

Examining attention given to threats to elephant conservation on social media

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Abstract

Although social media is growing rapidly as a news source, including for disseminating conservation information, studies comparing attention given to differing threats to species on social media are almost non-existent. As the amount of attention given to differing threats can influence what people perceive to be important and impact the formation of environmental policies, it is vital that conservationists understand which issues are being discussed online. Using elephants (*Loxodonta africana*, *Loxodonta cyclotis*, and *Elephas maximus*) as test species, we conducted a content analysis of tweets about elephants posted to Twitter during 2019. According to the global conservation authority, the International Union for Conservation of Nature, the most pressing threats to the conservation of wild elephant populations are habitat loss, human-elephant conflict, and poaching, with the magnitude of each threat differing between the three species of elephants. Our Twitter analysis revealed that these major threats were infrequently discussed, with habitat loss being the most infrequently discussed (<1% of all tweets). Instead, elephant welfare issues, such as tourist elephant rides, were the most frequently discussed topic (23%). Users from non-elephant range countries were the dominant voice on Twitter (72% of tweets with an identifiable location), with these tweets likely to discuss elephant welfare concerns and trophy hunting, which is not a threat to elephant conservation. Conversely, tweets from users from African elephant range countries (14%) were more likely to discuss human-elephant conflict, poaching, and promote elephant tourism. Similarly, users from Asian elephant range countries (13%) were likely to discuss human-elephant conflict and elephant tourism but unlikely to tweet about poaching. Given the relatively low representation of local stakeholders and the limited coverage of key conservation threats, there is a need to ensure that social media discussions do not overly influence decision-makers.

KEYWORDS

content analysis, elephant welfare, habitat loss, human-elephant conflict, online discourse, poaching, sentiment analysis, Twitter

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1 | INTRODUCTION

Human activities on the environment are driving global declines in biodiversity at ever-increasing rates (Tilman et al., 2017). Addressing this crisis requires evidence-based policy commitments targeted at the most damaging anthropogenic activities (Stafford & Jones, 2019). While the International Union for Conservation of Nature (IUCN) has assessed and identified the threats towards more than 37,000 species (IUCN, 2021), making significant progress on tackling these threats has proven difficult. Addressing threats requires not only an understanding of the drivers of threats, but also needs public and political will to take action (Barrios-O'Neill, 2021). Therefore, public interest and support are critical and can be the difference between species recovery or extinction (Kidd et al., 2018).

Public awareness is often a prerequisite in gaining support for conservation initiatives (Papworth et al., 2015). Media coverage of threatened species plays a crucial role in raising awareness and informing the public of the primary challenges facing species. However, according to agenda-setting theory, how the media frames a topic can influence what the public view as the critical issues about a topic and what needs to be done (Feezell, 2018; McCombs & Shaw, 1972). Consequently, if media attention is not focused on the most pressing threats to wildlife, public support may be misdirected towards efforts that have little impact on addressing biodiversity loss (Ford et al., 2021). For example, the current attention afforded to the effect of plastic pollution on marine biodiversity has been highlighted as disproportionate compared with the scale of the threat (Stafford & Jones, 2019). While there is a need to address plastic pollution, the current emphasis on this threat in the media may be detracting from addressing more pressing threats, such as climate change and overfishing (Stafford & Jones, 2019). Monitoring media attention is therefore essential to understand whether the most pressing threats are receiving public attention.

As the popularity of social media has grown, so too has social media's impact on agenda-setting (Su & Borah, 2019). Due to the volume of information social media users receive, repeated exposure to information is required to adopt this information (Gomez-Rodriguez et al., 2014). As a result, topics that frequently occur on a user's platform are likely to be more easily recalled and perceived as more important. Furthermore, repeated exposure to information not only increases the perceived importance of an issue but also makes it more believable (Hasher et al., 1977; Pennycook et al., 2018). An analysis of news content on social media found that exposure to even one fake news post increases perceptions of the truthfulness of subsequent misleading posts (Pennycook

et al., 2018). This is concerning given the growing concerns around the negative impacts of misinformation in conservation (Bergman et al., 2022; Ford et al., 2021; Hart et al., 2020). If there are repeated false claims on social media about the most pressing threats to a species, this may severely impact conservation efforts.

Additionally, debates and discussions on social media can have real-world impacts on policy-makers and conservation (Lunstrum, 2017). Social media has the potential to connect diverse groups of people with conservation that otherwise would not be possible. Tourists using social media to document their holiday experiences help reach a broad range of people leading to increased interest and associated funding (Tsavo Trust, 2019). However, social media can also lead to negative consequences for biodiversity. For example, online discussions of measures to reduce poaching often advocate extreme violence against suspected poachers. Policy-makers may interpret these discussions as endorsing severe punishment and as a result, pursue policies which lead to more harm, particularly towards those living closest to wildlife, who are often least represented in social media conversations (Dickman et al., 2020; Lunstrum, 2017). Therefore, it is vital that policy-makers understand who is leading these discussions and if social media posts are likely to represent people living with wildlife.

