A practical tool for assessing pollination services at a site level
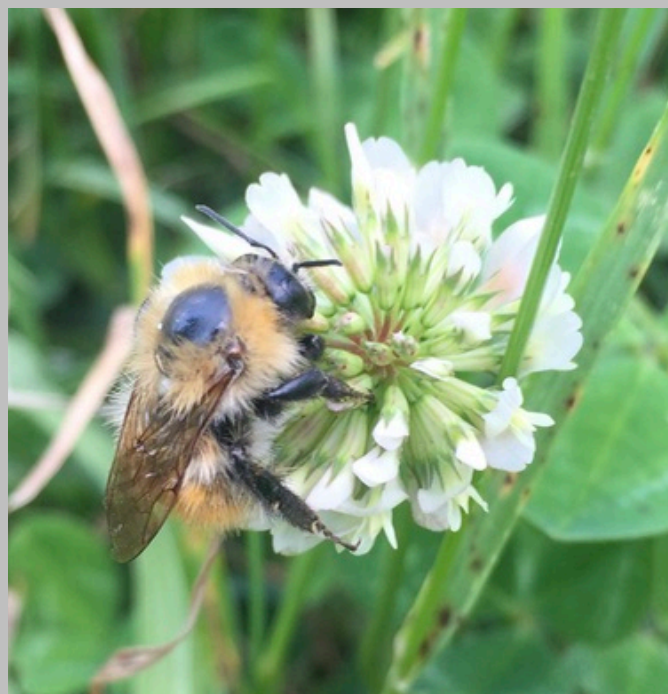
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Introduction

Background
- Animal pollination provides several benefits to people by securing quantity and quality of food, maintaining wild plants populations and providing a number of social and cultural benefits
- The substantial decline of managed and wild pollinators worldwide has triggered a growth in research on how human-induced land change affects wild pollinators and their ability to deliver pollination services
- In this context, the assessment of Pollination Services (PS) becomes paramount to human-well-being

Problem
- Most currently available ecosystem services assessment tools, which include PS (e.g. ARIES, InVEST), operate at a global or regional scale or rely on high technical expertise
- Accessible and practical tools to enable decision making at the operation level (i.e. a nature reserve) are still lacking

Objective
- Develop a novel, rapid and inexpensive protocol for the assessment of pollination services at a site scale.
- Incorporate the final output into the Tool for Ecosystem Services Site-based assessment (TESSA)

Methods

The protocol development took place in six consecutive phases:

Phase 1: Online forum
- Establish feasibility of the project
- Discuss and select approaches for rapid assessment
- Draft pollination assessment methods

Phase 2: Expert workshop
- Establish feasibility of the project
- Discuss and select approaches for rapid assessment
- Draft pollination assessment methods

Phase 3: Post workshop
- Collate information gathered in Phase 1 and 2
- Generate draft of pollination protocol
- Discuss and resolve any remaining issues

Phase 4: Peer review process
- Identify reviewers
- Address comments and issues raised
- Edit protocol following reviews

Phase 5: Piloting the protocol
- Pilot the methods at a nature reserve in the UK
- Assess feasibility and scientific robustness of methods

