

Does seed predation by carabids (*Coleoptera*, *Carabidae*) contribute to biological weed control ?

A simulation study.

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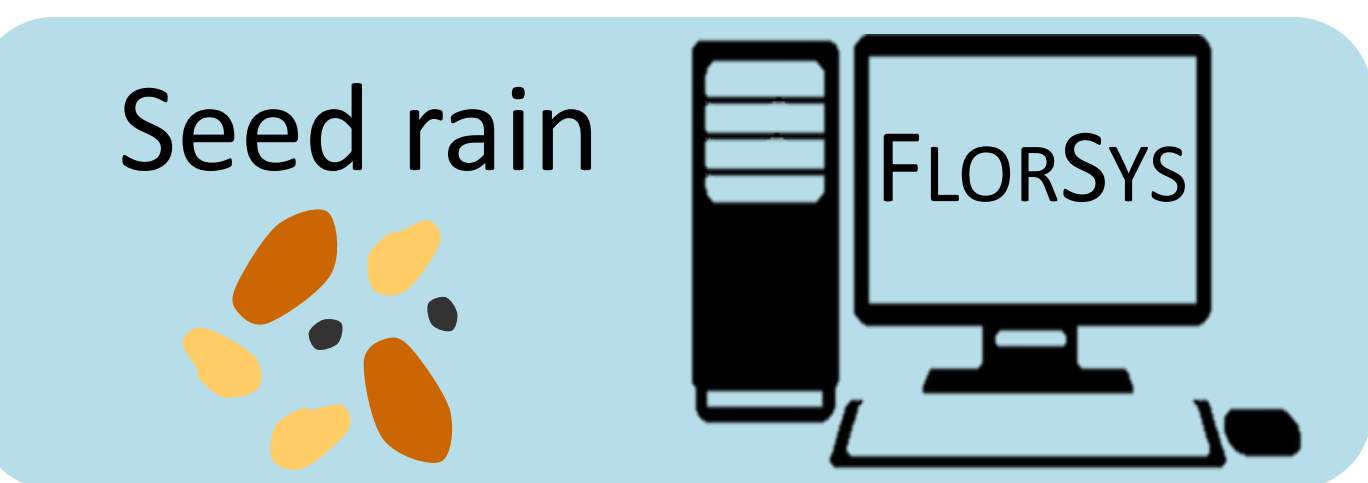
Carabid beetles may contribute to weed control but little evidence

Objective : To model predation of weed seeds by carabids in order to improve integrated weed management

