



Bijensterfte kritisch bekeken en innovaties om hieraan te verhelpen

Prof. Dr. Dirk de Graaf

Casino Koksijde, 12 oktober 2026

- Inleiding
- Honingbijen en bijenteelt
- Kritische kijk op de imkers-praktijken
- Het pad naar kwetsbare honingbijen
- Bijenteelt: een (on)evenwichtsoefening
- Na 10 jaar is de puzzel bijna gelegd

vrt nws



Milieu & Klimaat

27 procent van bijen van Vlaamse imkers heeft winter niet overleefd

Het VBI doet jaarlijks bij zijn imkers een enquête over de wintersterfte. De norm van wintersterfte ligt al decennialang op 10 procent, maar wordt al lang niet meer gehaald. Net als vorig jaar zijn er grote regionale verschillen.

Bij sommige imkers liepen de verliezen op tot boven de 80 procent. In gemeentes als Elversele, Mariakerke, Hertsberge, Elewijt, Houwaart, Hofstade en Diepenbeek gingen zelfs alle bijenvolken verloren. Vlaams-Brabant (30 procent) en Antwerpen (29 procent) zijn de provincies met de grootste bijensterfte.

Volgens het VBI ligt een "cluster van factoren" aan de basis van de wintersterfte, "wat het probleem zeer complex maakt en moeilijk te beheren". Bovendien deed zich vorige herfst, dus nog voor de gebruikelijke wintersterfte, voor de eerste keer een duidelijk verlies aan bijenvolken voor ten gevolge van de aanwezigheid van de Aziatische hoornaar. Die invasieve exoot is al enkele jaren aan een opmars bezig in ons land, en ziet in de honingbij een gegeerde prooi.

DE
TIJD

Nieuws Beleggen Mijn Geld Sabato

ABONNEER NU

Ekopak wipt na remonte weer over 100 miljoen euro beurswaarde

Euronext Brussel: AB InBev zet rem op Bel20

NIEUWS | ONDERNEMEN | VOEDING & DRANK

Bij de meest trotse imker van Vlaanderen: 'Veel mensen romantiseren bijen, wij zien ze als een product'

-  KOPIER LINK
-  (TWITTER)
-  FACEBOOK
-  WHATSAPP
-  LINKEDIN
-  E-MAIL
-  BEWAAR
-  SCHENK DIT ARTIKEL



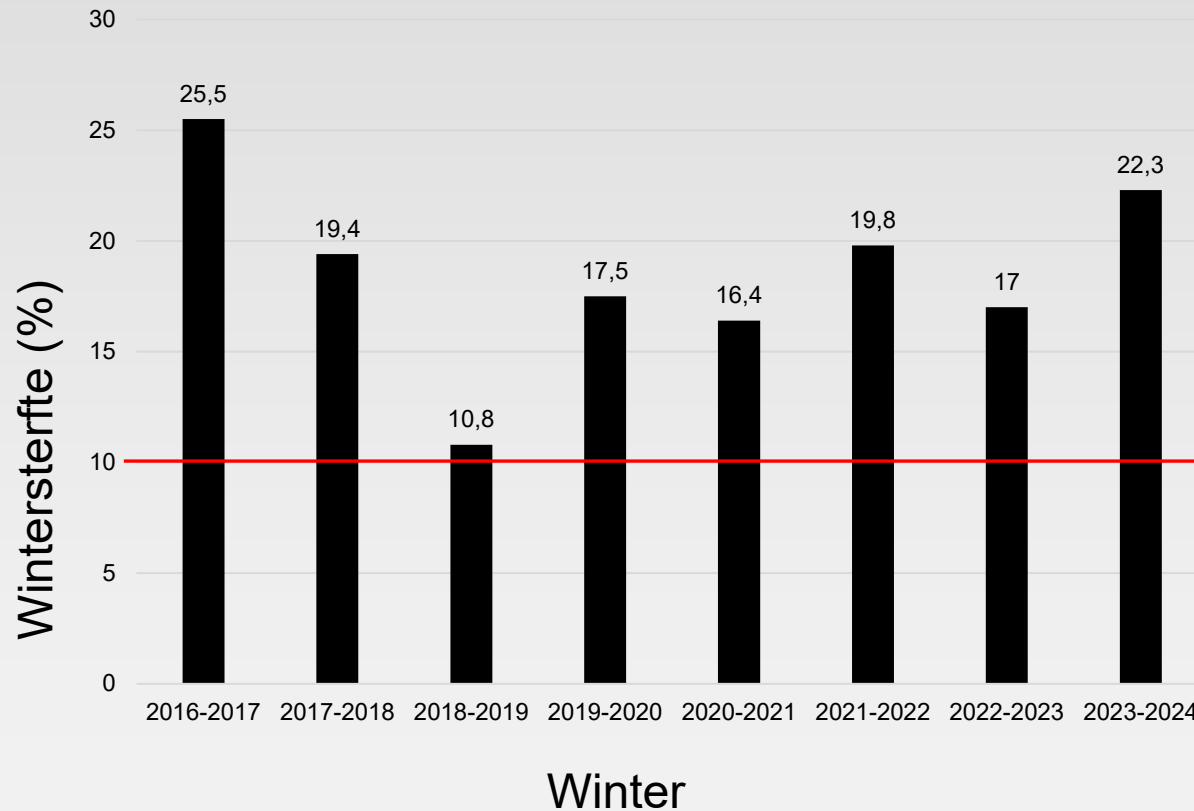
Imker Davy Petit kan door zijn aanpak zonder bescherming werken. 'Hoe wij met de bijen omgaan, ik ben daar trots op.' ©Diego Franssens

Terwijl de sterfte bij honingbijen in tien jaar nooit hoger was, sneuvelen in de kasten van de Antwerpse imker Davy Petit tien keer minder bijen dan gemiddeld in Vlaanderen. Wat is zijn geheim? 'Wij spelen een beetje vals. Dat is wat de imkerij nodig heeft.'

Bijensterfte = wintersterfte



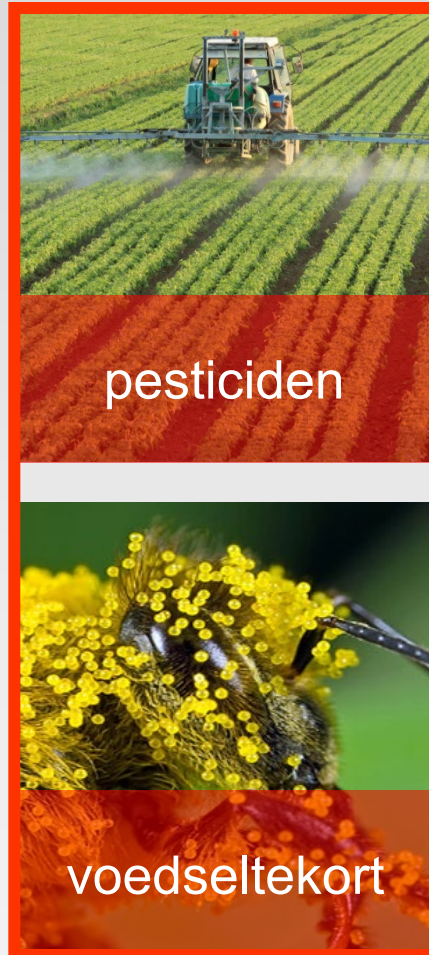
Wintersterfte voor België (COLOSS bevraging)



Blootstelling aan stressoren



omgeving
gerelateerd



bijenteelt
gerelateerd

STRESSOREN

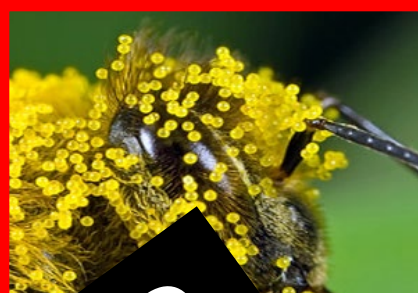
Twée parallele processen



VERLIES AAN BIODIVERSITEIT
= massaal uitsterven van soorten



vervuiling



bruik



invasieve
soorten



klimaat-
veranderingen

STRESS

INTENSIEVE BIJENTEELT
= nieuwe bijenteelt-praktijken



intensieve
bijenteelt

KWETSBAAR
& STRESS

Verlies aan biodiversiteit





6^{de} periode van massaal uitsterven van soorten

International Union of Conservation of Nature: Red List

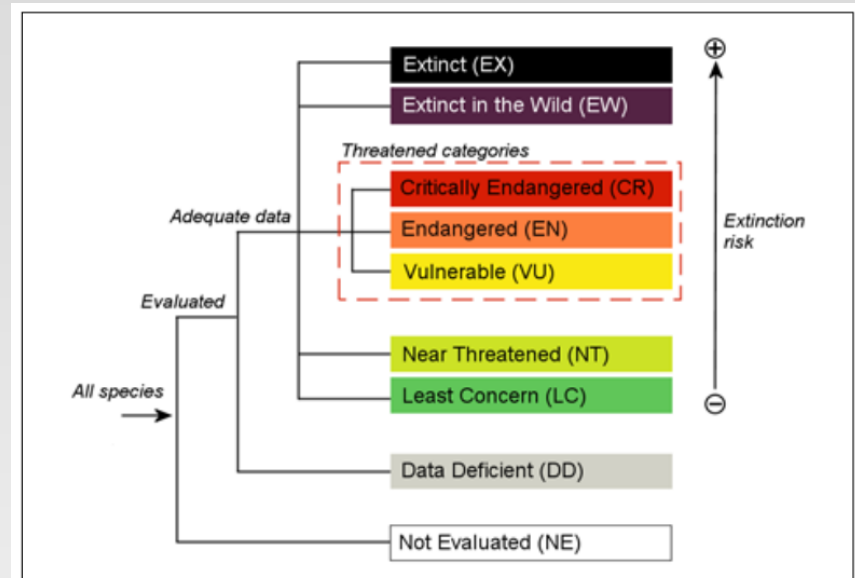
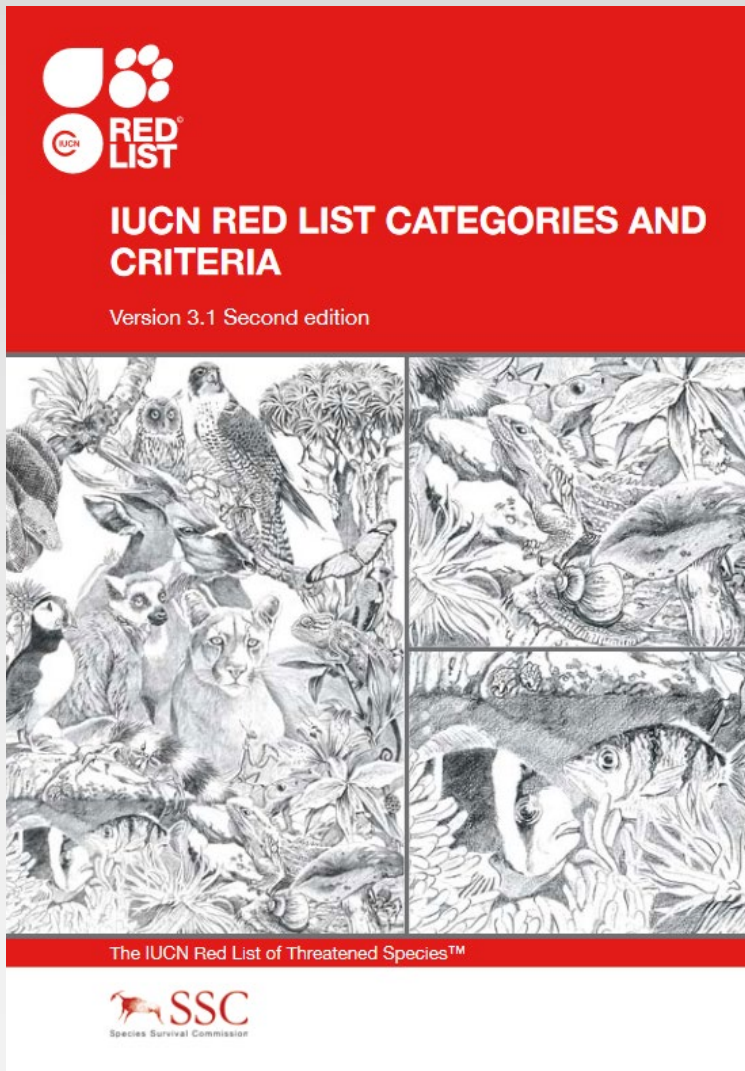


Figure 1. Structure of the categories

EX = uitgestorven
 CR = kritisch bedreigd
 EN = bedreigd
 VU = kwetsbaar

International Union of Conservation of Nature: bijen in België

Table 3. Assessment of the IUCN status of the 31 bumblebee species recorded in Belgium.

IUCN Status	Number of species	Bumblebee species	Total percentage
Least concern (LC)	6	<i>Bombus hypnorum</i> , <i>B. lapidarius</i> , <i>B. pascuorum</i> , <i>B. pratorum</i> , <i>B. sylvestris</i> , <i>B. terrestris</i>	19%
Near Threatened (NT)	4	<i>B. bohemicus</i> , <i>B. hortorum</i> , <i>B. lucorum</i> , <i>B. vestalis</i>	13%
Vulnerable (VU)	4	<i>B. campestris</i> , <i>B. jonellus</i> , <i>B. norvegicus</i> , <i>B. soroeensis</i>	45%
Endangered (EN)	4	<i>B. cryptarum</i> , <i>B. magnus</i> , <i>B. ruderarius</i> , <i>B. rupestris</i>	
Critically Endangered (CR)	6	<i>B. barbutellus</i> , <i>B. humilis</i> , <i>B. muscorum</i> , <i>B. ruderatus</i> , <i>B. sylvarum</i> , <i>B. veteranus</i>	
Regionally extinct (RE)	7	<i>B. confusus</i> , <i>B. cullumanus</i> , <i>B. distinguendus</i> , <i>B. pomorum</i> , <i>B. quadricolor</i> , <i>B. subterraneus</i> , <i>B. wurflenii</i>	23%

(CR) KRITISCH BEDREIGD

hommels

Bombus sylvarum

= boshommel



Halictidae

Lasioglossum quadrinotatum

= kleine bandgroefbij

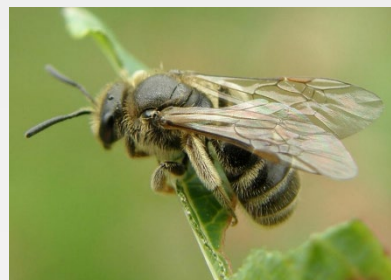


Table 4. Assessment of the IUCN status of the 84 Halictidae species recorded in Belgium.

IUCN Status	Number of species	Species	Percentage
Data Deficient (DD)	4	<i>Lasioglossum glabriusculum</i> , <i>L. fratellum</i> , <i>L. subfulvicorne</i> , <i>Sphecodes majalis</i>	5%
Least Concern (LC)	38	<i>Halictus rubicundus</i> , <i>H. scabiosae</i> , <i>Lasioglossum calceatum</i> , <i>L. fulvicorne</i> , <i>L. laticeps</i> , <i>L. lativentre</i> , <i>L. leucozonium</i> , <i>L. lucidulum</i> , <i>L. majus</i> , <i>L. malachurum</i> , <i>L. minutissimum</i> , <i>L. morio</i> , <i>L. nitidiusculum</i> , <i>L. nitidulum</i> , <i>L. pallens</i> , <i>L. parvulum</i> , <i>L. pauxillum</i> , <i>L. punctatissimum</i> , <i>L. puncticolle</i> , <i>L. semilucens</i> , <i>L. sexnotatum</i> , <i>L. sexstrigatum</i> , <i>L. villosulum</i> , <i>L. zonulum</i> , <i>Seladonia tumulorum</i> , <i>Sphecodes albilabris</i> , <i>S. crassus</i> , <i>S. ephippius</i> , <i>S. ferruginatus</i> , <i>S. geoffrellus</i> , <i>S. gibbus</i> , <i>S. hyalinatus</i> , <i>S. longulus</i> , <i>S. miniatus</i> , <i>S. monilicornis</i> , <i>S. pellucidus</i> , <i>S. puncticeps</i> , <i>S. reticulatus</i>	45%
Near Threatened (NT)	3	<i>Lasioglossum albipes</i> , <i>L. leucopus</i> , <i>L. rufitarse</i>	4%
Vulnerable (VU)	10	<i>Seladonia confusus</i> , <i>Halictus maculatus</i> , <i>H. sexcinctus</i> , <i>Lasioglossum laevigatum</i> , <i>L. minutulum</i> , <i>L. pygmaeum</i> , <i>L. quadrinotatum</i> , <i>L. monstificum</i> , <i>L. marginatus</i> , <i>L. niger</i>	12%
Endangered (EN)	6	<i>Dufourea dentiventris</i> , <i>Halictus simplex</i> , <i>Lasioglossum brevicorne</i> , <i>L. prasinum</i> , <i>L. xanthopus</i> , <i>Sphecodes scabricollis</i>	7%
Critically Endangered (CR)	10	<i>Dufourea halictula</i> , <i>D. inermis</i> , <i>Eurygnatus compressus</i> , <i>Seladonia leucaheneus</i> , <i>Halictus quadricinctus</i> , <i>Lasioglossum quadrinotatum</i> , <i>L. tarsatum</i> , <i>Rophites quinquespinosus</i> , <i>Sphecodes rufiventris</i> , <i>S. spinulosus</i>	12%
Regionally extinct (RE)	13	<i>Dufourea minuta</i> , <i>Seladonia subaurata</i> , <i>Lasioglossum breviventre</i> , <i>L. costulatum</i> , <i>L. interruptum</i> , <i>L. leave</i> , <i>L. lineare</i> , <i>L. nigripes</i> , <i>L. politum</i> , <i>L. subfasciatum</i> , <i>L. subhirtum</i> , <i>Rhophitoides canus</i> , <i>Sphecodes rubicundus</i>	15%

Table 5. Assessment of the IUCN status of the 72 Megachilidae species recorded in Belgium.

