

Barcode UK: saving plants and pollinators using DNA barcoding

Natasha de Vere
National Botanic Garden of Wales

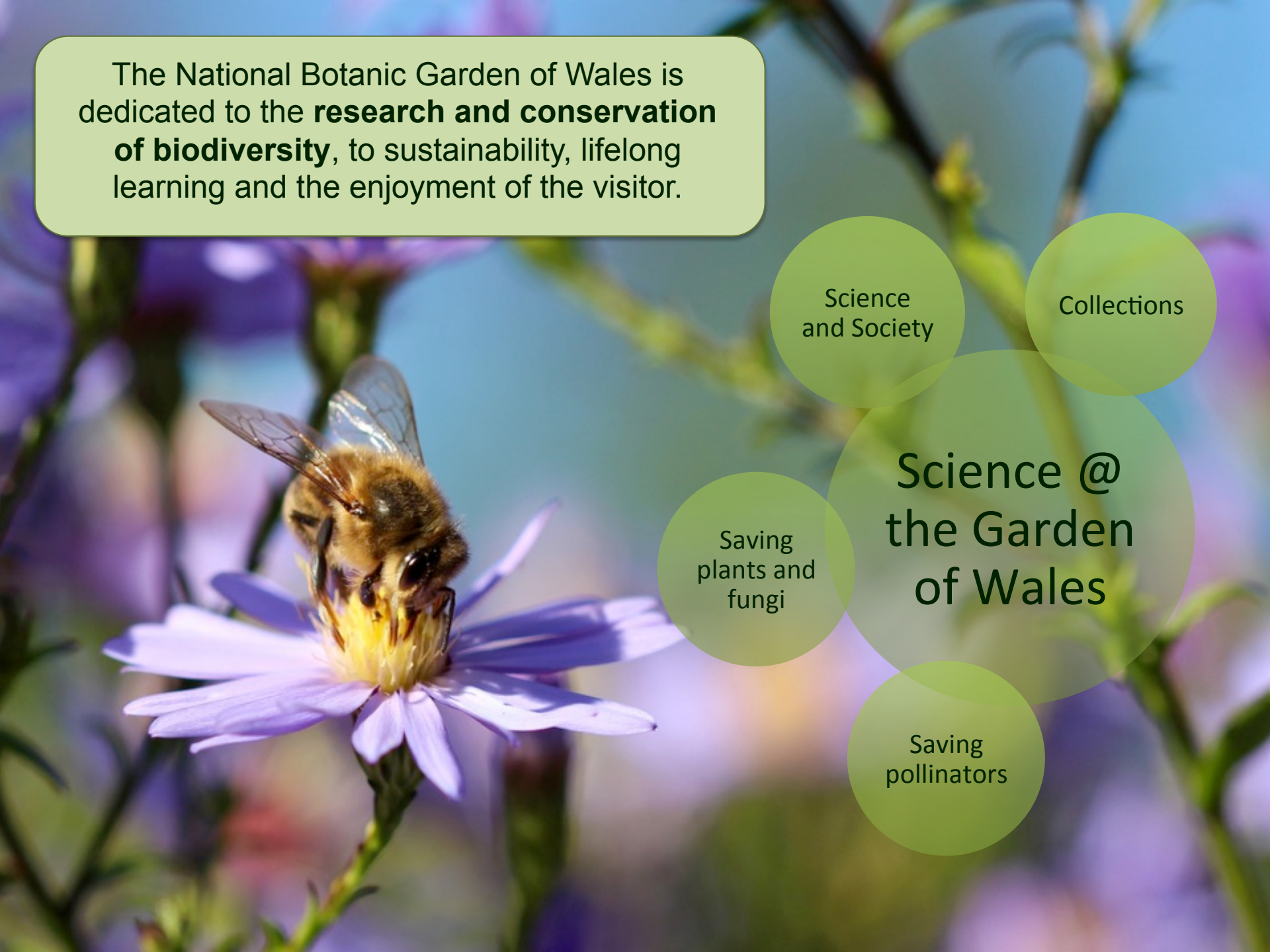
Gwyddoniaeth yng Ngardd Cymru

Science @ the Garden of Wales

Cefnogi planhigion, peillwyr a phobl

For plants, pollinators and people



A close-up photograph of a bee on a purple flower, serving as the background for the entire slide. The bee is positioned in the lower-left quadrant, facing right towards the center of the flower. The flower has many light purple petals and a bright yellow center. The background is a soft-focus blue sky with some green foliage.

The National Botanic Garden of Wales is dedicated to the **research and conservation of biodiversity**, to sustainability, lifelong learning and the enjoyment of the visitor.

