AUTHOR:
Jasper A. Slingsby[1,2]

AFFILIATIONS:
[1]Fynbos Node, South African Environmental Observation Network, Centre for Biodiversity Conservation, Cape Town, South Africa
[2]Centre for Statistics in Ecology, Environment and Conservation, Department of Biological Sciences, University of Cape Town, Cape Town, South Africa

CORRESPONDENCE TO:
Jasper Slingsby

EMAIL:
jasper@saeon.ac.za

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Forest restoration or propaganda? The need for Transparency and Openness Promotion (TOP) scores to uphold research integrity

In a time of environmental crisis and 'fake news', there are calls for scientists to engage in public debate or advocacy. Some are wary, fearing that revealing subjective views poses a risk to scientific credibility or erodes trust in scholarly publishing. Others are less concerned, seeing it as their duty to society or an opportunity to boost their profile. Ideally, we need better checks and balances that allow scientists to contribute to public discourse without fear of compromising the credibility of their science, while avoiding subjective views influencing the outcomes of peer-reviewed research. For better or worse, scientists have personal views. The question is not whether they should be condoned or condemned, but how they should be managed in the context of scholarly publishing to maximise benefits and minimise negative outcomes. Using the recent contention around global tree 'restoration' potential as an example, I propose we score journals and articles based on the Transparency and Openness Promotion (TOP) guidelines and associated criteria. A high TOP score means readers have sufficient access to information to assess the objectivity and credibility of scientific publications and their authors. I show that current practice provides very little access to information, and readers are essentially being asked to have faith in the scholarly publication system. We must do better.

Significance:

- Science is predicated upon objectivity, yet readers are rarely given enough information to assess the objectivity, and thus integrity, of peer-reviewed research.
- To address this issue, a scoring system is proposed, which is based on the principles of transparency and openness.
- Improving transparency and openness in scholarly publishing is essential for allowing readers to assess the objectivity of published research and researchers, growing public trust, and allowing researchers to engage in public debates without fear of loss of scientific credibility.

A recent publication with a simple message 'The global tree restoration potential'[1] has caused controversy and discomfort in the scientific community. Controversy, because commentaries by leaders in the field highlighted several assumptions or omissions, which they viewed as critical flaws[2-8], but these were largely disregarded by the authors and journal[9,10] (Table 1). Discomfort, because the authors are strongly advocating for the implementation of their research and aim 'to start a global movement'[11] – planting trees on a massive scale to mitigate CO_2 emissions. This despite the perceived flaws in their analysis, many known negative outcomes of afforestation,[12] and a perceived conflict of interest in being the beneficiaries of a USD17 million research grant from a foundation with a stated interest in forest restoration. High-profile publications with potential conflicts of interest are becoming increasingly common, and are challenging scientists to critically assess our role in advocacy and how to balance this against, or integrate it with, the way we do science. Here I use Bastin et al.[1] as an example to argue that we need greater transparency and openness in scholarly publishing to strike the balance between protecting the public from flawed science and protecting scientists from being ostracised for engaging with public issues.

The lack of systemic change in the use of fossil fuels and management of natural resources has increased calls for scientists to communicate their research, become advocates, or even activists, around the global climate and extinction crises.[13,14] Engaging with advocacy raises fears among scientists that their work will lose credibility, because revealing personal views may undermine the scientific objectivity of their research. These fears are unfounded and counterproductive. Scientific objectivity is a noble, but largely unattainable, ideal that is best approached by disclosing all assumptions and biases for others to assess.[15] While publicly airing personal views may incur costs to the individual researcher, there are also many potential gains and the opportunity to improve science in general. Few, if any, scientists do not hold personal views on their subject matter, and denial in any form rarely has positive outcomes. Acceptance and acknowledgement of subjective views can be positive for science as it allows reviewers, editors and readers to assess whether researchers' beliefs may have biased their analyses or findings. Unfortunately, this raises practical drawbacks in that it relies on the honesty of the researcher, and puts the burden on the journal and editors to call out any undue subjectivity. The system fails when sources of bias are not revealed, or where the checks and balances to detect and remedy undue subjectivity are insufficient.

