

Focus and social contagion of environmental organization advocacy on Twitter

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Abstract

Agriculture, overexploitation and urbanization remain the major threats to biodiversity in the Anthropocene. The attention these threats garner among leading environmental nongovernmental organizations (eNGOs) and the wider public is critical in fostering the political will necessary to reverse biodiversity declines worldwide. I analyzed the advocacy of leading eNGOs on Twitter by scraping account timelines, screening content for advocacy relating to biodiversity threats and, for prevalent threats, further screening content for positive and negative emotional language with a sentiment lexicon. Twitter advocacy was dominated by the major threats of climate change and overexploitation and the minor threat of plastic pollution. The major threats of agriculture, urbanization, invasions, and pollution were rarely addressed. Content relating to overexploitation and plastic pollution was more socially contagious than other content. Increasing emotional negativity further increased social contagion, whereas increasing emotional positivity did not. Scientists, policy makers, and eNGOs should consider how narrowly focused advocacy on platforms like Twitter will contribute to effective global biodiversity conservation.

Introduction

In the decades following the 1992 UN Convention on Biological Diversity (CBD), humanity has presided over consistent declines in biodiversity, despite multiple national and international policy commitments aimed at reversing these trends (Mace et al. 2018).

Humanity is pushing planetary boundaries (Steffen et al. 2015), and, as the breadth of anthropogenic activities continues to grow, humanity is also focused on emerging threats to biodiversity (Sutherland et al. 2019). But the major threats to biodiversity known in the decade of CBD ratification—including agriculture, overexploitation, and urbanization—remain the major threats today (Wilcove et al. 1998; Maxwell et al. 2016). Multiple threats can interact to drive extinctions (Graham et al. 2011), and threats such as climate change will become increasingly problematic in the coming decades (Foden et al. 2013), but reversing global biodiversity declines will necessarily hinge on moving the known, major, and contemporary threats down and off the threat ledger (Table 1).

The global scale of many major threats to biodiversity require in-kind global-scale solutions that must be underpinned by public and political will. For decades, environmental nongovernmental organizations (eNGOs) have served as a crucial and influential bridge between the wider public and intergovernmental processes (Annan 1998). These organizations have been major drivers of successful multilateral agreements, ranging from the commercial whaling moratorium (Keith 1981) to the Montreal Protocol, which phased out the production of ozone-depleting chemicals worldwide (Mate 2002). Because the success of eNGOs is so dependent on marshaling and engaging public opinion, the global rise of social media use (Perrin 2015) is now centrally important to eNGO advocacy (Buhrmester et al. 2018). On social media platforms, eNGOs must compete for attention in the melee of global conversations, where the most socially contagious content (i.e., that which is propagated

more widely) is often highly emotional (Berger & Milkman 2018) and where discourse is increasingly characterized by partisanship and polarization (Brady et al. 2017).

The world's largest eNGOs have garnered large social media audiences (10^5 - 10^6 followers on Twitter [Supporting Information]) and are influential actors in this space (Jørgens et al. 2016). In 2014, for example, Greenpeace targeted Shell's oil drilling activities in the Arctic, specifically with a video highlighting Shell's partnership with the toy manufacturer Lego (Miller 2014). At the time of writing, this video had been viewed 8.7 million times on YouTube alone, demonstrating the potential reach of social-media advocacy. At the same time, increasing worldwide use of social media is providing novel opportunities to effectively gather conservation-relevant information on issues ranging from illegal wildlife trading (Di Minin et al. 2018) to the preferences of ecotourists (Hausmann et al. 2018). But the many apparent ways in which eNGOs and the wider conservation movement benefits from social-media data and advocacy must be carefully weighed against) the tendency toward polarization and the fact that active social media users are not representative of the wider public or stakeholders, with user demographics varying between platforms and countries (Ladle et al. 2016). These organizations clearly do wage successful campaigns on social media, but it is less clear how effective these campaigns are at fostering long-term change (Buhrmester et al. 2018) or, indeed, whether the aggregate focus of eNGO advocacy is aligned with current, major conservation issues (Table 1).

