ELINK-2 Terrestrial Landscape: Modelling exposure and effects across terrestrial landscapes - a case study of a non-target arthropod

Nika Galic[1], Fabian Gruber[2], Philip Branford[3], Sascha Bub[4], Oliver Jakoby[5], Jorge Olivares[6], Melissa Reed[7], Edna Roedig[1], Thomas Sinclair[8], Marie Trijau[9], Sanne van den Berg[10]

[1]Syngenta Crop Protection, [2]Austrian Agency for Health and Food Safety, [3] ADAMA Agricultural Solutions,[4]University of Kaiserslautern-Landau, [5] RIFCON GmbH, [6]knoell Germany GmbH, [7]Health and Safety Executive,[8] BASF Agricultural Solutions Deutschland GmbH, [9]ibacon GmbH, [10]Wageningen University and Research Centre

Background and context

- The **Terrestrial Landscape Working Group** (EL-LA-Terra WG) forms part of the broader ELINK-2 framework (Figures 1 and 2).
- Its objective is to develop and apply **a spatially explicit modelling framework** that links pesticide exposure to effects on the non-target arthropod *Bembidion lampros* across terrestrial landscapes.
- The framework is designed to **align closely with current regulatory requirements** and assessment approaches.
- It will assess how spatial heterogeneity-including crop diversity and the proportion of semi-natural habitat-influences species abundance and population resilience under realistic agricultural scenarios.
- Ultimately, the WG aims to evaluate how in-field effects translate into effects at the landscape scale.

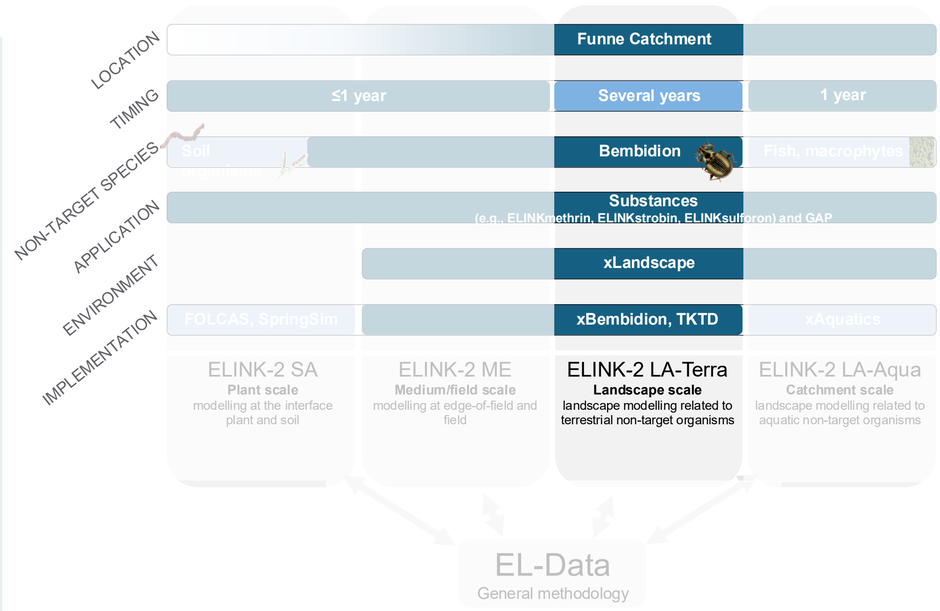

Figure 1. Overview of case studies and working groups of the ELINK-2 project spanning across the scales.

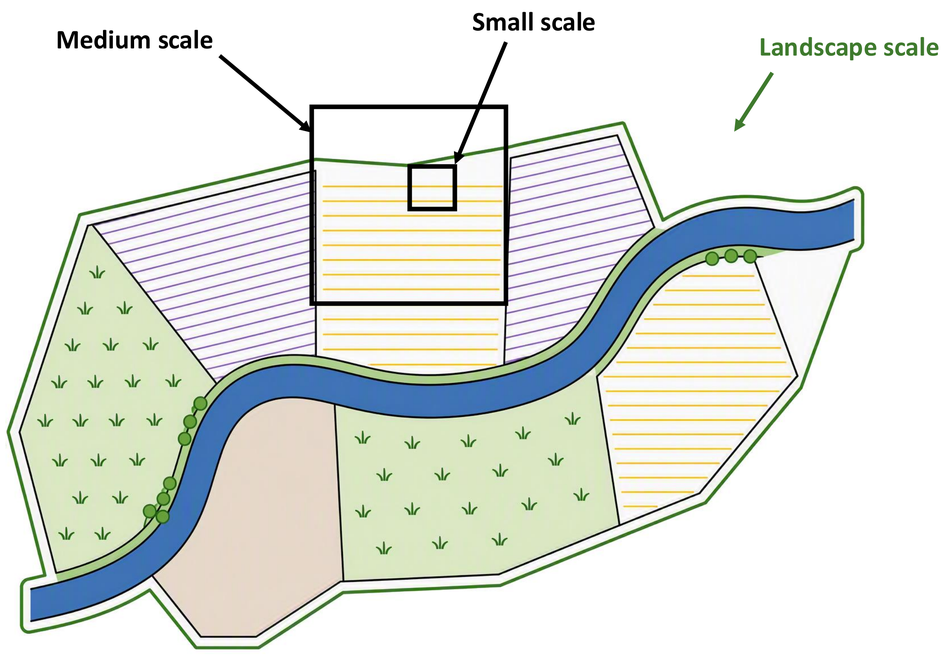

Figure 2. The landscape level integrates the small and medium scales across the three terrestrial subgroups.

