XVIII EFSA Scientific Colloquium, 15-16 May 2013

The risk assessment of stressors in bees: a multi-level approach

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Presentation Outline

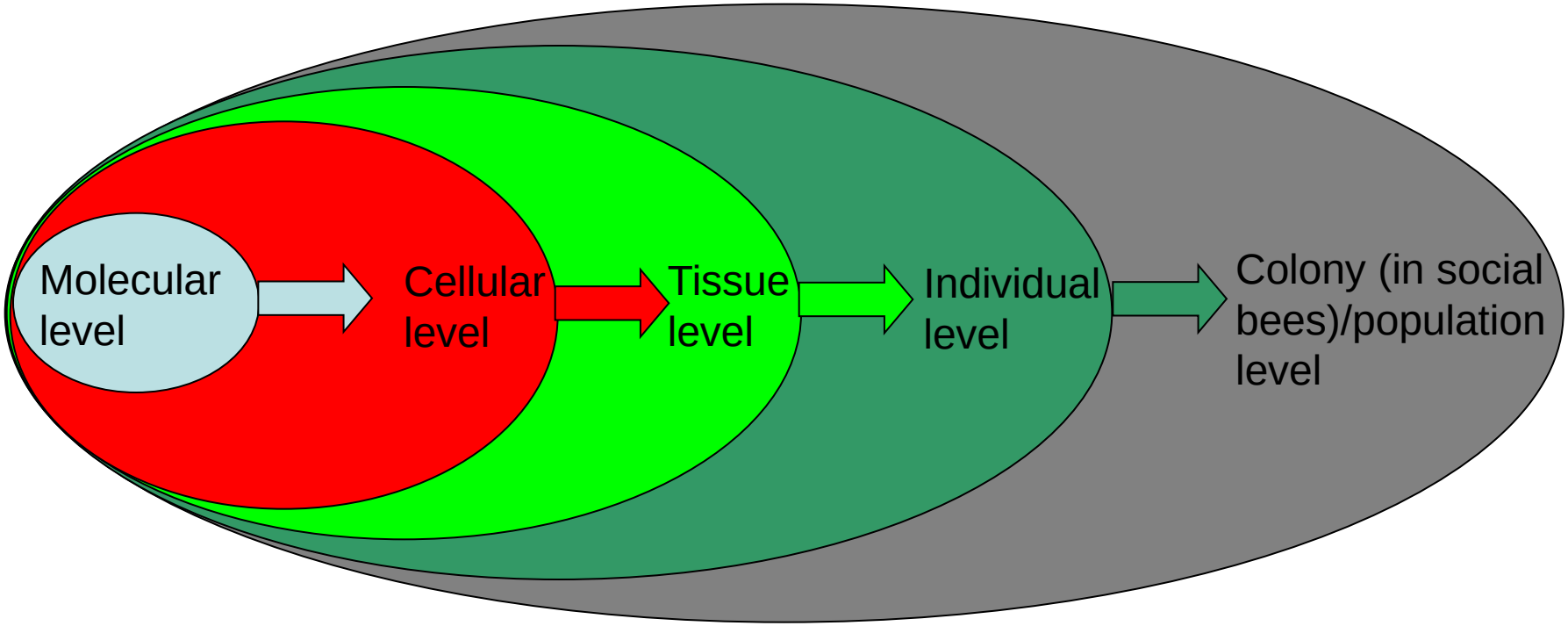
- The strengths and limitations of laboratory and field studies in relation to their use in the environmental risk assessment scheme.

- The overview of the new test protocol candidates in the risk assessment procedures.

- The extrapolation of the effects from individual to colony/population levels.

The risk assessment of stressors in bees: levels of investigation

Structural levels of a bee's organization



Behavioural and physiological effects

?

Ecological effects on colony size and survival/population dynamic.

Tiered approach in the registration process of Plant Protection Products: from laboratory to field tests

Laboratory tests

- Effects on individual bees;
- Individual exposure;
- 100% of exposure level (protection of the compound by degradation);
- Controlled conditions;
- Many replicates;
- Lower cost;

Field tests

- Effects on colony;
- Colony exposure;
- Field level of exposure (real exposure);
- Higher cost

Establishment of a WG with experts in the area of bees health and exposure (September 2011)

EFSA Opinion on the science behind...
...adopted in April 2012

Draft Guidance (1° round of public consultation) in September 2012

efsa
European Food Safety Authority
EFSA Journal 2012;10(5):2668

SCIENTIFIC OPINION

Scientific Opinion on the science behind the development of a risk assessment of Plant Protection Products on bees (*Apis mellifera*, *Bombus* spp. and solitary bees)[1]

EFSA Panel on Plant Protection Products and their Residues (PPR)[2, 3]

European Food Safety Authority (EFSA), Parma, Italy

Abstract

The PPR Panel was asked to deliver a scientific opinion on the science behind the development of a risk assessment of plant protection products on bees (*Apis mellifera*, *Bombus* spp. and solitary bees). Specific protection goals options were suggested based on the ecosystem services approach. The different routes of exposure were analysed in detail for different categories of bees. The existing test guidelines were evaluated and suggestions for improvement and further research needs were listed. A simple prioritisation tool to assess cumulative effects of single pesticides using mortality data is suggested. Effects from repeated and simultanous exposure and synergism are discussed. Proposals for separate risk assessment schemes, one for honey bees and one for bumble bees and solitary bees, were developed.

Key words

Guidance Document, PPR opinion, honey bees, bumble bees, solitary bees, pesticide, risk assessment

[1] On request from the European Commission, Question No EFSA-Q-2011 00417, adopted on 18 April 2012.

[2] Panel members: Jos Boesten, Claudia Bolognesi, Theo Brock, Ettore Capri, Anthony Hardy, Andrew Hart, Karen Hirsch-Ernst, Susanne Hougaard Bennekou, Robert Luttik, Michael Klein, Kyriaki Machera, Bernadette Ossendorp, Annette Petersen, Yolanda Pico, Andreas Schäffer, Paulo Sousa, Walter Steurbaut, Anita Stromberg, Maria Tasheva, Ton van der Linden, Christiane Vleminckx. Correspondence: pesticides.ppr@efsa.europa.eu3

[3] Acknowledgement: The Panel wishes to thank the members of the Working Group on Bee Risk Assessment (Robert Luttik, Gérard Arnold, Jos Boesten, James Cresswell, Andrew Hart, Jens Pistorius, Fabio Sgolastra, Noa Simon Delso, Walter Steurbaut, Helen Thompson) for the preparatory work on this scientific opinion,the hearing expert (Anne Alix) and EFSA staff (Franz Streissl, Domenica Auteri, Jean-Lou Dorne, Agnès Rortais, Klaus Swarowsky, Csaba Szentes) for the support provided to this scientific opinion.

