

## Upper tidal flats are disproportionately important for the conservation of migratory shorebirds

Tong Mu and David S. Wilcove

### Article citation details

*Proc. R. Soc. B* **287**: 20200278.

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### Review timeline

Original submission: 13 February 2020

Revised submission: 17 April 2020

Final acceptance: 6 May 2020

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

## Review History

RSPB-2020-0278.R0 (Original submission)

Review form: Reviewer 1 (Theunis Piersma)

### Recommendation

Accept with minor revision (please list in comments)

**Scientific importance: Is the manuscript an original and important contribution to its field?**

Excellent

**General interest: Is the paper of sufficient general interest?**

Excellent

**Quality of the paper: Is the overall quality of the paper suitable?**

Excellent

**Is the length of the paper justified?**

Yes

**Should the paper be seen by a specialist statistical reviewer?**

No

**Do you have any concerns about statistical analyses in this paper? If so, please specify them explicitly in your report.**

No

**It is a condition of publication that authors make their supporting data, code and materials available - either as supplementary material or hosted in an external repository. Please rate, if applicable, the supporting data on the following criteria.**

**Is it accessible?**

Yes

**Is it clear?**

Yes

**Is it adequate?**

Yes

**Do you have any ethical concerns with this paper?**

No

### **Comments to the Author**

This is a terrific and important and innovative study. It is also very well written and composed, so I have rather few comments other than some suggestions as to anchor it even better in the published literature:

Lines 104-105: that the two study sites were 'well-known' made me curious to the scientific references describing these sites!

Lines 140-144: although red and great knots were grouped together, in Table 1 they are also treated separately. You should probably announce these 'double assignments' here?

Lines 364-368: That the tidal movements are not taken to account in shorebird distribution is probably true for multispecies studies, but this is certainly not true for monospecific studies, and should this not be acknowledged? See, e.g.: van Gils, J.A., Spaans, B., Dekinga, A. & Piersma, T. (2006). Foraging in a tidally structured environment by red knots (*Calidris canutus*): ideal, but not free. *Ecology* 87, 1189-1202. Oudman, T., Piersma, T., Ahmedou Salem, M.V., Feis, M.E., Dekinga, A., Holthuijsen, S., ten Horn, J., van Gils, J.A. & Bijleveld, A.I. (2018) Resource landscapes explain contrasting patterns of aggregation and site fidelity by red knots at two wintering sites. *Movement Ecology* 6, 24.

Lines 372-373: 'change in response to local environmental conditions': here a reference to Oudman et al. (2018, *Move. Ecol.* See previous point) may be in order, as they make exactly this point.

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## Review form: Reviewer 2 (Richard Fuller)

### Recommendation

Major revision is needed (please make suggestions in comments)

**Scientific importance: Is the manuscript an original and important contribution to its field?**

Good

**General interest: Is the paper of sufficient general interest?**

Acceptable

**Quality of the paper: Is the overall quality of the paper suitable?**

Excellent

**Is the length of the paper justified?**

Yes

**Should the paper be seen by a specialist statistical reviewer?**

No

**Do you have any concerns about statistical analyses in this paper? If so, please specify them explicitly in your report.**

No

**It is a condition of publication that authors make their supporting data, code and materials available - either as supplementary material or hosted in an external repository. Please rate, if applicable, the supporting data on the following criteria.**

**Is it accessible?**

Yes

**Is it clear?**

Yes

**Is it adequate?**

Yes

**Do you have any ethical concerns with this paper?**

No

### Comments to the Author

This is a thought-provoking study that brings some fresh thinking to an old problem in shorebird foraging ecology, that of characterising the use by foragers of the highly dynamic intertidal environment. I like the study design and analysis method, and it is great to see this being done at one of regions of the world with ongoing and rapid shorebird population declines.

### GENERAL COMMENTS

There is an underlying assumption that the current pattern of tidal flat use “simulate[s] the impacts of coastal development of the tidal flats on shorebird foraging”. This is based on the observation that coastal reclamation projects typically extend from the shoreline over the upper tidal flat, thus progressively removing tidal flat from the shoreward side. The “simulation” assumes no re-sorting of the benthic communities. This is vaguely hinted at in lines 438-442, but needs to be developed a little more. For example, perhaps there is an initial instantaneous loss resulting from an upper shore development, but that the benthic fauna rapidly reassorts – a

comprehensive benthic sampling / shorebird monitoring program before and after a reclamation event would really be needed to test whether the present study is indeed a simulation, and perhaps this sort of approach could be suggested.

