> Five-finger	1	1	1									
3	<i>Vitex lucens</i> Pūriri	1	1	1	1	1							1
4	<i>Hebe stricta</i> Koromiko		1	1	1	1							
5	<i>Coprosma robusta</i> Karangū			1	1								
6	<i>Pseudopanax lessonii</i> Houpara							1	1	1			
7	<i>Hoheria populnea</i> Houhere	0.5									1	1	0.5
8	<i>Hoheria sexstylosa</i> Houhere	0.5									1	1	0.5
TOTAL (not including target crop)		4	3	4	3	3	1	2	1	1	2	2	3



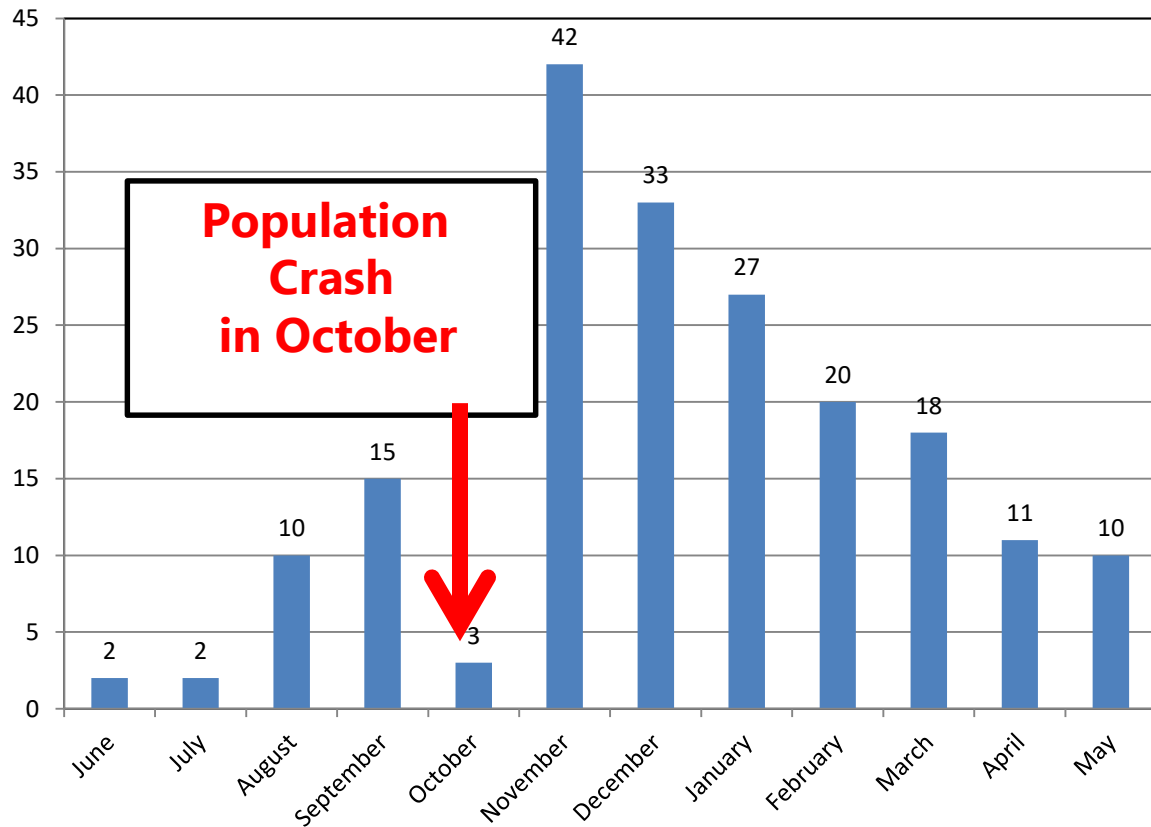
# Bee Forage Profile Chart

NUMBER OF TREES		JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
	<i>Leptospermum scoparium</i> Mānuka												
1	<i>Pittosporum eugenioides</i> Tarata					40	40	40					
2	<i>Pseudopanax arboreus</i> Five-finger	35	35	35									
3	<i>Vitex lucens</i> Pūriri	20	20	20	20	20							1
4	<i>Hebe stricta</i> Koromiko		100	100	100	100							
5	<i>Coprosma robusta</i> Karangū			100	100								
6	<i>Pseudopanax lessonii</i> Houpara							30	30	30			
7	<i>Hoheria populnea</i> Houhere	40									40	40	40
8	<i>Hoheria sexstylosa</i> Houhere	40									40	40	40
TOTAL (not including target crop)		135	155	255	220	160	40	70	30	30	80	80	81

