



ENGAGING BIODIVERSITY SCIENTISTS THROUGH SOCIAL MEDIA

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Abstract: Brazil is facing setbacks in the public trust in scientists due to the political interests of some groups, poor scientific education, and distance between science institutions and society. Given the lack of training for undergraduate and graduate students to communicate science, we share our experience organizing a virtual space on Twitter where biodiversity scientists can engage in science communication, engaging with almost 8,000 followers. We argue that collaborative actions would help scientists engage in science communication activities.

Keywords: career; collaboration; outreach; science communication; social media.

The world faces setbacks in the public trust in science. Even with recent improvements, some countries still endure anti-scientific movements from the public and the government (Funk *et al.* 2020, Taylor 2021). A tragic example comes from Brazil, where President Jair Bolsonaro urges his voters not to wear masks, undermines COVID-19 vaccination, and compromises the federal budget

for science (Barbara 2021). Also, Bolsonaro's administration ignored scientists, dismantled the legislative and administrative structure for environmental protection (Ferrante & Fearnside 2019, Agapito *et al.* 2022, Garcia *et al.* 2022) and poorly responded to the wildfires in the Pantanal and Amazon (Brando *et al.* 2020, Berlinck *et al.* 2022). A large portion of the Brazilian population

considers themselves interested in science, technology, and the environment (Centro de Gestão e Estudos Estratégicos 2019). Nonetheless, a part of the population still celebrates the current administration, displays strong scientific denialism, and promotes pseudo-facts and conspiracy theories (Silva 2021a, 2021b, Ostermann 2022, Rajão *et al.* 2022). Explanations for such social phenomena encompass political projects based on spreading fake news (Scheufele & Krause 2019) that prey on the poor science literacy and the gap between scientists and the public (Peters 2013, Howell & Brossard 2021).

Scientists and managers can improve public perception by engaging in scientific communication and popularization (hereafter SciComm). These activities range from in-person activities in institutional spaces to virtual meetings and seminars such as Skype a Scientist. SciComm promotes knowledge, fun, interest, opinions, and an understanding of science by connecting people with varied intellectual backgrounds to scientific information (Burns *et al.* 2003) and creating a more human image of the scientists (Schinske *et al.* 2016). Society needs organized spaces for scientists to engage with the public (Leite & Diele-Viegas 2020, Muindi *et al.* 2020). Social media is increasingly important for scientists to interact with heterogeneous audiences and then bridge the interaction gaps between them and the public (Van Noorden 2014, Collins *et al.* 2016). One example is Twitter, which is widely used by scientists that shape a network of engagement with peers, journalists, civil society, and politicians (Walter *et al.* 2019). Twitter displays several possibilities when tweeting (*e.g.*, using links, hashtags, mentions, images, and retweet system) to increase the information's visibility (Wilson & Perkin 2021).

As early-career scientists living through the scientific denialism in Brazil, the reality struck us – we rarely communicated with people outside the academia, and the ones that tried to communicate specific topics were discredited. We needed to reach people, but we felt lost. We did not find places to engage in science communication, did not have any training, and were overwhelmed with our research. We imagined our early career colleagues must have felt the same, given that the lack of training to communicate science is

a structural pattern in our undergraduate and graduate courses. Then, we decided to create an organized space for scientists like us to engage with a more general audience.

The *Biodiversidade em Foco* (www.twitter.com/BiodivFoco) is a Portuguese language-based Twitter account that welcomes a different scientist every week to share science and their journeys. Since launching in May 2020, over 90 Brazilian scientists, from undergraduate students to professors, participated in the action and reached almost 8,000 followers. Threads encompassed several topics, including freshwater pufferfishes, the ecological importance of cockroaches, and the actions to undertake when spotting a snake in your house. Some threads generated political debate, such as those on the roads to be constructed near protected areas and the federal government undermining environmental laws. Frequently, they generated dozens or hundreds of likes, shares, and comments, but reached over 20 thousand likes in a thread about Sci-Hub creator. The space enabled scientists to engage in SciComm parallelly to their day-to-day activities by reducing the labor to create and maintain personal platforms and still interact with a large community interested in biodiversity.