This same issue occurs in L407-410, where the claim now dramatically oversteps the data “By simulating progressive seaward development of the tidal flat, we show that the loss of upper tidal flats causes substantial and disproportionately severe reductions in overall foraging opportunities”. This causal effect has certainly not been “shown” by the present study. I think this language really needs to be toned down, as several other pieces of information are needed before one can conclude that the population impact of reclamation is much greater than the area removed. The patterns documented here are perhaps necessary, but not sufficient, to reach that conclusion – the present study is hypothesis-generating, not hypothesis-testing. Also, I’m not aware of the obvious go-to paper that demonstrates that tidal flat loss has been focused on the upper shore. I agree with the basic proposition, but am not sure it has been unequivocally shown – indeed, in many places entire flats have disappeared.

These lines of thinking lead to the potentially alarming “recommendation” in L448-451 that existing reclamations are extended rather than new ones started. I understand the logic, but I think the evidence base is too weak to go that far. Especially as the same species can show very different foraging patterns in different places. Perhaps instead, this could be phrased more as a hypothetical rather than so definitively. To further alleviate this issue, L451-454 could go much further and suggest that detailed foraging studies of the type conducted in the present paper would be needed wherever a reclamation is being considered, to enable a locally relevant decision to be made.

#### SPECIFIC COMMENTS

Line 16  
Typo

Line 263-266  
Another interpretation of the fact that in 7 of the 9 cases where species occurred at both sites showed a different foraging profile is that spurious associations are emerging because of low sample size or some other factor. What confidence do we have that these potentially fascinating differences are consistent and real? Can some studies to test this be proposed, e.g. in the discussion near lines 373-376?

L433  
Typo.

## Decision letter (RSPB-2020-0278.R0)

06-Apr-2020

Dear Mr Mu:

Your manuscript has now been peer reviewed and the reviews have been assessed by an Associate Editor. The reviewers’ comments (not including confidential comments to the Editor) and the comments from the Associate Editor are included at the end of this email for your reference. As you will see, the reviewers and the Editors have raised some concerns with your manuscript and we would like to invite you to revise your manuscript to address them. One of the concerns raised was the generality of your work and whether it would be of interest to the

general readership of ProcB. I would ask that you consider revising your manuscript such that the generality and importance of the research is clear.

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 Associate Editor, 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. Please note that we cannot guarantee eventual acceptance of your manuscript at this stage.

To submit your revision please log into <http://mc.manuscriptcentral.com/prsb> 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.

When submitting your revision please upload a file under "Response to Referees" - in the "File Upload" section. This should document, point by point, how you have responded to the reviewers' and Editors' comments, and the adjustments you have made to the manuscript. We require a copy of the manuscript with revisions made since the previous version marked as 'tracked changes' to be included in the 'response to referees' document.

Your main manuscript should be submitted as a text file (doc, txt, rtf or tex), not a PDF. Your figures should be submitted as separate files and not included within the main manuscript file.

When revising your manuscript you should also ensure that it adheres to our editorial policies (<https://royalsociety.org/journals/ethics-policies/>). You should pay particular attention to the following:

#### Research ethics:

If your study contains research on humans please ensure that you detail in the methods section whether you obtained ethical approval from your local research ethics committee and gained informed consent to participate from each of the participants.

#### Use of animals and field studies:

If your study uses animals please include details in the methods section of any approval and licences given to carry out the study and include full details of how animal welfare standards were ensured. Field studies should be conducted in accordance with local legislation; please include details of the appropriate permission and licences that you obtained to carry out the field work.

#### Data accessibility and data citation:

It is a condition of publication that you make available the data and research materials supporting the results in the article. Datasets should be deposited in an appropriate publicly available repository and details of the associated accession number, link or DOI to the datasets must be included in the Data Accessibility section of the article (<https://royalsociety.org/journals/ethics-policies/data-sharing-mining/>). Reference(s) to datasets should also be included in the reference list of the article with DOIs (where available).