Materials and Methods

- The work focuses on the univoltine carabid *Bembidion lampros* (Figure 3), a ground-dwelling predatory beetle widely distributed across European agricultural landscapes.
- An existing individual-based population model for *B. lampros* was selected for the working-group application.
- The model originates from the ALMaSS modelling framework [1] and is re-implemented within the open source xLandscape framework [2].
- Simulations are conducted across multiple scenarios designed to represent European agricultural landscapes (Figure 4).

Figure 3. The carabid *Bembidion lampros* is the model species in this case study.
Photo by David Nicholls.

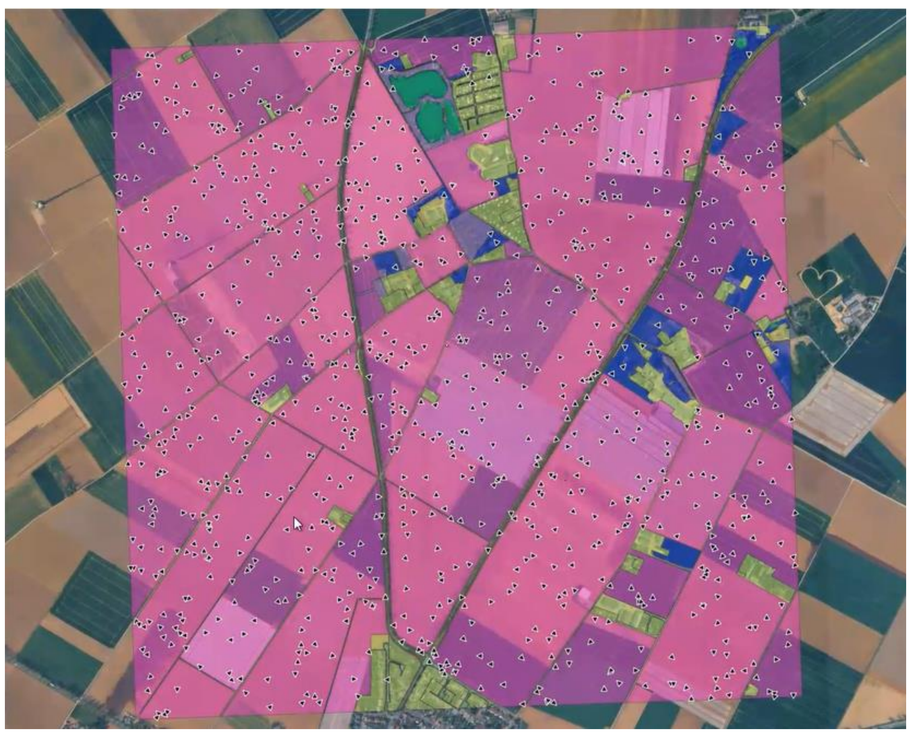

Figure 4. A landscape in North-Rhine-Westphalia in Western Germany (satellite imagery) with a 2 km x 2 km region digitized for Bembidion modeling (overlay). Colors represent different types of landscape elements (fields, wood, water, roads, etc.), which exhibit different habitat suitability for the Bembidions (full, partial, none). The triangles are ~1000 Bembidions distributed randomly within habitats.

Highlights and Challenges of EL-LA-Terra

Highlights

- Part of the broader ELINK-2 initiative, leveraging established modelling tools to investigate **pesticide exposure and effects in realistic agricultural landscapes**.
- Selection of focal species and development of representative scenarios ensure **relevance to the current EU regulatory context**.
- Integration of complementary modelling approaches supports **extrapolation across biological levels of organisation and spatial scales**.

Challenges

- The existing *Bembidion* **model requires further refinement and testing**, including potential adaptations to density dependence and organism movement within the modelled landscape.
  - Proposed modifications are being evaluated for their impact on run time and model outputs.
- As Bembidion is not a standard test species, surrogate species and relevant data were identified to support TKTD modelling.
  - An **NTA GUTS model** now requires calibration, integration, and testing within the overall framework.
- The **lack of validation data** currently limits the ability to substantiate model predictions.
- **Representative landscape and modelling scenarios** must be defined, while maintaining coordination across groups to connect processes and aggregate them appropriately across relevant spatial and temporal scales.

REFERENCES

[1] Topping CJ (2022) The Animal Landscape and Man Simulation System (ALMaSS): a history, design, and philosophy. Research Ideas and Outcomes 8: e89919. https://doi.org/10.3897/rio.8.e89919

[2] https://github.com/xlandscape

CONTACT nika.galic@syngenta.com, fabian.gruber@ages.at