Science
and Society

Collections

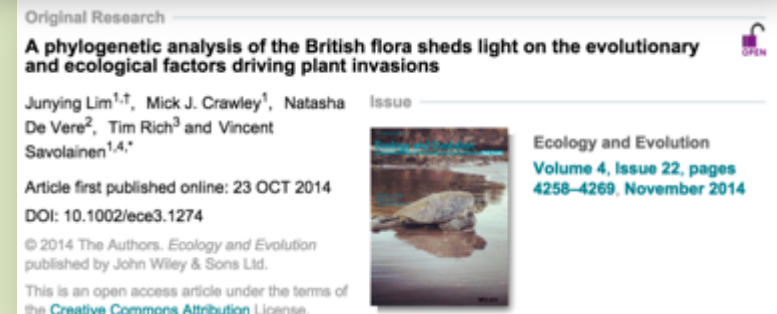
Saving
plants and
fungi

Science @
the Garden
of Wales

Saving
pollinators

Saving Plants and Fungi: Barcode UK and DNA barcoding applications

- DNA barcoding uses short sections of DNA to identify species.
- Projects throughout the world are DNA barcoding all living things. Open Science is key!
- Wales: first nation in the world with a DNA barcoded flora. We have now completed the rest of the UK.
- Using DNA barcoding to investigate pollinator foraging, community phylogenetics and aerobiology.



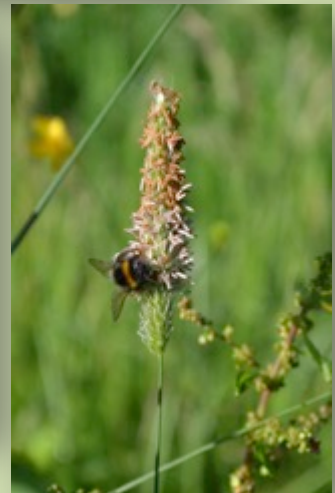
Saving Pollinators



- Insect pollination is a key regulating ecosystem service.
- Concern worldwide about declines in both wild pollinators and honeybees.
- Habitat loss, agricultural intensification, pests and disease, climate change.

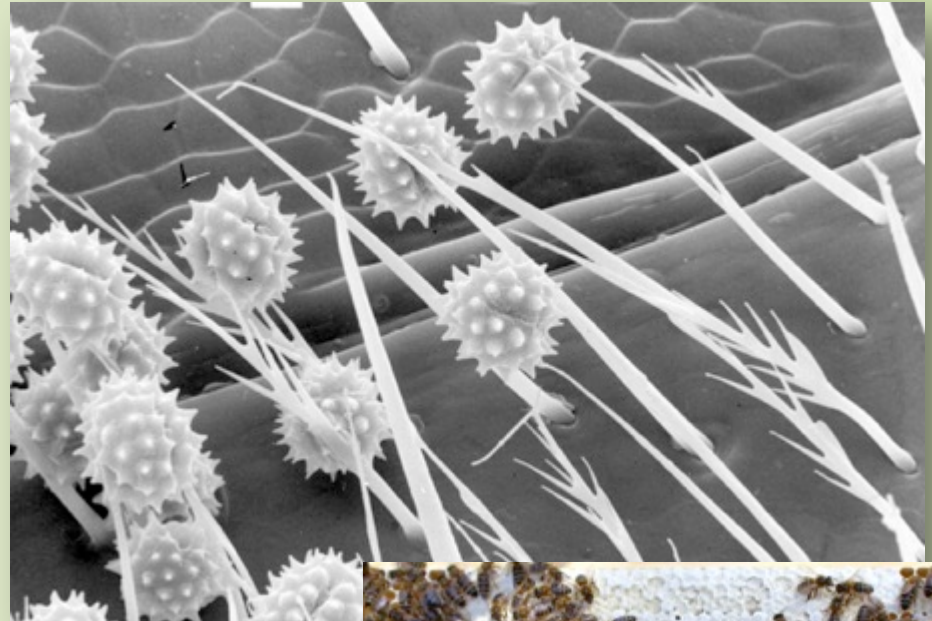
Pollinator Conservation

- Investigate habitat requirements, foraging preferences and dietary needs of pollinating insects.
- Provide guidance on land management.
- Develop targeted seed mixes for landowners & gardeners.



DNA Metabarcoding for Pollen I.D.

- Floral visitation can be tracked by DNA metabarcoding pollen collected by insects.
- Pollen can be retrieved from the bodies of insects, from pollen loads or honey from honeybees.



DNA Metabarcoding

1

- Retrieve pollen

2

- Extract DNA

3

- Amplify DNA barcode markers

4

- Next Generation DNA sequencing

5

- Use super computer to compare the unknown DNA sequences to the Barcode UK reference database

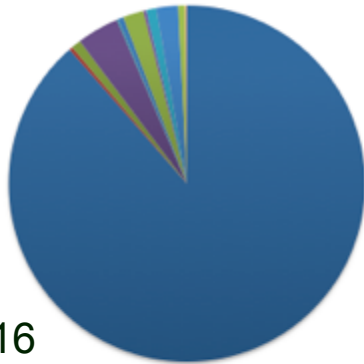
Hoverfly Foraging Preferences

- Hoverflies of the genus *Eristalis* (n=182).
- Sampled from four plant species-rich pastures.
- Early (June 1st - July 15th) and late (July 16th – Aug 31st) collections.

