Ecotoxicology of glyphosate: an ecologist's perspective

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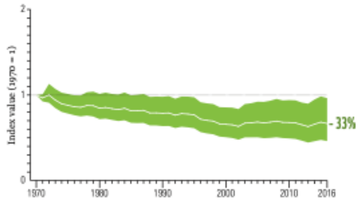
European Parliament - 18 September 2023

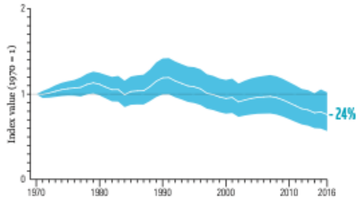
Biodiversity loss: one of biggest threats to nature

Decline of organisms across the globe

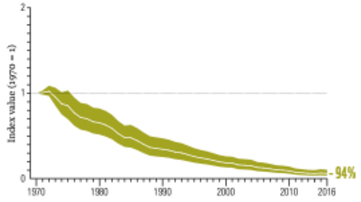
NORTH AMERICA **-33%**



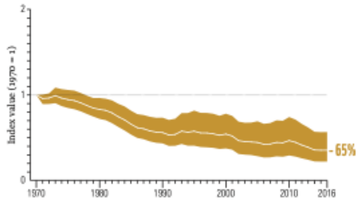
EUROPE & CENTRAL ASIA **-24%**



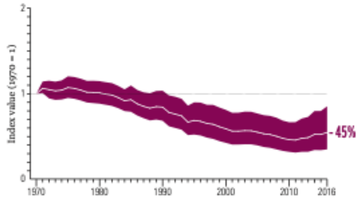
LATIN AMERICA & CARIBBEAN **-94%**



AFRICA **-65%**



ASIA PACIFIC **-45%**



Living planet index, monitoring >3700 species (start 1970)

Threats to biodiversity

Changes in land and sea use, habitat loss, degradation

Glyphosate involved !

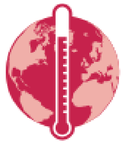
Species overexploitation

Invasive species and disease

Glyphosate involved !

Pollution

Glyphosate involved !

