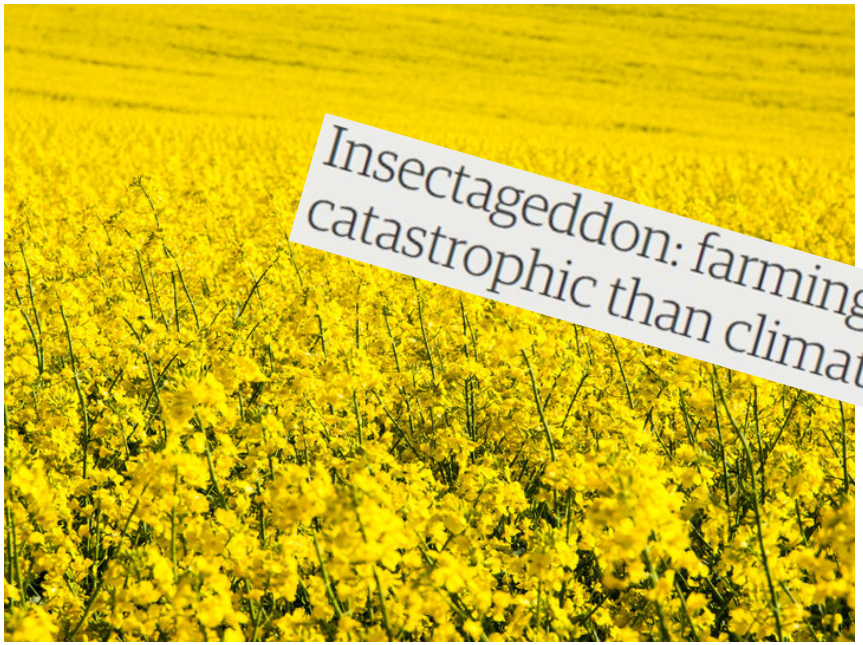
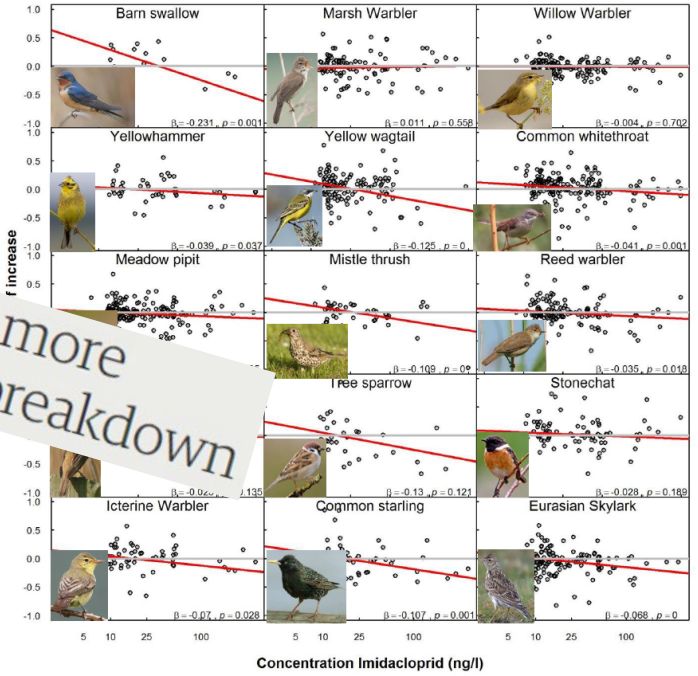
Can we escape the law of conservation of misery?

Dilemmas concerning rapid energy transformation and our biosphere





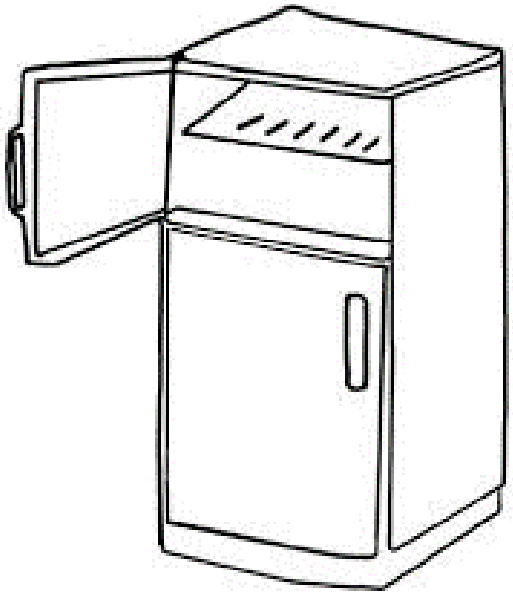
Jeroen P. van der Sluijs @Jeroen_vdSluijs

Senter for vitenskapsteori

Universiteit Utrecht

COÖPERATIEVE UNIVERSITEIT AMERSFOORT

Conservation of misery ("risk migration") classic example



- NH_3 -> acute health risk
- Propane -> explosion risk
- CFC -> ozone layer
  - *1987 Montreal Protocol*
- PFC -> greenhouse gas
  - *1997 Kyoto protocol*
- HFCs (HFO-1234yf)

Recent example

Review article

Non-exhaust PM emissions from electric vehicles

Victor R.J.H. Timmers [a, *], Peter A.J. Achten [b]

[a] University of Edinburgh, Edinburgh EH8 9YL, UK
[b] INNAS BV, 15 Nikkelstraat, 4823 AE Breda, Netherlands

H I G H L I G H T S

- A positive relationship exists between vehicle weight and non-exhaust emissions.
- Electric vehicles are 24% heavier than their conventional counterparts.
- Electric vehicle PM emissions are comparable to those of conventional vehicles.
- Non-exhaust sources account for 90% of PM_{10} and 85% of $PM_{2.5}$ from traffic.
- Future policy should focus on reducing vehicle weight.

Atmospheric Environment **134 (2016)** p.10-17

Types of risk migration / risk transformations

- Physical change
- Interpretational change

- Translational (replacing one risk with another)
- Diffusional (adding to a stock of risk)

Busby et al (2012)
https://www.tandfonline.com/doi/abs/10.1080/13669877.2011.601324

Survey results: selected cases

- Flat screen for computers and televisions
  - Energy efficiency / CO_2 reduction,
  - NF_3 world production increase (strong GHG)
- Spray Urethane Foam (PUR)
  - Floor insulation / energy efficiency
  - Sensitisation to Methylene Diphenyl Diisocyanate (MDI)
- Styrofoam (polystyrene)
  - Insulation . Energy efficiency;
  - persistence, bioaccumulation, styrene possible human carcinogen
- Ceramic tiles with (radioactive) zirconium
  - Zero energy buildings
  - Indoor exposure to ionizing radiation
- Biofuels
  - Renewable energy
  - Loss of biodiversity and landscape values
  - Land availability for food / intensification agriculture

https://dspace.library.uu.nl/handle/1874/314855

INSECTAGEDDON

2011

PNAS

Patterns of widespread decline in North American bumble bees

Sydney A. Cameron[a,1], Jeffrey D. Lozier[a], James P. Strange[b], Jonathan B. Koch[b,c], Nils Cordes[a,2], Leellen F. Solter[d], and Terry L. Griswold[b]