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Laboratory tests

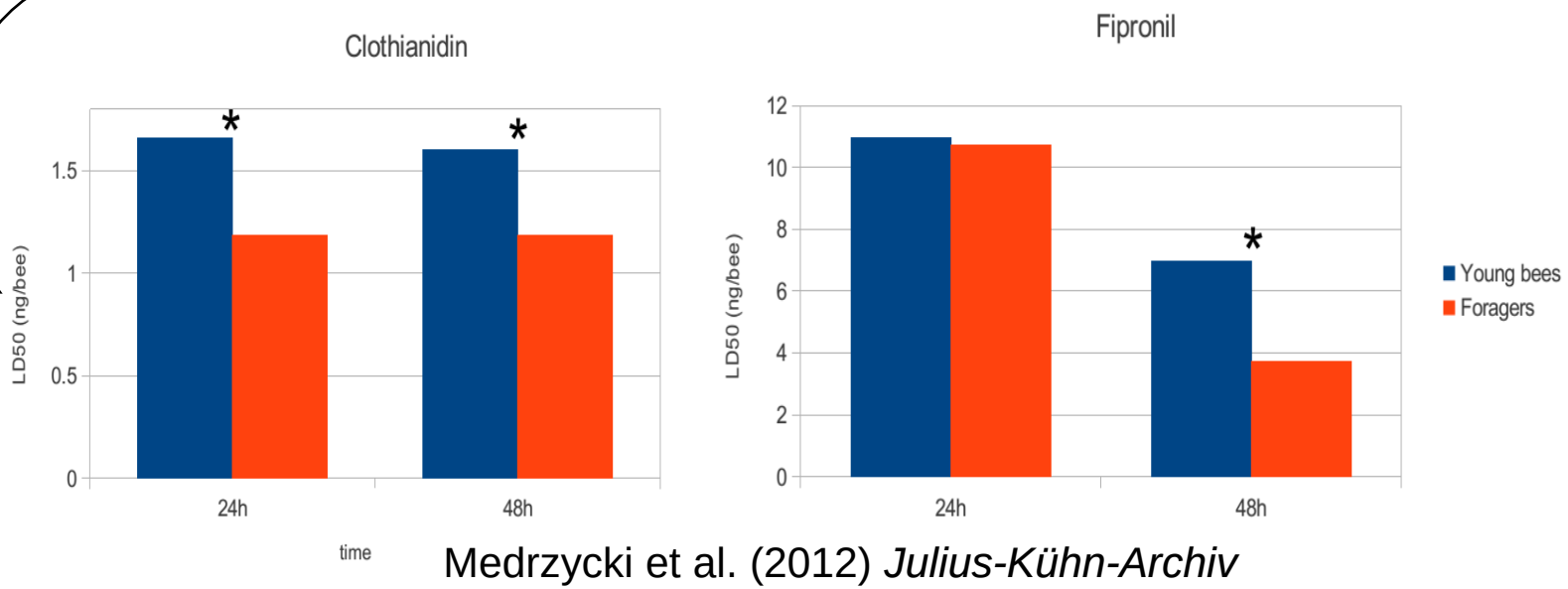
Test temperature

T (C)	DL_{50} 24h media		
	Fipronil	Clothianidin	Thiamethoxam
25 0.5	11.72	0.90	1.59
30 0.5	5.76	1.45	2.65
35 0.5	2.54	1.45	3.62
N	*4*	*4*	*3*

Medrzycki et al. (2012) *Julius-Kühn-Archiv*

Source of variations of the LD50 (i.e. Imidacloprid: 4-600 ng/bees)

Bee age
Young bee
Foragers



Medrzycki et al. (2012) *Julius-Kühn-Archiv*

Laboratory tests

Nutritional status

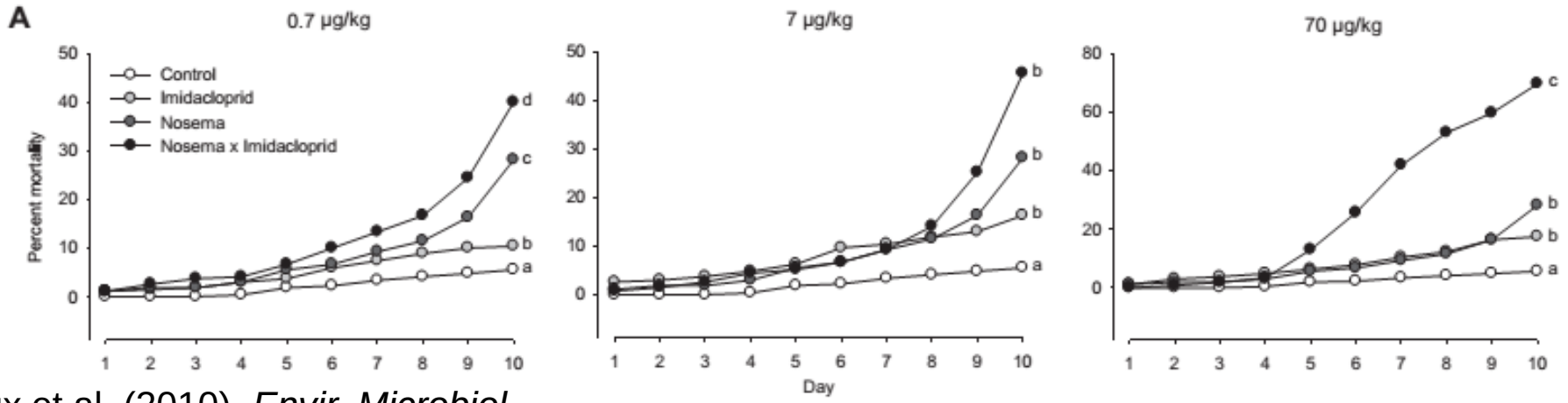
THIAMETOXAM

Pollen Diet	24h		48h		72h	
	LD50	SD	LD50	SD	LD50	SD
MIX	4.730	0.156	2.569	0.192	1.840	0.050
MAIZE	3.643	0.459	1.855	0.236	1.368	0.162
p (t Stud)	0.018		0.015		0.009	

Tosi et al. (2013) *Am. Bee Jour.*

Source of variations of the LD50 (i.e. Imidacloprid: 4-600 ng/bees)

Health status



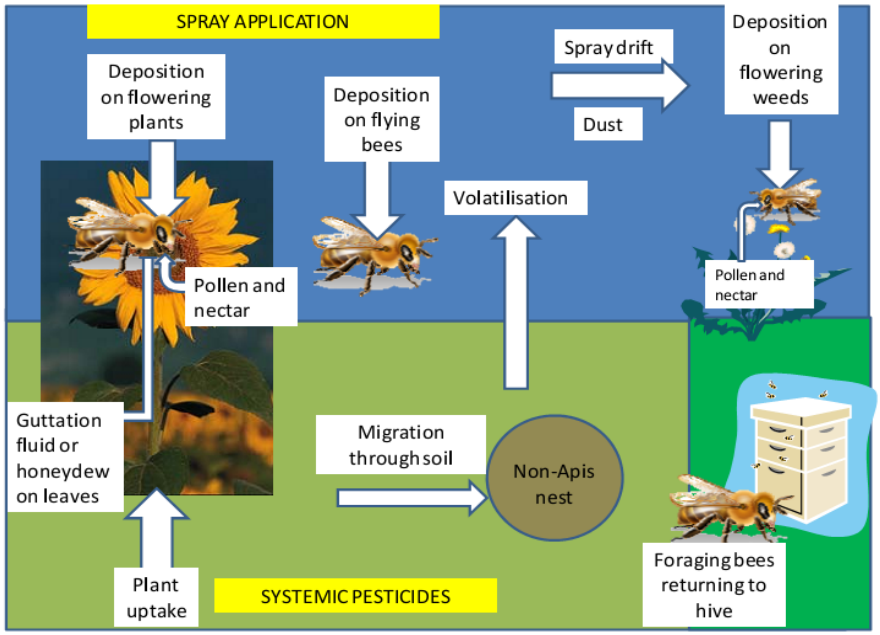
Alaux et al. (2010). *Envir. Microbiol.*