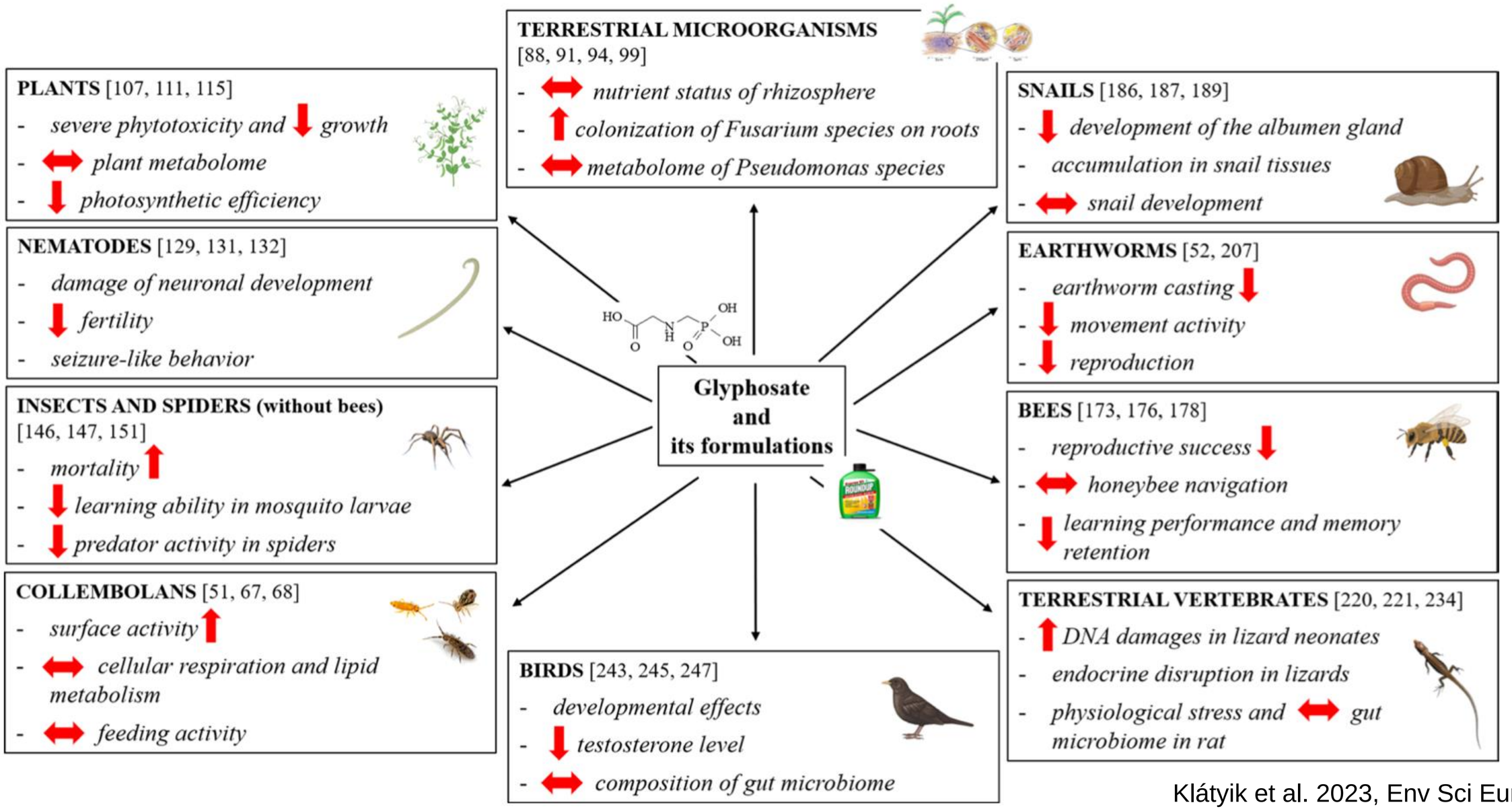


Climate change

Glyphosate involved !

World Wide Fund for Nature 2020 - IPBES 2019 - IUCN Red List 2020

