

New Zealand's extinct giant raptor (*Hieraaetus moorei*) killed like an eagle, ate like a condor

A. H. van Heteren, S. Wroe, L. R. Tsang, D. R. Mitchell, P. Ross, J. A. Ledogar, M. R. G. Attard, D. Sustaita, P. Clausen, R. P. Scofield and G. Sansalone

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Original submission: 30 August 2021
Revised submission: 3 November 2021
Final acceptance: 10 November 2021

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

Review History

RSPB-2021-1913.R0 (Original submission)

Review form: Reviewer 1

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?

Good

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

Interesting paper, clear and well written. It is a thorough analysis to interpret the functional ecology of the largest known eagle. This should be the definitive work on an extinct species with a unique history on New Zealand. There are several minor edits on the ms itself.

Review form: Reviewer 2

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

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Is it adequate?

Yes

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The article is well written, very interesting. The analyses and comparisons are relevant. The discussion is well conducted and convincing. I find it interesting to use the cave paintings as information on the morphology of the bird and its naked neck.

I have very few comments on the text.

L 138 :

It would be more convenient to have all the information on the six species gathered in a material section: name, abbreviations, weight or estimated weight and foraging behavior.

L 174 It would be interesting to have an global idea of the loading proportions for each case. I don't understand how and where the additional forces are applied. On the tip of the beak? Could you explain?

L 349 : A monachus does not tear to open the carcass. It eats the hard tissues that remain on the carcasses after the meal of the *Gyps fulvus*, which live at the same areas and are much more numerous. *G fulvus* make a hole in the skin of the carcass, pull and eat the viscera and eat the muscles. It remains then the skin, the tendons and the nerves, eaten by *A monachus*.

The figures can be easily improved to better complement the text:

In Figure 2, show the species names as in the other figures rather than letters.

Figure 3 would be more readable if it were constructed in the same way as figure 5, by placing the Von Mises strain contour plots of the crania of figure 2 on their place on the UPGMAs graphs

It seems to me that even if the drawings of the birds are beautiful, they do not bring more information than the name of the species on the graphs. They would be useful if they were associated with the information on the material, with the abbreviations, the information on size, diet and behavior. They would be useful to give an idea of the general morphology of the species.

Decision letter (RSPB-2021-1913.R0)

14-Oct-2021

Dear Dr van Heteren:

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.

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:

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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. Please see our Data Sharing Policies (<https://royalsociety.org/journals/authors/author-guidelines/#data>). 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,
Professor Gary Carvalho
mailto:proceedingsb@royalsociety.org

Associate Editor
Board Member: 1
Comments to Author:

The article presents new information on New Zealand's iconic extinct eagle (Haast's eagle). Myself and both reviewers agree that this is a thoughtful study that is well executed and provides new information that is of broad interest. Both reviewers have only minor comments. Once these minor comments are incorporated, I would consider this article ready for publication.

Reviewer(s)' Comments to Author:
Referee: 1

Comments to the Author(s)
Interesting paper, clear and well written. It is a thorough analysis to interpret the functional ecology of the largest known eagle. This should be the definitive work on an extinct species with a unique history on New Zealand. There are several minor edits on the ms itself.

Referee: 2
Comments to the Author(s)

The article is well written, very interesting. The analyses and comparisons are relevant. The discussion is well conducted and convincing. I find it interesting to use the cave paintings as information on the morphology of the bird and its naked neck.

I have very few comments on the text.

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The figures can be easily improved to better complement the text:
In Figure 2, show the species names as in the other figures rather than letters.

Figure 3 would be more readable if it were constructed in the same way as figure 5, by placing the Von Mises strain contour plots of the crania of figure 2 on their place on the UPGMAs graphs. It seems to me that even if the drawings of the birds are beautiful, they do not bring more information than the name of the species on the graphs. They would be useful if they were associated with the information on the material, with the abbreviations, the information on size, diet and behavior. They would be useful to give an idea of the general morphology of the species.

Author's Response to Decision Letter for (RSPB-2021-1913.R0)

See Appendix A.