This study investigates if social media posts focus on the most pressing threats to the viability of wild elephant populations. We examined elephants as all three species are highly threatened: the African savanna elephant (*Loxodonta africana*) and the Asian elephant (*Elephas maximus*), are considered endangered by the IUCN, while the African forest elephant (*Loxodonta cyclotis*) is classed as critically endangered (Gobush, Edwards, Balfour, et al., 2021; Gobush, Edwards, Maisels, et al., 2021; Williams et al., 2020). Despite the taxonomic split into three species, social media discussions tend to refer simply to "elephants," so we assessed these public conversations about elephants as one grouped taxon. In addition to their endangerment, elephants are flagship species (Verissimo et al., 2011), are highly charismatic (Albert et al., 2018), and receive significant attention and debate over how best to protect them (Biggs et al., 2017). Given these factors, we would expect public knowledge of threats to elephants to be high, and therefore public attention, as reflected by social media, should mirror these threats. To determine attention to threats, we retrieved content related to elephants from Twitter and used this data to explore the following questions:

1. Which topics receive the most attention?
2. Does attention to topics differ by where a user is from?

3. Are events which generated the highest volume of tweets related to the most pressing threats to elephants?

2 | METHODS

2.1 | Data collection

Twitter is a popular “microblogging” site with around 187 million monetizable daily active users worldwide (Statista, 2020), which allows its users to post 280 character messages (140 characters before September 2017) (Twitter, 2020). We chose to focus on Twitter data, rather than other social media platforms, as Twitter aspires to facilitate real-time public conversations (Leetaru, 2015). The public nature of these conversations alleviates some of the privacy concerns when analyzing social media data and Twitter also facilitates research by making all public posts available to academic researchers (Twitter, 2021). The availability of historic data and Twitter’s influence on public policy makes Twitter a popular platform for analysis of online political opinion (Fink et al., 2020). As with all social network sites, Twitter users are not representative of the general population. A study of British social media users found that they are generally younger, better educated, and pay more attention to politics than non-users (Mellon & Prosser, 2017). However, even if not representative, as policy-makers are influenced by popular public opinion on social media, conservationists must engage with social media to understand its impact on environmental policies (Smith et al., 2018).

The data collection took place in February 2021 using Twitter’s Academic Research product track (Twitter, 2021). A query for the term “elephant*” of English language tweets between January 2019 and December 2019 was conducted and a list of tweet ids collected. To gather the associated metadata, these tweet ids were then rehydrated using the desktop version of hydrator (Documenting the Now, 2020).

2.2 | Classification of spam and sentiment of tweets

As the term “elephant*” is very broad, a large number of tweets that did not refer to the animal elephant were collected. These included tweets selling elephant products (elephant necklaces, elephant stuffed toys), popular idioms which include the word elephant (“an elephant never forgets,” “white elephant”), musicians and songs (“Cage The Elephant,” “Elephant Revival”), and users whose screen name included the term elephant but did

not make reference to elephants in their tweet. To identify and remove these non-relevant tweets, we created a supervised machine learning spam filter using the `quanteda` `text.models` package (Benoit et al., 2020) in R (R Core Team, 2019). The `text.models` package includes two algorithms for classification problems (naïve Bayesian and support vector machine) which are well suited to binary classification problems (e.g., spam filtering). As these algorithms are supervised, they require a dataset with manually labeled data that can be used to train a classifier. The algorithm takes this training set and learns which words are associated with each category. The trained algorithm can then predict which class unseen data should be assigned.

To train our spam filter, we manually coded 8940 tweets as either relevant or irrelevant. This manually coded dataset was then split into a training and test set (80/20). These training and test sets were then used to evaluate the accuracy of differing classifiers.

To evaluate the reliability of a classifier, precision, recall, and F1 score are typically used (Powers, 2011). Precision is the ratio of true positives divided by the total number of predicted positives, so a classifier with high precision has a low number of false positives. Recall is the ratio of true positives divided by all observations in the class, so a classifier with high recall will be unlikely to misclassify true observations but may include a higher number of false positives. F1 score is the harmonized mean of precision and recall and therefore takes both false positives and false negatives into account. Depending on the classifier use case, researchers may prioritize one measure over the other. For example, in medicine, recall is likely to be prioritized as classifying a sick patient as healthy (false negative) can have serious implications. Whereas in email spam detection, precision is more important as falsely assigning an email as spam (false positive) may lead a user to miss crucial information. When a balance between precision and recall is required, the F1 score is typically used.

$$\text{Precision} = \frac{\text{True Positives}}{\text{True Positives} + \text{False Positives}}$$

$$\text{Recall} = \frac{\text{True Positives}}{\text{True Positives} + \text{False Negatives}}$$

$$\text{F1} = 2 * \frac{\text{Precision} * \text{Recall}}{\text{Precision} + \text{Recall}}$$

For our spam filter, the naïve Bayesian model had the highest performance with a macro precision of 0.8211, a macro recall of 0.8217, and a macro F1 score of 0.8214. Of the 1,290,762 tweets retrieved from the Twitter API,

782,487 were identified as spam. For a complete list of classifier performance results, see Appendix S1.

To classify the emotional sentiment of each remaining tweet, we utilized a well-regarded sentiment analysis tool, VADER: Valence Aware Dictionary and sEntiment Reasoner (Hutto & Gilbert, 2014), using the R package vader (Roehrick, 2020). This tool has been empirically tested and achieves high accuracy when compared with human coded Twitter data (Hutto & Gilbert, 2014). Where traditional sentiment analysis tools rely solely on a dictionary of words to score a text, vader builds on this by including a context-awareness. A limitation of some sentiment tools is their inability to account for valence-shifters, such as “not” (not good or not bad). Vader not only monitors for valence-shifters but also assesses emoticons, slang, punctuation, and capitalization. For example, the sentence “I LOVE elephants” will be assigned a more positive compound score (0.713) than “I love elephants” (0.637), where scoring ranges from -1 (very negative) to $+1$ (very positive). For this study, we calculated sentiment at the level of an individual tweet and plotted this data with the frequency of tweets to identify the main events in our data.