In order to ensure effective and robust dissemination and appropriate credit to authors the dataset(s) used should also be fully cited and listed in the references.

If you wish to submit your data to Dryad (<http://datadryad.org/>) and have not already done so you can submit your data via this link [http://datadryad.org/submit?journalID=RSPB&manu=\(Document not available\)](http://datadryad.org/submit?journalID=RSPB&manu=(Document not available)), which will take you to your unique entry in the Dryad repository.

If you have already submitted your data to dryad you can make any necessary revisions to your dataset by following the above link.

For more information please see our open data policy <http://royalsocietypublishing.org/data-sharing>.

Electronic supplementary material:

All supplementary materials accompanying an accepted article will be treated as in their final form. They will be published alongside the paper on the journal website and posted on the online figshare repository. 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. Please try to submit all supplementary material as a single file.

Online supplementary material will also carry the title and description provided during submission, so please ensure these are accurate and informative. Note that the Royal Society will not edit or typeset supplementary material and it will be hosted as provided. Please ensure that the supplementary material includes the paper details (authors, title, journal name, article DOI). Your article DOI will be 10.1098/rspb.[paper ID in form xxxx.xxxx e.g. 10.1098/rspb.2016.0049].

Please submit a copy of your revised paper within three weeks. If we do not hear from you within this time your manuscript will be rejected. If you are unable to meet this deadline please let us know as soon as possible, as we may be able to grant a short extension.

Thank you for submitting your manuscript to Proceedings B; we look forward to receiving your revision. If you have any questions at all, please do not hesitate to get in touch.

Best wishes,  
Dr Daniel Costa  
<mailto:proceedingsb@royalsociety.org>

Associate Editor  
Board Member: 1  
Comments to Author:

Two reviewers evaluated the paper and found interesting and important. One of the reviewer's, however, has specific concerns about over-reach – that the conclusions are too strong given an untested assumption. Please pay particular attention to this concern in your revision and response to reviewers.

Reviewer(s)' Comments to Author:

Referee: 1

Comments to the Author(s)

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Referee: 2

Comments to the Author(s)

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#### GENERAL COMMENTS

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#### SPECIFIC COMMENTS

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L433

Typo.

## Author's Response to Decision Letter for (RSPB-2020-0278.R0)

See Appendix A.

## RSPB-2020-0278.R1 (Revision)

### Review form: Reviewer 1 (Richard Fuller)

#### **Recommendation**

Accept as is

#### **Scientific importance: Is the manuscript an original and important contribution to its field?**

Excellent

#### **General interest: Is the paper of sufficient general interest?**

Excellent

#### **Quality of the paper: Is the overall quality of the paper suitable?**

Excellent

#### **Is the length of the paper justified?**

Yes

#### **Should the paper be seen by a specialist statistical reviewer?**

No



**Do you have any concerns about statistical analyses in this paper? If so, please specify them explicitly in your report.**

No

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**Is it accessible?**

Yes

**Is it clear?**

Yes

**Is it adequate?**

Yes

**Do you have any ethical concerns with this paper?**

No

#### **Comments to the Author**

The authors have fully addressed my major concern about overstating causality and generality.

## **Decision letter (RSPB-2020-0278.R1)**

06-May-2020

Dear Mr Mu

I am pleased to inform you that your manuscript entitled "Upper tidal flats are disproportionately important for the conservation of migratory shorebirds" has been accepted for publication in Proceedings B.

You can expect to receive a proof of your article from our Production office in due course, please check your spam filter if you do not receive it. PLEASE NOTE: you will be given the exact page length of your paper which may be different from the estimation from Editorial and you may be asked to reduce your paper if it goes over the 10 page limit.

If you are likely to be away from e-mail contact please let us know. Due to rapid publication and an extremely tight schedule, if comments are not received, we may publish the paper as it stands.

If you have any queries regarding the production of your final article or the publication date please contact [procb\\_proofs@royalsociety.org](mailto:procb_proofs@royalsociety.org)

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#### Electronic supplementary material:

All supplementary materials accompanying an accepted article will be treated as in their final form. They will be published alongside the paper on the journal website and posted on the online figshare repository. 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.