Field tests

Multi-exposure routes

Source of variations in field studies

Multi-compound exposure

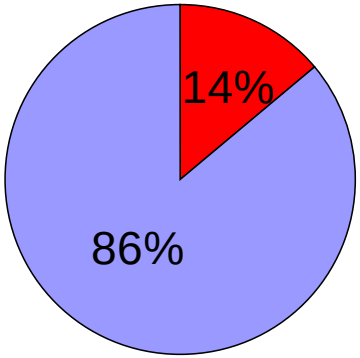


EFSA PPR (2012). *EFSA Journal*

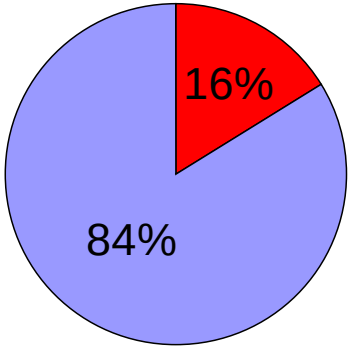
1 compound

>1 compounds

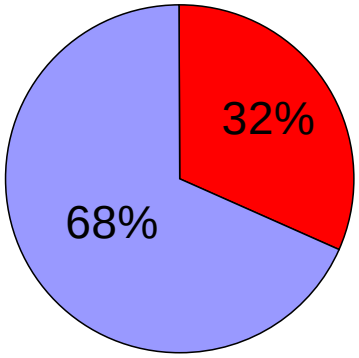
Bees (N=93)



Pollen (N=149)



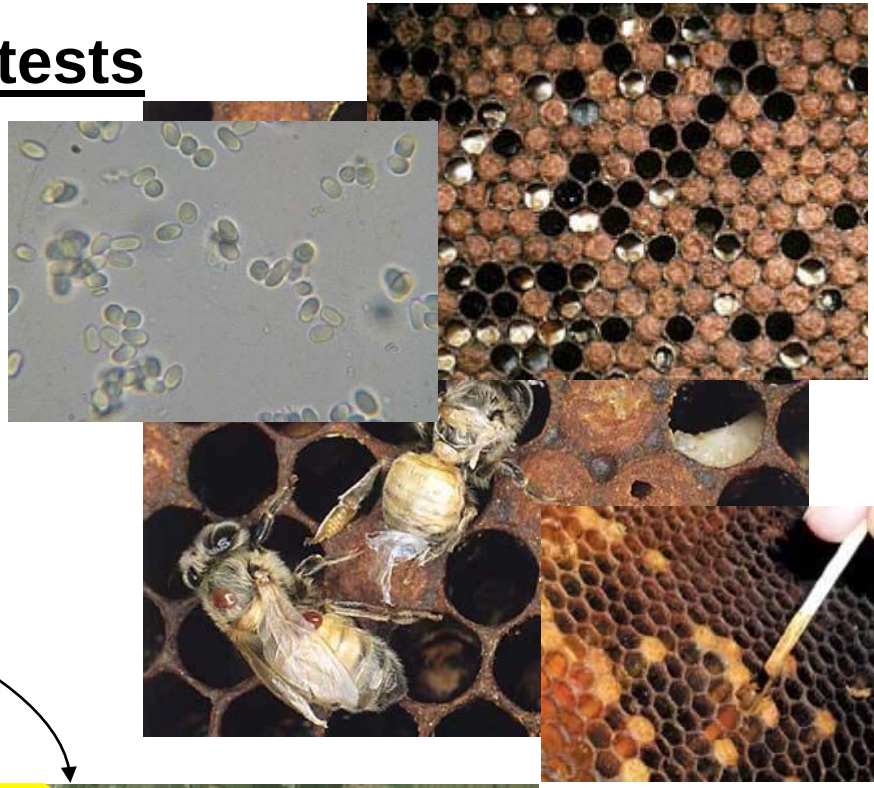
Wax (N=296)



CRA-API (2009, 2010). *Apenet project*

Field tests

Sanitary status of the colonies



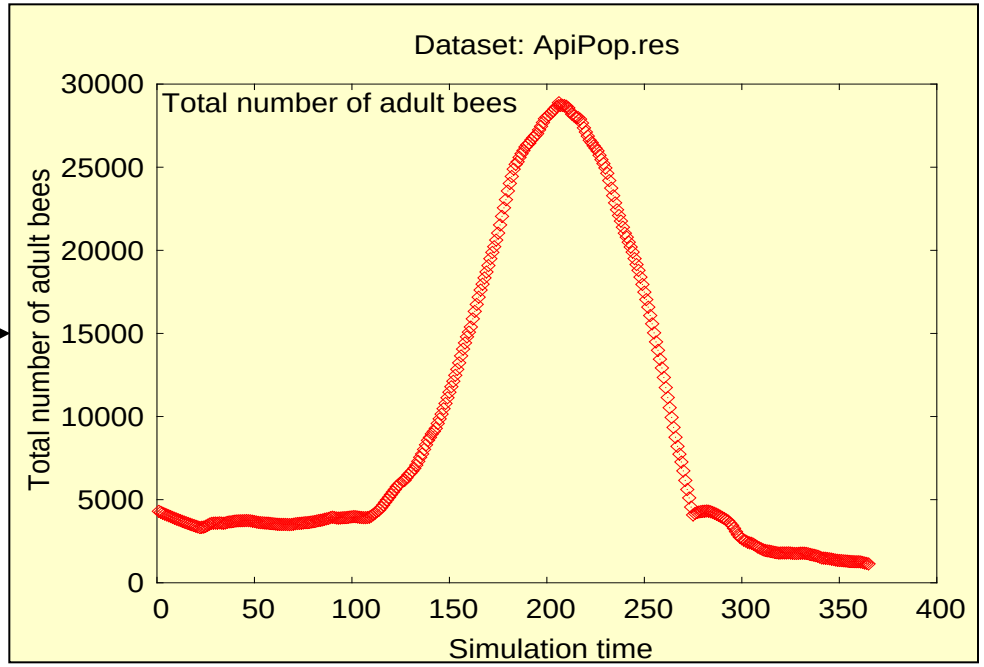
Source of variations in field studies

Environmental diversity (at landscape level)