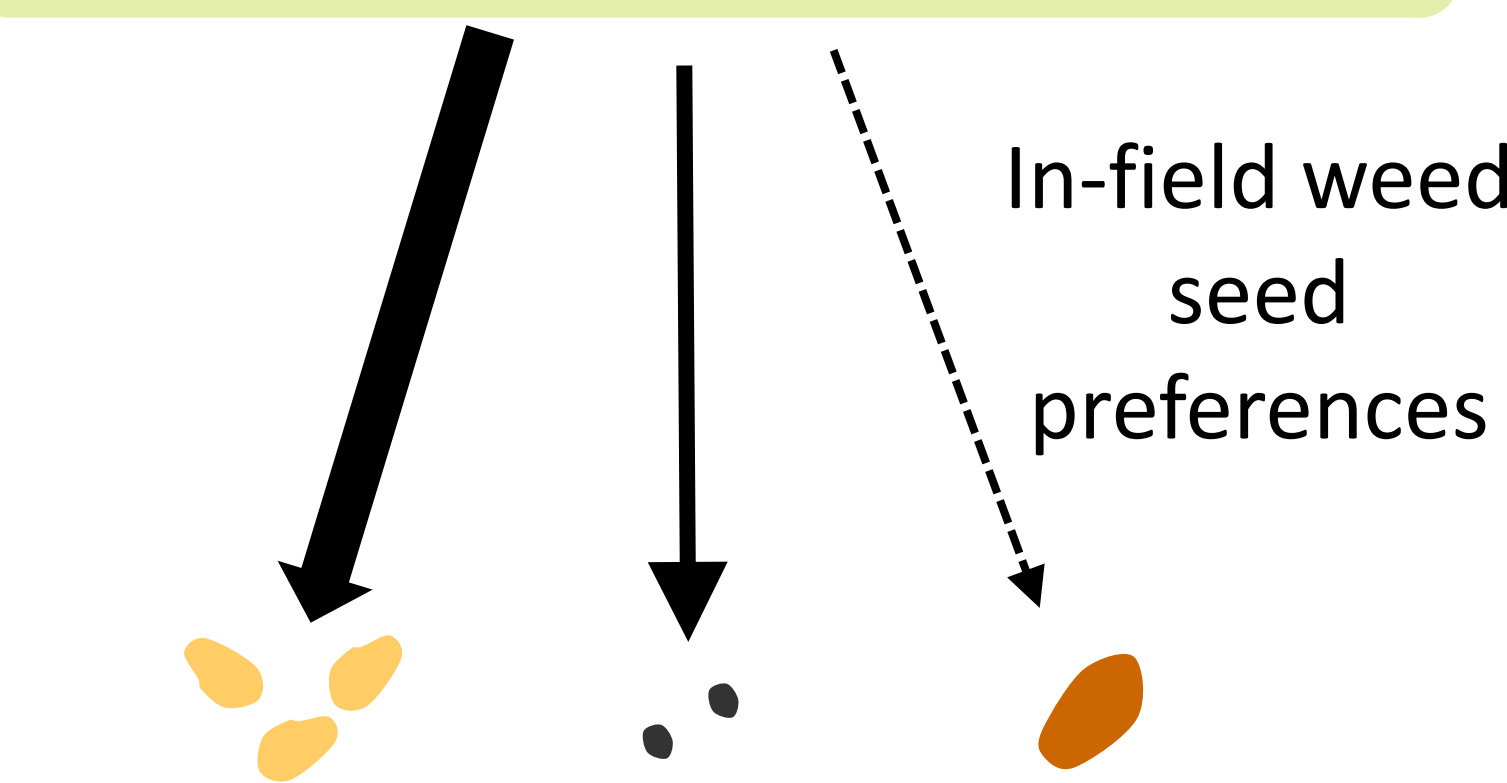


Weed seed predation model

- Data = literature and experiments
- Added to an existing weed dynamics model FLORSYS¹
- Proxy of carabids community = predation rate
- Daily time-step