IUCN Status	Number of species	Species	Percentage
Data Deficient (DD)	3	<i>Osmia brevicornis</i> , <i>Hoplitis mitis</i> , <i>Stelis odontopyga</i>	4%
Least Concern (LC)	30	<i>Anthidiellum strigatum</i> , <i>A. manicatum</i> , <i>A. oblongatum</i> , <i>A. punctatum</i> , <i>Megachile ericetorum</i> , <i>Chelostoma campanularum</i> , <i>C. florissomne</i> , <i>C. rapunculi</i> , <i>Coelioxys aurolimbata</i> , <i>C. inermis</i> , <i>Heriades truncorum</i> , <i>Hoplitis adunca</i> , <i>H. leucomelana</i> , <i>H. tridentata</i> , <i>Megachile centuncularis</i> , <i>M. lapponica</i> , <i>M. lignisea</i> , <i>M. pyrenaea</i> , <i>M. rotundata</i> , <i>M. versicolor</i> , <i>M. willughbiella</i> , <i>Osmia bicolor</i> , <i>O. bicornis</i> , <i>O. caerulescens</i> , <i>O. cornuta</i> , <i>O. leaiana</i> , <i>O. niveata</i> , <i>Stelis breviscula</i> , <i>S. punctulatissima</i> , <i>Trachusa byssina</i>	42%
Near Threatened (NT)	4	<i>Coelioxys rufescens</i> , <i>Osmia spinulosa</i> , <i>O. aurulenta</i> , <i>Stelis phaeoptera</i>	5,5%
Vulnerable (VU)	8	<i>Chelostoma distinctum</i> , <i>Coelioxys alata</i> , <i>C. elongate</i> , <i>C. mandibularis</i> , <i>Hoplitis claviventris</i> , <i>Megachile alpicola</i> , <i>M. leachella</i> , <i>Stelis ornatula</i>	11%
Endangered (EN)	5	<i>Megachile circumcincta</i> , <i>Osmia parietina</i> , <i>O. rufohirta</i> , <i>O. uncinata</i> , <i>Stelis signata</i>	7%
Critically Endangered (CR)	12	<i>Coelioxys afra</i> , <i>C. conoidea</i> , <i>C. quadridendata</i> , <i>Hoplitis anthocopoides</i> , <i>H. ravouxi</i> , <i>Megachile analis</i> , <i>M. genalis</i> , <i>M. lagopoda</i> , <i>M. maritima</i> , <i>M. pilidens</i> , <i>Osmia andrenoides</i> , <i>Stelis minuta</i>	17%
Regionally Extinct (RE)	10	<i>Coelioxys emarginata</i> , <i>Aglaoapis tridentata</i> , <i>Hoplitis papaveris</i> , <i>H. villosa</i> , <i>Megachile octosignata</i> , <i>Osmia inermis</i> , <i>O. mustelina</i> , <i>O. pilicornis</i> , <i>O. xanthomelana</i> , <i>Stelis minima</i>	14%

(CR) KRITISCH BEDREIGD

Megachilidae

Osmia andrenoides



35%

(RE) REGIONAAL UITGESTORVEN # 30

Bombus # 7

Halictidae # 13

Megachilidae # 10

ook in België sterke achteruitgang wilde bijen

Waarom is bijensterfte belangrijk?



appel



kers



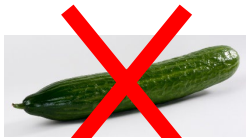
rijst



aubergine



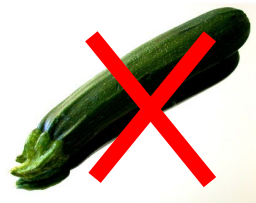
meloen



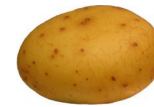
komkommer



pompoen



courgette



aardappel



amandel



cocos



mais



koffie



cacao



zonnebloem

71% voedselgewassen afhankelijk van bijen

Waarom is bijensterfte belangrijk?



bijen dragen bij tot de biodiversiteit

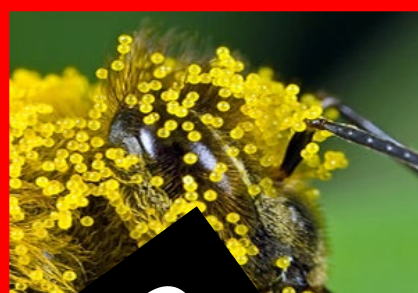
Twée parallele processen



VERLIES AAN BIODIVERSITEIT
= massaal uitsterven van soorten



vervuiling



bruik



invasieve
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klimaat-
veranderingen

STRESS

INTENSIEVE BIJENTEELT
= nieuwe bijenteelt-praktijken



intensieve
bijenteelt

KWETSBAAR
& STRESS

Honingbijen en bijenteelt

- Biologie van de honingbij
- De Varroa-mijt
- Het bijenvolk doorheen het jaar
- Korf-imkeren / kast-imkeren
- Intensieve bijenteelt



Niet alle honingbijen zijn gelijk



ei	larve	pop	adult
D1-3 (3)	D4-9 (6)	D10-23 (14)	D24
D1-3 (3)	D4-9 (6)	D10-15 (6)	D16
D1-3 (3)	D4-9 (6)	D10-20 (11)	D21

Het broed



Van ei tot werkster

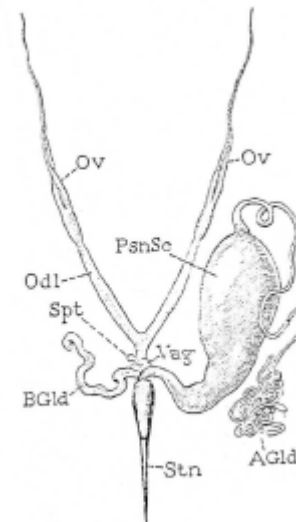
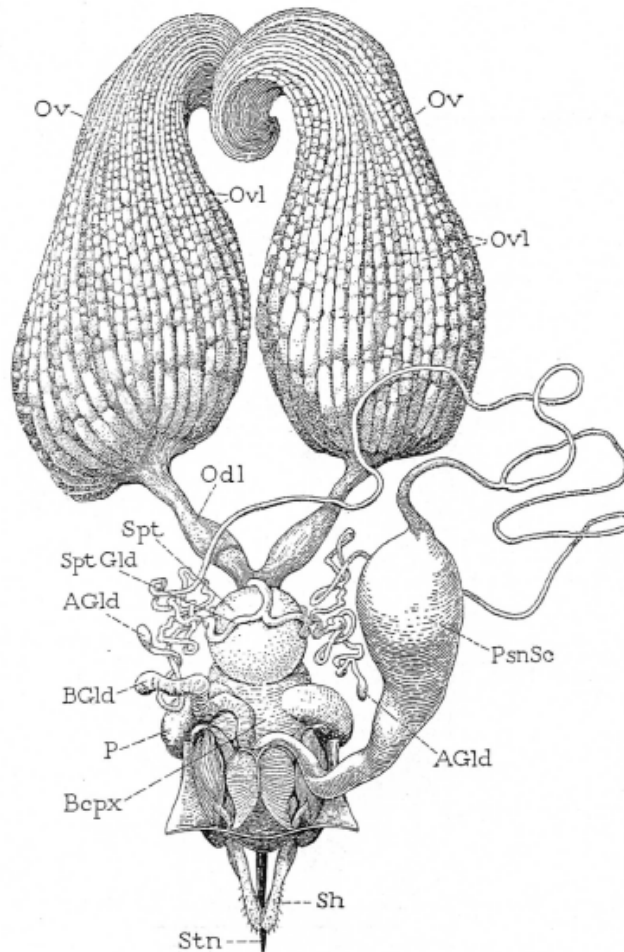
e-Lapse: Bees Hatch Before Your Eyes | National Geographic



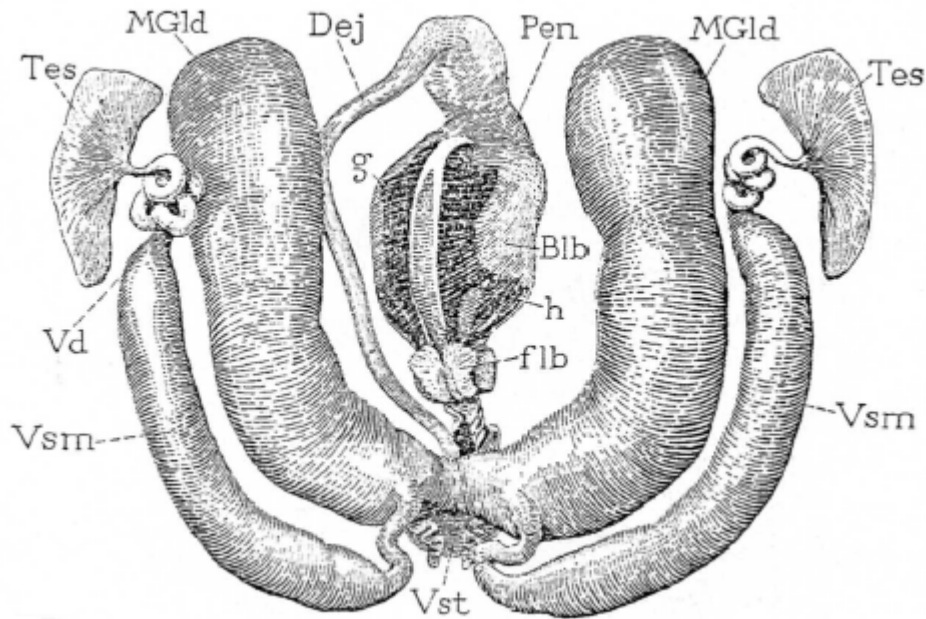
De geboorte van een koningin



Het geslachtsapparaat



Het geslachtsapparaat



De geslachtsdaad



Understanding the life cycle of the Varroa mite

1

The queen is the largest in the beehive. She lays up to 2,000 eggs per day in the brood cells.

2

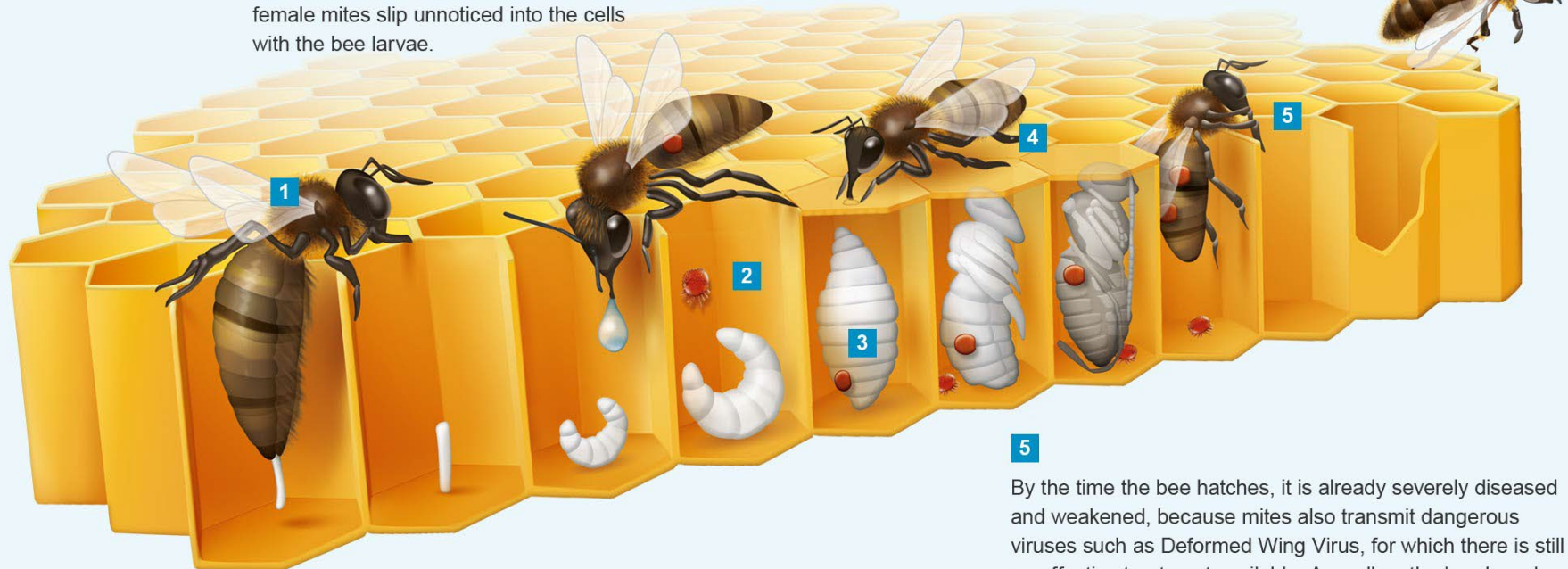
Worker bees often carry Varroa mites with them into the hive. Despite being deaf and blind, these mites can find their ways to the brood chambers thanks to their olfactory sense and numerous fine sensory hairs on the legs. Shortly before the workers cap the brood cells, the female mites slip unnoticed into the cells with the bee larvae.

3

A few days later, the mites lay the first eggs. The first to hatch is always a male. It is followed by up to five more eggs from which female mites hatch.

4

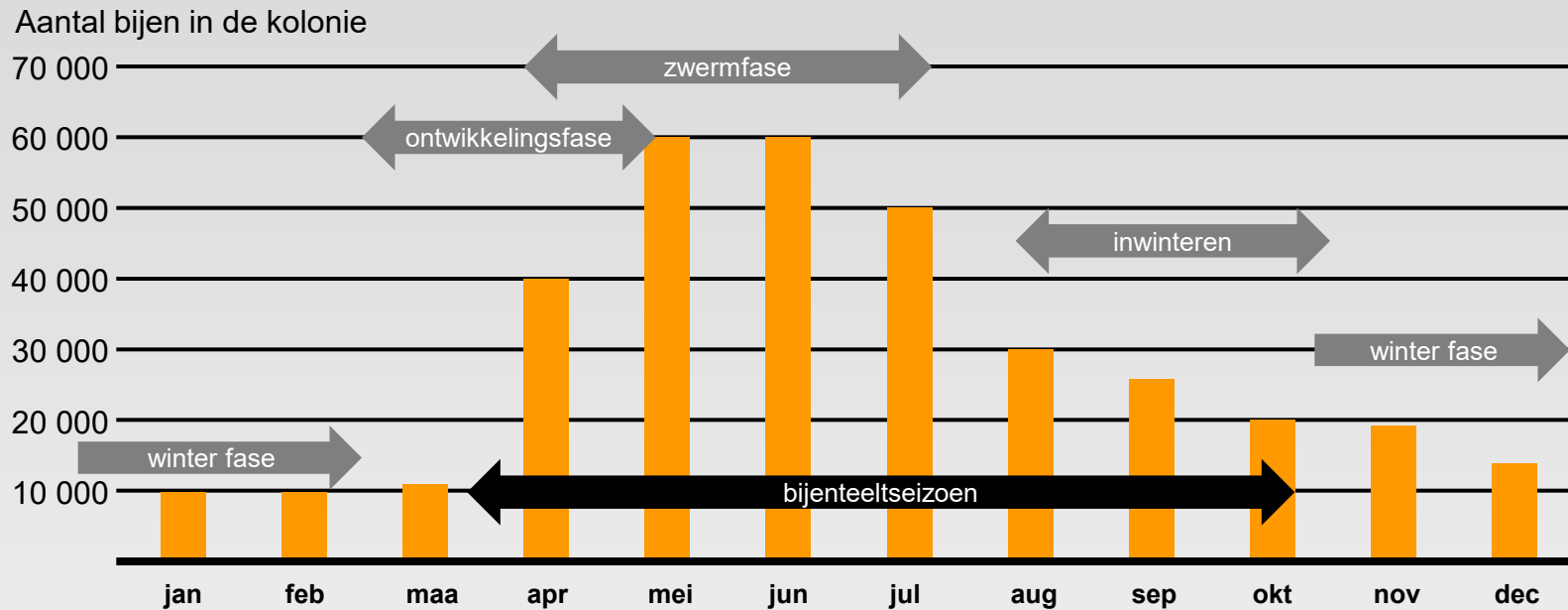
To feed its offspring, the mother mite pierces a feeding hole in the bee pupa which has developed in the meantime. Before the bee hatches, the mites mate again – during the bee season, the Varroa population in a hive can double every four weeks.



