REGIONE PIEMONTE

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Villafranca Piemonte (TO)

SEMINARIO BIO-AGRI-APIS

BIO-MONITORAGGIO
AGRI-COLTURA
APIS-MELLIFERA

Le api: sentinelle della salute ambientale

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Bee behaviour

There is so much to discover about the behaviour of bees that we can't stop buzzing.

Pesticides

Pesticides are a major stressor for bees, influencing their health and behaviour in multiple ways.

Bee nutrition

A major driver of bee health. We use bees as model species for nutrition research.

Risk Assessment

Risk assessments regulates the real world, and its refinement can lead to real changes.

Biomonitoring

Monitoring surveys are crucial to assess the real conditions of bees and our environment.

Bumblebees, solitary bees

Bumblebees and solitary bees are essential pollinators. We study their health and behaviour.

Science outreach

Because science is relevant when it reaches people. Have a look at Bee Human

...and more!

There's always more, we're just waiting for the right moment. Reach out: this might be it.

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Bioindicatori nella storia

350 B.C : Aristotele

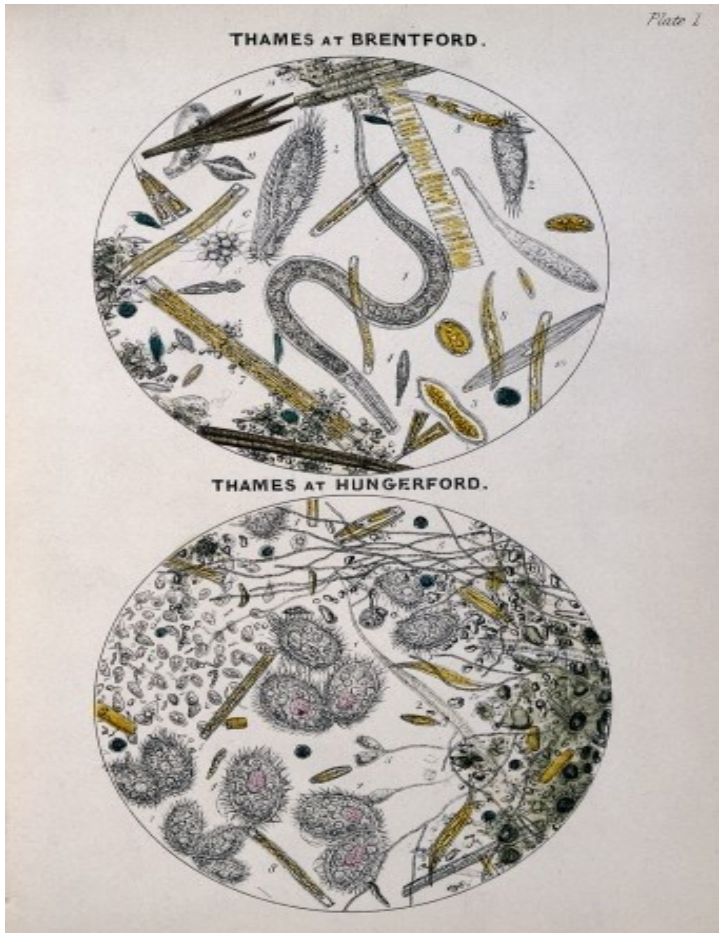
- Contaminazione da inquinamento delle acque a Megara
  - Alterazione delle comunità viventi (batteri, ditteri, vermi, …) associate a riduzione di ossigeno

Thienemann, 1912

Bioindicatori nella storia

XIX secolo

- Relazione tra inquinamento, fauna dei fiumi e la qualità delle acque potabili usando bioindicatori



An illustration from A. Hassall's book "A microscopic examination of the water supplied to the inhabitants of London and the suburban districts." 1850