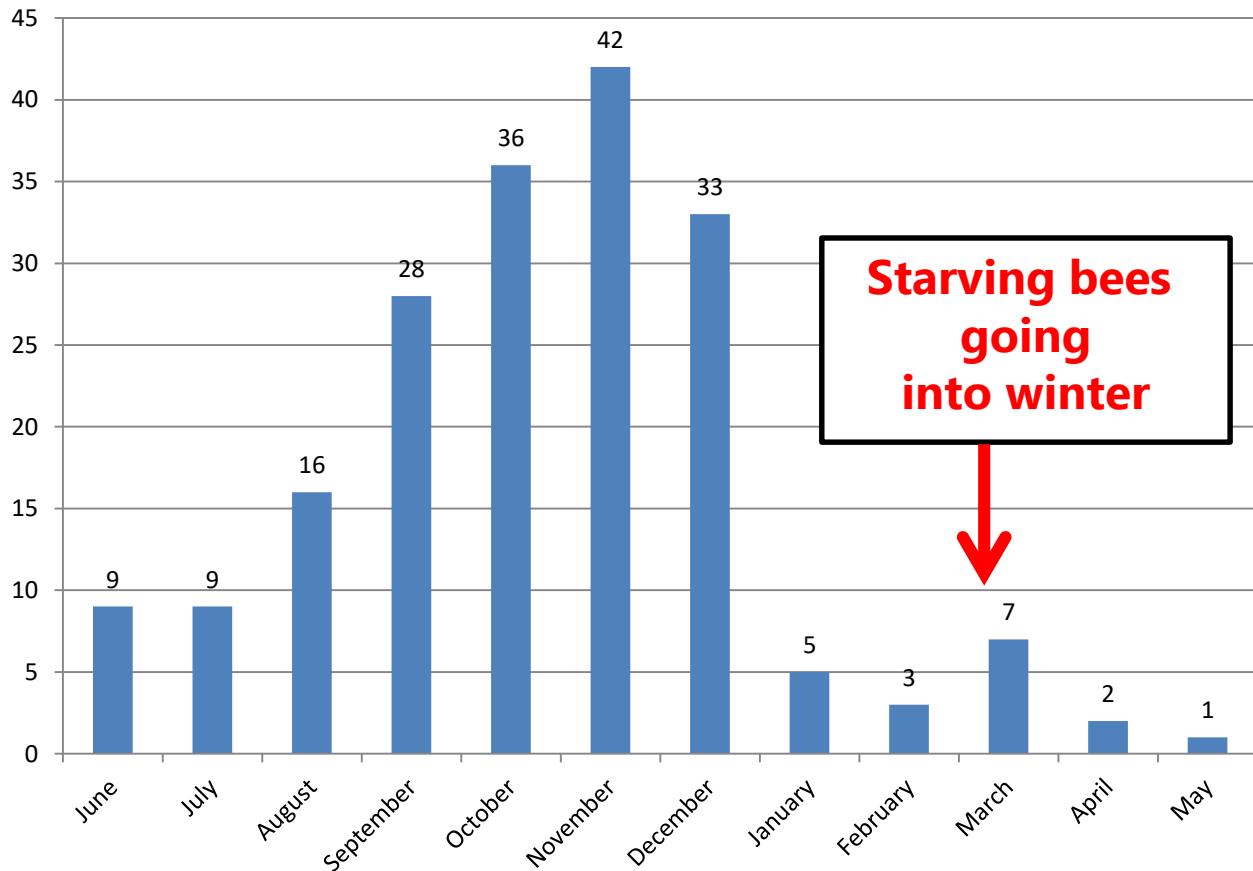




# Strategic planting = fill in the gaps



# Strategic Planting = fill in the gaps



# Trees for Bees Online Resources

## CURRENT SFF 2016 OUTPUTS

- Bee Pollen Identification Key
- Willow Identification Key
- Bee Flower Catalogue
- Demo Farm Handbooks
  - Manuka
  - Riparian
  - Guide to Planting

## NEW SFF 2019 to produce

- More Handbooks
- Design Templates
- Plant Selector Tool
- Flowering Calendar and Charts
- Pollen Identification Expanded
- Bee Flower Catalogue Expanded



# Willow interactive key

by David Glenny and Trevor Jones

- wild and cultivated willows
- 56 species, hybrids, forms, cultivars
- 2300 images
- 44 identification features explained
- willow flora for NZ in prep

Manaaki Whenua's website, <https://keys.landcareresearch.co.nz/nzsalix/>,  
or by searching for "willow key NZ".



