

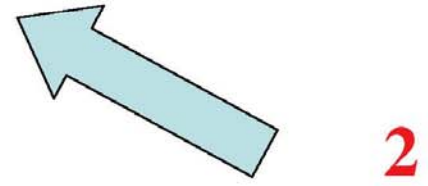
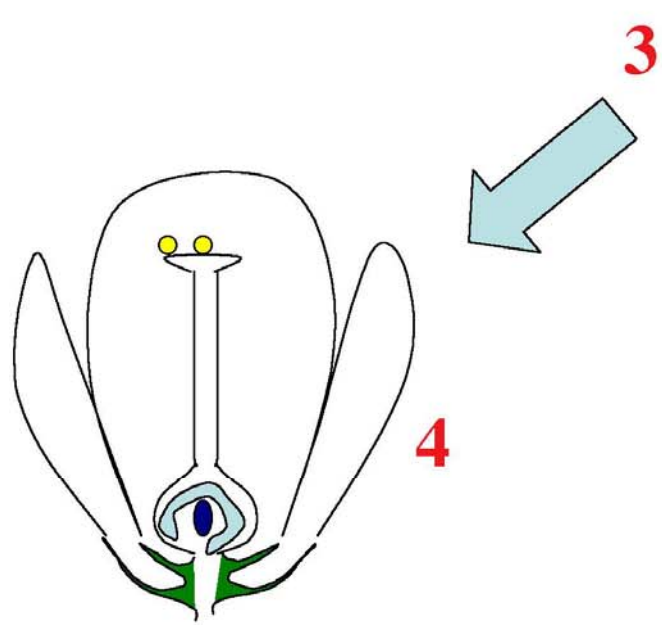
Plant-animal interactions in restoration: Pollination as a key process



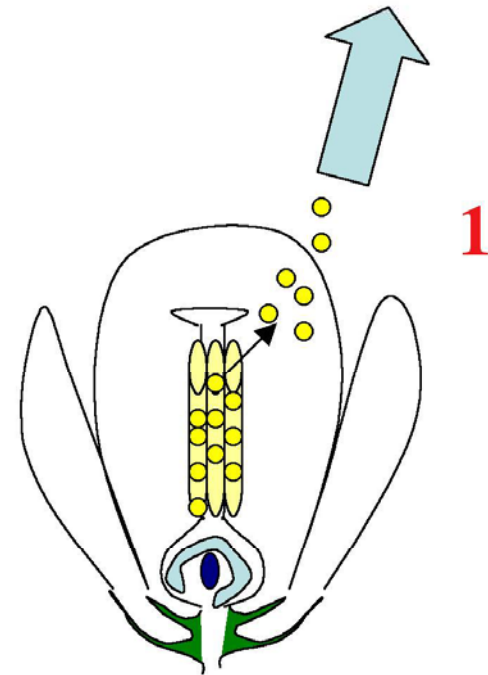
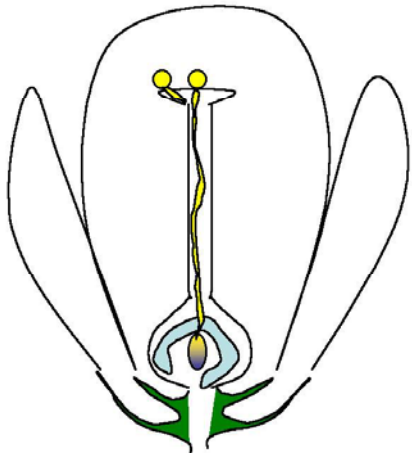
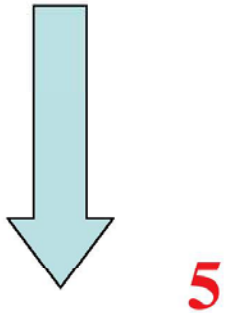
Dr Michael Kuhlmann