2.3 | Analysis of a random sample of tweets

A quantitative content analysis of a random sample of tweets was undertaken to understand what was discussed outside of the main events (Cavazos-Rehg et al., 2019). As tweets rarely specified a species of elephant, we examined threats to elephants at the taxonomic level. We defined threats as those which impact the viability of wild elephant populations as identified by the IUCN. From the threats to African and Asian elephants identified by the IUCN Red List (Gobush, Edwards, Balfour, et al., 2021; Gobush, Edwards, Maisels, et al., 2021; Williams et al., 2020), poaching and wildlife trade, human-elephant conflict, and habitat loss are the most pressing threats. Based on these threats and our reading of the sample of tweets, we identified eight topics occurring within our dataset. These topics were “elephant welfare concerns,” “general conservation messages,” “habitat loss,” “human-elephant conflict,” “poaching and wildlife trade,” “tourism,” “trophy hunting and culling,” and “videos and non-conservation news.” As tweets are short messages, we decided that each tweet should only be assigned to a single topic. Where tweets talked about more than one topic, they were assigned to the most salient topic. For example, the tweet “Zimbabwe rips

35 baby elephants from their mothers for export to Chinese zoo” talks about both export (Topic: poaching and wildlife trade) and issues with sending wild elephants to zoos (Topic: elephant welfare concerns). This tweet was assigned to the topic “poaching and wildlife trade” as it was determined that the main message was related to concerns about the impact of trade on wild elephants (See Table 1).

To determine if the tweet topic varied with a user's location, we manually assigned a country code to each tweet based on the user's text description of their location. Users do not always provide this location information or instead provide vague locations, such as Africa or Planet Earth, and therefore where a country location could not be determined, “Unknown” was assigned. The distribution of tweets with known user locations were mapped using QGIS (version 3.8.1 <https://qgis.org/>). Known user locations were then used to assign tweets to African elephant range countries, Asian elephant range countries, or non-elephant range countries based on elephant range data from the IUCN Red List (Gobush, Edwards, Balfour, et al., 2021; Gobush, Edwards, Maisels, et al., 2021; Williams et al., 2020). Chi-squared tests were used to test if there was a difference in attention to topics between users from African elephant range countries, Asian elephant range countries, non-elephant range countries, and users with an unknown location.

In line with recommendations by Di Minin et al. (2021), where example tweets are provided in this article, account details of individuals have been redacted.

3 | RESULTS

There were 508,275 non-spam tweets about elephants in 2019, retweeted 2,484,228 times and favorited 8,048,692 times. These tweets were posted by 270,622 users who had a combined 2,919,206,506 followers, with users on average posting 1.88 tweets in 2019.

3.1 | Topics that received the most attention

From a random sample of tweets, we conducted a manual content analysis of 4749 tweets, of which 1000 were non-relevant tweets missed by our spam filter, leaving 3749 relevant tweets for further analysis.

The number of tweets varied significantly between topics ($X^2_{[7]} = 1074$, $p = <.05$), with only 21% of tweets related directly to the three major threats to wild elephants as identified by the IUCN (Table 2). The most frequently

TABLE 1 Definitions used for the content analysis of tweets and example tweets from each topic

| Topic name | Topic description | Example tweet |
|----------------------------------|---|---|
| Elephant welfare concerns | Focus on the protection of individuals or groups of elephants where the priority is not conservation | Save Betty the Elephant Now! She Desperately Needs Medical Attention! #care2 |
| General conservation messages | General talk of population declines, general conservation news which did not specify any threats to elephants, or elephant facts | #RT @NatGeo: The growth of the elephant population is only part of the encouraging news from Gorongosa— lions, African buffalo, hippos, and wildebeests are all vastly more numerous now than in 1994 |
| Habitat loss | Fragmentation and loss of elephant habitat | Breaking: New Road Construction and #Deforestation for #PalmOil in Critical #Elephant Corridor in #LeuserEcosystem via @RAN |
| Human-elephant conflict | Elephant attacks on people, crop damage, solutions to human-elephant conflict and elephants accidentally killed (road deaths, etc.) | A MAN KILLED IN A WILD ELEPHANT ATTACK |
| Poaching and wildlife trade | Poaching and legal/illegal wildlife trade | Stop poaching Elephants. Botswana elephant poaching “no hoax” |
| Tourism | The promotion of elephants as a tourism attraction or the sharing of positive videos or photos taken during a tourism experience | The Serengeti Trail & Tarangire Safaris Tanzania and witness the elephants and centuries-old baobab trees of Tarangire, travel the endless plains of the world-famous Serengeti, search for the elusive Big 5 in the... |
| Trophy hunting and culling | Legal killing of elephants for trophies or population control | Mokgweetsi Masisi: GET BOTSWANA TO REINSTATE THE BAN ON ELEPHANT HUNTING! - Sign the Petition! via @UKChange |
| Videos and non-conservation news | Sharing cute videos or non-conservation related news | This baby elephant looks like he's rolling around in a big bowl of soup! |

TABLE 2 Number of tweets and retweets, mean sentiment, and the number of followers for each topic

| Topic | Number of tweets and proportion of the sample | Number of retweets | Mean sentiment | Topic follower count |
|----------------------------------|---|--------------------|----------------|----------------------|
| Elephant welfare concerns | 863 (23%) | 16,259 | -0.093 | 16,752,370 |
| General conservation messages | 708 (19%) | 3154 | 0.092 | 95,319,405 |
| Videos and non-conservation news | 654 (17%) | 3648 | 0.334 | 33,064,524 |
| Poaching and wildlife trade | 488 (13%) | 2697 | -0.202 | 7,008,624 |
| Trophy hunting and culling | 386 (10%) | 2347 | -0.304 | 3,951,699 |
| Tourism | 356 (9%) | 526 | 0.306 | 58,803,405 |
| Human-elephant conflict | 268 (7%) | 708 | -0.264 | 50,555,077 |
| Habitat loss | 26 (<1%) | 133 | -0.035 | 264,608 |
| Total/mean | 3749 | 29,472 | -0.021 | 265,719,710 |

discussed topics were elephant welfare concerns (23%), general conservation messages (19%), and videos and non-conservation news (17%). Of the topics directly related to the major threats to wild elephants, the most frequently discussed was poaching and wildlife trade (13%), followed

by human-elephant conflict (7%) and habitat loss (<1%). Furthermore, regarding topics which are not considered conservation threats to elephants, trophy hunting and culling (10%), and tourism (9%) had moderate tweet frequencies.

