**Responses to Reviewers’ Comments**

**Reference number**: 24-0020-EEN

**Title of article**: Free ride without raising a thumb: A citizen science project reveals the pattern of active ant hitchhiking on vehicles and its ecological implications

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Dear Dr. XXX,

Thank you for inviting us to submit a revised version of the manuscript. We greatly appreciate the valuable comments and feedback from you and the reviewers. We have carefully considered each comment and incorporated most suggestions. In particular, we have made the following major changes:

* Clarified how we determined “hitchhiking” cases based on groups of ants rather than just a few workers in the methods section.
* Added information that most hitchhiking species are not present in the destination areas, and that food was not present in or on the vehicles, to the discussion section.
* Added some discussion on how common ant hitchhiking behavior might be to the discussion section.

Please also see the following section for our detailed point-by-point responses. All line numbers refer to the changes we made in the revised manuscript. We believe that the revisions based on the review comments have improved the quality of this manuscript, and we hope that the manuscript is now suitable for publication in *Ecological Entomology*.

Sincerely,

XXX

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**Editor's comments**  
  
**Comment 1** > The manuscript "Free ride without raising a thumb: A citizen science project reveals the pattern of active ant hitchhiking on vehicles and its ecological implications" takes an interesting approach to looking into ant dispersal and possibly invasion biology. I think that with the revisions suggested by the reviewers, it will be a great short communication for the *Ecological Entomology* readers.

**Response** > Thanks for the positive feedback on this manuscript. We have made our greatest effort to incorporate the suggestions from the reviewers.

**Reviewer 1's comments**

**Comment 1** > The study of ant hitchhiking is novel and provides a unique angle to look into how human activity changes ant behavior, potentially affecting the ecology.  The manuscript could provide more information: 1) Are the hitchhiking species also presented in the destination area? 2) Is there any food in the vehicles (If not, it can rule out the possibility of foraging rather than migration)? 3) How do we know if the ant is hitchhiking rather than relocating the nest? In that case, is there any evidence showing the ants would leave the vehicles after arriving at the destinations?

**Response** > Thanks for the suggestions. Below we address the three questions raised by the reviewer:

1. Are the hitchhiking species also presented in the destination area?

Many exotic hitchhiking species are not distributed in the intended destination areas, and therefore such hitchhiking can present a potential pathway for invasion. For example, the most frequent hitchhiker, the exotic black cocoa ant (*Dolichoderus thoracicus*), is currently distributed in central Taiwan (where most hitchhiking events of this species took place) but not at the destination areas. We have added this information to the discussion section (Line XXX).

1. Is there any food in the vehicles (If not, it can rule out the possibility of foraging rather than migration)?

In most cases, there was no food present in or on the vehicles. We have added this information in the discussion section (Line XXX).

1. How do we know if the ant is hitchhiking rather than relocating the nest? In that case, is there any evidence showing the ants would leave the vehicles after arriving at the destinations?

We did not have direct evidence showing that the ants would leave the vehicles after arriving at the destinations. However, we feel that this is likely to happen if the environmental conditions are suitable at the destination areas because ants are highly mobile. Moreover, the more such hitchhiking events, the more incidents that the ants will successfully disperse and colonize the new areas.

**Reviewer 2's comments**

**Comment 1** > This study asks a sensible question which is interesting to invasion biologists. However, it is also very small, and some critical information is missing. Most importantly, we do not know what the sampling effort was like, so we cannot estimate in any way the scale of the issue raised. Is hitchhiking common? My guess would be yes, because the chances of people becoming aware of the facebook group are low, so the overlap of those people and people who note an ant infestation should be even lower. Perhaps some sort of discussion of how common this behaviour is would be useful.

**Response** > In this study, we did not conduct systematic data collection (e.g., questionnaire surveys), and therefore we were not able to estimate the frequency of the hitchhiking behavior. We agree with the reviewer that most vehicle owners would likely be unaware of this phenomenon, and even fewer would post their observations to Facebook. Still, we were able to record 52 cases over a five-year period, and therefore we believe that ant hitchhiking should be more common than what the number in our dataset suggests. We have added this in the discussion section (Line XXX). But despite a relatively small dataset, the estimated sampling completeness was appropriate (0.94 [95% CI: 0.89–0.99]; Fig. S3).

**Comment 2** > The definitions are not quite clear: are ALL events of ants on vehicles noted - including just some workers walking around outside or inside the vehicle? Or are only situations considered where it looks like ants are moving in: many individuals grouped together in a small gap or hidden space? This needs clarifying, as I do not think a forager or two walking on the surface of a car is ecologically interesting, while the presence of brood and queens certainly is. I think occasions of a few workers on the outside of the car should not be included in the dataset.

**Response** > Thanks for the comments. During our data collection process, we checked all the photos provided by the vehicle owners, and only cases where there were groups of ants (at least XXX individuals) present on the vehicles were considered as “hitchhiking” and included in our dataset. We have clarified this in the methods section (Line XXX).

**Comment 3** > The finding that most of these hitchhiking events occurred under trees, especially in contact with trees, is very useful, as is the seasonal data. This could lead to clear guidelines about parking cars, for example when they are stored en-masse for later transport, or of rental cars. With that said, it seems unlikely that the vast majority of people will be willing or able to change their behaviour based on such guidelines.

**Response** > We attempted to provide information on what environmental conditions may be associated with ant hitchhiking on vehicles. This information can be used to establish parking guidelines to reduce the probability of hitchhiking events. Although implementing such guidelines is not the focus of our study, it can be the next step in terms of the actual management and applications.

**Comment 4** > Useful would be some sort of information about where in the car the ants were found – especially the incidence with queens or brood.

**Response** > All hitchhiking cases were found on the surface of the vehicles as confirmed by the photos provided by the owners. We have added this information to the results section (Line XXX).

**Comment 5** > Abstract – please mention specifically how many of the incidents involved queen or brood.

**Response** > We have added this information to the abstract (Line XXX).

**Comment 6** > Line 54 pg 3 – this is not systematic data collection.

**Response** > We have removed the word “systematically” from the sentence (Line XXX).

**Comment 7** > Line 54 pg 3 – this is not metadata. It is data. Metadata is essentially the description of what the different data categories are.

**Response** > Thanks for pointing this out. We have replaced “metadata” with “data” in the methods section (Line XXX and XXX).

**Comment 8** > Line 31 pg 4 – did the 8 incidents of brood include the 3 incidents of queens?

**Response** > We checked the photos again and there was no case with both queens and brood. We have added this information to the results section (Line XXX).