5

By the time the bee hatches, it is already severely diseased and weakened, because mites also transmit dangerous viruses such as Deformed Wing Virus, for which there is still no effective treatment available. As well as the bee brood, Varroa can also infest adult bees.

Het bijenvolk doorheen het jaar



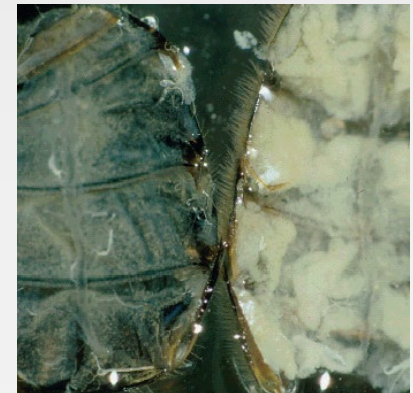
wintertros



broed



zwerm



winterbijen

Het korf-imkeren



zwerm scheppen



vaste raatbouw



jaagstand



honing persen

pluspunten:

- er wordt gewerkt met locale rassen
- de tussenkomst van de imker beperkt zich tot huisvesting en honingoogst
- geen verstoring van de volksontwikkeling en het reproductieproces

pijnpunten:

- beperkte toegankelijkheid van de korf (enkel langs onder)
- vaste raatbouw (geen raampjes; honing oogsten door destructie)
- beperkt volume (30L; beperkte opbrengst en snel zwermvluchtig)

Lorenzo Langstroth (1810-1895): ontdekking modulaire bijenkast (1852)

- te openen langs boven
- bestaande uit stapelbare rompen
- met uitneembare raampjes waarin de raten worden gebouwd



Lorenzo Langstroth



modulaire bijenkast, simplex formaat

De intensieve bijenteelt



hergebruik was



zwermverhindering



moerteelt



import koninginnen



eilandbevruchting



kunstmatische inseminatie



behandeling tegen ziekten



focus op honingopbrengst

De intensieve bijenteelt



Wat hebben we geleerd vandaag?

De intensieve bijenteelt



pluspunten:

- hoge honing opbrengst
- zachte bijen (raamvast en niet steeklustig)
- beperkte zwerm drift
- toegankelijkheid van de bijenkast
- laat grootschaligheid toe

pijnpunten:

- verstoring van de biologische processen
- de imker is de bepalende factor in de volksoontwikkeling en het reproductieproces
- het imkeren is arbeidsintensief



MAAR ER IS MEER AAN DE HAND...

Kritische kijk op de imkers-praktijken

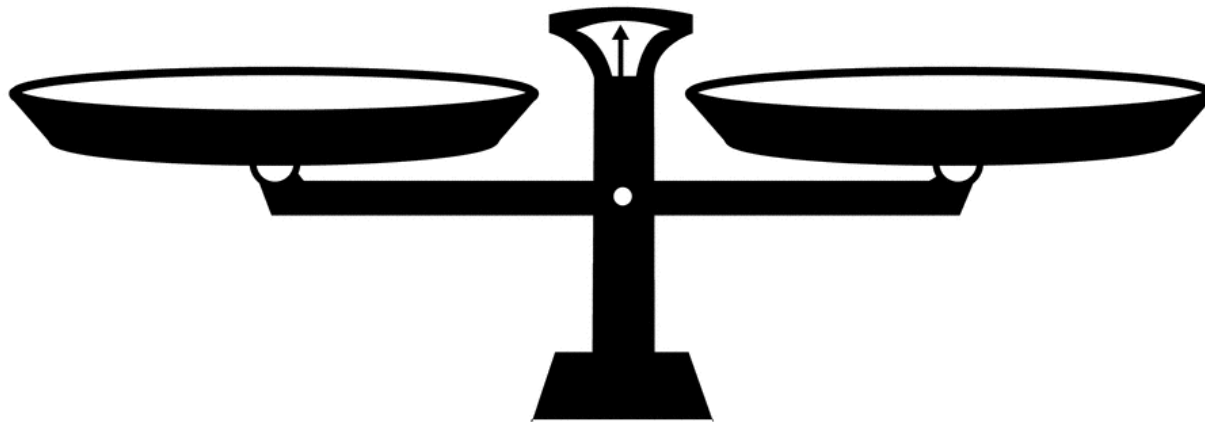
- Kolonie-densiteit
- Huisvesting
- Reproductie



aantal kolonies



draagkracht van het landschap



kolonie-densiteit ~ voedsel
>> - kwaliteit larven
- omvang van het broed
- cannibalisme

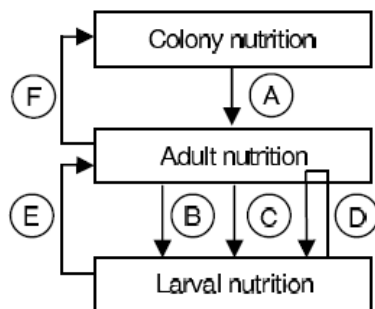


Figure 1. A schematic representation of the three levels of honey bee nutrition, dependencies, and possible effects of protein malnutrition. A: dependency of adults on colony food stores; B: investment in larval quality; C: regulation of larval number; D: cannibalism; E: impact of larval nutrition on next adult generation; F: impact of adults on colony nutrition.

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Review article

Nutrition and health in honey bees*

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Abstract – Adequate nutrition supports the development of healthy honey bee colonies. We give an overview of the nutritional demands of honey bee workers at three levels: (1) colony nutrition with the possibility of supplementation of carbohydrates and proteins; (2) adult nutrition and (3) larval nutrition. Larvae are especially dependant on protein and brood production is strongly affected by shortages of this nutrient. The number of larvae reared may be reduced to maintain the quality of remaining offspring. The quality of developing workers also suffers under conditions of larval starvation, leading to slightly affected workers. Larval starvation, alone or in combination with other stressors, can weaken colonies. The potential of different diets to meet nutritional requirements or to improve survival or brood production is outlined. We discuss nutrition-related risks to honey bee colonies such as starvation, monocultures, genetically modified crops and pesticides in pollen and nectar.

malnutrition / pollen / protein / carbohydrates / supplemental feeding

1. INTRODUCTION

Adequate nutrition is a honey bee colony's basis for growth and development. De Groot (1953) reported the amino acid requirements for honey bee growth and development, and Haydak (1970) extensively reviewed the general dietary requirements of honey bees. This knowledge led to the formulation of special diets that support colony development (Tab. 1). Because landscapes have become increasingly characterized by agriculturally intensive monocultures, and since honey bee pollination services often occur within a human-defined ecosystem, bees nutritional needs may not be provided for properly (Naug, 2009). Thus the question arises if and how bees should be provided with supplemental food when nutritional deficits occur.

Honey bees are social insects, often regarded as super-organisms (Seeley, 1989). Thus, nutrition can be investigated on three

levels – colony nutrition, adult nutrition and larval nutrition – with increasing complexity, because disorders in prior stages affect subsequent stages, and vice versa. Poor colony pollen stores may hinder adults from feeding larvae properly or from rearing all larvae to adulthood. Hence the quality or the number of adults in the next generation may be poor, which could affect colony nutritional state and thus influence subsequent brood rearing (Fig. 1). In a colony, the nutritional levels are closely connected through numerous adult-brood interactions and trophallactic contacts. Trophallaxis describes the social transfer of food from one adult individual to another, partly in a directed manner, and partly generating a common stomach that enables all bees to obtain knowledge of the nutritional status of the colony (Crailsheim, 1991, 1998). Both larvae and adults are highly dependent on colony food stores, and adult honey bees may adapt their foraging or brood-care strategies according to the respective need and supply of carbohydrates and proteins (Schmickl and Crailsheim, 2004).

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kolonie-densiteit ~ ziekten
>> vervliegen, roverij
>> ziektenoverdracht



PLOS ONE

RESEARCH ARTICLE

Mite bombs or robber lures? The roles of drifting and robbing in *Varroa destructor* transmission from collapsing honey bee colonies to their neighbors

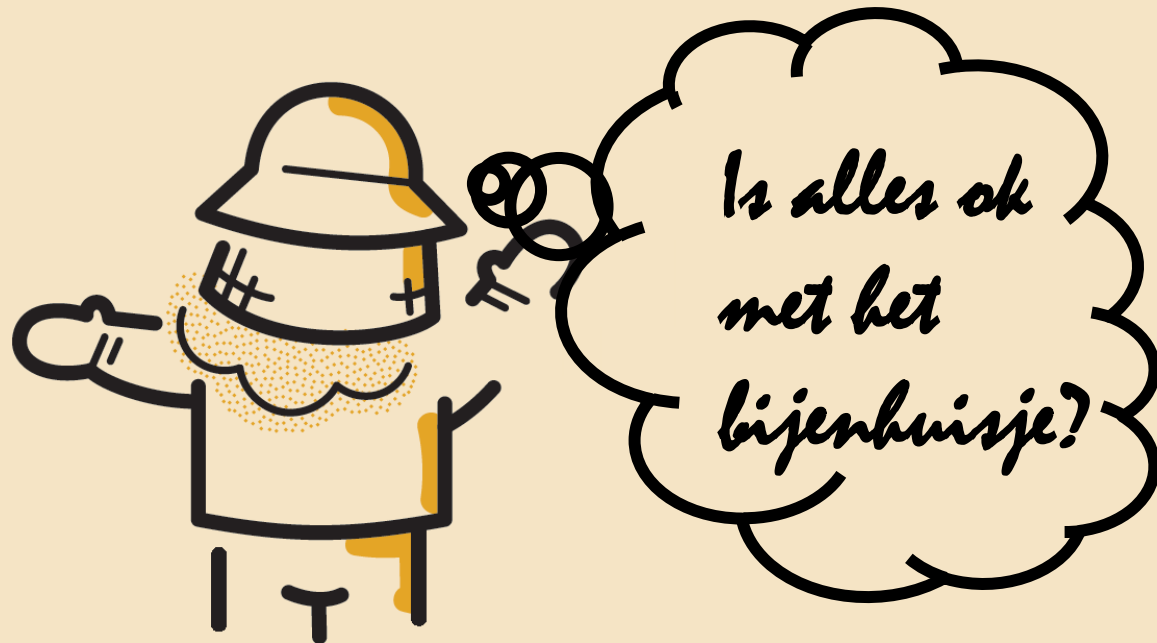
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PLoS ONE (2019) 14 (6): e0218392





huisvesting: in functie van thermoregulatie en raatbouw



thermoregulatie:

modulaire bijenkast versus
boomnest:

- warmteverlies tot $\sim 70\%$
- hoge bijendensiteit nodig $>150\%$
- >> om conventiestromen te stoppen

Journal of Thermal Biology 122 (2024) 103882



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Are man-made hives valid thermal surrogates for natural honey bee nests
(*Apis mellifera*)?

Derek Morville Mitchell

Institute of Thermofluids, School of Mechanical Engineering, University of Leeds United Kingdom, Woodhouse Ln, Woodhouse, Leeds, LS2 9JT, UK



Fig. 1. Artificial tree nest constructed from wood and foam.

raatbouw:

- (historische) contaminatie
- wasvervalsing (paraffine, stearine)

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journal homepage: www.elsevier.com/locate/scitotenv

Pesticide and veterinary drug residues in Belgian beeswax: Occurrence, toxicity, and risk to honey bees

Noémie El Agrebi^a, Kirsten Traynor^b, Olivier Wilmart^c, Simone Tosi^d, Laurent Leinartz^e, Ellen Danneels^f, Dirk C. de Graaf^{f,g}, Claude Saegerman^{a,*}

^a Research Unit of Epidemiology and Risk Analysis Applied to Veterinary Sciences (UREAR-ULiège), Fundamental and Applied Research for Animal and Health (FARAH) Center, Faculty of Veterinary Medicine, University of Liège, Quartier Vallée 2, Avenue de Caraghém 7A, B42, 4000 Liège, Sart-Tilman, Belgium

^b Global Biosocial Complexity Initiative, Arizona State University, Tempe, AZ, USA

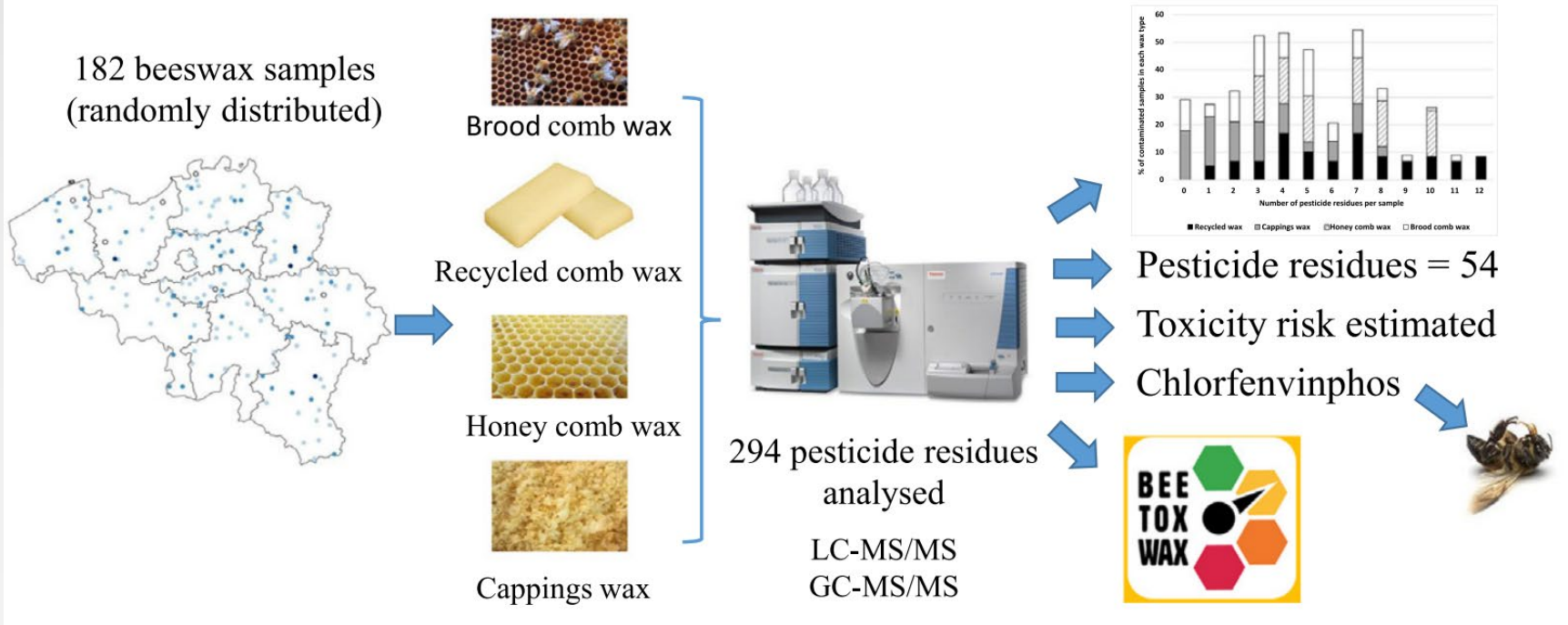
^c Federal Agency for the Safety of the Food Chain (FASFC), Directorate Control Policy, Staff Direction for Risk Assessment, Boulevard du Jardin Botanique 55, 1000 Brussels, Belgium

^d Epidemiology Unit, University Paris Est, ANSES (French Agency for Food, Environmental and Occupational Health and Safety) Animal Health Laboratory, Maisons-Alfort, France

^e Teaching Support Unit, Faculty of Veterinary Medicine, University of Liège, Quartier Vallée 2, Avenue de Caraghém 5C-5D, B41, 4000 Liège, Sart-Tilman, Belgium

^f Faculty of Sciences, Honeybee Valley, Ghent University (UGent), Krijgslaan 281 S33, 9000 Ghent, Belgium

^g Faculty of Sciences, Laboratory of Molecular Entomology and Bee Pathology, Ghent University (UGent), Krijgslaan 281 S2, 9000 Ghent, Belgium



raatbouw:

- larven onder stress
- >> expressie immuniteit & ontgiftingsgenen

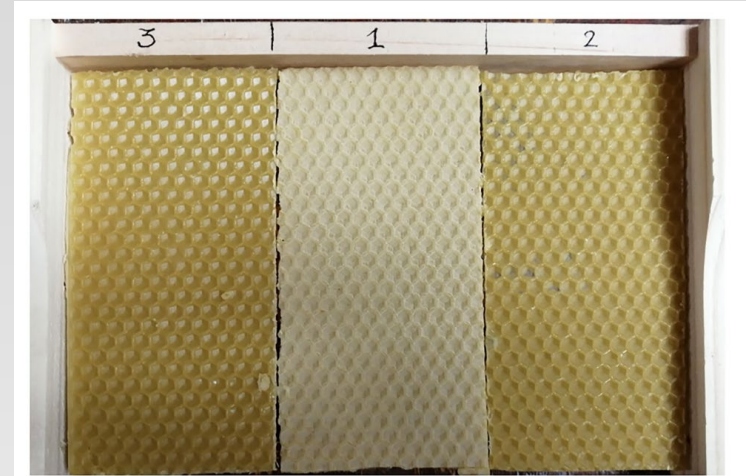


Fig 2. Mini Plus frame with a set of 3 comb sections, 2 contaminated and 1 control placed here in the centre.