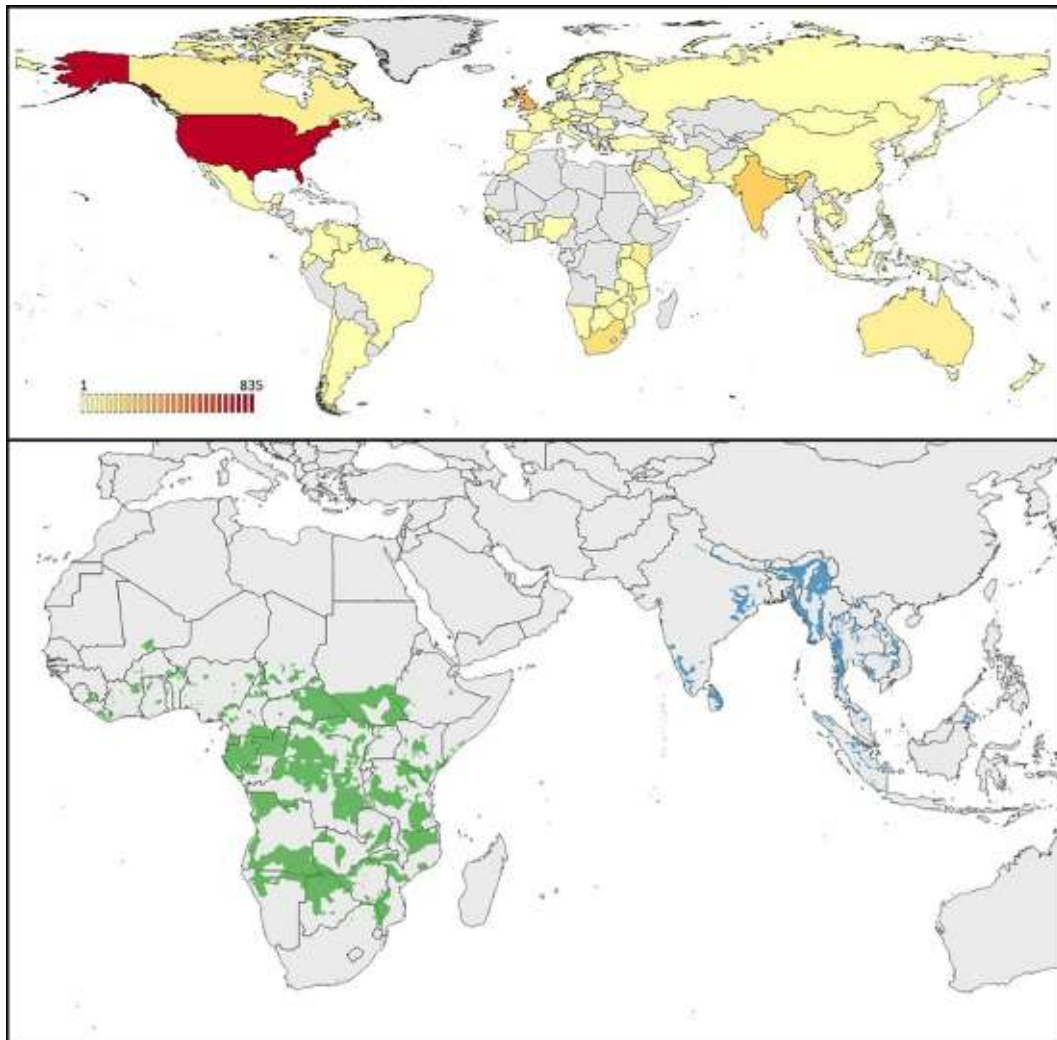


FIGURE 1 (Above) Distribution of sample tweets sent by users from 83 countries. (Below) Distribution of elephants across Africa (green) and Asia (blue)

3.2 | The relationship between a user's location and interest in topics

Tweets in our random sample were posted by 3291 users from 83 countries (Figure 1), with a significant difference in tweet frequencies depending on users' location ($X^2_{[3]} = 1698, p = <.05$). Tweets were most likely to be sent by users from non-elephant range countries ($n = 1599, 43\%$ of sample tweets), followed by users from unknown locations ($n = 1536, 41\%$), African elephant range countries ($n = 317, 8\%$), and Asian elephant range countries ($n = 297, 8\%$). This means that of 2213 tweets with a known location, nearly three-quarters (72%) came from non-elephant range countries, while 14% came from African elephant range countries and 13% from Asian elephant range countries. Of the 36 African elephant range countries, tweets came from 15 of them, with South Africa ($n = 124, 39\%$ of African range tweets) and

Kenya ($n = 83, 26\%$) the most active. In comparison, users sent tweets from 11 of the 13 Asian elephant range countries, with India accounting for the vast majority of these tweets ($n = 211, 71\%$ of Asian range tweets).

