

The protection of bees and pollination under global change :

Perspectives in a challenging applied science

Axel Decourtye, Cédric Alaux, Yves Le Conte, Mickaël Henry

The protection of bees and pollination under global change :

- **Aims:**

- Impact of threats on bee populations on bee science
(the published literature)

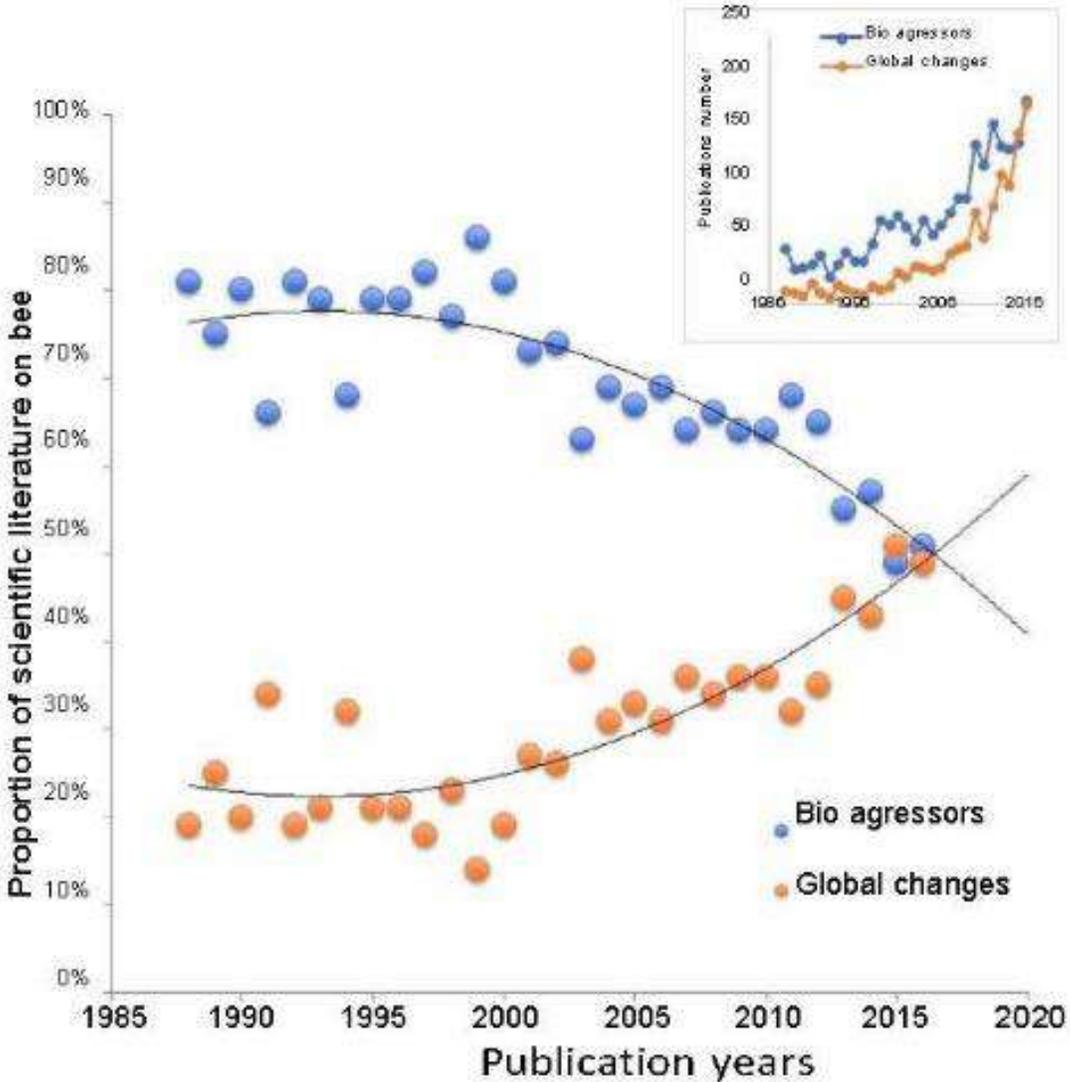
- what further studies are needed to offer mitigation options ?

Impact of threats on bee populations on bee science

Bibliometric analysis (1987–2016)