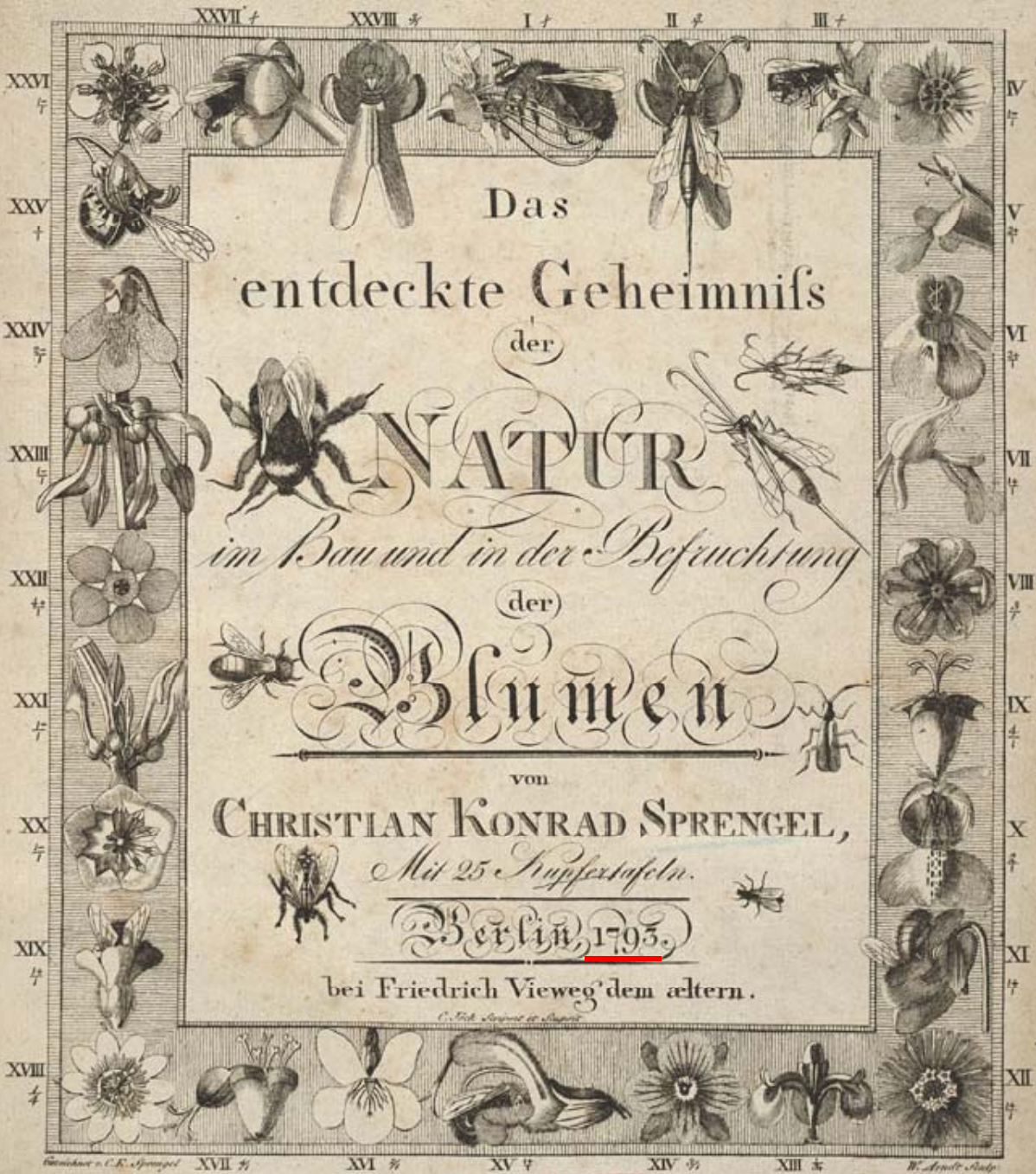
Overview

- **Introduction: Pollination & Pollinators**
- **Pollination – a threatened key ecosystem service**
- **Pollination networks**
- **Restoration of pollination service?**
- **How to perform a pollination study**
- **Summary**



POLLINATION AND FERTILIZATION





PacBook
AK653
.S77
1793

XXVII ♀ XXVIII ♀ I ♀ II ♀ III ♀

XXVI ♀
XXV ♀
XXIV ♀
XXIII ♀
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XI ♀
XII ♀

Das
entdeckte Geheimniß

der
NATUR
im Bau und in der Befruchtung

der
Blumen

von
CHRISTIAN KONRAD SPRENGEL,
Mit 25 Kupfertafeln.
Berlin, 1793.

bei Friedrich Vieweg dem altern.

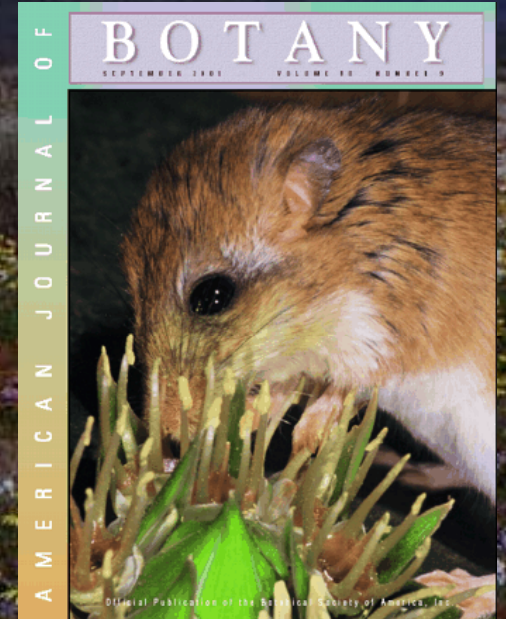
Geschnitten v. C.K. Sprengel XVII ♀ XVI ♀ XV ♀ XIV ♀ XIII ♀ *W. Ande's Stulp*

MISSOURI
BOTANICAL
GARDEN.

The Actors



The Actors



Kinds of Pollinators

INSECTS

- **Bees**
- Beetles
- Butterflies
- Crickets
- **Flies**
- Midges
- Mosquitoes
- **Moths**
- Wasps

REPTILES

- Geckos
- Skinks
- Anoles
- Lizards
- Tegus and Whiptails

BIRDS

- **Hummingbirds**
- Sunbirds
- Honeyeaters
- Sugarbirds
- Flowerpeckers
- White-winged Doves

MAMMALS

- **Bats**
- Opossums and Marsupials
- Monkeys and Lemurs
- Rodents

[WIND]

[WATER]



Honeybees ...



... and the unsung thousands



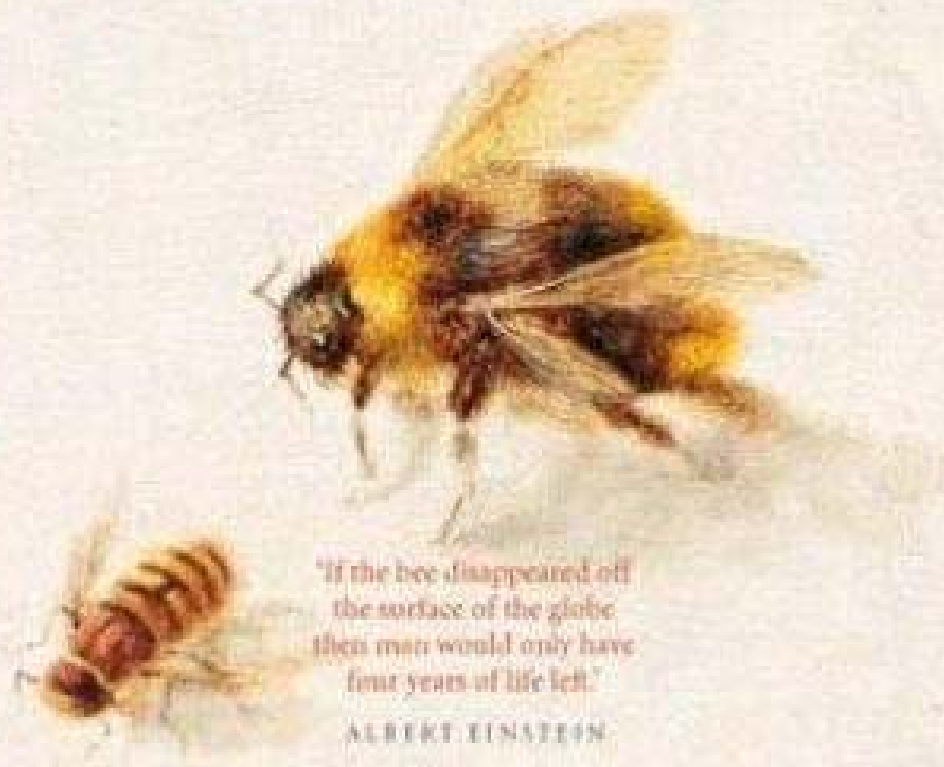
> 25 000 bee species globally



Why all the Buzz about Pollination?

