



CORRESPONDENCE

Pollinator declines: reconciling scales and implications for ecosystem services [v1; ref status: indexed, <http://f1000r.es/14f>]

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Abstract

Despite the widespread concern about the fate of pollinators and the ecosystem services they deliver, we still have surprisingly scarce scientific data on the magnitude of pollinator declines and its actual contribution to crop pollination and food security. We use recently published data from northeastern North America to show that studies at both the local and regional scales are needed to understand pollinator declines, and that species-specific responses to global change are broadly consistent across scales. Second, we show that bee species that are currently delivering most of the ecosystem services (i.e. crop pollination) are not among the species showing declining trends, but rather appear to thrive in human-dominated landscapes.

Open Peer Review

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version 1 published 02 Jul 2013	report	report

- 1 **Gary Luck**, Charles Sturt University Australia
- 2 **Ryan Chisholm**, National University of Singapore Singapore

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Main text

There is widespread concern regarding the fate of pollinators and the ecosystem services they deliver¹. However, the information we have is still limited and at times appears contradictory. Four recent articles, three from *Science* and one from *PNAS*, highlight this point²⁻⁵. Burkle *et al.*² show that 50% of the bee species in one locality in the Midwestern USA became locally extinct during the last century, which in combination with recent evidence that wild pollinators are critical to global crop pollination³, has led some to conclude that we might face an imminent collapse of crop pollination⁴. In contrast, Bartomeus *et al.*⁵ explored bee declines over a similar time scale but at a regional scale (the northeastern USA) and reported only a 15%, non-significant decline in bee species richness. Here we present new analyses that help to reconcile this apparent contradiction in the magnitude of bee declines, while also suggesting that any effects on crop pollination might be less than previously thought.

First, we used the 67 bee species included in both the regional-scale⁵ and the local-scale² analyses (see data file below) to show that the two studies in fact found broadly consistent results: the locally

extinct species of Burkle² tend to be declining regionally, whereas the locally persistent species tend to be increasing regionally (Figure 1A, ANOVA: $F = 5.89$, $df = 1,65$, $P = 0.01$). Second, we used data from Garibaldi *et al.*³ on the bee species that provide ecosystem services to four crops in the region covered by Bartomeus *et al.*⁵ to show that these ecosystem service providers tend to have increasing population trends compared to non-ecosystem service providers (Figure 1B, $F = 7.12$, $df = 2,184$, $P = 0.001$). All analyses were conducted in R⁶.

Northeastern North American bee species information on population trends and ecosystem services delivered

1 Data File

<http://dx.doi.org/10.6084/m9.figshare.701173>

Thus, our analyses demonstrate that, as one would expect, local-scale extinctions do not imply regional-scale extinctions; and that bee species that are important crop pollinators are less likely to be declining at the regional scale. It is important to remember that all

