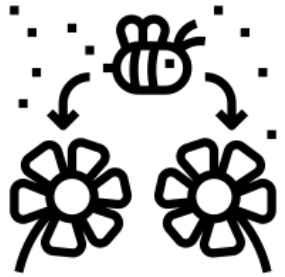
Determining pesticide levels in honeybee products

Dr Darren O'Connell

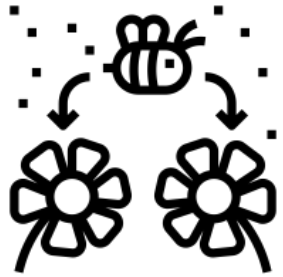
The importance of Honey Bees

The importance of Honey Bees



Pollination

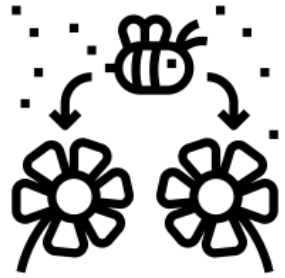
The importance of Honey Bees



Pollination

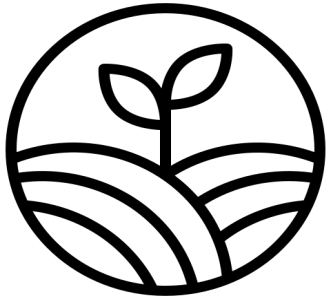
Biodiversity

The importance of Honey Bees



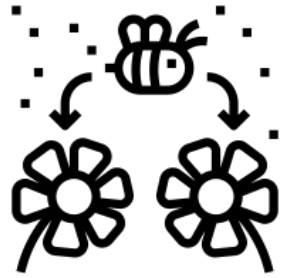
Pollination

Biodiversity



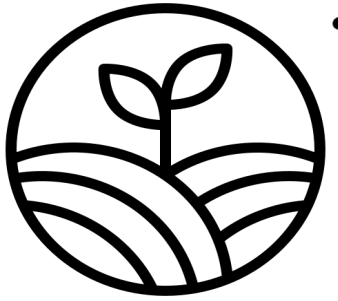
Agriculture

The importance of Honey Bees



Pollination

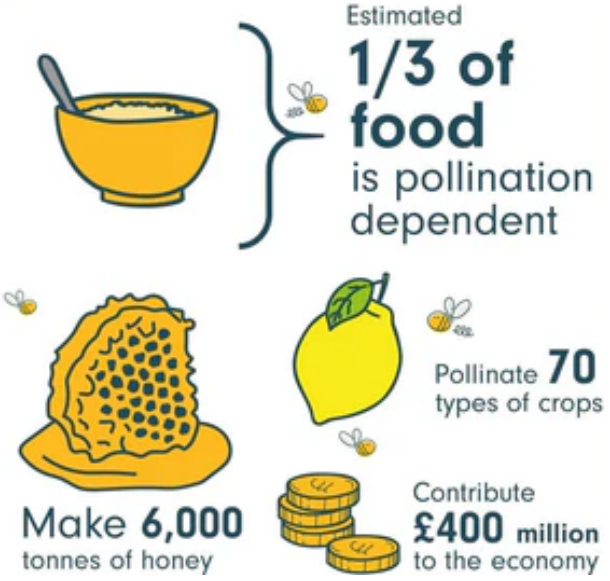
Biodiversity



Agriculture

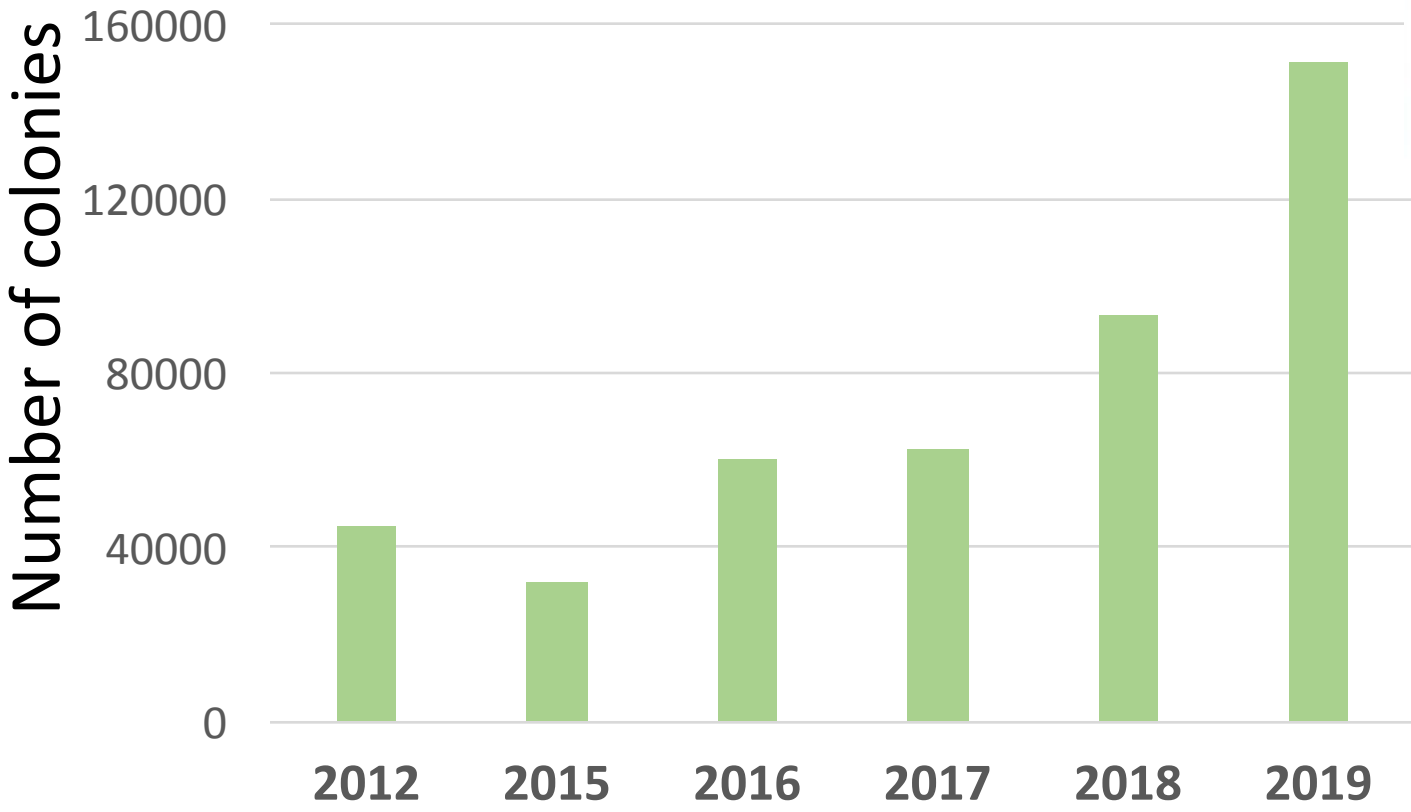
Food Security

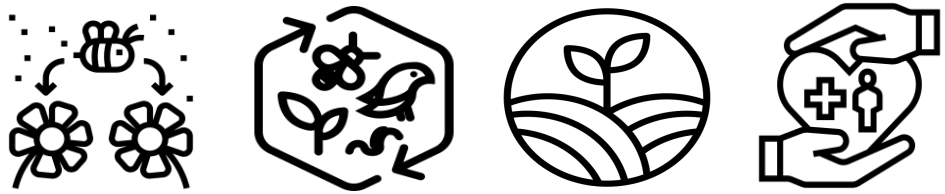
Human Health



Survey of European Beekeepers

Increased Colony Losses





What are the reasons for increased colony losses?

Changes

What are the reasons for increased colony losses?

Environmental Changes

What are the reasons for increased colony losses?

Environmental Changes

Pathogen Infestations

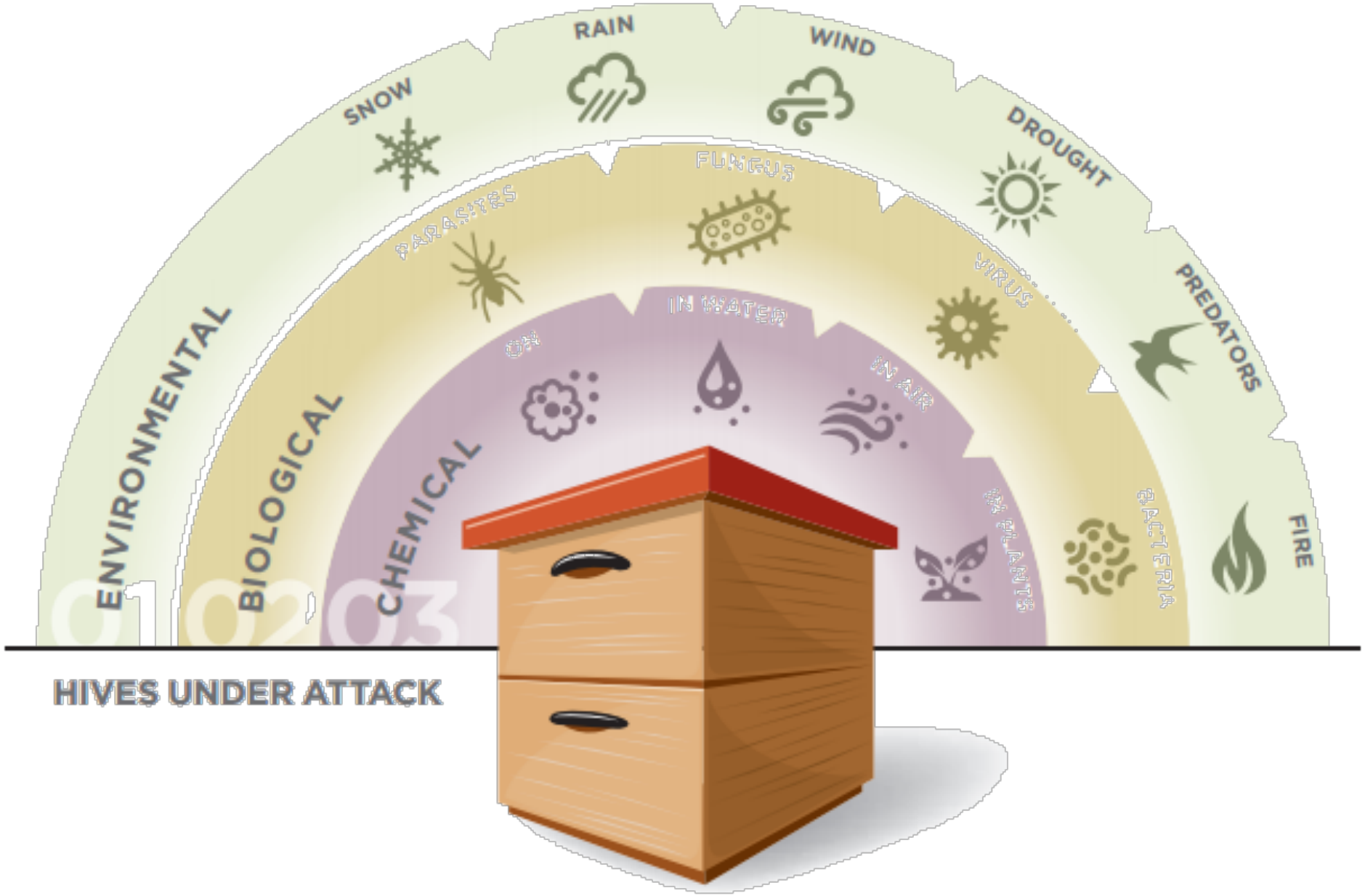
What are the reasons for increased colony losses?