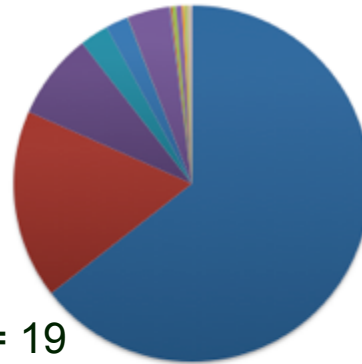


Hoverfly Foraging Results: Early Summer

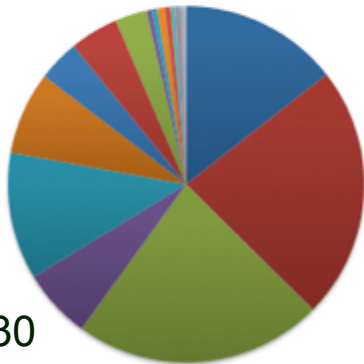
CADE (11)



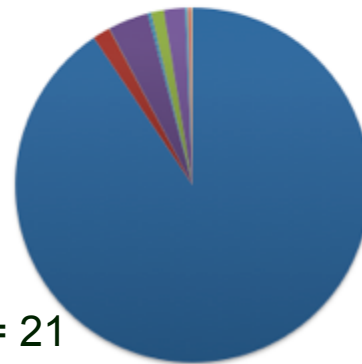
LLCE (14)



RHCE (22)



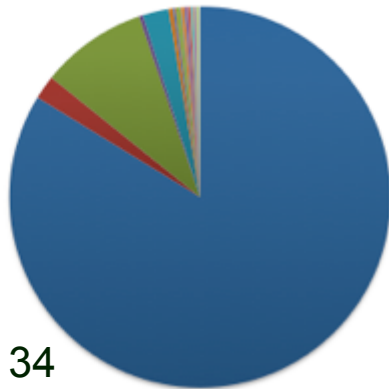
TREE (9)



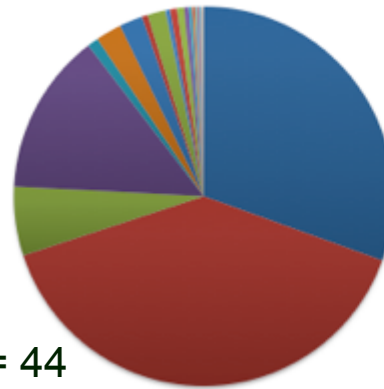
- Rubus
- Apieceae
- Senecio spp
- Sambucus nigra
- Cardueae
- Dactylorhiza spp
- Ranunculus spp
- Potentilla spp
- Cichorieae
- Rosa spp

Hoverfly Foraging Results: Late Summer

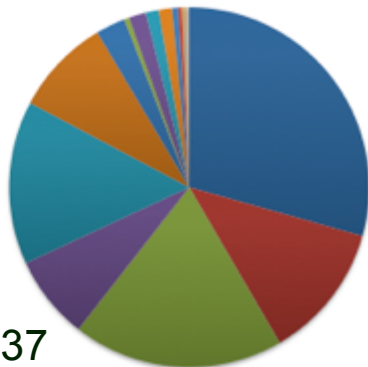
CADL (42)



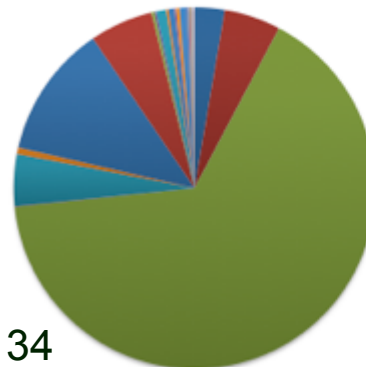
LLCL (32)



RHCL (37)



TREL (15)



- Succisa pratensis
- Cardueae
- Rubus
- Hypericum spp
- Calluna vulgaris
- Filipendula ulmaria
- Apiaceae spp
- Brassicaceae
- Unknown
- Achillea millefolium
- Mentha spp
- Senecio spp

Honey Bee Foraging

20 honeys collected throughout Wales and the UK.