- **> 80%** of flowering plants are pollinated by animals
- **$\geq 1/3$** of the world's *major* food crops: **Every third bite!**
- **\$200 Billion** annually in value for global agriculture
- **Key ecosystem service**
- **Growing evidence that pollinators are declining**

A WORLD WITHOUT BEEES



*"If the bee disappeared off
the surface of the globe
then man would only have
four years of life left."*

ALBERT EINSTEIN

ALISON BENJAMIN
AND BRIAN MCCALLUM

**If the bees disappear off
the surface of the globe
then man would only
have 4 years of life left.**

Albert Einstein

**2008 CYBER GUIDE TO HONEYBEE
COLONY COLLAPSE
DISORDER (CCD)**

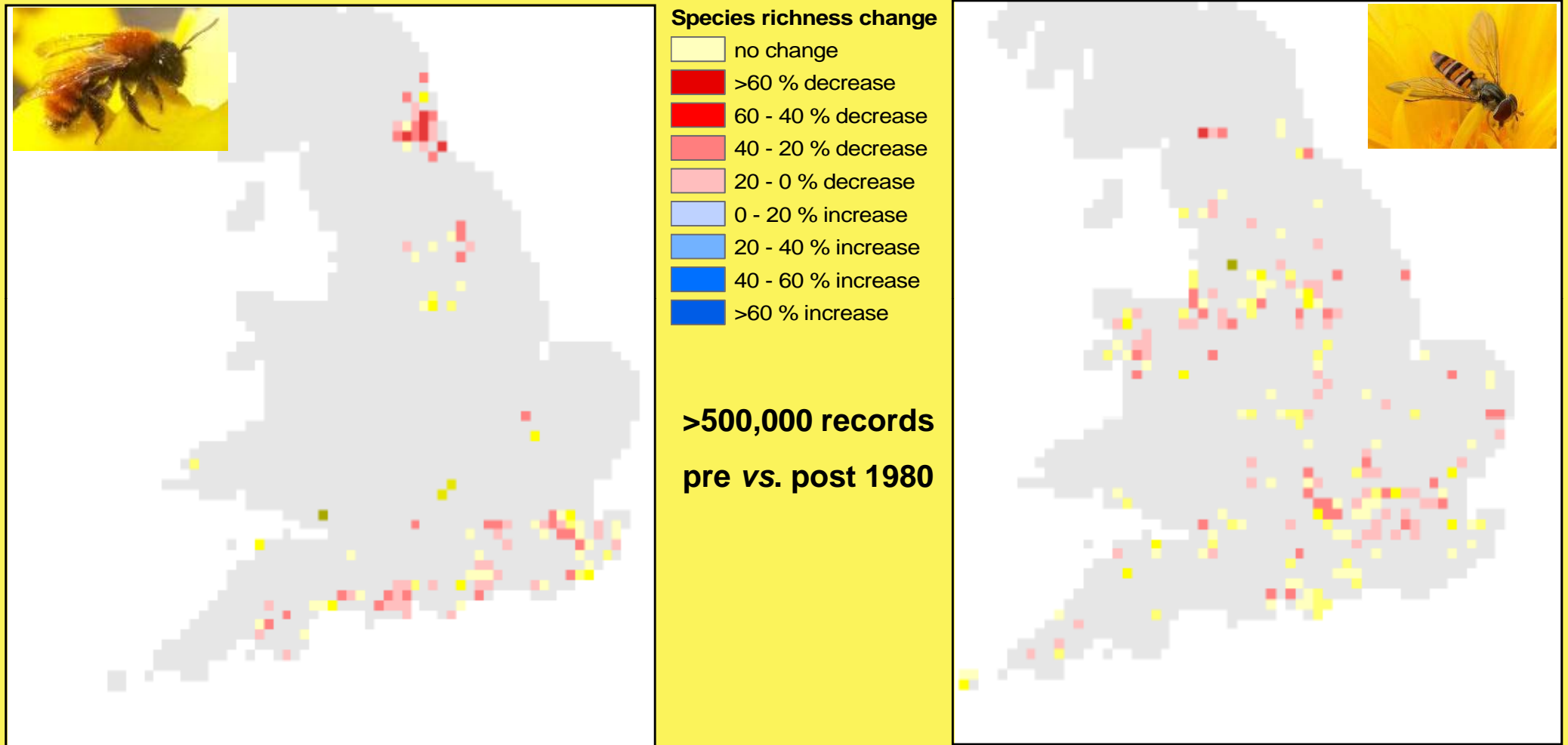


**COMPLETE COVERAGE
OF THREAT
TO BEE COLONIES
AND FOOD
SUPPLY**

CD-ROM



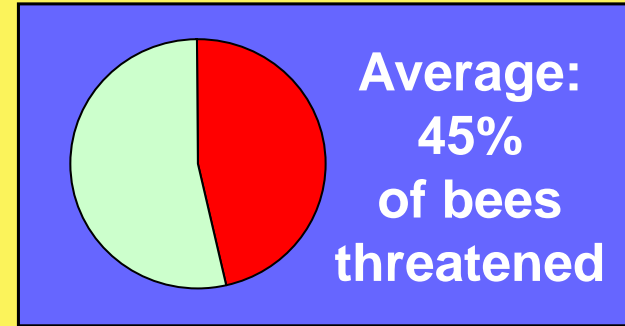
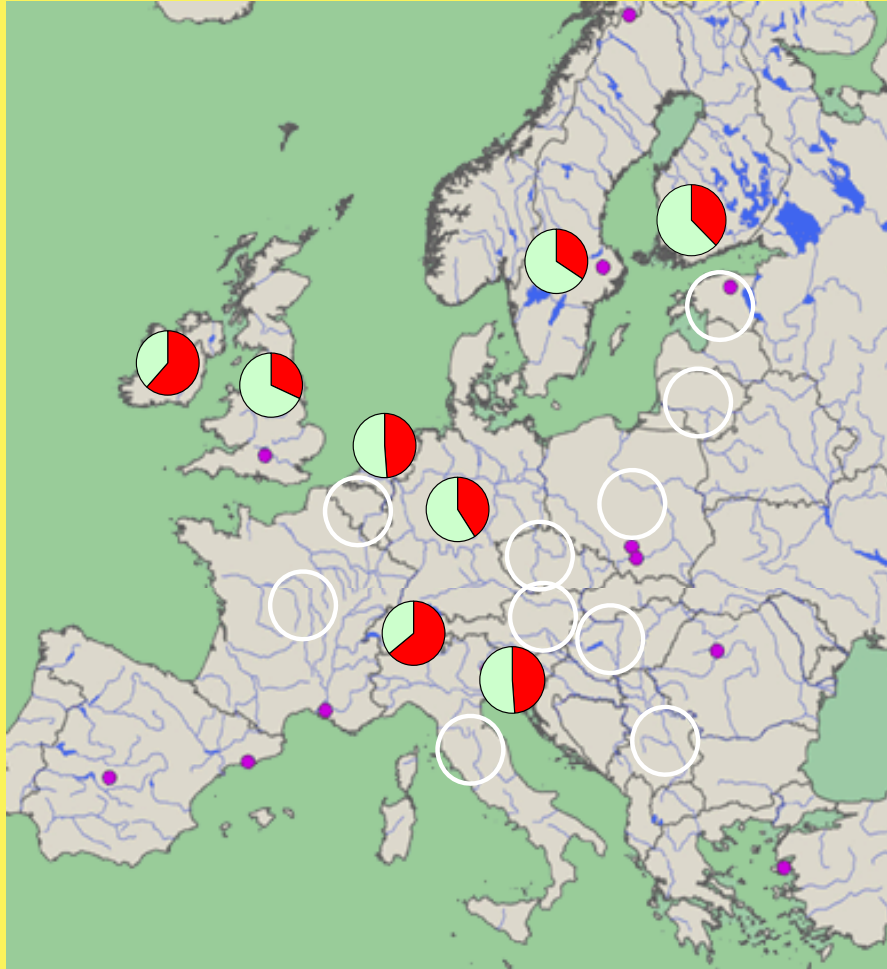
Wild Bees & Hoverflies decline (UK)



Serious declines in bee and hoverfly diversity, abundance and ranges

Serious parallel declines in insect-pollinated wild flowers

How widespread are declines?



Range:
~35% Sweden and Finland
>60% Ireland and Switzerland



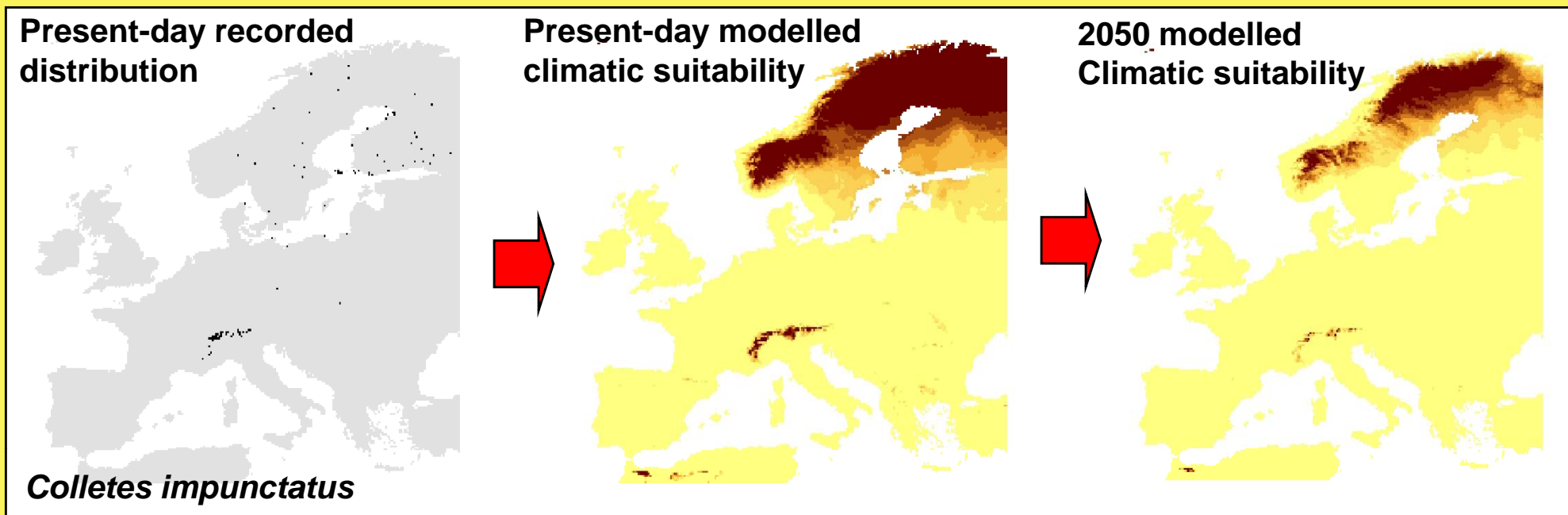
Assessment based on national red lists and expert opinion

(Roberts et al. in prep.)