A. H. Hassal, London, UK. 1850.
F. Cohn, Breslau, Poland. 1853.

Bioindicatori nella storia

XVIII-XIX secolo

- Canarini nelle miniere indicano situazioni a rischio per i minatori

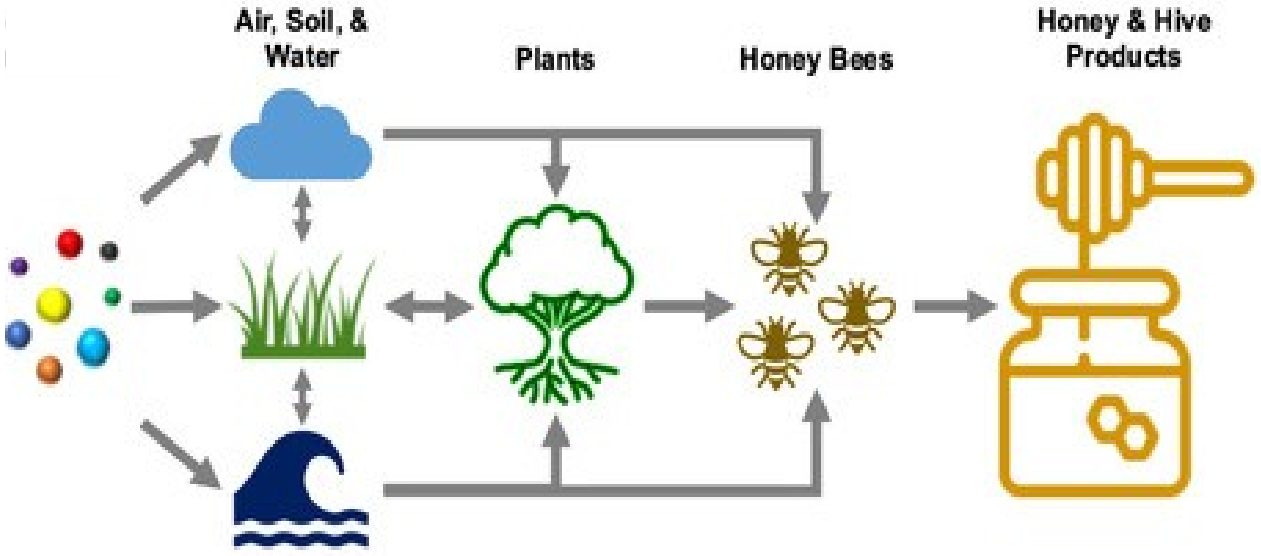
Bioindicatori nella storia

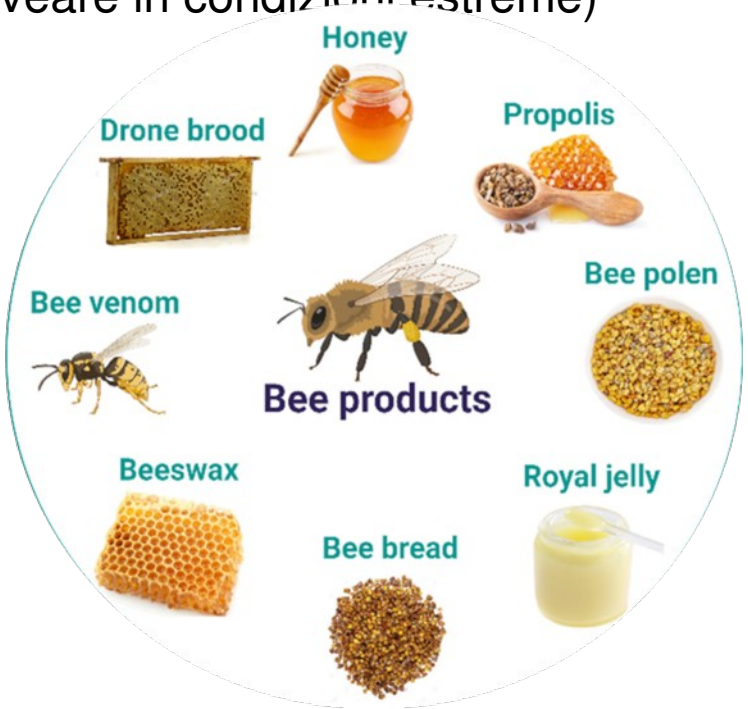
- 1850-1900
  - Crescita dei licheni associata all’inquinamento atmosferico

William Nylander, 1822–1899

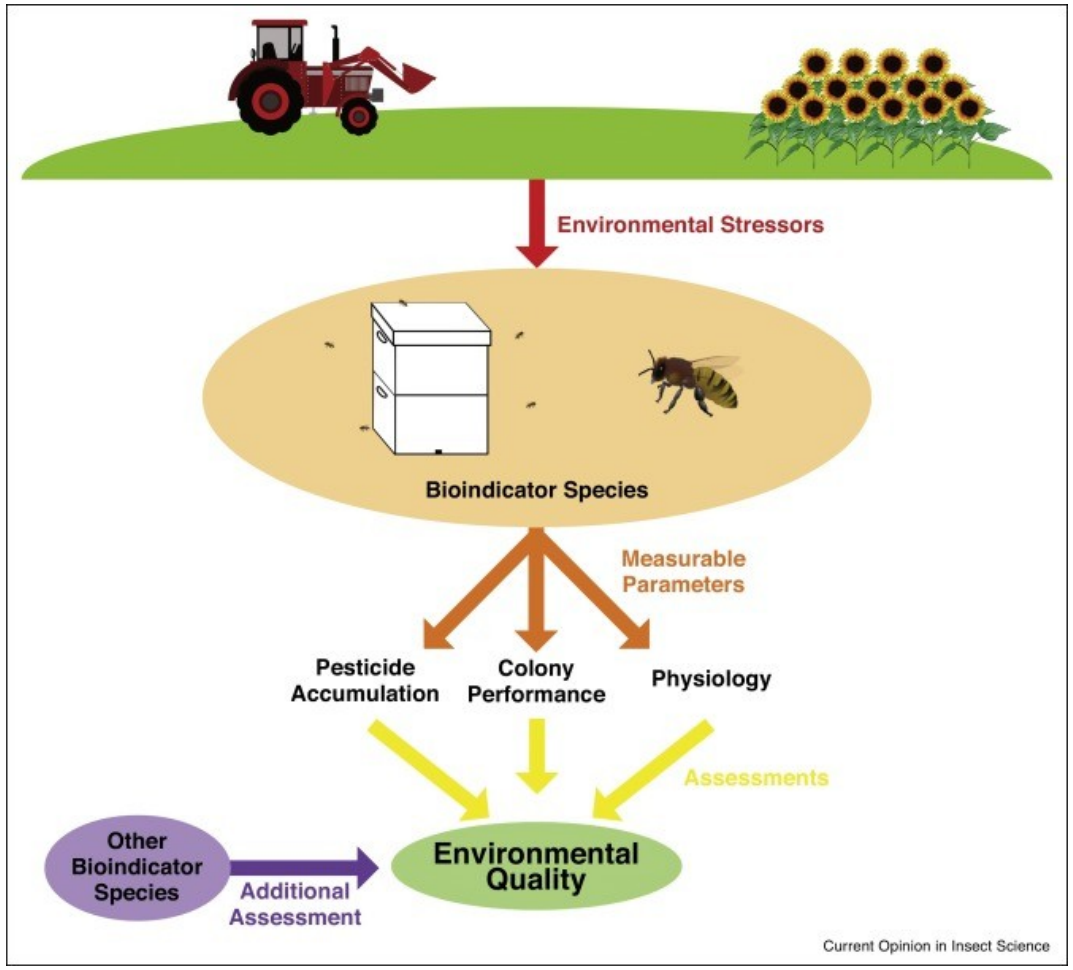
Api come bioindicatori

- Quasi ubiquitarie
- Gestite dall'uomo
- Stabili
    - Immagazzina matrici ambientali nell'alveare: nettare, polline, acqua
- Mobili
    - Raccoglie dati dai principali settori ambientali (terreno/vegetazione, acqua, aria)
    - In un giorno una famiglia di api può visitare milioni di fiori
    - Ampia area di campionamento (fino a 10 km di raggio dall'alveare in condizioni estreme)
- Alta sensibilità a fattori di stress antropica e ambientale





