An experimental approach to evaluate the potential of drones in terrestrial mammal research: a gregarious ungulate as a study model

Natalia M. Schroeder, Antonella Panebianco, Romina Gonzalez Musso and Pablo Carmanchahi

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Original submission: 26 August 2019
1st revised submission: 30 October 2019
2nd revised submission: 4 December 2019
Final acceptance: 6 December 2019

Note: Reports are unedited and appear as submitted by the referee. The review history appears in chronological order.

Review History
RSOS-191482.R0 (Original submission)

Review form: Reviewer 1

Is the manuscript scientifically sound in its present form?
No

Are the interpretations and conclusions justified by the results?
Yes

Is the language acceptable?
No

Do you have any ethical concerns with this paper?
No
Have you any concerns about statistical analyses in this paper?
No

Recommendation?
Major revision is needed (please make suggestions in comments)

Comments to the Author(s)
This paper presents the results of several experiments to determine the reaction of guanaco to drones, and the variation of manual counts of these animals based on photos taken from the drone. Both of these tests were performed for a variety of drone heights and speeds of approach to the animals. The experimental design with regards to the drone operations themselves is ok, but the analysis needs more work to be of publishable quality. The methods and results section are somewhat unclear and lack necessary detail. It’s true that there is not a lot of previous work in the reactions of animals to drones; and this reviewer agrees that it is likely species specific, and subject to many factors, and that we should be making note of animal reactions and adjusting observing strategies accordingly. Overall this paper does provide some new insight which may be of use to the community, provided some revisions are made.

The authors have missed a significant amount of literature on this subject. The statement in the abstract that progress so far has “mainly been derived from aquatic fauna studies” is perhaps not accurate given the wealth of other studies on terrestrial animals, such as those listed at the end of my review.

Throughout the paper the authors make incorrect use of the word “altitude”. Altitude has a specific meaning, which is the height above sea level. To say you flew the drone at 60m altitude at the co-ordinates specified would likely mean you were flying underground. All instances of the word altitude should be replaced with “height” or “height AGL”. I know this might not sound very scientific but it is the correct term.

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Recommendation?
Accept with minor revision (please list in comments)

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Discussion

Is it possible to highlight the importance and contribution of this study in contrast to Bennitt et al. 2019’s recent analysis? Perhaps by paying more attention to inter-species differences and why reproducing these studies across a range of species and ecotypes is necessary. Given that responses may vary by species, could you also provide some discussion of the importance of these findings that may be specific to Guanacos or to disturbance potentially caused by the increasing recreational use of drones (if this is also occurring across S. America)?

L202 perhaps “aid” would make more sense here than “collaborate”?

Decision letter (RSOS-191482.R0)

28-Sep-2019

Dear Dr Schroeder,

The editors assigned to your paper (“An experimental approach to evaluate the potential of drones in terrestrial mammal research: a gregarious ungulate as a study model”) have now received comments from reviewers. We would like you to revise your paper in accordance with the referee and Associate Editor suggestions which can be found below (not including
confidential reports to the Editor). Please note this decision does not guarantee eventual acceptance.

Please submit a copy of your revised paper before 21-Oct-2019. Please note that the revision deadline will expire at 00.00am on this date. If we do not hear from you within this time then it will be assumed that the paper has been withdrawn. In exceptional circumstances, extensions may be possible if agreed with the Editorial Office in advance. We do not allow multiple rounds of revision so we urge you to make every effort to fully address all of the comments at this stage. If deemed necessary by the Editors, your manuscript will be sent back to one or more of the original reviewers for assessment. If the original reviewers are not available, we may invite new reviewers.

To revise your manuscript, log into http://mc.manuscriptcentral.com/rsos and enter your Author Centre, where you will find your manuscript title listed under "Manuscripts with Decisions." Under "Actions," click on "Create a Revision." Your manuscript number has been appended to denote a revision. Revise your manuscript and upload a new version through your Author Centre.

When submitting your revised manuscript, you must respond to the comments made by the referees and upload a file "Response to Referees" in "Section 6 - File Upload". Please use this to document how you have responded to the comments, and the adjustments you have made. In order to expedite the processing of the revised manuscript, please be as specific as possible in your response.