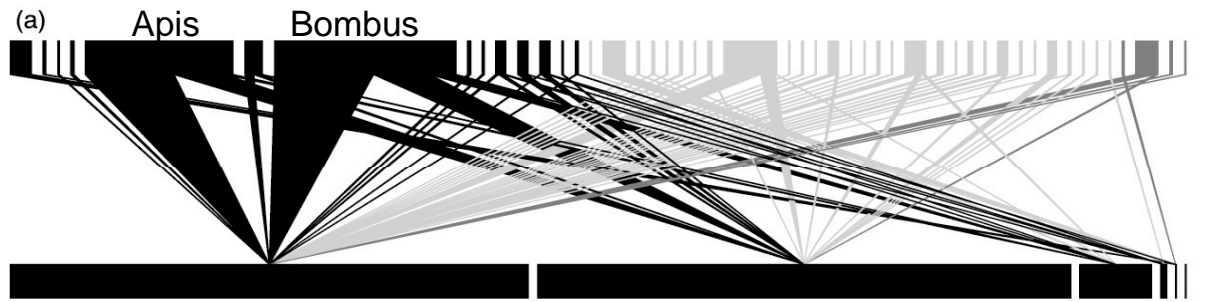
Climate Change Impact

Case study using important guild of pollinating bee *Colletes*:

- Current records used to model current distribution of climatic suitability
- 2050 predicted distribution under climate change



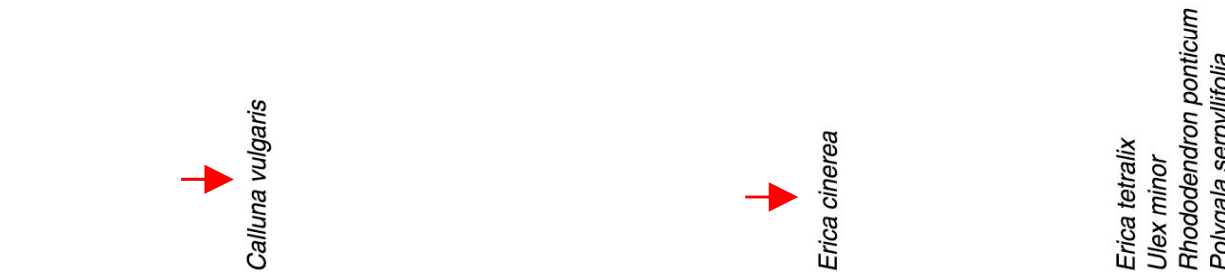
Pollination networks (ancient heathland)



Insect abundance

Quantitative flower visitation network

Flower abundance



Insect abundance

Quantitative pollen transport network

Pollen abundance on insects' bodies

→ *Calluna vulgaris*

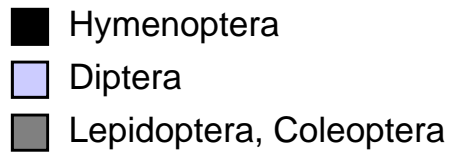
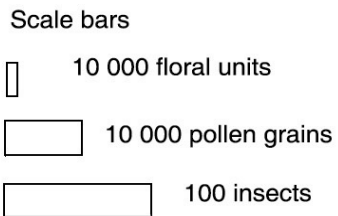
→ *Erica cinerea*

Erica tetralix
Ulex minor
Rhododendron ponticum
Polygala serpyllifolia

→ *Calluna vulgaris*

→ *Erica cinerea*
Erica tetralix
Ulex europaeus

Ulex minor
Rhododendron ponticum



Generalist bees are the most important pollinators

Restoration of Pollination Service?

Restoration of **pollination service** by generalist pollinators is (partly) possible ...

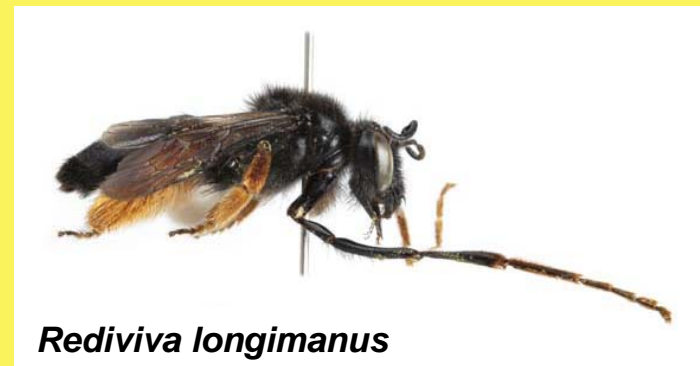
... but what about restoration of the **pollinator fauna** and its diversity?

Pollinators are sensitive

Pollination webs can compensate loss of pollinator species

BUT:

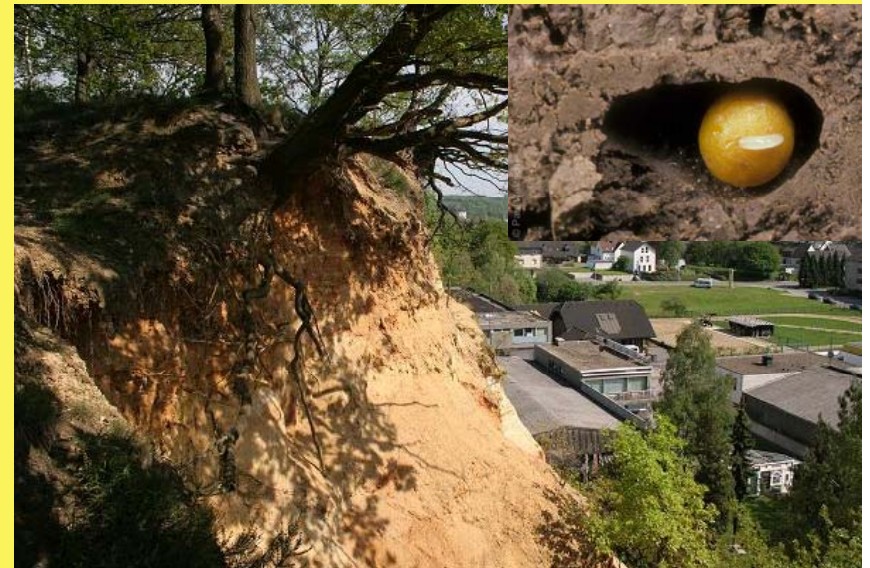
- Pollinators are much more extinction prone than most plants
- Specialized mutualisms are especially threatened