Environmental Changes

Pathogen Infestations

Pesticide Exposure

Honey bees face compound stressors

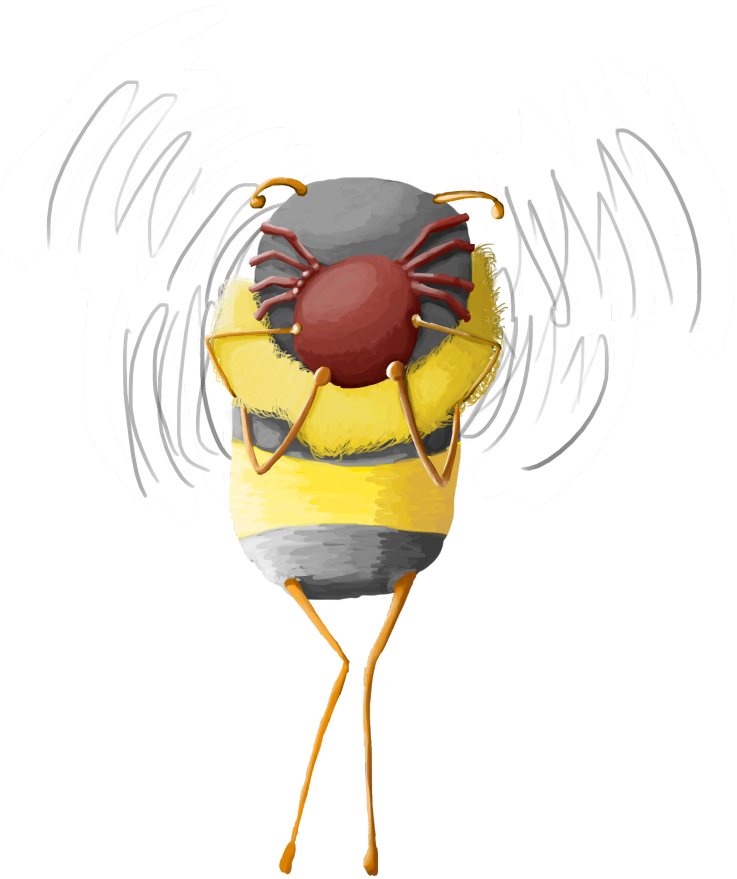


National Apicultural Programme

- Investigating multiple stress factors in honey bees across Ireland

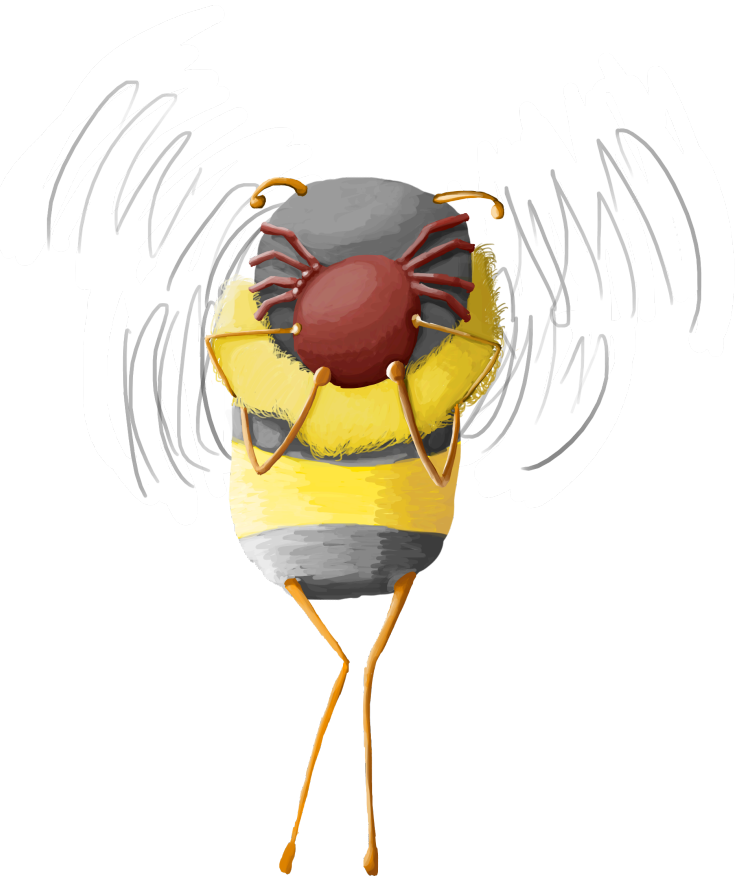
National Apicultural Programme

- Investigating multiple stress factors in honey bees across Ireland



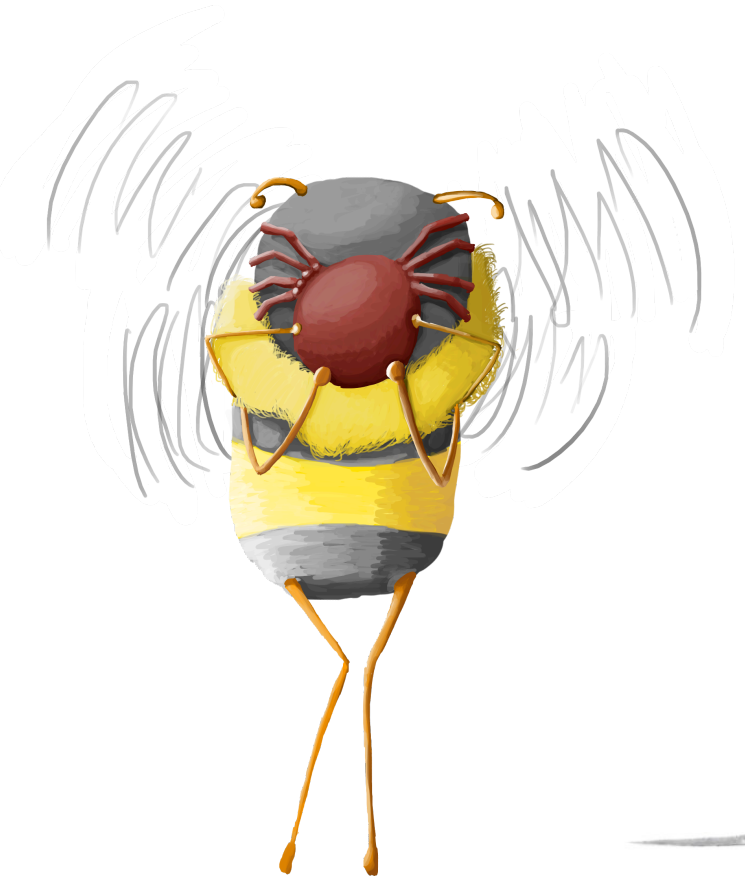
National Apicultural Programme

- Investigating multiple stress factors in honey bees across Ireland



National Apicultural Programme

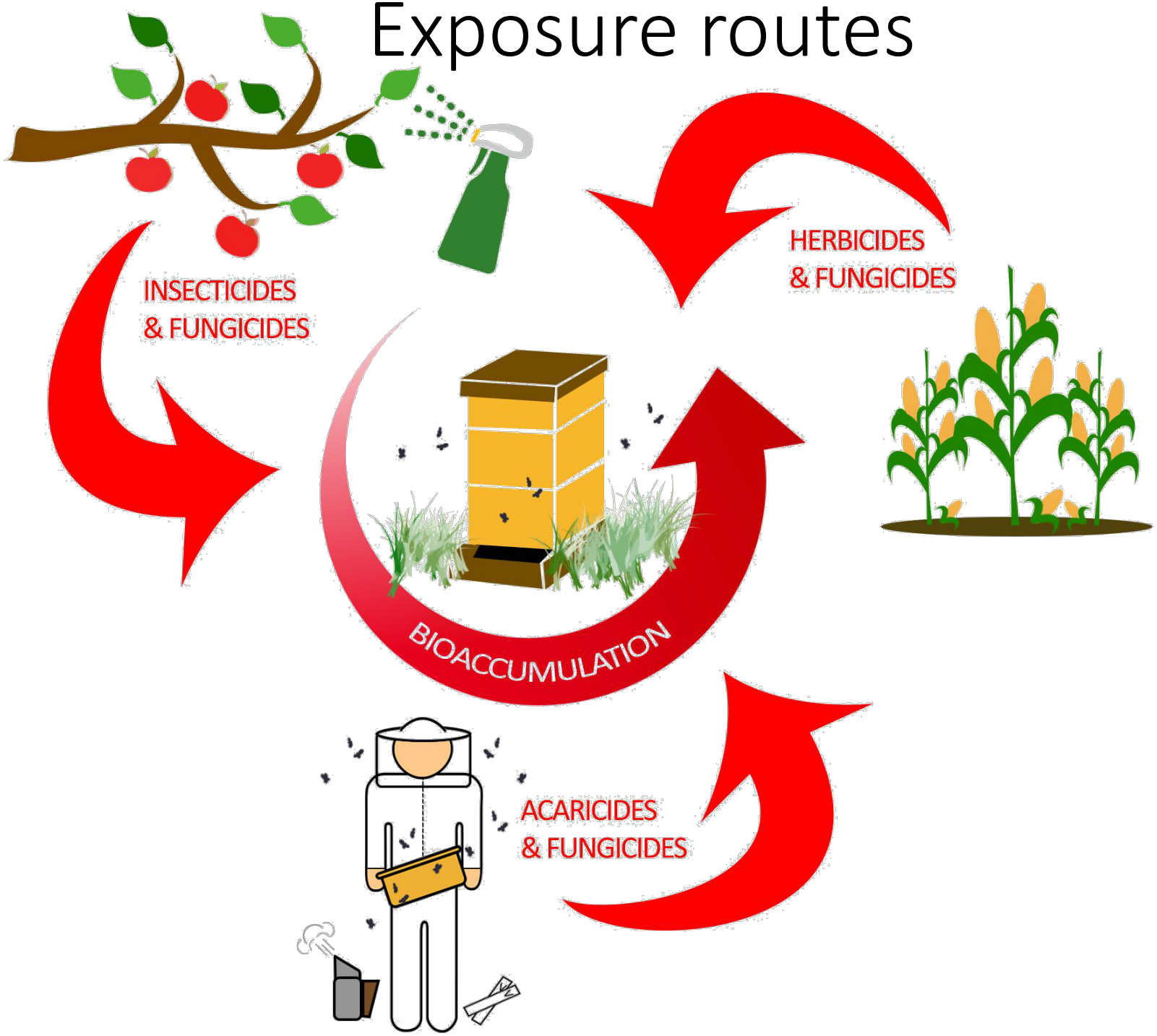
- Investigating multiple stress factors in honey bees across Ireland



National Apicultural Programme

- Investigating multiple stress factors in honey bees across Ireland

Exposure routes



Pesticide impacts

Pesticide impacts

REVIEW article

Front. Insect Sci., 25 January 2022
Sec. Insect Health and Pathology
Volume 1 - 2021 | https://doi.org/10.3389/finsc.2021.808335

This article is part of the Research Topic
Effects of Multiple Stressors on Insect Health
View all 3 Articles >

Interaction of Insecticides and Fungicides in Bees

 Antonia Schuhmann[1*], Anna Paulina Schmid[1],  Sarah Manzer[1], Janna Schulte[1,2] and  Ricarda Scheiner[1]

REVIEW article

Front. Insect Sci., 25 January 2022
Sec. Insect Health and Pathology
Volume 1 - 2021 | https://doi.org/10.3389/finsc.2021.808335

This article is part of the Research Topic
Effects of Multiple Stressors on Insect Health
View all 3 Articles >

Interaction of Insecticides and Fungicides in Bees


Antonia Schuhmann[1*], Anna Paulina Schmid[1], Sarah Manzer[1], Janna Schulte[1,2] and Ricarda Scheiner[1]

ELSEVIER

International Journal for Parasitology: Parasites and Wildlife

Volume 18, August 2022, Pages 232-243

Do pesticide and pathogen interactions drive wild bee declines?

Lars Straub [a], Verena Strobl [a], Orlando Yañez [a], Matthias Albrecht [b], Mark J.F. Brown [c], Peter Neumann [a d]

Science of the Total Environment 879 (2023) 162971

Contents lists available at ScienceDirect

Science of the Total Environment

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

Pesticide mixtures detected in crop and non-target wild plant pollen and nectar

Elena Zioga [a,*], Blánaid White [b], Jane C. Stout [a]

[a] Botany, School of Natural Sciences, Trinity College Dublin, Dublin 2, Ireland
[b] School of Chemical Sciences, DCU Water Institute, Dublin City University, Dublin 9, Ireland

HIGHLIGHTS

- Pesticide residues in plant pollen and nectar may pose a hazard for pollinators.
- We evaluated the pesticide residues in a crop and a wild plant species in Ireland.
- Most detections were in fields with no recent application of the compounds detected.
- Azoxystrobin, boscalid and clothianidin was the most common compound mixture.
- Clothianidin was detected in both plant species several years after its application.

GRAPHICAL ABSTRACT

Scientific objectives

Scientific objectives

- Map the distribution of all pesticides in honey bee colonies across the island of Ireland

Scientific objectives

- Map the distribution of all pesticides in honey bee colonies across the island of Ireland

- Relate pesticide prevalence to colony loss

Prevention of Honey Bee COlony LOSSes
COLOSS

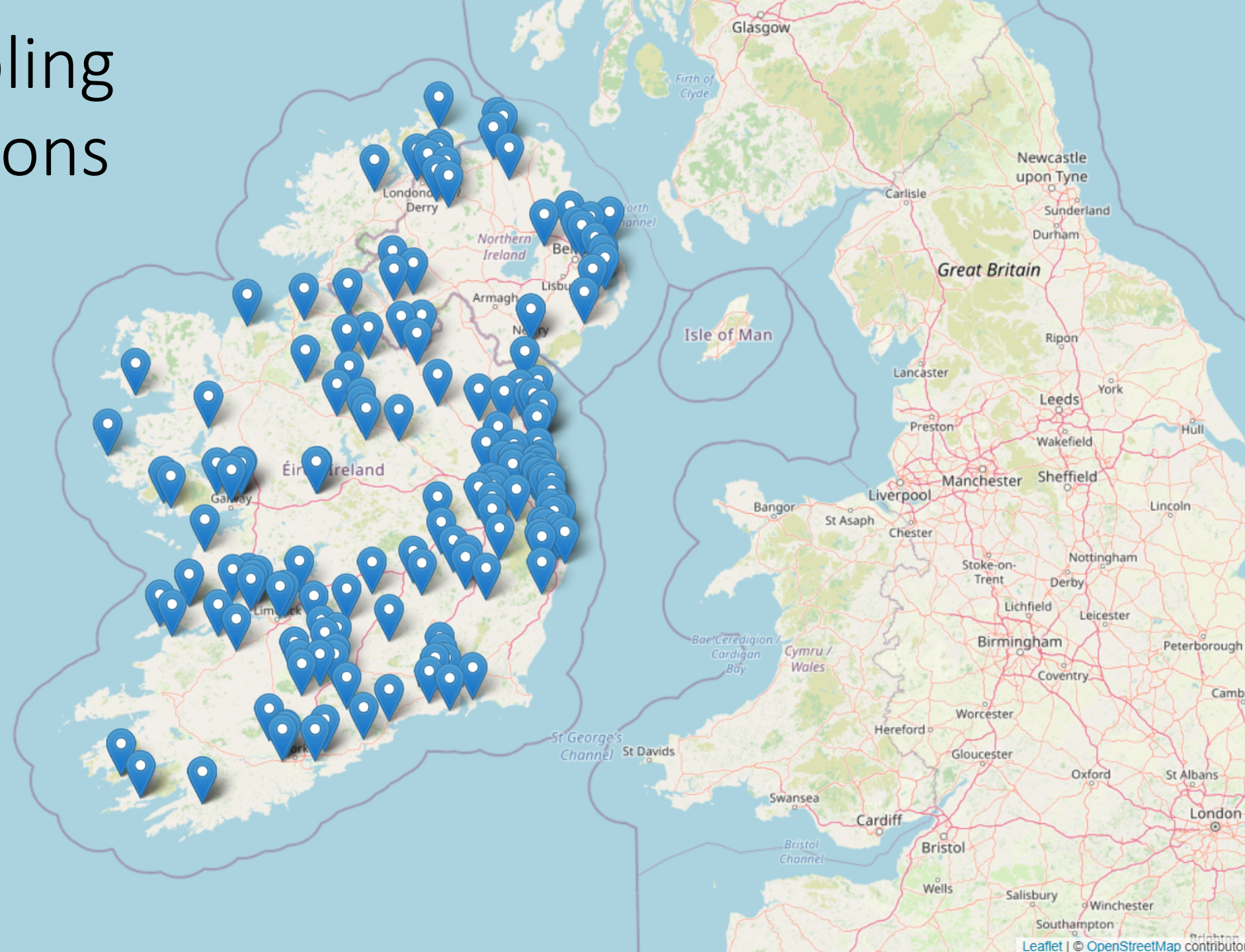
Scientific objectives

- Map the distribution of all pesticides in honey bee colonies across the island of Ireland
- Relate pesticide prevalence to colony loss

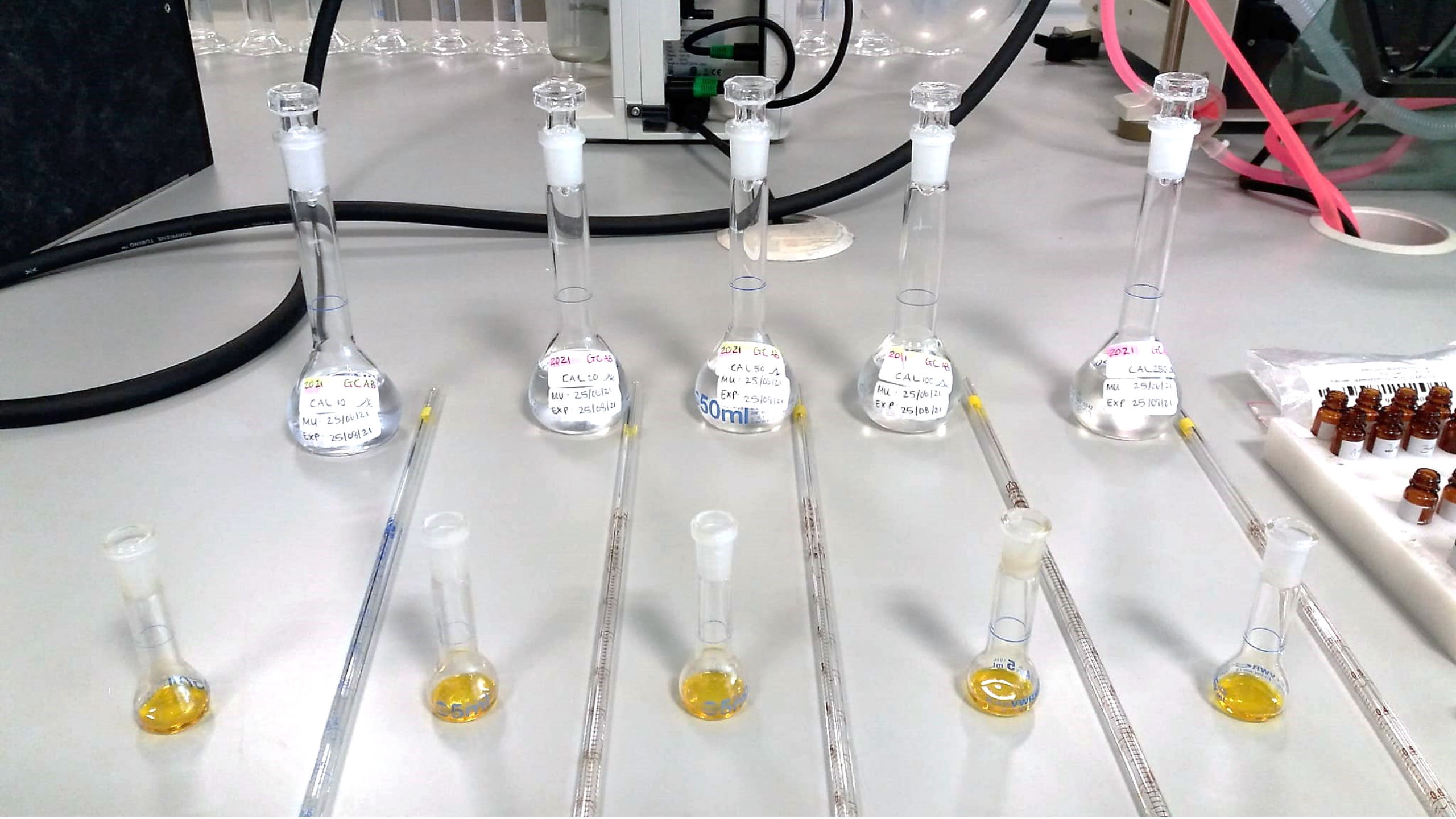
Sampling

- In depth sampling of pollen and honey by a network of beekeepers

Sampling locations

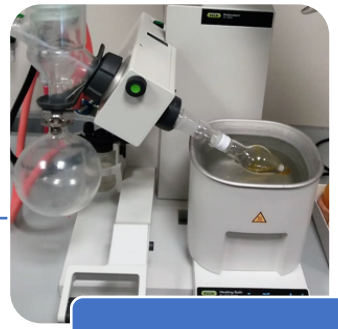


National Apiculture Programme Sampling


2021 GC AB
CAL 10
MU 25/06/21
EXP 25/08/21
2021 GC AB
CAL 20
MU 25/06/21
EXP 25/08/21
2021 GC AB
CAL 50
MU 25/06/21
EXP 25/08/21
2021 GC AB
CAL 100
MU 25/06/21
EXP 25/08/21
2021 GC AB
CAL 250
MU 25/06/21
EXP 25/08/21
50ml