Review on terrestrial ecotoxicity of glyphosate



Klátyik et al. 2023, Env Sci Europe

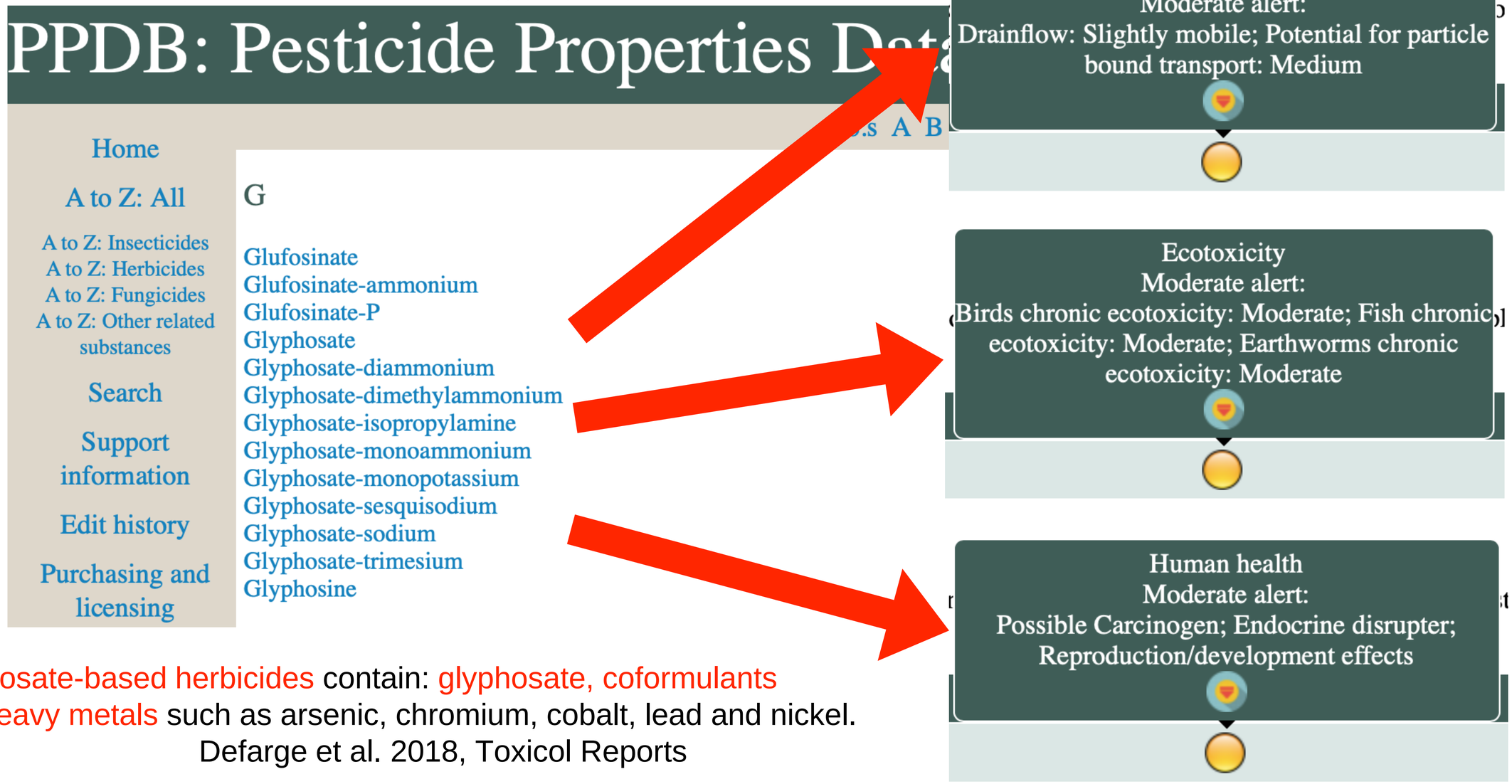
Results on terrestrial ecotoxicity of glyphosate

