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Commentary

Games for Gaia: Leveraging Gaming Interventions for Biodiversity Conservation

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For over two thirds of people on Earth using the internet, digital platforms have become integral to daily life, profoundly influencing how we engage with the world, including our interactions with nature. According to ITU (International Telecommunication Union) estimates, approximately 5.4 billion people were using the Internet in 2023 (ITU 2024). As urbanisation continues to rise, with predictions that 70% of the global population will reside in urban areas by 2050 (United Nations 2023), up from 55% in 2022, digital technologies are likely to increasingly mediate people's interactions with wildlife.

Video games, played by more than three billion individuals—representing 81.9% of internet users aged 16 to 64 (We Are Social and Meltwater 2023)—provide unique opportunities for experiencing nature within virtual environments. Conservation practitioners responding to mass species loss would therefore benefit from greater understanding of how these gameful modes of human-wildlife engagement impact pro-environmental engagement and behaviour. In this context, the work of Sandbrook et al. (In press) is both timely and important. However, we believe that existing evidence has been largely left underexplored. To advance knowledge on the subject, our goal is to offer empirical insights into the role of gameful experiences for engaging with biodiversity, building on Sandbrook et al.'s attention to matters of 1) learning, connection, and empathy; 2) political ecologies; and 3) ethics, commodification, and carbon.

TYPOLOGY OF GAMES

It is important to clarify general distinctions between gamification, serious games, and entertainment games. Misunderstanding their differences can compromise their design, implementation, and subsequently, any intended effects (de Salas et al. 2022).

'Gamification' is widely understood as "the use of game design elements in non-game contexts" (Deterding et al. 2011: 10; Gil-Aciron 2024). These experiences are not full-fledged games (e.g., *Ant Forest*; Alipay 2016), instead typically only employing simple mechanics such as points, leaderboards, badges, and progress bars to incentivise user engagement and retention for tasks/activities (de Salas et al. 2022; Dicheva et al. 2015; Sailer et al. 2013). 'Serious games' (or 'educational games', such as *Fate of the World*; Red Redemption Ltd. 2011) may also have non-game-related goals (see Figure 1). However, they are complete gaming experiences that can use fun interactive virtual environments to simulate real-world phenomena in order to influence knowledge, reflection, attitudes, and behaviour (Boncu et al. 2022; Gu et al. 2023; Tan and Nurul-Asna 2023). The intention of these games is explicitly defined; the game is used as a platform to deliver educational content, and gameplay is purposively built around meeting its objectives (Becker and Parker 2014; Becker and Gopin 2016). Serious games are better suited to directly targeting long-term behaviours than gamification (de Salas et al. 2022), but they require much more investment in their development (Dicheva et al. 2015). 'Entertainment games' (or 'commercial off-the-shelf games', such as *Animal Crossing: New Horizons*; Nintendo 2020) may also educate their audiences, but player experience is prioritised (i.e., the game must be fun; Díaz et al. 2022). Unlike serious games and gamification, they typically deliver richer audio-visual experiences that appeal to massive audiences (Abraham and Jayemanne 2017; Prestopnik and Tang 2015). However,

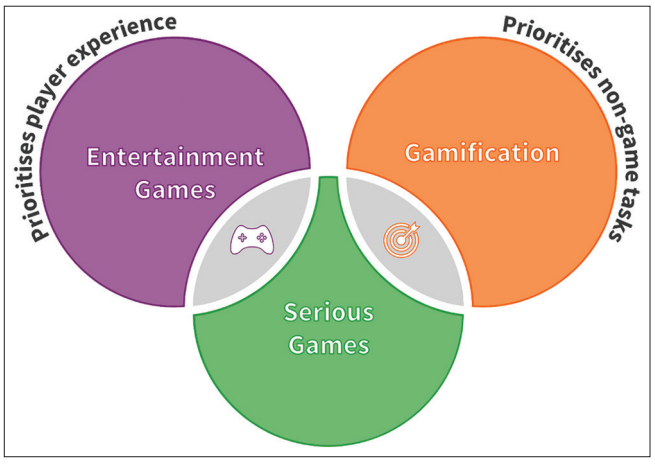

Figure 1
Venn diagram representing how entertainment games, serious games, and gamification typically differ in their purpose for players

developing games for mainstream success demands expertise and resources that conservationists rarely possess, and may come at the expense of accurately portraying complicated phenomena (Sandbrook et al. 2015).