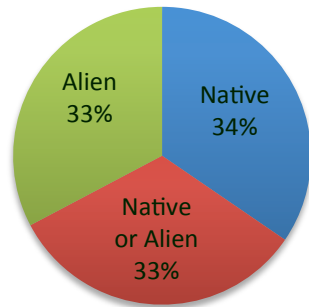
Honey I.D.	Number of taxa detected
H1	18
H2	14
H4	13
H6	19
H7	15
H8	21
H9	23
H11	18
H13	14
H14	17
H15	1
H16	4
H17	15
H18	16
H19	1
H20	31
H21	18
H22	1
H23	10
H24	18

Taxa	%	Taxa	%
<i>Taraxacum officinale</i>	85	<i>Bellis</i>	15
<i>Trifolium repens</i>	65	<i>Crepis</i>	15
<i>Rubus fruticosus</i>	60	<i>Calluna vulgaris</i>	15
<i>Trifolium</i>	55	<i>Ononis</i>	15
<i>Rosa</i>	55	<i>Quercus</i>	15
<i>Prunus</i>	50	<i>Digitalis / Antirrhinum / Veronica</i>	15
<i>Cirsium</i>	40	<i>Epilobium</i>	15
<i>Brassica napus</i>	40	<i>Festuca</i>	15
<i>Sambucus / Viburnum</i>	40	<i>Poa pratensis</i>	15
<i>Solidago</i>	35	<i>Filipendula ulmaria</i>	15
<i>Impatiens glandulifera</i>	35	<i>Ribes</i>	15
<i>Centaurea</i>	25	<i>Erigeron</i>	10
<i>Brassica</i>	25	<i>Cornus</i>	10
<i>Polygala</i>	25	<i>Hydrangea</i>	10
<i>Oxalis</i>	25	<i>Philadelphus</i>	10
<i>Crataegus monogyna</i>	25	<i>Fabaceae</i>	10
<i>Malus</i>	25	<i>Lathyrus</i>	10
<i>Hypochaeris</i>	20	<i>Trifolium pratense</i>	10
<i>Brassica oleracea</i>	20	<i>Vicia sativa</i>	10
<i>Erysimum</i>	20	<i>Castanea sativa</i>	10
<i>Escallonia</i>	20	<i>Centaureum</i>	10
<i>Ulex</i>	20	<i>Geranium</i>	10
<i>Persea</i>	20	<i>Euphrasia</i>	10
<i>Salix</i>	20	<i>Chamerion angustifolium</i>	10
<i>Holcus lanatus</i>	20	<i>Agrostis capillaris</i>	10
<i>Cotoneaster</i>	20	<i>Arrhenatherum elatius</i>	10
<i>Sorbus</i>	20	<i>Athyrium filix-femina</i>	10
<i>Saxifraga</i>	20		

Taxa most frequently found in 20 honeys

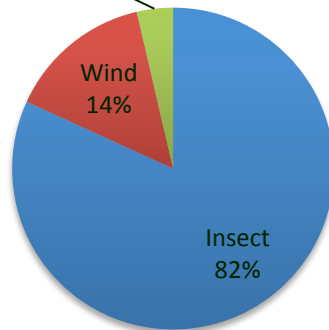
Types of Plant Honey Bees use for Forage