[a]Department of Entomology and Institute for Genomic Biology, University of Illinois, Urbana, IL 61801; [b]United States Department of Agriculture-Agricultural Research Service Pollinating Insects Research Unit, Utah State University, Logan, UT 84322; [c]Department of Biology, Utah State University, Logan, UT 84321; and [d]Illinois Natural History Survey, Institute of Natural Resource Sustainability, University of Illinois, Champaign, IL 61820

Edited* by Gene E. Robinson, University of Illinois, Urbana, IL, and approved November 24, 2010 (received for review October 3, 2010)

Bumble bees (*Bombus*) are vitally important pollinators of wild study in the United States identified lower genetic diversity and intensive nationwide surveys of >16,000 specimens. We show that the relative abundances of four species have declined by up to 96% and that their surveyed geographic ranges have contracted by 23–87%, some within the last 20 y. We also show that declining populations have significantly higher infection levels of the microsporidian pathogen *Nosema bombi* and lower genetic diversity compared

2017

RESEARCH ARTICLE

More than 75 percent decline over 27 years in total flying insect biomass in protected areas

Caspar A. Hallmann[1]*, Martin Sorg[2], Eelke Jongejans[1], Henk Siepel[1], Nick Hofland[1], Heinz Schwan[2], Werner Stenmans[2], Andreas Müller[2], Hubert Sumser[2], Thomas Hörren[2], Dave Goulson[3], Hans de Kroon[1]

1 Radboud University, Institute for Water and Wetland Research, Animal Ecology and Physiology & Experimental Plant Ecology, PO Box 9100, 6500 GL Nijmegen, The Netherlands, **2** Entomological Society Krefeld e.V., Entomological Collections Krefeld, Marktstrasse 159, 47798 Krefeld, Germany, **3** University of Sussex, School of Life Sciences, Falmer, Brighton BN1 9QG, United Kingdom

* c.hallmann@science.ru.nl

2018

In NL **181 of 358 bee species** on Red List: **at risk of extinction**

Abstract

Global declines in insects have sparked wide interest among scientists, politicians, and the general public. Loss of insect diversity and abundance is expected to provoke cascading effects on food webs and to jeopardize ecosystem services. Our understanding of the extent and underlying causes of this decline is based on the abundance of single species or taxonomic groups only, rather than changes in insect biomass which is more relevant for ecological functioning. Here, we used a standardized protocol to measure total insect biomass using Malaise traps, deployed over 27 years in 63 nature protection areas in Germany (96 unique location-year combinations) to infer on the status and trend of local entomofauna. Our analysis estimates a seasonal decline of 76%, and mid-summer decline of 82% in flying insect biomass over the 27 years of study. We show that this decline is apparent regardless of habitat type, while changes in weather, land use, and habitat characteristics cannot explain this overall decline. This yet unrecognized loss of insect biomass must be taken into account in evaluating declines in abundance of species depending on insects as a food source, and ecosystem functioning in the European landscape.

http://journals.plos.org/plosone/article/file?id=10.1371/journal.pone.0185809&type=printable

theguardian

UK world sport football opinion culture business lifestyle fashion environment tech travel all

home › opinion columnists letters editorials

Insects Opinion

Insectageddon: farming is more catastrophic than climate breakdown

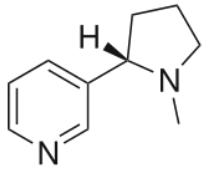
George Monbiot

The shocking collapse of insect populations hints at a global ecological meltdown

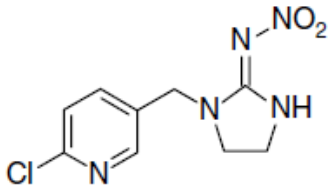
"The impact on wildlife of changes in farming practice (and the expansion of the farmed area) is so rapid and severe that it is hard to get your head round the scale of what is happening. A study published this week in the journal Plos One reveals that flying insects surveyed on nature reserves in Germany have declined by 76% in 27 years. The most likely cause of this Insectageddon is that the land surrounding those reserves has become hostile to them: the volume of pesticides and the destruction of habitat have turned farmland into a wildlife desert."

https://www.theguardian.com/commentisfree/2017/oct/20/insectageddon-farming-catastrophe-climate-breakdown-insect-populations

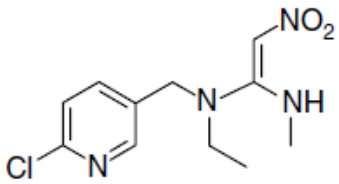
Neonicotinoids



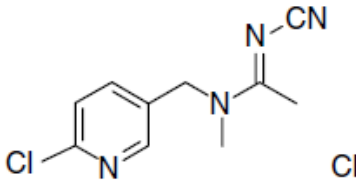
Nicotine



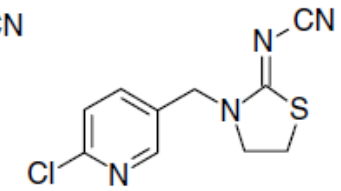
Imidacloprid (**1**)



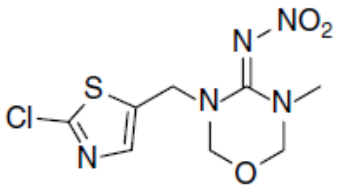
Nitenpyram (**2**)



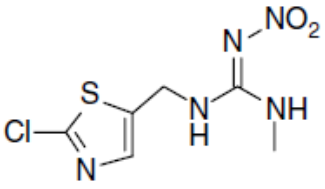
Acetamiprid (**3**)



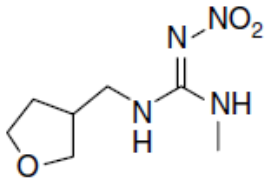
Thiacloprid (**4**)



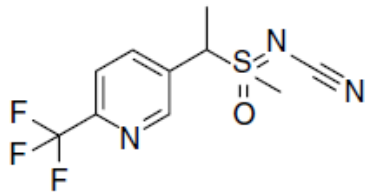
Thiamethoxam (**5**)



Clothianidin (**6**)



Dinotefuran (**7**)



Sulfoxaflor (**8**)

Systemic means:

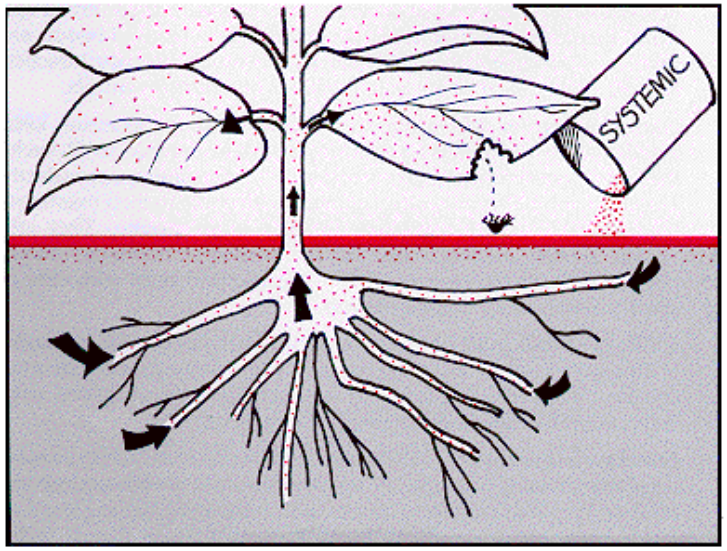
- **opposite of IPM: pre-emptive strike** in stead of last resort
- **convenience pesticides**

Imidacloprid + Thiamethoxam + Clothianidin in EU (before ban):

>200 products

>1000 allowed applications

http://www.tfsp.info/assets/WIA_2015.pdf



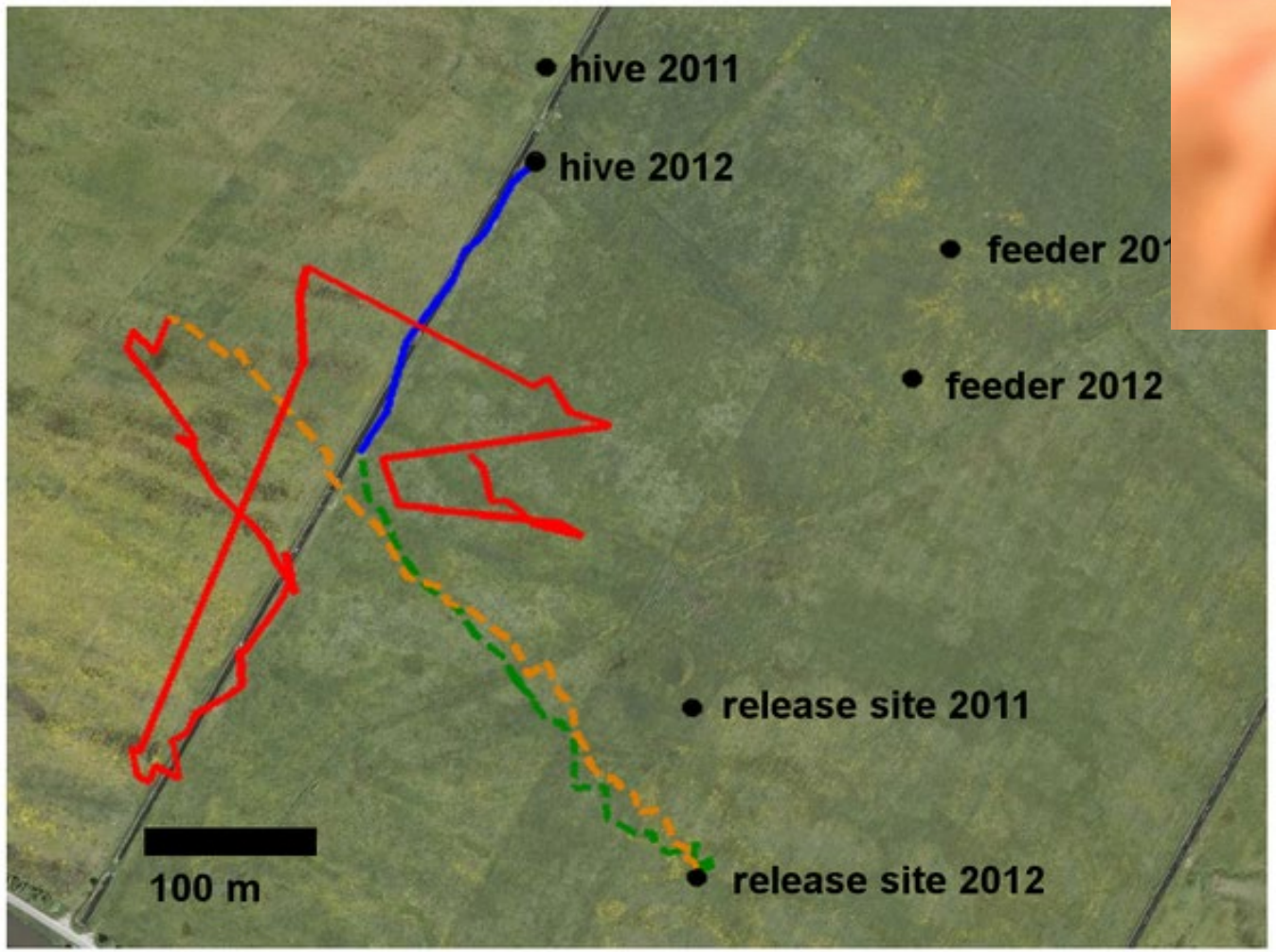
Systemic = crop takes it up into its plantsap: chemical makes plant toxic from inside

Toxicity of neonicotinoids

Pesticide	®	Use	LD50 (ng/honeybee)	Toxicity index relative to DDT
DDT	Dinocide	insecticide	27000	1
Amitraz	Apivar	insecticide / acaricide	12000	2
Coumaphos	Perizin	insecticide / acaricide	3000	9
Tau-fluvalinate	Apistan	insecticide / acaricide	2000	13.5
Methiocarb	Mesurol	insecticide	230	117
Carbofuran	Curater	insecticide	160	169
λ-cyhalothrin	Karate	insecticide	38	711
Deltamethrine	Decis	insecticide	10	2700
Thiamethoxam	Cruise	insecticide	5	5400
Fipronil	Regent	Insecticide	4.2	6475
Clothianidine	Poncho	Insecticide	4.0	6750
Imidacloprid	Gaucho	Insecticide	3.7	7297

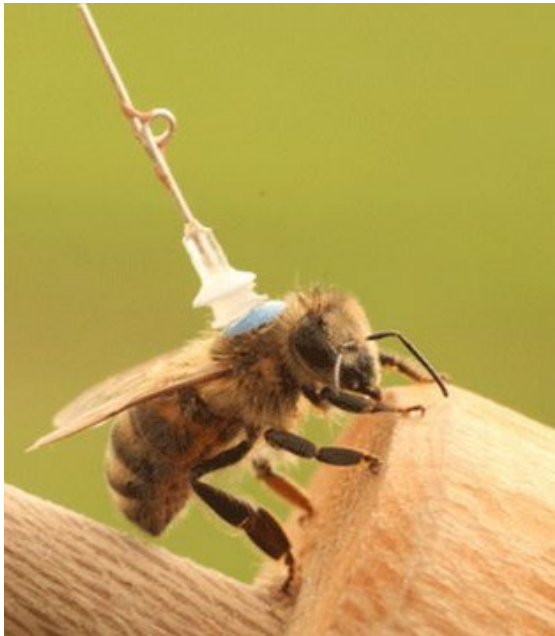
Toxicity of insecticides to honeybees compared to DDT. The final column expresses the toxicity relative to DDT. (Source: Bonmatin, 2009)
http://www.bijensterfte.nl/images/Bonmatin-conclusions-sentinelle-gb-2009.pdf