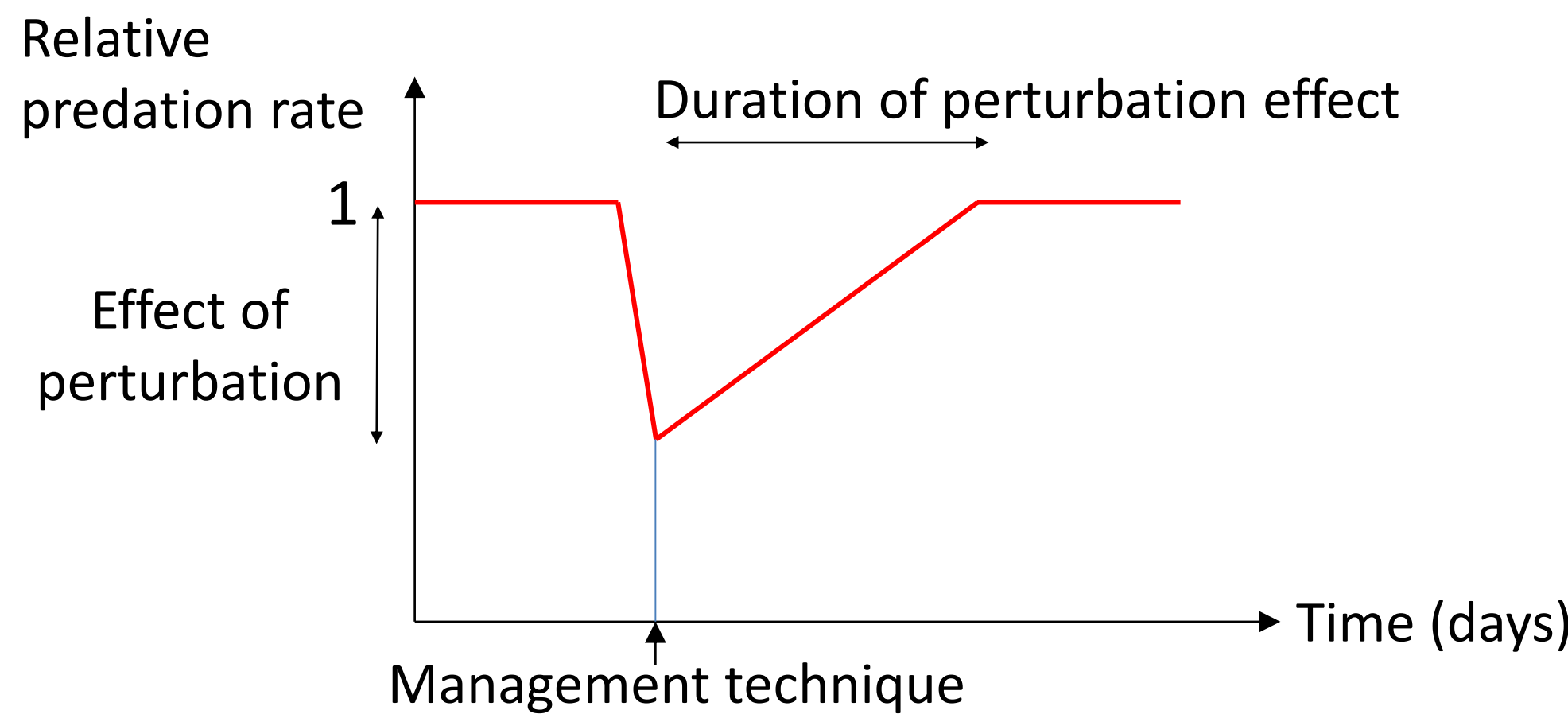
Predation rate = function of



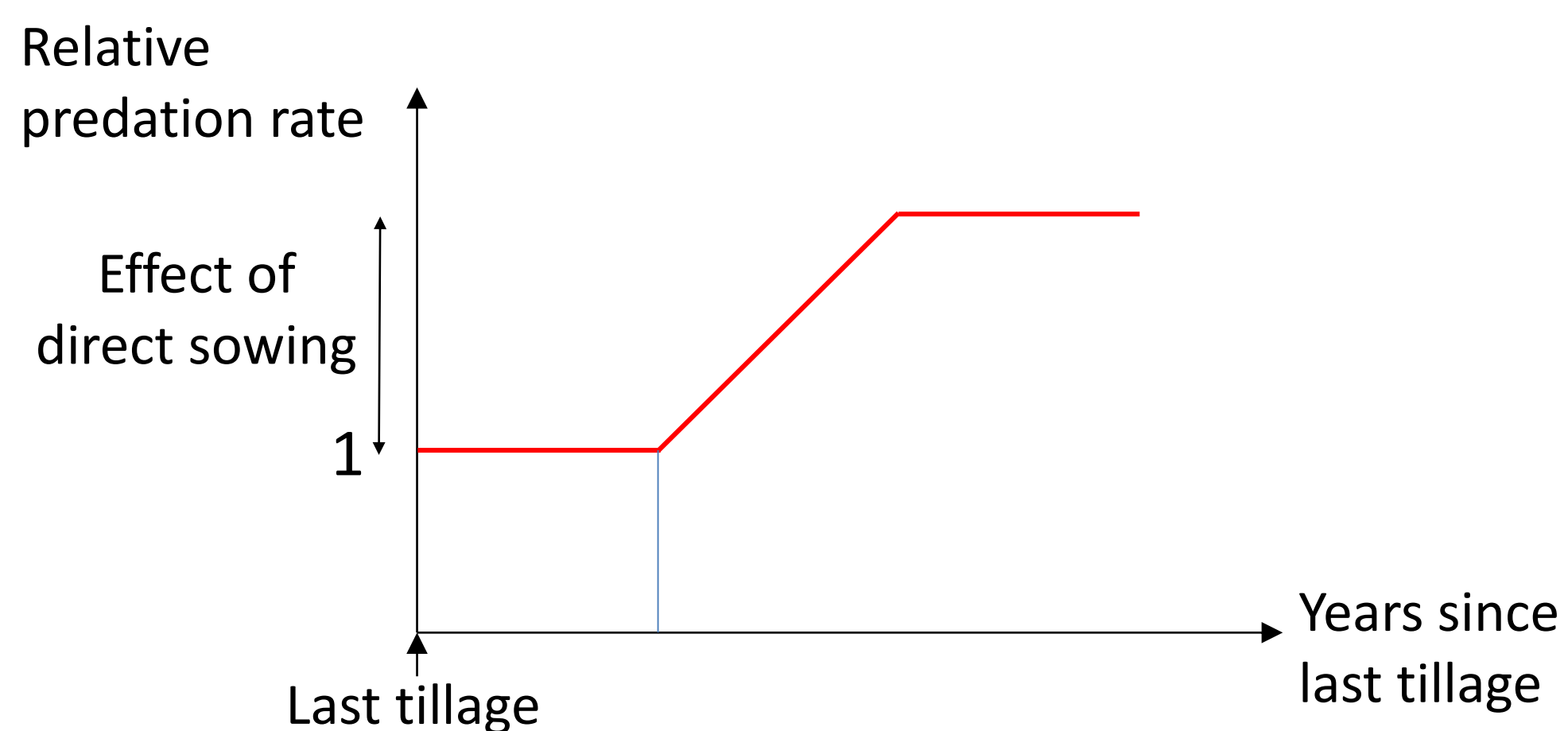
Predation rate per weed species

- Management techniques
- Time since last harvest
- Vegetation cover
- Temperature, incident radiation
- Intra-annual carabids' abundance

Tillage, insecticides



Direct sowing



Cropping systems simulations

10 cropping systems simulated with and without predation

Burgundy's main cropping system: Oilseed rape (OR)/wheat/barley x 30 years
 Cropping systems conceived² to { weed harmfulness, herbicide use } x 10 weather series

| Cropping systems | Main change from R | Species richness [0;25] | | Pollinator resource [0;+∞] | | Yield loss [0;+∞] | | Field infestation % | |
|------------------|--|-------------------------|--------|----------------------------|--------|-------------------|--------|---------------------|--------|
| | | Mean* | Diff** | Mean* | Diff** | Mean* | Diff** | Mean* | Diff** |
| R | OR/wheat/barley | 18,71 | -3,29 | 2,66 | -0,14 | 62,85 | | 1,96 | |
| R' | Withdrawn herbicides replace by authorized | 18,33 | -3,01 | 2,89 | -0,24 | 58,96 | -8,80 | 1,50 | 1,50 |
| A1 | OR/wheat/sunflower/barley | 18,10 | -2,54 | 2,51 | -0,29 | 72,36 | -9,56 | 2,51 | |
| A2 | Lucerne/wheat /barley | 19,90 | -5,75 | 3,93 | | 88,75 | | 2,71 | |