The danger to society is when the facts are misrepresented or concealed to further an agenda – i.e. when what appears to be science or advocacy is actually propaganda. A case in point is the infamous Tobacco Wars, where tobacco companies used marketing, influence and undisclosed funding of scientists to obscure the truth and influence scientific and public debate around the health risks associated with cigarette smoke.[16] Similar approaches have been used to sow doubt about a range of important issues, including global warming.[17] There are a number of pathways by which research can be abused for propaganda, some of which involve dishonesty by various parties, while others rely on poor checks and balances. The production and communication of science includes linkages between backers (i.e. funders and other influences) and researchers, the transfer of manuscripts from researchers to journals for vetting

Table 1: Flaws, errors or omissions of Bastin et al.'s[1] analysis highlighted in technical comments and letters

Issue raised	Response by Bastin et al.
Confounding afforestation with restoration[3]	Argued that afforestation is restoration in all the areas where their model predicts there should be trees[9]
Grossly underestimating historical carbon emissions and overestimating tree sequestration potential by accounting for atmospheric CO_2 only[2,4]	Claimed that this was inconsequential to their argument[9]
Grossly overestimating carbon storage per forest area[2-4,6]	Claimed that this was due to differences in the definition of 'forest' used by the author and the commentaries[9]
Ignoring carbon in existing land cover[2-4,6]	Provided new methods explaining how existing carbon was taken into account. But these methods revealed that they used a limited set of values for different ecosystem types, which include assuming that tundra has 80% and savanna has 100% tree cover[9]
Ignoring feedbacks with albedo, atmospheric CO_2[2-4] and the water cycle[8]	Argued that exploring the effects of albedo was beyond the scope of their study and did not meaningfully comment on the water cycle[9,10]
Ignoring fire and herbivory[3]	Argued that these are included in the training data as they are from protected areas, although they are not explicitly included in the model[9]
Ignoring that their proposed 'solution' treats the symptom (atmospheric CO_2) not the cause (CO_2 emissions)[2-4]	Altered their abstract from reading 'global tree restoration as our most effective climate change solution to date' to 'global tree restoration as one of the most effective carbon drawdown solutions to date'[9]
Ignoring operational feasibility[5] or negative externalities relating to social fairness, water, biodiversity and other opportunity costs[3,7]	Argued that they are merely highlighting possibilities and not proposing actions and that balancing these trade-offs are not for them to decide[9,10]

and publication, and the communication of the findings to the public (including scientists). Perhaps the most common source of propaganda is the hijacking of communication to the public by self-interested parties and the misquoting or other abuse of honest, largely objective research in marketing or social media campaigns. Another pathway is corruption: when researchers and/or journals are dishonest and publish bias or fake science that furthers their own interests, views and agendas or those of their backers. A third pathway is when researchers and/or journals are manipulated by their backers or coerced into nefarious actions in the belief that they are being objective or contributing to a greater cause. This scenario is currently a real fear with the recent offer of USD1 billion in research funding from a tobacco company.[18] Embracing, rather than denying, the subjective views of researchers, editors and backers may actually provide the opportunity to formally improve research integrity and strengthen the checks and balances needed to identify sources of bias and potential propaganda.

Fear of subjectivity and propaganda in science is not new, and there have been several mechanisms put in place and refined over the decades to help reduce their prevalence and improve public trust in science. Perhaps the longest standing and best known are scholarly peer review and 'conflict of interest' statements, but these have deficiencies and are not applied in a consistent manner across journals. Peer review is predominantly performed behind closed doors, with no accountability, while conflict of interest statement requirements are highly varied, poorly reported and predominantly apply to financial interests only. Moves towards open peer review[19] and the expansion, standardisation and public registration of researcher conflict of interest statements[20] are positive moves in this regard. Additional refinements or additions could include establishing a code of ethics or peer review for press releases associated with the publication of articles, and conflict of interest statements for journals and funders that are lodged with discoverable registries, disclosing their funding sources and ideologies.

A recent move to improve our ability to assess the credibility of scientific contributions and their authors is the development of standards to promote a culture of transparency and open science.[21] These Transparency and Openness Promotion (TOP) guidelines are aimed at journal procedures and policies for publication and are increasingly and incrementally being adopted by journals. While many of these principles and standards are not yet implemented or enforced by journals, they can easily be voluntarily adopted and implemented by researchers engaged in science communication or advocacy to defend their credibility. Table 2 presents an approach for scoring the transparency of an article or journal based on applying the TOP guidelines and others based on peer review and the declaration of conflicts of interest. I have indicated scores for each criterion achieved by Bastin et al.[1] and *Science*, based on information available from the article and the journal website. The system allows scores to range from 0 (no transparency or openness) to 1 (maximum transparency and openness). This scoring system could be extended to authors by averaging the TOP scores of all their research outputs over a particular time window such as 2 or 5 years, as is done for the h-index. TOP scores align closely with, and provide a method to quantify, many of the principles proposed in the draft *Hong Kong Manifesto for Assessing Researchers: Fostering Research Integrity* presented at the recent 6th World Conference on Research Integrity in Hong Kong.[22]