## Features Available: 44

- Plant form
- Peeled branchlet wood ridges ('striations')
- Branchlets weeping
- Last season's branchlets golden
- Leaves and or branches contorted
- Hairs on last season's branchlets
- Waxy bloom on last season's branchlets
- Leaves opposite or alternate
- Dead leaves persisting over winter
- Stipules
  - 170 mm Leaf blade length (at any season)
  - Leaf blade length (largest summer leaf)
  - 34 mm Leaf width (at any season)
  - Leaf width (largest summer leaf)
  - Leaf blade length to width ratio (divide length by width)
  - Leaf petiole length
- Leaf hairs
- Leaf margins
- Upper leaf surface smooth or bullate
- Upper leaf surface stomata
- Leaf underside glaucous or not
- Leaf galls (willow sawfly galls)
- Flower bract colour

## Features Chosen: 2

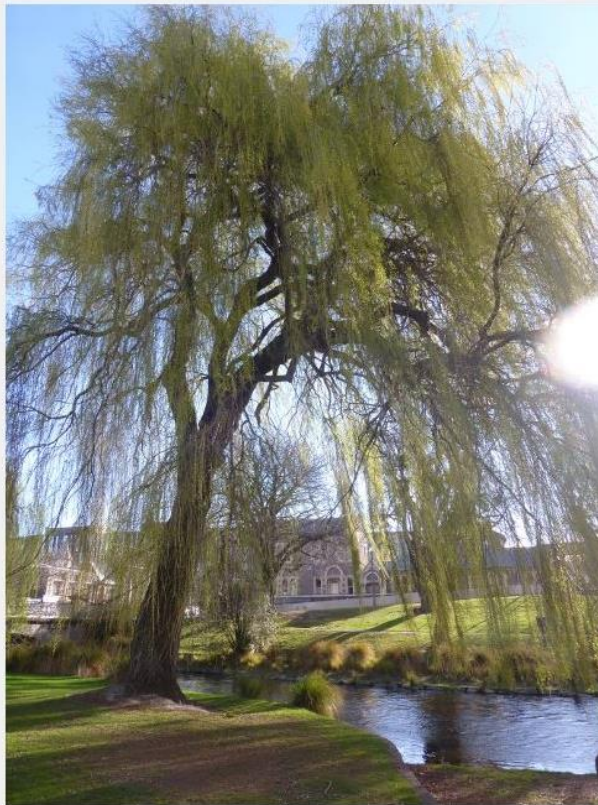
- 170 mm Leaf blade length (at any season)
- 34 mm Leaf width (at any season)

## Entities Remaining: 5

- Salix subgenus Salix - tree willows
  - Salix x meyeriana (S. euina x S. pentandra)
  - Salix x pendulina - weeping willows
    - Salix x pendulina f. pendulina (S. alba x S. babylonica x S. euina) - weeping willow
    - Salix x pendulina f. salamonii -(S. babylonica x S. x fragilis f. vitellina) - golden weeping willow
- Salix subgenus Vetrix - shrub willows, osiers, sallows
  - Salix magnifica
  - Salix x calodendron (S. caprea x S. cinerea x S. viminalis) - holm willow

## Entities Discarded: 51

- Salix subgenus Vetrix - shrub willows, osiers, sallows
  - Salix acutifolia - violet willow
  - Salix appenina
  - Salix atrocinerea - rusty willow
  - Salix basaltica (incl. S. cantabrica) - sage-leaf willow
  - Salix caprea - goat willow
  - Salix cardiophylla
  - Salix cinerea - grey willow
  - Salix daphnoides - violet willow
  - Salix eleagnos - hoary willow, bitter willow, rosemary willow
  - Salix eriocephala - heart-leaf willow
  - Salix gmelinii (= S. dasyclados)
  - Salix gracilistyla
  - Salix hookeriana - dune willow
  - Salix lasiolepis - arroyo willow
  - Salix exigua - narrow-leaf willow
  - Salix myricoides (= S. glaucophylloides) - blue-leaved willow
  - Salix myrsinifolia (incl. S. atrovirens, S. nigricans) - dark-leaved willow
  - Salix petiolaris
  - Salix purpurea - purple willow
  - Salix reinii
  - Salix repens (incl. S. arenaria) - creeping willow



Salix pendulina f. salamonii, form of tree  
Photo: David Glenny, © Landcare Research



Salix x pendulina f...



Salix x pendulina f...



Salix x pendulina f...



Salix x pendulina f...



Salix x pendulina f...







# What to plant?

## Apiary assessment tool

- what pollen bees bringing in?
- apiary foraging area very large
- analyse pollen loads (hive trap)
- analyse pollen in nectar/honey



# What flowers are bees foraging on?

## DIY Pollen ID kit

- pollen reference collections
- Ian Raine and Xun Li at GNS