Large eNGOs are rarely single-issue organizations (Supporting Information); many also focus on a range of human health and environmental issues that may not intersect with biodiversity conservation per se. Successful multilateral agreements like the international whaling moratorium demonstrate that focused eNGO advocacy can have positive outcomes for biodiversity conservation (Noad et al. 2019). But the assumption that campaigning to address minor threats (e.g., banning certain single-use plastics) will be a net positive for

mobilizing meaningful action on major threats requires scrutiny (Stafford & Jones 2019). Two related and empirically well-supported phenomena justify this scrutiny: the information overload experienced by social media users (Rodriguez et al. 2014) and the availability heuristic, which demonstrates that perceptions of the importance of issues skew toward those that are easiest to recall (Kahneman & Tversky 1973). If public perceptions about the severity of a threat to biodiversity depend on the ease of recalling the details of that threat, then the type and quantity of advocacy produced by eNGOs has the potential to be a major shaper of those perceptions.

I sought to determine whether the world's leading eNGOs are focusing social-media advocacy on major contemporary threats to biodiversity. To do this, I scraped content from the Twitter accounts of leading eNGOs and used this data to explore how advocacy is partitioned among leading threats; how leading eNGOs differ in their advocacy; how specific threat types and use of positive or negative emotional language influences the social contagion of content, and how Twitter advocacy relates to mission statements obtained from eNGO websites.

Methods

I scraped content from 10 Twitter accounts of 9 eNGOs with the largest platforms (WWF under two separate monikers, Greenpeace, Jane Goodall Institute, The Nature Conservancy, Sierra Club, Ocean Conservancy, Royal Society for the Protection of Birds, Sea Shepherd, and Friends of the Earth). I used the statistical software R (R Core Team 2019) and the package `rtweet` (Kearney 2018). Supporting Information contains details of account-selection criteria. I standardized data for platform size by establishing relationships between size and content sharing (Supporting Information) and for effort of content production among eNGOs by analyzing the 1000 most recent tweets for each account (total period of 496 days, 9 November 2017 to 20 March 2019). Different eNGOs produce content at different rates;

thus, each timeline represents a different total period. Because Twitter's API limits scrapable content to the latest 3200 tweets for any one timeline, it is impossible to subsample content to correct for this discrepancy without reducing sample size. As such, I test scraped data to demonstrate that my findings were robust to time-constrained analyses (Supporting Information).

I manually screened the content of each tweet and assessed associated media content (images, videos, and links to articles). Where content pertained a known threat to biodiversity, I assigned it to one of the ten major threat categories identified by Salafsky et al. (2008) (Table 1). The ranking of threats in Table 1 synthesizes the best available knowledge of threats faced by species on IUCN's Red List (Maxwell et al. 2016), rather than threats to all species. Any extrapolation to wider biodiversity rests on the assumption that a majority of unassessed species face comparable threats, in both degree and kind. Because of the notable prevalence of plastic-pollution content in the data, I also categorized it discretely, and, finally, I included content in which multiple threats were identified in single tweets. Categorization rules and a categorization accuracy analysis detailed in Supporting Information.

I conducted five related analyses of the categorized data set. First, I used a simple partitioning of aggregated content among threats to determine which threats dominate the online advocacy of these ten accounts. Second, I used principal components analysis of content among accounts to illustrate how eNGOs differ in their overall online advocacy. Third, to obtain a better measure of the intrinsic tendency of content to be socially contagious, I compared the degree of social contagion among threats by nonparametrically bootstrapping ($n=2000$) median corrected retweets and favorites to obtain 95% CIs for those values. Fourth, I further analyzed these data by applying the National Research Council Canada (NRC) sentiment lexicon (Mohammad & Turney 2010) to identify the use of emotional language (positive and negative words) in tweets (Supporting Information). I used linear models to

explore whether the degree (i.e., word counts) of positivity or negativity in content is predictive of social contagion ($\log_n[\text{retweets} + 1]$). For the three most prevalent biodiversity threats in the data—climate change, overexploitation, and plastic pollution—I used threat type as an additional categorical predictor in a second set of linear models. Finally, I compared mission statements on eNGO websites with eNGO Twitter advocacy to qualitatively assess messaging consistency.

Results

Landscape of online eNGO advocacy

Across the dataset, 41% of all tweets produced by these eNGOs pertained to one or more known threats to biodiversity. By far the largest share of all threat content related to climate change (39%). Overexploitation (19%) and plastic pollution (16%) were respectively the second and third most prevalent threats in the data. Collectively, these three categories dominated (74%) the biodiversity threat content produced by leading eNGOs (Fig 1a). As a result, other threats occupied less bandwidth. Notable among threats that did not garner attention in proportion to their scale were agriculture (7%), pollution (3%), urbanization (<1%), and invasive species (<1%) (Fig. 1a). However, when combined, threats that are major drivers of habitat loss—including agriculture and urbanization—represented 12% of content (Supporting Information). The use of hashtags to promote specific issues and to access wider audiences (Fig 2) reflected the focus of content among threats (Fig 1a); climate- (e.g. #climatechange) and plastic pollution (e.g. #BreakFreeFromPlastic) related hashtags dominated. Further, eNGOs took advantage of grassroots movements (e.g., #YouthClimateStrike) and political events (e.g. #COP24) to amplify their content (Fig 2).

