Environmental risk assessment of plant protection products using the ecosystem services concept: Prospective proof of concept case study

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Introduction

'Proof of concept' study

European apple orchard managed according to integrated crop management (IPM) principles

Stepwise process:

1. Ecosystem service selection,
2. EFSA approach to ecosystem services-based ERA,
3. Detailed ecosystem service assessment,
4. Trade-off analysis.

1. Ecosystem service selection

Ecosystem services		Cider orchard areas	Potentially affected by PPP	Example SPUs (EFSA, 2016)
Regulatory services	Pollination	√	√	Pollinators: arthropods, such as bees, hoverflies, butterflies and other pollinator species
	Pest control	√	√	Natural enemies such as ladybirds, ground beetles, true bugs, lacewings, spiders, parasitic wasps), vertebrate predators and fungal species
	Soil quality regulation	√	√	Soil fauna (e.g. earthworms, ants, springtails), microorganisms, primary producers, detritivores
Cultural services	Recreation and ecotourism – observing nature	√	√	attractive plants, animals (birds, mammals), invertebrates, landscape features (e.g. hedgerows, vegetation)

Figure 1. Selected ecosystem services for the proof of concept study.

2. EFSA approach to ecosystem services-based ERA

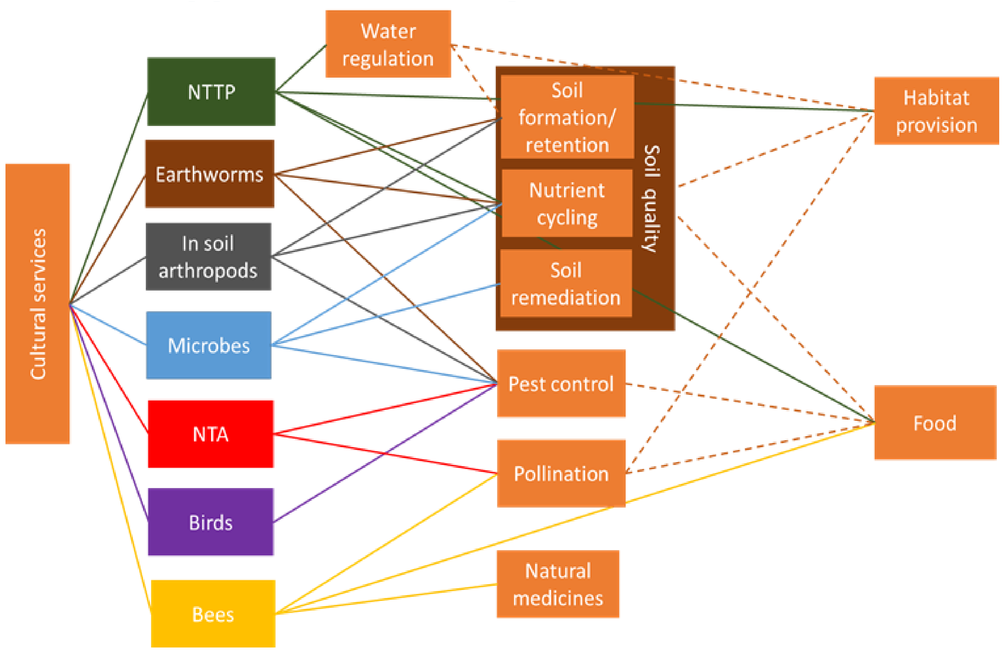

Figure 2. Contributions of terrestrial taxa to terrestrial ecosystem services.

Magnitude	Non-target arthropods, in soil organisms.	Bees
Negligible	Reduction < 10 % (comparable to non-detectable effects)."	3.5-7% reduction in colony size
Small	Reduction ≥10 % but < 35 % ;	7-15% reduction in colony size
Medium	Reduction ≥ 35 % but < 65 %;	15-35% reduction in colony size
Large	pronounced reduction above 65 %;	>35% reduction in colony size

Duration	Non-target arthropods, in soil organisms	Bees
Days	Up to 7 days	To be defined
Weeks	Up to 4 weeks	up to 3 weeks (one brood cycle for honey bees)
Months	Maximum of 6 months	up to 3 months (4 brood cycles for honey bees)
Seasons		up to 4 seasons (12 months)
Years	Not considered adequate to satisfy protection goals unless effects are negligible.	More than 1 year

Figure 3. Classification of magnitude and duration of Service Providing Units.

3. Detailed ecosystem service assessment

Population models were used to evaluate the potential population-level effects of the study compound to services providers relevant to four ecosystem services for which unacceptable risk has been identified:

A: Pollination	Bee model
B: Natural pest control	Ladybird model
C: Soil quality	Earthworm and springtail model
D: Recreation (aesthetic value)	Butterfly model