As administrators of the project, our primary concern is to manage the space. We seek potential content creators, promote training, and organize information and schedules. Finding potential curators is the hardest of the tasks – people are often insecure about engaging with SciComm when they are not used to it. This is hardly a surprise given the lack of formal scientific training in Brazil and the importance of such training opportunities to build skills and confidence for communicating science to the public (Besley & Tanner 2011, Brownell *et al.* 2013). So, most content creators were scientists in our social network who already had interests in SciComm but did not know how to begin. Less often, we reach peers already engaged on Twitter, or people reached us through an open formulary. We also frequently update a website that centralizes general information on the project, contact formularies, and information on every scientist that contributed to the project. After participating in the project, we also provide a certificate for complimentary hours often used by undergraduate students. The project's

core is content creation, which is up to the weekly curators. We provide some guidelines, instructions, and directions on what we would find interesting to communicate. However, we enforce curators' liberty to create the content that most interests them. We support their creation primarily through a WhatsApp group, in which we provide feedback and help with some Twitter specificities (such as the use of hashtags or adding alt text to images).

We believe that organized virtual spaces, such as the *Biodiversidade em Foco* Twitter account, support scientists already engaged in social media and the scientists with less practice in it. The platform amplifies the voice of those already with social media presence by providing them with new or broader audiences. For the others, the participation introduced them to a new form of SciComm. Finally, the platform created the opportunity for different voices to be heard and undergraduate students and people outside academia to identify with scientists. In two powerful stories on how they struggled to enter academia, two students from the Graduate Program in Ecology at the Universidade Federal do Rio de Janeiro, both women from the periphery of Rio de Janeiro, shared their difficulties in accessing and remaining in academia. They received heartwarming feedback, such as that stating that Suzane's story stimulated the person to persist in science. Therefore, these platforms can also share and empower human narratives in science (Muindi *et al.* 2020).

Institutions and the government must support SciComm to increase its effectiveness through strategic programs that merge the expertise of scientists and communicators (Eise 2019, Besley 2020). The advance in the professionalization of SciComm at the institutional level is urgent because individual-level actions may fail because of the inadequate identification of communication targets, objectives, and effective approaches (Besley 2020). Nevertheless, the reduced budget for Science & Technology in Brazil and the low budget for science in some countries may hamper institutional-level approaches. Individuals must demand public policies that advance science and science communication in such scenarios. However, scientists may still engage in SciComm through individual or community-level actions.

We will make mistakes and take our time to improve our communication skills and strategies. In this sense, it is necessary to evaluate the outcomes and the profile of the people engaged with the SciComm activities, both scientists and target audience, to direct future actions more strategically. Nonetheless, we must prioritize connecting with society, and building the discussed virtual SciComm spaces may be an interesting pathway. These spaces should persist in the long run and compose a diversified virtual background for SciComm to reach a diversified public.

From our experience managing the *Biodiversidade em Foco* twitter, we advocate that scientists should: (i) prioritize group-based projects because SciComm is only one of a scientist's multiple tasks, thus group activities can be organized to keep functioning despite one person being away; (ii) take advantage of diverse pathways to include people in their SciComm projects to create diversified programs; (iii) create several tools for supporting and engaging people in the planned activities; and finally, (iv) communicate the outcomes of outreach actions with their peers so we can keep growing as a community. In this sense, we highlight the importance of developing a culture of openness for sharing skills and experiences in science and SciComm through programs like Open Life Sciences (www.openlifesci.org/) and the Stem Advocacy Institute (www.stemadvocacy.org/). By doing so, we would be able to take advantage of the scientific community's shared experiences and be increasingly empowered not only in SciComm but also to push societal changes that require organization and engagement, such as recent pushbacks against racial and gender-based biases in scientific publishing and access to education (Barros *et al.* 2021, Pettorelli *et al.* 2021, Marques *et al.* 2022, Oliveira *et al.* 2022).

