

APPLIED ECOLOGY

Working constructively toward an improved North American approach to wildlife management

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Mawdsley *et al.* (2018) respond disapprovingly to our 2018 review of 667 wildlife management systems across Canada and the United States, which found that many of these systems lacked the scientific hallmarks of clear objectives, evidence, transparency, and independent review. Although we strongly agree with several of Mawdsley *et al.*'s points about the role of science in management, their response suggests confusion about three elements of our approach that we clarify herein: (i) the selection of hallmarks, (ii) the role of science in wildlife management, and (iii) our engagement with wildlife agencies. We contend that both critics and defenders of the current approach to wildlife management in Canada and the United States similarly desire rigorous management that achieves social and ecological benefits. Our original study—which used a clear approach to define hallmarks of science-based management, employed a reasonable set of indicator criteria to test for them, and was based on data available to the general public on whose behalf management is conducted—found evidence that the current approach falls short. However, it also provided a framework for addressing shortcomings moving forward. We suggest that advancing discussion on the operational role of science in management, including clarifying what “science-based management” actually means, could curtail practitioners and critics of the status quo talking over each other's heads and encourage all parties to work constructively to improve the governance of wildlife at a continental scale.

Mawdsley *et al.* (1) respond disapprovingly to our 2018 continental-scale review of 667 wildlife management systems. In our review, we found that many management systems across Canada and the United States lacked the scientific hallmarks of clear objectives, evidence, transparency, and independent review. For example, only 26% of systems provided measurable objectives, only 11% described how hunting quotas were set (one of the indicators we used for the transparency hallmark), and only 6% were subject to independent review (2).

Mawdsley *et al.*'s response includes several points in which we are in strong agreement. For example, they echo our emphasis (2) that management necessarily includes dimensions beyond the natural sciences. Likewise, we agree that a deep scientific basis might not be possible for all decisions and all applications of wildlife management, although we also explicitly emphasized that caution and transparency are especially required in cases of limited scientific information (2).

However, Mawdsley *et al.*'s response suggests confusion about three elements of our approach, on which we provide further clarity herein: (i) the selection of hallmarks, (ii) the role of science in wildlife management, and (iii) the use of wildlife management plans and engagement with wildlife agencies. As we describe below, we used a clear approach to define hallmarks of science-based management. Our approach included a reasonable set of criteria, which we tested in management systems across both countries. Our results reflected what is observable to the public, informed by direct communication with the management agencies involved. If, as Mawdsley *et al.* imply, the management systems do not operate according to the information that is publicly available, then this lack of transparency is not reassuring.

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SELECTION OF HALLMARKS

The impetus for our work was that decision-makers, wildlife agencies, and politicians in the United States and Canada often claim a scientific basis to wildlife management, although what that means is rarely defined. Notably, this claim is central to the North American Model of Wildlife Conservation, which guides wildlife management across both countries. For example, a central pillar of the model is that “Science is the proper tool to discharge wildlife policy,” as some of the authors of Mawdsley *et al.* have stated in other work [for example, (3, 4)]. However, such claims cannot be assessed without a concrete description of what science-based management actually means.

To fill this void and to encourage a discussion on what is meant by “science-based” management, we proposed four “hallmarks” (clear objectives, evidence, transparency, and independent review), which might be expected of any management regime invoking the term “science” to describe its approach. We describe how these hallmarks are appropriate, including a substantial supporting literature, in the “Hallmarks of science-based management: Expanded descriptions” section of the supplementary materials (<http://advances.sciencemag.org/content/suppl/2018/03/05/4.3.eaao0167.DC1>). As noted in (2), we did not suggest that the list is exhaustive but, rather, that it is foundational. That is, although the hallmarks presented do not by themselves guarantee a rigorous approach to wildlife management, it is difficult to envisage a rigorous approach without them.

Encouragingly, Mawdsley *et al.* suggest general support for our hallmarks by repeating most of them in their own descriptions of idealized approaches to management. For example, they note that jurisdictions “routinely invite public and expert review and critique of conservation plans through multiple mechanisms.” This process aligns with our independent review hallmark (assuming that the review is sufficiently independent from the agencies in question). Similarly, they assert that state and provincial agencies make decisions using “best available information and insight from ecological and social science,”

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a statement that mirrors the description of our evidence hallmark. Moreover, they declare that standard practices include “defining the need for action; articulating clear objectives,” an appropriate description of our objectives hallmark. Finally, they invoke the “public trust” framework, which, as Sax wrote about compellingly (5), demands transparency, suggesting at least indirect agreement on the importance of transparency, the fourth of four hallmarks that we identified.