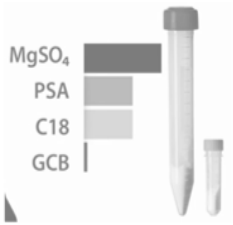
Pesticide detection process

Sample preparation



Extraction

Dutch mini-Luke

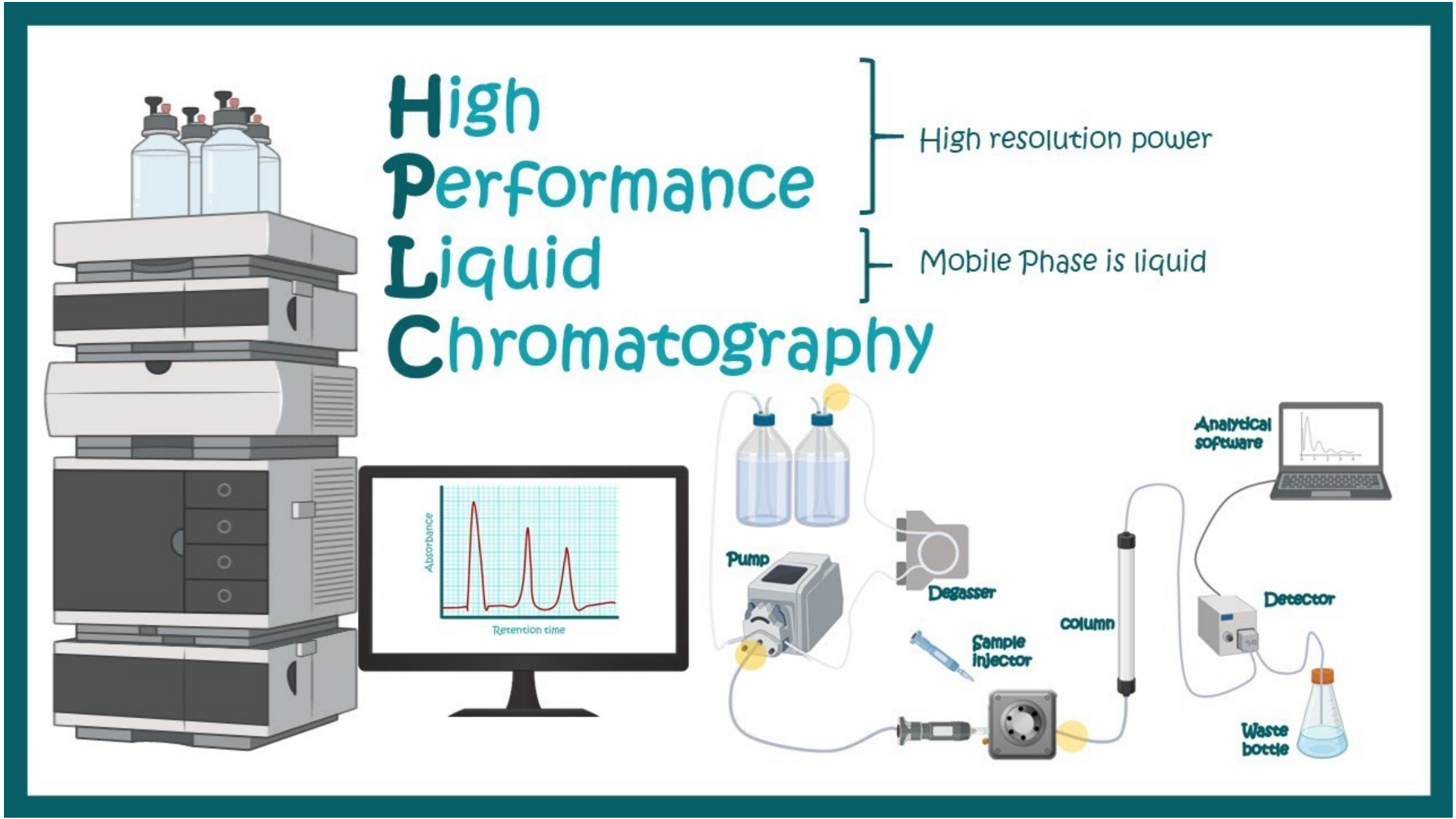


Clean-up*

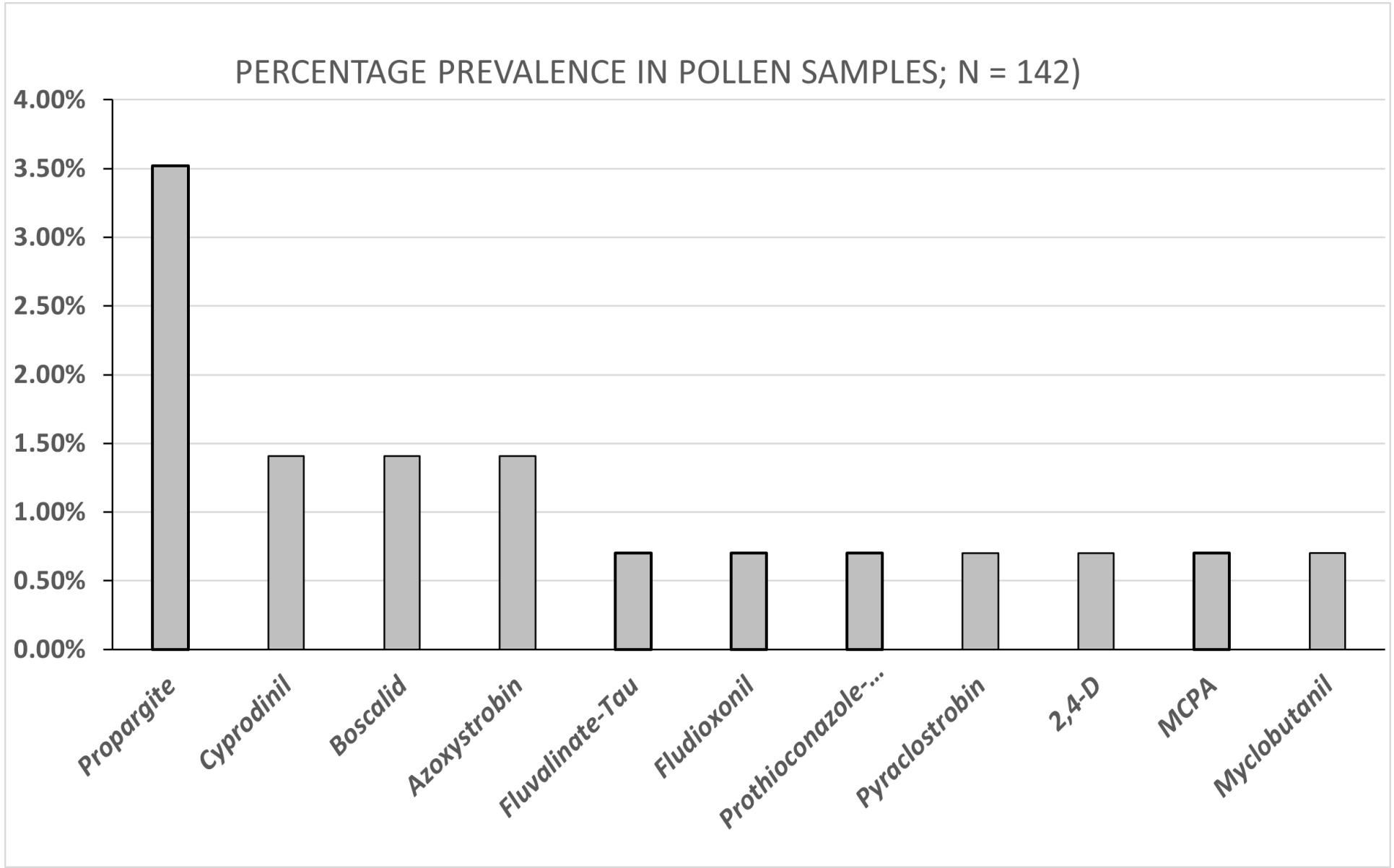
Analysis

GC-QQQ
LC-MS/MS

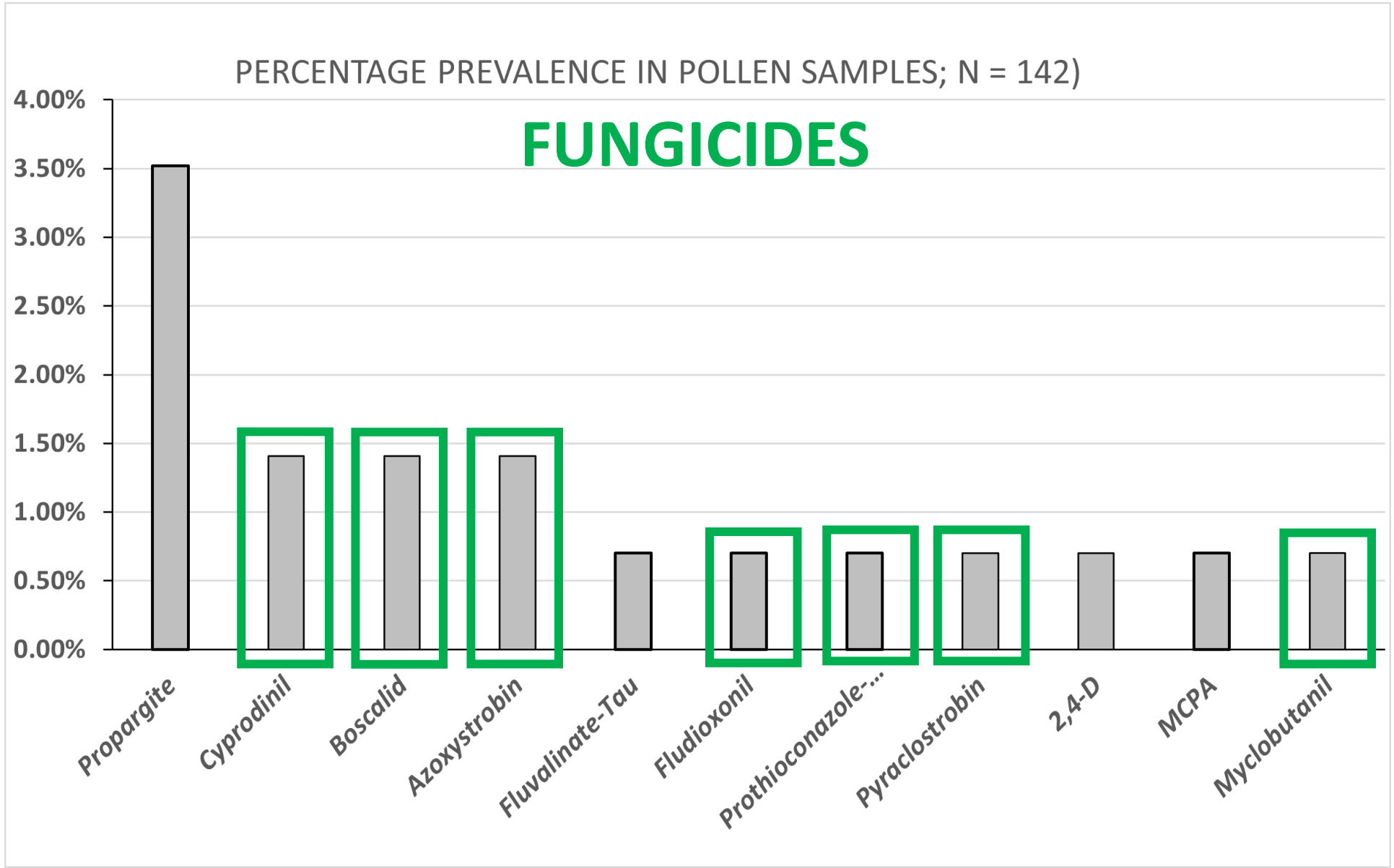
Screening for 360 pesticides



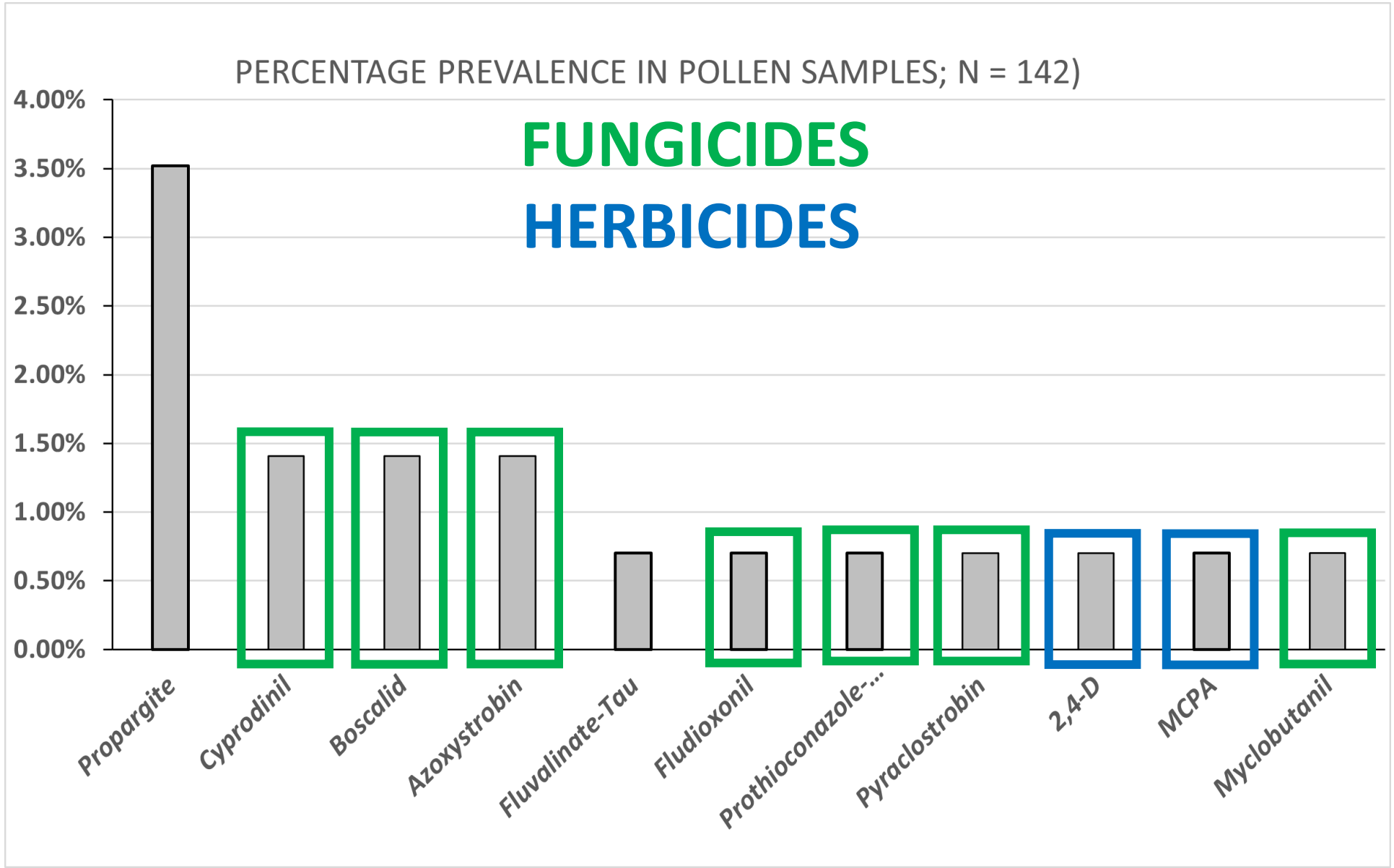
Pesticide prevalence fairly low



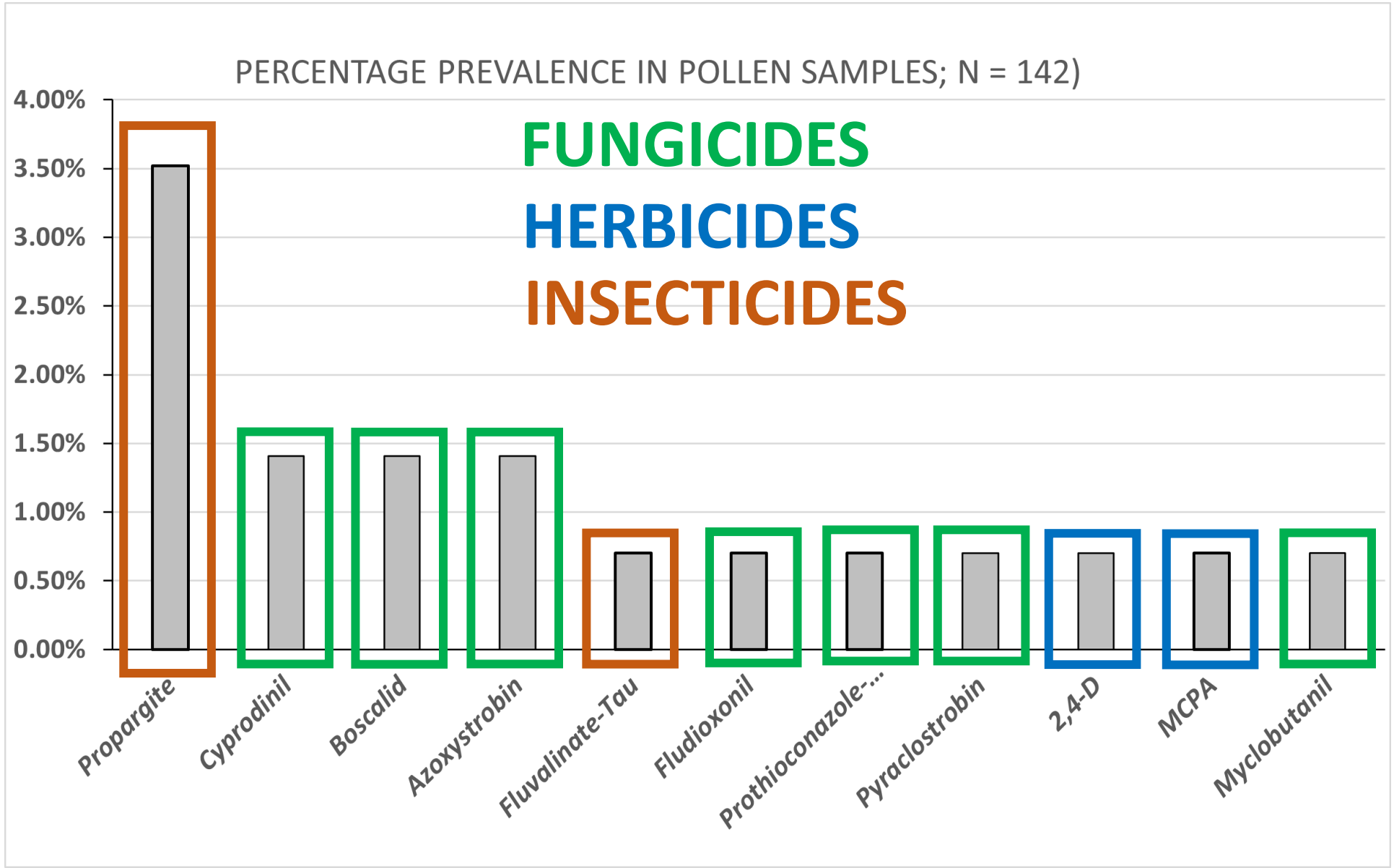
Pesticide prevalence fairly low



Pesticide prevalence fairly low



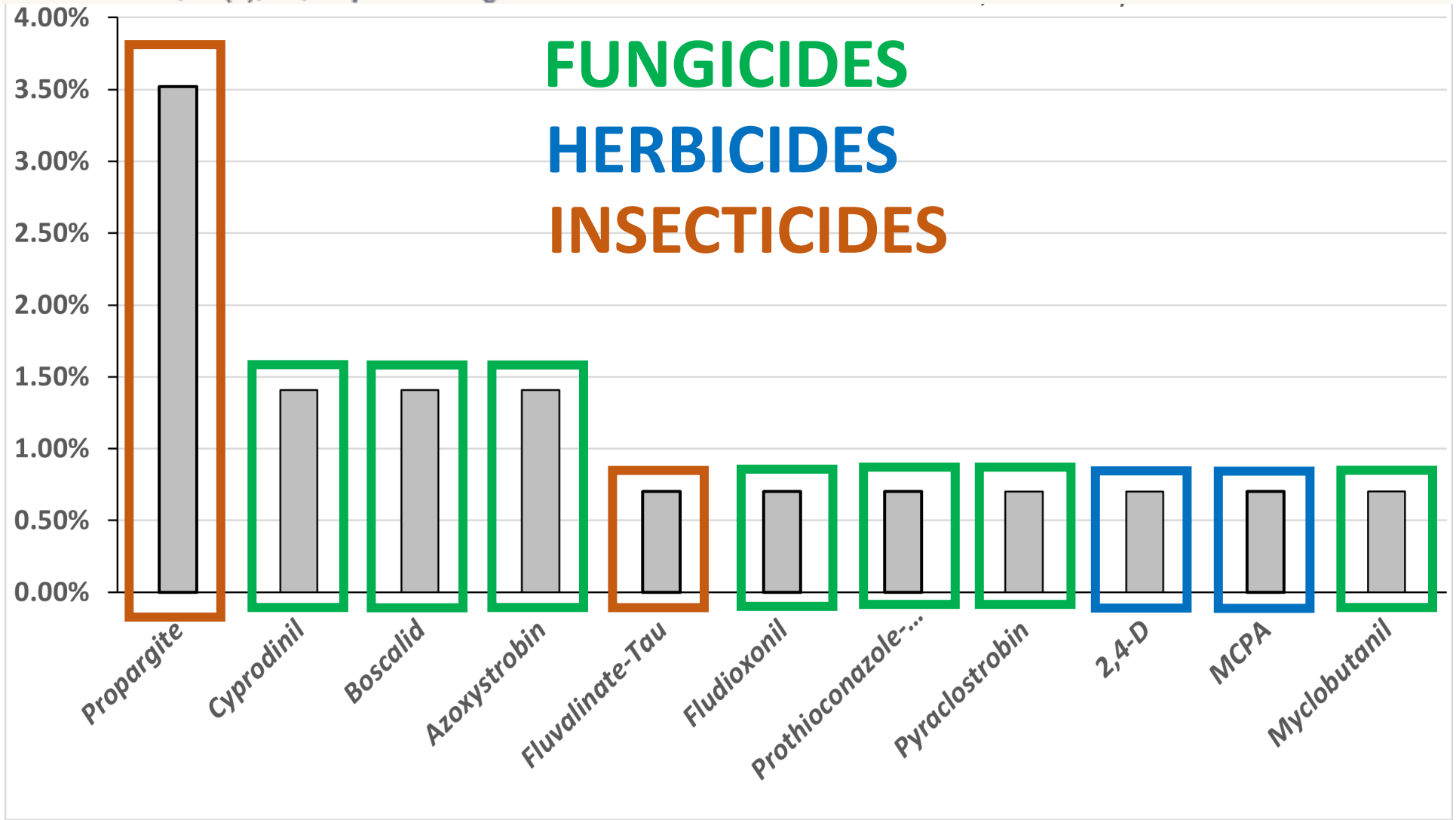
Pesticide prevalence fairly low



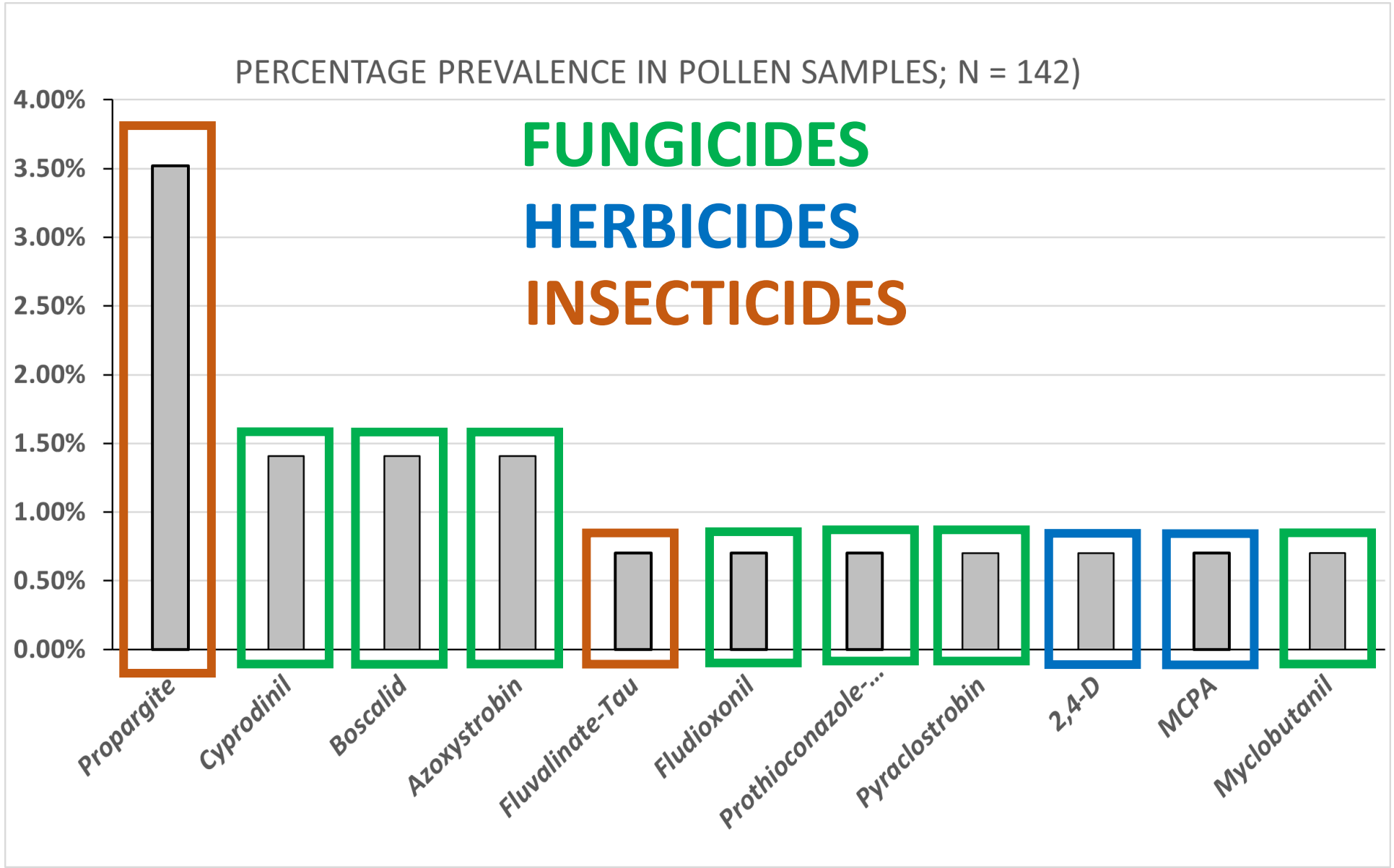