Despite the significance of habitat loss as a threat to elephants, due to the very low number of tweets related to this threat, tweets categorized in this topic were removed to allow for Chi-squared testing ($N = 26$). Chi-squared testing indicated that there was a significant association between the location of a user and the topic tweeted ($X^2_{[18]} = 349, p \leq .05$) (Figure 2). Users from non-elephant range countries were the most likely to tweet about elephant welfare concerns (26% of non-elephant range tweets) and the least likely to tweet about human-elephant conflict (5%). While just 12% of non-elephant range tweets were about trophy hunting and culling, this accounted for 51% of all tweets on this topic, resulting in users from non-elephant range countries

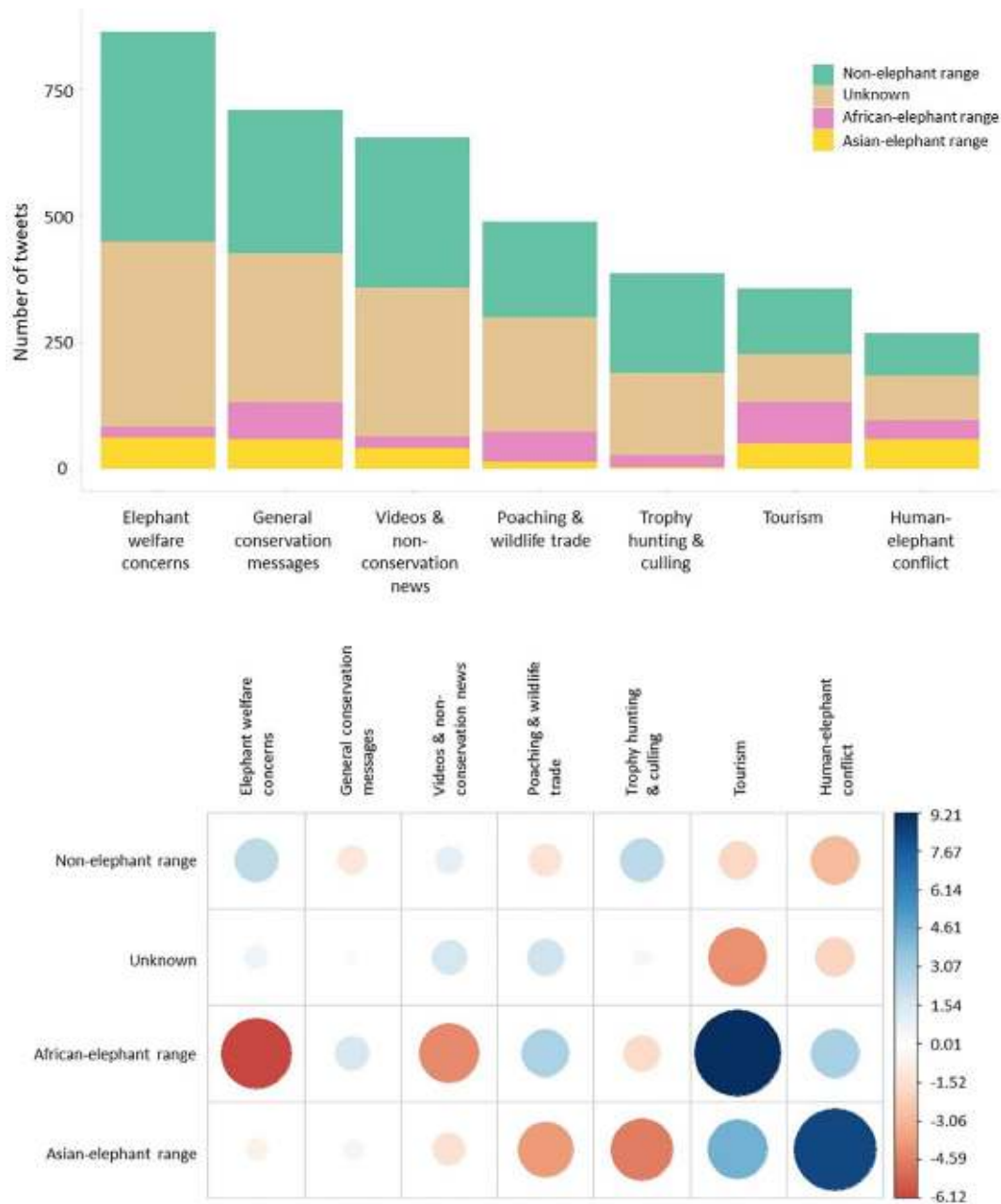


FIGURE 2 (Above) Bar plot with the share of manually coded topics by user location. (Below) visualization of Pearson residuals using the package corrplot in R, where positive correlations are displayed in blue and negative in red. The size of the circle and color intensity is proportional to the correlation coefficients. The topic “habitat loss” was removed from correlation analysis due to insufficient sample size

being the most likely to tweet about trophy hunting. Users from Asian elephant range countries, on the other hand, were the least likely to tweet about trophy hunting (1% of Asian elephant range tweets) and poaching and wildlife trade (5%). Instead, users from Asian elephant range countries frequently tweeted about elephant welfare concerns (21%), human-elephant conflict (20%), general conservation messages (20%), and tourism (18%). Similarly, users from African elephant range countries frequently discussed tourism (26% of African

elephant range tweets), general conservation messages (23%), and human-elephant conflict (12%). However, unlike users from Asian elephant range countries, users from African elephant range countries were very unlikely to tweet about elephant welfare concerns (7%). Users from African elephant range countries were also more likely to tweet about poaching and wildlife trade than users from Asian elephant range countries (19% of African elephant range tweets vs. 5% of Asian elephant range tweets).

