



Intergenerational Inequity: Stealing the Joy and Benefits of Nature From Our Children

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INTRODUCTION

The Earth's wildlife and wild places provide essential ecosystem services for current and future generations of humanity, including visual and aural amenity, clean air and water, climate regulation, carbon sequestration, cultural services, energy, disease and pest control, fire regulation, food, habitat provisioning, medicine, land stabilisation, mitigation of natural disasters, pollination, resistance to high winds, and seed dispersal (Costanza et al., 1997). The utilitarian value of biodiversity, assessed via the use-values and ecosystem services that nature provides and upon which humanity's survival depends, does not reflect the entirety of the benefits humanity obtains from nature. There are additional elements of the human experience that are intrinsically connected to nature, in particular our physical, mental, cultural and spiritual well-being (Hough, 2014).

Yet, policy making and current neoliberal economic paradigms of infinite economic growth in a finite natural system are at odds with the conservation of biodiversity and critical ecosystem services for future generations. The value of nature is becoming more obvious as it becomes scarcer, but awareness is not growing fast enough for humanity to stop the loss of wildlife and wild places that are disappearing as our planet passes through the Anthropocene. One species—*Homo sapiens*—is likely to be imparting more profound impacts on the geological record than ever before by changing its climate, releasing excessive amounts of pollution, harvesting a vast array of other species at unsustainable rates, introducing invasive species, simplifying ecological communities, and clearing

much of the globe's terrestrial areas of native vegetation. Collectively, these factors are leading to a rate of biodiversity extinction that is unprecedented in geologic time (Smith et al., 1993).

Older generations are increasing their wealth at a proportionally greater rate than younger generations, largely on the back of unsustainable utilisation of natural resources (Christophers, 2018). Virtually the entire history of humanity has been defined by the expectation that young people would live longer and “better” than their parents. This expectation however, is no longer certain. Furthermore, the unsustainable exploitation of natural resources deprives future generations of the value of nature (*sensu stricto* based on Soga and Gaston, 2018), causing the benefits of nature to humanity to be distributed unequally across time. Hence, people in the future will be less likely to experience wildlife and wild places, and will be unable to reap the economic, ecological, and psychological benefits of nature. This is a vicious cycle as the extinction of the experience of biodiversity is a major threat to society's connection to nature, and, by consequence our ability to conserve biodiversity (Miller, 2005; Soga and Gaston, 2018).

We discuss the principal issues of this intergenerational inequity of nature and wild places. We focus on the broader issue regarding the decrease in nature-based experiences future generations will face, and how the lack of such experiences will shape the future of biodiversity conservation. Throughout this manuscript we use *biodiversity* –the variety and variability of life on Earth– and *species* –the key units representing biodiversity– somewhat interchangeably to broaden the understanding of this paper beyond the scientific community.

Spiritual Values of Nature

People have forged cultural and spiritual connections with nature, animals, and plants for millennia. There are countless examples: the jaguar *Panthera onca* was a symbol of political and military power in the ancient Americas, and it was associated with the underworld and mortality in the Mayan world; the Baird's tapir *Tapirus bairdii* is the creator of Earth for the Bribri people of Costa Rica; the elephant *Elephas maximus* Ganesha god is the Hindu religion's most revered deity. Yet, many of the animals that are worshipped as divinities are on the brink of extinction, potentially leading to a loss of cultural heritage. Similarly, numerous plants were considered sacred and magical in human societies because of their medicinal or psychoactive properties. However, many of these plant species such as the black cohosh *Cimicifuga racemosa* –used by Native Americans to support women's health ailments—and the peyote *Lophophora williamsii* –a cactus sacred for its healing and hallucinogenic powers and that was already consumed in the pre-Colombian Mesoamerican civilizations by the Tarahumara, Olmec, Aztec, Huichol, and other indigenous groups in Mexico to communicate with their gods– are now threatened because of habitat loss and overharvesting due to increased global demands. This disappearance is a prejudice to many human cultures and natural heritage across the world. Nature experience is of cultural importance the world over, and this point perhaps requires much better recognition and accommodation in policy.

Health Benefits From Nature

Our detachment from nature has ailed the human mental condition, which is particularly concerning at a time when ~15% of the global population suffer from mental disorders (Dattani et al., 2021). While the causes of such global distress are multifaceted and complex, many studies now show a strong relationship between increased contact with nature and improved mental health and physical well-being (Hough, 2014).

Poor physical and mental health is also associated with lower socio-economic and education status (Dattani et al., 2021), a disparity responsible for fracturing social cohesion and increasing the “extinction of experience” (Pyle, 2003; Soga and Gaston, 2018). The theft of the joy of nature risks increasing the apathy of future generations to its conservation, further contributing to a downward spiral of both global population health and nature.