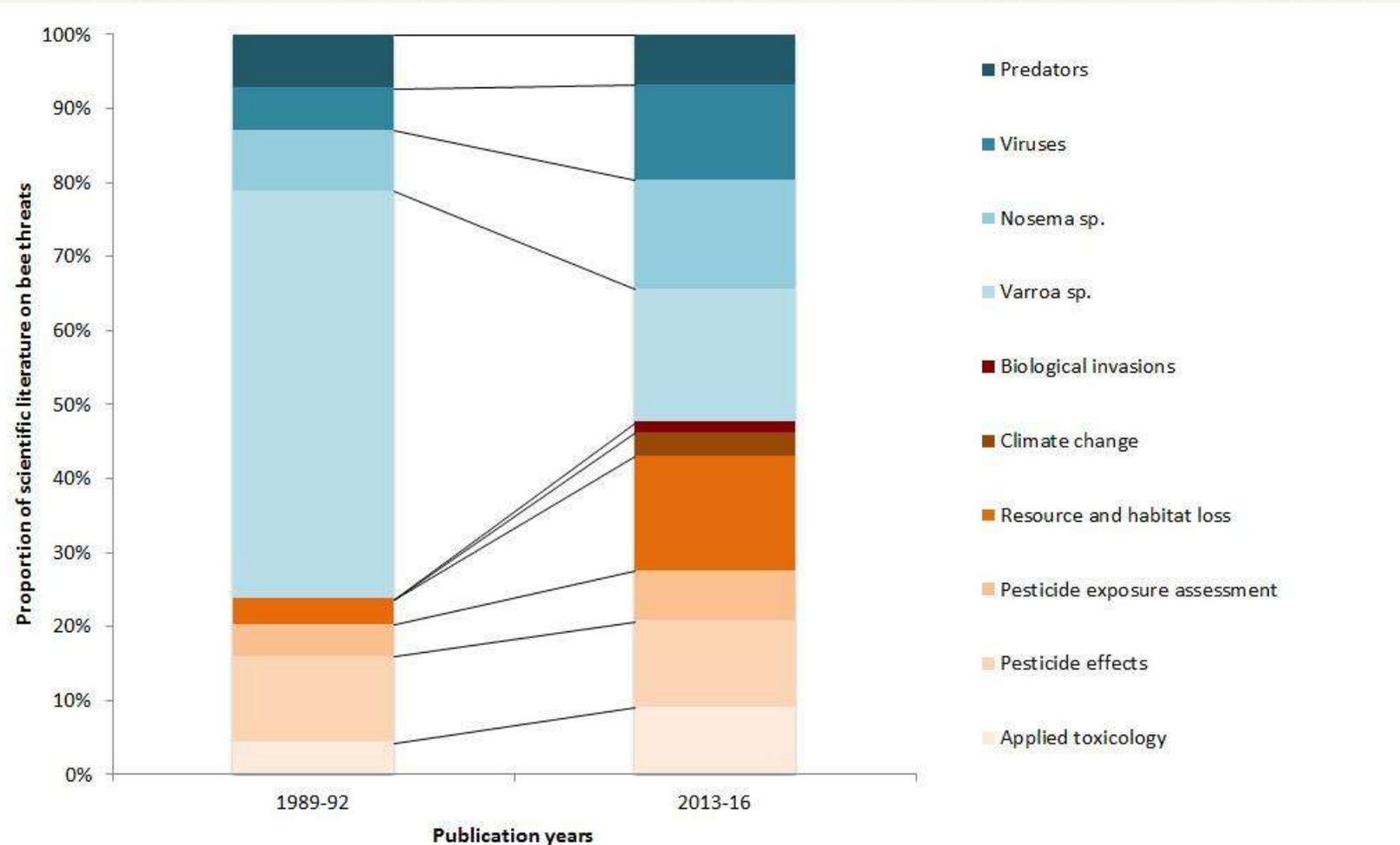
- Web of Science
- Bee research: 33,000 referenced publications
- 11.8% explicitly investigate the biological and environmental threats involved in bee declines

Bibliometric analysis (1987–2016)



Two-fold increase in the proportion of global change publications in the last 30 years: shifting point !

Prime concerns of scientists : 1989 - 92 versus 2013 - 16



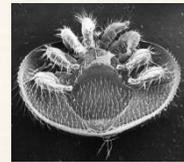
- Varroa mite, the most studied in the early 90's (28 to 55 per year), decreased in proportion
- Floral resources and habitat loss: being marginally investigated 30 years ago, but now >15% of research effort (rise of wild bees)
- Pesticide-related topics: developed substantially, now account 27.7%

4 challenges for future agrosystems to protect bees and pollination services in global changes

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1. Developing sustainable and adaptive beekeeping

- Honey bee losses impact Sustainability of beekeeping
 - economic, social and environmental issues of bee farming systems
 - tools for assessment of sustainability
- Fighting diseases
 - the varroa mite!
- Genetic adapted to global change
 - What kind of bees and plants for climate changes ?
 - What Selection?
- Monitoring devices / transhumance / local floral resources
- New diseases for honeybees
 - Research on the risk associated with bee exchanges
 - Development of new practices to fight pests



4 challenges for future agrosystems to protect bees and pollination services in global changes

2. Redesigning farming systems toward a reduction of chemical dependency

- Bee-friendly and effective farming systems:
 - Alternative strategies to chemical use !!!!!!!!!!!!!!!!!!!!!
 - Toxicity assessment in a real world!
 - Ecological intensification
 - Diversification of farming systems



4 challenges for future agrosystems to protect bees and pollination services in global changes