<https://doi.org/10.1371/journal.pone.0302183.g002>

PLOS ONE

RESEARCH ARTICLE

A field realistic model to assess the effects of pesticides residues and adulterants on honey bee gene expression

Noémie El Agrebi¹, Lina De Smet^{2,3*}, Caroline Douny⁴, Marie-Louise Scippo⁴, Lidija Svečnjak⁵, Dirk C. de Graaf^{2,3}, Claude Saegerman^{1*}

1 Research Unit of Epidemiology and Risk analysis applied to Veterinary sciences (UREAR-ULiège), Fundamental and Applied Research for Animal and Health (FARAH) Center, Faculty of Veterinary Medicine, University of Liège, Liège, Belgium, **2** Faculty of Sciences, Laboratory of Molecular Entomology and Bee Pathology, Ghent University (UGent), Ghent, Belgium, **3** Faculty of Sciences, Honeybee Valley, Ghent University (UGent), Ghent, Belgium, **4** Laboratory of Food Analysis, Department of Food Sciences, Faculty of Veterinary Medicine, Fundamental and Applied Research for Animals & Health (FARAH) Center, Faculty of Veterinary Medicine, University of Liège, Liège, Belgium, **5** University of Zagreb, Faculty of Agriculture, Department of Fisheries, Apiculture, Wildlife Management and Special Zoology, Zagreb, Croatia

* These authors contributed equally to this work.

* claude.saegerman@uliege.be (CS); lina.desmet@ugent.be (LDS)

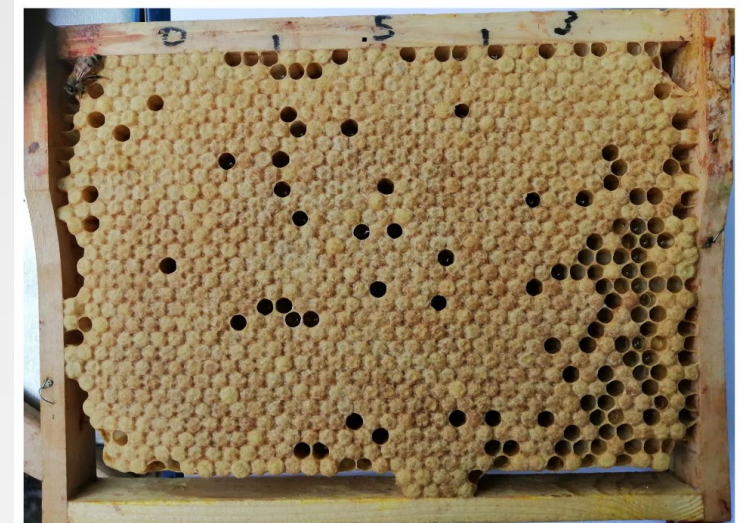


Fig 3. Brood frame with 3 percentages (0, 5 and 3%) of stearin showing empty cells for the accounting of larvae mortality rates. From left to right, the three percentages are 0, 5 and 3.

<https://doi.org/10.1371/journal.pone.0302183.g003>



moerteelt:

moerdop (zwerm)

> te verwachten subfamilies

redcel (moerloos)

> zeldzame subfamilies

>> competitie tussen larven

+ werksters kiezen

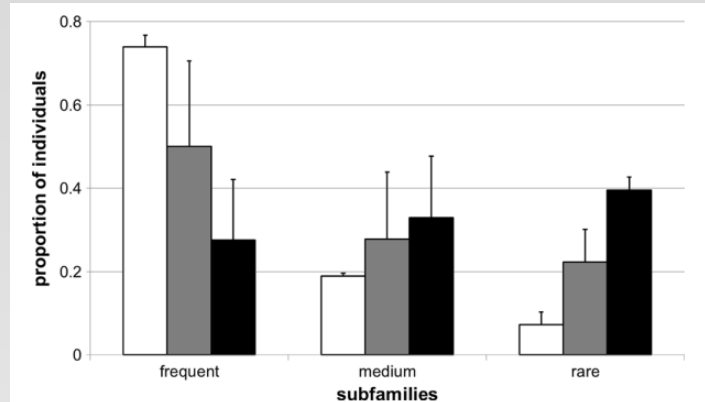


Fig. 1 Frequency distribution of frequent, medium, and rare subfamilies of samples of workers (*white*), swarm queens (*grey*), and emergency queens (*black*) over all four colonies tested. Separation into frequent, medium, and rare subfamilies was done per colony subdividing all subfamilies, sorted for the number of individuals, of a colony into three equal parts (tertiles) and counting the number of individuals within tertiles. Shown are the mean and s.d.

Behav Ecol Sociobiol (2016) 70:1411–1417
DOI 10.1007/s00265-016-2151-x



ORIGINAL ARTICLE

Context dependent bias in honeybee queen selection: swarm versus emergency queens

H. Michael G. Lattorff^{1,2} • Robin F. A. Moritz^{1,2}

aanparing:

darrenverzamelplaats

> niet alle darrenvolken zijn even
succesvol

>> 'fitness' darren bepaalt aanparing

Male fitness of honeybee colonies (*Apis mellifera* L.)

F. B. KRAUS,* P. NEUMANN,* H. SCHARPENBERG,* J. VAN PRAAGH† & R. F. A. MORITZ*

*Institut für Zoologie, Martin Luther Universität Halle/Wittenberg, Halle Saale, Germany

†Niedersächsisches Landesinstitut für Bienenkunde, Celle, Germany

genetische diversiteit:

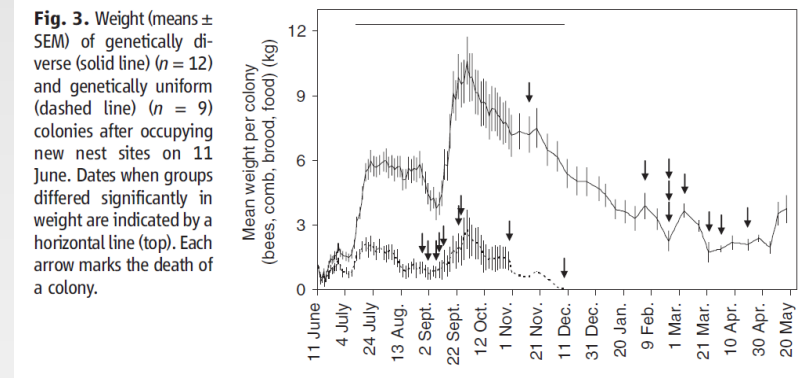
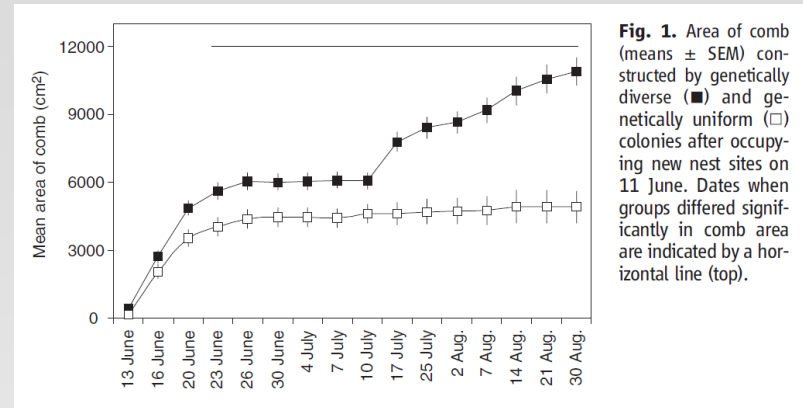
genetische diversiteit verhoogt de 'fitness' (darren productie en overleving):

- haaldrift
- populatie dynamiek

REPORTS

Genetic Diversity in Honey Bee Colonies Enhances Productivity and Fitness

Heather R. Mattila* and Thomas D. Seeley



Science (2007) 317: 362-364



Wat hebben we geleerd vandaag?

vaststellingen/werkpunten:

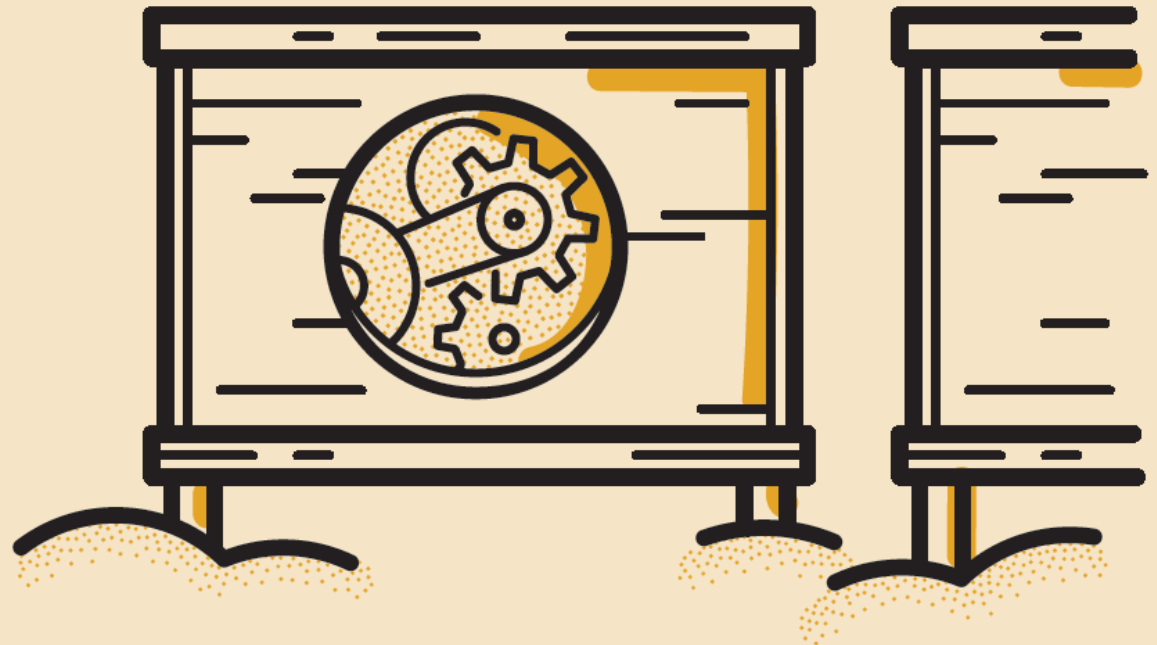
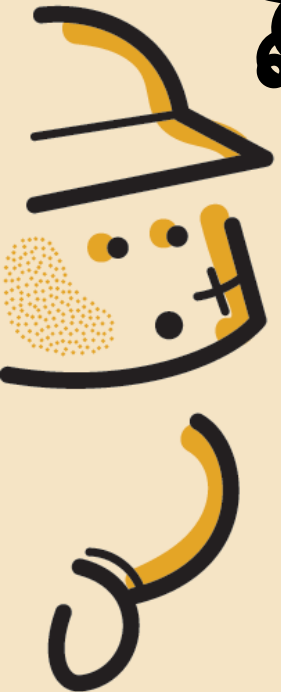
- respecteren draagkracht landschap
- ziekteoverdracht door vervliegen, roverij
- thermoregulatie modulaire bijenkast
- hergebruik van bijenwas
- keuze larven voor moerteelt
- aanparing door 'fitte' darren
- behoud/herstel genetische diversiteit
- [introductie van een broedvrije fase]



Het pad naar kwetsbare honingbijen

- Natuurlijke regelmechanismen
- Toegepast op de honingbij
- Bij plotse veranderingen
- Onder intensieve bijenteelt

*Hoe werken deze
dingen in de natuur?*



vorige generatie

filter

volgende generatie



‘fitness’
= aangepast
= adaptatie



overleven



meedoen
aan de
reproductie

natuurlijke selectie

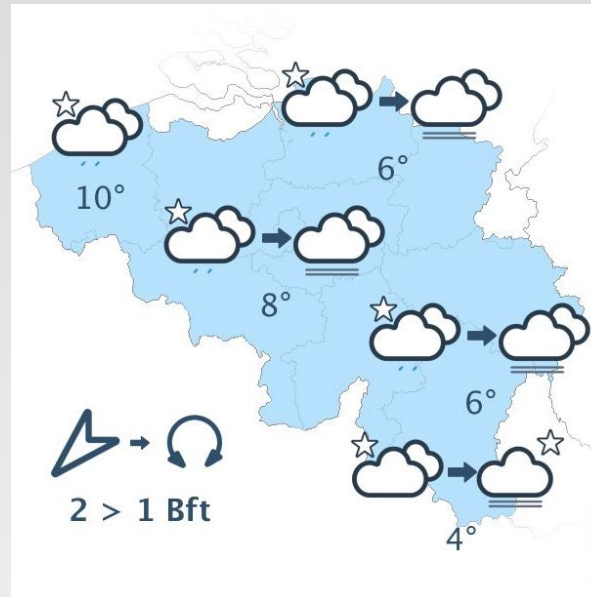
Toegepast op de honingbij



vorige generatie

filter = klimaat

volgende generatie



‘fitness’
= voorjaars-
ontwikkeling



overleven



meedoen
aan de
reproductie

natuurlijke selectie

Toegepast op de honingbij



vorige generatie

filter = vegetatie

volgende generatie



'fitness'
= volks-
ontwikkeling



overleven



meedoen
aan de
reproductie

natuurlijke selectie

Bij plotse veranderingen



vorige generatie

filter = stressor

volgende generatie



'fitness'
< genetische
diversiteit



overleven



meedoen
aan de
reproductie

natuurlijke selectie

Bij plotse veranderingen



vorige generatie

stressor = varroa

volgende generatie



‘fitness’
< defensieve
kenmerken



overleven



meedoen
aan de
reproductie

natuurlijke selectie

Bij plotse veranderingen



vorige generatie

stressor = virus

volgende generatie



'fitness'
< immuniteit



overleven



meedoen
aan de
reproductie

natuurlijke selectie

Onder intensieve bijenteelt



vorige generatie

filter = productiviteit

volgende generatie



'fitness'
< honing-
opbrengst



overleven



meedoen
aan de
reproductie

mensgestuurde selectie

Onder intensieve bijenteelt



vorige generatie

stressor = varroa

volgende generatie



'fitness'
< medicatie



overleven



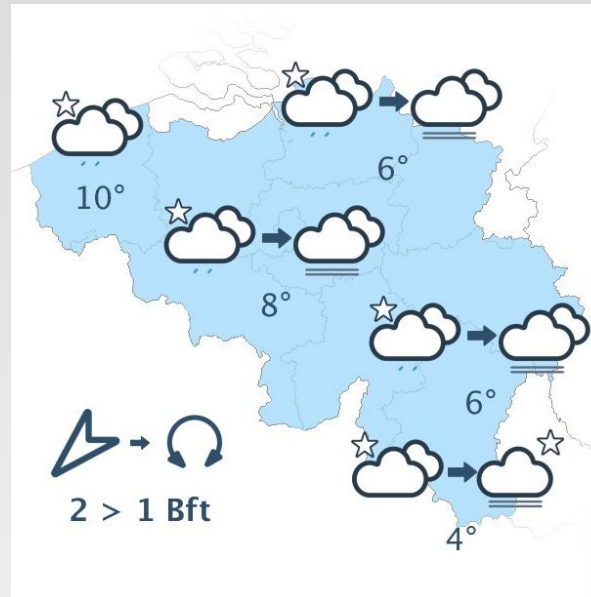
meedoen
aan de
reproductie

gebrek aan adaptatie

vorige generatie
= **import bijen**

filter = klimaat

volgende generatie



‘fitness’
< **interventies**

overleven

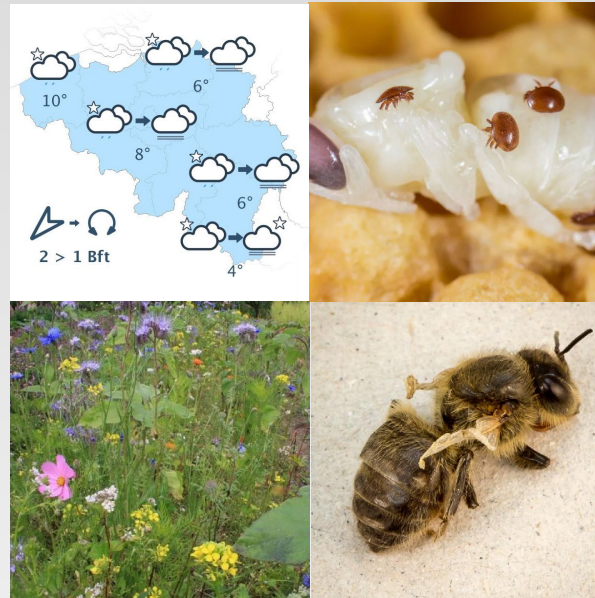
meedoen
aan de
reproductie

gebrek aan adaptatie

vorige generatie
= import bijen

veelheid aan stressoren

volgende generatie



interventies



overleven



meedoen
aan de
reproductie

kwetsbare honingbijen

Het pad naar kwetsbare honingbijen



Wat hebben we geleerd vandaag?