LEARNING, CONNECTION, AND EMPATHY

There is substantive evidence that serious games and gamification can improve users' environmental and ecological knowledge (Boncu et al. 2022; Tan and Nurul-Asna 2023); augmented reality (AR) and virtual reality (VR) technologies are commonly used to deliver these experiences (Cosio et al. 2023; Gu et al. 2023; Webber et al. 2023). Therefore, Sandbrook et al.'s findings that the 'Race the Wild' challenge could prompt learning aligns with an already strong evidence base. Whilst no formal synthesis yet exists for how entertainment games may engage players with biodiversity or conservation—a gap currently being addressed (see Blake et al. 2024 [preprint])—they also show promise for ecological learning. For example, *Wildeverse* (Internet of Elephants 2020) had a comparable impact to a documentary for improving players' knowledge about great apes and their protection (Dunn et al. 2021). Compared to non-players, players can identify real-world species with increasing accuracy as they are more commonly encountered in *Red Dead Redemption 2* (Rockstar Games 2018; Crowley et al. 2021). Moreover, *Animal Crossing: New Horizons* players outperform non-players when identifying species featured in the game (Coroller and Flinois 2023). Both groups perform similarly for species not featured in the game. Contrary to Sandbrook et al.'s (In press) concerns that games tend to prioritise including large and charismatic species (i.e., mammals) and are therefore limited in their educational potential, these findings largely related to fish and invertebrates.

Still, lack of knowledge is not the main barrier to environmental action (Cosio et al. 2023). Although receiving somewhat limited attention compared to their role for learning, serious games can impact players' empathy and connection to nature (Gu et al. 2023; Tan and Nurul-Asna 2023). Gamification does not seem to have been studied as extensively, making Sandbrook et al's insights particularly interesting and worthy of further investigation. Research on entertainment games has focused more on players' connection to nature than empathy, with particular attention to how it may influence in-game behaviour. For example, unlike players reporting a high connectedness to real-world nature, those who report poor connectedness were more motivated to play *World of Warcraft* (Blizzard Entertainment 2004) for nature-related reasons (e.g., to access green landscapes; Truong et al. 2018). Players may search for these virtual worlds to fulfil biophilic needs, and Truong et al. (2018) discuss the implications of this for conservation (e.g., whether players may become more interested in virtual than real nature). Other research has explored how players' environmental ideologies (e.g., anthropocentric versus biocentric relatedness to nature) correlate with ecologically destructive actions in *Animal Crossing: New Horizons* (Vuong et al. 2021; Ho et al. 2022a,b). These authors encourage mainstream games to consider how their design may better engage players with pro-environmental activities, perhaps by collaborating with environmental non-governmental organisations or other stakeholders.

POLITICAL ECOLOGIES

Ecological crises are deeply intertwined with culture, politics, and human history (Webber et al. 2023). Games can help players to understand such complex entanglements, and the conflicts that occur during environmental management (Redpath et al. 2018; Tan and Nurul-Asna 2023). As examples, two renowned serious games about mitigating climate change, *Fate of the World* and *KEEP COOL* (Eisenack and Petschel-Held 2004), have improved players' systems thinking and appreciation of diverse stakeholder perspectives (Eisenack 2013; Waddington and Fennewald 2018). Serious games may also be used to share Indigenous worldviews with huge player communities. For example, Louis Riel School Division partnered with *Minecraft Education* (Mojang Studios 2016) to commemorate *Anishinaabe Peoples*, with attention to their land ethic (see https://www.lrsd.net/page/1493/). Moreover, entertainment games have been criticised for encouraging colonialist practices that are harmful for conservation (e.g., *Animal Crossing: New Horizons*; Smith 2022). Yet, LaPensée's (2017) *Thunderbird Strike*—designed as a form of cultural resistance to oil drilling activities that threaten biodiversity and Indigenous communities—was condemned as "ecoterrorism" by advocates of fossil fuel infrastructure (Kinder 2021). In contrast to serious games, these examples reinforce Sandbrook et al.'s (In press) concern that games may obscure the physical realities of ecological management—whether by design, or because those that do not conform to Western capitalist ontologies are publicly censured by bureaucratic forces. Blake et al.'s (2024) systematic map will offer further insight into how entertainment games represent political ecologies surrounding conservation.

ETHICS, COMMODIFICATION, AND CARBON

Whilst the rapid evolution of digital technology offers unprecedented opportunities to redefine social experiences of wildlife, the intersection of biopower and ethics in gamification, as highlighted in the 'Race the Wild' challenge, carries ethical implications. Given the positive and transformational impact that games and gamification can have, the focus should be on responsibly leveraging these technologies to support conservation efforts. Although animals are unknowingly 'watched' via some digital experiences, this represents a non-intrusive alternative to traditional, and very often exclusive, tourism and research expeditions, which, in turn, can scale globally without such significant physical consequences and restrictions. For instance, *Ant Forest*, a gamification platform within Alipay, has become one of the world's largest online public environmental platforms (Chen et al. 2020). By the

end of July 2019, the number of *Ant Forest* users exceeded 500 million (Chen and Cai 2019; Zhang et al. 2022), all participating in eco-friendly activities that translate virtual achievements into tangible environmental impacts, such as planting trees (Ant Group 2019).