While some criteria (e.g. preregistration) are often less feasible in ecology, the scores are generally low (Bastin et al. = 8/36 = 0.222; *Science* = 9/39 = 0.23). These scores are of concern because they are likely to be among the highest scores in ecology. Bastin et al.[1] went out of their way to make their analyses repeatable, while *Science* is one of the leading TOP journals. Together, this highlights that there is great room for improvement in the transparency and openness enforced by scientific journals in general. Until this happens, it is up to authors to go the extra mile to improve the TOP scores of their articles. While the TOP guidelines improve openness and repeatability, they do little to counter any subjectivity in the presentation or interpretation of results. This is where open peer review and improved disclosure of interests could make a telling contribution.

The TOP scoring exercise presented drives home that readers are really being asked to have faith in scientists and publishers, and are not given enough information to assess the objectivity, and thus credibility, of scientific publications, editors and authors. This is highly problematic, because in an era of fake news there is an increasing need for scientists to engage with public debate without threat to their credibility. There is also an increasing risk of scientific propaganda.

Whether you trust the science put forward by Bastin et al.[1] or agree with the approach they have adopted or not, get used to it – it is a model that is likely to become increasingly prevalent. The onus is on the scientific community to adopt and enforce principles and standards that ensure openness and transparency, allowing scientists to contribute to public discourse without fear of losing their credibility, but also rooting out and debunking propaganda. Finally, an additional advantage of greater transparency and openness is that as our philosophy of science evolves, such as becoming more inclusive of methods of knowledge generation and verification beyond the Western paradigm, we should have the materials available to assess and validate the record of research through a new lens.

Table 2: A transparency scoring system for articles and journals based on the standards and levels of the Transparency and Openness Promotion (TOP) guidelines, type of peer review, and disclosure of financial and ideological conflicts of interest. The minimum standards implemented by *Science* are indicated with an ***S***, while the score for the Bastin et al.[1] article is indicated with a ***B***.

TOP guidelines	Score			
	0	1	2	3
Citation standards	None or encouraged	Journal describes standards and rules in author guidelines	Article adheres to guidelines, but this is not a requirement for publication	Appropriate citation for data and materials provided ***B, S***
Data transparency	None or encouraged	Article states whether data are available	Data posted to a trusted repository ***B, S***	+ analyses reproduced independently prior to publication
Analytic methods (code) transparency	None or encouraged	Article states whether code is available	Code made available ***B, S***	+ analyses reproduced independently prior to publication
Research materials transparency	None or encouraged	Article states whether materials are available, and, if so, where to access them ***B, S***	Materials posted to a trusted repository. Exceptions allowed.	+ analyses reproduced independently prior to publication
Design and analysis transparency	None or encouraged ***B, S***	Journal articulates standards	Adherence to journal standards required	Adherence to journal standards required and enforced
Study preregistration	None or encouraged ***B, S***	Article states whether preregistration exists	+ allows journal access during peer review for verification	Preregistration required and link and badge in article to meeting requirements provided
Analysis plan preregistration	None or encouraged ***B, S***	Article states whether preregistration exists	+ allows journal access during peer review for verification	Preregistration required and link and badge in article to meeting requirements provided
Replication *[Not relevant to individual articles]*	None or discouraged	Encouraged ***S***	Encouraged and conducts results blind review	Uses Registered Reports for replication studies with peer review prior to observing the study outcomes
Additional guidelines				
Openness of peer review	None ***B, S***	Reviews reported	Reviews and reviewers reported	Transparent review: public can see manuscripts, reviews, reviewer names and author responses
Open disclosure of funders and potential financial and ideological conflicts of interest by authors	Funders and financial interests only ***B, S***	+ ideological and non-financial	+ in open online registry	+ in open online registry, time stamped and up to date
Open disclosure of funders and potential financial and ideological conflicts of interest by journal	None ***B, S***	Funders and financial interests	+ ideological and non-financial	+ in open online registry, time stamped and up to date
Open disclosure of funders and potential financial and ideological conflicts of interest by funders	None ***B, S***	Funders and financial interests	+ ideological	+ in open online registry, time stamped and up to date
Peer review of press release	None ***B, S***	Reviewed by journal staff	Peer-reviewed	Open peer review

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Competing interests

The author has no competing financial interests, but declares that he is ideologically opposed to the inappropriate afforestation of open ecosystems without due consideration of the trade-offs with water delivery, biodiversity and livelihoods.

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