Honey Bee Exposure to Pesticides: A Four-Year Nationwide Study

by Nancy Ostiguy [1,*], Frank A. Drummond [2], Kate Aronstein [3], Brian Eitzer [4], James D. Ellis [5], Marla Spivak [6] and Walter S. Sheppard [7]

Insects **2019**, *10*(1), 13; https://doi.org/10.3390/insects10010013



Pesticide prevalence fairly low



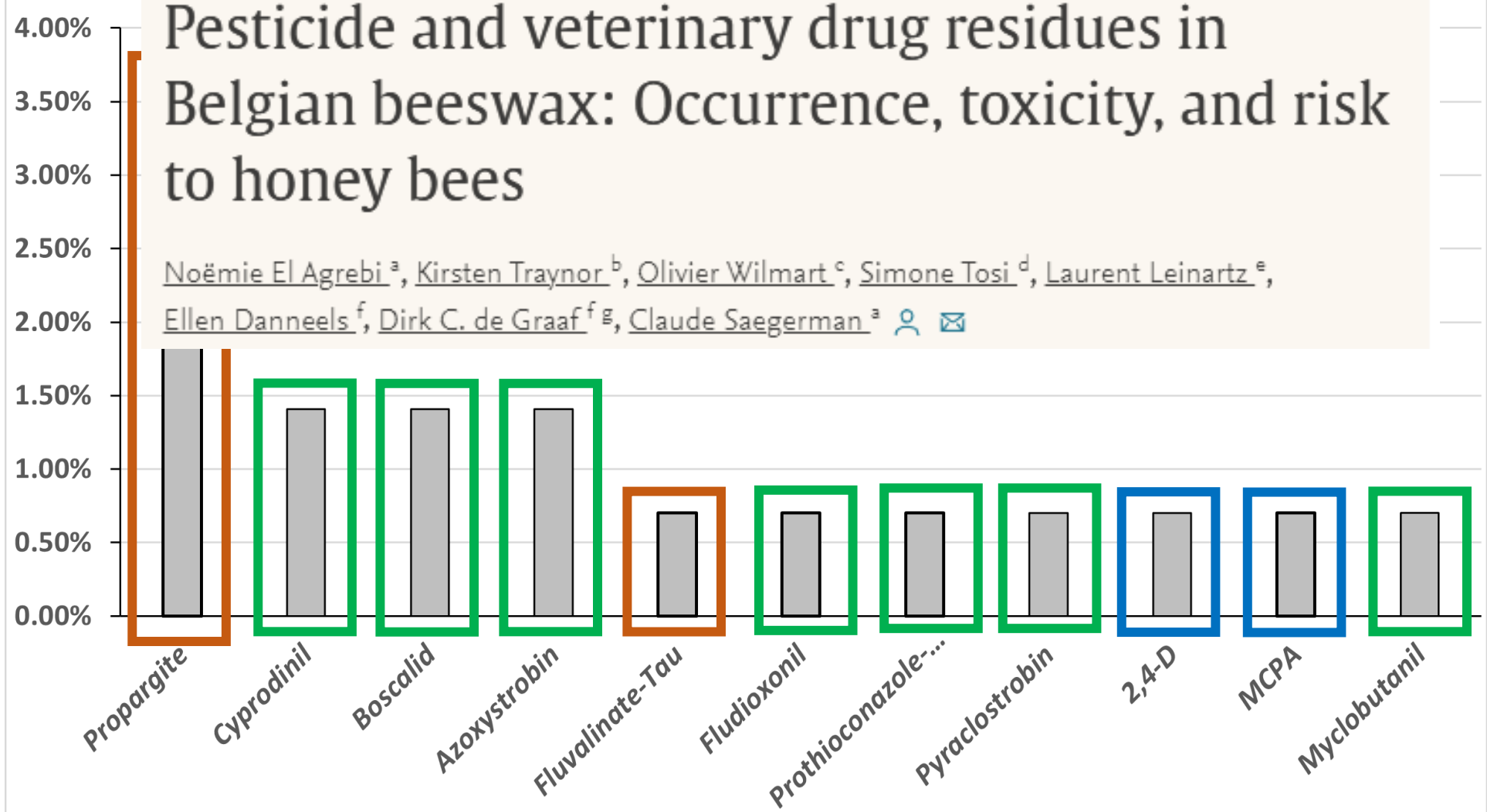
ELSEVIER

Science of The Total Environment

Volume 745, 25 November 2020, 141036

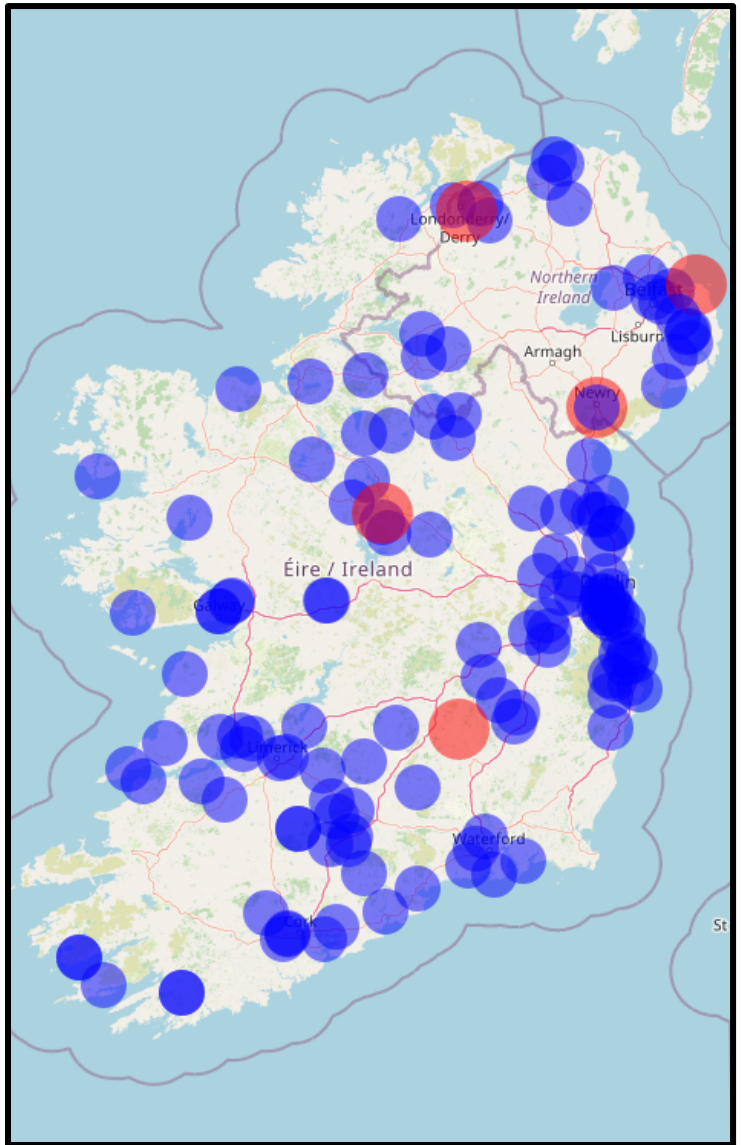
Pesticide and veterinary drug residues in Belgian beeswax: Occurrence, toxicity, and risk to honey bees