In addition to addressing all of the reviewers' and editor's comments please also ensure that your revised manuscript contains the following sections as appropriate before the reference list:

- **Ethics statement (if applicable)**
  If your study uses humans or animals please include details of the ethical approval received, including the name of the committee that granted approval. For human studies please also detail whether informed consent was obtained. For field studies on animals please include details of all permissions, licences and/or approvals granted to carry out the fieldwork.

- **Data accessibility**
  It is a condition of publication that all supporting data are made available either as supplementary information or preferably in a suitable permanent repository. The data accessibility section should state where the article's supporting data can be accessed. This section should also include details, where possible of where to access other relevant research materials such as statistical tools, protocols, software etc can be accessed. If the data have been deposited in an external repository this section should list the database, accession number and link to the DOI for all data from the article that have been made publicly available. Data sets that have been deposited in an external repository and have a DOI should also be appropriately cited in the manuscript and included in the reference list.

  If you wish to submit your supporting data or code to Dryad (http://datadryad.org/), or modify your current submission to dryad, please use the following link: http://datadryad.org/submit?journalID=RSOS&manu=RSOS-191482

- **Competing interests**
  Please declare any financial or non-financial competing interests, or state that you have no competing interests.
• Authors’ contributions
All submissions, other than those with a single author, must include an Authors’ Contributions section which individually lists the specific contribution of each author. The list of Authors should meet all of the following criteria; 1) substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data; 2) drafting the article or revising it critically for important intellectual content; and 3) final approval of the version to be published.

All contributors who do not meet all of these criteria should be included in the acknowledgements.

We suggest the following format:
AB carried out the molecular lab work, participated in data analysis, carried out sequence alignments, participated in the design of the study and drafted the manuscript; CD carried out the statistical analyses; EF collected field data; GH conceived of the study, designed the study, coordinated the study and helped draft the manuscript. All authors gave final approval for publication.

• Acknowledgements
Please acknowledge anyone who contributed to the study but did not meet the authorship criteria.

• Funding statement
Please list the source of funding for each author.

Once again, thank you for submitting your manuscript to Royal Society Open Science and I look forward to receiving your revision. If you have any questions at all, please do not hesitate to get in touch.

Kind regards,
Andrew Dunn
Royal Society Open Science Editorial Office
Royal Society Open Science
openscience@royalsociety.org

on behalf of Dr Alecia Carter (Associate Editor) and Kevin Padian (Subject Editor)
openscience@royalsociety.org

Associate Editor's comments (Dr Alecia Carter):

Dear authors,
I have now received two reviews of your manuscript and read it myself. We are all in agreement that your study is timely and interesting and, in general, well-executed. However, I agree with the reviewers that the manuscript requires improvements. In particular, much greater clarity in the methods and results sections is required for this work to be understandable (and replicable). The reviewers also highlight a large literature on terrestrial applications of drones that has been missed in this submission. The feedback from both reviewers is very constructive and I anticipate that this manuscript will be greatly improved by carefully incorporating their comments in a resubmission.

Thank you for submitting your manuscript to RSOS.
Comments to Author:

Reviewers' Comments to Author:
Reviewer: 1

Comments to the Author(s)
Review also attached as pdf

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L114 can you also provide more detail on the behavioural data? i.e. data categories (forage, vigilance etc., is mentioned at the group level – was this scored based on the majority of the individuals in the group or quantified in some way i.e. number of individuals doing each behaviour on each behavioural scan? L134-139 as above, I think this needs some clarification on the unit of analysis (i.e. one measure of behaviour per group, or individuals?) L140 can you clarify if this is using imagery? L150 “with VC counts at 200 m found to be more variable compared to”

Discussion
Is it possible to highlight the importance and contribution of this study in contrast to Bennitt et al. 2019’s recent analysis? Perhaps by paying more attention to inter-species differences and why reproducing these studies across a range of species and ecotypes is necessary. Given that responses may vary by species, could you also provide some discussion of the importance of these findings that may be specific to Guanacos or to disturbance potentially caused by the increasing recreational use of drones (if this is also occurring across S. America)? L202 perhaps “aid” would make more sense here than “collaborate”?

Author’s Response to Decision Letter for (RSOS-191482.R0)
See Appendix A.