Relatedness of threat content and audiences among eNGO accounts

Among the ten eNGO accounts I considered, Sea Shepherd produced the most distinctive content; a focus on the threat of overexploitation drove this distinctiveness (Supporting Information). The RSPB also produced distinctive content, characterized by the threats of urbanization and human disturbance (Supporting Information). The Ocean Conservancy, Nature Conservancy, and the Jane Goodall Institute clustered as a result of producing content relating to a range of less highlighted threats, and the remaining eNGO accounts clustered in association with several more frequently highlighted threats, including climate change and plastic pollution (Supporting Information). Substantial overlap existed in the audiences of all eNGO accounts (Supporting Information). At minimum, overlap was on the order of 10^3 followers (e.g., Sea Shepherd and the Nature Conservancy: 6253). For the largest platforms, overlap was on the order of 10^5 followers. Despite ubiquitous overlap, some of the largest platforms, such as WWF, retained large exclusive audiences (Supporting Information).

Social contagion of biodiversity threat content

Platform-size adjusted retweets and favourites were correlated ($r = 0.96$, $p < 0.001$) (Fig. 1b). Content relating to exploitative biodiversity threats was highly socially contagious, receiving significantly more platform-size adjusted retweets and favourites than any other threat (non-overlapping 95% CIs) (Supporting Information). Similarly, content relating to plastic pollution was highly socially contagious; it had significantly more retweets than most other threats (Supporting Information) and was favorited more than many threats (Supporting Information). However, climate-change content was not contagious to the degree that might be expected from its dominant content share (Fig 1); it was significantly less retweeted than overexploitation, plastic pollution, and pollution (Supporting Information).

For all threats pooled, increasing content negativity increased social contagion (coefficient = 0.27, $p < 0.001$, AIC = 16118.97, AIC_{null} = 16215.50) (Fig 3a), but no such increase in contagion was apparent for increasing content positivity (coefficient < 0.01 , $p = 0.964$, AIC =

16217.50) (Fig 3b). When considering the three most prevalent threats in the data (climate change, overexploitation, and plastic pollution), the same trends in contagiousness with respect to pooled threat content negativity and positivity were consistently reflected (Fig. 3b, c). However, contagiousness differed among threats (Supporting Information); overexploitation was most contagious (intercept = 3.60, $p < 0.001$; intercept = 3.53, $p < 0.001$) and plastic pollution was least contagious (intercept = 3.11, $p < 0.001$; intercept = 3.24, $p < 0.001$) (Fig. 3). Importantly, high variance in contagiousness (and small R^2 [Supporting Information]) indicated that positive content was often highly contagious and that negative content often was not. Although the most negative content was, on average, five times more contagious than the most positive content. Full model summaries and AICs are given in Supporting Information.

Consistency between Twitter advocacy and eNGO mission statements

The WWF included the most identifiable threats in its mission statements and Sea Shepherd included the fewest (Supporting Information). Climate change and overexploitation were included in the most mission statements, whereas human disturbance was not explicitly included in any (Supporting Information). Invasions, system modification, and transport were all rarely included in eNGO mission statements. Sixteen percent of the categorical threat content on Twitter did not match threats outlined in eNGO mission statements, indicating broad coherence between mission statements and the presence of Twitter advocacy.

Discussion

The threats of climate change, overexploitation, and plastic pollution dominated the Twitter advocacy of leading eNGOs, whereas the major threats of agriculture, urbanization, pollution, and invasive species were infrequently highlighted. Content relating to some major threats, such as overexploitation, was highly socially contagious and the specific use of negative language further increased social contagion. In the context of a shift in media coverage away

from biodiversity toward issues such as climate change (Veríssimo et al. 2014) and plastic pollution (Stafford & Jones 2019), my findings illustrate the challenges the conservation movement faces in attempting to effectively address major threats to biodiversity.