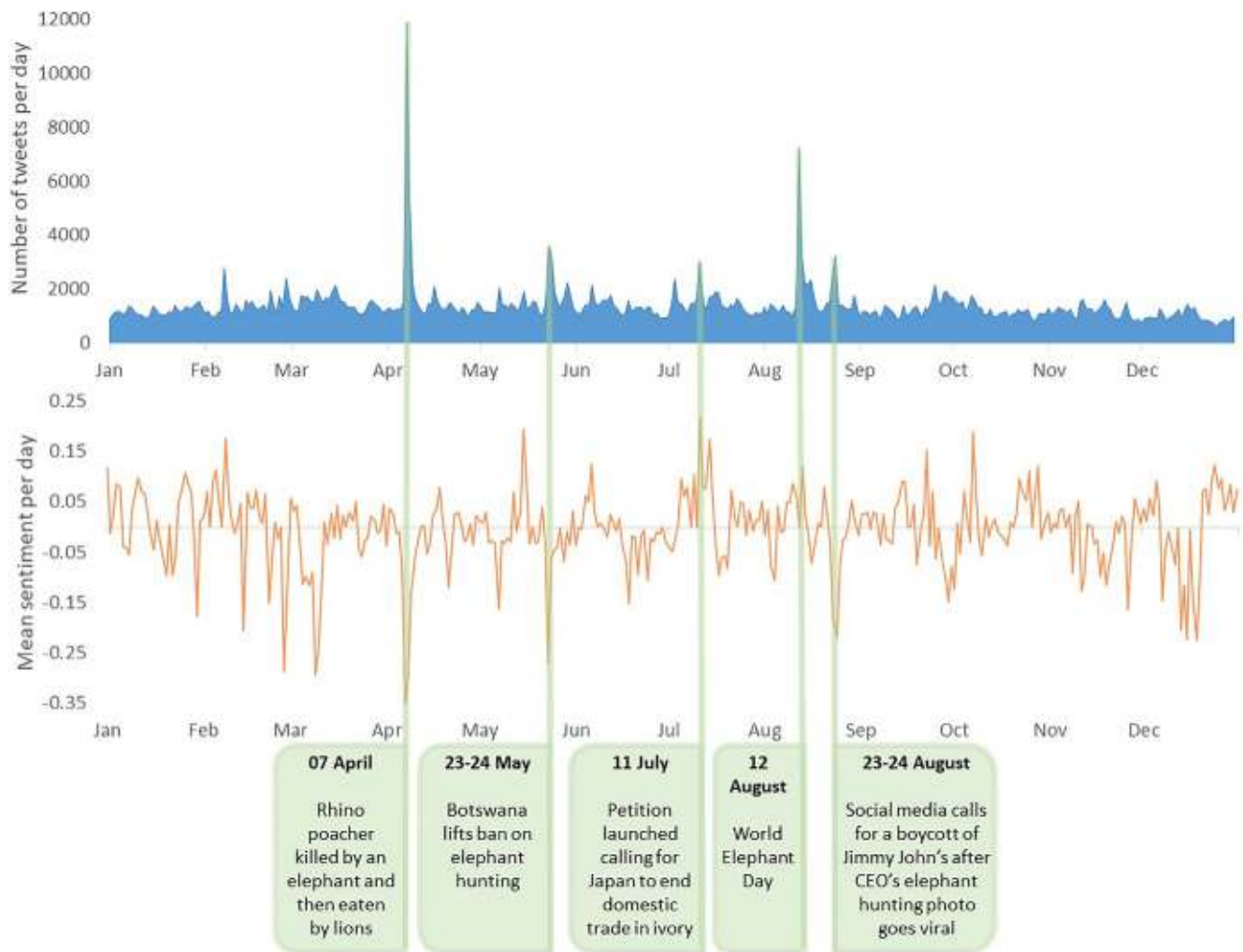


FIGURE 3 Daily variation in Twitter activity related to elephants in 2019, the mean daily sentiment score, and the events associated with the five highest peaks in Twitter volume. Data were retrieved from the Twitter academic research product track API in February '21. The sentiment analysis was calculated using the R package vader. This package detects the sentiment of a text by assigning positive or negative values to words based on their appearance in a dictionary of sentiment-related words

3.3 | Events that generated the most interest

The variation in the volume of tweets over time is illustrated in Figure 3. The daily tweet volume ranged from 599 to 11,902 tweets per day (mean = 1393), with a neutral sentiment (-0.01 ± 0.076) overall. The largest daily peak (11,902 tweets) and the lowest mean daily sentiment score (-0.358) occurred on 7 April in response to media reports of a suspected poacher killed by elephants and eaten by lions. Rather than the sentiment corresponding to sympathy for the loss of life, the most popular hashtag on the day was “#karma,” with users expressing that this was a fair outcome for the suspected poacher. On 23 May, Botswana announced the lifting of their suspension on elephant hunting, leading to a largely negative reaction (mean daily sentiment: -0.268).

On 11 July, a petition calling for an end to the legal trade in ivory in Japan was launched. Tweets sharing this petition called on Japan to implement a ban before Tokyo's Olympics. The second highest peak coincided with World Elephant Day on 12 August, with #worldelephantday the overriding hashtag. On 23 August, the hashtag #boycott-jimmyjohns was trending after a photo of the company's CEO next to a trophy hunted elephant resurfaced.

The popularity of these events was evident in the most frequently used terms (See Appendix S3). The fifth most popular term was “lion” due to the death of the South African poacher. “Botswana” and “hunt” were the 12th and 13th most frequent terms due to the news that Botswana planned to reintroduce trophy hunting. However, the third most frequent term, “baby elephant,” was not related to the major peaks in interest. Instead, this term was generally used to share cute videos of baby

elephants, tweets highlighting the poor conditions in zoos, and tweets campaigning to end the sale of wild elephants to zoos in China. This campaign was also evident in the most popular hashtags, with #zimbabweelephants and #zimwildtrade the two most popular hashtags in 2019. The most frequent terms also highlighted Twitter users' interest in sharing petitions. "Sign" and "petition" were the 4th and 9th most frequent terms, demonstrating Twitter users' eagerness to be active in helping elephants.

Although tweets related to elephant welfare were the most frequent overall, no single elephant welfare event registered in the top five highest peaks in interest. Instead, events related to the topics "poaching and wildlife trade" and "trophy hunting and culling" led to peaks in interest, with four of the five highest peaks related to these two topics. This highlights the importance of examining the Twitter discourse outside of peak events, as events in 2019 would have indicated that trophy hunting, poaching, and wildlife trade are the most frequently discussed topics.