Noëmie 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]

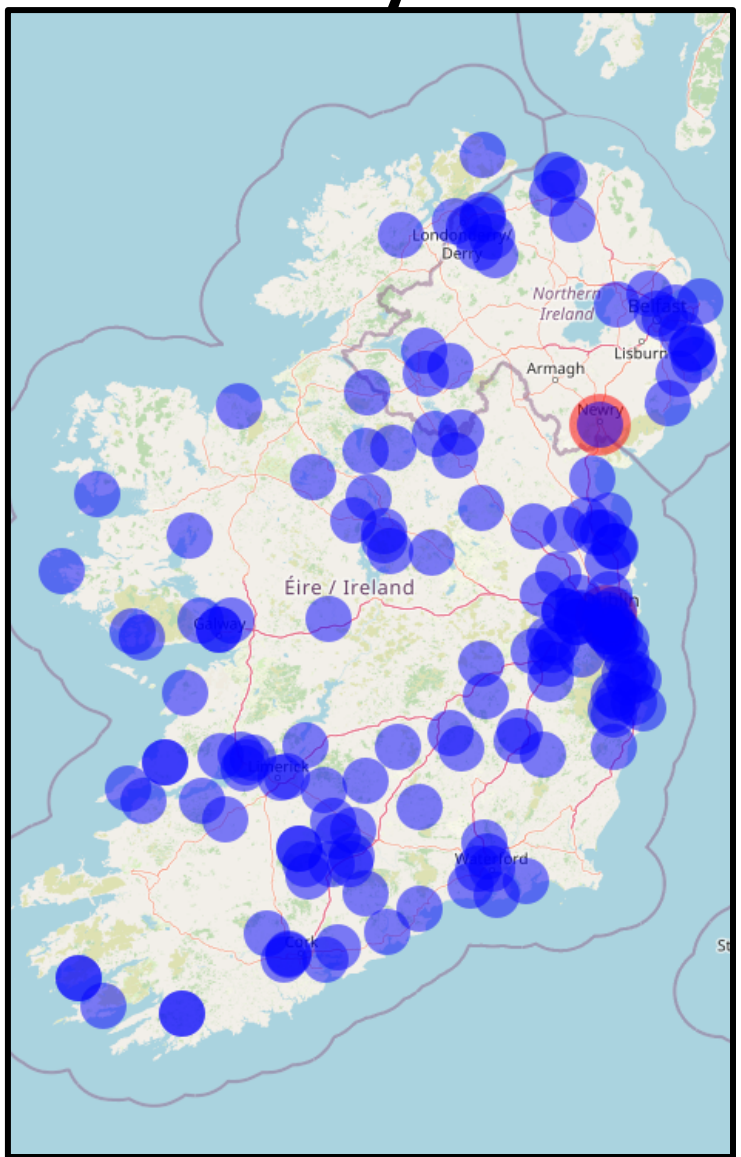


Results – Propargite distribution

- Pollen



- Honey



What does it mean for hives?

What does it mean for hives?

- Relating beekeeper colony loss data from sampled apiaries to pathogen load

What does it mean for hives?

- Relating beekeeper colony loss data from sampled apiaries to pathogen load

- Proportion of hives surviving over-winter ~ environmental factors + pesticide_01 + pesticide_02 + . . . pesticide_*n*

What does it mean for hives?

- Relating beekeeper colony loss data from sampled apiaries to pathogen load

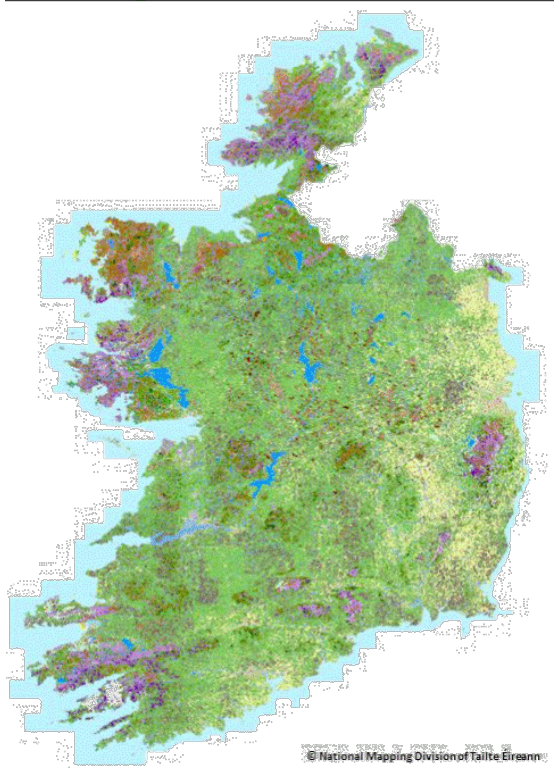
- Proportion of hives surviving over-winter ~ environmental factors + pesticide_01 + pesticide_02 + . . . pesticide_*n*

- No significant impact on colony survival by pesticides

Next steps for pesticide work

Next steps for pesticide work

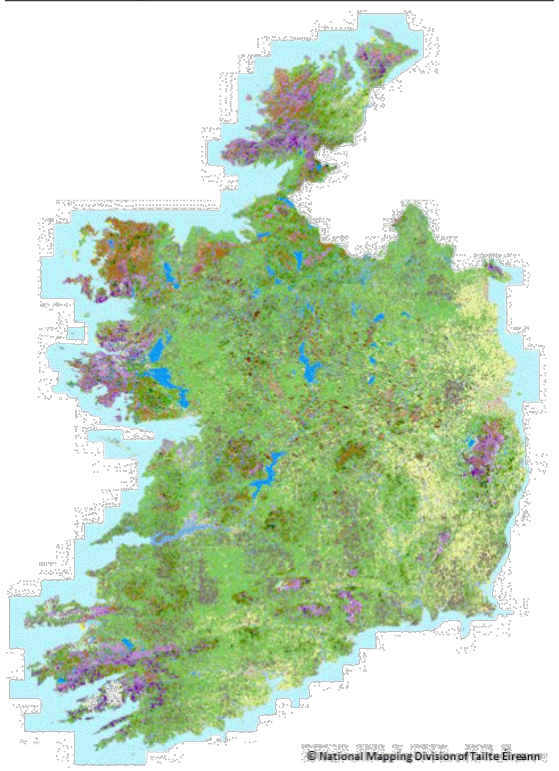
- Look at how exposure is impacted by land use - new National Landcover Map

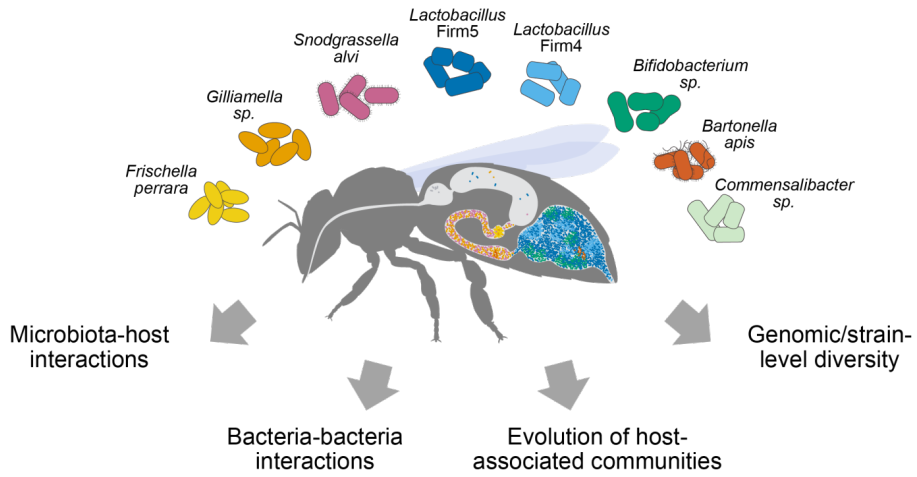


Next steps for pesticide work

- Look at how exposure is impacted by land use - new National Landcover Map

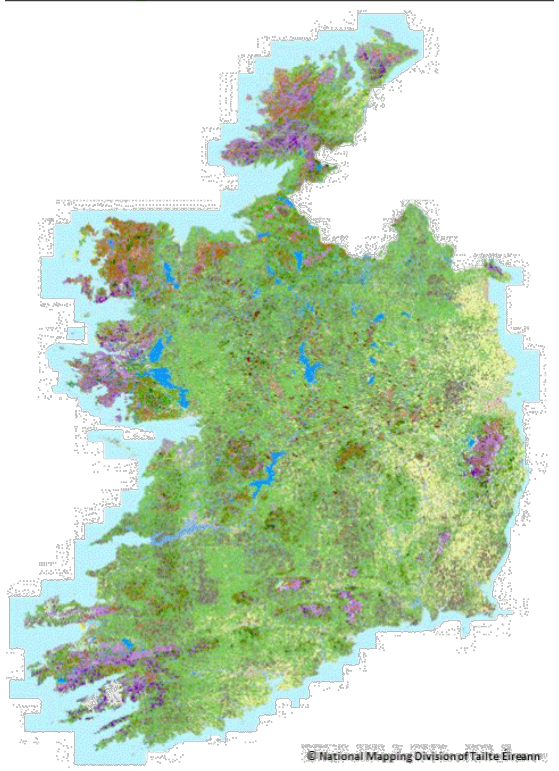
- Assess the interaction with gut microbiota

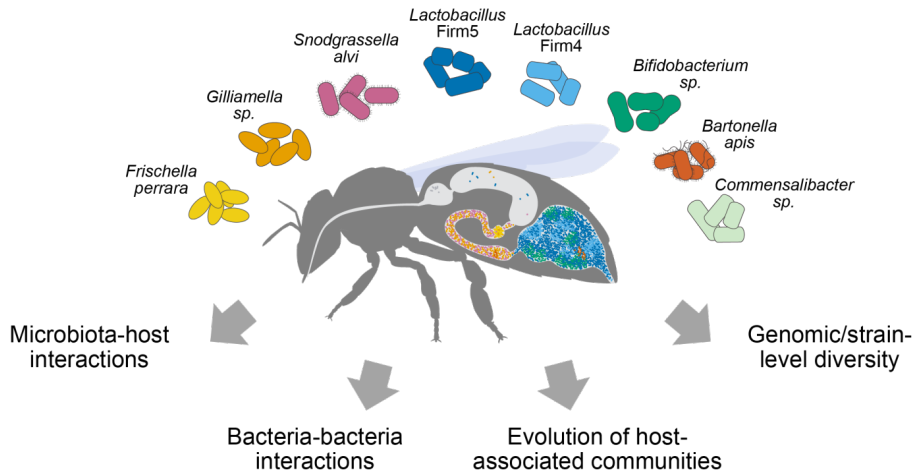




Next steps for pesticide work

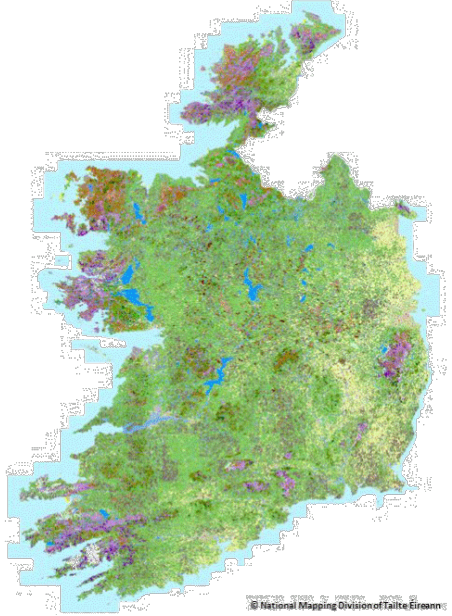
- Look at how exposure is impacted by land use - new National Landcover Map
- Assess the interaction with gut microbiota
- Investigate cryptic inputs



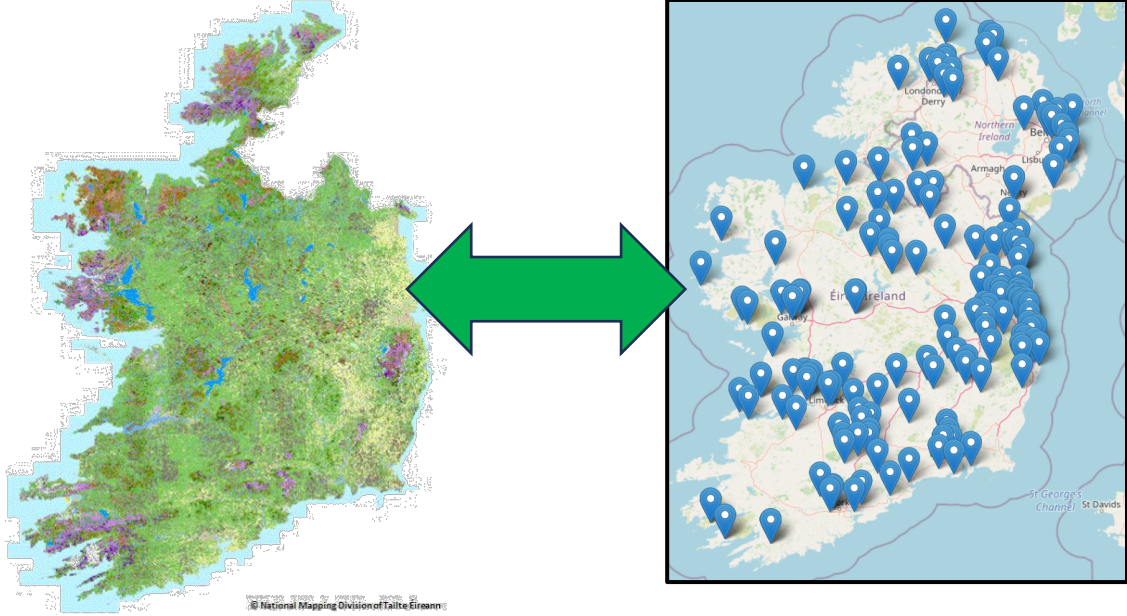


Pesticide exposure – land cover relationship

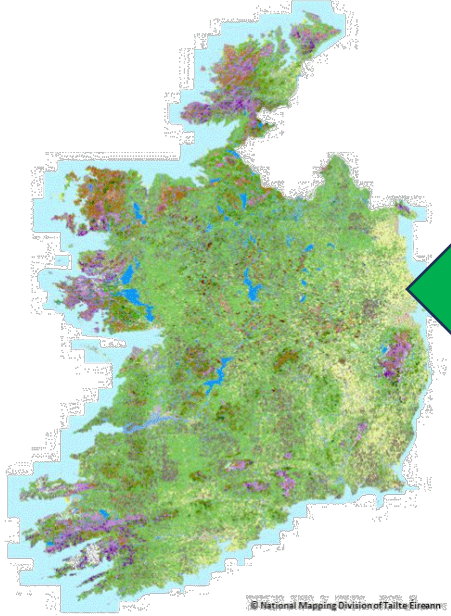
Pesticide exposure – land cover relationship