While digital tools have associated carbon footprints that should not be ignored, they need to be considered in relation to the alternatives. For example, physical tourism to natural spaces (i.e., ecotourism), has long been both described as a major contributor to nature conservation (Weaver 2000) and a source of unsustainable environmental pressures (Buckley and Pannell 1990; Hjalager 1996). The notion that we are 'loving national parks to death' is often associated with ecotourism (Vaske et al. 2000),with land degradation, habitat and species loss, pollution (including but not limited to carbon emissions from travel), stress and behaviour modification of species among its key impacts (Lilieholm and Romney 2000; Tribe et al. 2000). The environmental impact of an individual flight far exceeds the annual usage of a mobile phone, underscoring the potential of digital alternatives to reduce carbon footprints significantly. Compared to a single one-way economy class flight from London to New York—emitting just over a tonne of CO_2e—a mobile phone can be used for a full hour every day in a year (Berners-Lee 2010). The World Economic Forum places the tourism industry's impact at 8% of all global carbon emissions (over four billion tonnes per year; Lenzen et al. 2018; Greif and Houdre 2024).

Digital expansion needs to be balanced with sustainable, commercial practices. There are notable efforts within the gaming industry to mitigate general environmental impacts. For example, *Terra Nil* (Free Lives 2023), a game about restoring habitats, supports real-world conservation by planting a tree for each game sold and donating a portion of profits to environmental causes. Stairway Games (2022) further exemplifies this approach by donating 100% of profits from two DLCs (downloadable content) of their game *Coral Island* to the NGO Coral Guardian, an initiative which raised $87,500 in two months for coral restoration (Humble Games 2023). Yet, there remains the issue of the extraction of minerals for gaming consoles and mobile phones, which can infringe upon human rights and greatly disrupt habitats. While mobile phone companies like Fairphone (2024) are advancing sustainability through initiatives like "Fair Materials", the gaming industry has opportunities to drive significant environmental changes. For instance, the Playing for the Planet alliance, supported by the United Nations Environment Programme (2023), focuses on decarbonising the gaming industry by encouraging companies to pledge to reduce their carbon footprints and integrate sustainable practices. Ubisoft, a member of the alliance, has committed to reducing its carbon emissions and aims to align its 2030 carbon reduction objective to limit global warming to 1.5°C (Playing for the Planet 2024; Ubisoft 2024).

Finally, we turn to the commodification of wildlife through games and gamification. While iconic brands such as Jaguar Land Rover with its jaguar, Cartier with its panther, and Chanel with the lion have used animal imagery for over a century to enhance brand identity, digital games and gamification go a step further by providing a platform that actively engages users in real-world conservation actions. For example, platforms like *Zooniverse* (University of Oxford, Chicago's Adler Planetarium, the University of Minnesota – Twin Cities 2009) and *eBird* (Cornell Lab of Ornithology, Cornell University 2022) enable users to contribute to scientific research through 'citizen science', using gamification to transform virtual interactions into actionable data that supports conservation. A study by Callaghan and Gawlik (2015) demonstrated that *eBird* data was effective for conservation planning and monitoring, offering estimates of bird diversity and richness comparable to those from standardised surveys. Many games also influence societal attitudes towards extinction and conservation. For instance, *Red Dead Redemption* (Rockstar San Diego 2010) uses the in-game extinction of bison to evoke historical wildlife management issues and raise awareness (Backe 2017), demonstrating how digital platforms can serve as powerful tools for environmental education.

FINAL LEVEL: UNLOCKING CONSERVATION THROUGH GAMING

Digital games offer a powerful and innovative platform for engaging global audiences with biodiversity and its conservation. As urbanisation and digital integration increase, games provide unique opportunities to simulate nature, educate players, and foster empathy towards environmental issues. While challenges remain, particularly in balancing entertainment with accurate representation of ecological complexities, the potential for games to inspire real-world conservation actions is real. As done by Sandbrook et al. (In press), considering the ethical and environmental implications of game design provides the theoretical groundwork for empirical examinations of their role. Our overview introduces such work, but a more comprehensive and systematic synthesis of literature is needed. In particular, reviews have thus far focused more on gamification and serious games. Yet, thorough documentation of current studies and gaps related to commercial games is necessary to strengthen any holistic understanding of these gameful modes of human-wildlife engagement. Only then can practitioners fully gauge the capabilities of these technologically-mediated experiences, and ensure they are responsibly leveraged to support sustainable environmental outcomes.

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