RSOS-191482.R1 (Revision)

Review form: Reviewer 1

Is the manuscript scientifically sound in its present form?
Yes

Are the interpretations and conclusions justified by the results?
Yes

Is the language acceptable?
No

Do you have any ethical concerns with this paper?
No

Have you any concerns about statistical analyses in this paper?
No

Recommendation?
Accept with minor revision (please list in comments)
Comments to the Author(s)
The paper is much improved and generally scientifically sound for publication. There are only a few minor points I would like to see addressed.

Lines 53-54: "outweighed by several limitations" This is a pretty strong statement, and in fact the advantages of drones over foot surveys are already quite distinct even if some work does still need to be done. Please soften this.

Line 54: "low sampling area coverage" Relative to a foot survey even a 20-30 min drone survey can cover a much larger area, so this statement doesn't seem right.

Line 56: "time consuming data processing" It's true that processing lots of drone data by eye or by hand can be very time consuming, however is this time spent more than would be spent on a very long ground survey to make the same animal counts? The statement could perhaps be quantified better.

Line 66: "approximation" is the wrong word to use here. "Proximity" maybe?

Line 299: "results question previous mostly indirect and observational evidence" This is too strong a statement as you have only examined one species of animal. It's an important new observation but in context with the rest of the literature I think more evidence is needed to make a statement that strong.

Review form: Reviewer 2

Is the manuscript scientifically sound in its present form? Yes

Are the interpretations and conclusions justified by the results? Yes

Is the language acceptable? Yes

Do you have any ethical concerns with this paper? No

Have you any concerns about statistical analyses in this paper? No

Recommendation? Accept with minor revision (please list in comments)

Comments to the Author(s)
The changes made to the manuscript have better contextualized this research with what has been done to date and improved the clarity of the objectives and methods used. I have included just a few more comments below mostly regarding clarity and English.
L23 this sounds as though the studies themselves are a concern – perhaps better to just say “Few studies to date have experimentally evaluated the effect of UAS approach on animals and have usually focused primarily on aquatic fauna”

L29 “limit disturbance of animals and flying low enough to maintain count precision…”

L58 “Moreover, images provide a permanent recording of data that can be re-visited and analysed again in the future, unforeseen research questions.”

L67 different types

L70 “However, few studies have experimentally… animals, whilst those studies done to date have focused primarily…”

L78 Include the authors names here and put the citation at the end of the relevant text., same for 22 and 23

L99 whilst maintaining count precision

L134 english needs amending, perhaps “We approached the drone at 200 AGL until it was positioned directly above a previously selected group of guanacos. Then the drone was slowly lowered and pictures were taken at…”

L139 approached the drone towards it

L149 To be absolutely clear state whether group size was recorded by the observer here.

L189-194 Were these behaviours recorded as counts of individuals doing each behaviour, as the predominant behaviour displayed by most of the group, or by focal individuals by the observer?

L210 were not was – perhaps clearer to say “At 100 and 150m AGL only a small number of photos were captured that contained offspring, so we could not include these images in the analysis.

L229 14% more groups reacted when the UAS was flown at 8-10m/s.

L277 has been shown to

L287 “which supports previous research suggesting other terrestrial mammals (which ones?) also react more to auditory disturbance”

L298 spelling usually

L318 include author names and move citation to end of text if structuring sentences this way

L324 highlights

L328 especially not specially

L329-331 This sentence is very unclear, can you check and rephrase?

Table 1. why is flight height presented 60/180 for Feb 2018?

Figure 3. still says altitude instead of height

Decision letter (RSOS-191482.R1)

27-Nov-2019

Dear Dr Schroeder,

On behalf of the Editors, I am pleased to inform you that your Manuscript RSOS-191482.R1 entitled "An experimental approach to evaluate the potential of drones in terrestrial mammal research: a gregarious ungulate as a study model" has been accepted for publication in Royal Society Open Science subject to minor revision in accordance with the referee suggestions. Please find the referees' comments at the end of this email.

The reviewers and Subject Editor have recommended publication, but also suggest some minor revisions to your manuscript. Therefore, I invite you to respond to the comments and revise your manuscript.
• Ethics statement
If your study uses humans or animals please include details of the ethical approval received, including the name of the committee that granted approval. For human studies please also detail whether informed consent was obtained. For field studies on animals please include details of all permissions, licences and/or approvals granted to carry out the fieldwork.

