

Accepted Manuscript

Title: Tweeting for their lives: Visibility of threatened species on Twitter

Authors: Lindall R. Kidd, Emily A. Gregg, Sarah A. Bekessy, Jenny A. Robinson, Georgia E. Garrard



PII: S1617-1381(18)30118-3
DOI: <https://doi.org/10.1016/j.jnc.2018.10.001>
Reference: JNC 25667

To appear in:

Received date: 2-4-2018
Revised date: 19-9-2018
Accepted date: 6-10-2018

Please cite this article as: Kidd LR, Gregg EA, Bekessy SA, Robinson JA, Garrard GE, Tweeting for their lives: Visibility of threatened species on Twitter, *Journal for Nature Conservation* (2018), <https://doi.org/10.1016/j.jnc.2018.10.001>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

For consideration as a short communication: Journal for Nature Conservation

Tweeting for their lives: visibility of threatened species on Twitter

Lindall R. Kidd*¹, Emily A. Gregg¹, Sarah A. Bekessy¹, Jenny A. Robinson² & Georgia E. Garrard¹

¹*ICON Science, School of Global, Urban and Social Studies, RMIT University, Vic 3000 Australia*

²*School of Media and Communication, RMIT University, Vic 3000 Australia*

* Correspondence to Lindall.kidd@gmail.com

'Declarations of interest: none'

ABSTRACT

Unpopular and uncharismatic species receive less conservation support, potentially impacting their long-term survival. This study assesses the attention directed towards Australian threatened species on the online social network Twitter, an increasingly common way for scientists and the general public to communicate about conservation. We find a difference in how often Twitter users mention (i.e. "tweet") threatened species across different taxa and find that many threatened species are not mentioned at all. As expected, mammals and birds

receive the most tweets, with invertebrates and frogs receiving less attention. Threatened species with recovery plans are more likely to be tweeted about than those without. Alarming, the majority of threatened species receive little interest on Twitter, indicating the public profile of these species is low. We identify five traits shared by popular threatened species on Twitter and suggest understanding these commonalities can inform conservation education and marketing campaigns aiming to raise the profile of less popular threatened species.

Keywords: threatened species, Twitter, popularity, public engagement, social media, conservation marketing

INTRODUCTION

For threatened species, popularity and public interest can mean the difference between extinction and recovery (Czech et al. 1998). While there is a wealth of literature about the popularity of threatened species (e.g. Clucas et al. 2008; Veríssimo et al. 2008; Jepson & Baura 2015; Colléony et al. 2017), little information exists about popularity on social media. A single study has investigated the popularity of threatened species on social media, and this focused solely on mammals and birds (Roberge 2014) which are known to receive disproportionately high conservation attention (Clark and May 2002). Social media has created new possibilities for quantifying people's preferences and measuring relative public interest (Kumar et al. 2014) and has begun to be used in conservation biology (Di Minin et al. 2015). In particular, Twitter has been recognized as a powerful tool to deliver conservation messages to wide audiences (Parsons et al. 2014). For example, Twitter is widely used by many environmental NGOs, students, academics, scientific journals and organizations, the general public, and journalists (Darling et al. 2013). As such, an understanding of what makes a threatened species popular on Twitter has important implications for conservation. Here, we quantify the level of public attention on Twitter for threatened fauna listed under the Australian Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). Australia has an alarmingly high rate of extinction and a lack of public interest has contributed to two recent extinctions (Woinarski et

al. 2017). Understanding what drives popularity on Twitter will provide an important baseline for what to focus on when engaging audiences on social media.

DATA COLLECTION

Twitter is a dominant online social network and is growing in importance as an information source for scientific research and public engagement (Signorini et al. 2011; Malleson & Andresen 2015; Papworth et al. 2015). We quantified how often threatened species listed under the EPBC Act were mentioned within public posts from 2008 (the beginning of the Twitter public search query) to September 5th, 2017. The EPBC Act is the Australian Government's central piece of environmental legislation and lists nationally threatened species. For every EPBC-listed threatened and extinct fauna species, we collected information on taxonomic group, threat status, and applicable recovery plans (Commonwealth of Australia 2017). We considered a species to have a recovery plan if they were covered by single species, multi-species, ecological community or regional plans at the State or Federal level. We included sub-species and distinct geographic populations, with a total of 496 species from multiple taxa.