Radar-tracking experiment Randolf Menzel:
Bees exposed to neonicotinoids loose orientation



Yellow-Red
Thiacloprid-bees

Green-Blue
Control bees



Fischer J, Müller T, Spatz A-K, Greggers U, et al. (2014) Neonicotinoids Interfere with Specific Components of Navigation in Honeybees. PLoS ONE 9(3): e91364. doi:10.1371/journal.pone.0091364
http://www.plosone.org/article/info:doi/10.1371/journal.pone.0091364

PLOS | ONE

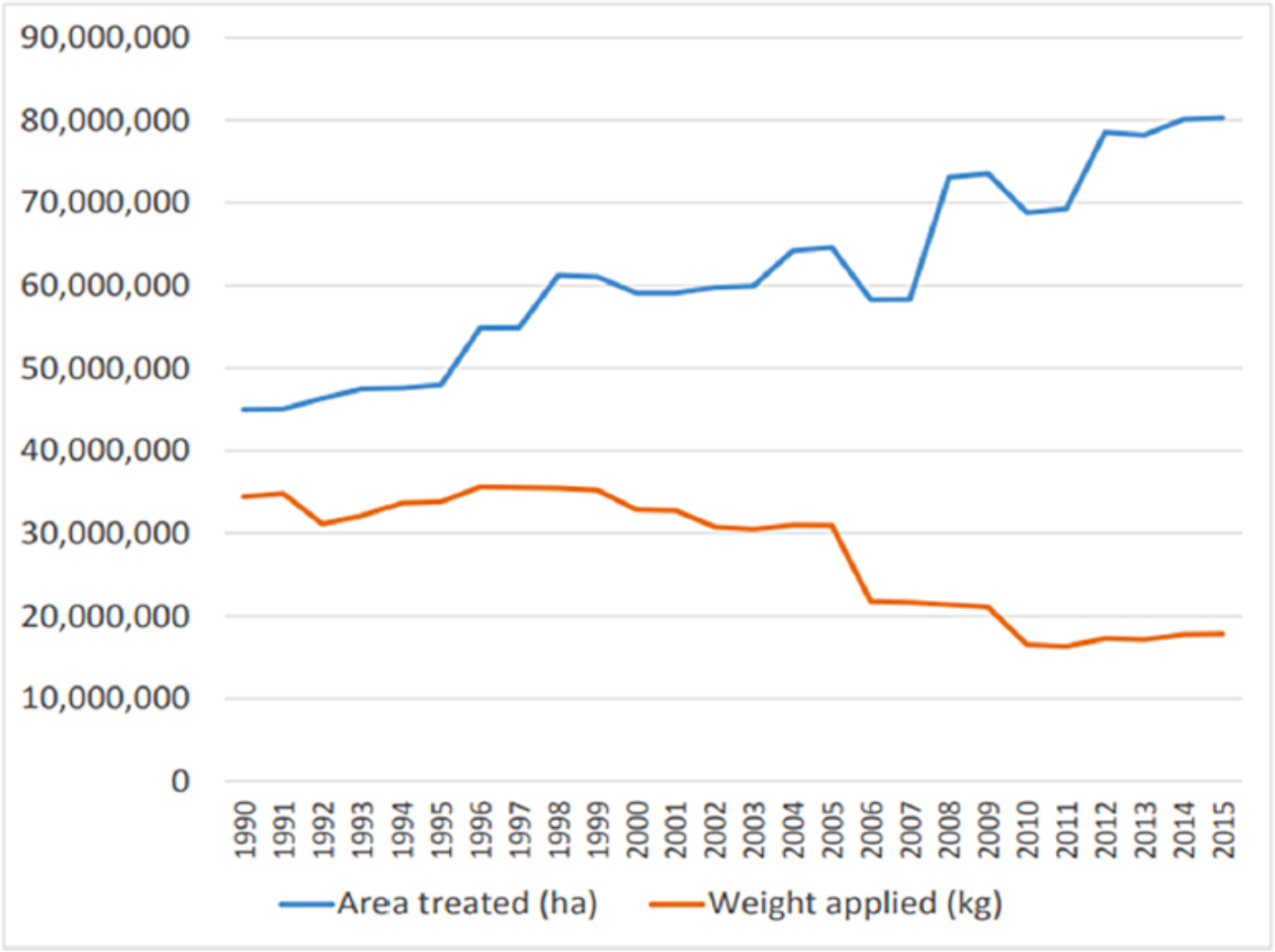


Figure 1 Area of crop treated (blue line, hectares) and mass of pesticide applied (red line, kilograms) from 1990 to 2015. The total area of crop remained approximately constant at 4.6 million hectares. In 1990 each hectare of cropped land on average received a total of 7.5 kg of pesticide active ingredient delivered in 9.8 applications. By 2015 each hectare of land received 3.9 kg of pesticide in 17.4 applications.