4 | DISCUSSION

This study examined the Twitter discourse related to elephants to understand if the most pressing threats to the viability of populations of wild elephants receive the most attention. Our results reveal that the major threats towards elephants were rarely discussed, with habitat loss—a primary threat—the most infrequently discussed topic. Although the threats to elephants were seldom discussed, this varied significantly by users' location, with users from elephant range countries more likely to tweet about human-elephant conflict than users from non-elephant range countries. As the volume of tweets from elephant range countries was less than half that of non-elephant range countries, issues prominent in discussions by users from elephant range countries are often lost in the overall volume of tweets. While the major threats were rarely discussed overall, when they were, then poaching and wildlife trade was the most frequently discussed threat. However, reactions to the death of a poacher highlighted a growing issue on social media where users often demand extreme violence be taken against poachers (Büscher, 2016; Lunstrum, 2017). These findings indicate that policy-makers need caution when considering how to engage with social media and make policy decisions regarding contested issues, as the most pressing threats are rarely discussed online, and the views of local stakeholders are likely to be underrepresented.

The finding that the most pressing threats do not receive the most attention is concerning given that the

amount of attention given to different issues can influence the policymaking agenda (Feezell, 2018). While the IUCN does not list either trophy hunting or culling as threats to the viability of wild elephant populations, we found that they were often portrayed as such on Twitter and garnered more attention than human-elephant conflict and habitat loss combined. This attention has helped push trophy hunting, in particular, onto the political agenda in many countries (Macdonald et al., 2016). In the UK and US, there are ongoing parliamentary debates on banning the import of trophies (California Legislature, 2020; UK Parliament, 2020); however, to our knowledge, there are currently no similar debates on how to tackle habitat loss or human-wildlife conflict. While Twitter users may have valid concerns about the morality and ethics of trophy hunting as a tool for elephant conservation, the framing of trophy hunting as a threat to the viability of wild elephant populations is misleading and may be consuming time and resources which could otherwise be allocated towards addressing IUCN listed threats.

These results highlight the need for conservationists to examine how to improve communication on social media to refocus attention towards the major threats. Barrios-O'Neill (2021) examined posts of environmental Non-Governmental Organisations (NGOs) on Twitter, finding that environmental NGOs are not giving sufficient attention to the most pressing threats. Aligning NGOs communication strategies towards the major threats may therefore provide a practical first step towards addressing the mismatch in attention on social media. The results also demonstrate that policy-makers should be alert to the risks of being swayed by social media campaigns, given the low correlation between social media attention and major conservation threats, and the relative dominance of external voices over those living in elephant range countries. Indeed, in line with Brackzowski et al. (2018) and Fink et al. (2020), we found that users from non-range countries dominate the Twitter discourse on species conservation. This may partly be explained by this study's focus on Twitter and English language tweets. Other platforms and languages may have better representation; however, users' location was significantly associated with differences in attention. While all users very infrequently discussed habitat loss, interest from users from elephant range countries more closely reflected threats and issues with elephants from their geographic area.

While there were differences in interest between users from African and Asian elephant range countries, human-elephant conflict was one area that was important for both; however, it received little attention from users from non-elephant range countries. A lack of awareness of the impacts of human-elephant conflict has