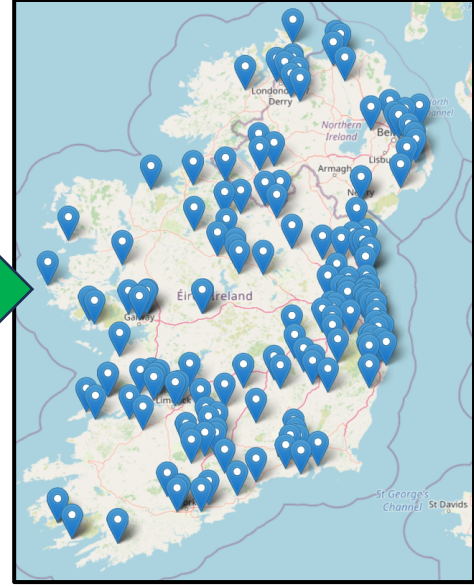


Pesticide exposure – land cover relationship

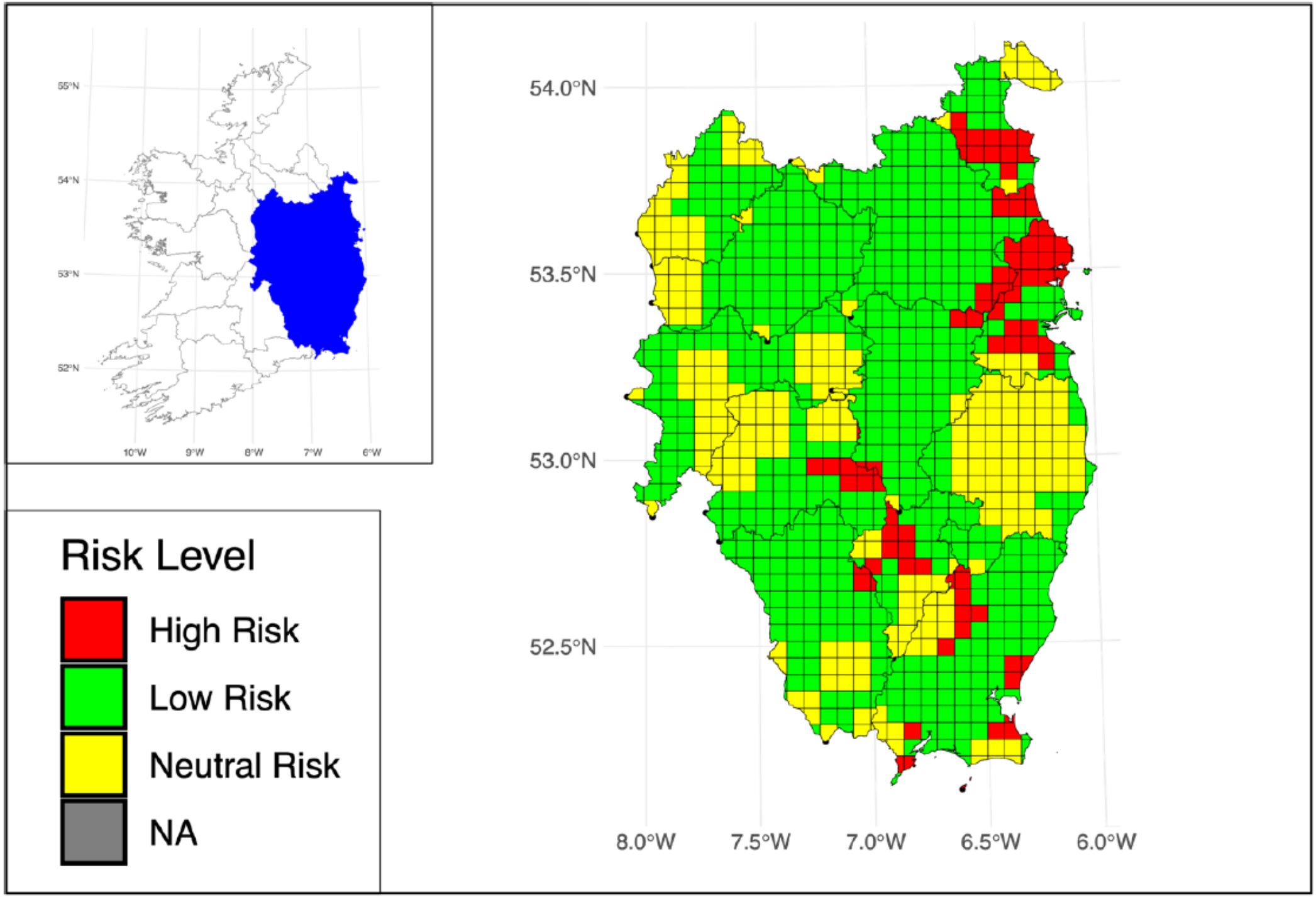


Pesticide exposure – land cover relationship





LULC variable	Predicted no. of pesticides	Risk
Artificial surfaces	7.262	High
Cultivated land	6.108	High
Exposed surfaces	5.306	High
Waterbodies	5.101	Neutral
Heath & Bracken	4.747	Neutral
Peatland	3.829	Low
Grassland	2.521	Low


55°N
54°N
53°N
52°N
10°W
9°W
8°W
7°W
6°W
54.0°N
53.5°N
53.0°N
52.5°N
8.0°W
7.5°W
7.0°W
6.5°W
6.0°W
Risk Level
High Risk
Low Risk
Neutral Risk
NA

The honey bee gut microbial community

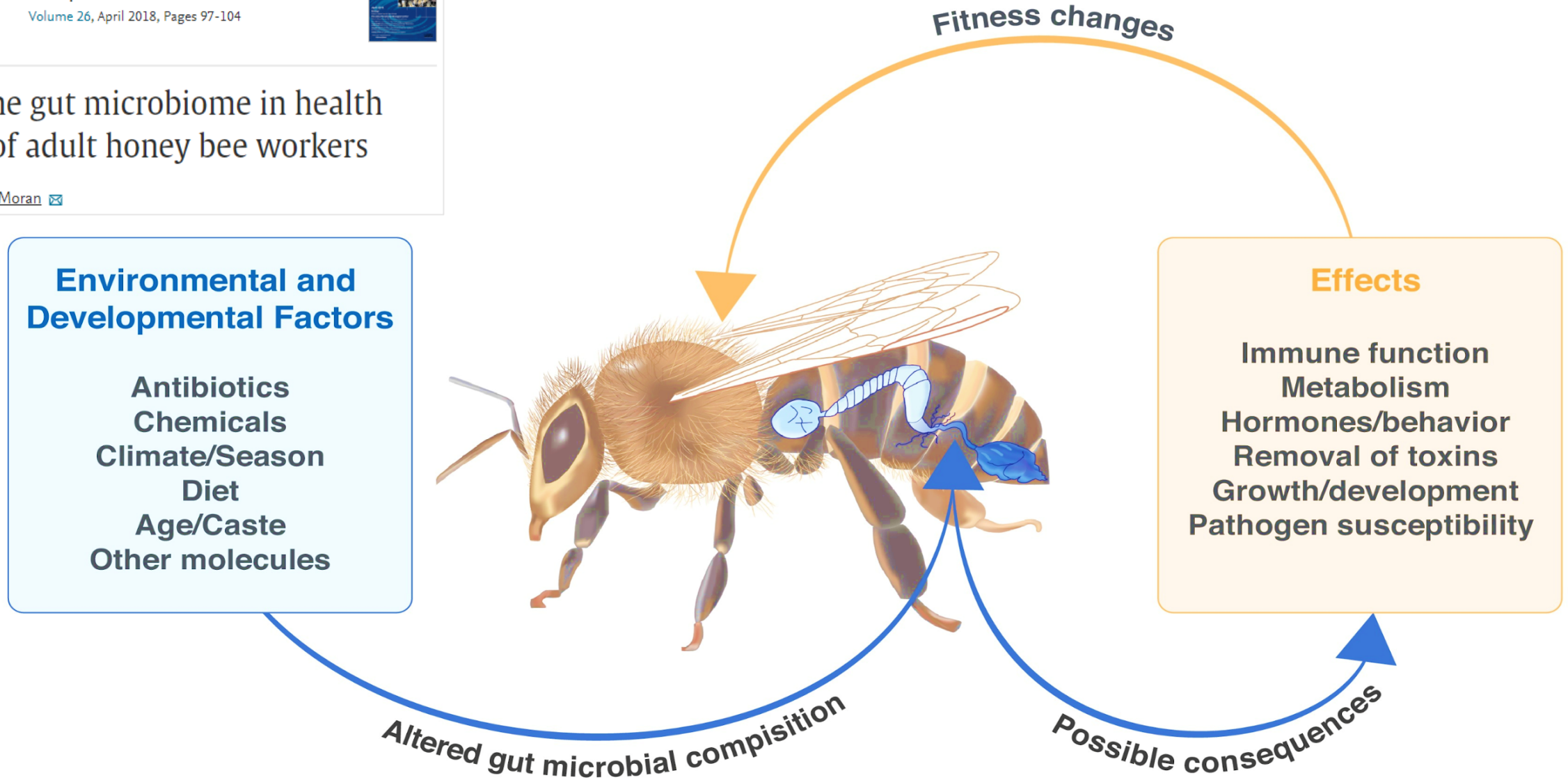
ELSEVIER

Current Opinion in Insect Science

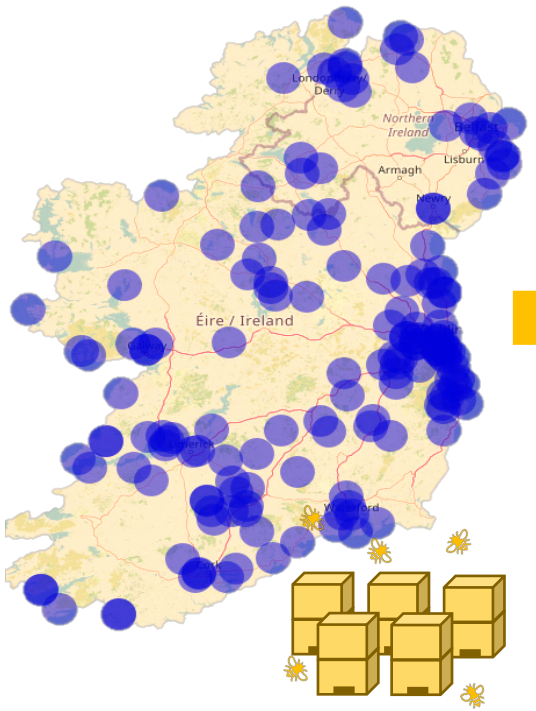
Volume 26, April 2018, Pages 97-104

The role of the gut microbiome in health and disease of adult honey bee workers

Kasie Raymann [1], Nancy A Moran



Could pesticides disrupt the microbiome?



159 apiaries sampled

Key factors	
Pathogens	✓
Pesticides	✓
Season	✓
Landscape	✓
Host genotype	?

Drivers for microbial changes

Whole Metagenome Sequencing (WMS)