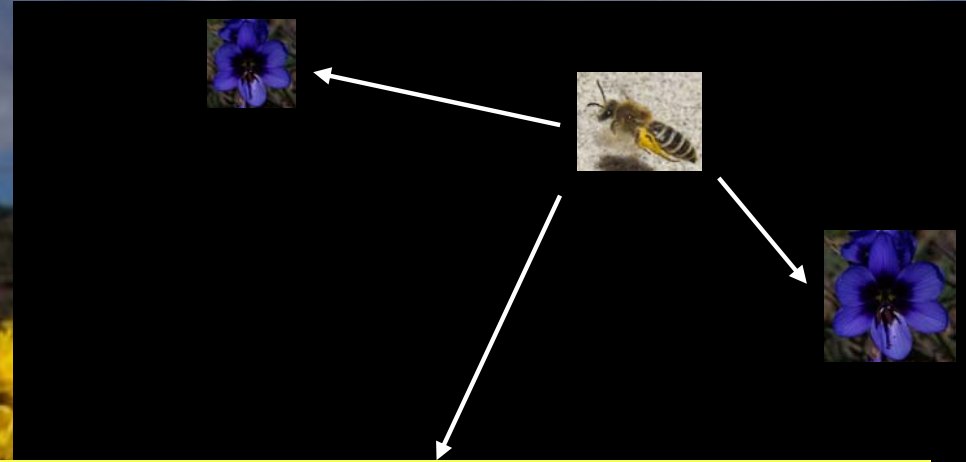
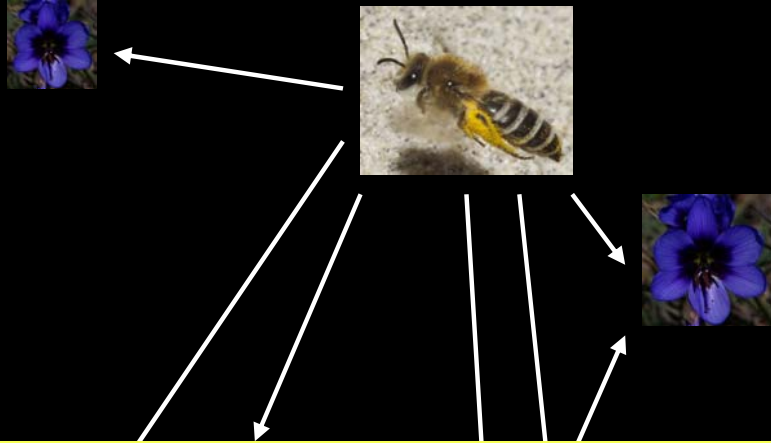


Reintroduction of solitary bees?

Introduction hampered by habitat requirements

- Most species are soil nesters
- Females are 'central place foragers'



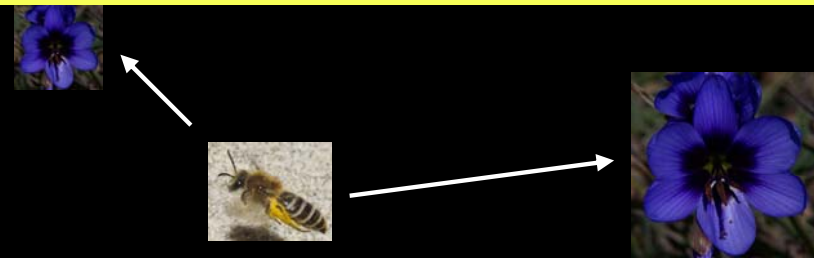


Recolonisation – Size matters!

Foraging range of female bees is limited by body size

Greenleaf et al. (2008) *Oecologia* 153: 589-596.