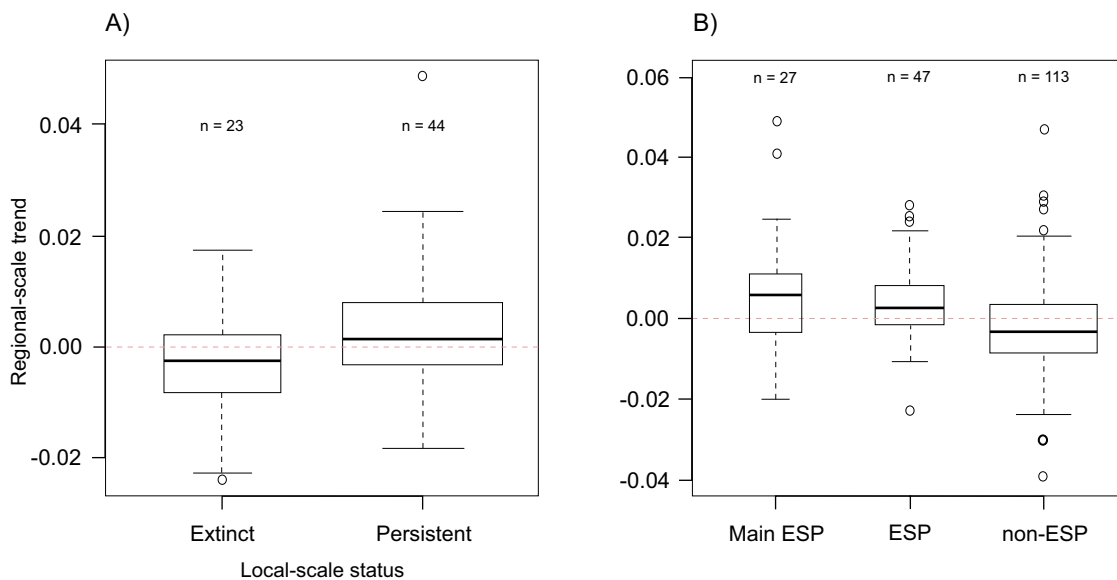


Figure 1. Trend in bee species' relative abundance in northeastern North America calculated over the period 1870–2011. **A)** For species that either became locally extinct or persisted in Carleville, Illinois. **B)** For species that either are not ecosystem-service providers to crops (non-ESP), are at least occasionally ecosystem-service providers to crops (ESP), or are among the species cumulatively responsible for 90% of the pollinator visitation to at least one crop (main ESP). Regional data from Bartomeus *et al.*⁵, local data from Burkle *et al.*² and crop pollinator data from Garibaldi *et al.*³.

bee species may well be crucial to providing ecosystem functions in natural systems and therefore merit conservation attention.

Author contributions

IB analyzed the data and IB and RW wrote the manuscript.

Competing interests

No competing interests disclosed.

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The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

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This is a straightforward analysis and the interpretations are justified. I have two minor comments:

- Figure 1B shows that ecosystem-service-providing (ESP) bee species tend to be increasing whereas non-ESP species tend to be decreasing. But how is ESP measured? Is there any possibility that this result could be artefact, in that declining species are now rare and that therefore their ESP behaviour is less likely to be recorded? I would like to see this issue addressed briefly.
- The final sentence "It is important to remember that all bee species may well be crucial to providing ecosystem functions in natural systems and therefore merit conservation attention." seems like a non-sequitur, because the authors have just finished talking about how important pollinators are less likely to be declining. Presumably the authors mean that we have incomplete information and that it would be risky to assume that apparent non-pollinators are genuinely playing no useful ecosystem-service role. This could be expressed better.

I have read this submission. I believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Competing Interests: No competing interests were disclosed.

Author Response (Member of the F1000 Faculty) 10 Jul 2013

Ignasi Bartomeus, Department of Ecology, Swedish University of Agricultural Sciences, Sweden

Regarding your first comment, ESP is measured as any bee species visiting flowers of at least one of four main crops the study area, based on data we collected in the recent period (2004-2011) and published in [Garibaldi *et al.*, 2013](#). Thus the reviewer is correct that there could have been species that were ESP in the past but, due to population decline, were not recorded as ESP in our recent surveys, and our results should be interpreted in this light. However, we believe that our finding, that ESP are declining less than other species, has generality for two reasons. 1) We report in [Bartomeus *et al.* 2013](#) that most of the bee species that have been declining over the past 140 years in our study region are still frequently recorded, hence our measure of ESP as "any species observed visiting crops at least once" should capture declining species as well if they commonly visit crops 2) Even the current ESP are a subset of the historical ESP, [Garibaldi *et al.*, 2013](#) shows that the under this current situation, wild pollinators enhance fruit set, suggesting that the resilience of the current ESP to global change may buffer the effects of a pollinator decline. Lastly, on a priori grounds it would not be surprising if ESP were more robust to land use change (a primary form of

global change in our study region) than non-ESP because by definition species found pollinating crops are able to persist in agricultural areas.

Regarding your second question, it is important to note that the last sentence refers to "natural systems." While our data and analyses refer to simplified crop systems, where a few dominant pollinators are responsible for most of the function delivered to a single plant species (the crop), natural systems are far more complex and high levels of bee diversity are likely to be necessary to provide function to the full community. Hence our results should not be extrapolated to other, non-agricultural systems.

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This short article comes to the important conclusion that while declines in pollinator [bee] abundance at local and regional scales are generally consistent, these declines are not occurring among those species responsible for delivering the majority of pollination services to particular crops. This insight makes a valuable contribution to the recent debate on the implications of pollinator declines for food production and will hopefully spur more studies that look closely at the relative contribution of different species to delivering pollination services across different crop types, and how the abundance of these species has changed over time.

I have read this submission. I believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Competing Interests: No competing interests were disclosed.