Decision letter (RSPB-2021-1913.R1)

10-Nov-2021

Dear Dr van Heteren

I am pleased to inform you that your manuscript entitled "NEW ZEALAND'S EXTINCT GIANT RAPTOR (HIERAAETUS MOOREI) KILLED LIKE AN EAGLE, ATE LIKE A CONDOR" 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

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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,

Professor Gary Carvalho

Editor, Proceedings B

mailto: proceedingsb@royalsociety.org

Associate Editor:

Board Member

Comments to Author:

(There are no comments.)

Appendix A

Response to Referees

Dear Professor Gary Carvalho,

Please find below our responses (in blue) to the reviewers and the editorial staff. We are very grateful for their comments (in black) and feel they have significantly improved the manuscript.

We also note that following our initial submission we commissioned a detailed reconstruction of the Haast's eagle (attached). This was achieved through collaboration with an excellent palaeoartist, Katrina Kenny, who has previously produced covers for a range of highly regarded journals, including Nature and Science Advances. Based on 3D models supplied to the artist, we believe that this reconstruction is as anatomically accurate as it is visually arresting. We hope that you might consider it as a cover for Proceedings B. We can supply a higher resolution image if needed.

Best regards on behalf of the author-team,

Anneke van Heteren

Associate Editor

Board Member: 1

Comments to Author:

The article presents new information on New Zealand's iconic extinct eagle (Haast's eagle). Myself and both reviewers agree that this is a thoughtful study that is well executed and provides new information that is of broad interest. Both reviewers have only minor comments. Once these minor comments are incorporated, I would consider this article ready for publication.

We are pleased that you find our study interesting and have improved the manuscript regarding the concerns offered. We include a version of the manuscript with tracked changes.

Reviewer(s)' Comments to Author:

Referee: 1

Comments to the Author(s)

Interesting paper, clear and well written. It is a thorough analysis to interpret the functional ecology of the largest known eagle. This should be the definitive work on an extinct species with a unique history on New Zealand. There are several minor edits on the ms itself.

We appreciate the overall positive outlook on our manuscript, and we have improved it based on the comments presented to us. Replies to the comments are in the manuscript itself.

Referee: 2

Comments to the Author(s)

The article is well written, very interesting. The analyses and comparisons are relevant. The discussion is well conducted and convincing. I find it interesting to use the cave paintings as information on the morphology of the bird and its naked neck.

Thank you very much for this flattering description.




I have very few comments on the text.




L 138 :

It would be more convenient to have all the information on the six species gathered in a material section: name, abbreviations, weight or estimated weight and foraging behavior.

Rather than a material section, we have added a table (p. 27) with all this information. This also allows us to associate the bird drawings with the information on the material (see below).

Table 1. Basic information on the six species used in this study.

Icon in the figures	Latin abbreviations	English name	Model volume as proxy for mass (mm ³)	Foraging behaviour
	<i>Hal. sphenurus</i>	Whistling kite	770	active hunter, variety of small animals but will also feed on carrion
	<i>Hie. morphnoideus</i>	Little eagle	11865 (1250 g)	active hunter, mammals and birds, can catch prey exceeding own body mass
	<i>Agu. audax</i>	Wedgetailed eagle	24037	active hunter, dietary generalist, feeding on mammals, birds, and reptiles

	<i>Hie. moorei</i>	Haast's eagle	67807	
	<i>Aeg. monachus</i>	Cinereous vulture	64489	obligate scavenger, ripper, medium-sized to large carcasses
	<i>Vul. gryphus</i>	Andean Condor	31891	obligate scavenger, gulper, medium-sized to large carcasses

L 174 It would be interesting to have an global idea of the loading proportions for each case. I don't understand how and where the additional forces are applied. On the tip of the beak? Could you explain?

The analyses are described in detail in the supplementary information (p. 2-7). We have added a short sentence in the main text and a reference to the supplementary information (l. 175-177), to prevent any further confusion: "The force was applied to the tip of the beak. Detailed information on the models can be found in the electronic supplementary material."