We used the Twitter search query utility (<http://search.twitter.com>) to collate lists of all posts (known as 'tweets') mentioning each species listed under the EPBC Act. The search was limited to individual tweets and did not include retweets. We employed a manual search rather than using Twitter's application programming interface (API), because 1) the publicly available API only allowed searches of the last 7 days; 2) this method allowed us to scrutinize every tweet and exclude those which did not refer directly to the animal (e.g. metaphors or place names); and 3) we could quantify species and subspecies separately. We collated a total of 62,275 tweets. We searched common names of species listed in EPBC Act. For popular species, we stopped counting once we reached 1000 tweets and included these species as >1000 in our data set ($n=31$). For this subset of highly-tweeted species, we identified potential drivers of popularity based on a broad qualitative analysis of tweet content.

RESULTS

Most species (57%) had fewer than 20 tweets (Figure 1). 15% of species had never been tweeted about (Figure 1); of these, 35% were invertebrates. Only 6% of species had over 1000 tweets, with mammals representing 39% of these. There was significant variation in the number of tweets across taxa, with frogs and invertebrates receiving substantially fewer tweets on average than other taxa (Figure 2a). We found no difference in tweet number between extant threat categories, although extinct species had considerably fewer tweets on average than extant threatened species (Figure 2b).

In addition to taxonomic group, a number of factors influenced how often a species was tweeted about. Species with recovery plans (42% of listed threatened species) had more tweets on average (mean = 187, SE = 21.42) than those without (mean = 95, SE = 15.34) (Figure S1). Subspecies (8% of species listed) received little attention from Twitter users. The average number of tweets about a subspecies was 20 (SE = 4.69), compared to an average of 170 (SE = 16.12) tweets for taxonomically distinct species.

Qualitative analysis of tweets about species with more than 1000 tweets revealed additional potential drivers of popularity, including having an extraordinary or charismatic physical characteristic, being the focus of a high-profile conservation campaign, or being a so-called 'Lazarus' species (Table 1).

DISCUSSION

We present the most comprehensive search for mentions of threatened species on social media to date. Our results highlight that many of Australia's threatened animal species are receiving little or no attention on Twitter. More than half of Australia's threatened species have been tweeted about fewer than 20 times in a decade. Given that a lack of public interest was highlighted as a key factor contributing to the recent extinction of two Australian species

(Woinarski et al. 2017), our findings could indicate a key risk factor for the conservation of Australia's threatened fauna.

A central finding of our study is that threatened species with recovery plans are tweeted about more frequently than those without, indicating that government planning and commitment to species recovery may be important for raising the profile of threatened species on social media. However, it is difficult to determine whether a species receives interest on Twitter because it has a recovery plan, or because it is charismatic to begin with. Threatened species lists are biased towards charismatic species (Farrier et al. 2007) and similar taxonomic biases occur for species receiving recovery plans (Taylor et al. 2005). In Australia, fish, reptiles and invertebrates are under-represented in the recovery planning process (Walsh et al. 2013).

A recovery plan can increase the public profile of a species by attracting a dedicated network of volunteers, researchers and scientists to implement conservation (Cox 2018). In Australia, a 'species champion' is an important component of threatened species recovery, and a recovery plan is known to create the conditions under which species' champions emerge (Garnett et al. 2018). Our results support this; the most popular threatened species on Twitter have their own species champion and are often the focus of an ongoing conservation campaign. These species are more likely to appear in media related tweets and many have a Twitter account in their name (Table 1).

Our results confirm that the popularity of threatened species on Twitter align with known taxonomic preferences. For instance, birds and mammals receive more conservation attention than other taxonomic groups, such as invertebrates (Metrick & Weitzman 1996; Clark & May 2002; Clucas et al. 2008). Indeed, we found that frogs and invertebrates receive fewer tweets than mammals and birds. Similarly, we found that threat status did not substantially influence how often a species was tweeted about, in agreement with other studies showing little effect of threat status on popularity (see Czech et al. 1998; Roberge 2014).

Some guidance about how to enhance a species' popularity on social media can be drawn from our study. Our findings suggest that important events such as the rediscovery of a species believed to be extinct, or particular physical or behavioural characteristics of some species may be leveraged to increase popularity on social media. For example, the Mary River Turtle's green algae Mohawk was the focus of many tweets, and the Quokka has become popular due to a recent trend of 'selfie' photography with the animal, which appears to smile for the camera. Identifying interesting traits and popularity trends is an important area of future research that may have important implications for marketing and fundraising for threatened species (Smith et al. 2010).

