

A review of the impact of climate change and land management on solitary bees; threats, conservation strategies and future research requirements as identified by experts.

Despite making up 70% of wild bee species, little is known about solitary bees compared to their eusocial counterparts, honeybees and bumblebees. Their economic and intrinsic value are increasingly recognised in literature, showing their importance to ecosystems which humanity and biodiversity relies upon. But as this body of literature on solitary bees is growing, significant knowledge gaps are becoming evident.

An important knowledge gap concerns threats to solitary bee populations from existing land-use practices and climate change. A better understanding of these threats will facilitate the creation of models predicting the future of pollination services by solitary bees, informing the design of effective mitigation strategies, and encouraging engagement with their conservation by stakeholders. Currently, there has been no assessment of these knowledge gaps and how to fill them.

To address this, a combination of expert interviews and literature review was used to compile knowledge on (i) key points of vulnerability in the solitary bee life cycle, (ii) potential mitigative measures against threats to aid conservation efforts (iii) knowledge gaps on the impacts of land-management (agriculture, forestry and urbanisation) and climate change on solitary bees. The data collected was quantitatively analysed, using grounded theory as a theoretical framework to identify key themes.

Key lethal and sub-lethal threats to solitary bees were found to include extreme temperature, agrochemical use, diminishing floral and nesting resources (see fig 1). Adult life-stages were more vulnerable to both climate change and land management than juvenile life-stages but solitary bees face threats from both, at every life-stage.

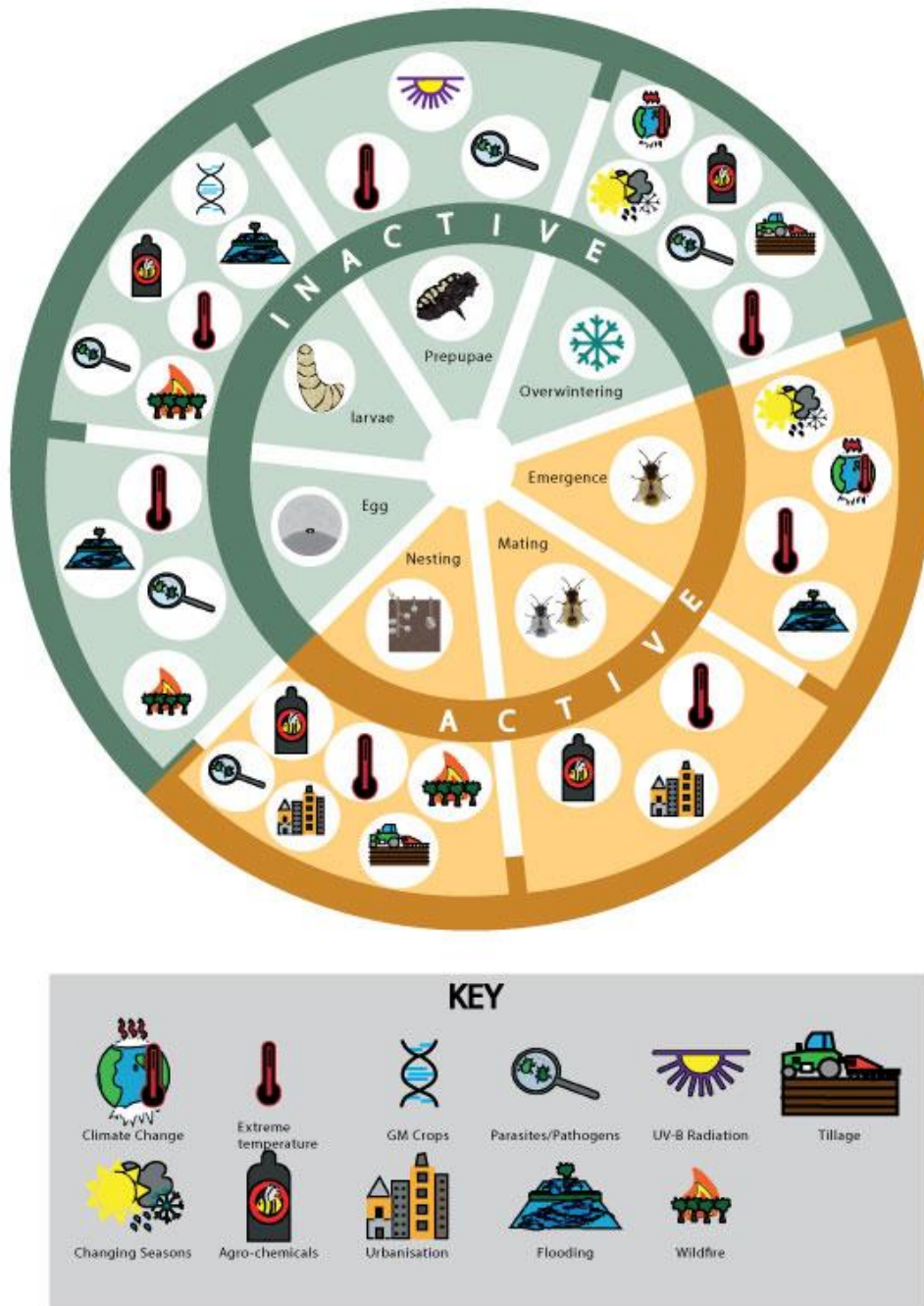


Fig 1. Depiction of the main lethal/sub-lethal threats to solitary bees at different life-stages.