Biomonitoraggio



Contaminazione ambientale

Metalli pesanti: Svoboda (1961); Crane (1984), Ruschioni et al. 2012

Radionuclidi: Gilbert & Lisk (1978), Balestra (1992); Fresquez et al. (1997ab), Wieczorek et al. 2020;

Policlorobifenili (PCB): Anderson, J. F. & M. A. Wojtas (1986); Morse et al.,(1987)

Antibiotici: Nagata T. (1995); Cooper et al. (1998)

Idrocarburi Policiclici Aromatici (IPA): Amorena, M. et al., (2009)

Pesticidi: Kevan, P.G. (1975); Kalnins, A.A. & Detroit, B.F. (1984); Atkins, E. L., & Kellum, D. (1986)

Microplastics (Edo et al, 2021)

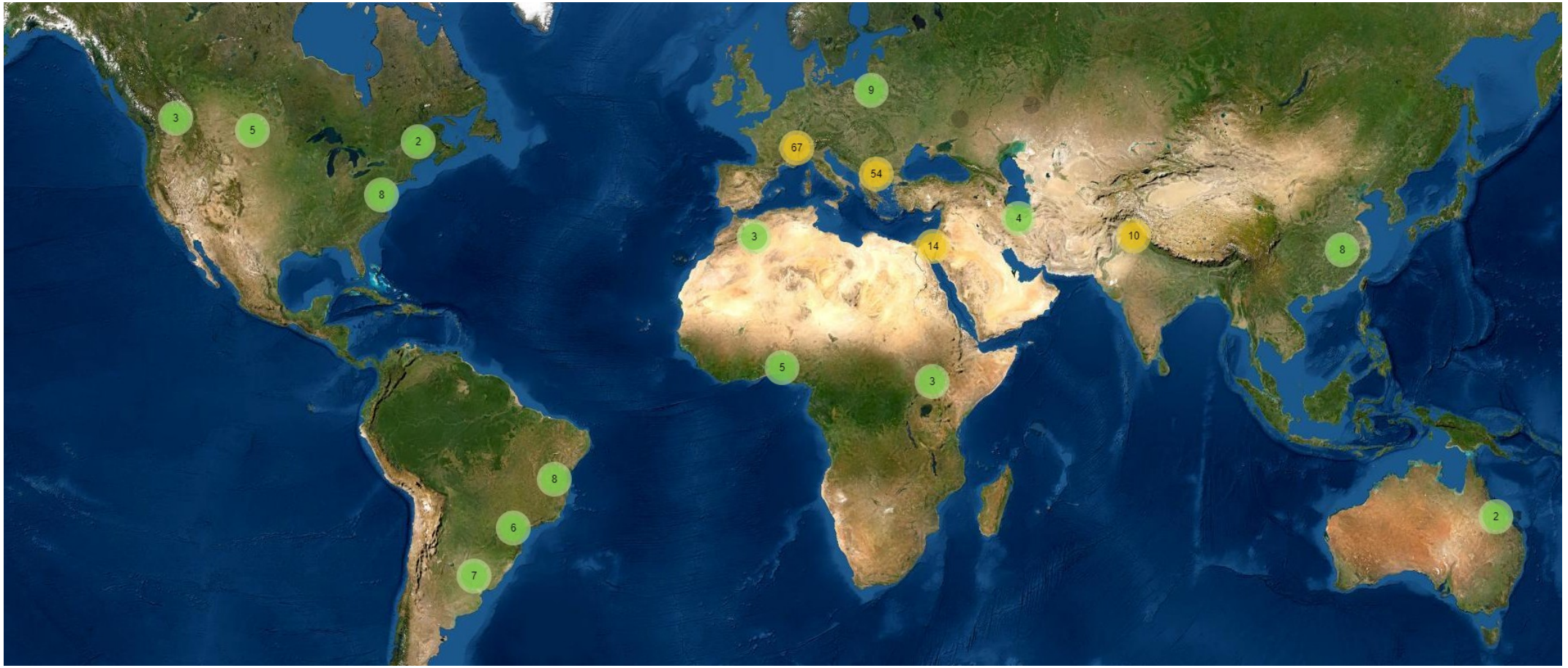
Il biomonitoraggio nel mondo

- Analisi sistematica della letteratura scientifica
- Meta-analisi dei risultati
- Articoli scientifici studiati:
  - **n = 7890**
  - **Dal 1948 al 2022**

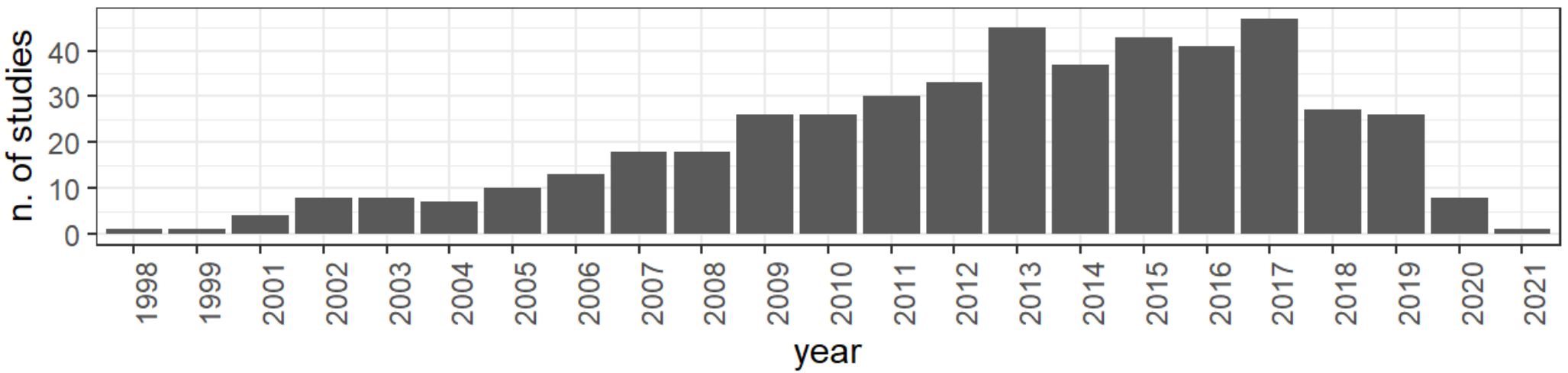
Velez-Trujillo, Carisio, Tosi (in preparation)