| A3 | OR/wheat - 1 herbicide (OR) | 17,75 | -2,72 | 2,36 | -0,13 | 61,90 | | 1,86 | |
| A3' | A3 + mechanical weeding (OR) | 17,56 | -2,26 | 2,65 | | 53,78 | | 1,47 | |
| A4 | Reduced tillage + 1 herbicide (barley) | 17,51 | -2,30 | 2,76 | | 56,65 | | 1,52 | -0,25 |
| A5 | OR/wheat/pea/barley | 11,95 | -1,84 | 1,50 | | 46,74 | | 1,19 | |
| A6 | Herbicides applied later | 17,38 | -2,21 | 2,41 | | 67,01 | | 2,04 | |
| O | A5 + mechanical weeding | 18,32 | -2,53 | 2,83 | | 44,67 | | 1,21 | |

* Mean without predation ■ worst value ■ best value for indicator
 ** Significant difference with – without predation { ↘ biodiversity or ↗ harmfulness, ↗ biodiversity or ↘ harmfulness }

Weed seed predation by carabids:

- species richness = results from model construction
 Carabids eat weed seeds according to their species preference

- depends on weed species growing in field = changes the resources available for carabids

If main resource is seeds of melliferous plant, predation decrease pollinator resource

Discussion

- Predation depends on cropping systems = necessity to think management techniques such as crop diversification that enhance predation rate
- Make seed predation also depend on seed density in the model
- Simulate cropping systems with direct sowing that increases carabids' abundance