Status



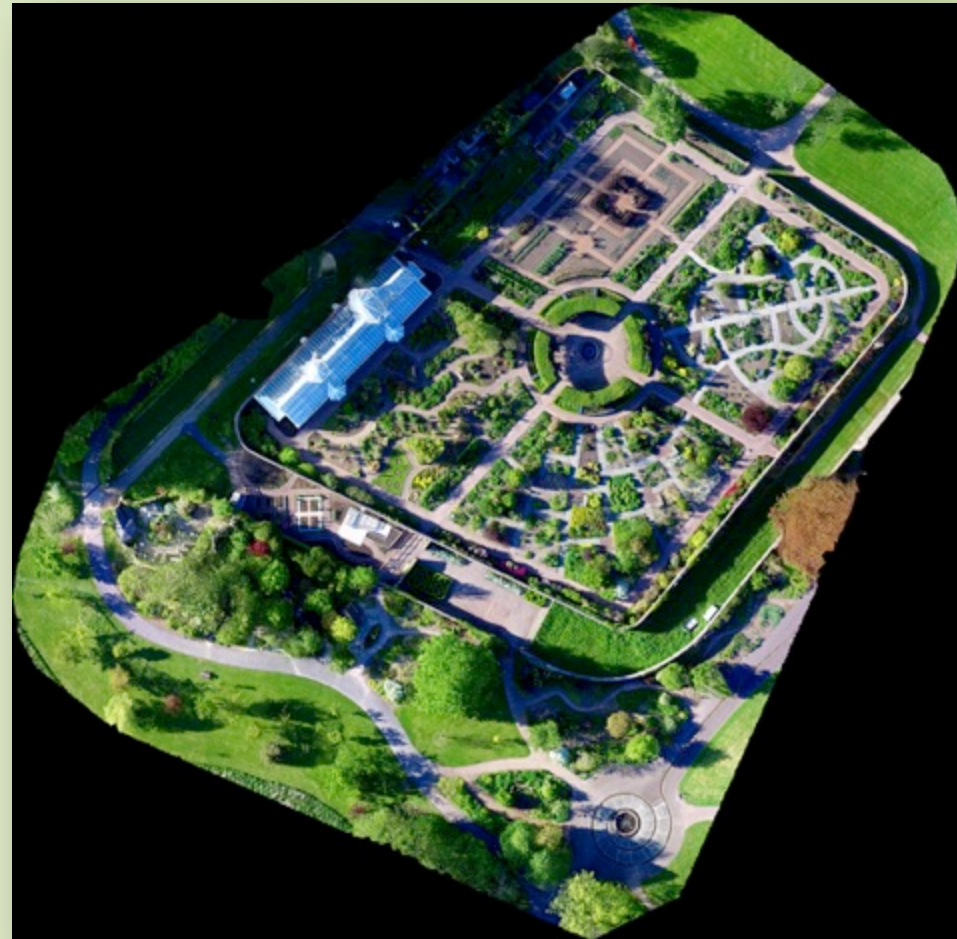
Pollination

Both
4%



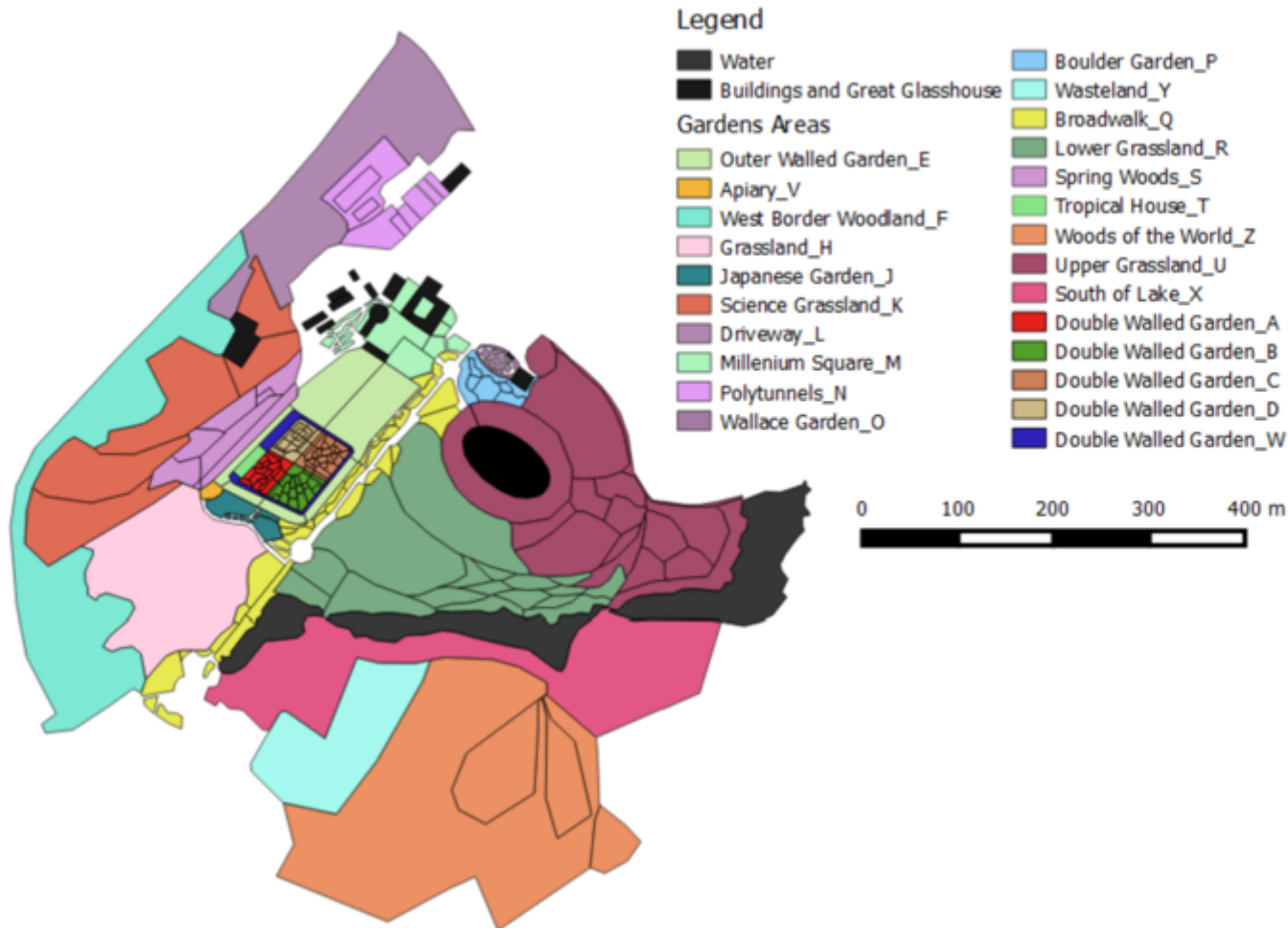
Honey Bee Foraging: Spatial Ecology

- National Botanic Garden of Wales Apiary.
- Botanic Garden contains 8000 plant taxa.
- Collect pollen and honey samples throughout the year.
- Map all plants in flower using citizen science and drones.