- Unintended side-effects on many terrestrial organisms including mammals.
- Important mechanism: oxidative stress with effects on biochemistry and DNA damage.
- Disruptions of various physiological, behavioral and ecological processes.
- Most studies have examined only short-term effects of a single glyphosate application, or glyphosate-based herbicides to a single species.
- Agricultural practice: 2-3 glyphosate applications per season, interactions with other agrochemicals applied to the same field, and ecological interactions within the field and landscape.
- Toxicity of glyphosate-based herbicides exceeds the toxicity of glyphosate active ingredient: „inert“ co-formulants are either toxic in their own right or add to the toxicity of glyphosate.

Klátyik et al. 2023, Env Sci Europe

Glyphosate is not just one chemical

Pesticides Properties Database, University of Hertfordshire, UK



Glyphosate-based herbicides contain: glyphosate, coformulants and heavy metals such as arsenic, chromium, cobalt, lead and nickel.

Defarge et al. 2018, Toxicol Reports

Glyphosate contaminates aquatic ecosystems

Systematic literature review: 73 papers from 21 countries worldwide.

Glyphosate may pose a moderate to high risk in 95% of countries investigated.

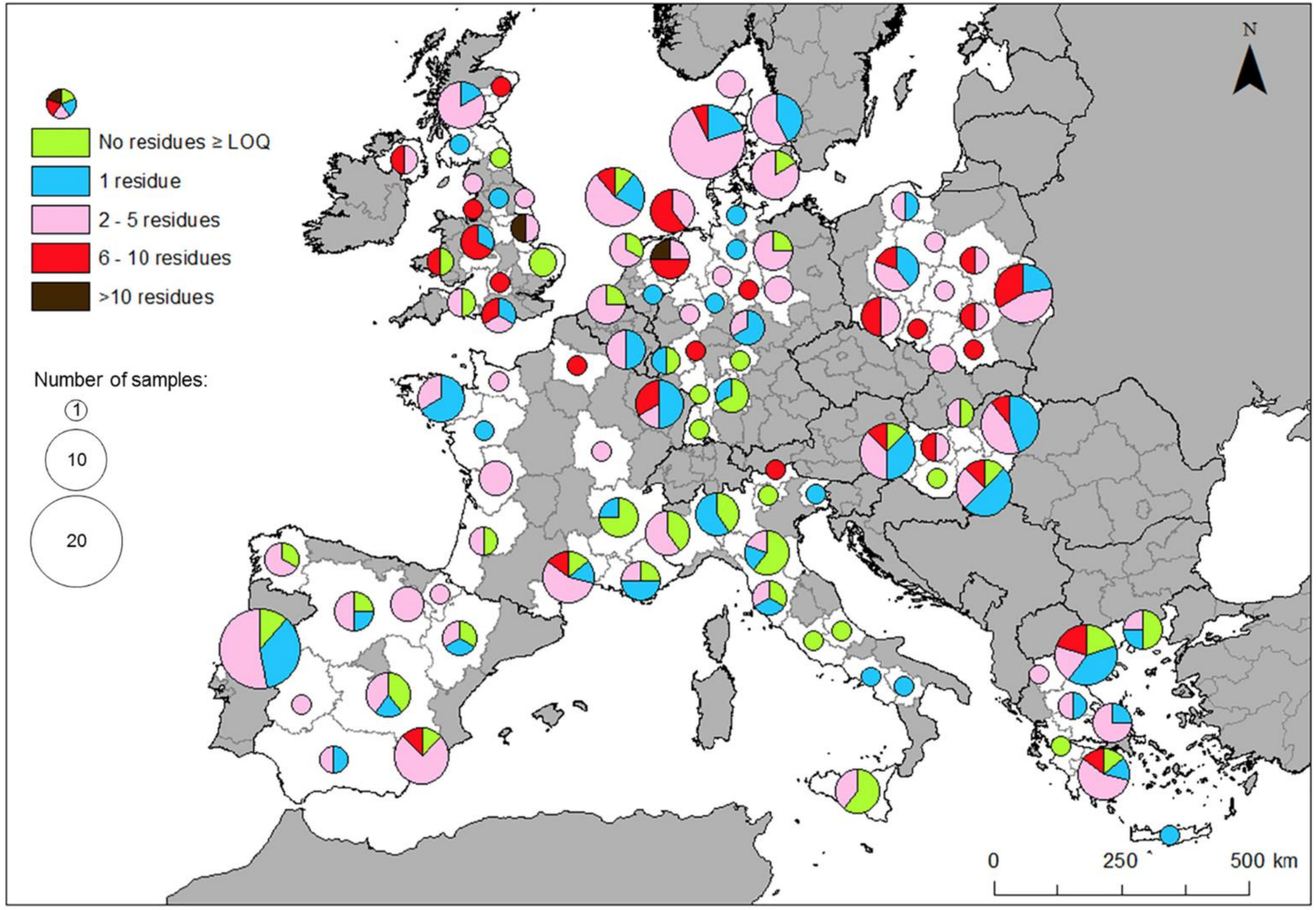
Brovini et al. 2021, Env Sci Poll Res

Study across 12 European countries, sampling in October 2022.

Glyphosate and/or AMPA were detected in 74% of the samples, in 11 out of the 12 countries.
In 22% of samples (collected in Austria, Spain, Poland, Portugal), glyphosate levels were **not suitable for human consumption.**

PAN 2023

Glyphosate contaminates European soils



- 76 pesticides found in 317 agricultural soils.
- **80% of soils** with pesticide contamination.
- Most frequently found: **Glyphosat** (+ AMPA), **DDT** (+metabolites) and **broadband fungicides** (boscalid, epoxiconazole, tebuconazole).
- pesticide mixtures commonly found

Silva et al. 2019, Science Total Environm

Glyphosate contaminates ambient air

Science of the Total Environment 838 (2022) 156012

Contents lists available at ScienceDirect

Science of the Total Environment

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

Pesticides in ambient air, influenced by surrounding land use and weather, pose a potential threat to biodiversity and humans

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Passive air sampling at 15 locations in Eastern Austria.

Analysis of 566 chemical substances.