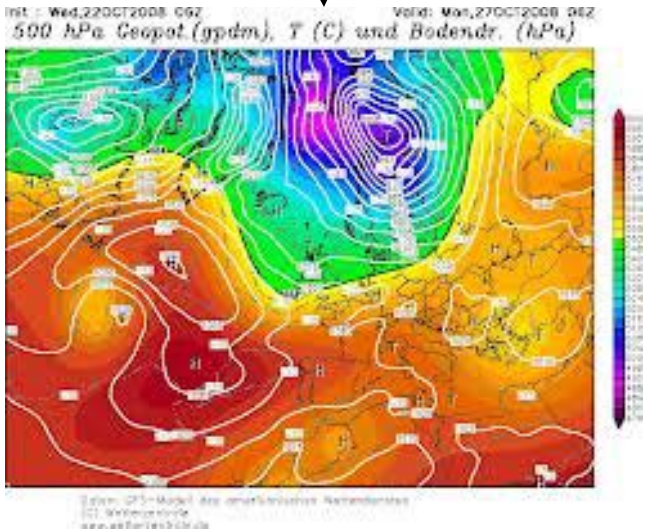
Field tests

Source of variations in field studies

Colony size and strength



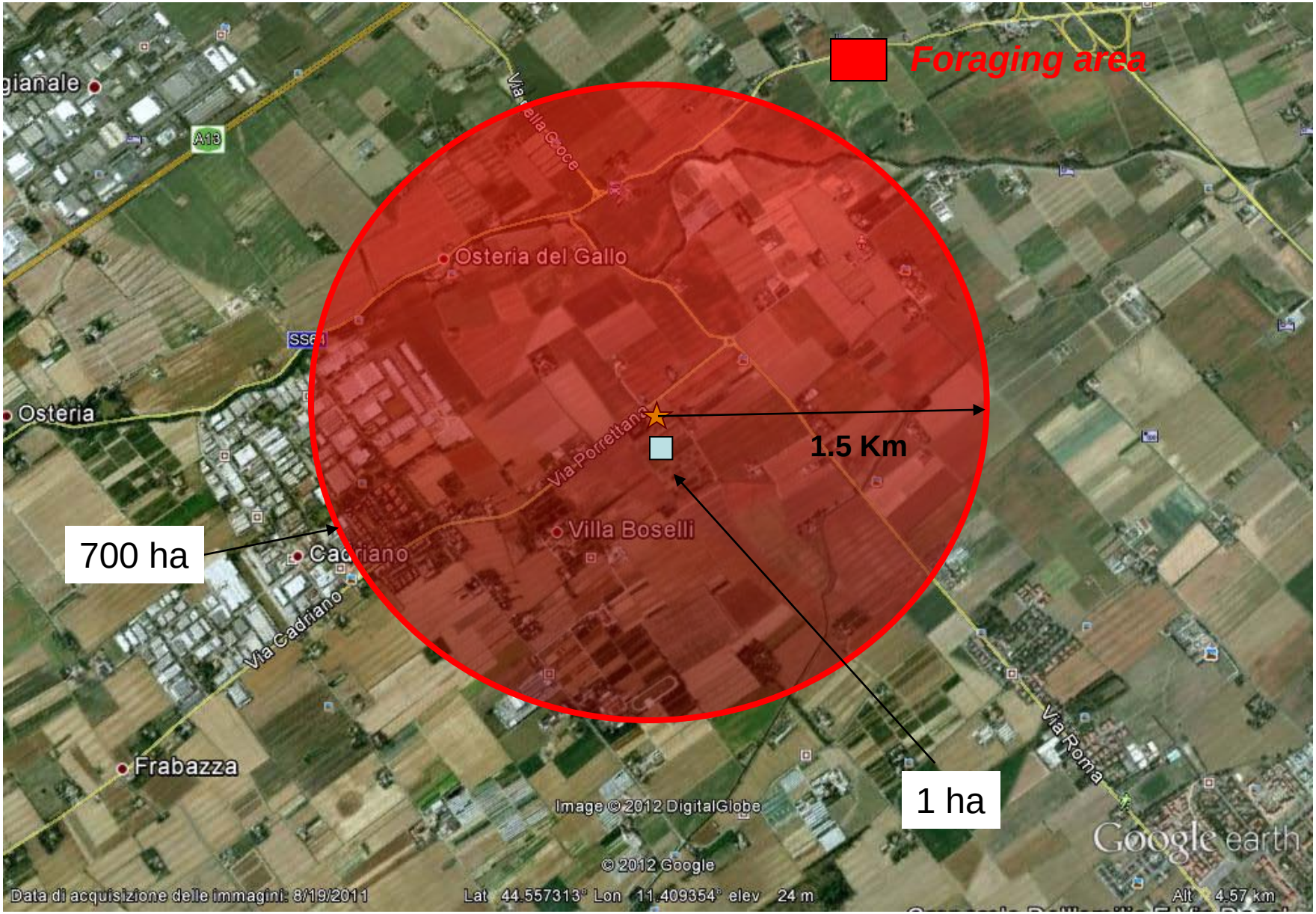
Meteorological conditions/Season



Other source of variations: genetic, local climatic conditions…

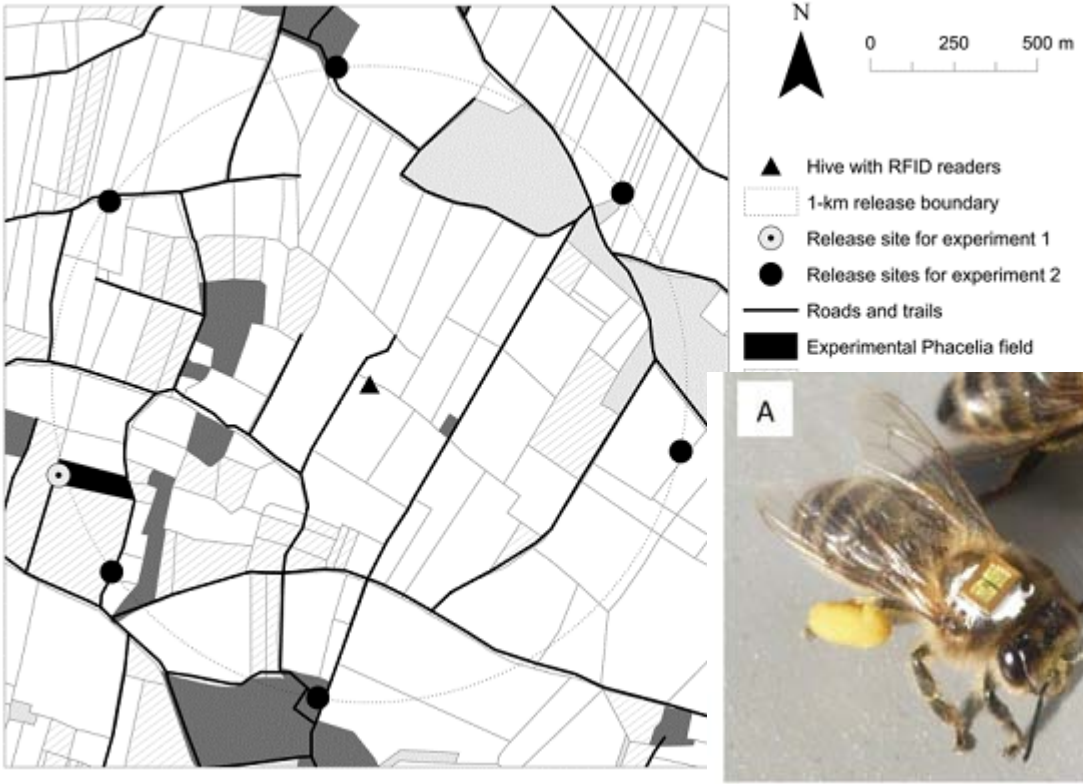
Field tests

Size of the treated field

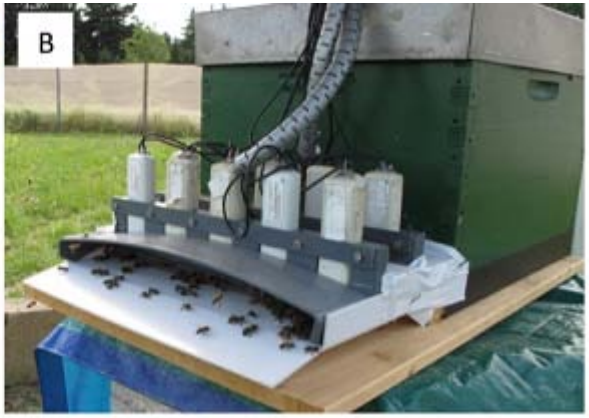


Field tests

Distance hive-treated field



Several bees exposed at 1.34 ng of thiametoxam did not return to the hive when they were released at 1 Km from the hive.