Canadian Centre for Computational Genomics

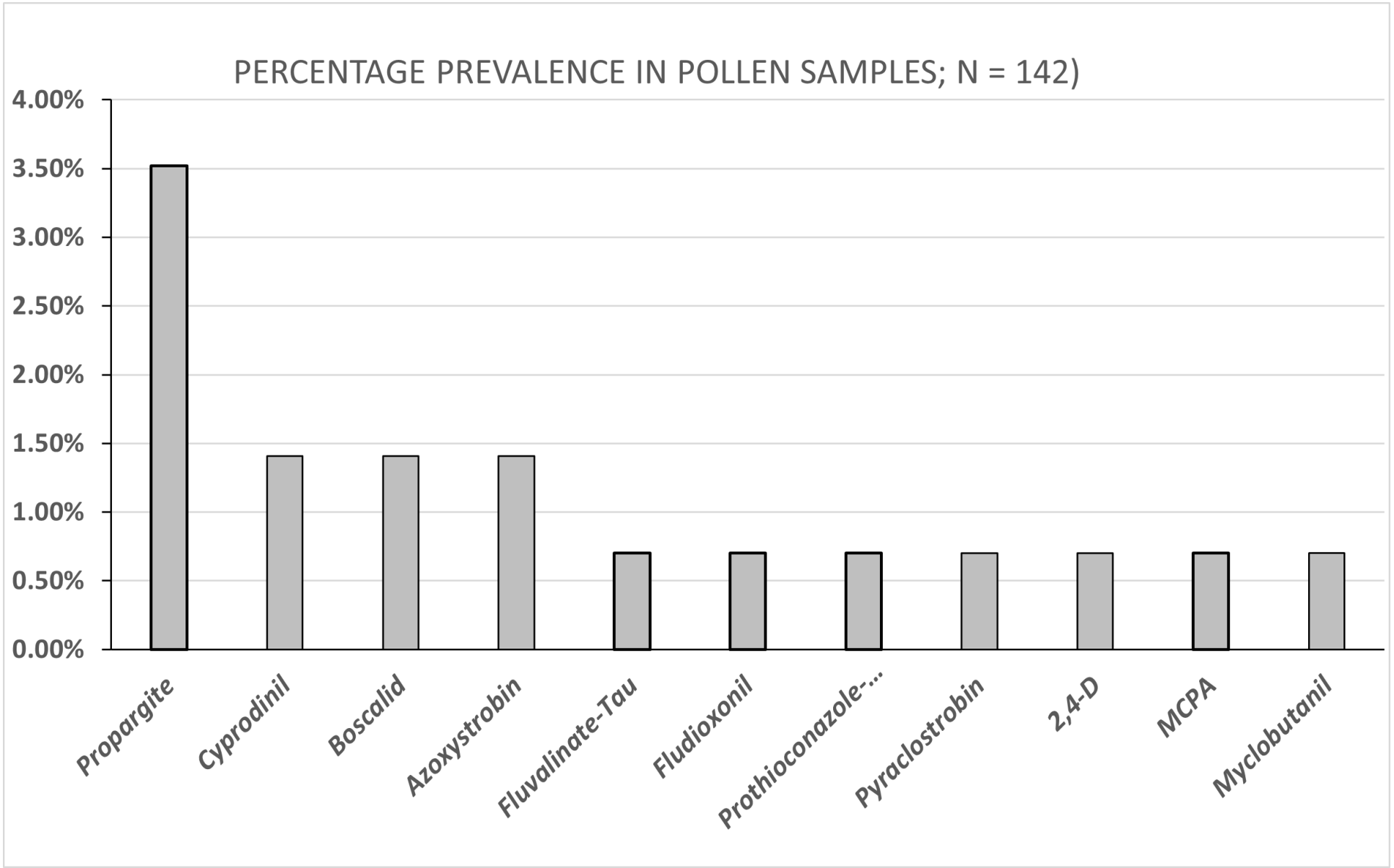
Calcul Québec

Honey bee microbiome profile

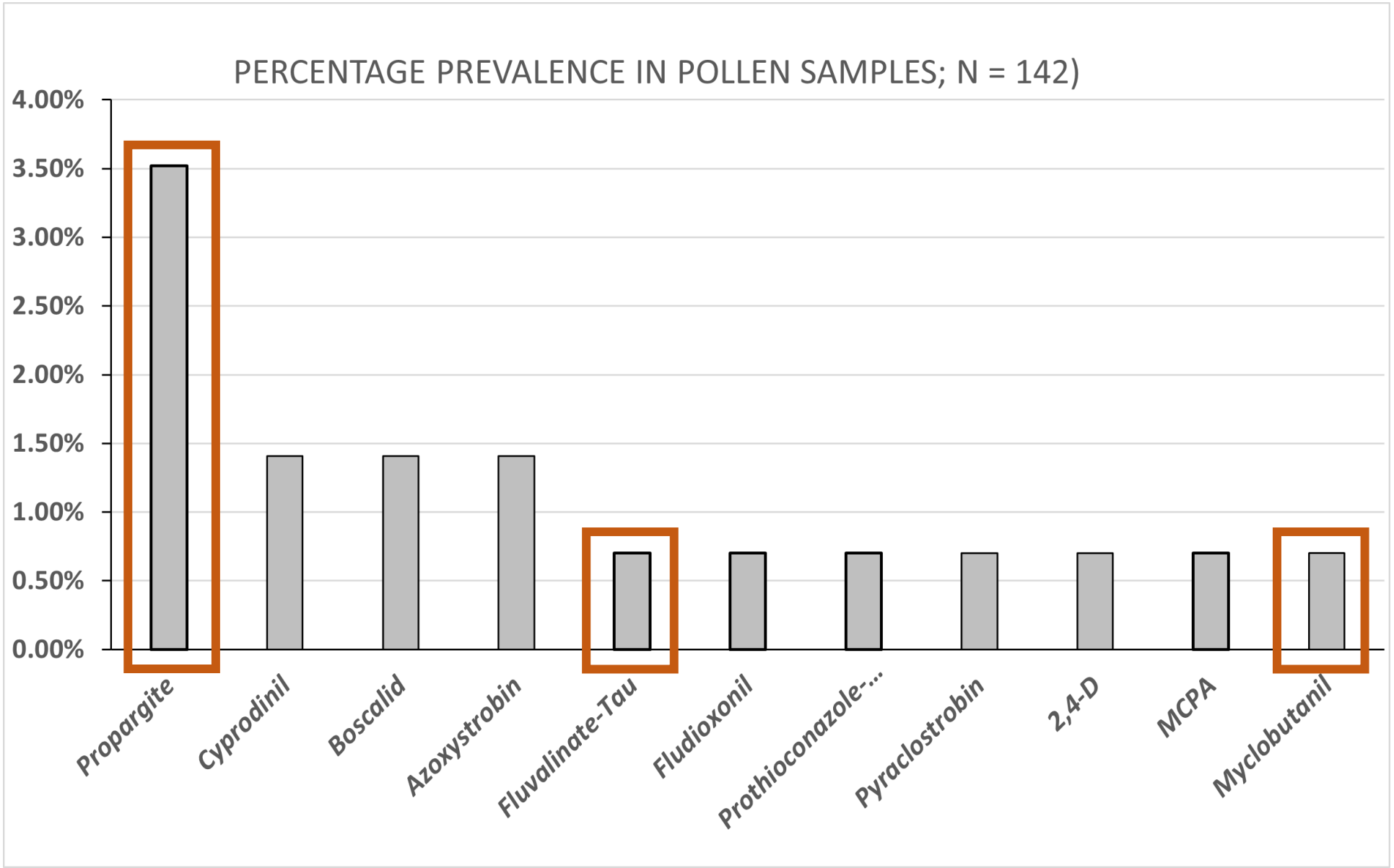
Identify target functional genes

Honey bee genotype profile

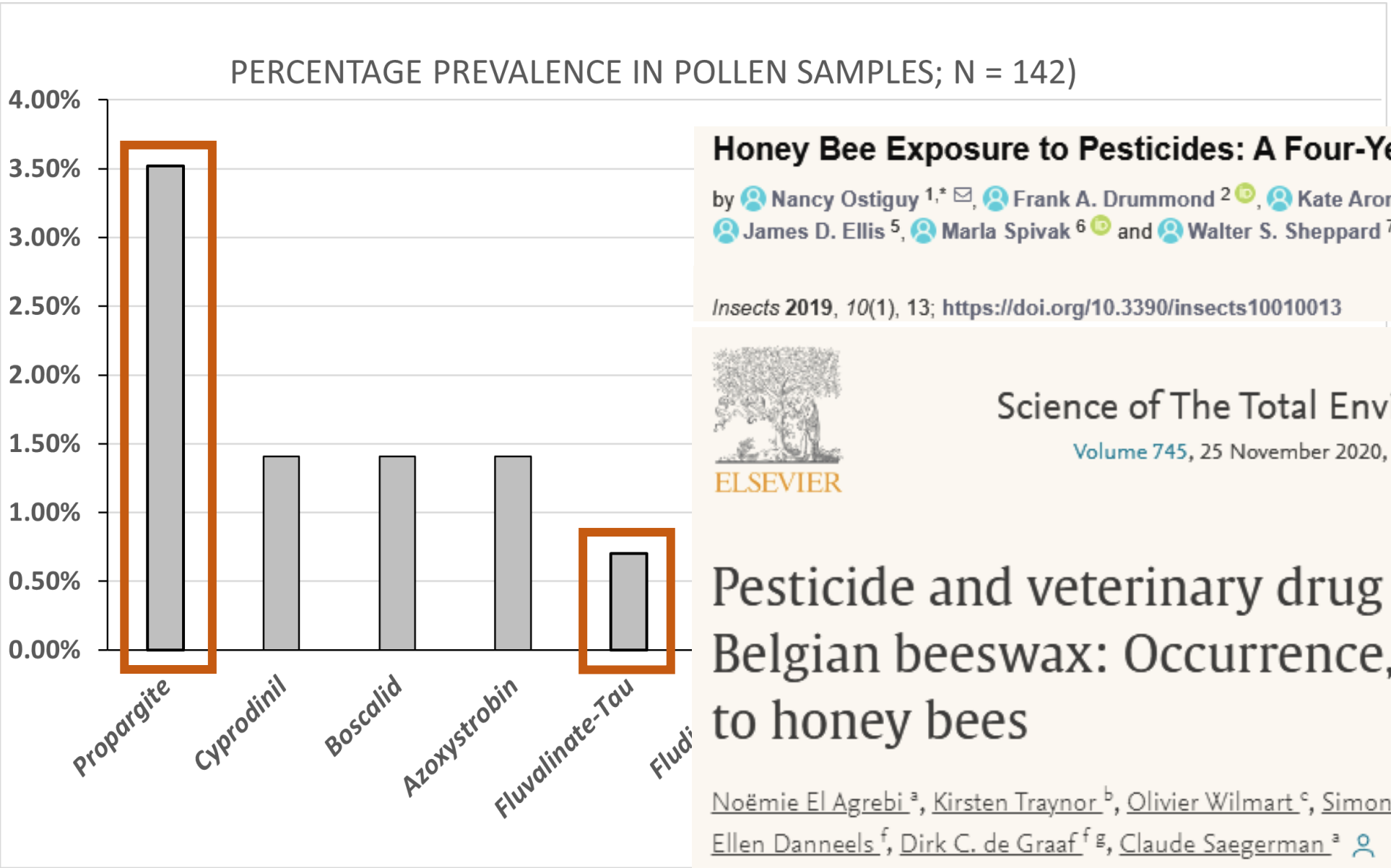
Cryptic source of pesticide exposure



Cryptic source of pesticide exposure



Cryptic source of pesticide exposure



Honey Bee Exposure to Pesticides: A Four-Year Nationwide Study

by Nancy Ostiguy [1,*], Frank A. Drummond [2], Kate Aronstein [3], Brian Eitzer [4], James D. Ellis [5], Marla Spivak [6] and Walter S. Sheppard [7]

Insects **2019**, *10*(1), 13; https://doi.org/10.3390/insects10010013

ELSEVIER

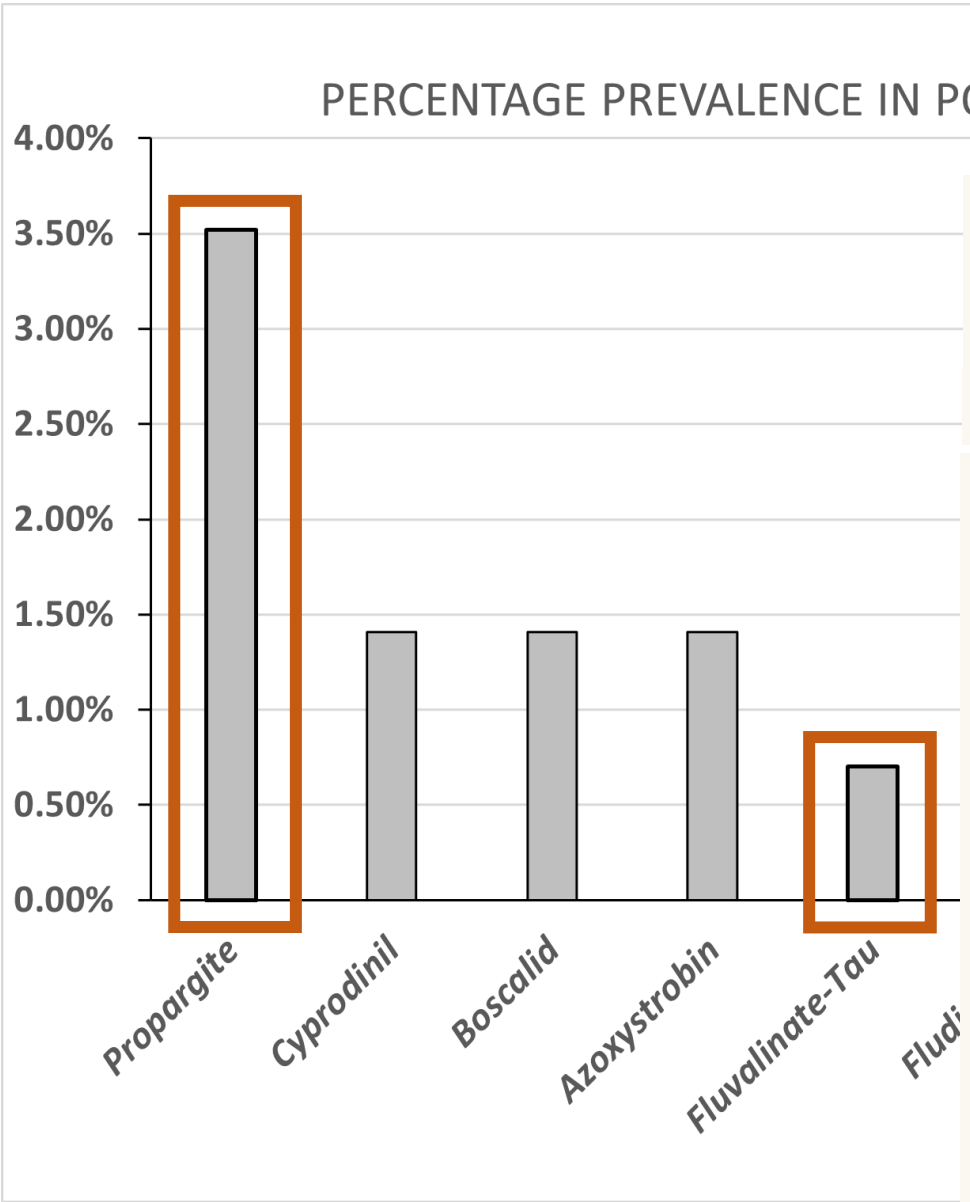
Science of The Total Environment

Volume 745, 25 November 2020, 141036

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

Noëmie 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]

Cryptic source of pesticide exposure



Honey Bee Exposure to Pesticides: A Four-Year Nationwide Study

by Nancy Ostiguy [1,*], Frank A. Drummond [2], Kate Aronstein [3], Brian Eitzer [4], James D. Ellis [5], Marla Spivak [6] and Walter S. Sheppard [7]

Insects **2019**, *10*(1), 13; https://doi.org/10.3390/insects10010013

ELSEVIER

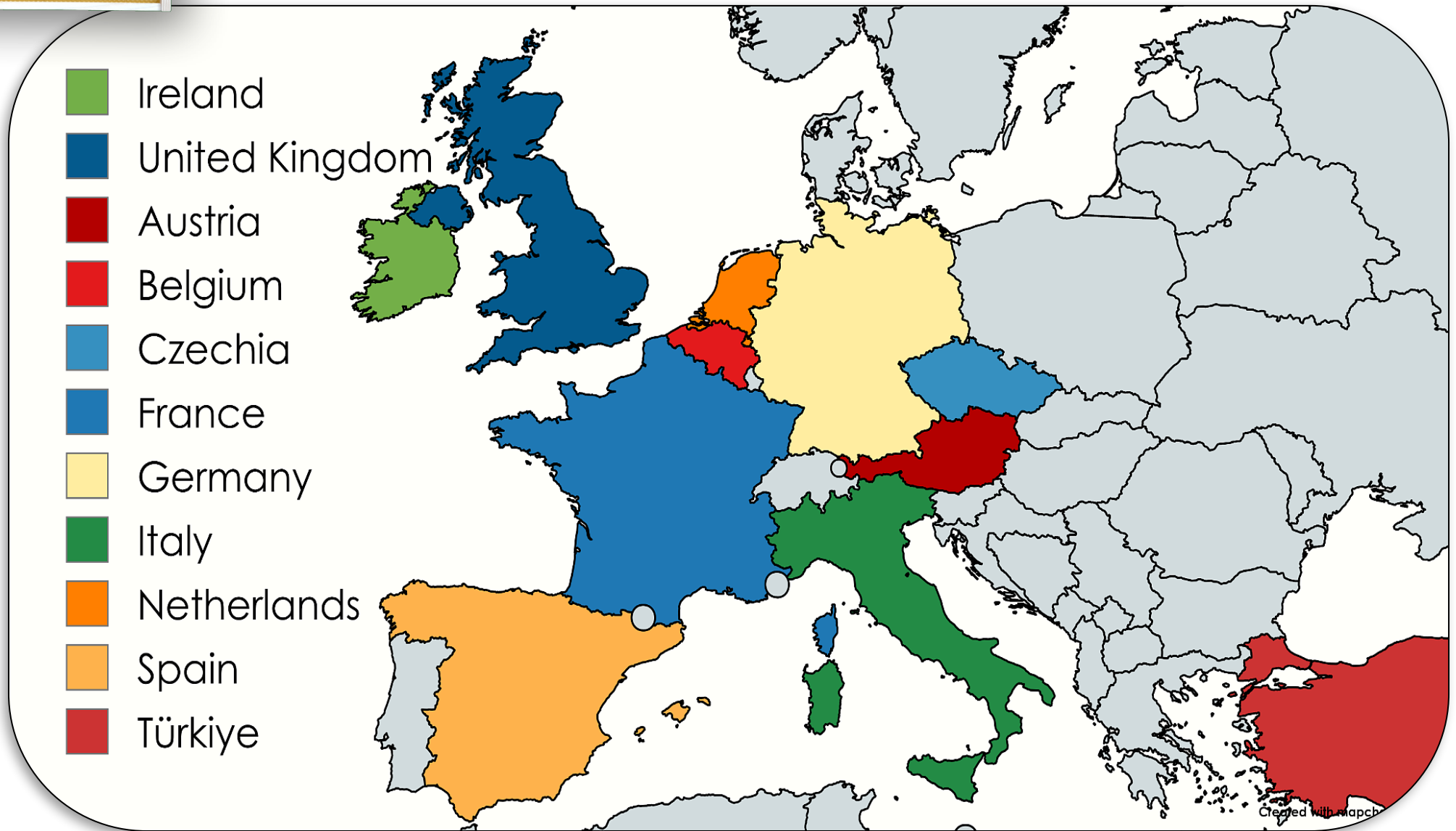
Science of The Total Environment

Volume 745, 25 November 2020, 141036

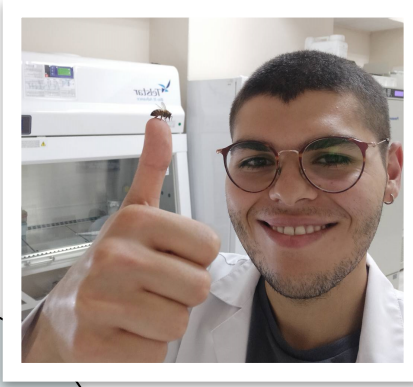
Pesticide and veterinary drug residues in Belgian beeswax: Occurrence, toxicity, and risk to honey bees