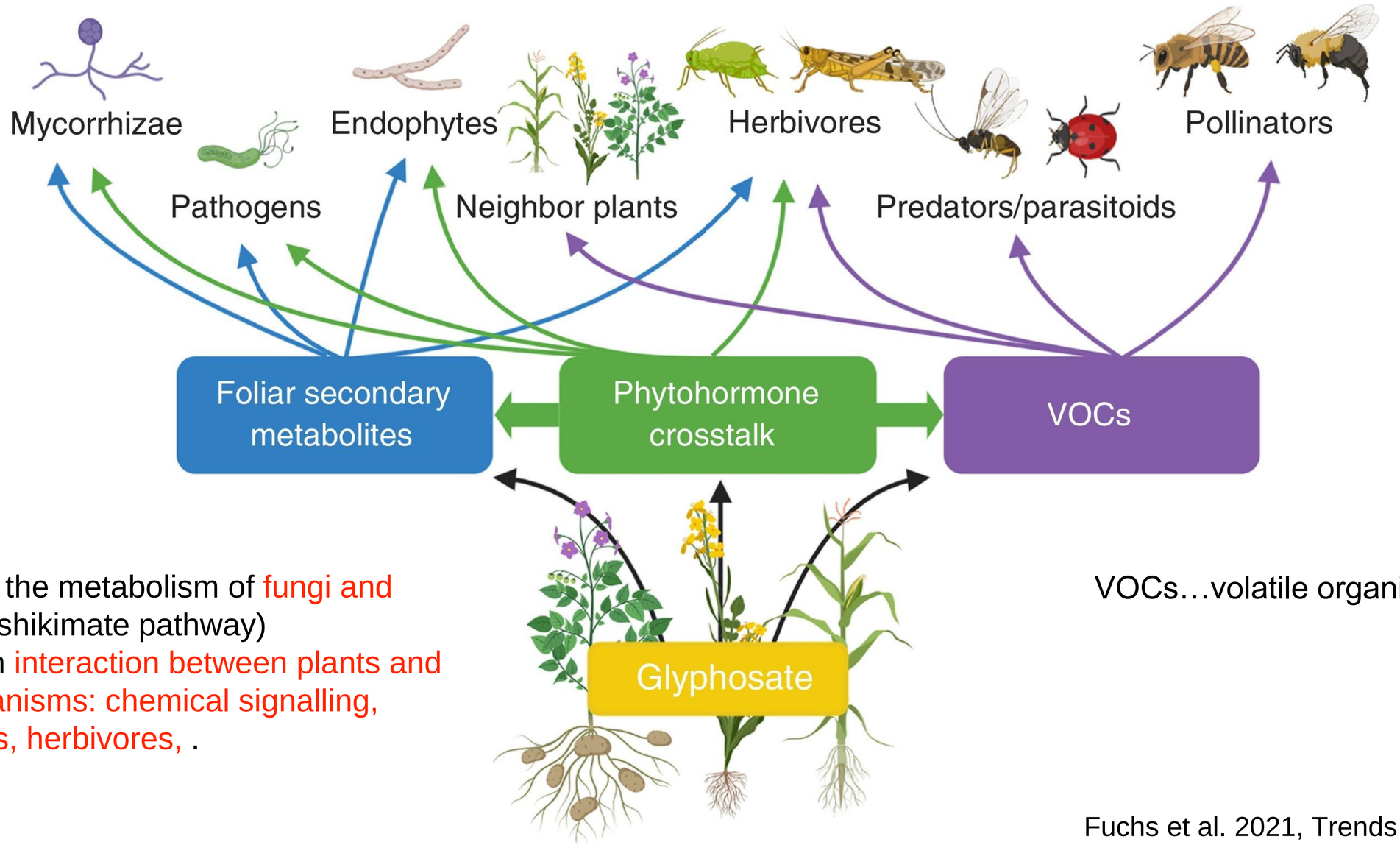
Results: **67 pesticides**, 4 pesticide metabolites; pesticide cocktails found everywhere.

Locations with more agriculture in surrounding with higher contamination.

Glyphosate was also found in two National Parks and in the city center of Vienna!

Zaller et al. 2022, Science of the Total Environment

Glyphosate affects plant defence and health

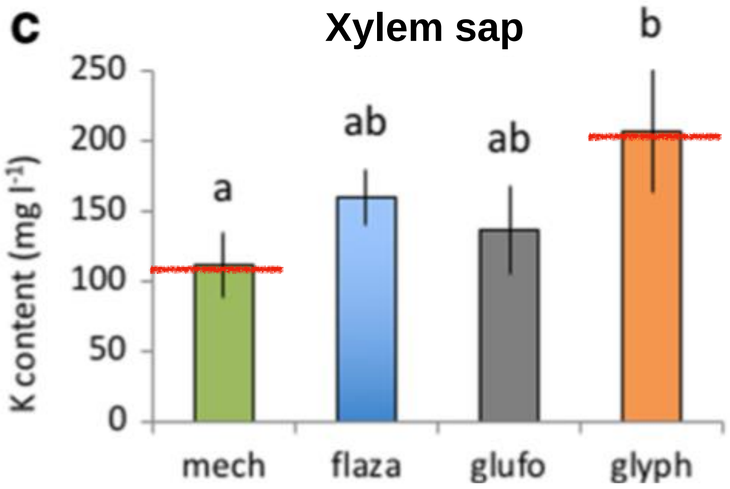


- Effects of the metabolism of fungi and bacteria (shikimate pathway)
- Effects on interaction between plants and microorganisms: chemical signalling, pollinators, herbivores, .