L 349 : A monachus does not tear to open the carcass. It eats the hard tissues that remain on the carcasses after the meal of the *Gyps fulvus*, which live at the same areas and are much more numerous. *G. fulvus* make a hole in the skin of the carcass, pull and eat the viscera and eat the muscles. It remains then the skin, the tendons and the nerves, eaten by *A. monachus*.

Thank you very much for this explanation. We have adapted this section accordingly (l 351-354): "Bird skin is typically less tough than that of mammals [1, 49], so *Hie. moorei* was able to open the carcasses itself. It is notable that *Hie. moorei* is less well-adapted eating hard tissues, such as tendons, than *Aegyptius* [41], but likely preferred viscera and muscles, like *Vultur* [48]".

The figures can be easily improved to better complement the text:

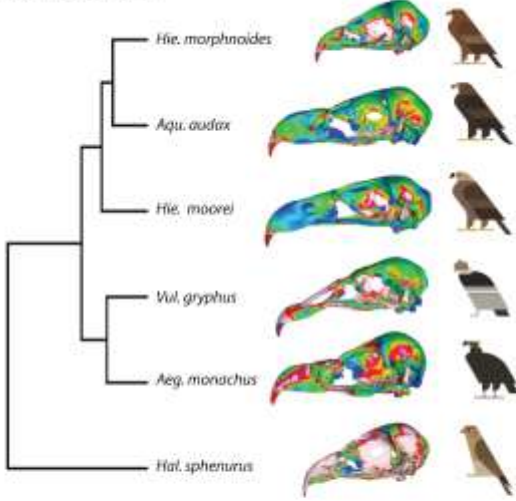
In Figure 2, show the species names as in the other figures rather than letters.

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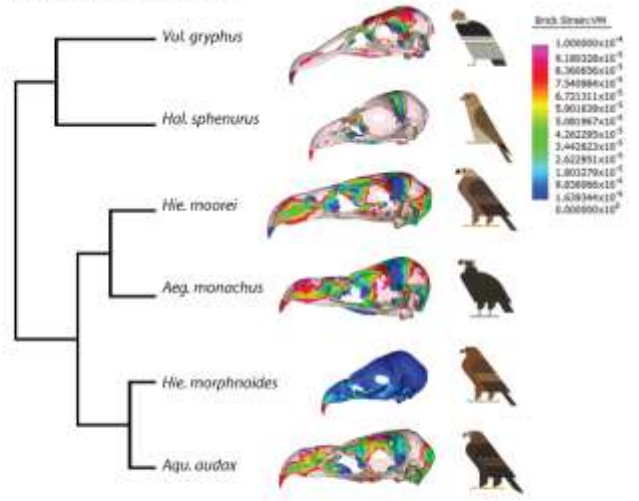
We have combined figures 2 and 3 as suggested and used species names rather than letters. We have associated the bird drawings with the information on the material in table 1 (see above) and we have given

Haast's eagle a bald head so it better represents the general morphology of the species according to our hypothesis.

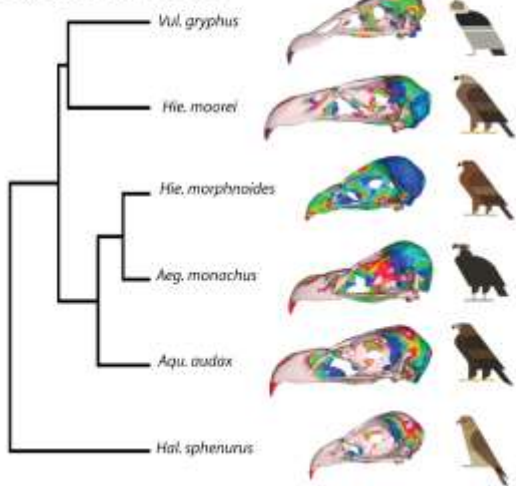
(a) Intrinsic



(b) Dorsoventral



(c) Lateral shake



(d) Pullback