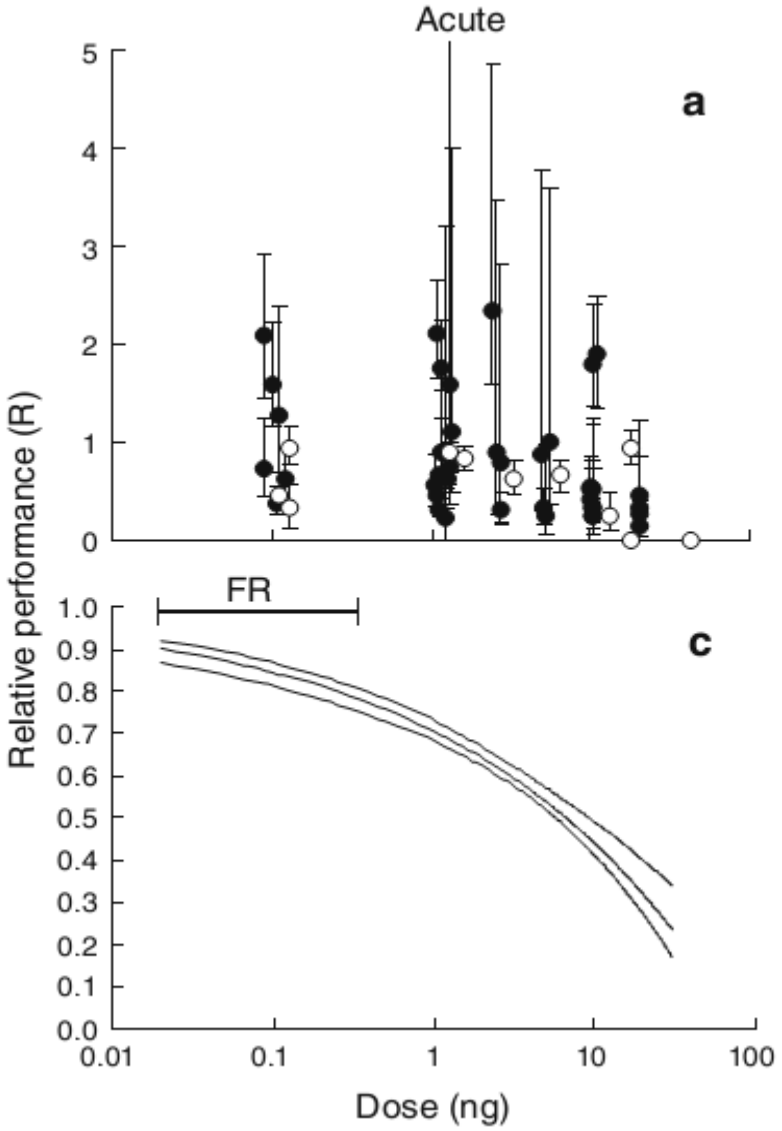


Henry et al. (2012). *Science*

Field tests

Statistical power of the test

No real effects in field
or low statistical power?



Cresswell (2011). *Ecotoxicoloy*

Presentation Outline

- The strengths and limitations of laboratory and field studies in relation to their use in the environmental risk assessment scheme.

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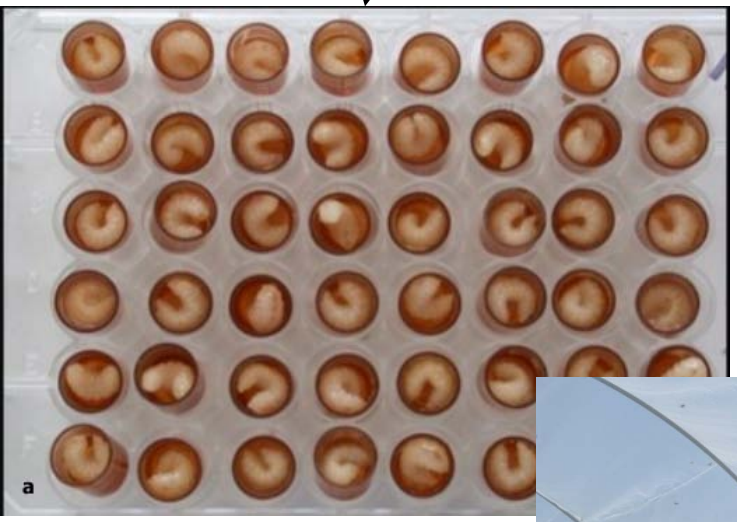
Overview of the new test methods

In vitro larvae test



Aupinel et al. (2005)
B. Insectology

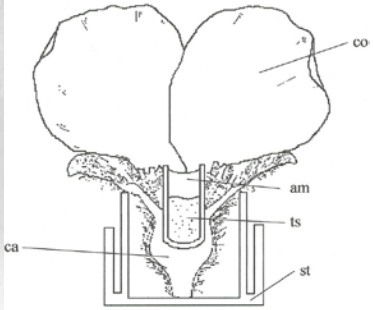
Test the effects of dust in cage and in field

Sgolastra et al. (2012).
B. Insectology

Georgiadis et al. (2012).
Julius-Kühn-Archiv

Overview of the new test methods

Method to feed individual bees



Ladurner et al. (2003). *Apidologie*

Test methods on solitary bees

Bioassay in laboratory with larvae of *Osmia*

Sgolastra et al., unpublished

Konrad et al. (2008). *Plos One*

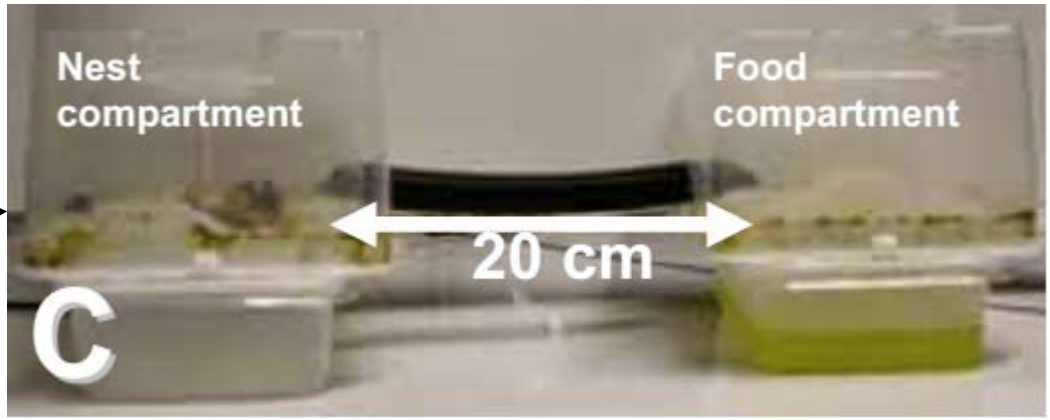
Cage or field studies to assess the nesting activity and fecundity in nesting females of solitary bees