Phase 6: Publication in TESSA version 2.0
- Format protocol to TESSA's layout
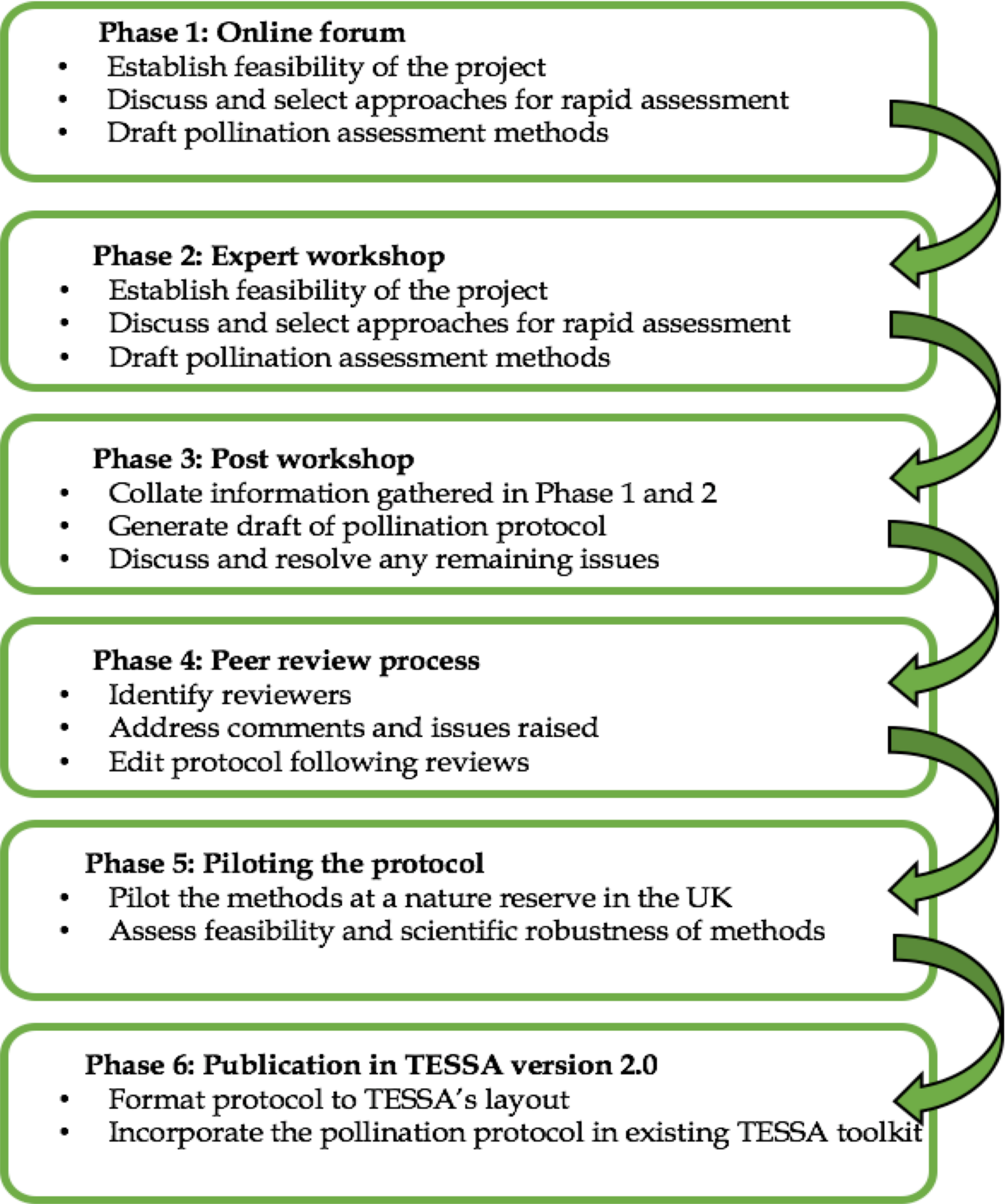- Incorporate the pollination protocol in existing TESSA toolkit

Fig 1- Flowchart showing the protocol development steps

The final output had to adhere to **TESSA's key principles**:
- Accessible (low technical expertise needed)
- Rapid and low cost
- No complex models
- Site-scale (decision-making scale)
- Use of field data collected from site of interest
- Comparative valuation with an *alternative state* (a state to which the site might plausibly change as a result of different management decisions)

Results

- The pollination protocol provides methods for the evaluation of pollination services in terms of total contribution of animal pollination to the production of cultivated and harvested wild goods
- Methods are available for the assessment of PS within the site of interest and within a 1km buffer area from the site
- Three sets of methods are available with different levels of expertise and resource requirements, based on a traffic light system (Fig 2).

Desk-based method (Red standard)
- Very limited resources available
- Builds a distance decay curve of PS value using published data on pollinator visitation rate and distance from natural habitat
- Uses published pollinator dependence ratios (DR)
- Low level of confidence
- Very quick and no cost

Field surveys method (Amber standard)
- Modest resources are available
- Builds a distance decay curve of PS value using pollinator visitation rate data collected from the site of interest and 1km buffer area
- Uses published pollinator dependence ratios (DR)
- Medium level of confidence
- Relatively quick and inexpensive

Exclusion experiments method (Green standard)
- Generous amount of resources are available
- Builds a distance decay curve of pollinator dependence ratio using data from exclusion experiments (e.g. bagging/caging) carried out in the site of interest
- High level of confidence
- Time demanding, some cost for equipment

Fig 2: Three pollination services assessment methods divided according to resources and expertise needed to be carried out.