Thank you for your fine contribution. On behalf of the Editors of the Proceedings B, we look forward to your continued contributions to the Journal.

Sincerely,

Dr Daniel Costa  
Editor, Proceedings B  
mailto: [proceedingsb@royalsociety.org](mailto:proceedingsb@royalsociety.org)

## Appendix A

Dear editors and reviewers,

Thank you for your time and attention to our manuscript. We have taken all of your suggestions and recommendation into consideration and carefully revised our manuscript in response, and we feel that the manuscript has been strengthened as a result.

Pertaining to the generality and importance issue, we revised the corresponding segments of the abstract, introduction and discussion to note that (1) migratory shorebirds in other parts of the world are also in decline, such that the situation along the East Asian-Australasian Flyway may provide insights into those other declines; (2) shorebirds exhibit interspecific and site-specific differences in their foraging behavior, which we feel is intrinsically interesting and could affect how we conserve them; and (3) detailed information regarding habitat use could improve our understanding of the threats to and conservation measures necessary to protect a wide array of migratory animals.

Below, we provide detailed responses to the referees' comments, and the changes that we have made in detail.

Thank you again,  
Tong Mu

### Comments and responses

Referee: 1

Comments to the Author(s)

This is a terrific and important and innovative study. It is also very well written and composed, so I have rather few comments other than some suggestions as to anchor it even better in the published literature:

--Response:

Thank you for your kind words.

Lines 104-105: that the two study sites were 'well-known' made me curious to the scientific references describing these sites!

--Response:

Thanks for the suggestion. We added a short description of the sites, and references were added in lines 164-167.

Lines 140-144: although red and great knots were grouped together, in Table 1 they are also treated separately. You should probably announce these 'double assignments' here?

--Response:

We have clarified that the “lumping” of the two knots pertained to one site only; at the other site, conditions permitted us to separate the two species. We have adjusted the wording in lines 206-207.

Lines 364-368: That the tidal movements are not taken to account in shorebird distribution is probably true for multispecies studies, but this is certainly not true for monospecific studies, and should this not be acknowledged? See, e.g.: van Gils, J.A., Spaans, B., Dekinga, A. & Piersma, T. (2006). Foraging in a tidally structured environment by red knots (*Calidris canutus*): ideal, but not free. *Ecology* 87, 1189-1202. Oudman, T., Piersma, T., Ahmedou Salem, M.V., Feis, M.E., Dekinga, A., Holthuijsen, S., ten Horn, J., van Gils, J.A. & Bijleveld, A.I. (2018) Resource landscapes explain contrasting patterns of aggregation and site fidelity by red knots at two wintering sites. *Movement Ecology* 6, 24.

--Response:

Thanks for the suggested references. We have noted that single-species studies have indeed considered the importance of tidal cycles in lines 442-447, and added the two suggested references to the single species studies, in addition to the ones we've already listed.

Lines 372-373: ‘change in response to local environmental conditions’: here a reference to Oudman et al. (2018, *Move. Ecol.* See previous point) may be in order, as they make exactly this point.

--Response:

Reference added on line 452.

Line 461: here reference to a freshly published study in which satellite telemetry was used to assign zonal importance at a Chinese coastal site maybe appropriate: Chan, Y.-C., Peng, H.-B., Han, Y.-X., Chung, S.S.-W., Li, L., Zhang, L. & Piersma, T. (2019) Conserving unprotected important coastal habitats in the Yellow Sea: Shorebird occurrence, distribution and food resources at Lianyungang. *Global Ecology and Conservation* 20, e00724

--Response:

Reference added on line 587.

Referee: 2

Comments to the Author(s)

This is a thought-provoking study that brings some fresh thinking to an old problem in shorebird foraging ecology, that of characterising the use by foragers of the highly dynamic intertidal environment. I like the study design and analysis method, and it is great to see this being done at one of regions of the world with ongoing and rapid shorebird population declines.

--Response:

We appreciate the kind comment.