ROLE OF SCIENCE IN WILDLIFE MANAGEMENT

Mawdsley *et al.* note that science comprises only one dimension of managers’ considerations. We strongly agree, as we stated in (2): “We do not suggest that science alone should shape management decisions. Social dimensions of management [...] and ethics can and should play prominent roles, but in a transparent manner.” However, the fact that other considerations have a role does not diminish the importance of understanding the contribution of science, but instead suggests a greater need for transparency as to where science begins and ends. As we originally noted in (2), agencies should “disclos[e] the relative contribution of science compared with other considerations” in justifying policy decisions.

Although we suggested that the hallmarks of science might be expected in management systems described as being rooted in science, we did not expect the management process to specifically follow the scientific method, a process that guides scientific research. Whereas clearly there is value in applied fields such as wildlife management following the scientific method [for example, (6)], we set a much lower bar, instead investigating only the presence of foundational hallmarks for science-based management: clear objectives, evidence, transparency, and independent review. Notably, some jurisdictions scored reasonably well, with five systems exhibiting at least 91% of total criteria examined and 66 systems exhibiting at least 77%. Despite the lower (and evidently attainable) bar, however, we still found hallmarks often lacking (2).

ENGAGING WITH WILDLIFE MANAGEMENT PRACTITIONERS

To allow for outside verification of our assessments by those with the most expertise in them, we endeavored to contact the practitioners responsible for all 667 management systems evaluated across Canada and the United States. As we described in (2), we successfully emailed available contacts for most (94%) and requested contact information for the remainder. In these emails, we were clear that we were conducting a broad-scale review [see the initial email in (2)]. We provided our initial assessments of each system and provided email recipients the opportunity to correct any errors that we might have made and to identify any information that we might have missed. We note that having in-person meetings between agency representatives, practitioners, and independent scientists would be very helpful to advance this discussion further on a case-by-case basis and suggest this moving forward. We also note, however, that this approach was infeasible here given the scale of our analysis (comprising 667 management systems across 62 U.S. states and Canadian provinces).

We were aware that management documents intended for a lay audience might not be expected to provide the finer details of wildlife management for our analysis. That is why our original emails also specifically invited agencies to provide any publicly available documents related to each management system for our evaluation.

Whereas it is reasonable that not all documents contain all information regarding management of public resources, systems where such information is completely lacking cannot be considered transparent. That is, assertions that, “the science was done, we just don’t show it” is antithetical to the transparency required for the governance of resources on behalf of the public. If any of the criteria examined were present but simply not disclosed, then making such information public is a tangible and (relatively) straightforward means of improving transparency in the future.

Finally, to insulate data collection from bias, we employed one informed nonspecialist who was neither on our authorship team nor directly involved with wildlife management to score management plans. This process reflected what an interested and informed member of the public would encounter when attempting to learn more about the natural resources managed on their behalf. Given the complexity of scoring hallmark criteria, we additionally tested and reported measures of precision and interobserver error in this scoring.

CONCLUSION

Our research found considerable deficits of scientific hallmarks in wildlife management across the United States and Canada. This finding is of particular concern because a scientific basis is often used by agencies and politicians to defend preferred, sometimes controversial, policy options. Our hope is for a shift from denial of existing problems toward practices that lead to better outcomes for managed species and better clarity to the public.

Advancing the discussion on where science actually begins and ends in wildlife management, including clearer definitions of what is universally expected of science-based management, might enable more constructive discussions, and avoid misdirected arguments caused by critics and defenders of the status quo talking over each other’s heads based on differing expectations and definitions. Advancements might be facilitated by future research into the extent to which different stakeholders (for example, practitioners, scientists, and the general public) agree with the importance (and completeness) of the current hallmarks and, in cases of disagreement, suggest refinements to the framework. Additional insight might be gleaned by interviews with practitioners, for example, by asking them the extent to which they believe their management practice currently follows the hallmarks of science framework and how their processes can be made clearer to the public. Future work investigating associations between the presence of hallmarks and social, economic, ecological, and political variation across jurisdictions might yield insight into broader patterns, and potential drivers, of scientific foundations in natural resource management. Finally, to assess evolution of this field over time, future studies might repeat a similar empirical assessment as (2), using a refined hallmarks framework if need be.

Ultimately, critics of the current model and its practitioners aspire to similar things—rigorous management that achieves both social and ecological benefits. In our assessment, we found evidence that we are not yet there, but we also provided a clearer working definition of what science-based management might entail and a framework for addressing shortcomings. Future work that advances a common understanding of the expectations of science in ostensibly science-based management, and an understanding of the underlying reasons for differences in adoption across systems, could help move this important discussion further, improving the governance of wildlife at a continental scale.

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