Pilot study at Noar Hill SSSI

- The methods were piloted on oilseed rape fields within a 1km radius from Noar Hill SSSI (Fig 3-5)
- The alternative state was identified as a hypothetical state of the site where the protected area had not been established and was used for farming

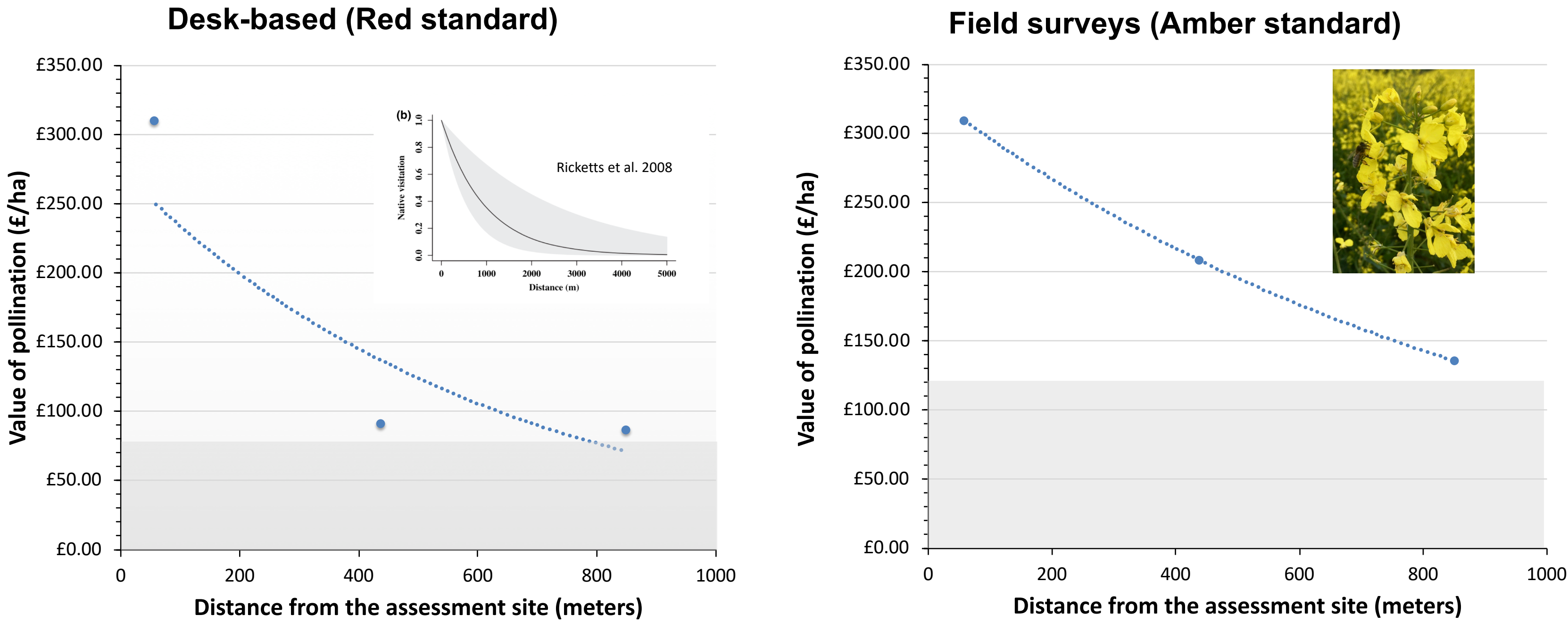**Desk-based (Red standard)**

Field surveys (Amber standard)