vaststellingen/werkpunten:

- adaptatie door natuurlijke selectie (overlevers)
- zowel naar omgeving als ziekten
- buffer door genetische diversiteit
- ziekte-resistentie door defensieve kenmerken of immuniteit
- selectie-focus op productie is mensgestuurd
- gebruik medicatie verhindert ziekte-adaptatie
- regio-vreemde bijen / genetisch materiaal verhindert omgevings-adaptatie
- bijenteelt gebaseerd op interventies maakt honingbijen kwetsbaar



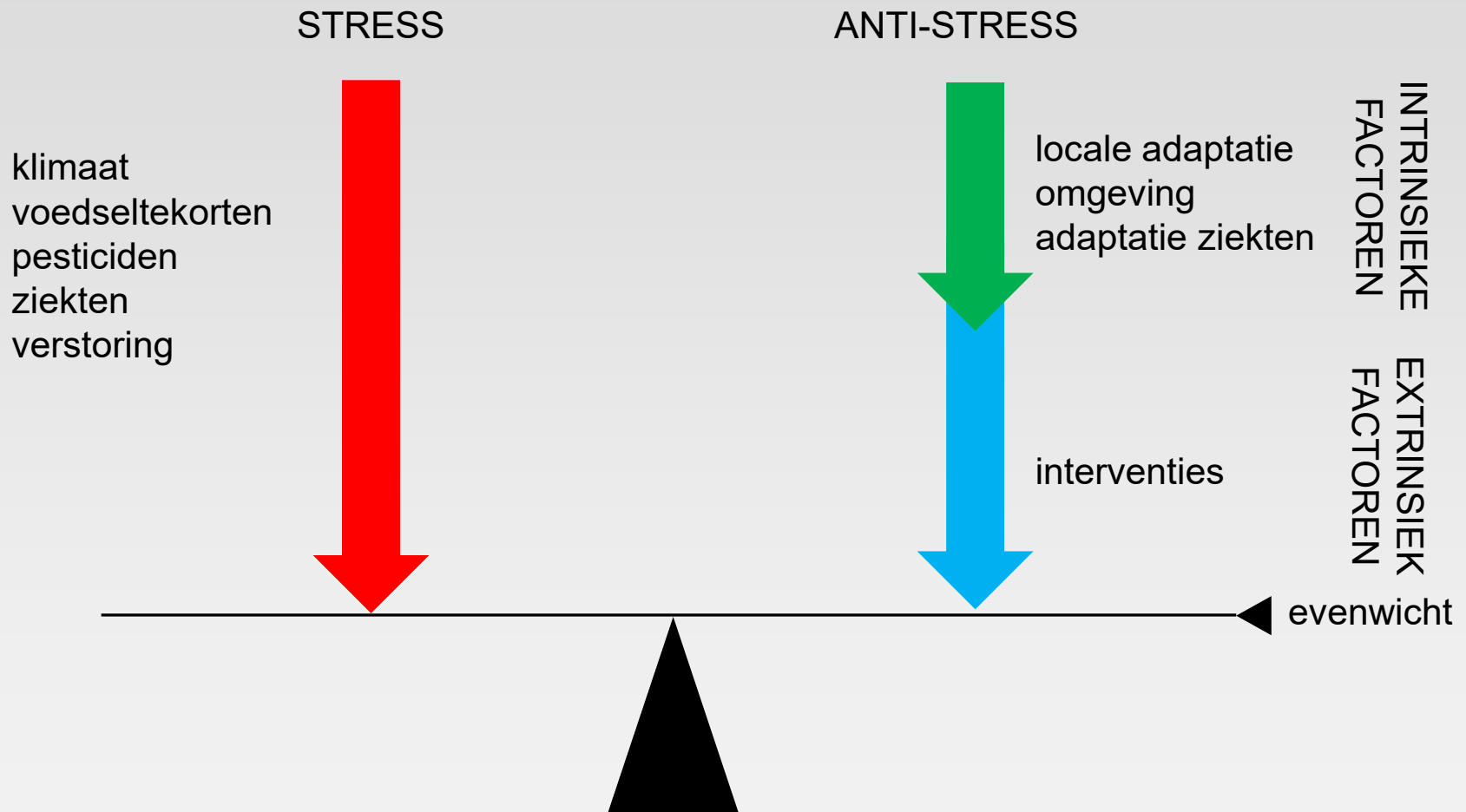
Bijenteelt: een (on)evenwichtsoefening

- Bijensterfte in een notendop
- Anders dan hoevedieren

Bijensterfte in een notendop



Bijensterfte in een notendop



Bijensterfte in een notendop



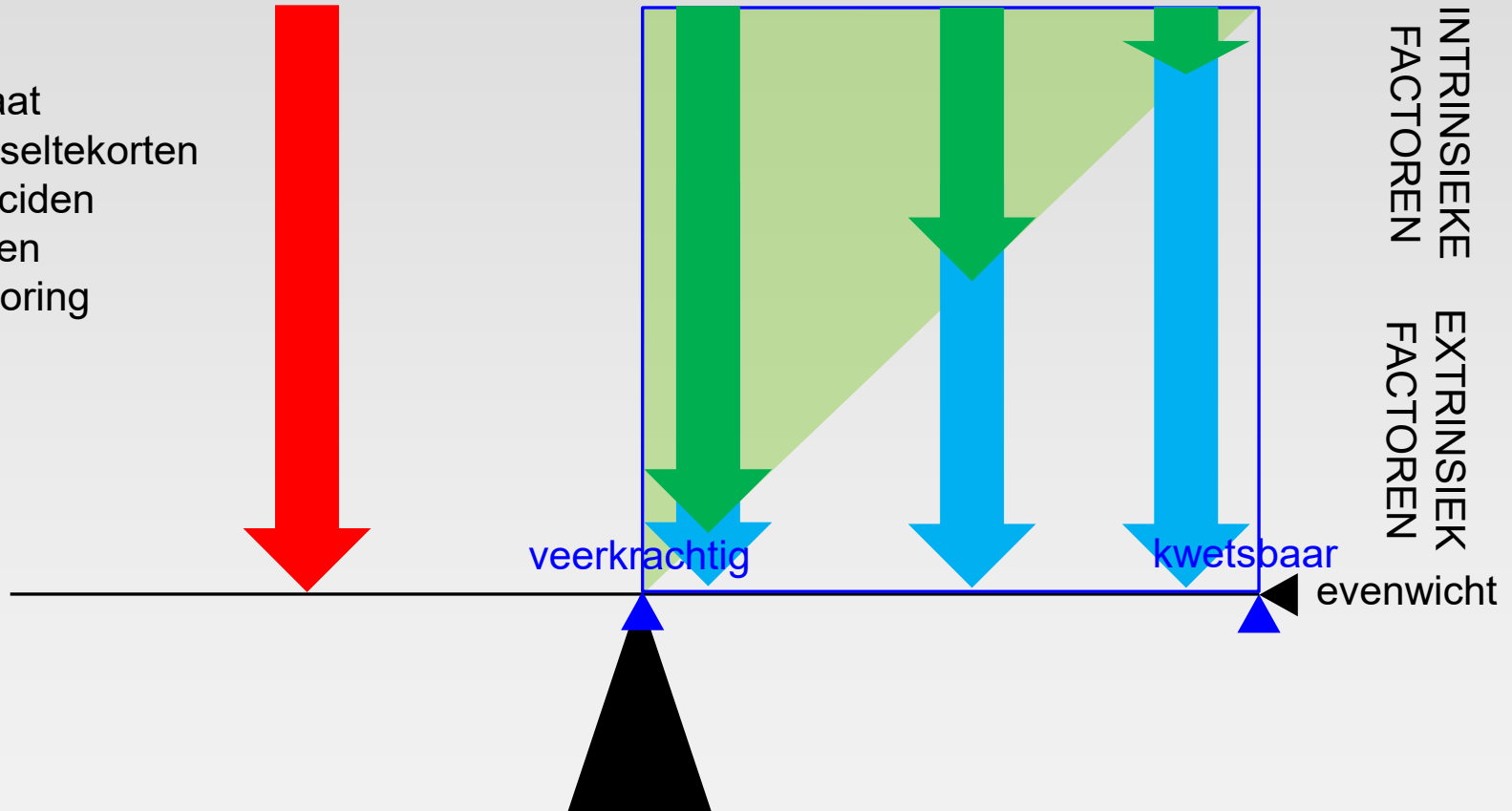
veerkracht gradient

STRESS

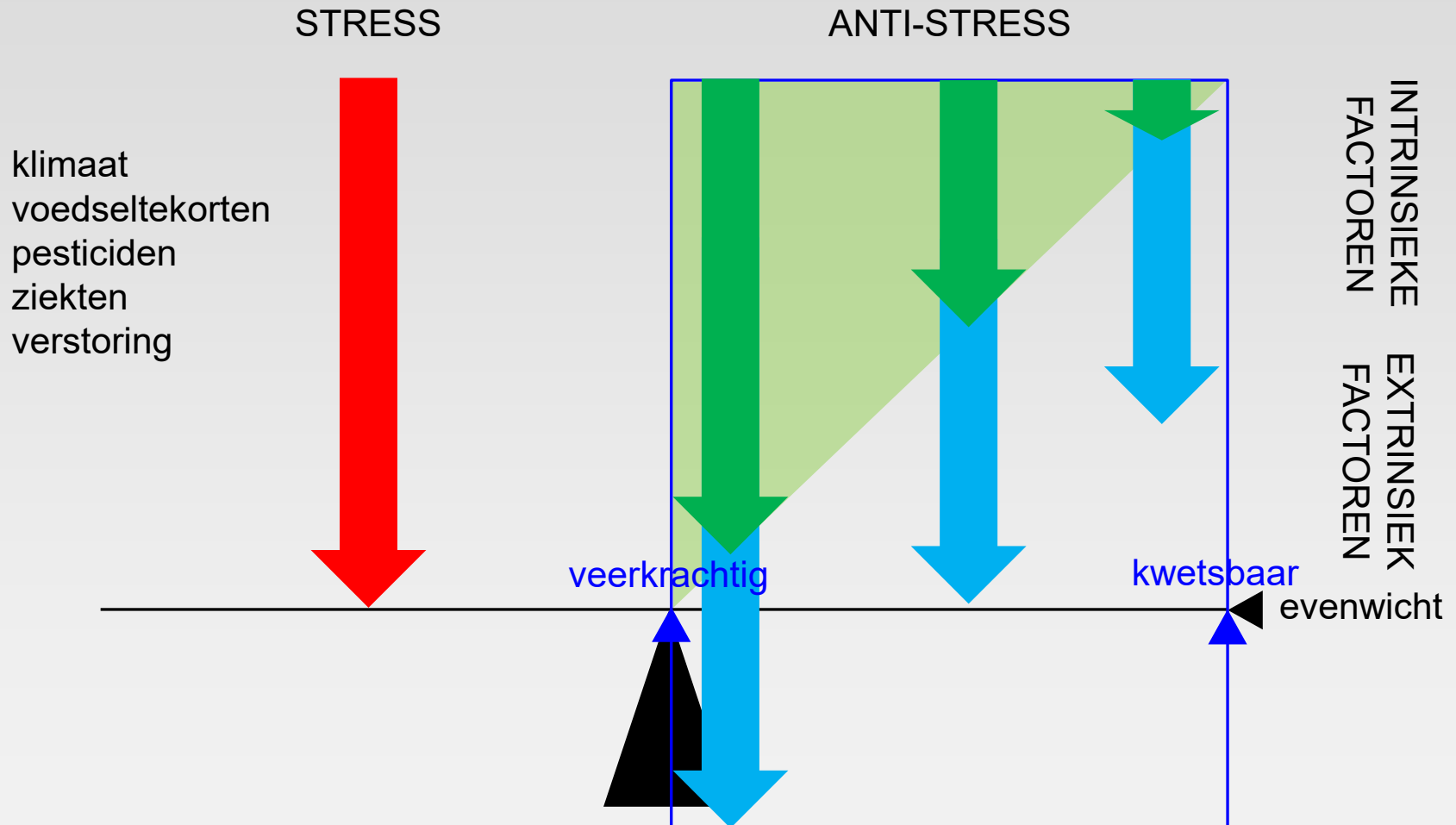
ANTI-STRESS

klimaat
voedseltekorten
pesticiden
ziekten
verstoring

INTRINSIEKE
FACTOREN
EXTRINSIEKE
FACTOREN



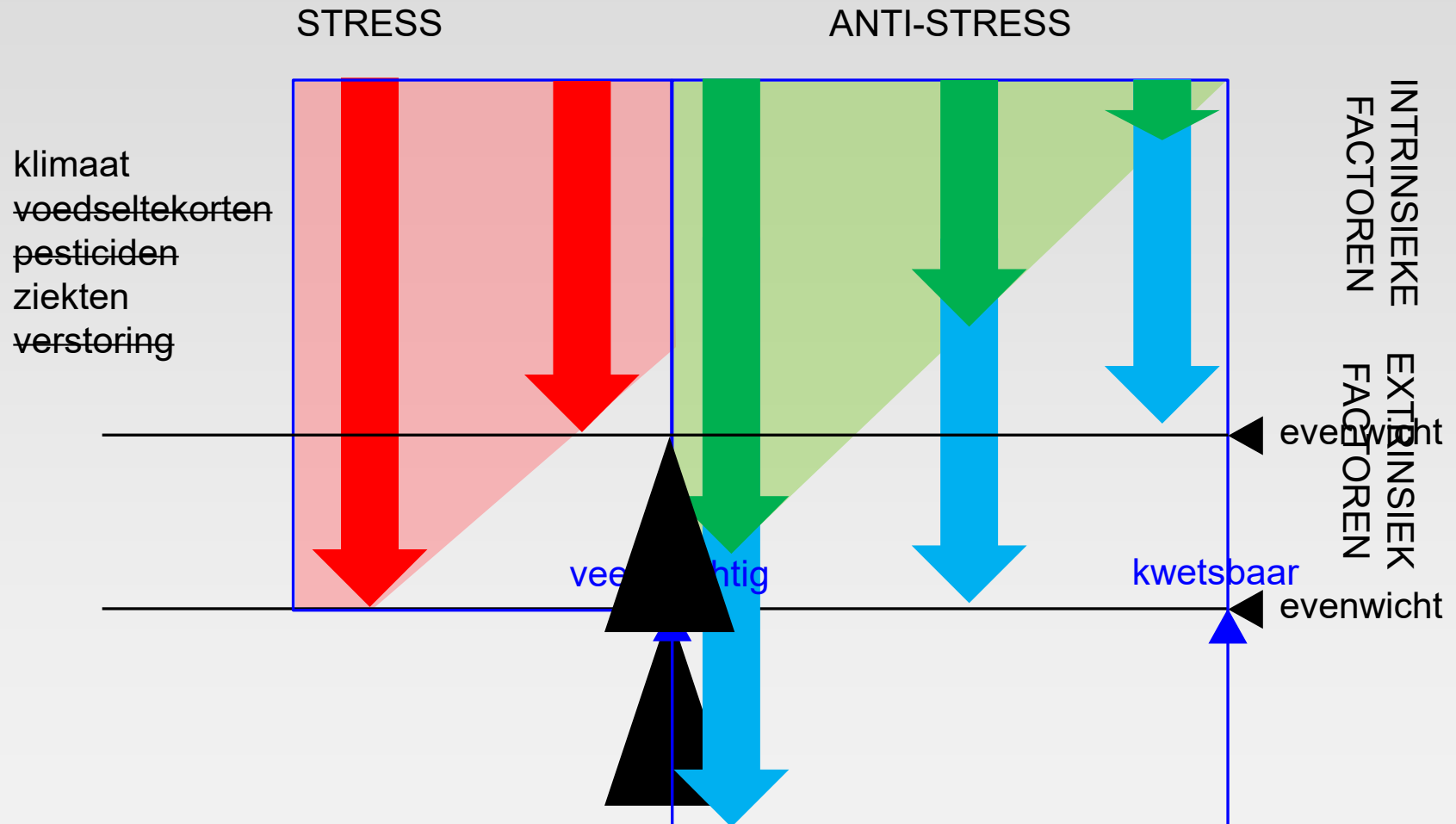
individuele opvolging kolonies en aangepaste interventies



