

DIVERSITY

Benefits of permanent adoption of virtual conferences for conservation science

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Article impact statement: Both the practice of ecology and the environment overwhelmingly benefit from virtual conferencing.

Disruptive events can trigger societal transformations with beneficial outcomes (Walker et al., 2020). For scientific professions, the COVID-19 pandemic triggered a comprehensive shift from in-person workshops, seminars, and conferences to the use of virtual formats for research and knowledge dissemination (e.g., Viglione, 2020). Despite the merits of virtual conferencing being advocated since the development of the internet (e.g., Reay, 2003; Gichora et al., 2010; Blackman et al., 2020), ecological and environmental sciences have historically relied on in-person events, and adoption of virtual conferencing for knowledge sharing and networking during so-called lockdowns and travel restrictions represented a radical change. Compelled by COVID-19, many conferences rapidly shifted to virtual formats. However, the combination of professional and personal attachment to in-person conferences, hopes of the effectiveness

of vaccines against COVID-19, and organizations planning to host solely in-person events as soon as possible suggests we risk missing an unparalleled opportunity to permanently reimagine scientific conferences to benefit the practice and culture of conservation research.

Conferences are deeply embedded in the culture of ecology (Sanders et al., 2020). For example, early career researchers and practitioners may aim to attend 1–2 national or international conferences annually. Registration costs for in-person events typically span 600–1000 pounds, Euros, or dollars, requiring grants, scholarships, or personal funds. Prior to COVID-19, in-person events were the primary and, in most cases, sole format for ecology and conservation conferences (e.g., Ecological Society of America, Society for Conservation Biology, and World Fisheries Congress), where routinely hundreds to thousands of

individuals gathered from around the globe to share their work. The benefits of conferences to the careers of individuals and to science are significant. However, these benefits are restricted to individuals with the resources necessary to attend—typically those who are associated with well-resourced organizations.

The chronic barriers to participation in in-person conferences have become more apparent as previously excluded groups have taken advantage of virtual conferences (Niner & Wassermann, 2021; Sarabipour, 2020; Vervoort et al., 2021). Registration, travel, and visa costs are prohibitive for many, including those from low- to upper-middle-income economies and unfunded or unemployed researchers. Attendance is also hampered for people with personal responsibilities and travel constraints, such as caregivers of children and relatives (Calisi, 2018) and those from rural and isolated communities. The timing of research itself can constrain participation; seasonal fieldwork often coincides with conferences. Undergraduate and graduate researchers may find it challenging to juggle conference attendance with coursework demands.

In addition to being inaccessible to many potential participants, in-person conferences are immensely carbon intensive. Up to 6 t of CO₂ are produced when an individual attends an international meeting, and total CO₂ emissions associated with an individual conference attended by 11,000–28,000 people spanned 40,000–80,000 t (Klöwer et al., 2020; Stroud & Keeley, 2015).

During the COVID-19 pandemic, virtual formats for conferences were adopted as a stopgap measure; there were frequent calls for a return to in-person events (Geitman, 2020; Murphy, 2020). We have an alternative view: virtual conferences offer almost all the benefits of in-person events to a broader range of participants. Rather than frame discussion around perceived drawbacks of virtual conferences, we advocate the ecology and conservation communities take the best aspects of virtual conferencing developed during the pandemic to build a future approach that better reflects principles of economic, social, and environmental sustainability.

Ecologists study global environmental issues and recognize the human dimensions of these problems. It is, therefore, unsurprising that ecological and conservation organizations and scientists call for urgent action on climate change (e.g., Bonar, 2021), improvements in outcomes for diversity and inclusion, and broadening the sharing of scientific ideas and evidence beyond a professional audience (Ngumbi, 2019). However, few calls for concerted actions reflect how in-person scientific conferences contribute to environmental impacts and inequitable access to professional opportunities. The actions of scientists matter significantly to the lay public and policy makers—especially in relation to calls for action on climate change (Rosen, 2017). Virtual conferences almost eliminate the emissions footprint of in-person conferences (Klöwer et al., 2020; Reay, 2003), resolving the hypocrisy of calling for climate action while not taking action to curb increasing emissions from increasing internationalization of science (Haage, 2020).