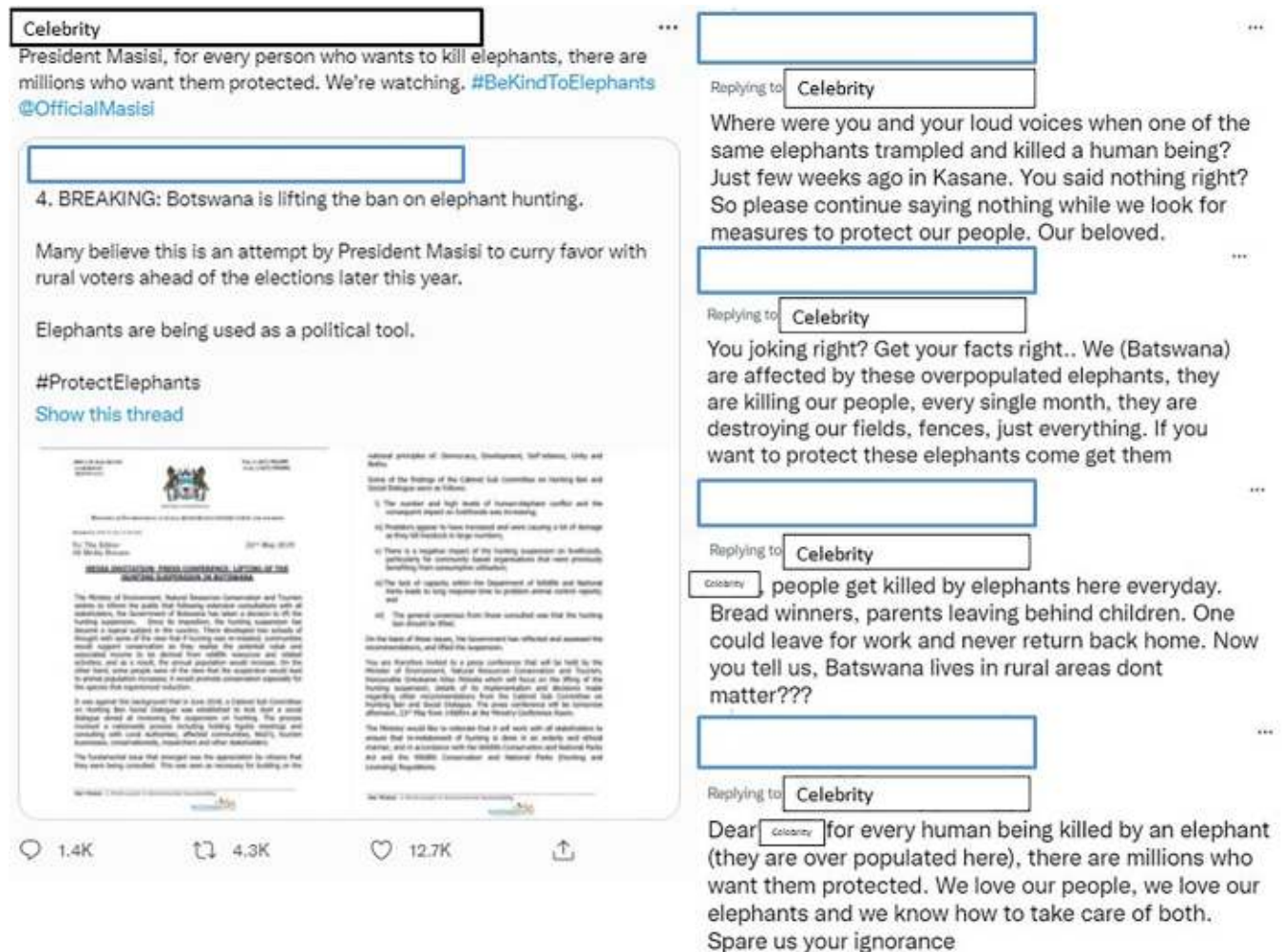


FIGURE 4 On the left is a tweet sent by a north American celebrity who was critical of the lifting of Botswana's trophy hunting ban in 2019 and on the right are example replies to this celebrity tweet from Batswana users. Batswana users were often critical of the focus on trophy hunting and not the dangers people face when living with elephants. Usernames of non-verified accounts have been removed

led to criticism from users from elephant range countries that people who do not live with elephants care more about wildlife than local communities do. Mkono (2019) examined African social media users' reactions to trophy hunting and found that 80% of posters criticized western societies for caring more for wildlife than African people. Similar sentiments were found within our dataset, particularly with tweets concerning Botswana's reinstatement of trophy hunting. Many users from Botswana expressed frustration with the focus on trophy hunting rather than the impacts of elephants on people (Figure 4). This lack of attention for human-elephant conflict by users from non-elephant range countries may stem from a lack of awareness and understanding of the realities of living with elephants, demonstrating the need for local realities to become more central in the discourse.

The death of a suspected poacher killed by elephants and eaten by lions (BBC, 2019) was the most discussed

event among our analyzed tweets. The discourse surrounding this event highlighted a worrying trend on social media where extreme violence towards poachers is routinely endorsed (Büscher, 2016; Lunstrum, 2017). Poachers are often portrayed as less than human, with no right to life or due process, and therefore extreme violence in response to poaching is reasonable (Dickman et al., 2020; Lunstrum, 2017). The death of this suspected poacher was no different, with comments suggesting that poachers are worthless and wishing that more poachers could have died (Figure 5). This sentiment is at odds with the rights afforded to suspected criminals in the countries of many Twitter users. For instance, the European Convention on Human Rights (Council of Europe, 2002) prohibits capital punishment. Yet, European social media users frequently advocate for a shoot-on-sight policy that advocates for the death penalty without a trial (Figure 5). This mismatch between the rights of Europeans and



FIGURE 5 Example tweets sent in response to news that elephants had killed a suspected poacher. Reaction to this news story was largely celebratory and often advocated extreme violence against alleged poachers. Usernames of non-verified accounts have been removed

suspected poachers is likely to reinforce the view that the lives of wildlife matter more than those of local people. The conservation community should call out and challenge dehumanizing narratives of poachers; otherwise, extreme violence will be perceived as a credible response to poaching and may alienate local communities from conservation (Dickman et al., 2020).

As our focus was on Twitter and English language tweets, this undoubtedly led to some limitations. The distribution of tweets highlights this language bias, with the majority of tweets coming from countries with higher levels of English proficiency. When this is taken into account with other biases, such as differences in access to the internet and the general demographic bias of Twitter users, it highlights the need for caution when social media is used to inform conservation policies. The views of people most affected by these policies are unlikely to be adequately represented on social media. Additionally, this research focused only on elephants in 1 year. It is possible that attention may differ significantly from year to year and that online discussions of other species may more accurately represent threats to those species. Future research examining how attention to threats differs between platforms (e.g., Twitter, YouTube, Facebook), languages, timeframes, and species would provide useful insights.

Although much of this article focused on the challenges associated with social media for elephant conservation, social media can be instrumental in generating

support for conservation initiatives (Bergman et al., 2022). Our data highlighted that a large number of social media users are motivated and willing to advocate for the protection of elephants; however, suitably harnessing this potential requires shifting the focus on social media towards the major threats to elephant conservation. NGOs with a large number of followers can play a vital role in disseminating information on threats to wild elephants by ensuring their social media campaigns closely align with the most pressing threats. Similarly social media companies can facilitate the dissemination of this information through the use of auto-generated messages. For example, Instagram provides auto-generated messages to educate users on the negative impacts of selfies with wild animals (Bergman et al., 2022). Similar auto-generated messages could be provided to remind the public of the realities of coexisting with elephants and the impact of dehumanizing narratives around poaching. Researchers could experimentally test the impacts of these messages to ensure they have a positive effect. NGOs and academics must also engage with policy-makers to ensure that policies aimed at addressing threats to the viability of wild elephant populations are not overly influenced by dominant voices on social media. They must also ensure that these policies address both the threats to elephants and concerns of local people, as resentment from users from range countries will continue to grow if the challenges faced by people living with wildlife continue to be overshadowed by users from non-range countries.

AUTHOR CONTRIBUTIONS

All authors conceived and designed the research. Niall L. Hammond collected and analyzed the data and wrote the initial draft. Amy Dickman and Duan Biggs provided significant feedback and revisions.

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CONFLICT OF INTEREST

The authors have no conflict of interest to declare.

DATA AVAILABILITY STATEMENT

Due to restrictions on sharing Twitter data, the full dataset cannot be distributed to third parties. However, a dataset containing only tweet IDs and columns curated by the authors may be accessible by request.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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