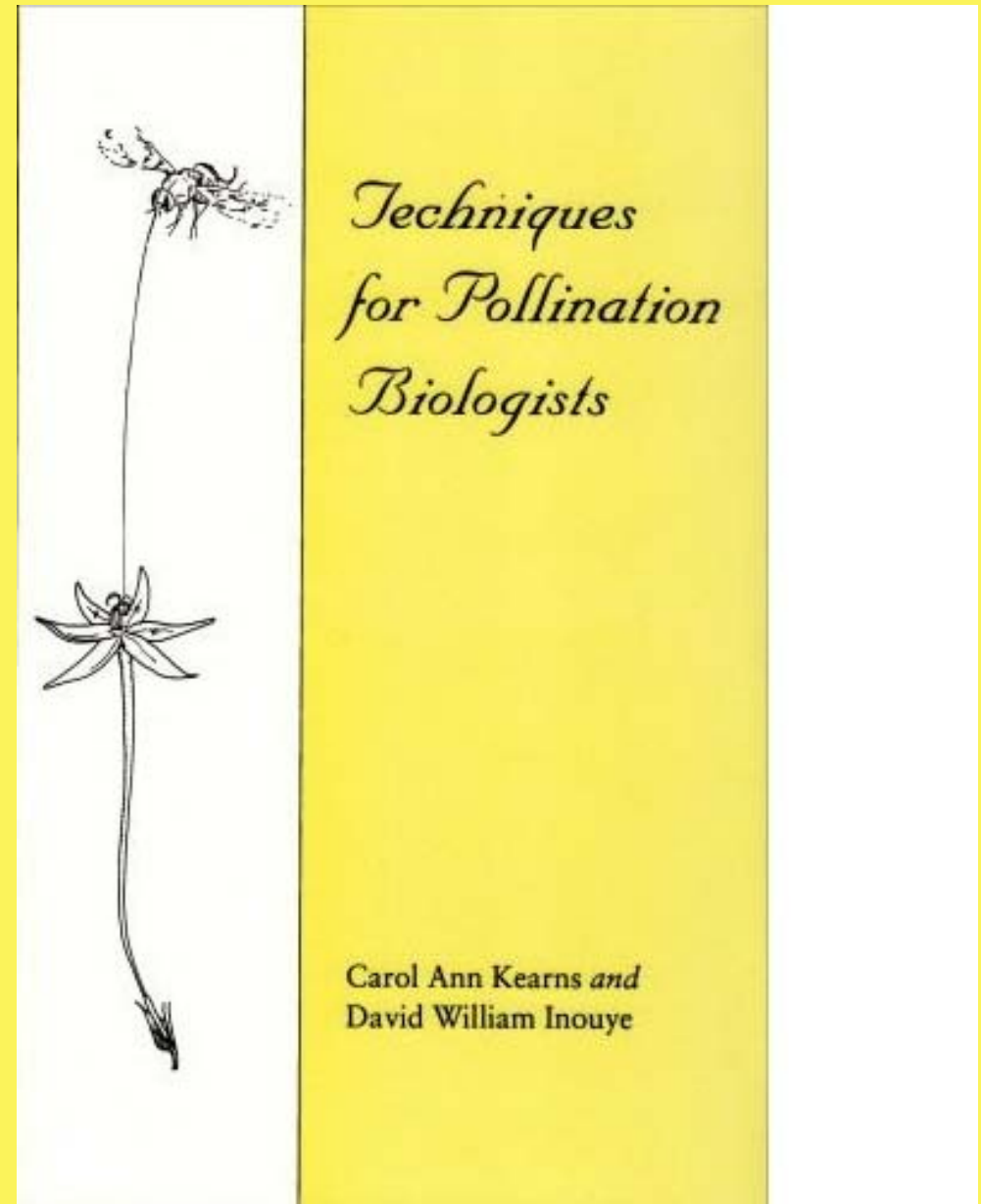
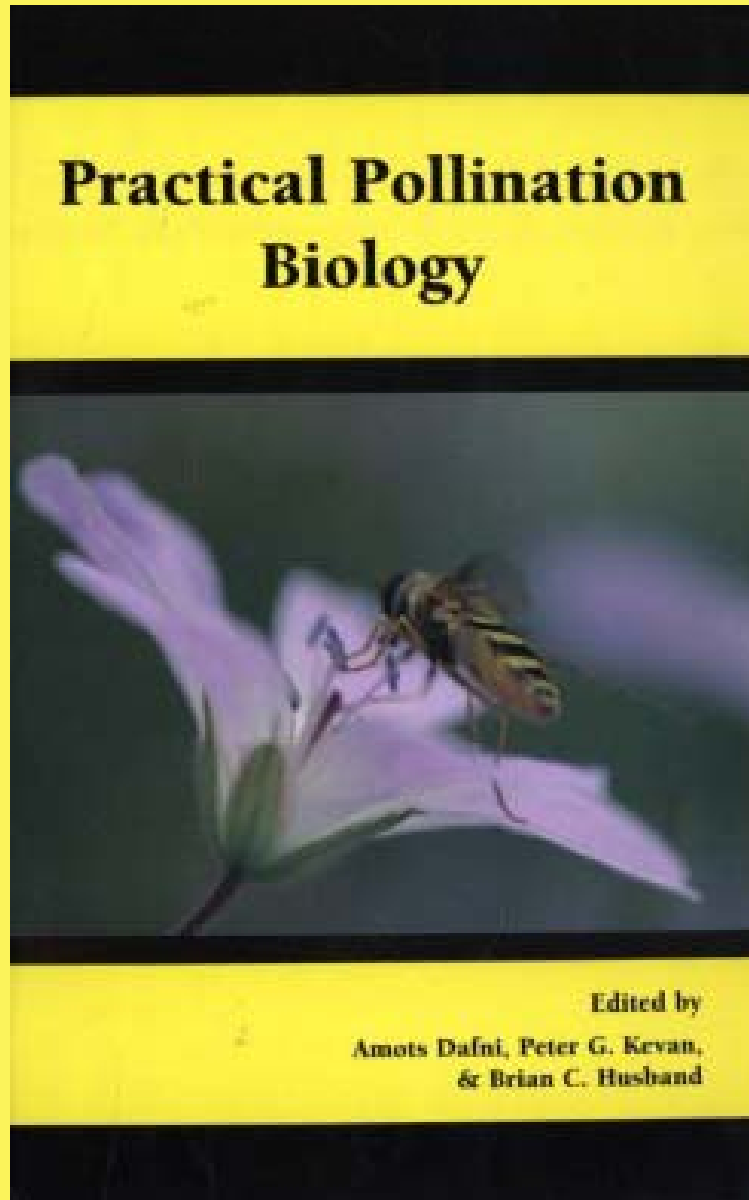
- Many species are slow colonisers
- Proximity to neighbouring populations crucial



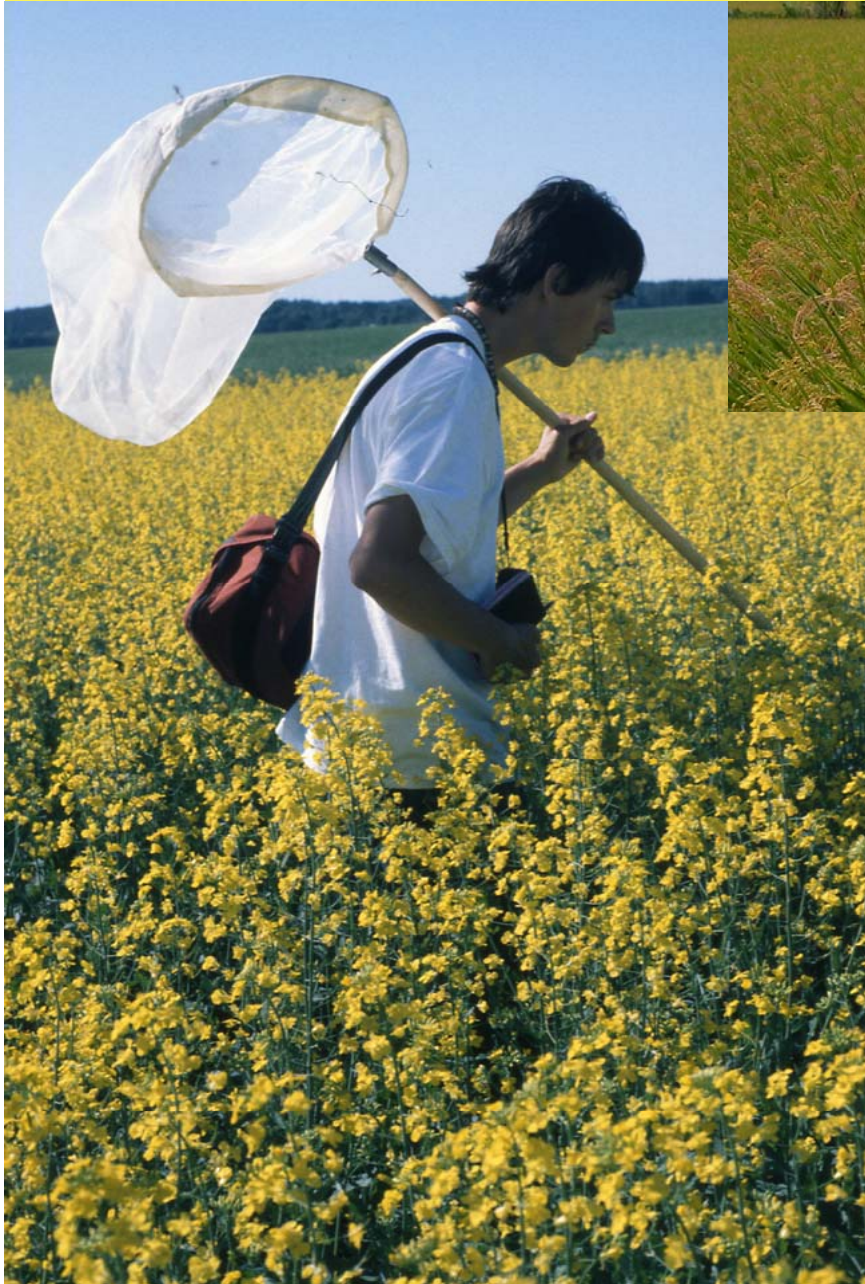
A photograph of a dirt road winding through a field of yellow wildflowers. The road is made of reddish-brown soil and has tire tracks. The field is filled with bright yellow flowers, likely wildflowers or a similar species, growing in a natural, uncultivated setting. The background shows more of the field and a small stream or ditch. The overall scene is a natural, rural landscape.