Extra werkpunten



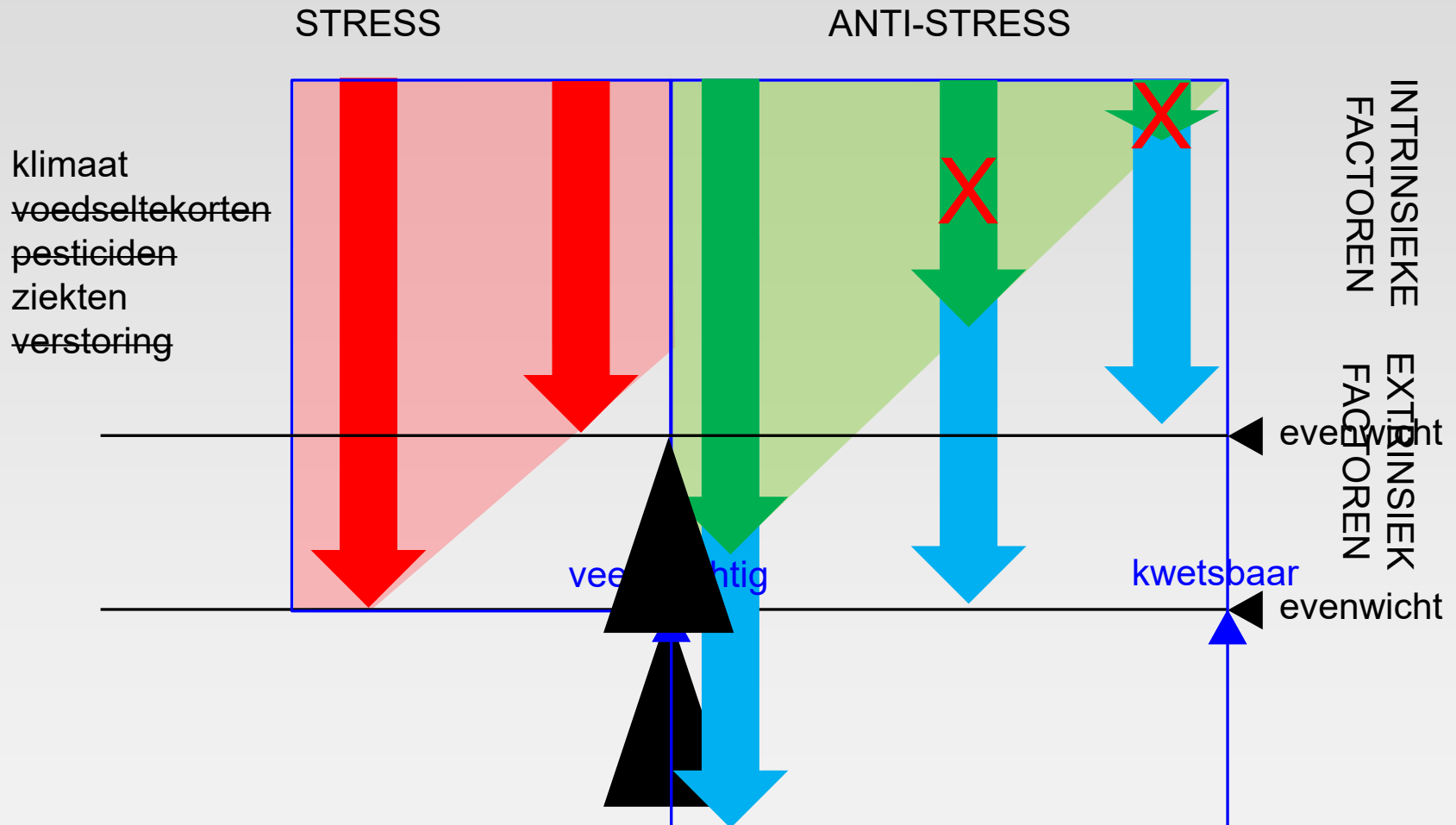
verlagen van het stress niveau



Extra werkpunten



selectie naar veerkrachtige bijen



Anders dan hoevedieren



- opstallen / opsluiten
- voedselaanbod
- ziekte beheersing
- overplaatsbaar
- profylaxe / vaccinatie
- diagnose / autopsie
- medicamenteuze behandeling
- focus op productiviteit
- bloedlijnen
- enge genetische diversiteit
- genetica los van omgeving





Wat hebben we geleerd vandaag?

werkpunten:

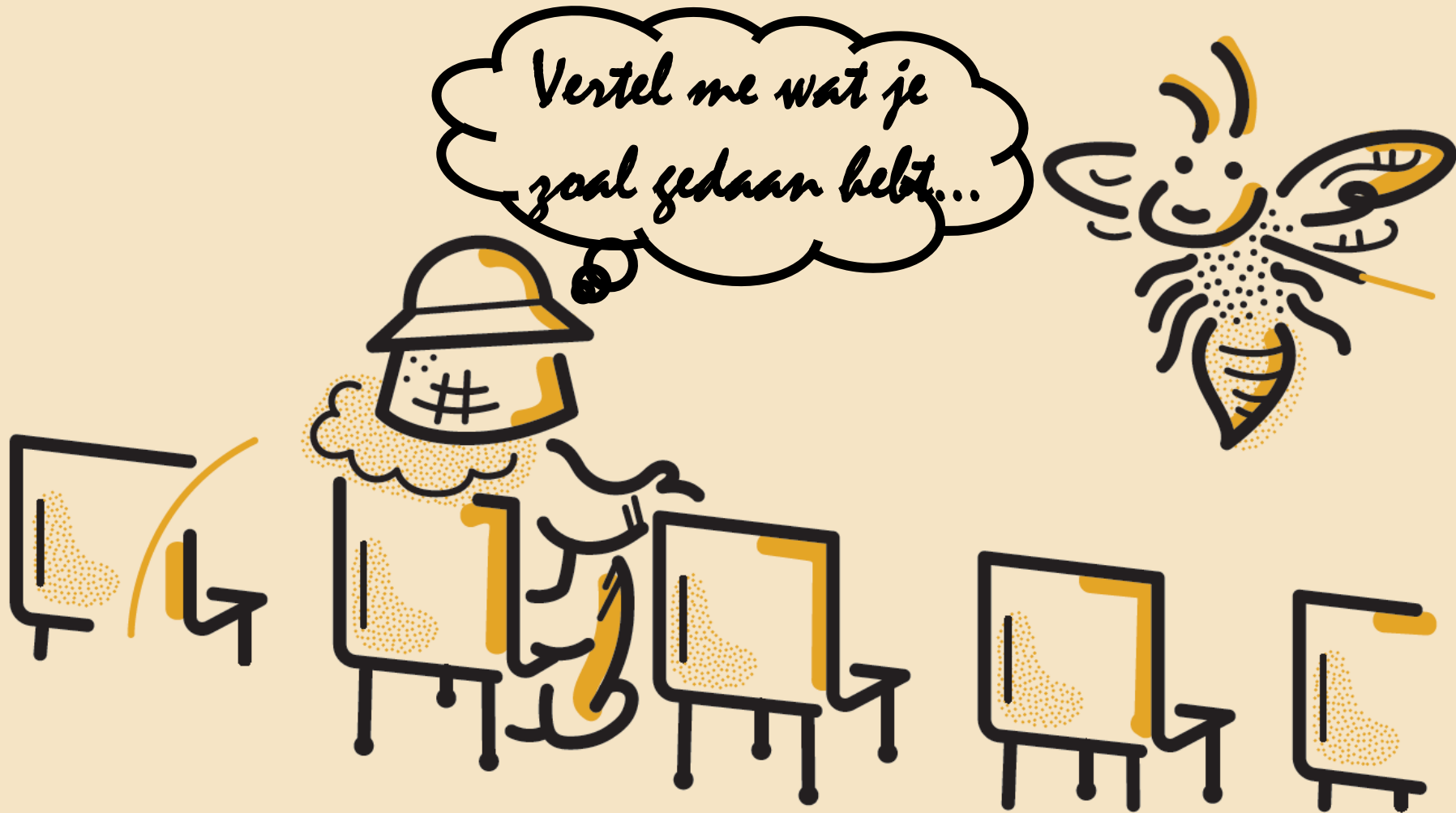
- individuele opvolging kolonies en aangepaste interventies
- verlagen van het stress niveau
- selectie naar veerkrachtige bijen door het uitsluiten van kwetsbare honingbijen (voor de nateelt)



Na 10 jaar is de puzzel bijna gelegd

- Werken aan de werkpunten
- Anders gaan imkeren
- Ontbrekende puzzelstukken
- Laatste stappen naar implementatie

Werken aan de werkpunten



Focus 1: Bijsturing bedrijfsvoering

- *uitgebalanceerde kolonie densiteit*
- *huisvesting verbeteren*
- *zuivere bijenwas*
- stress-luw imkeren
- introductie van een broedloze fase

Focus 2: Veerkracht herwinnen

- individuele opvolging volken
- selectie op defensieve kenmerken
- merker-gestuurde selectie
- Darwiniaanse selectie

Bepalen draagkracht van het drachtgebied en het voedseldelen met wilde bijen door modellering – Christopher Topping, Aarhus University (DK)

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dynamisch voedselbron-model voor het maken van een geschiktheidskaart voor bijenteelt en het voorspellen van het voedseldelen tussen HB en wilde bijen



Short introduction to ALMaSS

Alle undersider til ALMaSS findes kun på engelsk

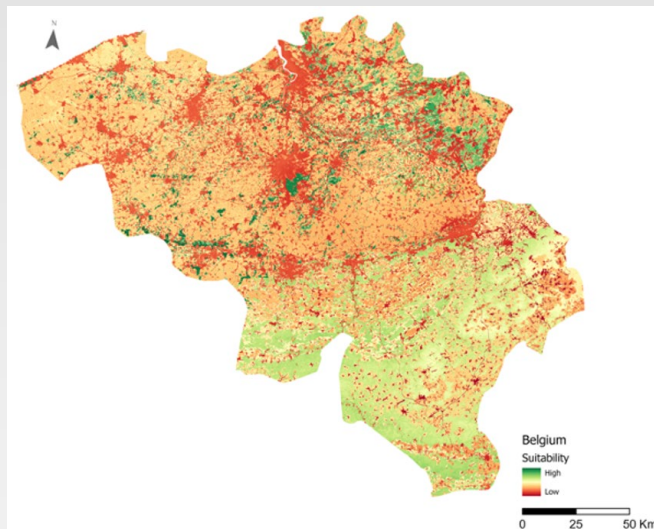
ALMaSS, The Animal, Landscape and Man Simulation System is a landscape scale simulation system for investigating the effect of changes in landscape structure and management on the population size and distribution of animals in the Danish landscape.

ALMaSS is since 2010 an **open-source open-science** project hosted on GitLab. The [ALMaSS project page](#) provides news, access to reprints and codes, and forums to discuss the ALMaSS project. Anyone interested in using or contributing to ALMaSS is encouraged to join GitLab and the ALMaSS project.

ALMaSS Overview

ALMaSS is an agent-based model system, which means that the animals are modelled as individuals (agents) which will move around inside a virtual landscape to breed and die much in the same way as the real animals do in their natural environment.

Apart from the detail often used in ALMaSS models, what sets this system apart from others is that from its conception it has utilized dynamic landscapes rather than static maps. A very substantial part of the system is therefore the modelling of environment that the animal models are placed into. See [landscape](#) for further details.

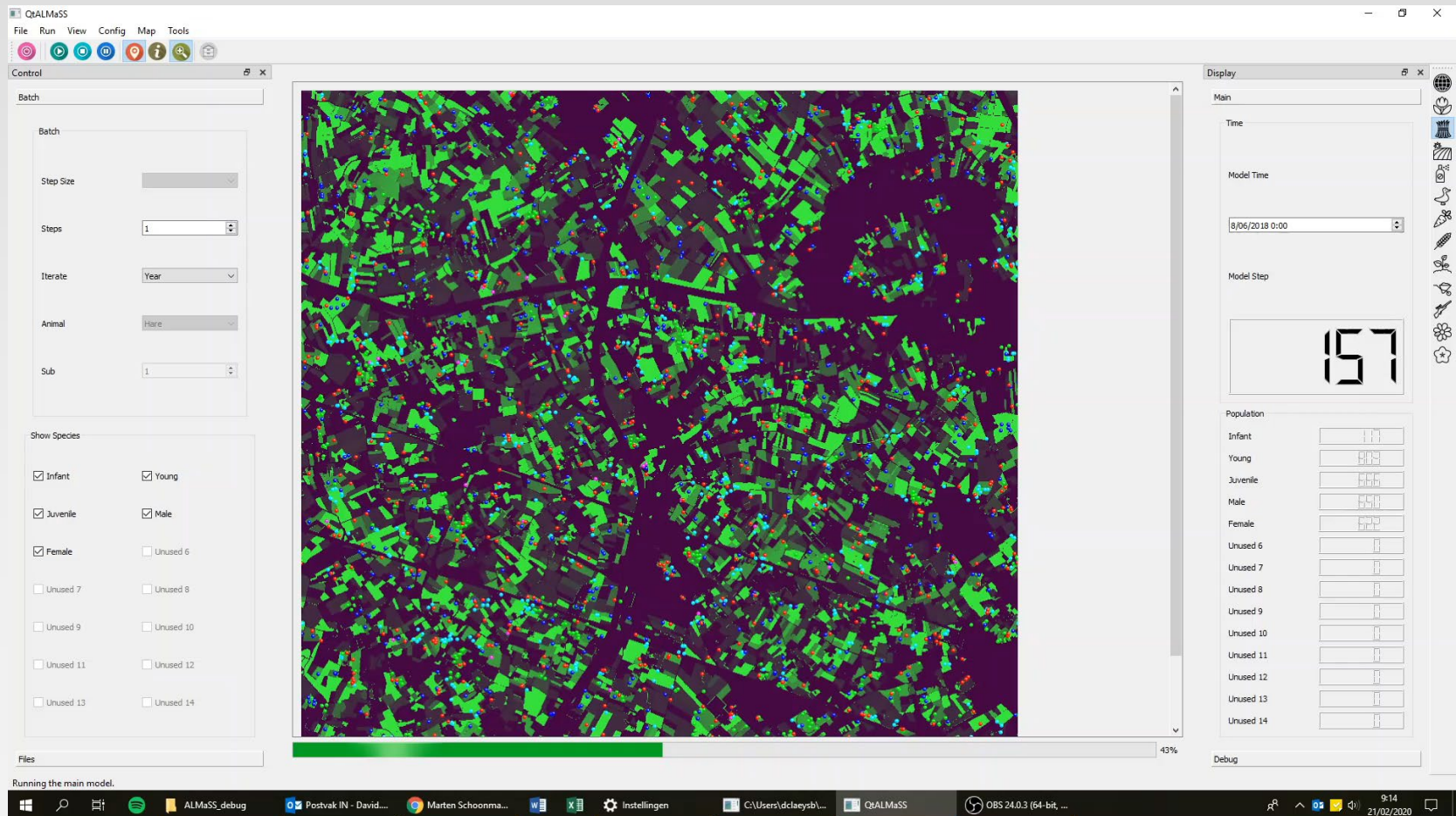


landschap geschiktheidskaart voor bijenteelt in België

ALMaSS in het Vlaamse landschap: Hazenpopulatie in een zich wijzigende landschap (biomassa) in Merelbeke