VOCs…volatile organic compounds

Fuchs et al. 2021, Trends Plant Science

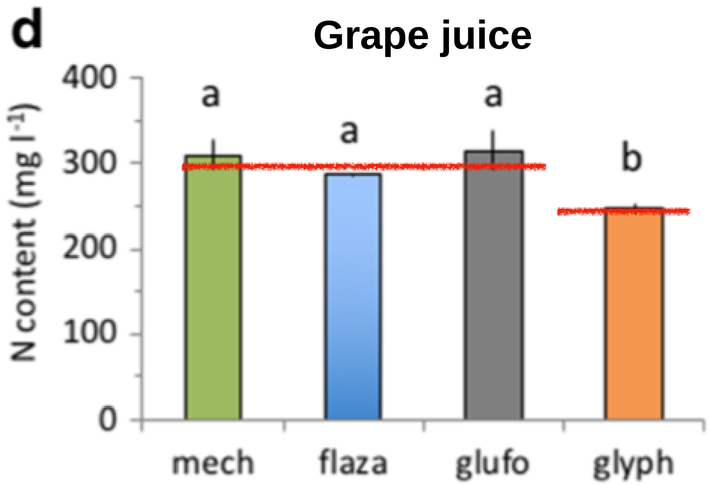
Glyphosate impairs the nutrient content of crops



+100%

11 months after glyphosate application

mech…mechanical weed control
flaza…herbicide with flazasulfuron (200 g/ha)
glufo…herbicide with glufosinate (3.75 l/ha)
glyph…herbicide with glyphosate (4.0 l/ha)