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REFERENCES

- Agapito, L. S., Miranda, M. A., & Januário, T. F. X. 2022. A Political Agenda in Conflict with Environmental Protection: A Critical Policy Essay from Brazil. *International Criminology*, 2, 206–218. DOI: 10.1007/s43576-021-00041-y
- Barbara, V. 2021. The Unveiling of Bolsonaro’s Supervillain Plot Is Weirdly Gripping. *The New York Times*.
- Barros, C. D. S., Pistón, N., Delciellos, A. C., & Leite, M. de S. 2021. Is oecologia australis promoting gender equality in its review process? *Oecologia Australis*, 25(3), 642–647. DOI: 10.4257/oeco.2021.2503.01
- Berlinck, C. N., Lima, L. H. A., Pereira, A. M. M., Carvalho, E. A. R., Paula, R. C., Thomas, W. M., & Morato, R. G. 2022. The pantanal is on fire and only a sustainable agenda can save the largest wetland in the world. *Brazilian Journal of Biology*, 82, 2–3. DOI: 10.1590/1519-6984.244200
- Besley, J. C. 2020. Five thoughts about improving science communication as an organizational activity. *Journal of Communication Management*, 24(3), 155–161. DOI: 10.1108/JCOM-03-2020-0022
- Besley, J. C., & Tanner, A. H. 2011. What Science Communication Scholars Think About Training Scientists to Communicate. *Science Communication*, 33(2), 239–263. DOI: 10.1177/1075547010386972
- Brando, P., Macedo, M., Silvério, D., Rattis, L., Paolucci, L., Alencar, A., Coe, M., & Amorim, C. 2020. Amazon wildfires: Scenes from a foreseeable disaster. *Flora*, 268, 151609. DOI: 10.1016/j.flora.2020.151609
- Brownell, S. E., Price, J. V., & Steinman, L. 2013. Science communication to the general public: Why we need to teach undergraduate and graduate students this skill as part of their formal scientific training. *Journal of Undergraduate Neuroscience Education*, 12(1), E6–E10.
- Burns, T. W., O’Connor, D. J., & Stocklmayer, S. M. 2003. Science communication: A contemporary definition. *Public Understanding of Science*, 12(2), 183–202. DOI: 10.1177/09636625030122004
- Centro de Gestão e Estudos Estratégicos. 2019. *Percepção Pública da C&T no Brasil - 2019. Resumo executivo*. Brasília - DF. p. 24.
- Collins, K., Shiffman, D., & Rock, J. 2016. How are scientists using social media in the workplace? *PLoS ONE*, 11(10), 1–10. DOI: 10.1371/journal.pone.0162680
- Eise, J. 2019. What institutions can do to improve science communication. *Nature*. DOI: 10.1038/d41586-019-03869-7
- Ferrante, L., & Fearnside, P. M. 2019. Brazil’s new president and “ruralists” threaten Amazonia’s environment, traditional peoples and the global climate. *Environmental Conservation*, 46, 261–263. DOI: 10.1017/S0376892919000213
- Funk, C., Tyson, A., Kennedy, B., & Johnson, C. 2020. Science and scientists held in high esteem across global publics. *Pew Research Center*. p. 1–133.
- Garcia, D. A. Z., Occhi, T. V. T., Agostinho, Â. A., Alves, G. H. Z., Brito, M. F. G., Casimiro, A. C. R., Couto, T. B. A., Cunico, A. M., Jarduli, L. R., Lima-Junior, D. P., Magalhães, A. L. B., Novaes, J. L. C., Orsi, M. L., Pelicice, F. M., Petrere, M., Rodrigues, F. L., Sampaio, F. D. F., Dos Santos, V. L. M., Soares, B. E., Tonella, L. H., Zuanon, J. A. S., & Vitule, J. R. S. 2022. More of the same: new policies continue fostering the use of non-native fish in Brazil. *Environmental Conservation*, 49(1), 4–7. DOI: 10.1017/S0376892922000029
- Howell, E. L., & Brossard, D. 2021. (Mis)informed about what? What it means to be a science-literate citizen in a digital world. *Proceedings of the National Academy of Sciences of the United States of America*, 118(15), 1–8. DOI: 10.1073/pnas.1912436117
- Leite, L., & Diele-Viegas, L. M. 2020. Fighting for Gender Equality in Science in Brazil. *Nature*, 587(7832), 163–164.
- Marques, P., Bello, M., Custódio, L., Dias, A., & Soares, B. E. 2022. Certificados de proficiência em língua inglesa são uma barreira para