Ladurner et al. (2008). *J. Econ. Entom.*

Overview of the new test methods

Mommaerts et al. (2010). *Ecotoxicology*

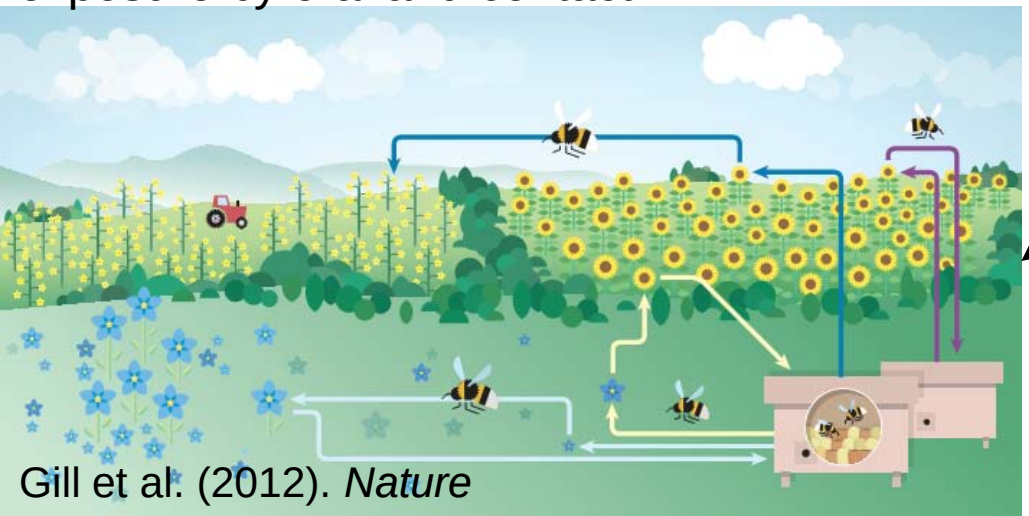
Laboratory based *Bombus* micro-colonies for evaluating reproductive effects



Test methods on bumblebees

Effects on queen production in colony exposed in the lab and development in field

Combined pesticide exposure by oral and contact



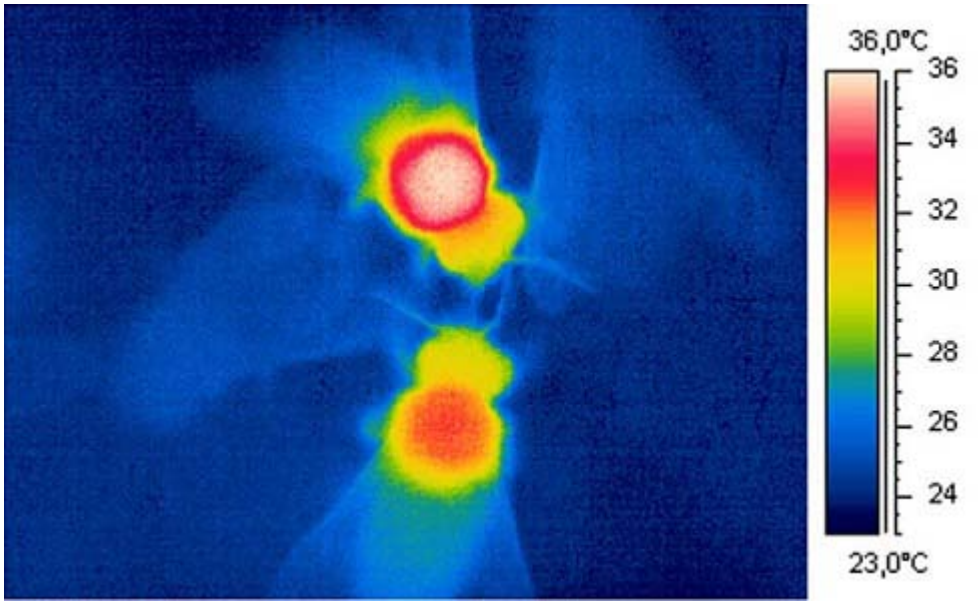
Gill et al. (2012). *Nature*

Whitehorn et al. (2012). *Science*

Overview of the new test methods

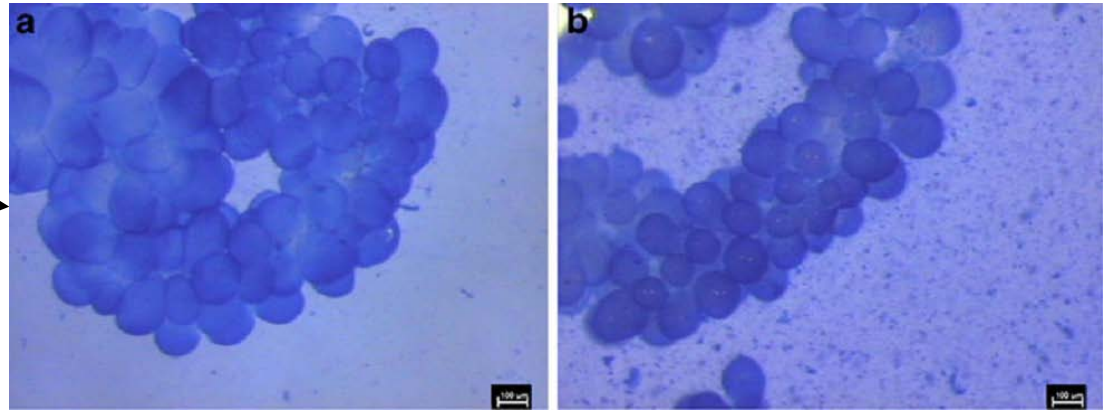
Effects on thermoregulation

Test methods on sub-lethal effects (physiological endpoints)



Vandame and Belzunces (1998). *Neurosc. Lett.*
Stabentheiner et al. (2010). *Plos One*

Effects on HPG development



Hatjina et al. (2012). *Apidologie*

Overview of the new test methods

Effects on learning capacity (PER test)

Decourtye et al. (2005). *Arch. Env. Con. Tox.*
CRA-API (2009, 2010)
Apenet project

Test methods on sub-lethal effects (behavioural endpoints)

Effects on homing ability

Bortolotti et al. (2003). *B. Insectology*;
Schneider et al. (2012). *Plos One*;
Henry et al. (2012). *Nature*