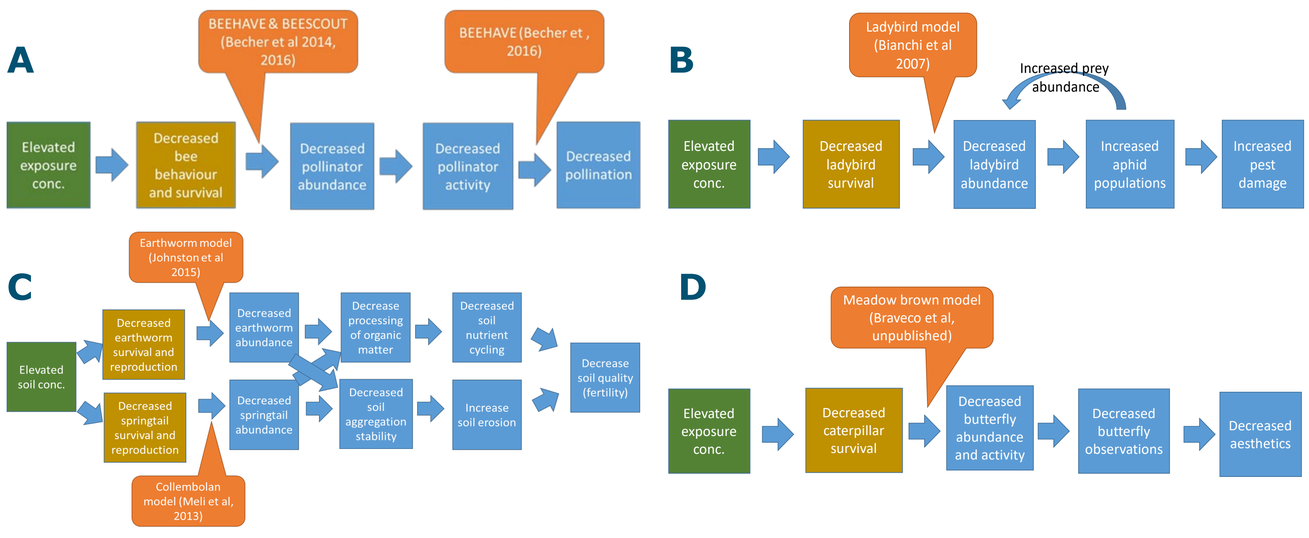

Figure 4. Logic chains for the four selected ecosystem services.

Relationships between maximum effect on population abundance and exposure modification factor (EMF), derived from population models were used to assess risk to focal service providers.

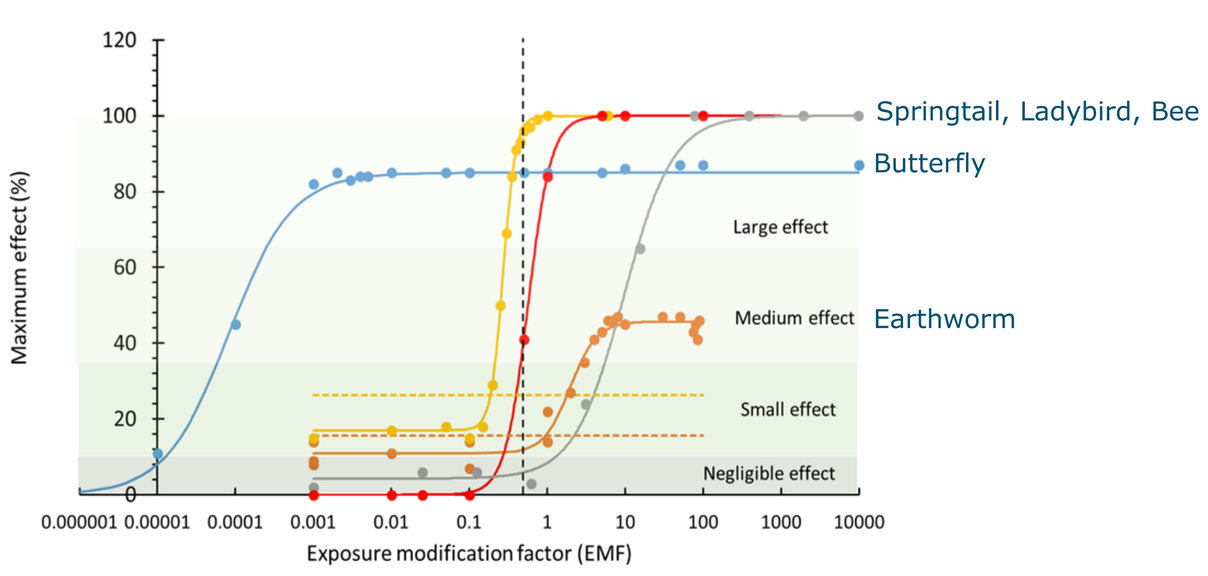

Figure 5. Relationships between maximum effect on relative population abundance (%) or colony survival (%) and exposure modification factor (EMF) for four focal species in the orchard: meadow brown butterfly (blue), springtail (yellow), ladybird (red), earthworm (brown) and bee (grey). The vertical dotted line indicates and EMF = 0.5 and the horizontal shaded areas indicate magnitude of effect as defined by EFSA (Table 3.1). Horizontal dashed lines indicate the NOR limits where available. .

4. Trade-off analysis (preliminary assessment)

Conventional versus ES risk assessment:

- The risk to pollination, and soil quality via earthworm activity are acceptable under ES not under conventional risk assessment,
- The risk to natural pest control has been reduced,
- However, the risk to recreational (aesthetic value) services provided by non-target arthropods (i.e. butterfly watching) remains high.

Acknowledgements

The authors thank CEFIC LRI for funding under the ECO 45 grant.

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