3. Restoring and improving nutritional resources

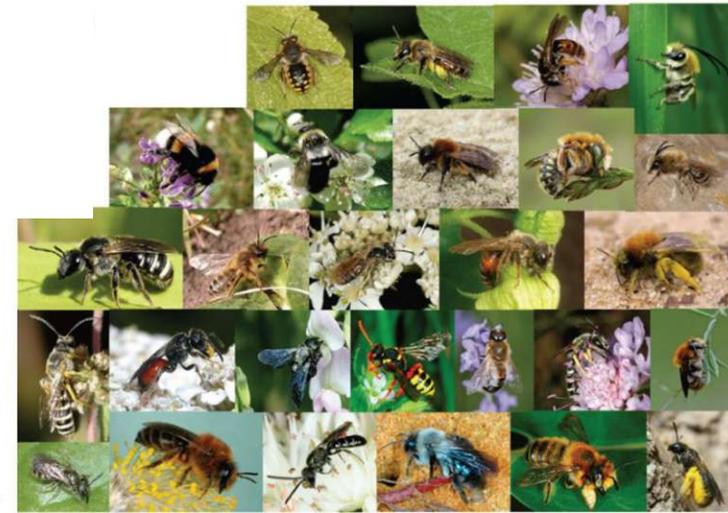
- Habitat enhancement and restoration
 - Native plants
 - Plant abundance and diversity
 - Their nutritional interest for bees?
 - Semi-natural habitats
- The often-neglected crop resources
 - crop breeding programs to improve floral nutritional resources



4 challenges for future agrosystems to protect bees and pollination services in global changes

4. Pollination:

- Lack of pollination services can induce decreasing pollinator demand
 - Biotechnology is engaged in reducing pollinator demands by limiting the dependence of crop varieties on insect-mediated pollination (pathenocarpy).
- Increasing pollinator supplies
 - Using managed and wild bees
 - balancing the trade-offs between beekeeping and wild bee conservation
- Ecological intensification and integrated crop pollination
 - Including both wild and managed bees

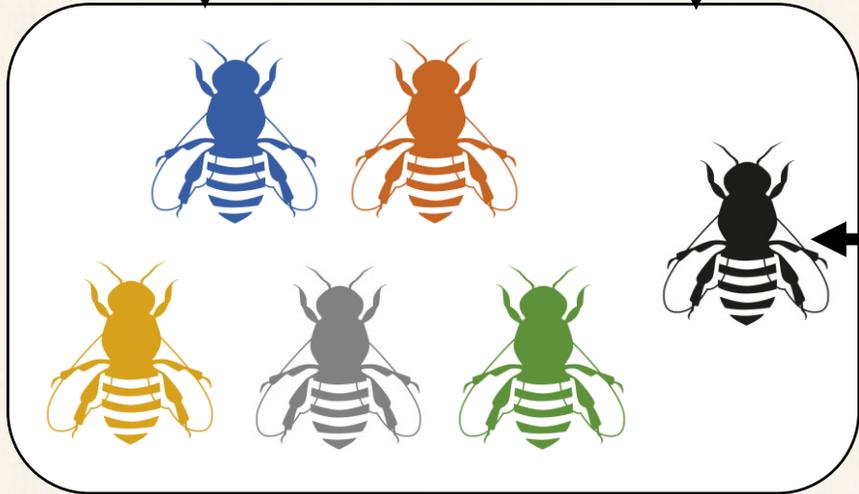


Future perspectives in a challenging applied science

- Restore and protect bee habitats (network of “green infrastructure” for foraging and nests)
- Test and support ecologically intensified farming
- Conserve diversity of beekeeping practices (genetic, diversified systems)
- Regulate movement of managed pollinators

Redesigning farming systems toward a reduction of chemical dependency
(diversification, reduction of chemical dependency, crops substitution...)

Restoring and improving food resources of bees
(restoration and protection of natural and semi-natural habitats)



Developing a sustainable and adaptive beekeeping
(genetic diversity, regulation of managed pollinators movement)

Integrated crop pollination - Association of honeybees and wild pollinators



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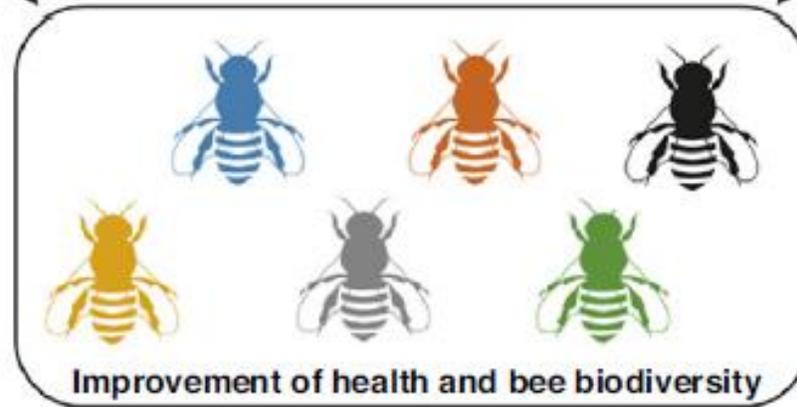
Axel Decourtye^{1,2,3}, Cédric Alaux^{1,4}, Yves Le Conte^{1,4} and Mickaël Henry^{1,4}



**Developing sustainable and adaptive
beekeeping**
(genetic diversity, regulation of managed
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**Redesigning farming systems toward a
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(restoration and protection of natural and
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**Integrated crop pollination-
Association of honeybees and wild pollinators**