Il biomonitoraggio nel mondo

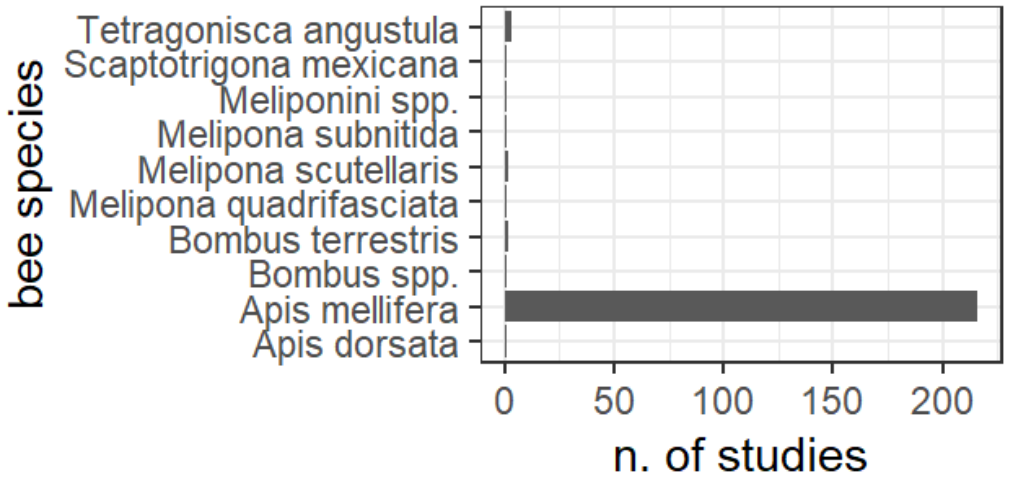
63 stati



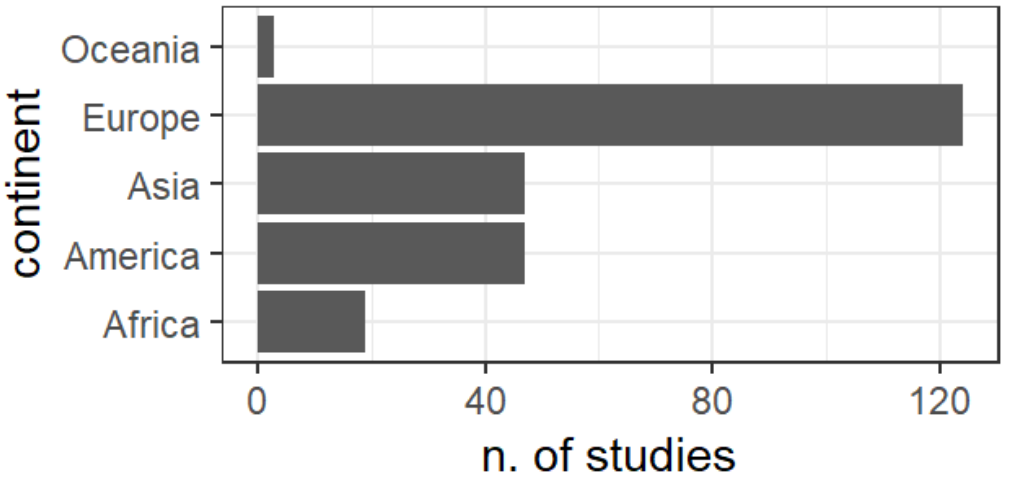
Il biomonitoraggio nel mondo



- **97% degli studi su *Apis mellifera***



- **La maggioranza in Europa**

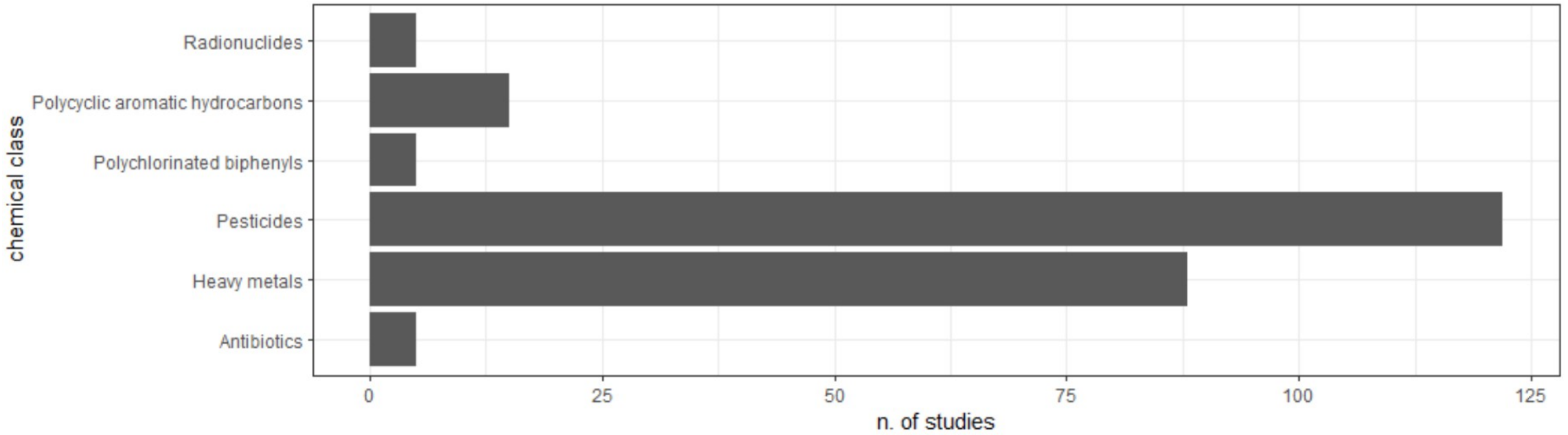


Velez-Trujillo, Carisio, Tosi (in preparation)