Equally, adoption of virtual conferences can reduce the well-known barriers to access, broadening participation and dissemination of ecological knowledge to better reflect the global nature

of research (Pettorelli et al., 2021). Registration costs of virtual conferences are typically 25–50% less than in-person meetings, increasing access for researchers with fewer funds (Castelvecchi, 2020). Although the trend is largely toward reduced costs for virtual conferences, costs can vary widely, depending on constraints and decisions by conference organizers and societies (e.g., reliance on conference fees to fund annual budgets). Virtual conferencing also broadens options among caregivers, who are poorly retained in conservation science. Emerging data on demographics and participation show stronger support for virtual than in-person conferences, with critical implications for addressing long-standing geographic disparities in global collaboration (Niner & Wassermann, 2021; Rimmel, 2021; Sarabipour, 2020). For example, the annual conference of the American Physical Society usually hosts 1600–1800 people, yet their 2020 virtual conference welcomed 7267 participants (Castelvecchi, 2020). The numbers of attendees at 22 virtual conferences in the fields of health, education, and biological sciences held in 2020 were 2–10 times higher than their equivalent in-person offerings in 2019 (Sarabipour, 2020).

However, total numbers do not tell the whole story. The largest gains in virtual conference participation were for early career researchers, and geographic diversity of participants was consistently higher, in some cases with double the number of countries represented (Sarabipour, 2020). Furthermore, virtual conferencing facilitates ongoing participation in science by the growing proportion of short-term contract, adjunct, or temporarily employed researchers (Milojević et al., 2018), many of whom lack opportunities and resources to attend far-flung in-person meetings. Also, science-adjacent audiences (e.g., non-governmental organizations, stakeholders, communicators, and the public) may be more likely to attend conferences when they are held virtually.

The rapid adoption of virtual conferencing during COVID-19 also provided opportunities to experiment with new approaches and formats. Some of these innovations show great promise to counteract downsides of virtual conferences, such as challenges of synchronizing participation across time zones, loss of spontaneous opportunities for networking, and Zoom fatigue. For example, automated language translation, captioning, and asynchronous and recorded presentations can address language, disability, and time-zone challenges, respectively (Castelvecchi, 2020), and technologies can create social and networking opportunities (e.g., Gather.town). Indeed, as virtual conferencing evolves, further benefits of this mode of engagement will emerge. Virtual conferences need not be merely broadcasted versions of in-person events. When invested with deliberation, they offer increased accessibility and new models of knowledge sharing, networking, and collaboration (e.g., Vervoort et al., 2021). Just as the use of email and social media by scientists has expanded collaboration, networking, and public engagement by reducing barriers to participation, virtual conferences hold similar transformative potential for how research is conducted and shared. For example, conservation science has been dominated by research from high-income economies (Pettorelli et al., 2021). Paradoxically, much important conservation research occurs in biodiversity hotspots

located in countries with low-income economies, where it is done by researchers who cannot afford to attend expensive in-person conferences (Fraser et al, 2017). Given the much-lauded collaboration and networking opportunities of conferences, enhancing participation of the global community through virtual conferences could help correct this imbalance.

Ecological societies and researchers share responsibility in driving transformation by advocating for, adopting, and innovating virtual conferences. The profession of ecology itself benefits from broader participation, diversity, and debate. But who should drive this change and how? Professional societies advocating for policy reforms and behavioral change related to diversity, environmental sustainability, and knowledge dissemination should promote and adopt virtual conferences to match calls for action. These organizations can also play a critical role by trialing alternative virtual conferencing models and tracking and publishing data comparing demographics and participation of virtual and previous in-person conferences (Niner & Wassermann, 2021; Sarabipour, 2020). Workplaces need to make clear that virtual conference participation is valued equally with in-person events to counter individuals' fears that they put their promotion or advancement at risk by not attending in-person events (e.g., Haage, 2020). We predict the most meaningful change will come from individuals. Senior researchers from high-income countries and practitioners with resources (whose careers have benefited from reliance on in-person conferences) hold the greatest sway to break the cycle of demand for in-person events by shifting to participating in and advocating for virtual formats. However, researchers at all career stages who have previously experienced barriers to participating, or those who support unfettered participation, can create demand for virtual conferences by taking advantage of the opportunities that they create and by being vocal about disenfranchisement for themselves or their peers. By leveraging this unique moment to embrace and advocate for virtual conferencing, we urge the conservation science community to make good on long-standing calls for action (Bonar, 2021; Ngumbi, 2019; Pettorelli et al., 2021) and transform research into a more sustainable, interactive, and truly global endeavor.

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