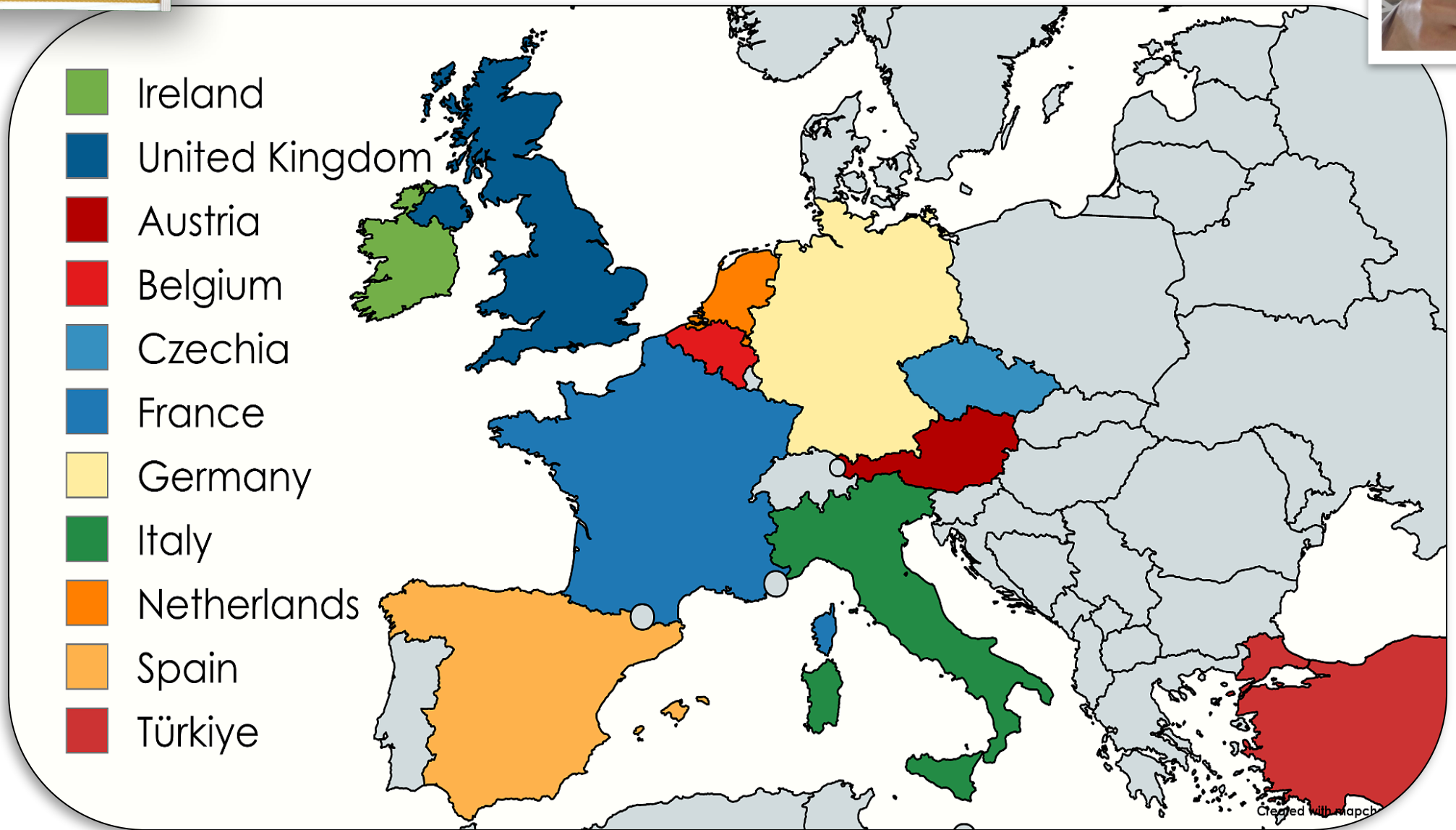
Noëmie El Agrebi [a], Kirsten Traynor [b], Olivier Wilmart [c], Simone Tosi [d], Laurent Leinartz [e], Ellen Danneels [f], Dirk C. de Graaf [f g], Claude Saegerman [a]

Screening of wax sources

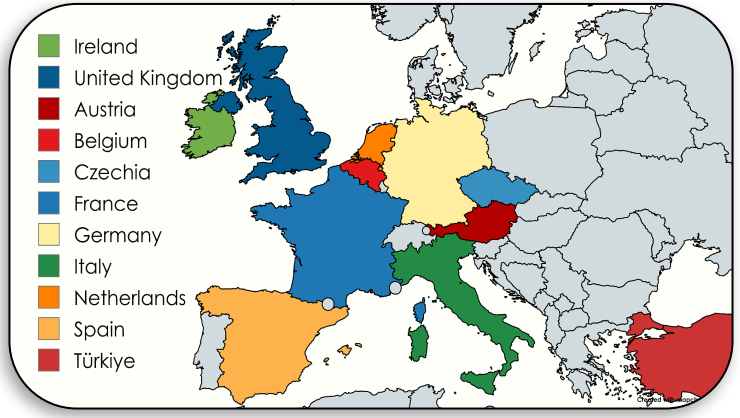


Screening of wax sources





Assessment of exposure risk

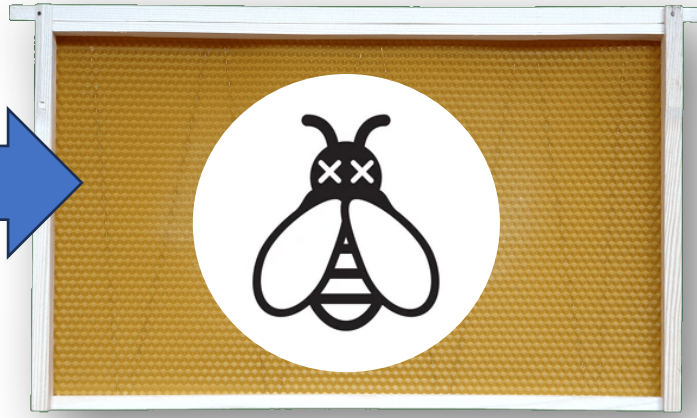


Commercially supplied wax foundation

QuEChERS Extraction

Pesticide detection

UHPLC-MS/MS and GC-MS/MS



Toxicity Risk Assessment

Overall pesticide results

Overall pesticide results

- Pesticides prevalence generally low

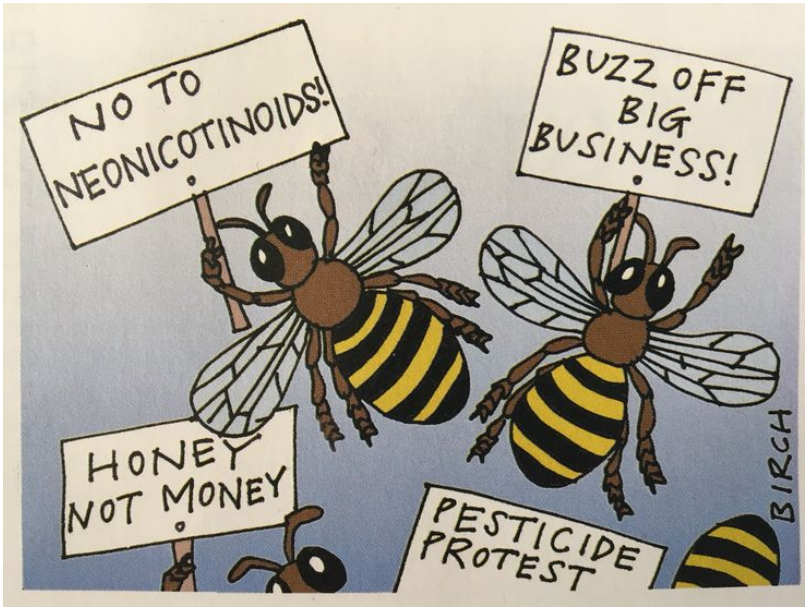
Overall pesticide results

- Pesticides prevalence generally low

- Only a small number of apiaries had more than one pesticide – important as pesticide synergies can be dangerous

Overall pesticide results

- Pesticides prevalence generally low
- Only a small number of apiaries had more than one pesticide – important as pesticide synergies can be dangerous
- No neonicotinoids



Overall pesticide results

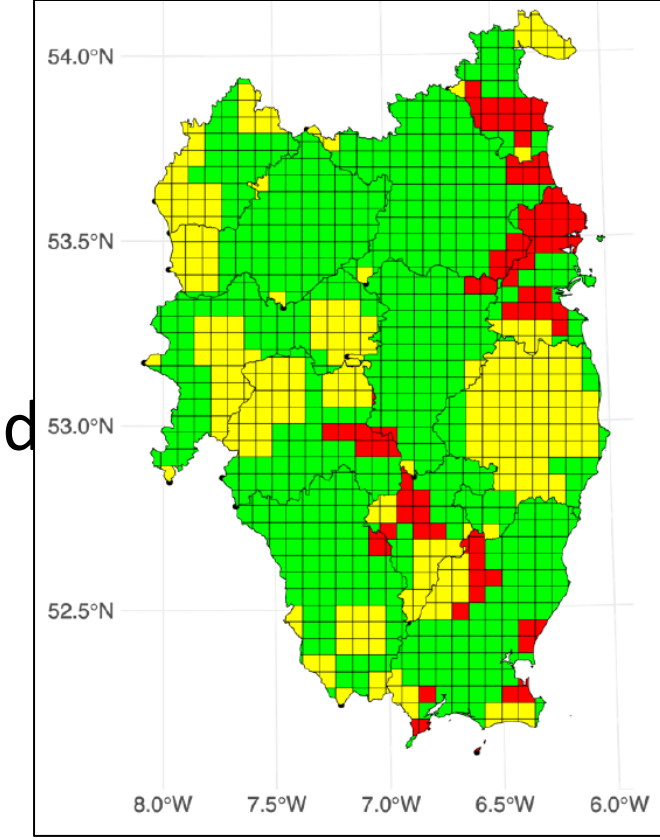
- Pesticides prevalence generally low
- Only a small number of apiaries had more than one pesticide – important as pesticide synergies can be dangerous
- No neonicotinoids
- No relationship with colony loss

Overall pesticide results

- Pesticides prevalence generally low
- Only a small number of apiaries had more than one pesticide – important as pesticide synergies can be dangerous
- No neonicotinoids
- No relationship with colony loss
- Next steps;

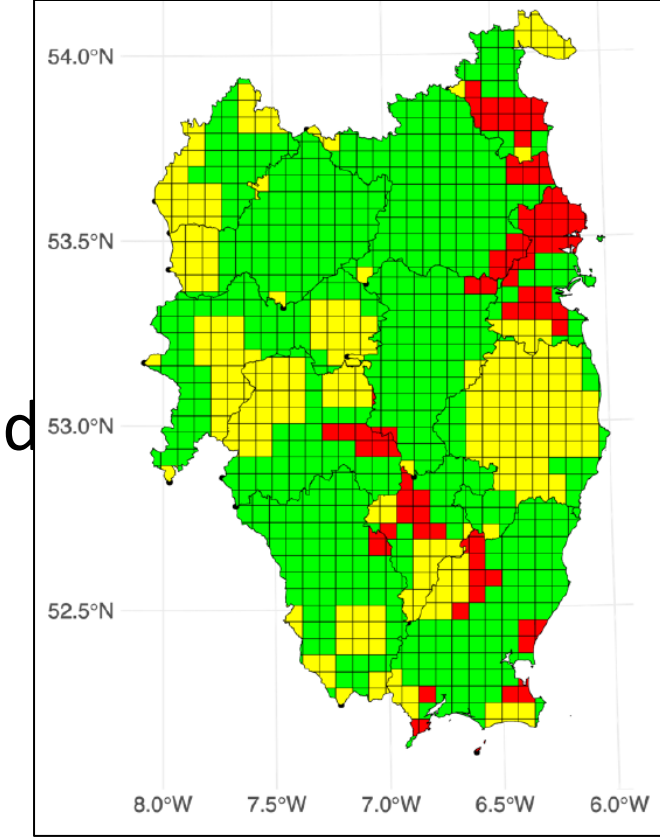
Overall pesticide results

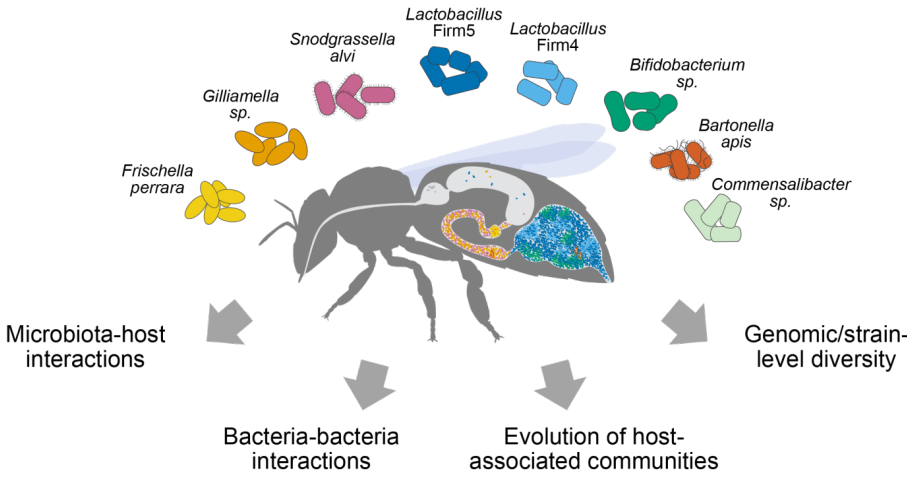
- Pesticides prevalence generally low
- Only a small number of apiaries had more than one pesticid – important as pesticide synergies can be dangerous
- No neonicotinoids
- No relationship with colony loss
- Next steps;
  - Mapping land cover risk



Overall pesticide results

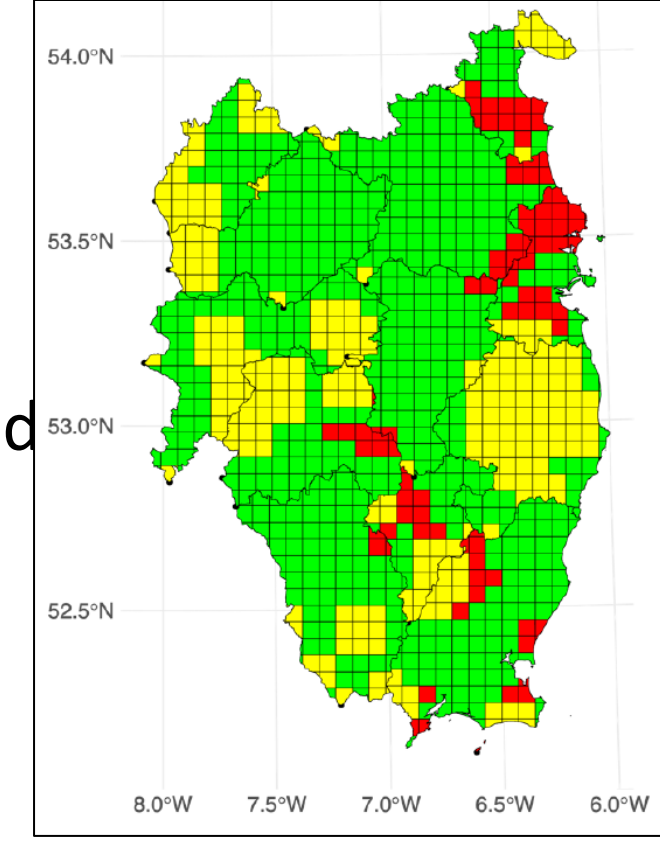
- Pesticides prevalence generally low
- Only a small number of apiaries had more than one pesticid – important as pesticide synergies can be dangerous
- No neonicotinoids
- No relationship with colony loss
- Next steps;
  - Mapping land cover risk
  - Finer measures of honey bee response

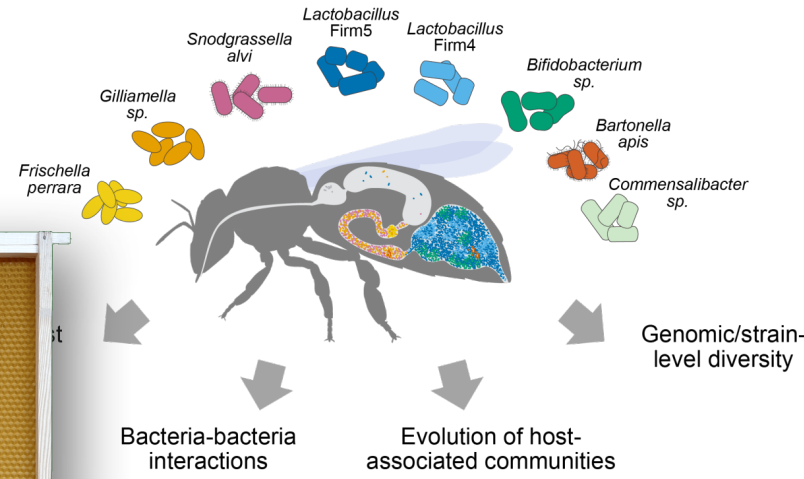




Overall pesticide results

- Pesticides prevalence generally low
- Only a small number of apiaries had more than one pesticid – important as pesticide synergies can be dangerous
- No neonicotinoids
- No relationship with colony loss
- Next steps;
  - Mapping land cover risk
  - Finer measures of honey bee response
  - Assessing sources of exposure



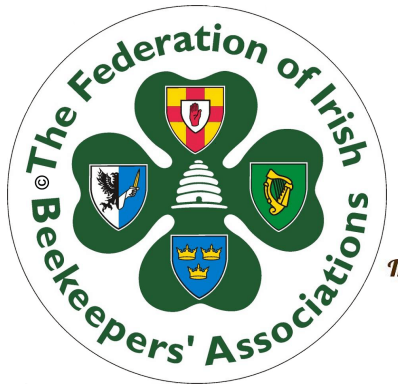


Acknowledgements

An Roinn Talmhaíochta,
Bia agus Mara
Department of Agriculture,
Food and the Marine

IRIAF
Instituto Regional de Investigación y Desarrollo
Agroalimentario y Forestal
Castilla-La Mancha

eagasc
Agriculture and Food Development Authority



Acknowledgements