• Data accessibility
It is a condition of publication that all supporting data are made available either as supplementary information or preferably in a suitable permanent repository. The data accessibility section should state where the article's supporting data can be accessed. This section should also include details, where possible of where to access other relevant research materials such as statistical tools, protocols, software etc can be accessed. If the data has been deposited in an external repository this section should list the database, accession number and link to the DOI for all data from the article that has been made publicly available. Data sets that have been deposited in an external repository and have a DOI should also be appropriately cited in the manuscript and included in the reference list.

If you wish to submit your supporting data or code to Dryad (http://datadryad.org/), or modify your current submission to dryad, please use the following link: http://datadryad.org/submit?journalID=RSOS&manu=RSOS-191482.R1

• Competing interests
Please declare any financial or non-financial competing interests, or state that you have no competing interests.

• Authors’ contributions
All submissions, other than those with a single author, must include an Authors’ Contributions section which individually lists the specific contribution of each author. The list of Authors should meet all of the following criteria; 1) substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data; 2) drafting the article or revising it critically for important intellectual content; and 3) final approval of the version to be published.

All contributors who do not meet all of these criteria should be included in the acknowledgements.

We suggest the following format:
AB carried out the molecular lab work, participated in data analysis, carried out sequence alignments, participated in the design of the study and drafted the manuscript; CD carried out the statistical analyses; EF collected field data; GH conceived of the study, designed the study, coordinated the study and helped draft the manuscript. All authors gave final approval for publication.

• Acknowledgements
Please acknowledge anyone who contributed to the study but did not meet the authorship criteria.

• Funding statement
Please list the source of funding for each author.

Please note that we cannot publish your manuscript without these end statements included. We have included a screenshot example of the end statements for reference. If you feel that a given
heading is not relevant to your paper, please nevertheless include the heading and explicitly state that it is not relevant to your work.

Because the schedule for publication is very tight, it is a condition of publication that you submit the revised version of your manuscript before 06-Dec-2019. Please note that the revision deadline will expire at 00.00am on this date. If you do not think you will be able to meet this date please let me know immediately.

To revise your manuscript, log into https://mc.manuscriptcentral.com/rsos and enter your Author Centre, where you will find your manuscript title listed under "Manuscripts with Decisions". Under "Actions," click on "Create a Revision." You will be unable to make your revisions on the originally submitted version of the manuscript. Instead, revise your manuscript and upload a new version through your Author Centre.

When submitting your revised manuscript, you will be able to respond to the comments made by the referees and upload a file "Response to Referees" in "Section 6 - File Upload". You can use this to document any changes you make to the original manuscript. In order to expedite the processing of the revised manuscript, please be as specific as possible in your response to the referees.

When uploading your revised files please make sure that you have:

1) A text file of the manuscript (tex, txt, rtf, docx or doc), references, tables (including captions) and figure captions. Do not upload a PDF as your "Main Document".
2) A separate electronic file of each figure (EPS or print-quality PDF preferred (either format should be produced directly from original creation package), or original software format)
3) Included a 100 word media summary of your paper when requested at submission. Please ensure you have entered correct contact details (email, institution and telephone) in your user account
4) Included the raw data to support the claims made in your paper. You can either include your data as electronic supplementary material or upload to a repository and include the relevant doi within your manuscript
5) All supplementary materials accompanying an accepted article will be treated as in their final form. Note that the Royal Society will neither edit nor typeset supplementary material and it will be hosted as provided. Please ensure that the supplementary material includes the paper details where possible (authors, article title, journal name).

Supplementary files will be published alongside the paper on the journal website and posted on the online figshare repository (https://figshare.com). The heading and legend provided for each supplementary file during the submission process will be used to create the figshare page, so please ensure these are accurate and informative so that your files can be found in searches. Files on figshare will be made available approximately one week before the accompanying article so that the supplementary material can be attributed a unique DOI.

Once again, thank you for submitting your manuscript to Royal Society Open Science and I look forward to receiving your revision. If you have any questions at all, please do not hesitate to get in touch.

Kind regards,

Lianne Parkhouse
Editorial Coordinator
Royal Society Open Science
Reviewer comments to Author:

Reviewer: 1
Comments to the Author(s)

The paper is much improved and generally scientifically sound for publication. There are only a few minor points I would like to see addressed.

Lines 53-54: "outweighed by several limitations" This is a pretty strong statement, and in fact the advantages of drones over foot surveys are already quite distinct even if some work does still need to be done. Please soften this.

