

## Large carnivore science: non-experimental studies are useful, but experiments are better

Allen, Benjamin L.; Allen, Lee R.; Andrien, Henrik; Ballard, Guy; Boitani, Luigi; Engeman, Richard M.; Fleming, Peter J.S.; Ford, Adam T.; Haswell, Peter; Kowalczyk, Rafal; Linnell, John D. C.; Mech, L. David; Parker, Daniel M.

### Food Webs

DOI:

[10.1016/j.fooweb.2017.06.002](https://doi.org/10.1016/j.fooweb.2017.06.002)

Published: 01/12/2017

Peer reviewed version

[Cyswllt i'r cyhoeddiad / Link to publication](#)

*Dyfyniad o'r fersiwn a gyhoeddwyd / Citation for published version (APA):*

Allen, B. L., Allen, L. R., Andrien, H., Ballard, G., Boitani, L., Engeman, R. M., Fleming, P. J. S., Ford, A. T., Haswell, P., Kowalczyk, R., Linnell, J. D. C., Mech, L. D., & Parker, D. M. (2017). Large carnivore science: non-experimental studies are useful, but experiments are better. *Food Webs*, 13, 49-50. <https://doi.org/10.1016/j.fooweb.2017.06.002>

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## Manuscript Details

<b>Manuscript number</b>	FOOWEB_2017_25
<b>Title</b>	Large carnivore science: non-experimental studies are useful, but experiments are better
<b>Short title</b>	Large carnivore science
<b>Article type</b>	Short communication

### Abstract

We recently described six interrelated issues that justify questioning some of the discourse about the reliability of the literature on the ecological roles of large carnivores (Allen et al. In press). Bruskotter and colleagues have responded to our article, and here we offer our reply. We agree that it is not 'equivocal' that predation can have an impact on herbivore abundance, and that over-abundant herbivore populations can have adverse impacts on habitats. What is equivocal is that (1) these simple predator-prey relationships inevitably produce important cascading consequences for entire food webs, (2) these effects are always strong (or one of the strongest) drivers of ecosystem structure, (3) any addition or removal of large carnivores will necessarily have important cascading consequences for ecosystem functions, and (4) large carnivores must be present and abundant for any ecosystem to be considered healthy or resilient. Moreover, the considerable value of large carnivores need not be linked to the demonstration of these things.

<b>Keywords</b>	Top predator, trophic cascades, mesopredator release, predator-prey relationships, science communication
<b>Manuscript region of origin</b>	Asia Pacific
<b>Corresponding Author</b>	Benjamin Allen
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<b>Order of Authors</b>	Benjamin Allen, Lee Allen, Henrik Andren, Guy Ballard, Luigi Boitani, Richard Engeman, Peter Fleming, Adam Ford, Peter Haswell, Rafal Kowalczyk, John Linnell, David Mech, Dan Parker
<b>Suggested reviewers</b>	Carl Mitchell, Matt Hayward, Craig Layman

## Submission Files Included in this PDF

### File Name [File Type]

Cover letter 170610.docx [Cover Letter]

Bruskotter reply to Bruskotter 170614.docx [Manuscript File]

To view all the submission files, including those not included in the PDF, click on the manuscript title on your EVISE Homepage, then click 'Download zip file'.

To the Editor in Chief,

Please find attached our short reply to Bruskotter and colleagues. We look forward to hearing from you shortly.

Ben Allen

University of Southern Queensland

# 1 **Large carnivore science: non-experimental studies are** 2 **useful, but experiments are better**

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## 45 **Response to Bruskotter and colleagues**

46 We recently described the following six interrelated issues that justify  
47 questioning some of the discourse about the reliability of the literature on the  
48 ecological roles of large carnivores ([Allen et al. In press](#)):

- 49 1. The overall paucity of available data,
- 50 2. The reliability of carnivore population sampling techniques,
- 51 3. The general disregard for alternative hypotheses to top-down forcing,
- 52 4. The lack of applied science studies,
- 53 5. The frequent use of logical fallacies,
- 54 6. The generalisation of results from relatively pristine systems to those  
55 substantially altered by humans.