## GENERAL COMMENTS

There is an underlying assumption that the current pattern of tidal flat use “simulate[s] the impacts of coastal development of the tidal flats on shorebird foraging”. This is based on the observation that coastal reclamation projects typically extend from the shoreline over the upper tidal flat, thus progressively removing tidal flat from the shoreward side. The “simulation” assumes no re-sorting of the benthic communities. This is vaguely hinted at in lines 438-442, but needs to be developed a little more. For example, perhaps there is an initial instantaneous loss resulting from an upper shore development, but that the benthic fauna rapidly reassorts – a comprehensive benthic sampling / shorebird monitoring program before and after a reclamation event would really be needed to test whether the present study is indeed a simulation, and perhaps this sort of approach could be suggested.

--Response:

The review raises an important issue that information on whether and how fast the benthic communities reassorts after coastal development is lacking. We have expanded the paragraph (lines 558-570) to explain that our model can only account for the instantaneous loss of foraging habitat and that the longer-term response of the benthic fauna could significantly alter the picture. We also changed our wording in the Methods, Results, and Discussion part correspondingly (lines 320-326, 374-378, and 512-524).

This same issue occurs in L407-410, where the claim now dramatically oversteps the data “By simulating progressive seaward development of the tidal flat, we show that the loss of upper tidal flats causes substantial and disproportionately severe reductions in overall foraging opportunities”. This causal effect has certainly not been “shown” by the present study. I think this language really needs to be toned down, as several other pieces of information are needed before one can conclude that the population impact of reclamation is much greater than the area removed. The patterns documented here are perhaps necessary, but not sufficient, to reach that conclusion – the present study is hypothesis-generating, not hypothesis-testing. Also, I’m not aware of the obvious go-to paper that demonstrates that tidal flat loss has been focused on the upper shore. I agree with the basic proposition, but am not sure it has been unequivocally shown – indeed, in many places entire flats have disappeared.

--Response:

Thank you for the comments. In line with our previous response, we agree that the simulation presented only one scenario of the consequences of upper tidal habitat loss given the assumptions mentioned above, and other outcomes are possible. We’ve changed the wording of the sentence to be more conservative in lines 512-524. At the same time, we do note that developing of the upper intertidal could affect the remaining portions of the tidal flats in ways that potentially could exacerbate harm to the shorebirds

(e.g., pollution, changes in sedimentation). Thus, the long-term consequences of loss of upper intertidal areas are difficult to predict, although we have no reason to think it will be beneficial to the birds. As for the disproportional loss of the upper shore, we had failed to find a go-to paper, too. However, it does appear that the upper shore is more heavily targeted not only in East Asia, but also in other parts of the world, as referenced in lines 538-550 (e.g. Fig 2 in Rolet et al 2015 Biological Conservation).

These lines of thinking lead to the potentially alarming “recommendation” in L448-451 that existing reclamations are extended rather than new ones started. I understand the logic, but I think the evidence base is too weak to go that far. Especially as the same species can show very different foraging patterns in different places. Perhaps instead, this could be phrased more as a hypothetical rather than so definitively. To further alleviate this issue, L451-454 could go much further and suggest that detailed foraging studies of the type conducted in the present paper would be needed wherever a reclamation is being considered, to enable a locally relevant decision to be made.

--Response:

We removed the specific recommendation on extending existing development projects outward, and modified the following recommendation to note the need for local studies in order to make locally relevant decisions (lines 577-583). However, we continue to flag the upper intertidal zone as worthy of conservation based on its observed importance for EAAF shorebirds.

## SPECIFIC COMMENTS

Line 16  
Typo

--Response:  
Corrected.

Line 263-266

Another interpretation of the fact that in 7 of the 9 cases where species occurred at both sites showed a different foraging profile is that spurious associations are emerging because of low sample size or some other factor. What confidence do we have that these potentially fascinating differences are consistent and real? Can some studies to test this be proposed, e.g. in the discussion near lines 373-376?

--Response:

Thanks for the question and suggestions. We noted the limitations in our assignment of foraging types, immediately after where you suggested (originally lines 378-391), which applies to why and how the same species may have different foraging types at different sites. We have now reorganized these two paragraphs (lines 449-461) to accommodate your suggestions regarding the potential effect of small sample/population sizes as well

as the need for future studies. Thus, we now report this finding with more caution than in the original submission.

L433

Typo.

--Response:

Corrected.