Line 54: "low sampling area coverage" Relative to a foot survey even a 20-30 min drone survey can cover a much larger area, so this statement doesn't seem right.

Line 56: "time consuming data processing" Its true that processing lots of drone data by eye or by hand can be very time consuming, however is this time spent more than would be spent on a very long ground survey to make the same animal counts? The statement could perhaps be quantified better.

Line 66: "approximation" is the wrong word to use here. "Proximity" maybe?

Line 299: "results question previous mostly indirect and observational evidence" This is too strong a statement as you have only examined one species of animal. Its an important new observation but in context with the rest of the literature I think more evidence is needed to make a statement that strong.

Reviewer: 2
Comments to the Author(s)

The changes made to the manuscript have better contextualized this research with what has been done to date and improved the clarity of the objectives and methods used. I have included just a few more comments below mostly regarding clarity and English.

L23 this sounds as though the studies themselves are a concern – perhaps better to just say “Few studies to date have experimentally evaluated the effect of UAS approach on animals and have usually focused primarily on aquatic fauna”
L29 “limit disturbance of animals and flying low enough to maintain count precision…”
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L67 different types
L70 “However, few studies have experimentally… animals, whilst those studies done to date have focused primarily…”
Include the authors names here and put the citation at the end of the relevant text., same for 22 and 23

whilst maintaining count precision

english needs amending, perhaps “We approached the drone at 200 AGL until it was positioned directly above a previously selected group of guanacos. Then the drone was slowly lowered and pictures were taken at…”

approached the drone towards it

To be absolutely clear state whether group size was recorded by the observer here.

Were these behaviours recorded as counts of individuals doing each behaviour, as the predominant behaviour displayed by most of the group, or by focal individuals by the observer?

At 100 and 150m AGL only a small number of photos were captured that contained offspring, so we could not include these images in the analysis.

14% more groups reacted when the UAS was flown at 8-10m/s.

“which supports previous research suggesting other terrestrial mammals (which ones?) also react more to auditory disturbance”

spelling usually

include author names and move citation to end of text if structuring sentences this way

highlights

especially not specially

This sentence is very unclear, can you check and rephrase?

Table 1. why is flight height presented 60/180 for Feb 2018?
Figure 3. still says altitude instead of height

Author’s Response to Decision Letter for (RSOS-191482.R1)

See Appendix B.

Decision letter (RSOS-191482.R2)

06-Dec-2019

Dear Dr Schroeder,

It is a pleasure to accept your manuscript entitled "An experimental approach to evaluate the potential of drones in terrestrial mammal research: a gregarious ungulate as a study model" in its current form for publication in Royal Society Open Science.

Please ensure that you send to the editorial office an editable version of your accepted manuscript, and individual files for each figure and table included in your manuscript. You can send these in a zip folder if more convenient. Failure to provide these files may delay the processing of your proof. You may disregard this request if you have already provided these files to the editorial office.
You can expect to receive a proof of your article in the near future. Please contact the editorial office (openscience_proofs@royalsociety.org) and the production office (openscience@royalsociety.org) to let us know if you are likely to be away from e-mail contact -- if you are going to be away, please nominate a co-author (if available) to manage the proofing process, and ensure they are copied into your email to the journal.

Due to rapid publication and an extremely tight schedule, if comments are not received, your paper may experience a delay in publication. Royal Society Open Science operates under a continuous publication model. Your article will be published straight into the next open issue and this will be the final version of the paper. As such, it can be cited immediately by other researchers. As the issue version of your paper will be the only version to be published I would advise you to check your proofs thoroughly as changes cannot be made once the paper is published.

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Thank you for your fine contribution. On behalf of the Editors of Royal Society Open Science, we look forward to your continued contributions to the Journal.

Best regards,

Lianne Parkhouse
Editorial Coordinator
Royal Society Open Science
openscience@royalsociety.org

on behalf of Dr Alecia Carter (Associate Editor) and Kevin Padian (Subject Editor)
openscience@royalsociety.org

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Response to Referees

First of all, the authors would like to thank the Associate Editor and referees for their comments, which have contributed to a notable improvement of our manuscript. Below, we respond in detail to each of the suggestions and comments.

Associate Editor's comments (Dr Alecia Carter):

We have included more detail in methods and results following each suggestion made, to give greater clarity and replicability to the manuscript. We have substantially changed the introduction, and also parts of the discussion, to incorporate information from the literature on UAS applications in terrestrial fauna suggested by the reviewers.