Full-size DOI: 10.7717/peerj.5255/fig-1

https://peerj.com/articles/5255/

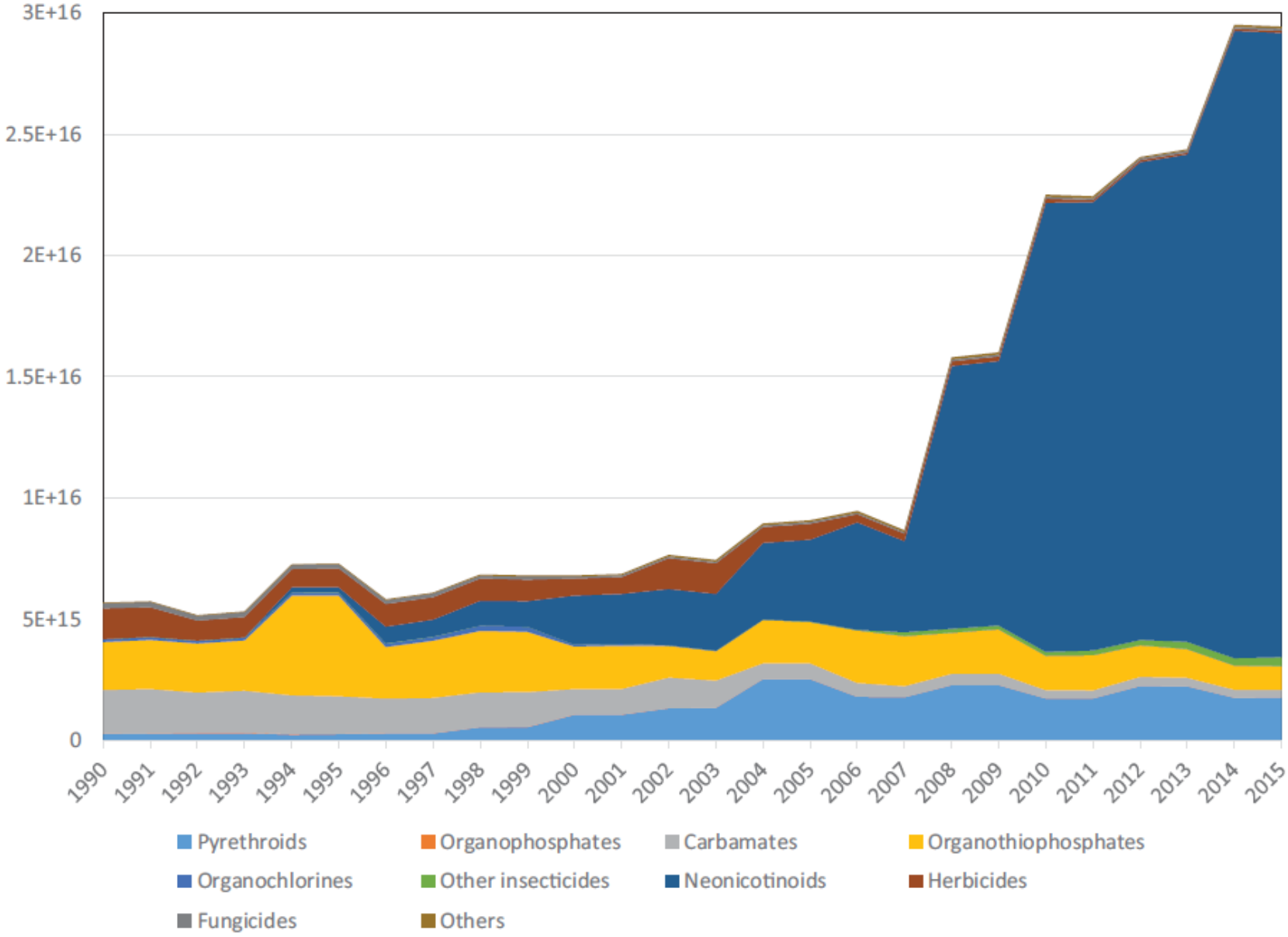


Figure 2 Potential number of honey bee LD_{50}s in pesticides applied to Great British farmland each year.

Full-size DOI: 10.7717/peerj.5255/fig-2

https://peerj.com/articles/5255/

Worldwide integrated assessment on systemic pesticides

Global collapse of the entomofauna: exploring the role of systemic insecticides

2014: Eight scientific papers (154 pages)

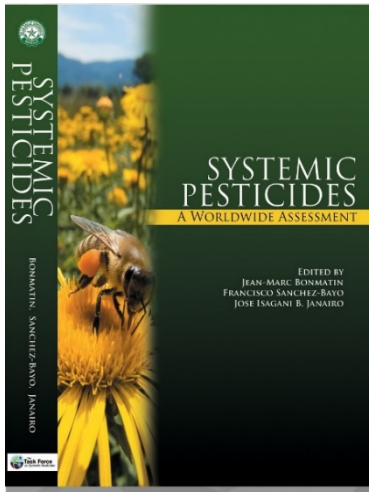
- **Five years study**
- **First meta-analysis on neonicotinoids and fipronil**
- **29 scientific authors (no conflict of interest)**
- **Comprehensive analysis (1121 publications & data from companies)**
- **Published in *Environmental Science and Pollution Research*, 2015**

DOI: 10.1007/s11356-014-3220-1
DOI: 10.1007/s11356-014-3180-5
DOI: 10.1007/s11356-014-3332-7
DOI: 10.1007/s11356-014-3628-7
DOI: 10.1007/s11356-014-3470-y
DOI: 10.1007/s11356-014-3277-x
DOI: 10.1007/s11356-014-3471-x
DOI: 10.1007/s11356-014-3229-5

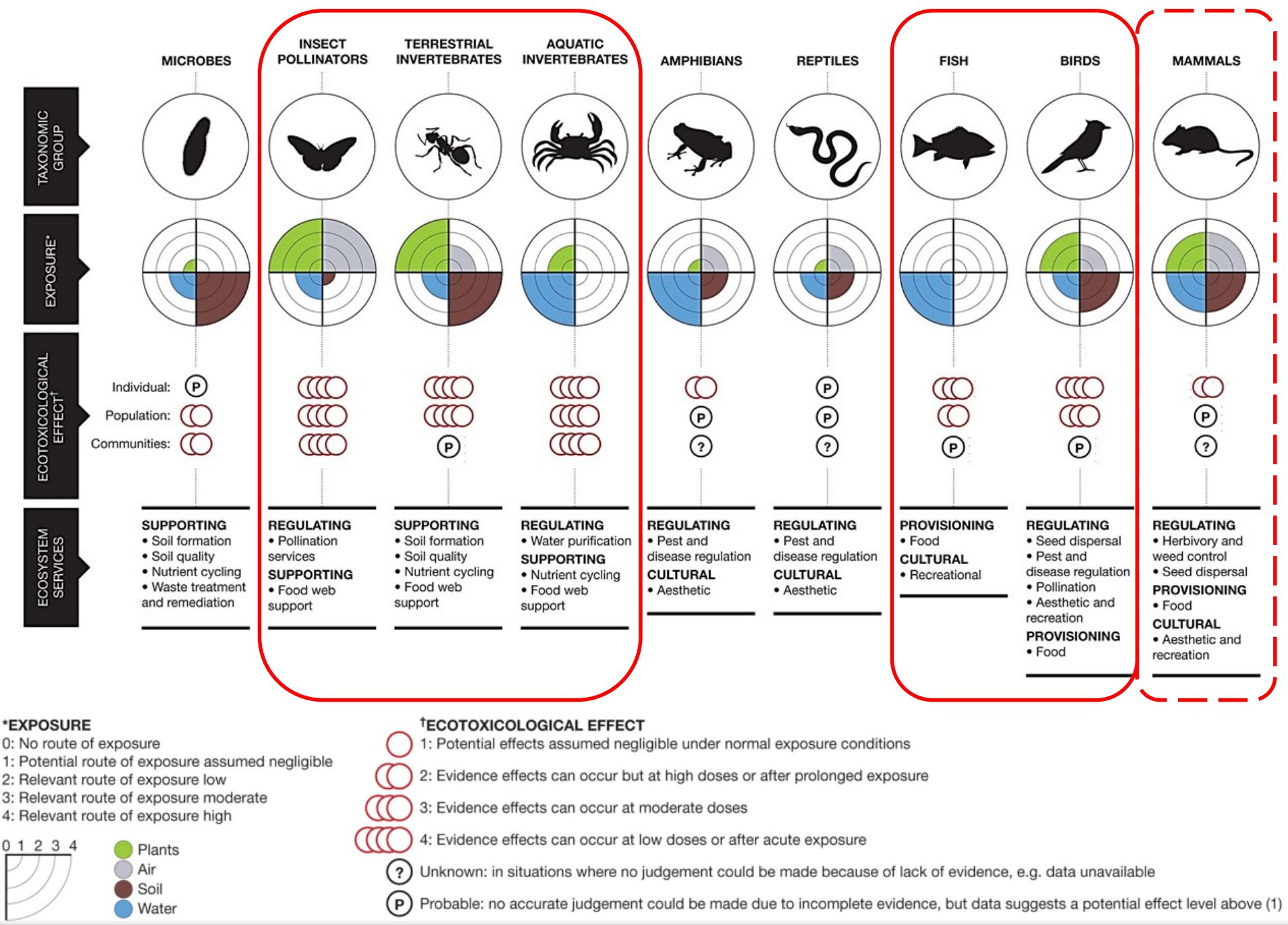
http://www.tfsp.info/assets/WIA_2015.pdf