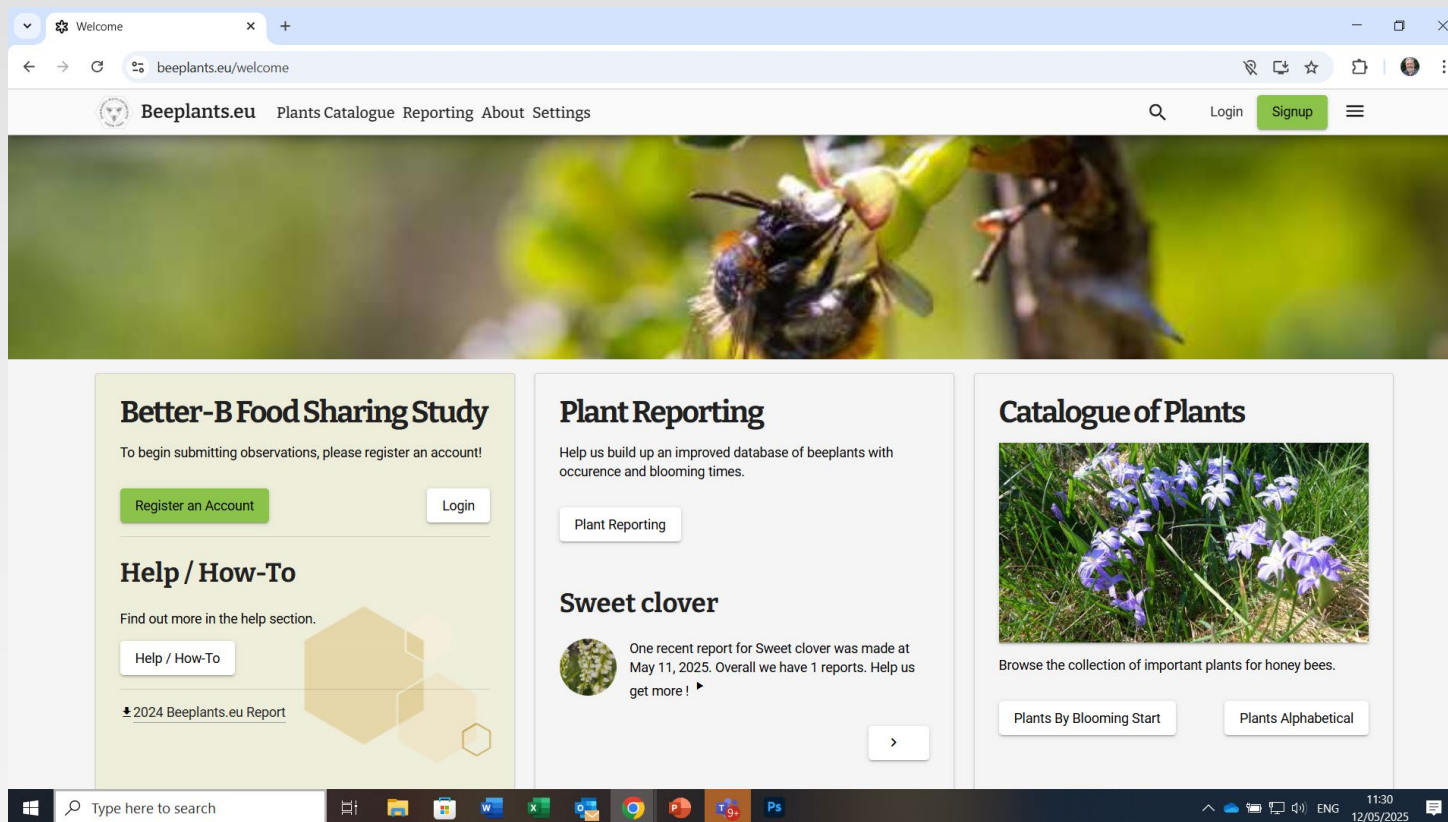
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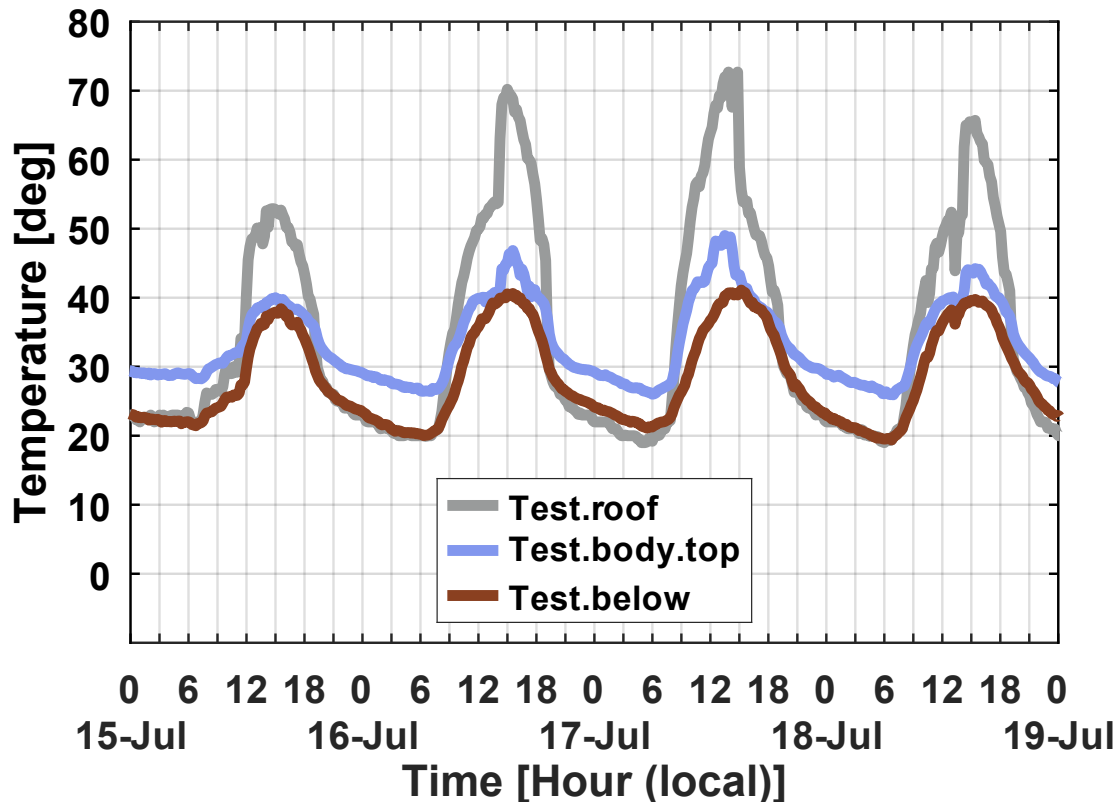
Burgerwetenschapstudie over voedseldelen tussen honingbijen en wilde bijen – Sjef van der Steen, zelfstandig consulent Alveus AB Consultancy, Oisterwijk (NL)

valideren van het dynamisch voedselbron-model door waarnemingen van burgers



Imkers gidsen bij de constructie van de bijenkasten vanuit een studie van de thermoregulatie van een lege/bevolkte bijenkast – Emmanuel Ruffio, Co-Actions, Bordeaux (FR)

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effect van
verschillende
materialen, verven en
coatings (vb.
afneembare witte kap
over het deksel)



Pesticiden en veterinaire medicatie in bijenwas: voorkomen, toxiciteit en risico voor de honingbijen – Claude Saegerman, Uliège (BE)



Volksgezondheid
Veiligheid van de Voedselketen
Leefmilieu



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Pesticide and veterinary drug residues in Belgian beeswax: Occurrence, toxicity, and risk to honey bees

Noémie El Agrebi^a, Kirsten Traynor^a, Olivier Wilmart^c, Simone Tosi^d, Laurent Leinartz^e, Ellen Dannaels^f, Dirk C. de Graaf^{g,h}, Claude Saegerman^{a,*}

^a Research Unit of Epidemiology and Risk Analysis Applied to Veterinary Sciences (URAEV-ELiège), Fundamental and Applied Research for Animal and Health (FARM) Center, Faculty of Veterinary Medicine, University of Liège, Quartier Viallet 2, Avenue de Crauthem 7A, B42, 4000 Liège, Sart Tilman, Belgium
^b Global Research Complexity Initiative, Arizona State University, Tempe, AZ, USA
^c Federal Agency for the Safety of the Food Chain (FSMC), Directorate General Policy, Staff Direction for Risk Assessment, Boulevard du Jardin Botanique 55, 1000 Brussels, Belgium
^d Epidemiology Unit, University Paris Est, ANSES (French Agency for Food, Environmental and Occupational Health and Safety) Animal Health Laboratory, Maitland-Orléans, France
^e Teaching Support Unit, Faculty of Veterinary Medicine, University of Liège, Quartier Viallet 2, Avenue de Crauthem 5C-5D, B41, 4000 Liège, Sart Tilman, Belgium
^f Faculty of Sciences, Hainaut Valley, Ghent University (UGent), Coupure 287 323, 9000 Ghent, Belgium
^g Faculty of Sciences, Laboratory of Molecular Entomology and Bee Pathology, Ghent University (UGent), Coupure 287 52, 9000 Ghent, Belgium

HIGHLIGHTS

- Pesticide levels in brood comb, recycled comb, honey comb, and cappings were compared.
- 54 different pesticide and veterinary drug residues were found in the four types of beeswax.
- In-hive applied or high lipophilic residues are more likely to be found in beeswax.
- A statistically significant influence of chlorfenvinphos on bee mortality was found.
- Cappings wax was substantially less contaminated.

GRAPHICAL ABSTRACT



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Beeswax
Pesticide
Residues
Veterinary drug

ABSTRACT

Pesticide and veterinary drug residues are one of the stress factors affecting bee health and mortality. To investigate the occurrence, the concentration and the toxicity risk to bees of pesticide residues in four different types of beeswax (brood comb wax, recycled comb wax, honey comb wax, and cappings wax), 182 samples were collected from apiaries located all over the Belgian territories, during spring 2016 and analyzed by LC-MS/MS and GC-MS/MS for the presence of 294 chemical residues. The toxicity risk to bees expressed as the Hazard Quotient (HQ) was calculated for each wax sample, according to two scenarios with different toxicological LD₅₀ values. Residues showing the highest prevalence were correlated to bee mortality in a multivariate logistic regression model and a risk-based model was used to predict colony bee mortality. Altogether, 54 different pesticide and veterinary drug residues were found in the four types of beeswax. The residues with a higher likelihood to be retained in beeswax are applied in-hive or with a high lipophilic nature. The multivariate logistic regression model showed a statistically significant influence of chlorfenvinphos on bee mortality. All our results indicated that cappings wax was substantially less contaminated. This national survey on beeswax contamination provides guidelines on the re-use of beeswax by beekeepers and shows the necessity to introduce maximum residue levels.

* Corresponding author.
E-mail address: claudio.saegerman@uliege.be (C. Saegerman).

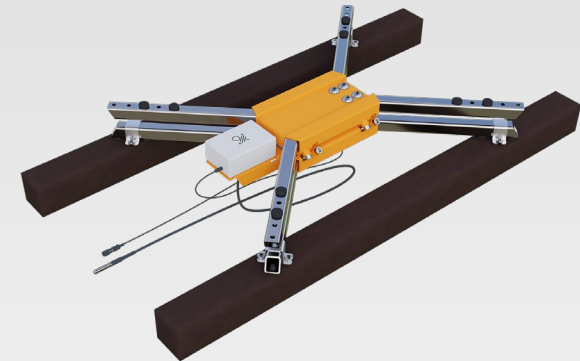
Individuele opvolging bijenvolken



Het gebruik van de digitale bijenkast in de bijenteelt – Ezra Jacobs, Nederlandse stichting BEEP (NL)

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||| B-GOOD



geautomatiseerde meting van
gewicht, temperatuur en geluid

algoritmen ontwikkelen om datastroom te verwerken en de imker te verwittigen bij problemen

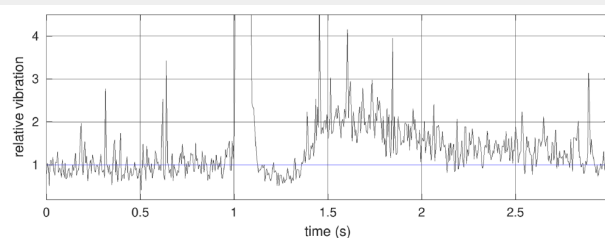
Vibraties in de bijenkast in relatie tot de gezondheid van het volk – Martin Bencsik, Nottingham Trent University (UK)
(voordracht in het Engels)

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veranderingen in het vibrationele patroon na
een artificiële stimulatie

bijenkasten met
stimulator en ontvanger



vibrationele patroon

scientific reports

Quantitative assessments of honeybee colony's response to an artificial vibrational pulse resulting in non-invasive measurements of colony's overall mobility and restfulness

Martin Bencsik^{1,2}, Adam McVeigh³, David Claeys Bouvaert⁴, Nuno Capela⁴, Frederick Penny⁵, Michael Ian Newton⁶, José Paulo Sousa⁴ & Dirk C. de Graaf¹

In this work we aim to provide a quantitative method allowing the probing of the physiological status of honeybee colonies by providing them with a gentle, short, external artificial vibrational shockwave, and recording their response. The knock is provided by an external electromagnetic shaker attached to the outer wall of a hive, driven by a computer with a 0.1 s long, monochromatic vibration at 340Hz set to an amplitude that occasionally yields a mild response from the bees, recorded by an accelerometer placed in the middle of the central frame of the colony. To avoid habituation, the stimulus is supplied at randomised times, approximately every hour. The method is pioneered with a pilot study on a single colony housed indoors, then extended onto eight outdoors colonies. The results show that we can quantitatively sense the colony's overall mobility, independently from another physiological aspect, which is phenomenologically explored. Using this, a colony that is queenless is easily discriminated from the others.

European honeybee colonies establish themselves in natural and man-made dark cavities, and cannot usually be seen unless the beekeeper inspects the hive by opening it invasively. Although the traffic of bees at the entrance of the hive gives an indication of its status, in the wintertime all foraging can cease for weeks or even months, and it is not even possible to tell whether the colony is alive or dead. Nowadays a thermal camera can be used to distinguish alive, warmer colonies from dead ones, but in the past many beekeepers have been simply knocking on their hives, with their hand, to check and listen for a positive buzzing response, indicating the liveliness of the colony.

The potential relevance of this simple test has never been investigated properly, even though it perhaps holds a key to non-invasively assess at least one aspect of the overall physiological status of the colony. Indeed, knocking on the hive, in order to then assess the detected response can be seen as exploiting one of the super-organisms' reflex arc.

Usually undertaken on vertebrates, the reflex arc test requires a stimulus to be provided to the living organism, resulting in a 'response' that can be measured quantitatively. As the response is achieved through a neural pathway (which may or may not require the brain), its features (i.e. magnitude, time duration, etc.) often yield an assessment of an aspect of the status of the organism's central nervous system, reflecting a particular detail of its physiological status. Since the reflex arc is involuntary, the assessment is free from subjective bias. Such tests must however not be undertaken at extremely regular times or in too close succession, in order to avoid habituation in the animal under investigation.