Fig 3-4: Distance decay curve of the value of pollination service for oilseed rape within 1 km from the reserve under the current state. The grey shading represents the value of pollination beyond 1 km provided by pollinators which inhabit within the agricultural matrix.
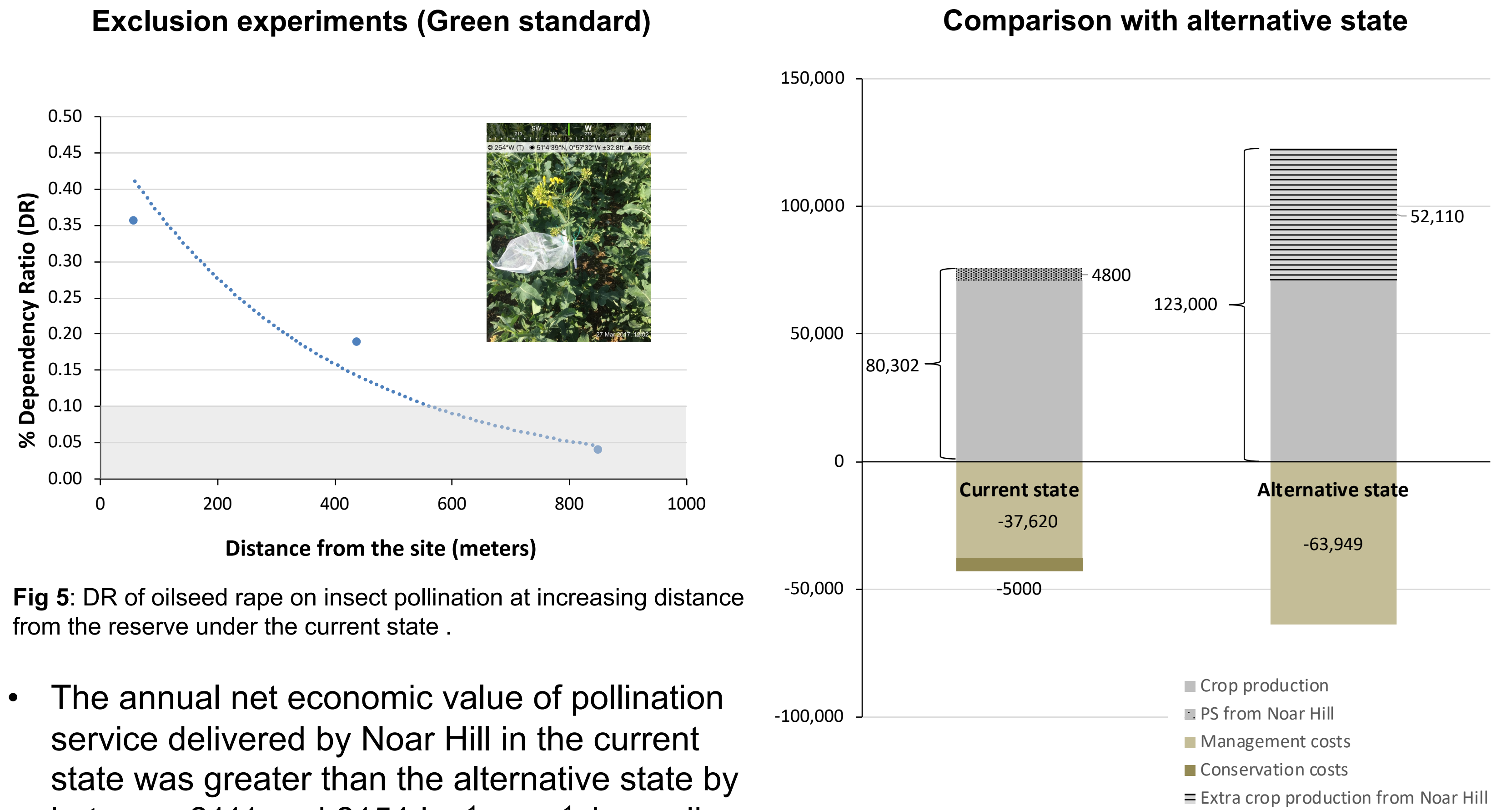
Exclusion experiments (Green standard)

Fig 5: DR of oilseed rape on insect pollination at increasing distance from the reserve under the current state.

Comparison with alternative state

Fig 6: A comparison of the pollination service values and management costs within 1 km buffer area from the reserve and of the same land if the reserve was converted into cropland

- The annual net economic value of pollination service delivered by Noar Hill in the current state was greater than the alternative state by between £111 and £151 ha^{-1} year^{-1} depending on the method adopted.

Conclusions

- Under the alternative state of the site crop production is reduced, which demonstrates the potential consequence of losing pollination services provided by the nature reserve
- Despite the different levels of confidence, the three methods unanimously show that Noar Hill contributes animal pollination services to the crop in the adjacent farmlands and that this contribution would be lost in the alternative state, confirming the robustness of all three methods
- The newly developed methods can be used by NGOs, Governments, land managers and non-experts
- Scientifically robust tool to support informed management decisions
- Data originated from these methods can be used as a baseline for more complex assessments

References
RICKETTS, T. H., REGETZ, J., STEFFAN-DEWENTER, I., CUNNINGHAM, S. A., KREMEN, C., BOGDANSKI, A., GEMMILL-HERREN, B., GREENLEAF, S. S., KLEIN, A. M., MAYFIELD, M. M., MORANDIN, L. A., OCHIENG, A. & VIANA, B. F. 2008. Landscape effects on crop pollination services: are there general patterns? *Ecology Letters*, 11, 499-515.