Il biomonitoraggio nel mondo

Sostanze studiate

- 6 categorie chimiche
  - più di 750 sostanze totali
  - Più di 500 pesticidi
  - Più di 50 elementi chimici tra cui 11 metalli pesanti



Velez-Trujillo, Carisio, Tosi (in preparation)

Il biomonitoraggio in Italia

Science of the Total Environment 615 (2018) 208–218

Contents lists available at ScienceDirect

Science of the Total Environment

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

A 3-year survey of Italian honey bee-collected pollen reveals widespread contamination by agricultural pesticides

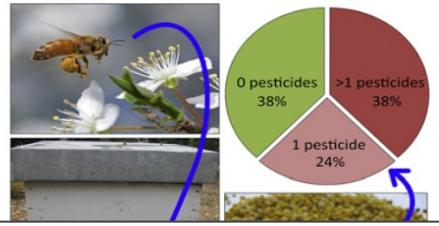
Simone Tosi [a,b,*], Cecilia Costa [c], Umberto Vesco [d], Giancarlo Quaglia [e], Giovanni Guido [d]

[a] Università di Bologna, Dipartimento di Scienze Agrarie, Viale Giuseppe Fanin 42, 40127 Bologna (BO), Italy
[b] University of California, San Diego, Division of Biological Sciences, Section of Ecology, Behavior, and Evolution, 9500 Gilman Drive, MC0116, La Jolla, CA 92093-0116, United States
[c] Consiglio per la Ricerca in Agricoltura e l'analisi dell'economia Agraria—Centro di Ricerca Agricoltura Ambiente, Via di Saliceto 80, 40128 Bologna (BO), Italy
[d] Unione Nazionale Associazioni Apicoltori Italiani—CRT Problematiche Ambientali e Nutrizionali e CRT Patologie Apistiche, Via Paolo Boselli 2, 50126 Firenze (FI), Italy
[e] Floramo Corporation Srl, Via Lime, 4, 12047 Rocca de' Baldi, CN, Italy

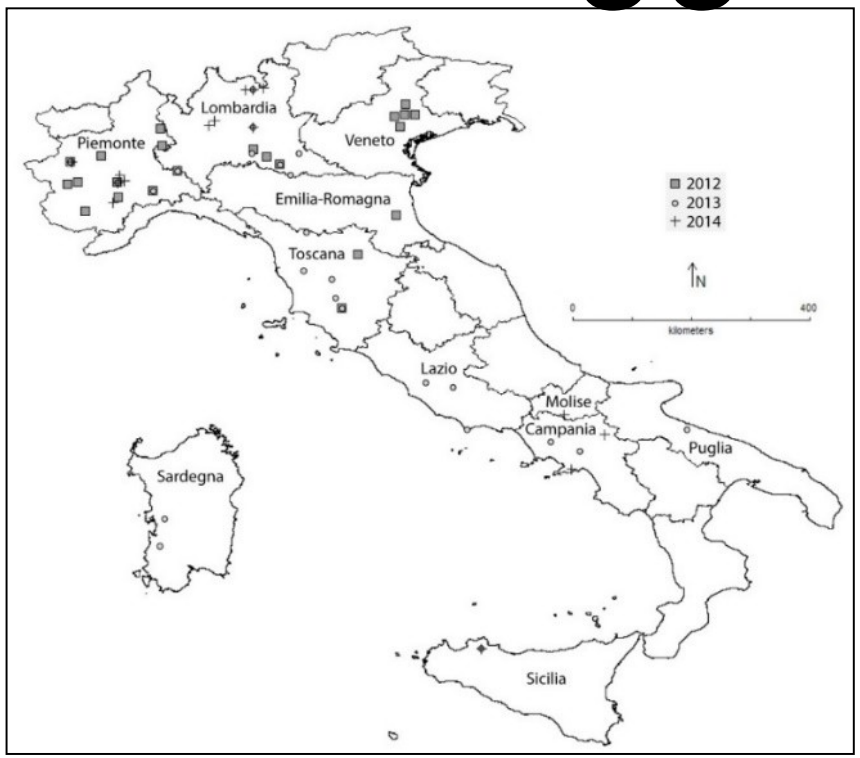
HIGHLIGHTS

- The majority (62%) of pollen samples contained at least one pesticide (2012–2014).
- Multiresidual samples (38%) were more frequent than single contaminations (24%).
- Chlorpyrifos was the most frequently detected pesticide (30%).
- Imidacloprid-contaminated samples