Reviewers' Comments to Author:

Reviewer: 1

General comments

1. Thanks to the reviewer for the list of literature provided. We have substantially changed the introduction, and also parts of the discussion, to incorporate information from the literature on UAS applications in terrestrial fauna suggested by the reviewer. We have therefore focused on contrasting the progress achieved in evaluating the technical feasibility of the use of drones in wildlife in general, with the little progress in understanding the reaction of animals, highlighting mainly the few experimental studies that exist to date on terrestrial mammals. We have also modified the abstract according to those changes.

2. We have replaced the word “altitude” with the word “height” and “height AGL” throughout the text.
3. As suggested, for Table 1 we divided the flights by height and photos taken, clarifying the flights in which no photos were recorded because they were for behaviour only. In the text we include a clarification about the precautions we had at the time of doing the experiments seeking not to fly over the same group more than once, and thus avoid the habituation of the animals. Also, we included the specific speeds of the scanning flights. In the horizontal flights (HF) the photos were taken manually on the groups that did not react. No overlap is established in that type of flights. The overlap in photos was programmed in the S and Sb flights and, as it is expressed in the text, was 20%, the minimum possible, since the photos were used individually, not as part of an orthomosaic.

4. We included a detailed description of how the observations were made and by how many people.

5. The aim of the study was not to count the total number of guanacos; we were only interested in the number per photo. This was so because our goal was to know if the ability to record adults and offspring in the photos varied with flight height. See also the comment 6 below. The scanning flights were made to obtain individual photos that would then be used in objective 1 for counting (S, Sb), or recording behaviour (Sb).

6. Following the reviewer’s observation, with which we agreed, we have removed or changed the word “accuracy” from the text when we refer to objective 1 and its derived results or discussions.

8. We agreed with the reviewer that given the variability in counts, there were surely false positives, as well as false negatives. But given that the observers gave us a spreadsheet with the counts they observed per photo, and not the photos with the individuals marked on them, we cannot identify exactly in which photos there were. Also, as the reviewer points out, we didn’t do “real” counts in the field to get a real count of animals, because that wasn’t our goal. We did not make comparisons of counts referring to a real value, but we were interested in analysing the variability of the
counts among themselves. However, the reviewer’s comment seems relevant to us and we include some lines of discussion on this point in the second paragraph of the discussion section.

9. The reviewer is right. There is literature that found a strong reaction to the descending flight of the drone. In our case, as the VF flights were not used for the behavioural objective, but for the counting one, we did not record behaviour during those flights. We could not descend less than 150 m during flights performed on wild animals, since they reacted to the drone and escaped. Instead, the captive population allowed us to descend to 50 m (Table 1). Probably, there must be a kind of habituation on the captive population to disturbances, but that was not the objective of our work; we used the captive population to guarantee having photos of the animals taken at low heights. This relates to the reviewer’s next question: "Was there a difference in behaviours between the wild and captive groups?". It was not an objective of this work to evaluate the difference in behaviour between the captive and the wild population, something that would be interesting to evaluate in future studies. Behavioural experiments were only performed in the wild population (figure 1, table 1).

10. In the first paragraph of the results section we clarify that the count variation is between different observers counting from the same images.

Line 47 - Although we were referring to satellite images, we removed this reference as it does not qualify as a "classic methods used in wildlife research", but satellite images are counting methods that are being tested recently.

Line 54 - As suggested, we included clarifications referred to the low sampling area coverage and autonomy of the small drones.

Lines 58-61 - We completely change this paragraph of the introduction, interpreting the literature on terrestrial mammals suggested by the reviewer.
Line 64 - We modified this part of the introduction.

Line 111 - We changed “y” for ‘and’

Line 163 - We clarified that 87% of the groups reacted, but of those that reacted (100%), 51.2% reacted at 2-4 m/s, while 48.8% reacted at 8-10 m/s.

Line 169 - We clarified there was a 14% more reaction of groups (not animals) at rapid speed.

Line 200 - We changed the original sentence to consider the reviewer’s comments.

Line 220 - We changed ‘engines’ for ‘motors’

Figures - We included more examples of photos from different heights to help illustrate why and how it is harder to count animals at higher height AGL.

