Competition between honeybees and wild bees

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Multiple drivers of wild bee decline

- Habitat destruction
  - Flower shortage
  - Lack of nesting sites
- Pesticides
- Nutritional stress
- Parasites/pathogens
- Disease stress
- Climate change
- Competition?
Honeybees in Denmark

- Native, but managed
- Pollinators of crops and wild flowers (400-700 mio dkr/year)

Axelsen et al. 2011 NERI Scientific Report

- C. 100 000 colonies in DK (0.024 hives/ha)
- >90% hobby bee keepers, <10 hives/bee keeper

Danish Beekeepers’ Association
Competition: the players

Honey bees (*Apis mellifera*)
- Perennial colonies
- 60,000 bees at peak
- Advanced communication system

Wild bees
- 287 species in Denmark
- Solitary
- Social (*Bombus*), <400 bees per colony
- Annual (weeks-months)
Does competition occur?

- Prerequisites for competition
  - Limited resources
  - Resource overlap
Ressource overlap?

- Honeybees
  - Generalist flower visitors
  - Temporal specialization

Pollen collected by 3 honeybee hives in an agricultural landscape

- 2-3 April: Willow, Veronica, Buttercup
- 2 May: Oilseed rape, Cherry type, Maple
- 27 June: Phacelia, White clover
- 9 August: White clover, Potato
- 20 September: White clover, Potato, Red clover

CSI Pollen, unpubl. data
Ressource overlap?

- Wild bees
- Oligolectic and polylectic species

22% 53% Andrena fulva
Ressource overlap: importance of scale

- Floral provision

1 queen, 15 000 - 60 000 workers
Provision: 30-50 kg honey + 20-50 kg pollen

1 female, 10-20 eggs
Provision: 150-600 mg
Ressource overlap: importance of scale

- **Floral provision**

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  - Provision: 30-50 kg honey + 20-50 kg pollen

  - 1 female, 10-20 eggs
  - Provision: 150-600 mg
Does competition occur?

- Prerequisites for competition
  - Limited resources
  - Resource overlap

- Evidence of competition
  - Studies of competition
  - Competition under field realistic conditions?
Evidence of competition? 
correlative studies of flower visitation

Forup and Memmott 2005 *Ecol Ent*  
Steffan-Dewenter and Tscharntke 2000 *Oecologia*
Evidence of competition
Experiment: fitness effects

- 3x3 m cages
- Treatments
  - 0, 100 and 300 hb/cage
- Density effect:

DK average: 0.024 hives/ha
Oilseed rape: 2 hives/ha

2.8 hives/ha
8.3 hives/ha

What is the critical density?
How does the results translate to field conditions?

Hudewenz and Klein 2015 *Ecol Evol*
Evidence of competition
Field density

Elbgami et al. 2014 *Apidologie*

Garbuzov et al. 2015 *AGEE*
Field density: seasonal variability

Population development of honeybee colony
Floral resource availability (agricultural landscape)

Willow oligolectics
Andrena apicata
A. clarkella
A. praecox
A. mitis
A. ruficrus
A. viridescens
Colletes cunicularius

Søgaard Jørgensen 2011 Biernes fødegrundlag
Does competition occur?

- Yes! Locally and certain times of the year

- But highly context dependent
  - Density of honeybees (number of hives, distance, season)
  - Availability of floral resources

- Most documented competition effects are at high honeybee densities and low resource levels
Multiple drivers of wild bee decline

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- Parasites/pathogens
- Nutritional stress
- Disease stress
- Climate change
- Competition?
Thank you!

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Historical decline of wild bees

RESEARCH

REVIEW

POLLINATION

Bee declines driven by combined stress from parasites, pesticides, and lack of flowers

Dave Goulson,* Elizabeth Nicholls, Cristina Botías, Ellen L. Rotheray

SCIENCE  sciencemag.org  2015 • VOL 347 ISSUE 6229
Does competition occur?

- Prerequisites for competition
  - Limited resources
  - Resource overlap

www.xerces.org
Evidence of competition?  
correlative studies of flower visitation

Fitness effect?  
Pollination compensation?

$ t = 2.92 $  
$ P = 0.01^* $
Importance of scale

- Foraging range

**Foraging distance (km)**

- Solitary bees
  - Greenleaf et al. 2007 *Oecologia*

- Honeybees
  - Garbuzov et al. 2015 AGEE

Foraging probability density:

- Low
- High
Fig. 1. Seasonal patterns of (a) pollen mass (g, n = 780 pollen samples) and (b) nectar reserve mass in brood chambers (kg, n = 1640 nectar samples). The thick line shows GAMM predictions (see Methods) and dashed lines show the confidence interval envelope (95% CI). The vertical lines delineate the temporal extent of spring and summer seasons. Light gray shading delineates mass-flowering periods of rapeseed and sunflower crops. Each point represents an observed value; dark gray points represent the subset of pollen samples selected for botanical identification (n = 450 pollen samples). Notice the log scale attenuates the seasonal peaks in pollen mass.
Lovende heder  

Hunewenz & Klein 2013 *J Insect Cons*

**Blomsterbesøg på hedelyng**

**Formering:**
Antal rede i trapnests

(a) **# Wild bee flower**  

(b) **# Stem-nesting wild bee species**

- **>500m**
- **<500m fra stader**
Fig. 1 Mean thorax widths (±SE) of workers of four bumblebee species in sites with and without honeybees.

Goulson and Sparrow 2009 J. Insect Cons.