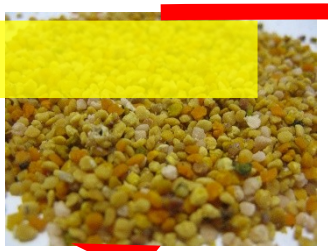
GRAPHICAL ABSTRACT



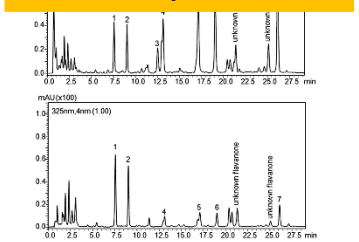
Il biomonitoraggio in Italia



Raccolta del polline



Analisi pesticidi



Tosi et al., 2018

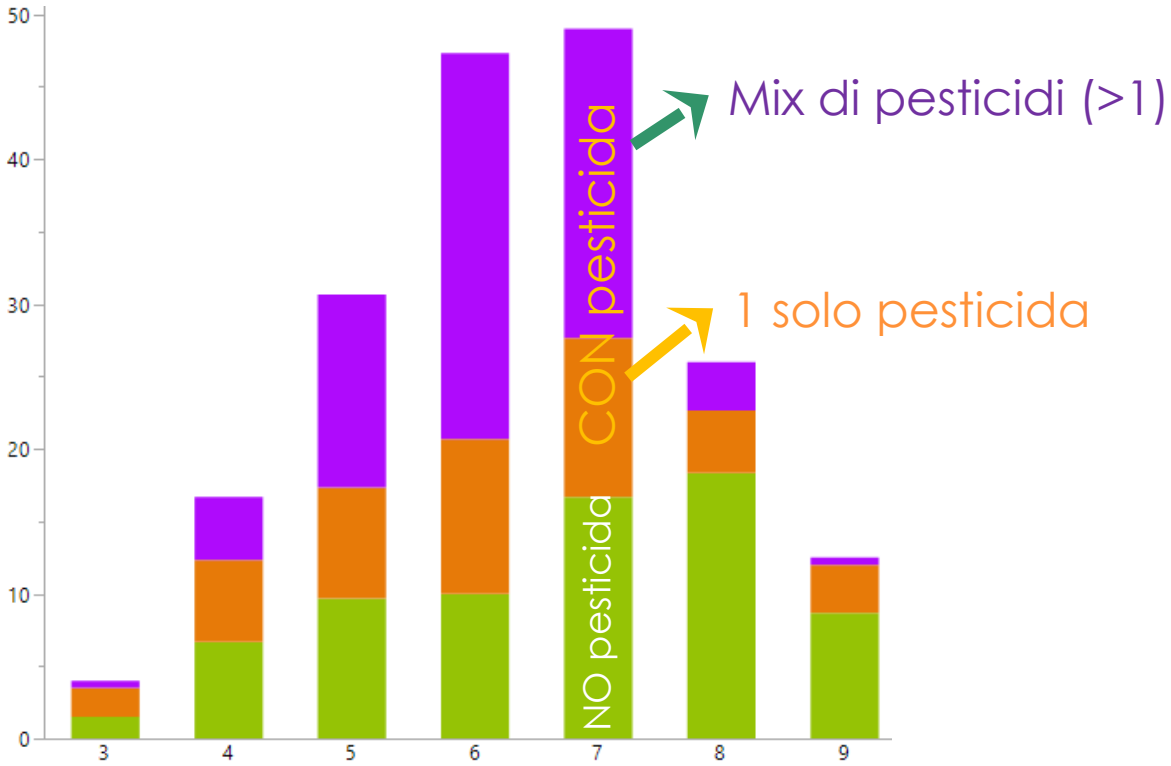
Il biomonitoraggio in Italia

Soprattutto mix (*cocktail*) di pesticidi

Senza pesticida

Con pesticida

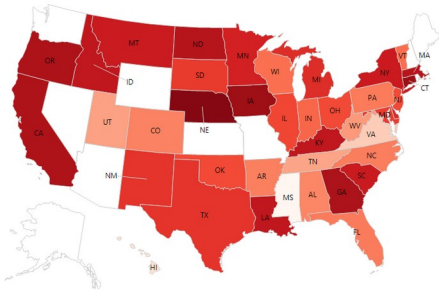
Mix di pesticidi



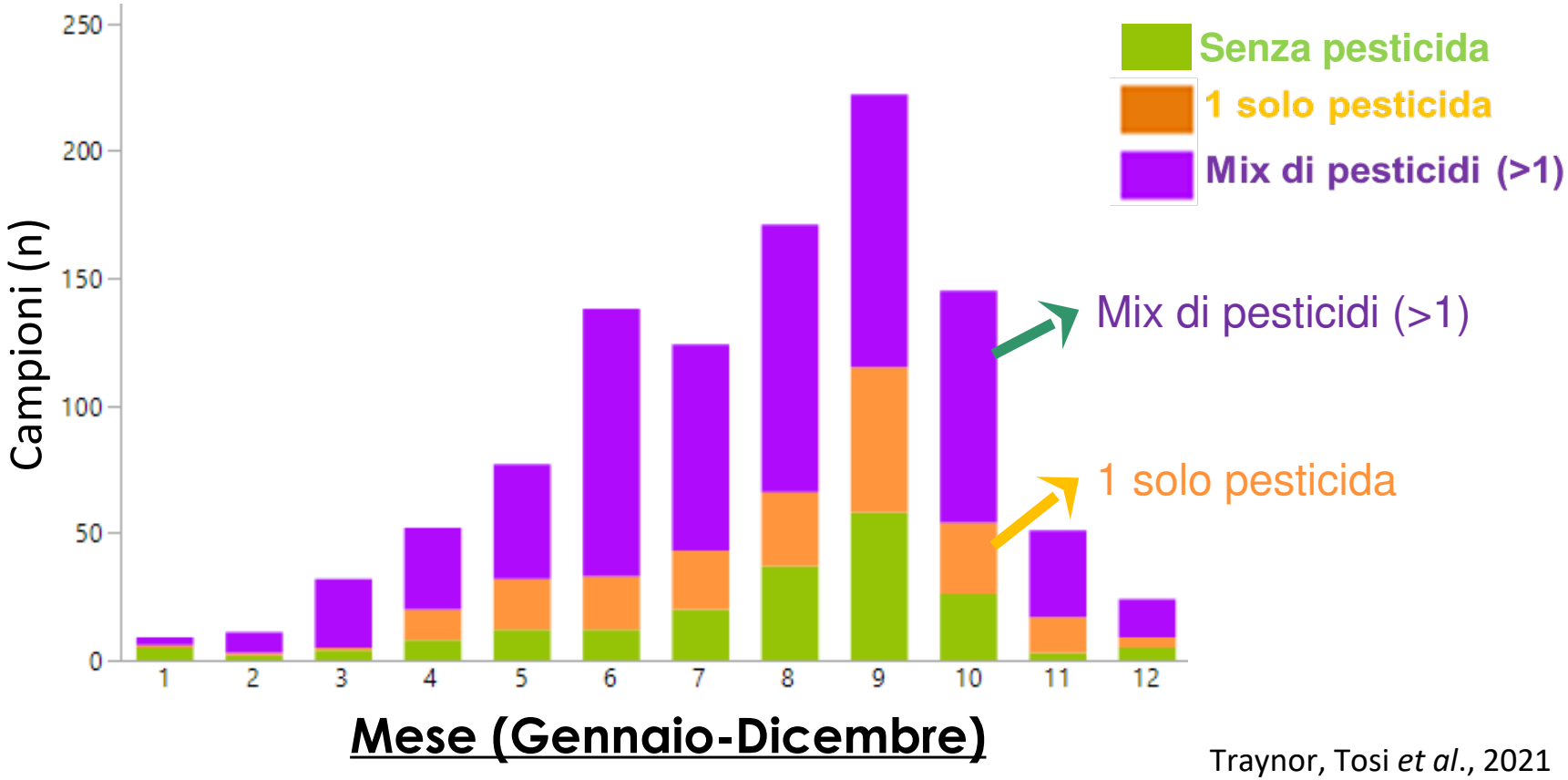
Tosi et al., 2018

Il biomonitoraggio in USA

- **7 anni**
- **42 Stati US**
- >5000 ispezioni in apiario



Soprattutto mix (*cocktail*) di pesticidi



Traynor, Tosi *et al.*, 2021

Effetti sinergici

1 + 1 ≠ 2

Additività

Effetto combinato (A+B)

=

Somma degli effetti individuali

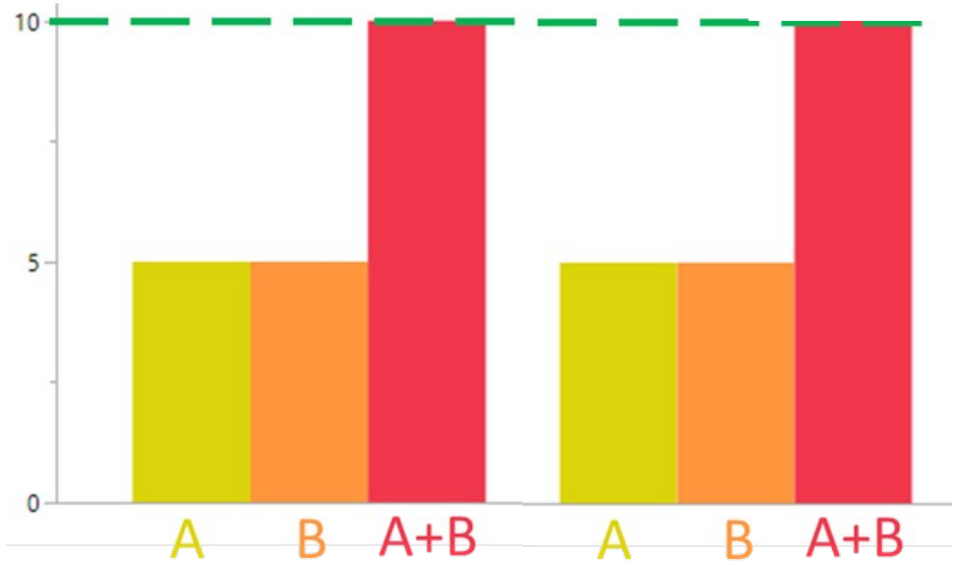
Sinergia

Effetto combinato (A+B)

>

Somma degli effetti individuali

A = stress 1
B = stress 2



Effetti combinati

Pochissime combinazioni studiate

Contents lists available at ScienceDirect

Science of the Total Environment

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

Review

Lethal, sublethal, and combined effects of pesticides on bees: A meta-analysis and new risk assessment tools