Reviewer: 2

Comments to the Author(s)

Introduction

According to the reviewer’s comments, we have changed the introduction to contextualize our research in more detail compared to what has been done to date. We included more information from previous research into disturbance of UAS on different species, particularly for terrestrial mammals. Specifically, we highlight the necessary progress that our study represents in contrast to the previous ones, such as Mulero-Pazmay et al. 2017, Bennitt et al. 2019 and others.
We removed remote sensing as it does not qualify as a "classic methods used in wildlife research", and included "UAS are safe for operators, relatively less noisy than manned aircraft...".

Yes, we mean that recording images using UAS offers an advantage over traditional ground surveys because the images are permanent and can be re-visited in the future for other, unforeseen analyses. We clarified the sentence, including at the end: "... as images can be checked and analysed several times".

We removed this sentence of the introduction, and we completely changed the paragraph.

We completely changed the paragraph.

Methods

We describe the enclosures of the Los Peucos farm to show the available space that guanacos have to react to drones.

We took only two photos in La Payunia (one at 150 m and another at 200 m) in VF flights, mainly because the groups in this wild population are quite reactive (as we later verified with our behaviour analysis) and it is difficult to reach and descending on them without getting them scared. But since the VF flights were performed for the counting objective, and not for the behaviour objective, we completed the amount of photos in Payunia with the S and Sb flights. It seems important to emphasize that for the purpose of counting, we seek to have as many photos as possible of adults and offspring, at different heights, beyond the population to which they belong.

We included a detailed description of how group size and behaviour was recorded, and of the precautions we had at the time of doing the experiments to avoid the habituation of the animals.
We clarified that behavioural data categories (forage, vigilance, locomotion, others) were scored for each of the members of the group using a scan sampling methodology.

We included the sentence “calculated as the number of animals displaying each behavioural category divided the total number of animals within each group” to clarify the unit of analysis for Sb behavioural data.

We clarified that neither group size nor behaviour was taken from the images, but by means of an observer (new lines 124-136).

As suggested, we included the phrase: “with VC counts at 200 m found to be more variable compared to”

Discussion
Following the suggestion, in the last paragraph of the discussion we highlighted the contribution of our study in contrast with the recent analysis of Bennitt et al. 2019 and we pointed out the importance of our findings for guanaco, associated to potential disturbance that could bring the recreational use of UAS, still little developed in South America, but in expansion worldwide.

We changed the word “collaborate” for the word “aid”.
Response to Referees

Again, we would like to thank the Associate Editor and referees for their comments, which are answered in detail below. In addition, we had the entire manuscript reviewed by an English-speaking colleague. Following this colleague’s suggestion, we changed “Variation coefficient (VC)” to “Coefficient of Variation (CV)” throughout the text, as it is the most commonly used term in literature.

Reviewers’ Comments to Author:

Reviewer: 1

Lines 53-54: Regarding this and the following two comments, we changed the paragraph substantially, to soften this statement.

Line 54: We removed this sentence

Line 56: We removed this sentence

Line 66: We changed “approximation” for “proximity.”

Line 299: We changed “results question previous mostly indirect and observational evidence” for “results call into question previous mostly...” in order to soften the sentence.

Reviewer: 2

L23 We changed the sentence according to the reviewer’s suggestion

L29 We changed the sentence according to the reviewer’s suggestion

L58 We changed the sentence according to the reviewer’s suggestion
We changed for “different types”

We changed the sentence according to the reviewer’s suggestion

For citations 21, 22 and 23 the names of the authors were included and the citation was placed at the end of the relevant text.

We changed the sentence according to the reviewer’s suggestion

We changed the sentence according to the reviewer’s suggestion

We used “flew the drone towards it”

We stated that group size was recorded by the observer.

We clarified this point, stating that “We observed all the animals as a focal group [29]” (lines 119-120) and that “We considered a flight reaction when at least one of the individuals of the focal group behaved that way, followed by the others (lines 174-175).

We changed the sentence according to the reviewer’s suggestion.

We changed the sentence according to the reviewer’s suggestion

We used “has been shown to”

We changed the sentence according to the reviewer’s suggestion.

We used “usually”

We included author names and moved citation to the end of text.
Table 1. We changed the presentation of the heights of HF for Feb 2018, but we also standardized the records in S and Sb, so as not to repeat heights. We believe that this way the table is better explained.

Figure 3. We used “height”