56 We thank Bruskotter et al. ([2017](#)) for responding to our concerns and engaging  
57 with this important issue. We agree completely that non-experimental studies  
58 can and do often have great value, and we recognise that in many (most) cases

59 these types of studies may provide the only data that are available. We  
60 acknowledge the many challenges of working on large, cryptic, dangerous, and  
61 highly-mobile animals in the wild. However, the absence of more robust data  
62 and the reality of these challenges do not excuse weak inference or overstating  
63 conclusions – a practice apparent in many studies (and communication of those  
64 studies) adopting only observational or correlative methods to infer the roles of  
65 large carnivores (reviewed in [Allen et al. In press](#)).

66 We advocated in our original article, agree with Bruskotter and colleagues, and  
67 reaffirm here, that bringing together studies based on multiple different methods  
68 is a powerful way to improve the quality of large carnivore science. But we  
69 reaffirm that not all studies are of equal value. Manipulative experiments have  
70 far greater inferential power than observational and correlative studies, which  
71 should accordingly be valued as ‘weaker’ than manipulative experiments (e.g. [Li](#)  
72 [1957](#); [Krebs 1999](#); [Hone 2007](#); [Fleming et al. 2013](#)). The need for such  
73 experiments may not be as strong where animal numbers are small and more  
74 easily observed, study area sizes are small, climates are stable, harvest does not  
75 occur, livestock are not present, land use changes are negligible, and past or  
76 present human effects are non-existent. In such cases, knowledge obtained from  
77 non-experimental studies can be informative. But where these and many other  
78 influential factors are present, manipulative experiments can be the only way to  
79 tease out the relative effects of all the potential causal factors that may explain  
80 our observations. We of course agree with Bruskotter and colleagues that the  
81 best situation is when multiple strands of evidence are considered (see also [Ford](#)  
82 [& Goheen 2015](#)), and we freely recognise that wildlife management decision-  
83 making should be informed by more than just scientific knowledge. The  
84 challenge lies in the integration of the multiple sources of information, the  
85 appropriate weighting or value attached to each, and the way they are used to  
86 inform carnivore conservation and management attitudes, policy and practice.

87 The Behaviourally Mediated Trophic Cascade Hypothesis (BMTCH), the  
88 Mesopredator Release Hypothesis (MRH), and the Trophic Cascade Hypothesis  
89 (TCH) have seen much public and scientific interest. But reports claiming strong  
90 carnivore effects (e.g. [Letnic et al. 2017](#); [Newsome et al. 2017](#)) and weak or  
91 attenuated carnivore effects (e.g. [Pasanen-Mortensen et al. 2017](#); [Rich et al.](#)  
92 [2017](#)) both continue to regularly appear in the literature. Calls for these

93 hypotheses to be considered universal and/or important phenomena (e.g. [Estes](#)  
94 [et al. 2011](#)) now appear premature and unsupported ([Peterson et al. 2014](#); but  
95 see also [Cooke & Soriquer 2017](#); [Haswell et al. 2017](#); [Morgan et al. 2017](#)).  
96 Nevertheless, many people have come to believe that evidence for these ideas is  
97 strong, so we fully expect some disagreement with these conclusions. We agree  
98 with Bruskotter et al. ([2017](#)) that it is not 'equivocal' that predation can have an  
99 impact on herbivore abundance, and that over-abundant herbivore populations  
100 can have adverse impacts on habitats. What *is* equivocal (see [Mech 2012](#); [Allen](#)  
101 [et al. In press](#)) is that (1) these simple predator-prey relationships inevitably  
102 produce important cascading consequences for entire food webs, (2) these  
103 effects are always strong (or one of the strongest) drivers of ecosystem  
104 structure, (3) any addition or removal of large carnivores will necessarily have  
105 important cascading consequences for ecosystem functions, and (4) large  
106 carnivores must be present and abundant for any ecosystem to be considered  
107 healthy or resilient. Moreover, the considerable value of large carnivores need  
108 not be linked to the demonstration of these things.

109 Our intention is to increase the degree of reflection among researchers and  
110 wildlife managers about the strength and utility of the available evidence for  
111 these effects when they seek to bridge the science-policy-practice interface in  
112 this explicitly value-laden field of conservation biology. We argue that there is a  
113 need for the scientific community to be much more humble and honest about the  
114 strength of our inferences and the certainty of our knowledge concerning  
115 complex ecological issues. Large carnivore conservation and management efforts  
116 are most likely to be successful when scientific evidence is clear, strong, and  
117 used in conjunction with other sources of information to support social,  
118 economic, and political change.

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