The influence of widespread social media use on global discourse should not be underestimated. Social media has been implicated in enhancing partisanship and echo chambers (Williams et al. 2015), in the spread of fake news (Lazer et al. 2018), and in precipitating political revolutions (Zeitsoff 2017). Leading eNGOs operating on social media are, perhaps inevitably, beholden to wider forces shaping these spaces. For example, the killing of a satellite-tagged lion named Cecil by a trophy hunter in Zimbabwe in 2015 sparked unprecedented international condemnation online (Buhrmester et al. 2018).

Similarly, the influence of the global youth climate strikes—which were instigated by a single individual (Fisher 2019)—can be clearly seen in the Twitter advocacy of the eNGOs I considered (prevalence of #YouthClimateStrike and #ClimateStrike) (Fig. 2). Before the rise of social media, Kofi Annan (1998) considered eNGOs “indispensable bridges between the general public and the intergovernmental process.” But contemporary social media campaigns are increasingly circumventing these bridges by directly connecting activists with policy makers (Marris 2019). The implications of this changing advocacy landscape for biodiversity conservation remain unclear. Some causes, such as the banning of trophy hunting, can rapidly attract global engagement and support, but whether such bans will be a net positive for biodiversity conservation is a topic of some controversy (Di Minin et al. 2016). Hunting and poaching are not monolithic issues for conservation (Montgomery 2020), and it seems unlikely that their complexities can be usefully communicated in an attention-limited social media environment. Successfully translating global engagement and support on social media to positive outcomes for conservation must begin with the recognition that emotion and reason are not easily separable facets of human judgement (Nelson et al. 2016).

The social contagion of the Cecil story and of Greenpeace's targeting of Shell via Lego (Miller 2014) illustrate the importance of tangible moral-emotional characteristics in drawing focus and directing advocacy. In Cecil, one may empathize with suffering of a charismatic nonhuman animal. People are also predisposed to elevate the moral status of humans above nonhuman animals (Singer 2009). Thus, the identification of unambiguous suffering (and particularly human suffering) by eNGOs is, by implication at minimum, also an appeal to morality. Consider the wider range of political, environmental, and public health issues that are relevant to eNGO advocacy, alongside the major threats to biodiversity addressed here. It is apparent that not all issues are equally (or even obviously) advantaged by an unambiguous moral-emotional quality. For example, the social contagion of Twitter content relating to overexploitation and plastic pollution was enhanced by negative language (Fig. 3). Such language seems entirely proportionate to the clear suffering often linked to these threats (Supporting Information). There is surely nothing positive to say or feel about an image of a turtle entangled in plastic. Indeed, antiplastic-straw campaigns may owe their genesis to one viral video of a turtle having a straw wrenched from its nostril (Minter 2018). But plastic pollution is a singular component of the wider threat of pollution, and, when considered in the fullest context of biodiversity loss and long-exceeded planetary boundaries, the focus afforded to this issue is arguably disproportionate to the scale of the threat posed (Stafford & Jones 2019). In contrast, overexploitation is a leading threat to biodiversity (Maxwell et al. 2016; Di Minin et al. 2019) that occupies a large share of eNGO Twitter advocacy while also being highly socially contagious (Fig 1b)—a combination that could be responsible for generating positive outcomes for biodiversity conservation.

Examining publicly available eNGO mission statements for mismatches between advocacy in principle and social media advocacy in practice revealed that leading eNGOs have remits that are at least superficially reflected in their Twitter advocacy (Supporting Information).

However, this observation masks the narrow aggregate focus of Twitter advocacy, in terms of actual content share (Fig 1a), suggesting that wider discourse is influencing that advocacy. An inevitable consequence of narrow focus is that many major threats are occupying less advocacy bandwidth than might be expected from the numbers of species known to be threatened (Fig 1a; Table 1). Agriculture, pollution, urbanization, and invasive species are all major drivers of biodiversity declines worldwide (Maxwell et al. 2016), but the moral-emotional characteristics of these threats are perhaps sometimes less obvious. For invasions, as the least amplified top-five threat (Fig. 1), it may be that measures necessary to protect biodiversity, such as extermination programs, are morally questionable at a first pass (Blackburn et al. 2010).