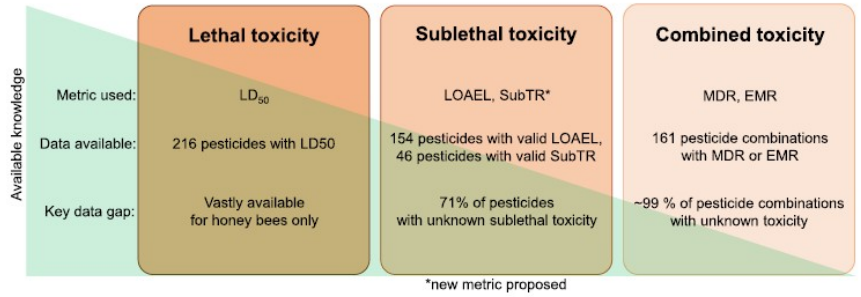
Simone Tosi [a,b,*], Cynthia Sfeir [b], Edoardo Carnesecchi [c], Dennis vanEngelsdorp [d], Marie-Pierre Chauzat [b,e]

[a] Department of Agricultural, Forest, and Food Sciences, University of Turin, Italy
[b] Paris-Est University, French Agency for Food, Environmental and Occupational Health & Safety (ANSES), Laboratory for Animal Health, Maisons-Alfort, France
[c] Institute for Risk Assessment Sciences (IRAS), Utrecht University, PO Box 80177, 3508, TD, Utrecht, the Netherlands
[d] Department of Entomology, University of Maryland, 4112 Plant Sciences Building, College Park, MD, 20742-4454, USA
[e] ANSES, Sophia Antipolis laboratory, Unit of Honey bee Pathology, European Reference Laboratory for Honeybee health, F-06902 Sophia Antipolis, France

HIGHLIGHTS

- Pesticides cause adverse lethal, sublethal, and combined effects on bees.
- Risk assessments focus on lethal effects, not sublethal or combined ones.
- Vast data gap on sublethal (71 % of pesticides) and combined (~99 %) effects.
- Sublethal Toxicity Ratio (SubTR) proposed to quantify sublethal toxicity magnitude.
- Open access harmonised Lethal, Sublethal, Combined Toxicity Datasets presented.