This research highlights a need for targeted conservation of solitary bees due to species differences. This has been overlooked by existing agri-environment schemes, yet focused conservation efforts in land-management are essential for protecting biodiversity of pollinators (and therefore food security) in the face of a changing climate. Suggested mitigative measures that would aid solitary bee conservation efforts involved more judicious use of pesticides, diversification of agricultural landscapes, minimum tillage, creating bigger rides in commercial forests and optimising grazing intensity of livestock.

Barriers to research were practical barriers, knowledge barriers and ethical barriers (fig 2). Fundamental knowledge gaps in solitary bee ecology, such as data deficiency on foraging preferences of many species, limit research on threats to solitary bees and should be addressed as a prerequisite for further research.

The primary practical barriers to research are a lack of funding and expert workforce. Overcoming these would help surmount logistical restrictions and low levels of replication in studies, improving the scope of studies and facilitating higher quality of research. As such, education and engagement of the public, policy makers and research donors on the value of solitary bees is necessary to ensure the future of solitary bee research and conservation.

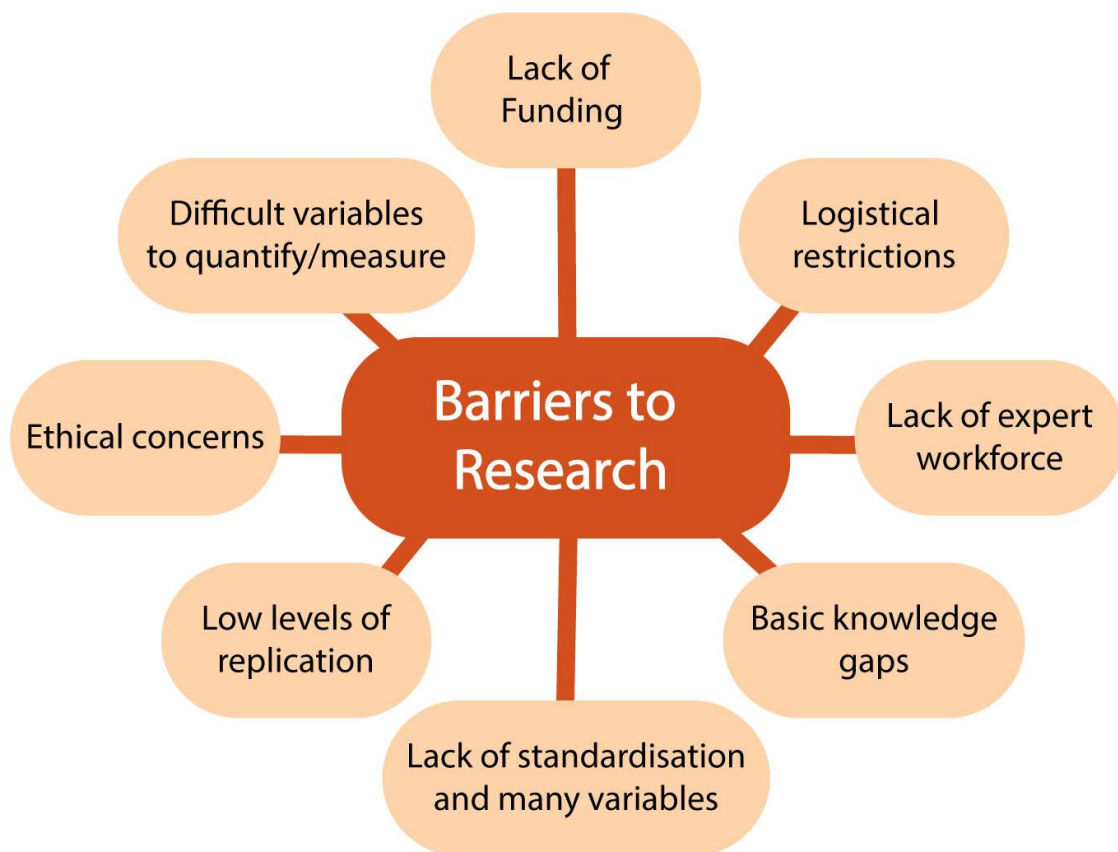


Fig 2. Summary of the main barriers to solitary bee research.