- pretos e pardos acessarem a pós-graduação no Brasil. SocArXiv. DOI: 10.31235/osf.io/45hnm
- Muindi, F. J., Ramachandran, L., & Tsai, J. W. 2020. Human Narratives in Science: The Power of Storytelling. *Trends in Molecular Medicine*, 26(3), 249–251. DOI: 10.1016/j.molmed.2019.12.001
- Oliveira, W., Soares, B. E., Marques, P., Souza, C., Dias, A. S., Bello, M., & Custódio, L. 2022. Advancing racial equity in Brazil's academia. *Science*, 376(6594), 707–707. DOI: 10.1126/science.abq5212
- Ostermann, F. 2022. Denialism and antiscience criticism: Decolonial questions. *Ciência & Educação*, Bauru, 28, e22000A. DOI: 10.1590/1516-731320220000A
- Peters, H. P. 2013. Gap between science and media revisited: Scientists as public communicators. *Proceedings of the National Academy of Sciences of the United States of America*, 110(SUPPL. 3), 14102–14109. DOI: 10.1073/pnas.1212745110
- Pettorelli, N., Barlow, J., Nuñez, M. A., Rader, R., Stephens, P. A., Pinfield, T., & Newton, E. 2021. How international journals can support ecology from the Global South. *Journal of Applied Ecology*, 58(1), 4–8. DOI: 10.1111/1365-2664.13815
- Rajão, R., Nobre, A. D., Cunha, E. L. T. P., Duarte, T. R., Marcolino, C., Soares-Filho, B., Sparovek, G., Rodrigues, R. R., Valera, C., Bustamante, M., Nobre, C., & Santos de Lima, L. 2022. The risk of fake controversies for Brazilian environmental policies. *Biological Conservation*, 266(6504), 109447. DOI: 10.1016/j.biocon.2021.109447
- Scheufele, D. A., & Krause, N. M. 2019. Science audiences, misinformation, and fake news. *Proceedings of the National Academy of Sciences of the United States of America*, 116(16), 7662–7669. DOI: 10.1073/pnas.1805871115
- Schinske, J. N., Perkins, H., Snyder, A., & Wyer, M. 2016. Scientist spotlight homework assignments shift students' stereotypes of scientists and enhance science identity in a diverse introductory science class. *CBE Life Sciences Education*, 15(3), 1–18. DOI: 10.1187/cbe.16-01-0002
- Silva, H. M. 2021a. The Brazilian Scientific Denialism Through The American Journal of Medicine. *American Journal of Medicine*, 134(4), 415–416. DOI: 10.1016/j.amjmed.2021.01.003
- Silva, H. M. 2021b. The danger of denialism: lessons from the Brazilian pandemic. *Bulletin of the National Research Centre*, 45(1). DOI: 10.1186/s42269-021-00516-y
- Taylor, L. 2021. “We are being ignored”: Brazil's Researchers Blame Anti-Science Government for COVID surge. *Nature*, 593, 15–16.
- Van Noorden, R. 2014. Online collaboration: Scientists and the social network. *Nature*, 512(7513), 126–129. DOI: 10.1038/512126a
- Walter, S., Lörcher, I., & Brüggemann, M. 2019. Scientific networks on Twitter: Analyzing scientists' interactions in the climate change debate. *Public Understanding of Science*, 28(6), 696–712. DOI: 10.1177/0963662519844131
- Wilson, M. J., & Perkin, E. K. 2021. Going rogue: What scientists can learn about Twitter communication from “alt” government accounts. *PeerJ*, 9, 1–14. DOI: 10.7717/peerj.12407

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