Dumping trash, including plastics, into rivers in the Amazon Basin is the result of poor public policies and a general lack of environmental awareness. There is an urgent need for environmental education, investments by state and municipal governments in sanitary and waste treatment infrastructure, and a reduction of single-use plastic items, as well as research on not only the types of microplastics present in the environment, but also their toxicity and bioaccumulation potential. Given that federal environmental regulations are unlikely to increase in the near-term (Fearnside 2018), Amazonian residents need to pressure state and municipal governments to address the problem. Continued failure to contend with plastic pollution in the Amazon has consequences that are far-reaching, because much of this plastic eventually reaches the Atlantic Ocean. The problem of plastic pollution has been well documented and publicized for the marine realm, as well as for rivers in Asia. New evidence of discarded plastics in the vast Amazon Basin clearly demonstrates the magnitude and complexity of this global environmental challenge.

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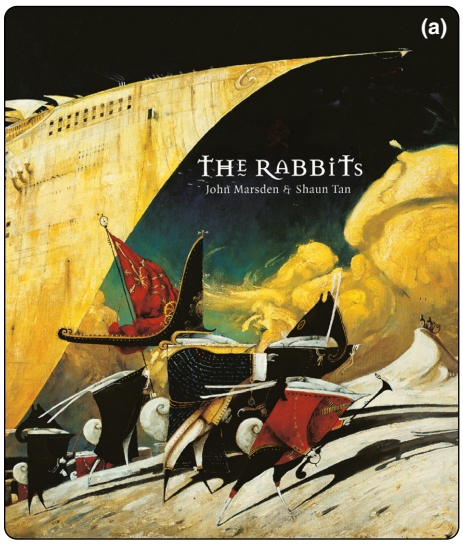
Science communication in a post-truth world: promises and pitfalls

The mass decline of biodiversity (Ripple *et al.* 2017) in this post-truth era (Lewandowsky *et al.* 2017) means that reliable and influential conservation science communication is more important than ever. In this era, truths and lies are increasingly difficult to distinguish, posing a major challenge to science communication (Lewandowsky *et al.* 2017). As a result, conservation scientists and managers are grappling with new ways of countering misinformation and sharing factual information. Facebook, Twitter, YouTube, Instagram, blogs, online news outlets (eg *The Conversation*), webcomics, and satirical articles all provide communication opportunities, but we still have a poor understanding of which of these are most effective, and when and where to best communicate science.

New technology, including algorithms that detect false information, and proactive campaigns against misinformation, may help combat the effects of fake news (Iyengar and Massey 2019). Somewhat unsettling and problematic, however, is that research suggests fake news is spread on social media because humans, not algorithms, choose to circulate false information, because it is perceived as novel (Vosoughi *et al.* 2018). As a result, exceptionally creative, funny, or unconventional (Figure 1) communications that surprise or shock audiences may reach more people because they are more engaging, even if not factual. In 2017, science-related Facebook pages with the highest online engagement (numbers of



the ONION (b)

Stuffed-Animal Biodiversity Rising

Heavenly Authorities Arrest God For Leaving Children In Overheating Planet

New Regulation Requires All Protected Species To Be Actively Looking For New Habitat In Order To Receive Funding

Figure 1. Creative examples of conservation science communication. (a) *The Rabbits* is a children's story with symbolic artwork depicting European colonization, non-native species, and environmental change from the perspective of the invaded (Marsden J and Tan S [illustrator]. 1998. The Rabbits. Port Melbourne, Australia: Lothian Children's Books). (b) Satirical environmental news headlines published by *The Onion* (used with permission by *The Onion*, © 2018; www.theonion.com).

shares, likes, or reactions) tended to have graphics with minimal text, represented calls to action, or were posts commenting on proposed changes to science funding (Hitlin and Olmstead 2018). These trends are consistent with findings from empirical research suggesting that posts with visual elements encourage audience engagement, while posts that are genuine, personal, and honest foster trust in science (Hwong 2018).

Principles of effective science communication (Bowater and Yeoman 2012; Cooke *et al.* 2017) will likely remain the foundation of engaging with society in the post-truth era, but the changing media landscape presents new opportunities and risks (Iyengar and Massey 2019). General recommendations for conservation science communication (Cooke *et al.* 2017) include not only clearly identifying the purpose, target audience (including key individuals), and platform of communication, but also seizing opportunities, while being creative, honest, measured, and engaging. An example of the fine line between being engaging and not overstating the results is a recent paper by Sánchez-Bayo and Wyckhuys (2019), who estimated that 40% of insect taxa are threatened with extinction; the authors' conclusions have been exaggerated in the media to promote headlines of a worldwide "insectageddon" and impending collapse of ecosystems globally. While insect declines are concerning, we simply do not have sufficient quantitative evidence (Thomas *et al.* 2019) to support claims that it is a global phenomenon, or to identify the causal agent behind an impending collapse of ecosystems. Attention-grabbing crisis headlines may increase media exposure but if the claims are not substantiated by evidence, we risk undermining society's trust in science (Weingart 2017).

Humor and satire can be persuasive forms of science communication (Bowater and Yeoman 2012), and they provide useful alternatives to the common "biodiversity crisis" framing of conservation issues (Chapron *et al.* 2018a; Kidd *et al.* 2019). Comedians regularly make light of environmental crises, often highlighting the absurdity of humanity's predicament and woefully inadequate response (Figure 1). Sarcastic political news and online comedy can increase people's awareness of topics they would not otherwise be interested in, such as climate change (Anderson and Becker 2018). However, most research on this strategy has been based on satire by comedians or satirists, not by scientists. Satirical peer-reviewed publications may cause confusion, given that satire is not expected in scientific journals. It is also important to weave in the seriousness of environmental problems because important messages about risk can become trivialized or misinterpreted if presented solely in a humorous context (Moyer-Gusé *et al.* 2011).

One example of conservation satire in the peer-reviewed literature is Chapron *et al.* (2018b), who attempted to satirically convey global conservation messages. In the well-known journal *Trends in Ecology and Evolution*, Chapron *et al.* (2018b) refused to accept limits on population growth and overconsumption. The satirical paper was welcomed by Ripple *et al.* (2018), but has already been inadvertently cited by Dyer and Forister (2019) seemingly as if it were a legitimate peer-reviewed publication.

Another cautionary tale about the extent to which humorous science can be misinterpreted comes from a satirical paper published in the prestigious *British Medical Journal* (Leibovici 2001). This paper, intended to be humorous, concerned the "benefits" of retroactive prayer in reducing the duration of hospital stays for people with infections. It now has 241 Google Scholar citations, is widely circulated and cited among religious groups as evidence of the healing power of prayer, and has even been accidently used in databases that inform public-health decision making (Ronagh and Souder 2015). Similar types of satirical or spoof science papers and social media posts in the lead-up to April Fool's Day or Christmas remain reasonably common, but may also backfire. In this new age of digital information in which we all grapple with distinguishing fiction from fact, any risk that information could be inadvertently misinterpreted or worse, used maliciously, should be minimized.

We encourage scientists and editors to creatively promote research that is based on real data and science but to be especially wary of blurring the line between real news and fake news further by publishing "fake science" papers, or overstating conclusions in the media. In striving for greater online impact, it is vital to ensure we do not compromise on the need for science communication to be fundamentally evidence-based. Importantly, scientific institutions must formally support the time commitments required for engagement with the public and invest in training students and staff to become more effective communicators (Brownell *et al.* 2013).

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