2017-2018: Three new scientific papers (107 pages)

- **Updated meta-analysis on neonicotinoids and fipronil**
- **24 scientific authors (no conflict of interest)**
- **Comprehensive analysis (700 additional publications)**
- **3 main chapters:**
  - **Exposures & Metabolism** — DOI:10.1007/s11356-017-0394-3
  - **Impacts & Ecosystems** — DOI: 10.1007/s11356-017-0341-3
  - **Resistances & Alternatives** — DOI: 10.1007/s11356-017-1052-5



Slide by: Dr. JM Bonmatin (CNRS) France

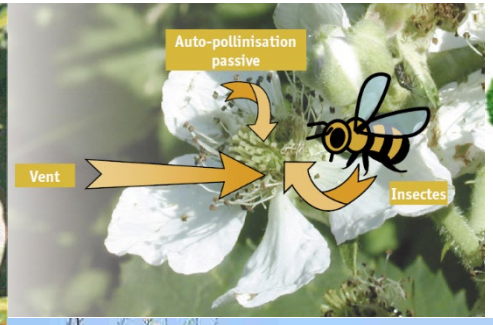


Pisa et al. 2017 https://link.springer.com/article/10.1007/s11356-017-0341-3

World wide: 25000 bee species; EU 1965
In NL about 350 bee species, 181 of them are on the Red List / at risk of extinction

The importance of bees

- 90 major crops (35% world food production volume) depend on pollinators
- Key nutrients: 90-100% from pollinator mediated crops (vit C, antioxidants, lycopene, β-tocopherol, vit A and folic acid)
- Value in Europe: 14.2 billion Euro / yr
- 94% of all flowering plants on earth depends on 25000 bee species for reproduction and evolution



Some crops pollinated by bees[3]

Alfalfa
Apple
Almond
Artichoke
Asparagus
Blackberry
Blueberry
Broccoli
Brussels sprouts
Cabbage
Cacao
Cantaloupe
Carrot
Cashew
Cauliflower
Celery
Cherry
Citrus
Dill
Eggplant/ Aubergine
Fennel
Garlic
Kale
Kola nut
Leek
Lychee
Macadamia
Mango
Mustard
Nutmeg
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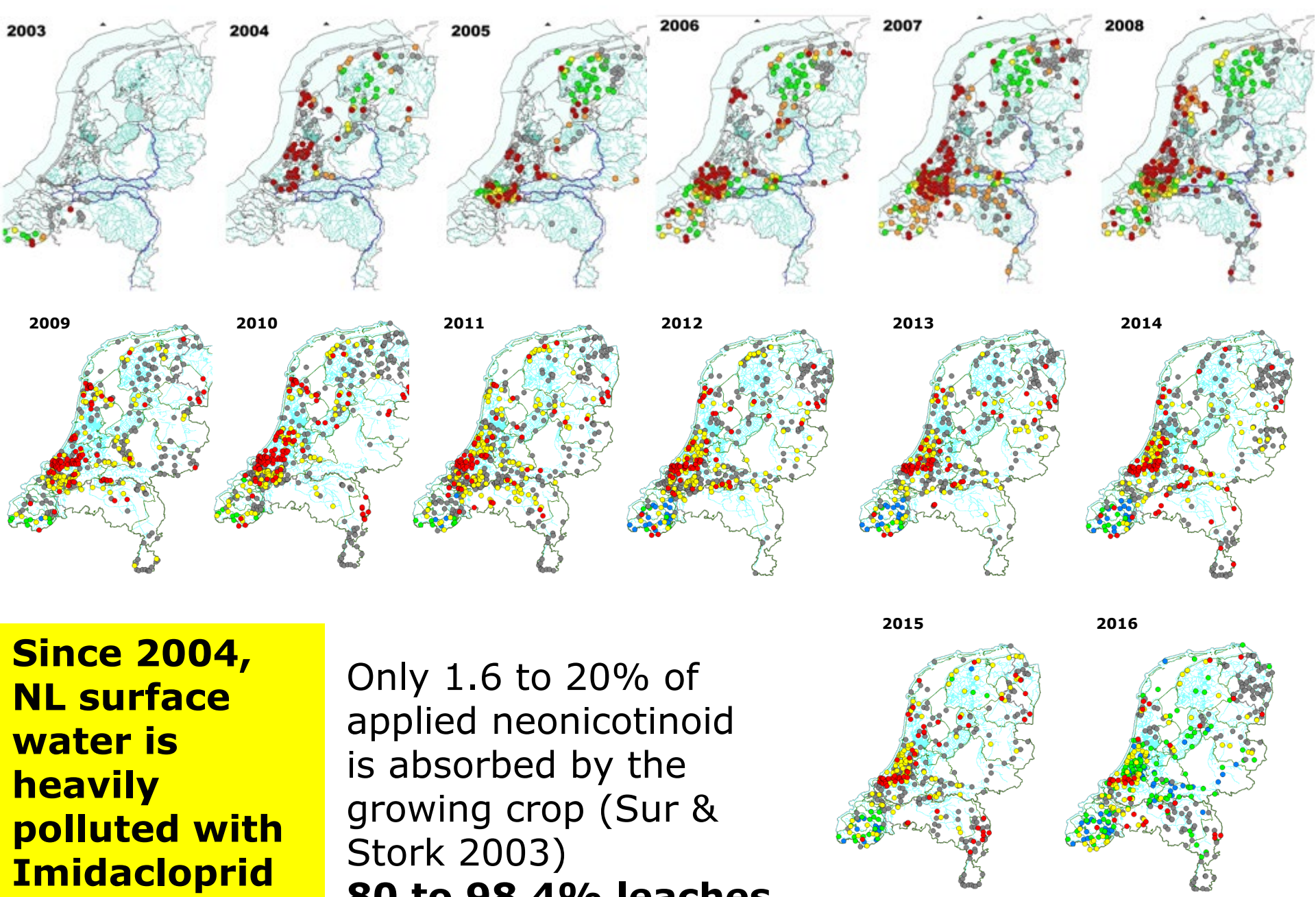
Peach
Pear
Plum
Pumpkin
Raspberry
Sapote
Squash
Sunflower
Tangerine
Tea
Watermelon