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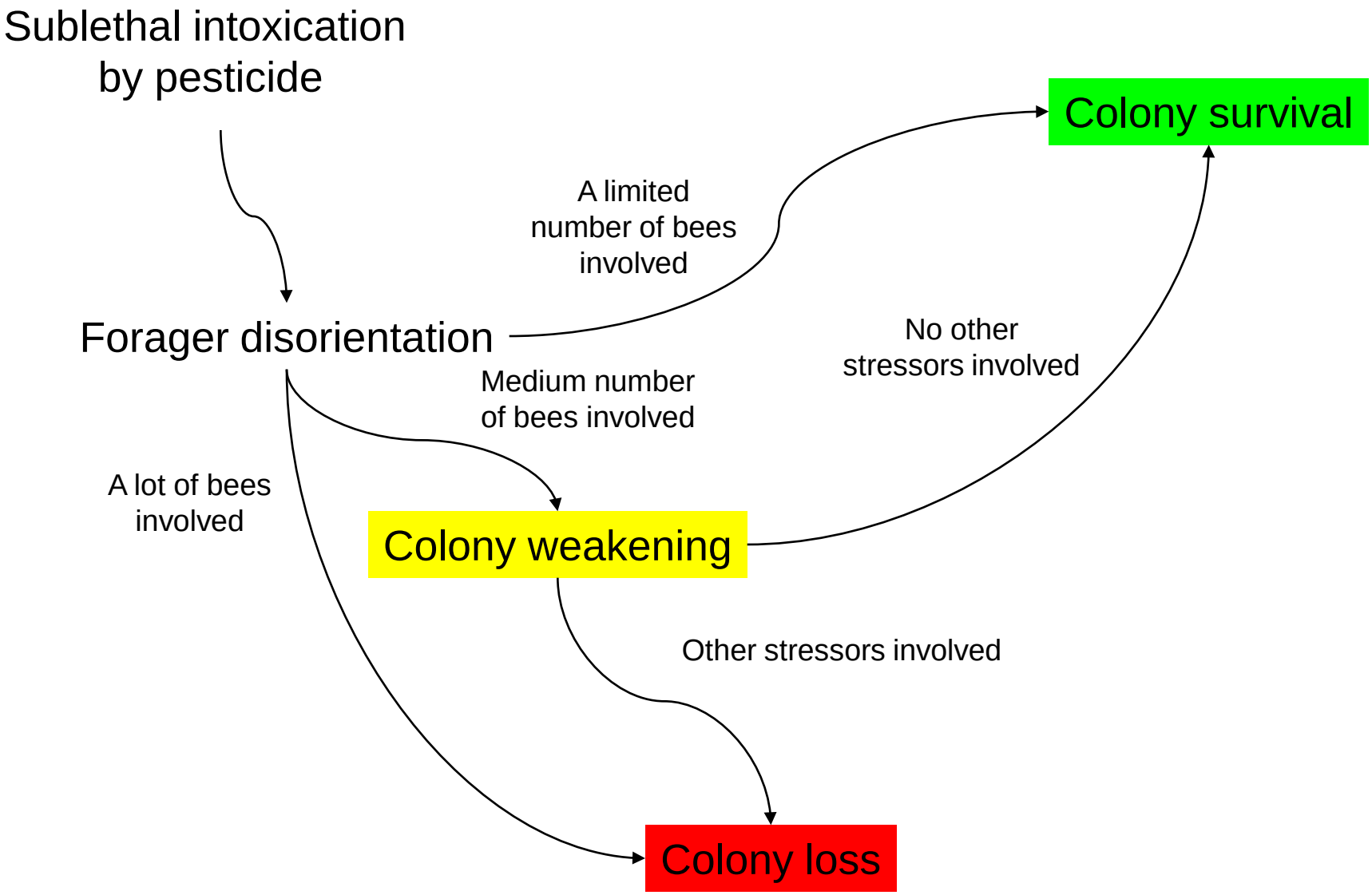
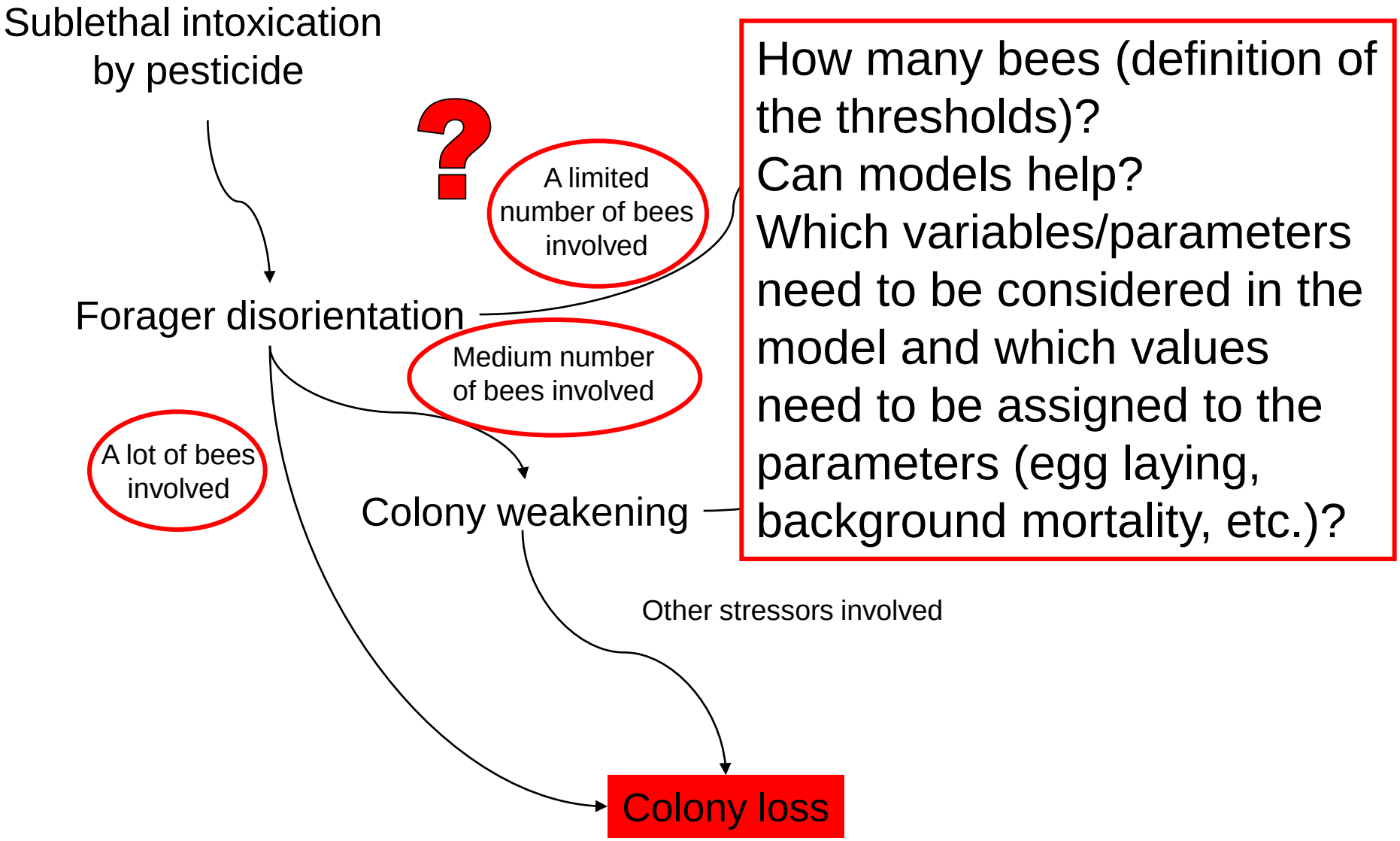
Effects from individual to colony

Effects on homing ability: different scenarios



Effects from individual to colony

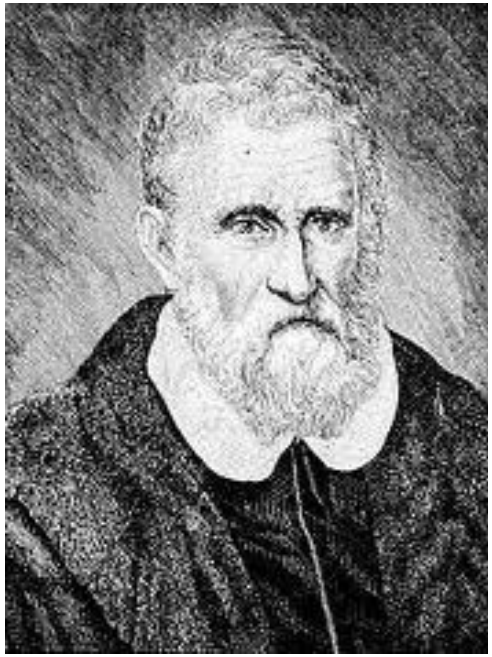
Effects on homing ability: different scenarios



Effects from individual to colony

"Models are always wrong…but many of them are useful"
Sharov (1996). Quantitative Population Ecology. E-Book