Limitations

The conclusions and interpretations I offer here should be clearly caveated on four counts. First, in considering a handful of influential eNGOs operating on a single platform over a limited period, this study is necessarily narrow in focus. This is a particularly acute issue for eNGOs with high rates of content production, where focus may be much broader over longer time frames. Second, the underlying classification of biodiversity threats (Salafsky et al. 2008; Maxwell et al. 2016) is sometimes arbitrary and subject to judgement, as exemplified by the alternative aggregation of drivers of habitat loss (Supporting Information). Third, schemes used to classify biodiversity threats established by conservation scientists and policy makers are not necessarily useful for the purposes of effective eNGO advocacy at the organization level. Finally, singular individuals, issues and events can and do drive online discourse—as illustrated by the Cecil story; thus, the apparent prevalence of a broadly defined threat in eNGO advocacy should not be conflated with consistent advocacy across all species and ecosystems subject to that threat.

Effective environmentalism

If the data presented here are indicative of the shape of prevailing environmental advocacy on social media platforms, then conservationists should consider what the consequences of such narrow focus may be for the wider aim of halting and reversing global biodiversity declines. Advocacy will refocus on different issues through time (Veríssimo et al. 2014), but, given the consistent biodiversity declines over the 27 years since CBD, I argue that an unwavering consistency in addressing major threats is urgently required. Consistency does not imply that efforts to tackle relatively minor or emerging threats are unimportant, but the conservation community should question whether disproportionate focus on some threats is a useful way to leverage wider engagement, or is instead a convenient distraction (Stafford & Jones 2019).

The problems that large, successful eNGOs focus on are not arbitrary. Because organizations dependent on donations and are beholden to public opinion, they necessarily reflect wider concerns, and this is perhaps truer today on social media than historically. Threats that have a clear moral-emotional dimension will inevitably draw attention, as the contagion of anti-exploitative advocacy online illustrates. But although the empathy felt at the sight of a turtle having a straw pulled from its nostril is certainly galvanizing, eNGOs should be aware that empathy has a spotlighting effect that can result in biased and innumerate decision-making (Bloom 2017). As such, individuals and organizations looking for solutions to the biodiversity crisis should be mindful that the specific issues amplified online are potentially consequential to the wider aim of fostering effective environmentalism in the Anthropocene.

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Supporting Information

Principal components analysis and shared followers among eNGO accounts (Appendix S1), eNGO account selection, biodiversity threat categorization, and categorization accuracy (Appendix S2), platform size correction (Appendix S3), time-constrained content analysis (Appendix S4), assessment of NRC sentiment analysis (Appendix S5), combining drivers of habitat loss (Appendix S6), model selection and outputs (Appendix S7), prevalence of positive and negative language among threats (Appendix S8), eNGO mission statements (Appendix S9), and quantifying differences among threat content shares (Appendix S10) are available online. The author is solely responsible for the content and functionality of these materials. Queries (other than absence of the material) should be directed to the author. Underlying data are available in an open-access online repository at <https://zenodo.org/record/3871796#.XtaTajpKiUk>.

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Tables

Table 1 International Union for Conservation of Nature biodiversity threats (Salafsky et al. 2008) ranked by association with the most (1) to the fewest (10) threatened or near-threatened species (Maxwell et al. 2016).

Threat rank	Threat	Subthreat examples
1	overexploitation	logging, poaching and fishing
2	agriculture	crops, livestock and aquaculture
3	urbanization	housing, tourism and industrial development
4	invasions	non-native species and disease
5	pollution	agricultural, domestic, industrial and airborne
(5)	plastic pollution	microplastics, fishing line and straws
6	system modification	fire and dams
7	climate change	habitat modification, drought and heatwaves
8	human disturbance	recreation, work and war
9	transport	roads, shipping lanes and service lines
10	energy production	mining, fossil fuels and renewables
>1 of 1-10	multiple threats	more than one of the categories 1-10

Figures

Figure 1 The (a) share and (b) amplification of original Twitter content produced by leading environmental nongovernmental organizations that relate to specific biodiversity threats (the larger the circle, the greater the content shares).

Figure 2 Word cloud of the most common hashtags used by leading environmental nongovernmental organizations (the larger the font, the more prevalent the hashtags; minimum prevalence for inclusion is 5).

Figure 3 The online amplification of biodiversity threat content produced by leading environmental nongovernmental organizations as a function of degree of negativity (a, c) or positivity (b, d) in that content: (a) and (b) include all uncategorized threat content (more transparent points are farther from the median amplification value at each word count value) and (c) and (d) include the 3 most prevalent threat categories in the data (climate change, overexploitation, and plastic pollution: 74% of all data) (lines are predictions from fitted linear models; shaded areas, 95% CIs; points jittered on the x-axis to aid visualization). Word counts are derived from the National Research Council Canada (NRC) sentiment lexicon (Mohammad & Turney 2010).