GRAPHICAL ABSTRACT



Tosi *et al.*, 2022

Quali effetti?

Effetti subletali

Api morte

Effetti subletali

https://youtu.be/5zC8AN3eItw

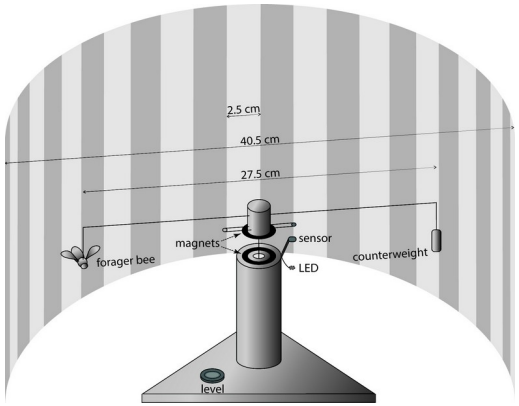
Abnormal behaviors

Name	Definition
Motion coordination deficits	Loss of coordination consisting of falling or stumbling while walking, walking in circles, or walking with erratic and irregular movements.
Hyperactivity	Excitation manifested as fast movements of legs and antennae, rapidly walking, sometimes including short jumps and flight attempts.
Trembling, shaking	Shivering, rapid twitching, or trembling of body, legs, or antennae. The bee is generally unable to move, and may flap its wings without flying for a prolonged time while also lying upside down on the floor.
Apathy	Hypoactivity consisting of remaining largely motionless or walking very slowly. Such bees also have severely reduced or delayed reactions to stimulation provided by light, movements of other bees, or air currents (e.g. generated by nearby bees).
Curved-down abdomen	The abdomen is unnaturally curved and is flexed ventrally.
Moribund	The bee appears close to death and exhibits partial paralysis with slight movements of legs and antennae. Will respond slightly to mechanical stimulation.

Tosi and Nieh, 2019, *Proc Roy Soc B*

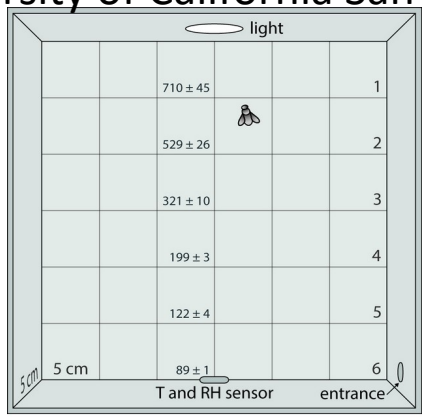
Volo

University of California San Diego



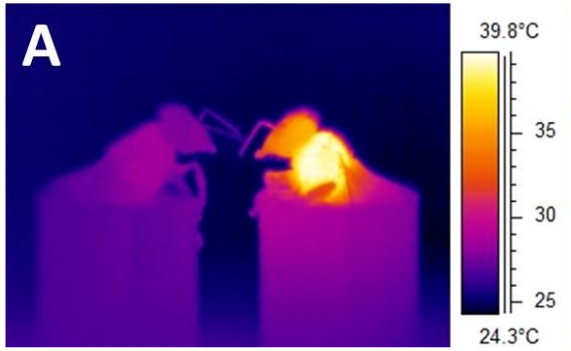
Camminare, arrampicare

University of California San Diego



Temperatura corporea

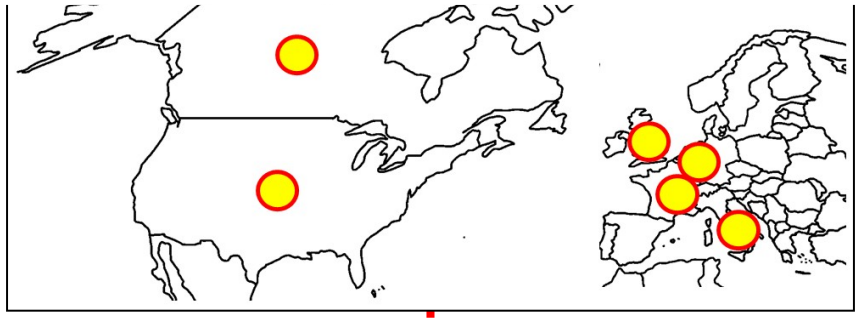
University of Pretoria (South Africa)

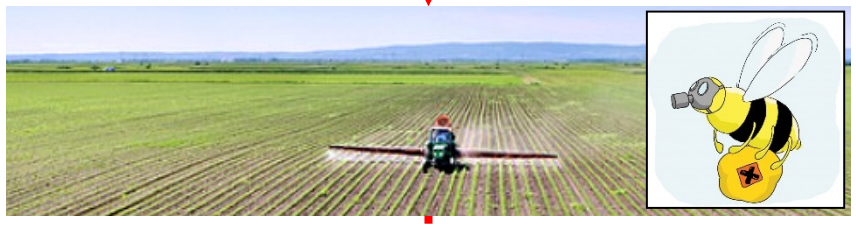


Tosi *et al.*, 2017a, *Sci Rep*

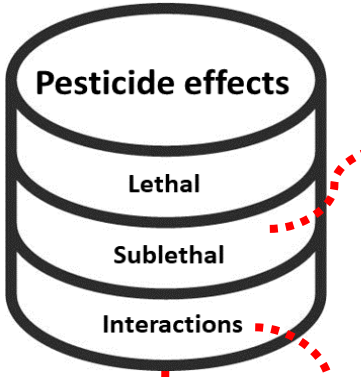
Una valutazione del rischio più «sofisticata»

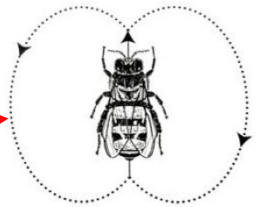
Raccolta e analisi di dati di esposizione





Database e metodologie sugli effetti subletali e combinati dei pesticidi (Tosi et al., 2022)





Tosi et al (in preparation)

Grazie!

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