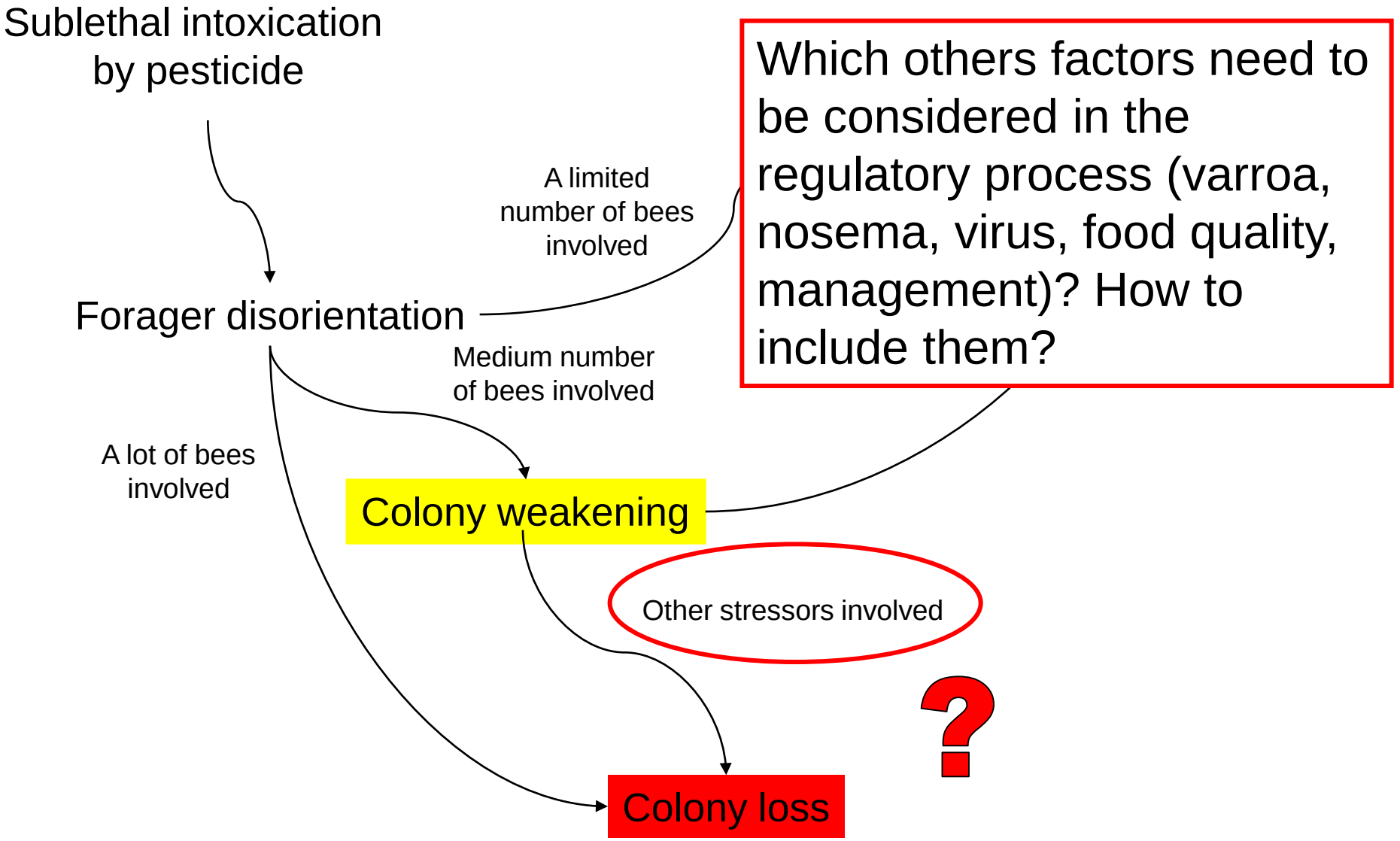
How a wrong model can give a correct answer?
In the same way as old maps were useful for travelers in the past



Marco Polo

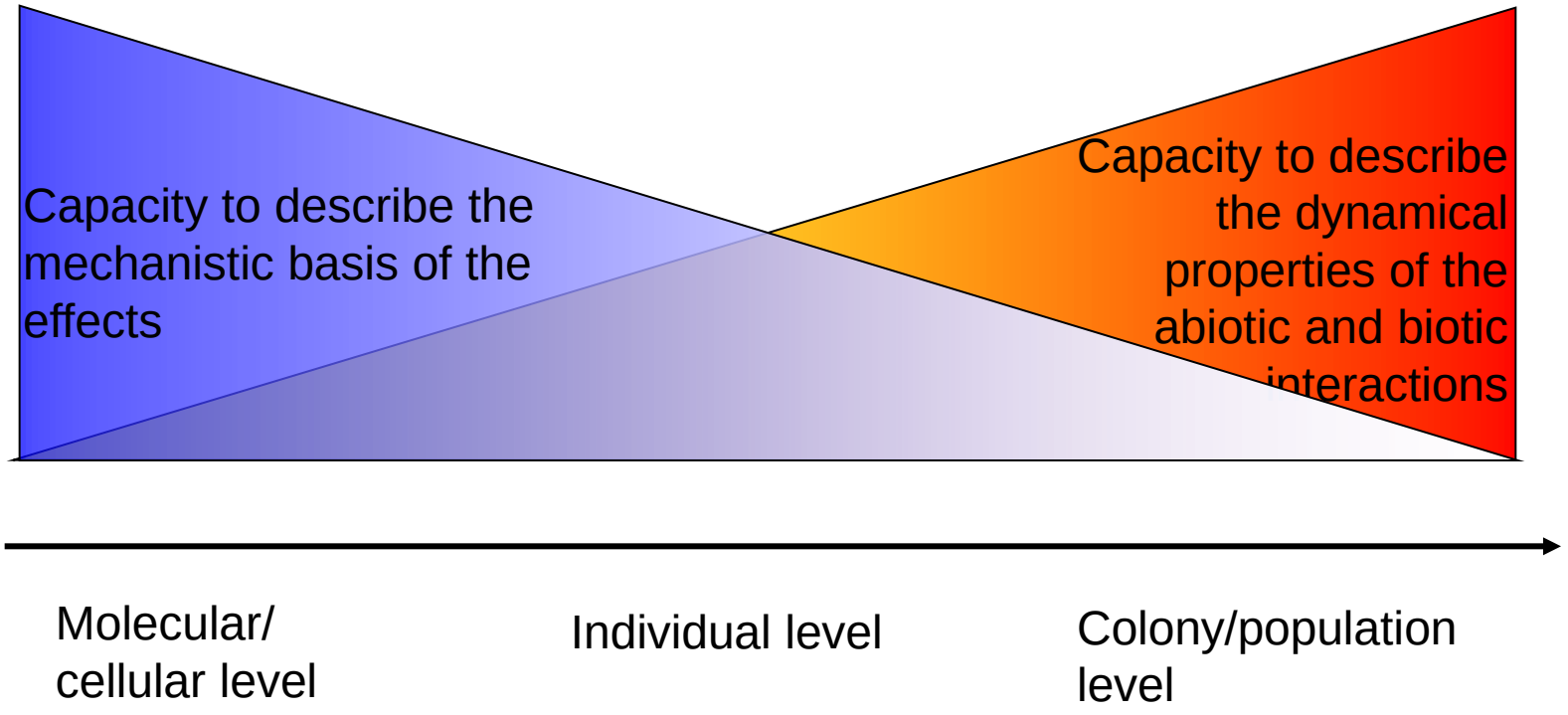
Effects from individual to colony

Effects on homing ability: different scenarios



The risk assessment of stressors in bee: conclusions

Difficult to extrapolate the effects from individual to colony due to the increasing of the complexity of the system



Thank you for your attention

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http://www.reterurale.it/flex/cm/pages/ServeAttachment.php/L/IT/D/5%252Ff%252Fc%252FD.5d70d88c74b5011d07e8/P/BLOB%3AID%3D4600

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