As with all data extracted from online social networks, our data presents some limitations (see Tufekci 2014 for a comprehensive list). Challenges of using social media data for conservation include geographic and content biases, self-selecting users, and ethical concerns (Di Minin et al. 2015). We did not collect data on the Twitter users themselves, but previous studies have shown that Ornithological Societies, Research Institutes and individual researchers can generate attention on Twitter (Dudley & Smart 2016), and Twitter may provide a useful platform for species champions to raise awareness about their subjects. Future research also could investigate the popularity of individual tweets (likes) and their community network reach, and how this links to the media (Wu et al. 2018).

In this short communication, we do not claim to present a comprehensive analysis of people's preferences towards Australian threatened species. Rather, we hope to raise awareness of the attention—or lack thereof—that some threatened species receive on social media, and to highlight factors that may be leveraged to increase the profile of threatened species on these forums. In particular, finding or becoming a species champion, or seizing opportunities associated with charismatic appearance or behaviour, or cultural or commercial affiliations, may be effective. Dedicated effort to raise the profile of threatened species on social media

may help to reduce extinction risk for some species, however this should be paired with additional research to establish clear causal links between social media activity and conservation success or extinction risk. With the increasing popularity of citizen science and online networks, a range of social media platforms provide different opportunities to boost the popularity of threatened species (Hausmann et al. 2018; Tenkanen et al. 2017; Wu et al. 2018). Twitter is a powerful way to engage people in conservation (Darling et al. 2013) and presents exciting potential for increasing the profile of threatened species.

ACKNOWLEDGEMENTS

This research was conducted with funding support from the Australian Government's National Environmental Research Program Threatened Species Recovery Hub and the Australian Research Council (ARC) Centre of Excellence for Environmental Decisions. S.B. is funded by an ARC Future Fellowship. We would also like to thank Dr. Jenny Martin for comments on an earlier draft.

REFERENCES

- Aslin, H. J., & Bennett, D. H. (2000). Wildlife and world views: Australian attitudes toward wildlife. *Human Dimensions of Wildlife*, 5(2), 15-35.
- Clark, J. A., & May, R. M. (2002). Taxonomic bias in conservation research. *Science*, 297(5579), 191-192.
- Clucas, B., McHugh, K., & Caro, T. (2008). Flagship species on covers of US conservation and nature magazines. *Biodiversity and conservation*, 17(6), 1517.
- Commonwealth of Australia (2017) *Species Profiles and Threats Database*. Department of the Environment, Water, Heritage and the Arts, Canberra, Australia. [Http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl](http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl) [accessed 17 September 2017].
- Colléony, A., Clayton, S., Couvet, D., Saint Jalme, M., & Prévot, A.-C. (2017). Human preferences for species conservation: Animal charisma trumps endangered status. *Biological Conservation*, 206, 263-269.
- Cox. (2018). Fantasy documents recovery plans failing Australia's endangered species. *The Guardian*. <https://www.theguardian.com/environment/2018/feb/20/fantasy-documents-recovery-plans-failing-australias-endangered-species> [accessed 10 March 2018].
- Czech, B., Krausman, P. R., & Borkhataria, R. (1998). Social construction, political power, and the allocation of benefits to endangered species. *Conservation Biology*, 12(5), 1103-1112.
- Darling, E. S., Shiffman, D., Côté, I. M., & Drew, J. A. (2013). The role of Twitter in the life cycle