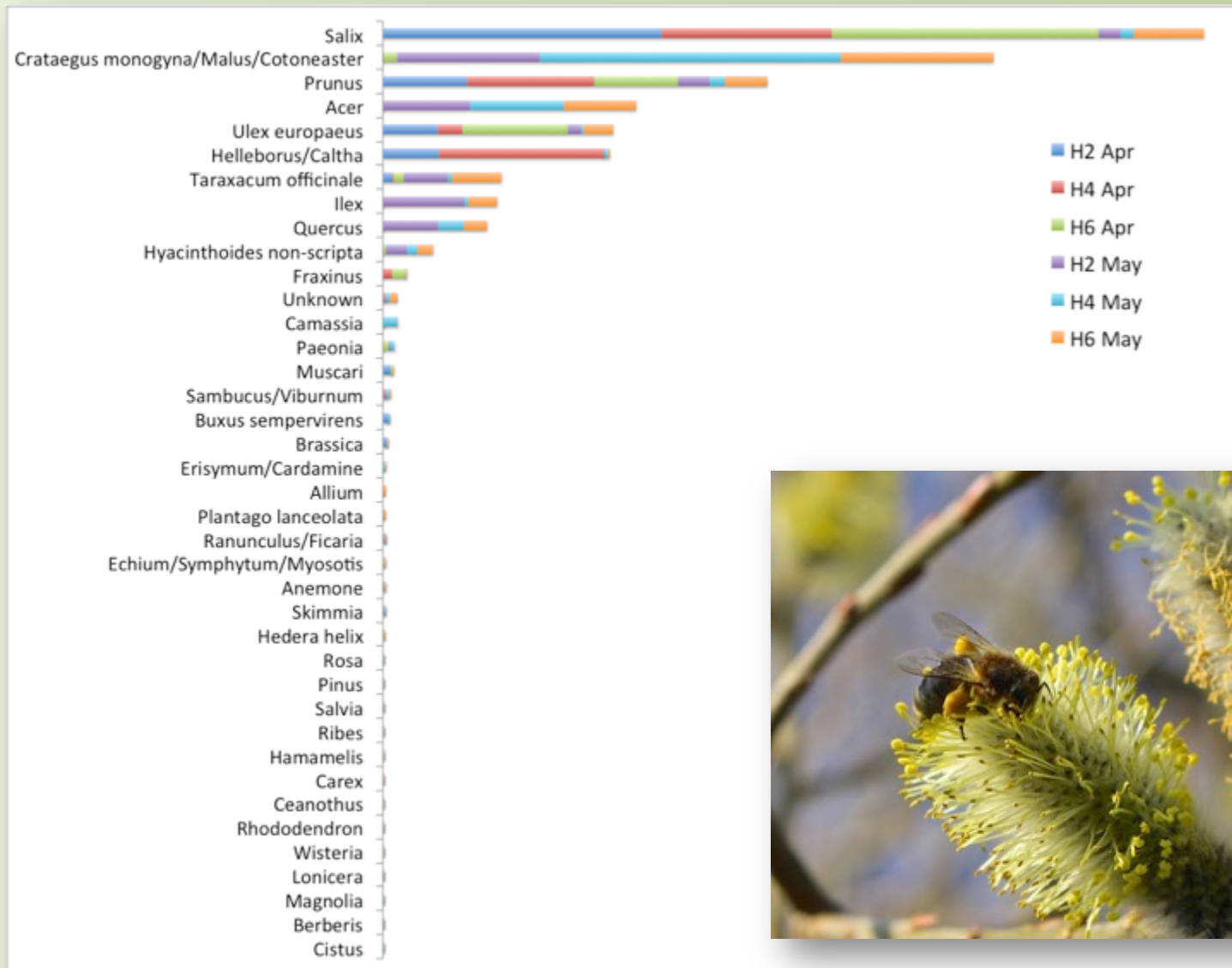


Created with Inspire 1 drone

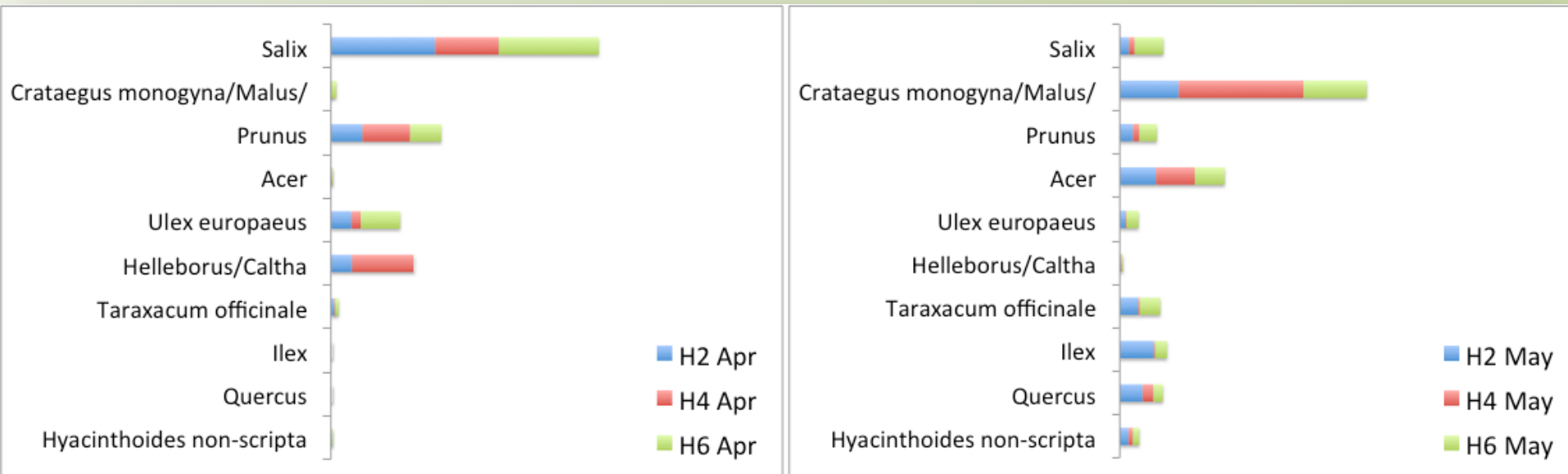
Honey Bee Foraging: Spatial Ecology



Honey Bee Foraging: Spring Results



Honey Bee Foraging: Spring Results

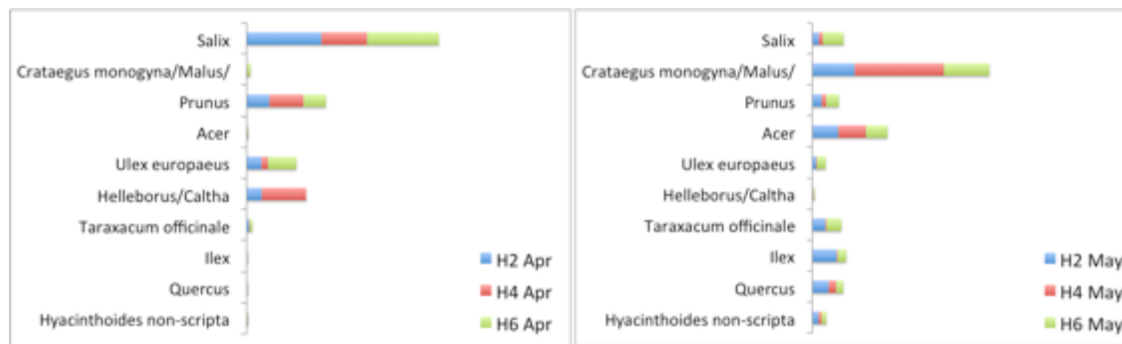


Most abundant plants recorded (%) in honey from April and May from three hives.

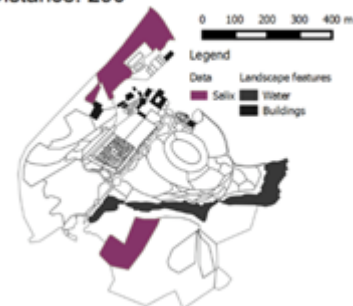
Honey Bee Foraging: Spring Results

	April 2015	May 2015
Number of families in flower	77	88
Number of families recorded in honey	17 (22%)	28 (32%)
Number of genera in flower	258	374
Number of genera recorded in honey	28 (11%)	44 (12%)

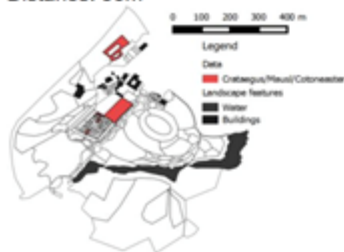




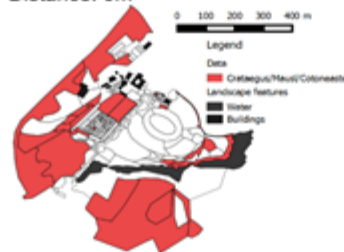
Salix, April (no May record)
Distance: 290



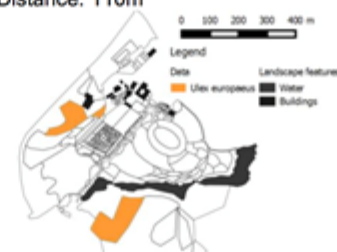
Crataegus/Malus/Cotoneaster, April
Distance: 90m