¹Nottingham Trent University, Nottingham, UK. ²Harry Butler Institute, Murdoch University, Perth, Australia. ³Honeybee Valley, Ghent University, 9000 Ghent, Belgium. ⁴Centre for Functional Ecology, Department of Life Sciences, Associated Laboratory TERRA, University of Coimbra, Coimbra, Portugal. ⁵email: martin.bencsik@ntu.ac.uk

Goede imkerspraktijken en selectie van interventies met laag stress-niveau op basis van een bevraging van imkers en experimentele stress-meting o.b.v. vibrationele patronen – Kamiar Torabi, UGent Honeybee Valley (BE)

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stress-meting o.b.v. vibrationele patronen na oxaalzuurbehandeling



bedruppeling



strips



sublimatie

Introductie van een broedvrije fase



De arrestraammethode – Ellen Danneels en Thomas Van Pelt,
UGent Honeybee Valley (BE)

broedvrije fase creëren door het opkooien van de koningin



 Project 'Onder arrest'

Stappenplan Arrestraammethode

Motivatie - biologie - planning - methode - samenwerking

Imkerteknik

Juni 2023

Auteurs: Dr. Ellen Danneels - Thomas Van Pelt

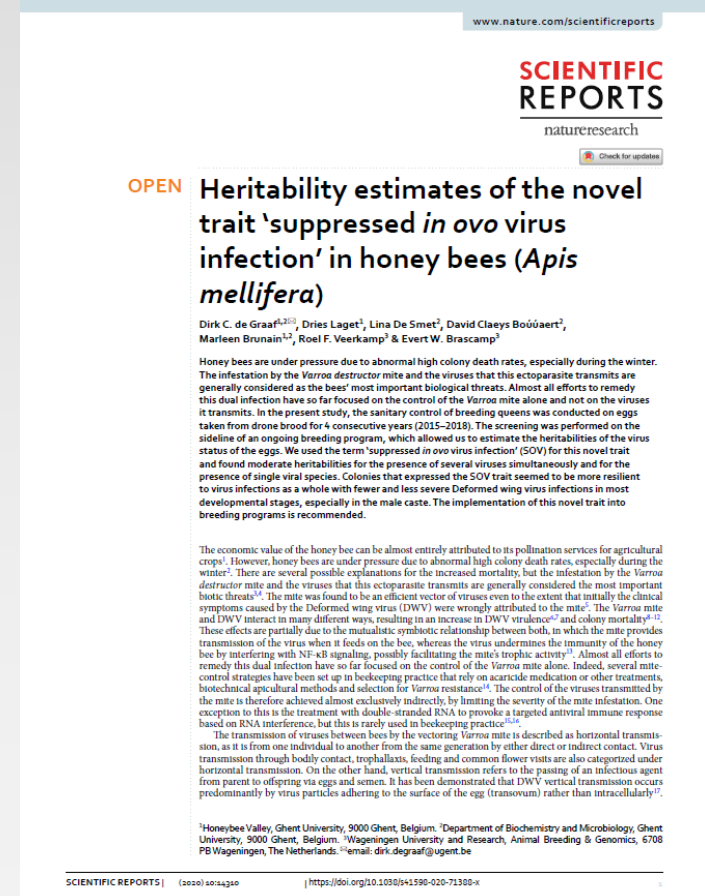


Tien jaar selectie naar virusresistente bijenvolken in Vlaanderen - Emma Bossuyt, UGent Honeybee Valley (BE)

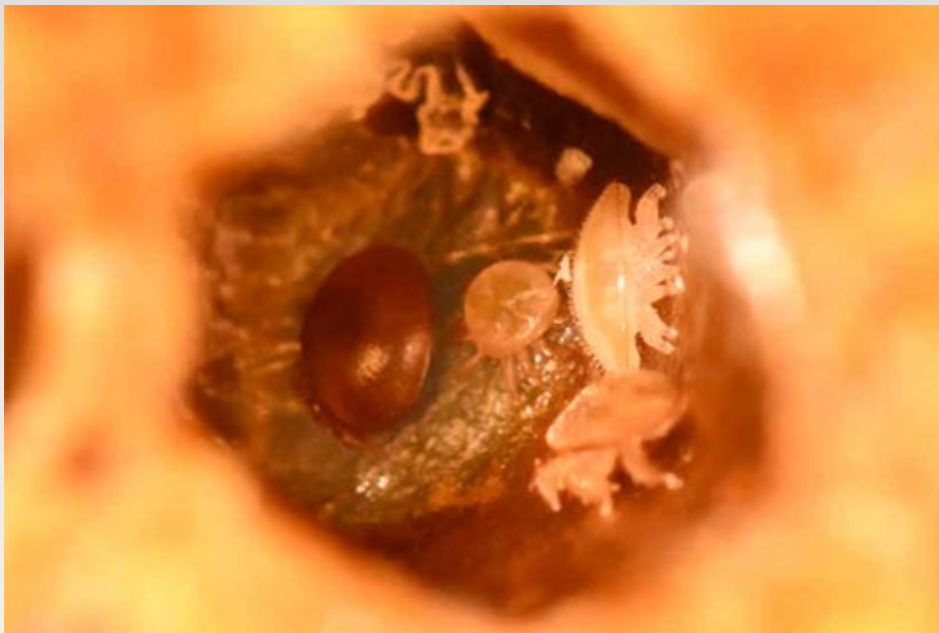


ei van de honingbij

bepaling van de viruslast van het ei om virus-resistente volken op te sporen

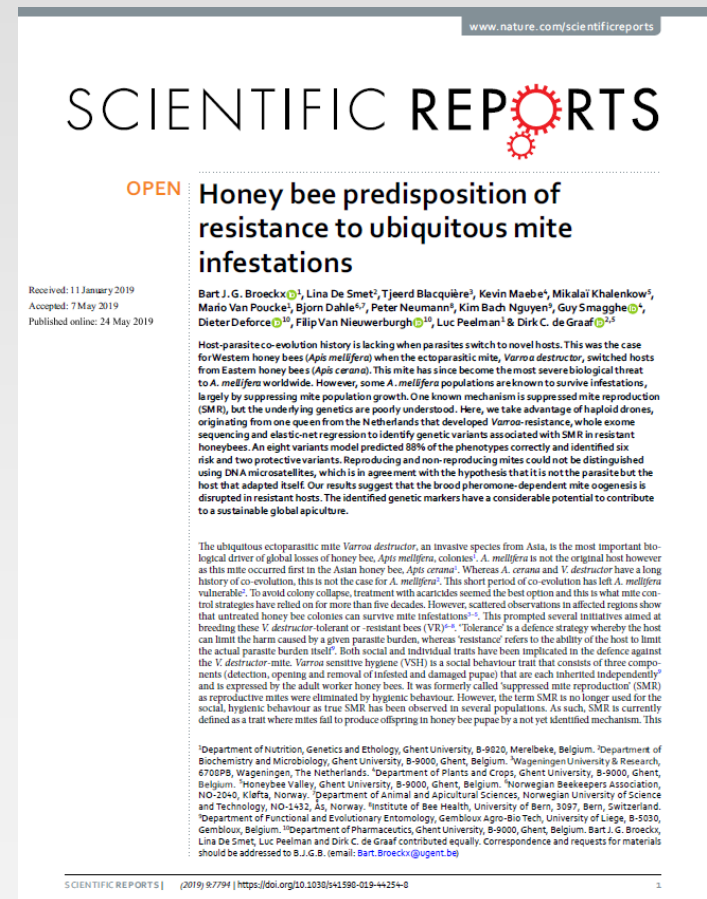


Merker-gestuurde selectie in de bijenteelt als hefboom naar veerkrachtige bijen - Regis Lefebvre, UGent Honeybee Valley (BE)



varroa-mijt met nakomelingen

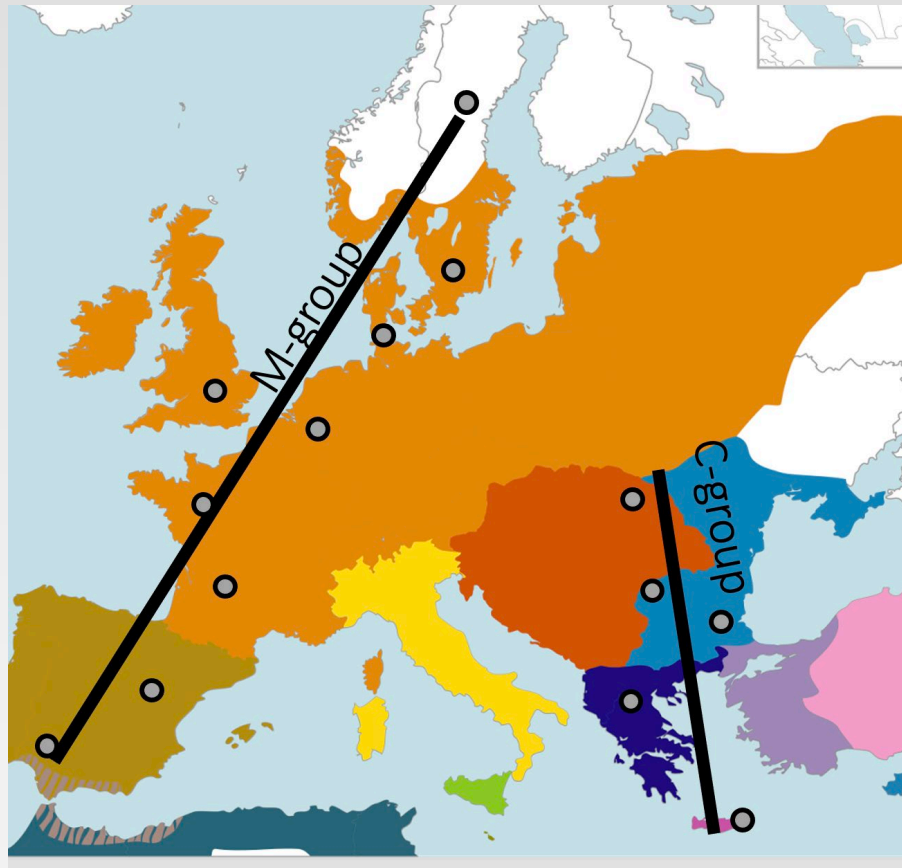
genetisch profilering om varroa-resistente
volken op te sporen



Genomische signatuur van lokale adaptatie



Whole Genome Sequencing van honingbijen verspreid over Europa om genen op te sporen die wijzen op lokale adaptatie -
Matthew Webster, University of Uppsala, Uppsala (SE)



Darwiniaanse selectie een optie?

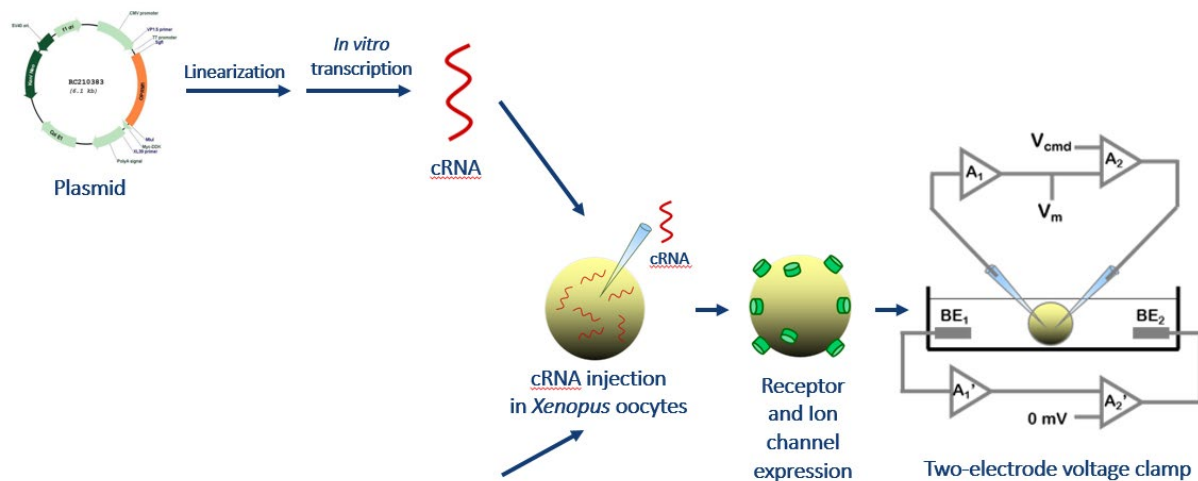


Simultane opstart van Darwiniaanse kweekprogramma's in 8 landen (inclusief BE: Honeybee Valley) – Séverine Kotrschal, Wageningen Research, Wageningen (NL)



overlevingsproef
zonder varroa-
behandeling

*Mutaties in pesticide-bindingsplaatsen en electrofysiologisch effect op het heterologe expressie systeem in *Xenopus* oocyten* - Gilles Verbinnen, UGent Honeybee Valley en KULeuven (Jan Tytgat)



Anaesthesia of
Xenopus laevis



Oocyte isolation by
partial ovariectomy

moleculaire oorsprong
van veerkracht
tegenover chemicaliën

Biol Invasions (2019) 21:2519–2528
https://doi.org/10.1007/s10530-019-02001-0



PERSPECTIVES AND PARADIGMS

Darwinian black box selection for resistance to settled invasive *Varroa destructor* parasites in honey bees

Tjeerd Blacquière  · Willem Boot · Johan Calis · Arrigo Moro  · Peter Neumann  · Delphine Panziera 

Apidologie (2025) 56:67

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Review article



Living in harmony with nature: the key to resilience of honeybees (*Apis mellifera*) in Africa

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Abstract – Managed honeybees play a crucial role in enhancing agricultural crop production and plant biodiversity conservation and ensuring food security. However, beekeepers, especially those in the Northern Hemisphere, are experiencing high honeybee colony losses, mainly due to the ectoparasitic mite *Varroa destructor*. This could threaten our future food security. The presence of *V. destructor* has also been reported in Africa; however, honeybees are less affected by the mite. Moreover, local beekeepers do not consider the mite as a threat to their colonies, and colonies survive without mites' treatment. Mite-resistant honeybee populations have also been reported in various parts of Europe, but they are limited in number and confined to specific regions. Therefore, understanding why mite-resilient honeybee populations are flourishing in many African countries is crucial for developing effective management strategies to improve honeybee health worldwide. Hence, this review synthesizes existing knowledge about the factors and traits that allow mite-resilient honeybee populations in Africa to flourish and aims to translate the insights gained from Africa into more effective approaches for managing the impact of *V. destructor* worldwide. The results suggest that African-derived honeybees are resilient to a broad set of threats including *V. destructor* because they live in harmony with nature. Resilience is attributed to a more bee-friendly environment, to better balanced colony densities, to beekeepers' management practices, and to the bee's behavioural adaptation and physiological and genetic traits. Nature-based beekeeping practices that allow natural selection to operate and maintain the genetic diversity of local honeybee subspecies are the key to their resilience against *V. destructor*.

African honeybees / Genetic diversity / Natural selection / Resilience / *Varroa destructor*

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scientific reports



OPEN Recapping and mite removal behaviour in Cuba: home to the world's largest population of *Varroa*-resistant European honeybees

Anais Rodríguez Luis¹, Isobel Grindrod², Georgiana Webb², Adolfo Pérez Piñeiro¹ & Stephen John Martin^{2,3} 

intrinsieke veerkracht herwinnen
is mogelijk

bijenteelt mag de harmonie van
het volk niet verstoren

Anders gaan imkeren



Harmonieuze Intensieve Bijenteelt:

bijsturen van intensieve bijenteelt o.b.v. wat we geleerd hebben van de kleinschalige imkerij (cfr. korf-imkeren en Afrikaanse bijenteelt)

= herstel van harmonie (binnen het volk en met zijn omgeving)

>> in de **reproductie-eenheid**

>> herstel intrinsieke veerkracht

= streven naar hoge productiviteit

>> in de **productie-eenheid**

>> recruteert uit de reproductie-eenheid



harmonieuze intensieve bijenteelt



natuurlijk imkeren (*tree beekeeping*)

Focus 1: Bijsturing bedrijfsvoering

- *uitgebalanceerde kolonie densiteit*
- *huisvesting verbeteren*
- *zuivere bijenwas*
- *stress-luw imkeren*
- *introductie van een broedloze fase*
- *beslissingsboom*

Focus 2: Veerkracht herwinnen

- *import-stop vreemde rassen*
- *vertrekken van brede basis*
- *individuele opvolging volken*
- *selectie op defensieve kenmerken*
- *merker-gestuurde selectie*
- *Darwiniaanse selectie*
- *selectie door cascade*

ONDERZOEK

bevestigen
verdienen



MOBILISATIE

communicatie
overtuigen



BELEID

advies
ondersteuning



EDUCATIE

kennisdeling
training



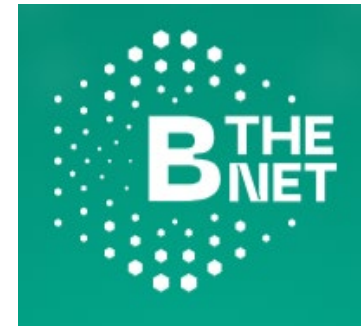


Vlaanderen
verbeelding werkt



Volksgezondheid
Veiligheid van de Voedselketen
Leefmilieu

fwo



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Research and Innovation SERI**



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and Innovation**

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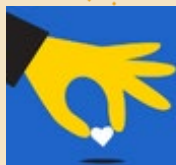
Prof. Luc Peelman (Universiteit Gent)
Prof. Martin Bencsik, The Nottingham Trent University, UK)
Prof. Christopher Topping (Aarhus University, DK)
Prof. Elzbieta Ziolkowska (Jagiellonian University, PL)
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Dr. Giovanni Formato (IZSLT, IT)
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