- of a scientific publication. *arXiv preprint arXiv:1305.0435*.
- Di Minin, E., Tenkanen, H., & Toivonen, T. (2015). Prospects and challenges for social media data in conservation science. *Frontiers in Environmental Science*, 3(63).
doi:10.3389/fenvs.2015.00063
- Dudley, S., & Smart, J. (2016). How social are ornithologists? *Ibis*, 158(4), 894-898.
- Farrier, D., Whelan, R., & Mooney, C. (2007). Threatened species listing as a trigger for conservation action. *Environmental Science & Policy*, 10(3), 219-229.
- Garnett, S., Woinarski, J., Lindenmayer, D., & Latch, P. (2018). *Recovering Australian threatened species: a book of hope*: CSIRO PUBLISHING.
- Hausmann, A., Toivonen, T., Slotow, R., Tenkanen, H., Moilanen, A., Heikinheimo, V., & Di Minin, E. (2018). Social Media Data Can Be Used to Understand Tourists' Preferences for Nature-Based Experiences in Protected Areas. *Conservation Letters*, 11(1), e12343.
- Jepson, P., & Barua, M. (2015). A theory of flagship species action. *Conservation and Society*, 13(1), 95.
- Kumar, S., Morstatter, F., & Liu, H. (2014). *Twitter data analytics*: Springer.
- Malleson, N., & Andresen, M. A. (2015). The impact of using social media data in crime rate calculations: shifting hot spots and changing spatial patterns. *Cartography and Geographic Information Science*, 42(2), 112-121.
- Metrick, A., & Weitzman, M. L. (1996). Patterns of behavior in endangered species preservation. *Land Economics*, 1-16.
- Papworth, S., Nghiem, T., Chimalakonda, D., Posa, M., Wijedasa, L., Bickford, D., & Carrasco, L. (2015). Quantifying the role of online news in linking conservation research to Facebook and Twitter. *Conservation Biology*, 29(3), 825-833.
- Parsons, E., Shiffman, D. S., Darling, E. S., Spillman, N., & Wright, A. J. (2014). How twitter literacy can benefit conservation scientists. *Conservation Biology*, 28(2), 299-301.
- Roberge, J. M. (2014). Using data from online social networks in conservation science: which species engage people the most on Twitter? *Biodiversity and conservation*, 23(3), 715-726.
- Signorini, A., Segre, A. M., & Polgreen, P. M. (2011). The use of Twitter to track levels of disease activity and public concern in the US during the influenza A H1N1 pandemic. *PloS one*, 6(5), e19467.
- Smith, R. J., Veréssimo, D., & MacMillan, D. C. (2010). *Marketing and conservation: how to lose friends and influence people*: Wiley-Blackwell.
- Taylor, M. F., Suckling, K. F., & Rachlinski, J. J. (2005). The effectiveness of the Endangered Species Act: a quantitative analysis. *BioScience*, 55(4), 360-367.
- Tenkanen, H., Di Minin, E., Heikinheimo, V., Hausmann, A., Herbst, M., Kajala, L., & Toivonen, T. (2017). Instagram, Flickr, or Twitter: Assessing the usability of social media data for visitor monitoring in protected areas. *Scientific reports*, 7(1), 17615.
- Tufekci, Z. (2014). Big Questions for Social Media Big Data: Representativeness, Validity and Other Methodological Pitfalls. *ICWSM*, 14, 505-514.
- Veréssimo, D., Fraser, I., Girão, W., Campos, A. A., Smith, R. J., & MacMillan, D. C. (2014). Evaluating conservation flagships and flagship fleets. *Conservation Letters*, 7(3), 263-270.
- Walsh, J. C., Watson, J. E., Bottrill, M. C., Joseph, L. N., & Possingham, H. P. (2013). Trends and biases in the listing and recovery planning for threatened species: an Australian case

study. *Oryx*, 47(1), 134-143.

Woinarski, J. C., Garnett, S. T., Legge, S. M., & Lindenmayer, D. B. (2017). The contribution of policy, law, management, research, and advocacy failings to the recent extinctions of three Australian vertebrate species. *Conservation Biology*, 31(1), 13-23.

Wu, Y., Xie, L., Huang, S.-L., Li, P., Yuan, Z., & Liu, W. (2018). Using social media to strengthen public awareness of wildlife conservation. *Ocean & Coastal Management*, 153, 76-83.

