Training program of the PhD student

The recruited PhD student will be incorporated into the LIFECAST project (PID2022-141004OA-I00), which has started in Sept 2023. They will be involved in all working packages of LIFECAST, focusing their thesis on investigating how positive interactions among dominant shrubs and dung beetles facilitate shrub expansion under climate change in drylands. The interdisciplinary nature of LIFECAST will allow the candidate to acquire a highly competitive skillset while working in an exceptionally international environment. A potential title for the thesis is:

Positive life-history feedbacks among vegetation and invertebrate ecosystem engineers as drivers of ecosystem-level change in drylands under climate change

The thesis can then be structured in **four chapters**:

Chapter 1: Synthesis on life-history responses of soil invertebrates to climate change

Training program: Building on current work on lacewings in my team, the PhD student will generate a dynamic database (combining raw data and published parameters) of studies that quantify variation in life-history responses across the life cycle of soil burrowing invertebrates.

Skills acquired: literature review, comparative demographic analyses, manuscript preparation, data curation, pipelines for open access data deposition

Chapter 2: Theoretical framework to integrate soil-invertebrate and plant life histories

Training program: The PhD student will learn current modeling approaches that project effects of climate change using single species or even populations. They will then advance these approaches by developing novel simulations in which they link climate-dependent life-history processes of interacting invertebrate and plant species to spatiotemporal abundance change. The simulations produced in this chapter will be integrated into the wider modelling framework as part of LIFECAST.

Skills acquired: life-history modeling, hypothesis-driven advanced computation modelling, development of open-access modeling workflows

Chapter 3: Empirically investigating how interactions between habitat-structuring invertebrates and plants affect ecosystem dynamics in an iconic dryland

Training program: Working closely with the local research team, the PhD student will lead passive warming experiments and monitoring of dung beetle abundances (using baited pitfall traps) at KRC, which will include biannual visits to the study site in South Africa.

Skills acquired: experimental design, fieldwork, expertise in shrub and dung-beetle demography, communication with stakeholders, navigating international collaborations

Chapter 4: Iterative forecasts scaling from interactions between dung beetles and shrubs to ecosystem processes

Training program: The PhD student will have the chance to use a Bayesian modelling workflow (N-mixture models) to integrate the results of the experiments and monitoring from chapter 3 with existing long-term data to forecast ecosystem wide impacts of interactions among shrubs and dung beetles.

Skills acquired: ecological forecasting, data integration in Bayesian modelling framework