Conservation of existing pollinator populations is crucial!

How to perform a Pollination Study



Monitoring Pollinators





Be aware:

**Flower visitors are not always
pollinators ...**

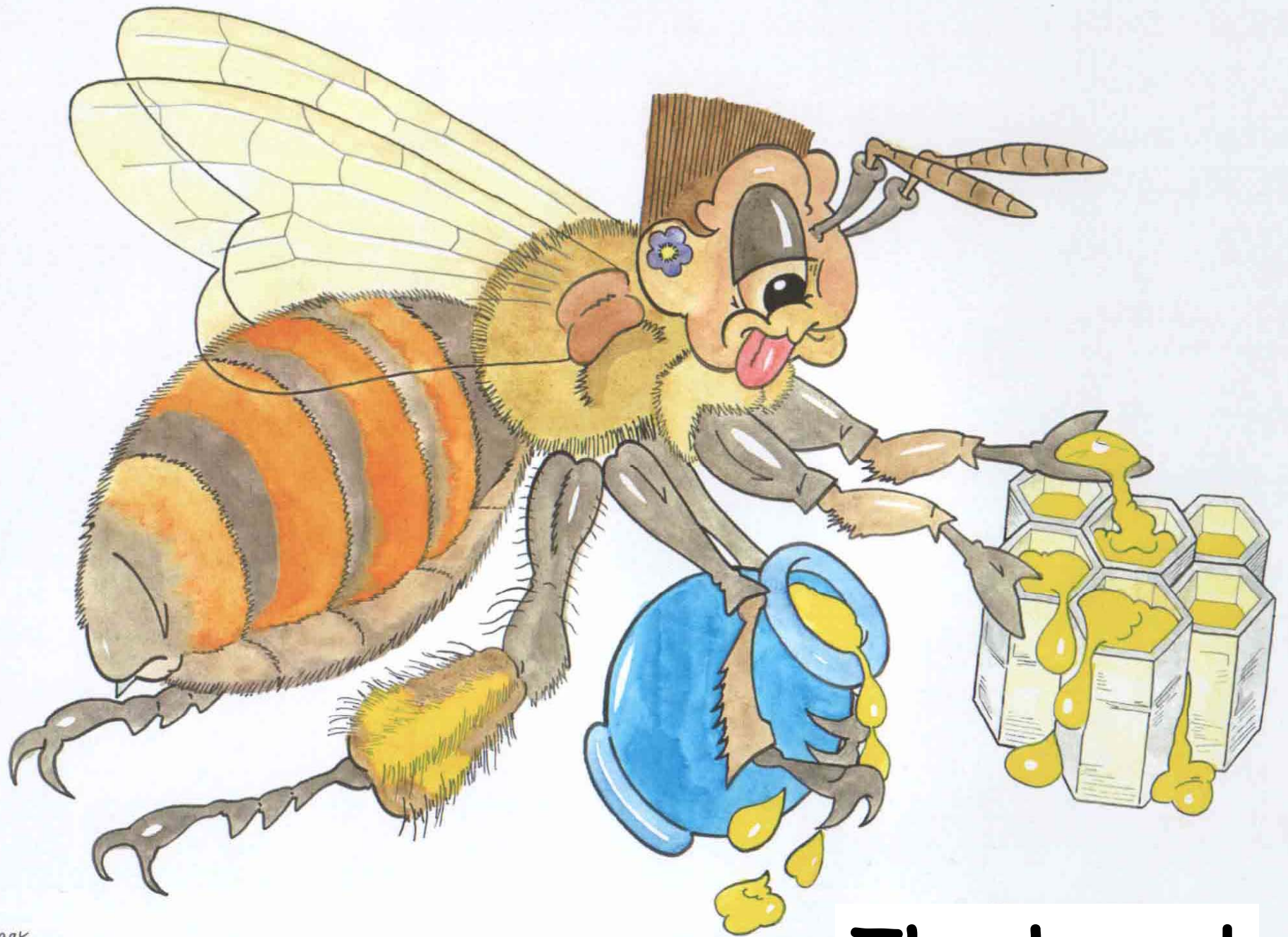
**... and the most abundant are not
necessarily the most efficient!**

Summary

- **Pollination ecological & economic key-process**
- **Bees are key-stone species providing vital ecosystem service**
- **Pollinators and pollination service under threat**
- **Restoration of **pollination service** by generalist pollinators (partly) possible**
- **Restoration of **pollinator fauna** hardly manageable**

?





G. Gad 99

Thank you!