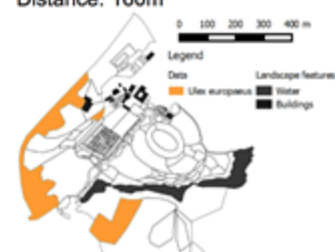
Crataegus/Malus/Cotoneaster, May
Distance: 0m



Ulex europaeus, April
Distance: 110m



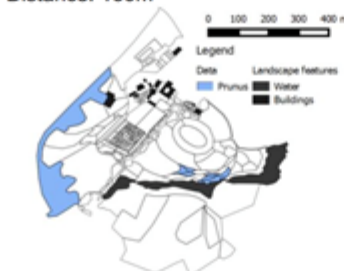
Ulex europaeus, May
Distance: 160m



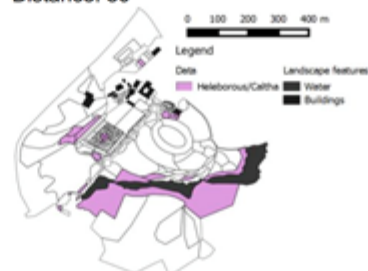
Prunus, April
Distance: 20m



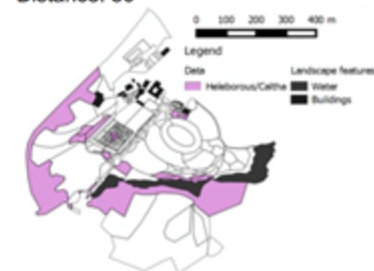
Prunus, May
Distance: 160m



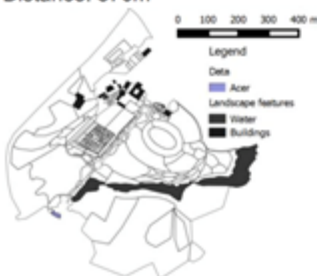
Helleborus/Caltha, April
Distance: 30



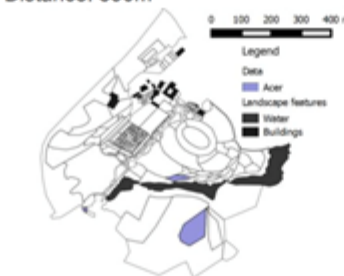
Helleborus/Caltha, May
Distance: 30



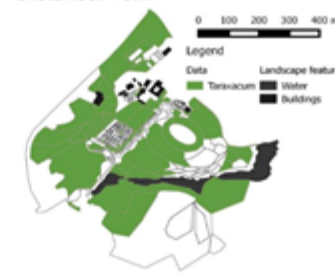
Acer, April
Distance: 370m



Acer, May
Distance: 390m



Taraxacum, April
Distance: 10m

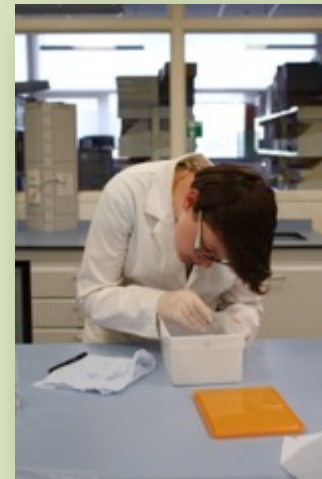


Taraxacum, May
Distance: 20m



Science and Society: Training the next generation of plant scientists

- Undergraduate internships.
- MSc and PhD studentships.
- Work experience opportunities: A level to postgraduate.
- Since 2007: 17 interns, 8 masters and 8 PhDs from 13 universities.



Science and Society: Public engagement

- Art-science: exhibitions in the Garden and internationally.
- Displays and interpretation: Bee Garden, Conserving Welsh Plants Area.
- Events, media and shows: Royal Welsh, National Eisteddfod, television, radio, social media.



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How DNA barcodes can beat the wildlife traffickers

Researchers in Wales are using cutting-edge techniques to catalogue species from tiny sections of genetic material. And these DNA 'barcodes' are now being used to catch plant and animal smugglers worldwide

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Public Engagement: Planting for Pollinators



These plants will attract pollinating insects to your garden

What kind?
Bees, hoverflies, butterflies, moths and even some beetles.

How come?
They are rich in nectar and pollen, great food sources for these beautiful insects.

Don't they have enough food elsewhere?
No. The number of pollinating insects in Wales has declined dramatically in the past 30 years – there are now fewer wild flowers and more deadly chemicals in today's countryside.

How can you help?
By growing these plants in your garden, you'll help to build up new places for pollinating insects to thrive. In return, these insects will add colour and summer sounds – they'll also help to pollinate your fruit trees and veg patch.

Give bees a chance



Public Engagement: Bee Garden



Public Engagement: Pollinator Trail



Public Engagement: Art-Science