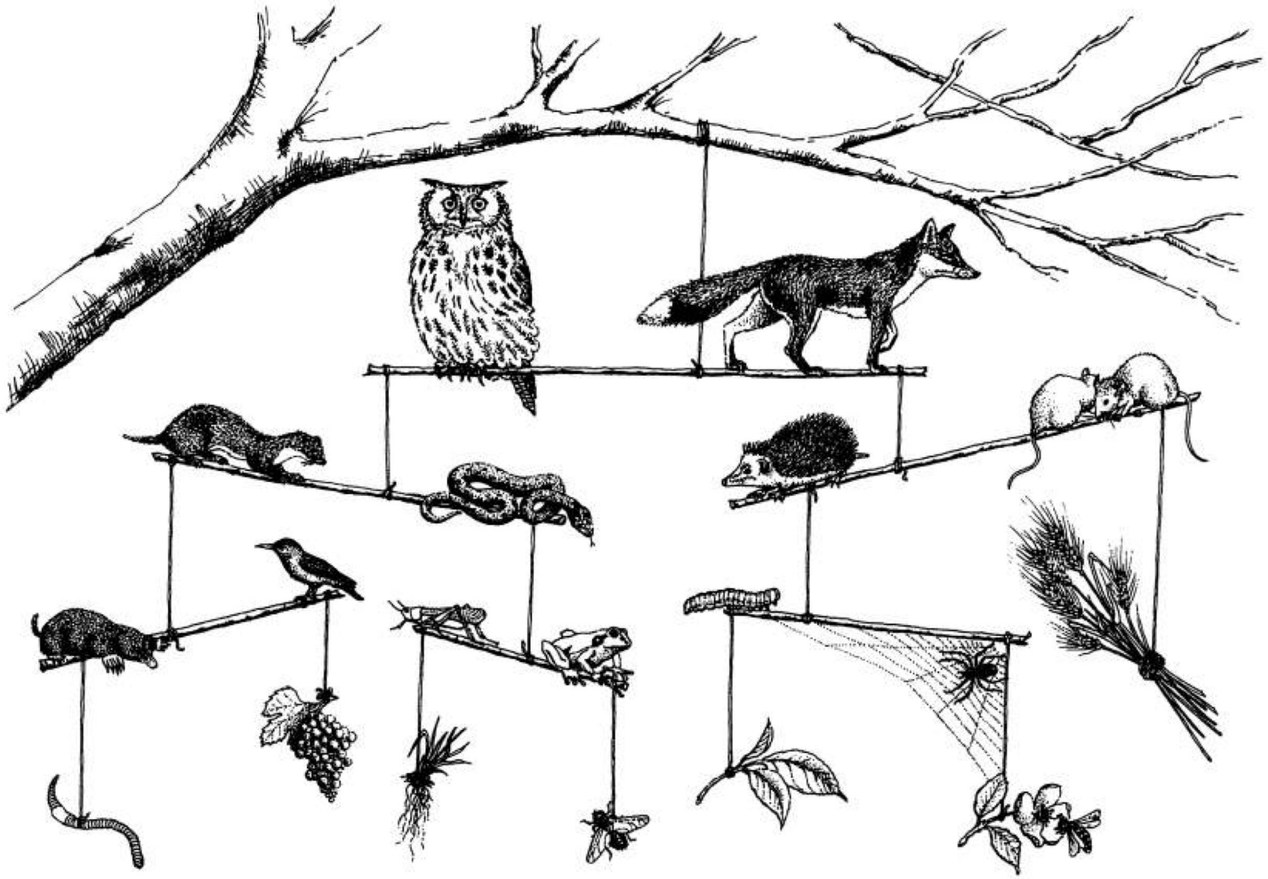


-20%

5 months after glyphosate application

Zaller et al. 2018, Env Sci Poll Res

Why we should care about ecological interactions



Katzmann & Schrom 1986

In agroecosystems, pests and diseases are kept in check by beneficial organisms
(= biological control).

These natural enemies need plants for food or shelter.

Glyphosate kills all plants and impairs ecological interactions between species.

We all benefit from biodiversity and healthy ecosystems

Millenium Ecosystem Assessment 2005

EFSA 2023 conclusion on ecotoxicology

- With respect to ecotoxicology, the data package allowed a conservative risk assessment approach, which identified a high long-term risk to mammals in 12 out of 23 proposed uses of glyphosate.

Precautionary principle: was it considered here?

Reminder: humans are also mammals!

https://www.efsa.europa.eu/sites/default/files/2023-07/glyphosate_factsheet.pdf

EFSA 2023 conclusion on biodiversity

- Experts recognised that the risks for biodiversity associated with the representative uses of glyphosate are complex and depend on multiple factors. They also noted a lack of harmonized methodologies and agreed specific protection goals. Overall, the available information does not allow firm conclusions to be drawn on this aspect of the risk assessment and risk managers can consider mitigation measures.

Isn’t everything complex and multifactorial?

Specific protection goal: to protect the environment and halt the loss of biodiversity.

What if they simply don't care to consider mitigation measures?

Scientists usually use the most appropriate methods.

SUCH A CONCLUSION IS A DISRESPECT OF BIODIVERSITY AND ECOLOGICAL SCIENCE.

https://www.efsa.europa.eu/sites/default/files/2023-07/glyphosate_factsheet.pdf

Conclusions of an ecologist

Glyphosate contaminates our ecosystems and has many unintended side effects on all organismic groups, not just on plants.

Official risk assessment is not assessing what is happening in the field: several pesticides applied along with glyphosate, interaction with other agrochemicals and contaminants, species interactions, climate change.

Limited assessment on very few surrogate species.

SINCE THE ENVIRONMENTAL RISK ASSESSMENT SYSTEM IS INADEQUATE, THE RESULTS SHOULD BE EVALUATED WITH APPROPRIATE CAUTION.

frontiers in Environmental Science

OPINION
published: 31 October 2019
doi: 10.3389/fenvs.2019.00177

Biodiversity Decline as a Consequence of an Inappropriate Environmental Risk Assessment of Pesticides

Carsten A. Brühl[1] and Johann G. Zaller[2]*

Thank you for your attention.

harrowing

weeding robot

hoeing

weeding robot

By the way, glyphosate is not necessary for successful farming.