Since 2004, NL surface water is heavily polluted with Imidacloprid

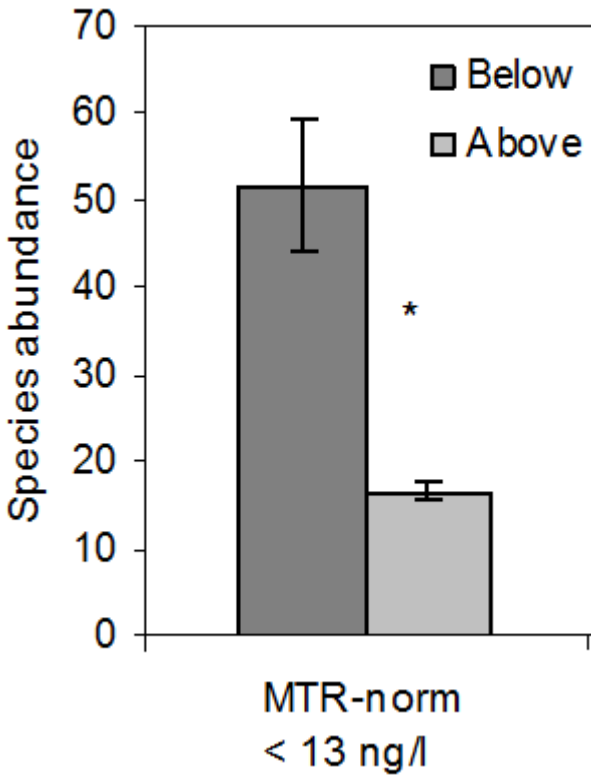
www.bestrijdingsmiddelenatlas.nl

Only 1.6 to 20% of applied neonicotinoid is absorbed by the growing crop (Sur & Stork 2003)

80 to 98.4% leaches to soil & water!

Findings on aquatic ecosystems

- 45% of all samples (*n*=9037) on 801 locations: imidacloprid exceeds MTR (>13 ng/l)
- **70%** reduction in macrofauna abundance in polluted water
- Permanent leaching of Imidacloprid year round from fields to surface water
- Meeting MTR requires reduction of use by at least 90%



https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0062374

nature International weekly journal of science

LETTER

doi:10.1038/nature13531

Declines in insectivorous birds are associated with high neonicotinoid concentrations

Caspar A. Hallmann[1,2], Ruud P. B. Foppen[2,3], Chris A. M. van Turnhout[2], Hans de Kroon[1] & Eelke Jongejans[1]

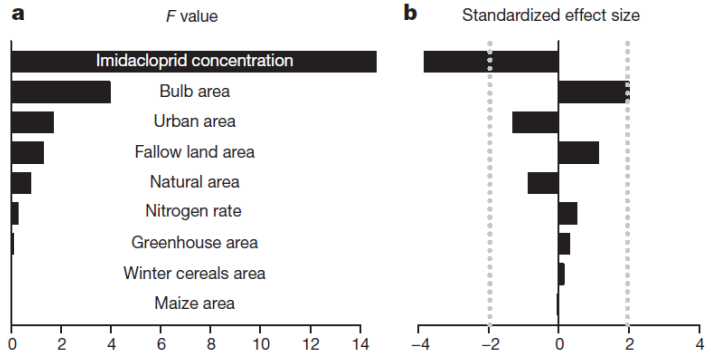
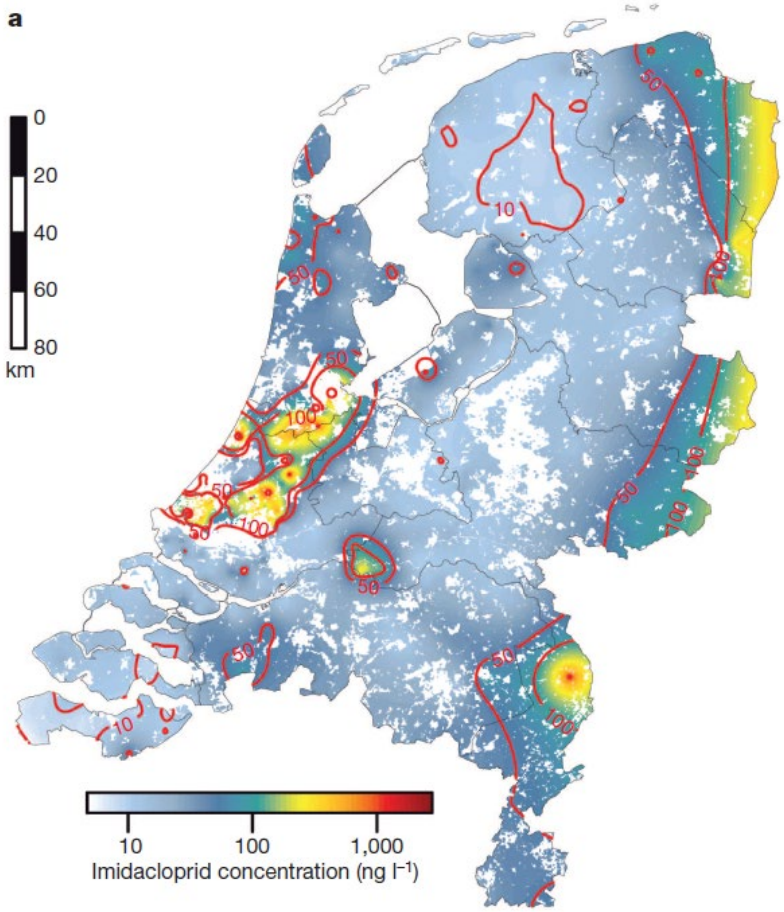
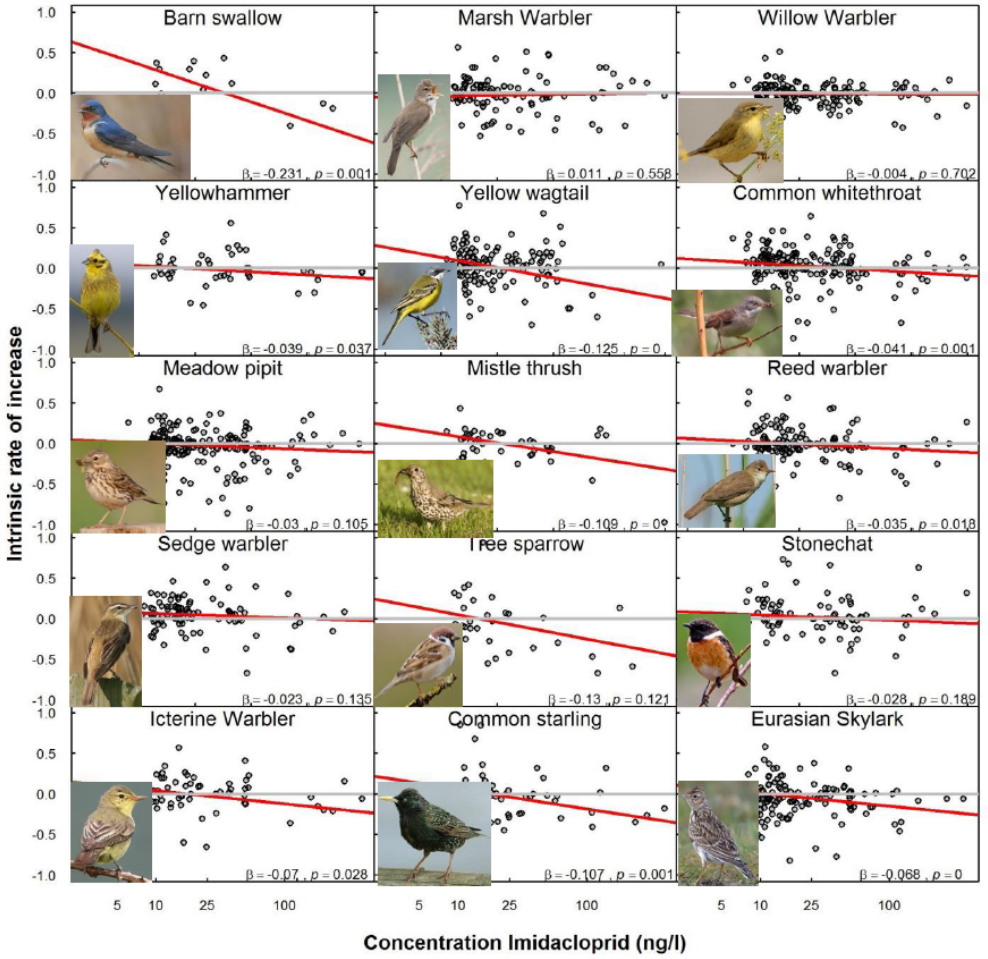