TABLES AND FIGURES

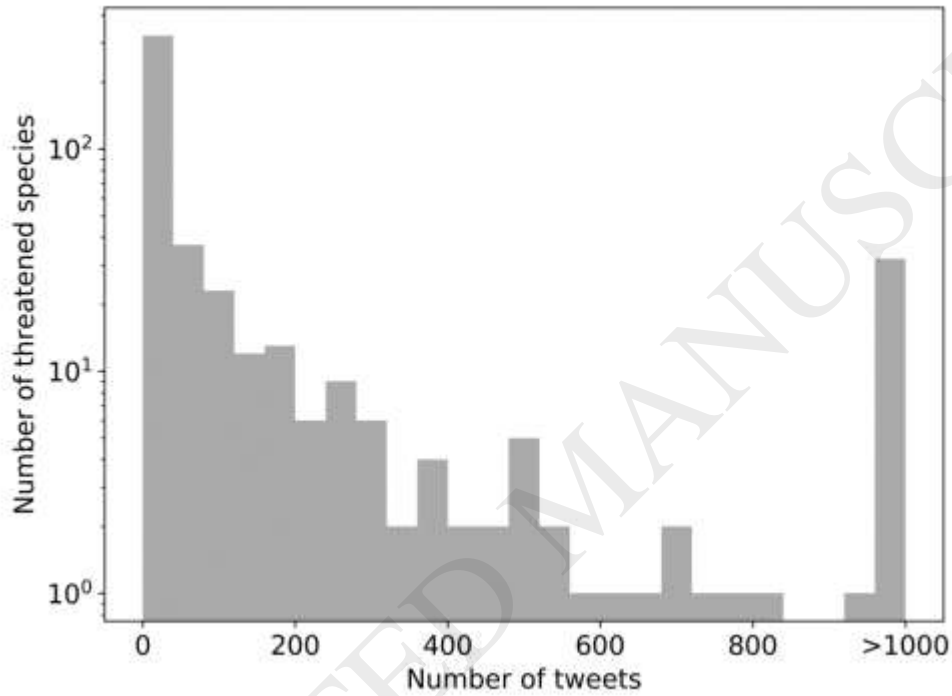


Figure 1: Histogram showing the number of tweets received by species listed on the EPBC Act on Twitter.

Table 1: Twitter winners and losers: examples of some threatened species listed on the EPBC Act that received over 1000 tweets or have never been tweeted about.

Examples of species with over 1000 tweets	Potential drivers of popularity
<p>Twitter account in their namesake: Wandering Albatross (<i>Diomedea exulans</i>); Gouldian Finch (<i>Erythrura gouldiae</i>); Leadbeater's Possum (<i>Gymnobelideus leadbeateri</i>).</p>	<p>Species have a dedicated 'species champion' (Garnett et al. 2018) which includes individual researchers, as well as major conservation organizations.</p>
<p>Focus of an ongoing conservation campaign by major conservation organizations (for example Birdlife</p>	
<p>Australia): Swift Parrot (<i>Lathamus discolor</i>); Orange-bellied Parrot (<i>Neophema chrysogaster</i>); Carnaby's Cockatoo (<i>Calyptorhynchus latirostris</i>).</p>	
<p>Greater Bilby (<i>Macrotis lagotis</i>); Numbat (<i>Myrmecobius fasciatus</i>); Tasmanian Devil (<i>Sarcophilus harrisii</i>);</p>	<p>Species have cultural or commercial affiliations as a quintessential Australian animal (Aslin & Bennett 2000).</p>
<p>Quokka (<i>Setonix brachyurus</i>); Mary River Turtle (<i>Elusor macrurus</i>); Largetooth Sawfish (<i>Pristis pristis</i>);</p>	<p>Species that 'trend' online due to extraordinary physical characteristics (for example the 'smiling' quokka).</p>
<p>Gouldian Finch (<i>Erythrura gouldiae</i>); Murray Cod (<i>Maccullochella peelii</i>);</p>	<p>Species are commonly kept as pets or hunted (for example popular aviary pets).</p>
<p>Night Parrot (<i>Pezoporus occidentalis</i>); Lord Howe Island Phasmid (<i>Dryococelus australis</i>).</p>	<p>Lazarus species: rediscovered species that were previously thought to be extinct.</p>
Examples of species never tweeted about	Shared characteristics
<p>Tasmanian Live-bearing Seastar (<i>Parvulastra vivipara</i>); Cape Range Remipede (<i>Kumonga exleyi</i>); Simson's Stag Beetle (<i>Hoplogonus simsoni</i>); Rosewood Keeled Snail (<i>Ordtrachia septentrionalis</i>); Arnhem Land Egernia (<i>Bellatorias obiri</i>); Glenelg Freshwater Mussel (<i>Hyridella glenelgensis</i>); Antbed Parrot Moth (<i>Trisyntopa scatophaga</i>); Mount Cooper Striped Lerista (<i>Lerista vittata</i>); Shannon Paragalaxias (<i>Paragalaxias dissimilis</i>).</p>	<p>These species represent multiple taxa including both vertebrates and invertebrates. All represent a distinct species (i.e., none are subspecies) and none have a recovery plan under the EPBC Act.</p>

Figure 2: Plot of means with SE of the number of tweets received by species listed on the EPBC Act on Twitter separated by (a) taxa and (b) threat status.