Figure 2 | Comparison of the effect of agricultural land-use changes and the effect of imidacloprid on bird population trends. **a**, The marginal variance





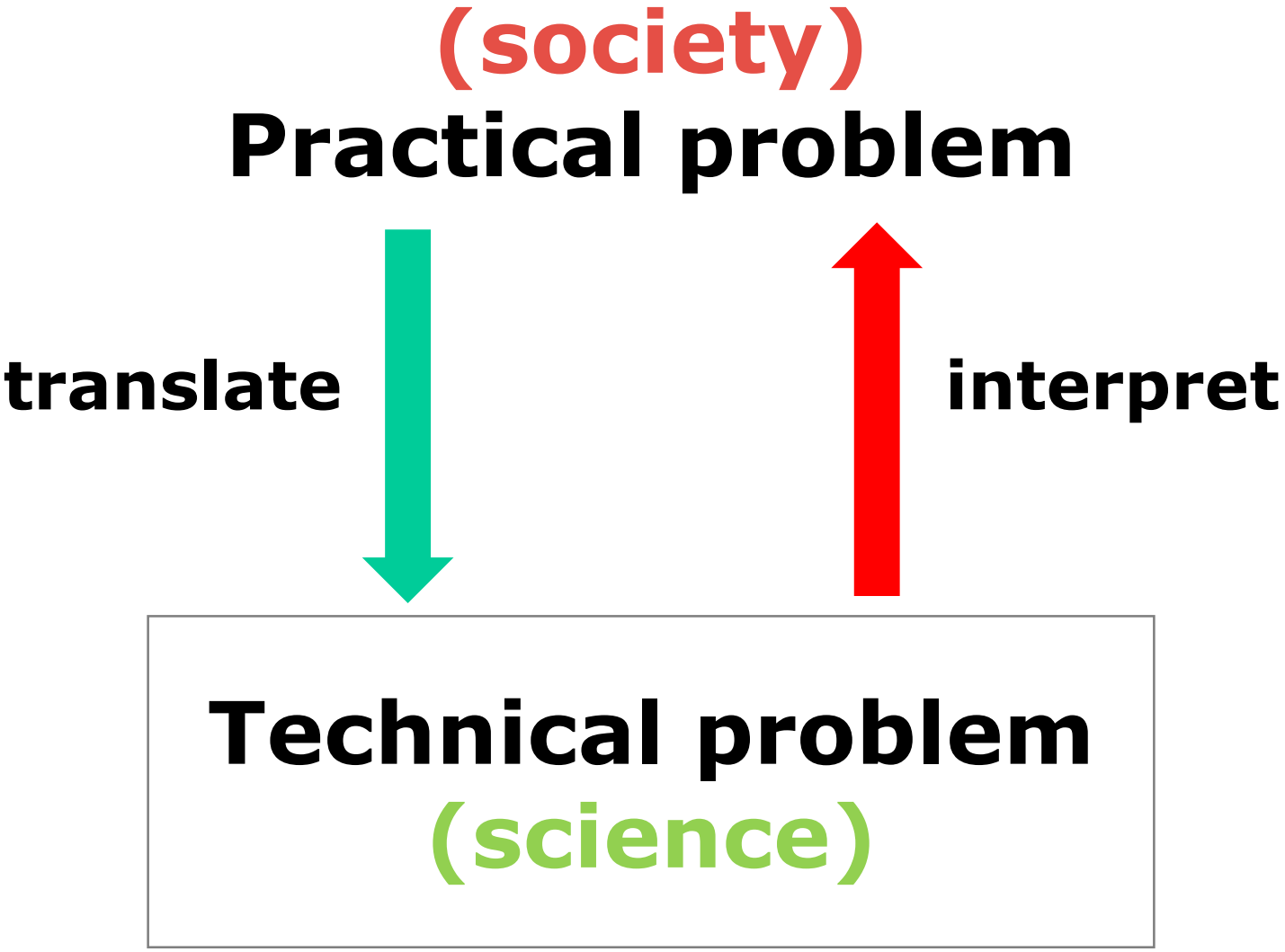
https://www.nature.com/articles/nature13531

Top 10 of circumstances / characteristics of risk migration

Rank	Circumstance / characteristic	# cases
1	Lack of systems analytic approach	37
2	Incomplete life cycle assessment	27
3	Lack of critical reflection on risks and promised benefits	25
4	No incentives to meet ALARA	25
5	Persistence and/or bioaccumulation	17
6	Ignoring ignorance	14
7	Novel material / special unfamiliar properties	11
8	Mismatch novel aspects and authorization tests / standards etc	10
9	Unreflective upscaling from small scale experiences	9
10	Non standard situations	4

https://dspace.library.uu.nl/handle/1874/314855

Is reducing complexity into technical SDG goals a recipe for conservation of misery?



Ravetz, J., 1971, Scientific Knowledge and its Social Problems, Oxford University Press.