Reduced Opportunities to Enjoy Wildlife and Biodiversity

Reducing human experiences of nature to sanitised, homogenised, and reduced biodiversity in small remaining patches of habitat, in captivity, or in highly modified landscapes, would be a loss of experience for future generations. For example, watching an elephant in a zoo in the USA is largely the same as watching one in a zoo in Australia, yet both experiences are vastly inferior to watching an elephant performing natural behaviours (e.g., shaking pods from a giant *Faidherbia albida* tree) in its natural habitat. Likewise, experiencing the reconstruction of a tropical forest at Biodôme in Montréal, Canada, can be instructive from an educational view, but is completely distinct from immersion into a natural wet forest. Conserving species in varying wild contexts (**Figure 1**) can offer greater equanimity of opportunity as well as equally rewarding experiences, while the loss of these kinds of encounters with wildlife elicit genuine feelings of grief in people (Albrecht et al., 2007; Conroy, 2019).

If we do not retain these species across their ranges, there will be spatial as well as intergenerational disparity in access to the diversity of experiences that exemplify biodiversity. Today, we are on a precipice of removing many species from much of their ranges, or extinguishing them entirely, such that future generations will not have the opportunities to experience the full range of nature's experiences. Lions *Panthera leo* now occupy just 8% of their historic range, and their numbers have dropped by around 50% in the last 25 years, the time between the release of the original and remake of Disney's Lion King. California condors *Gymnogyps californianus* can now only be realistically observed soaring the skies above Southwestern USA and Mexico, where the species range once covered a massive area from Canada to Mexico. Billions of birds in North America have disappeared in the last three decades (Elizabeth, 2019), meaning it will be difficult for future generations to experience the thrill of mighty flocks of calling birds and biodiverse symphonies of dawn choruses. The awe held by these species, and especially the large charismatic ones is not just a modern, western perspective of nature, as illustrated by the Maasai morans reverence toward lions to the extent that they show their



FIGURE 1 | Experiencing biodiversity at one site is not the same as experiencing it at others. Photo (a) shows the different experiences people have in viewing African elephants *Loxodonta africana* trying to eke out a living in the Namib Desert of Namibia compared to the waterworld of Botswana's Okavango Delta (b). Photo (c) shows a pride of lions *Panthera leo* feasting on a springbok *Antidorcas marsupialis* beneath a camel thorn acacia *Vachellia erioloba* tree on the dry bed of the Nossob River in the Kalahari Gemsbok National Park, while (d) shows a lion set amongst the emerald green grasslands of Murchison Falls National Park. Experiencing capercaillie lek in mountain meadows in the Black Forest (e) is vastly different from that in Scotland's coniferous forests (f). Watching a solitary monarch butterfly as it starts its migration in Quebec (g) is not comparable to watching it when it joins conspecifics in Mexico (h). Observing a humpback whale pod on their migration to their calving grounds in the tropics (i) is a substantially different experience from watching a pod lung feed in polar regions (j). Photo credits: (a) Greg Willis; (b) pixabay.com; (c) Matt and Gina Hayward; (d) Wikipedia Commons; (e) Jean Meyer; (f) Wikipedia Commons; (g) Flickr; (h) Wikipedia Commons; (i) Eduardo Estrada; and (j) Wikipedia.

bravery by killing them, and the great cave canvasses in Lascaux (France) and Arnhem Land (Australia), that date back to the Upper Palaeolithic.

While charismatic megafauna are often the face of biodiversity conservation, other less charismatic taxa, such as amphibians, invertebrates, and reptiles fulfil an inspirational function, and equally cause a strong sense of loss as they are declining rapidly due to humans activity (Cane and Tepedino, 2001; Basset and Lamarre, 2019). Examples include the mass agglomerations of monarch butterflies (Figure 1), deafening cicada choruses, firefly or plankton bioluminescence, or coral reefs and their spawning. Even the opportunity to observe a garden skink, common frog, or interesting beetle in one's own backyard can be joyful experiences that are also disappearing, and this reinforces our arguments for the intergenerational inequity of biodiversity. While shifting baselines lead us to accept this depleted abundance and diversity as the new normal (Pauly, 1995), children today have no recollection of the abundance of wildlife that once roamed the Earth (Vaughan, 2019). When they develop an understanding of this loss, it is likely that they experience a sense of injustice and grief, presumably leading to motivation or apathy to action.

In the same manner, plants and vegetation communities are also fundamental to the intergenerational bargain, but are declining (e.g., 5,714 plants threatened in 2002 vs. 16,460 in 2020, IUCN, 2020), while agriculture expands. Domesticated crops do not replace wild species: the diversity of fynbos flowering in South Africa, the wild flowers of Western Australia, or the mixed deciduous forest of Poland are arguably vastly more inspirational than a monoculture of flowering canola or a pine plantation. There may be some experiences of biodiversity that remain unchanged into the future, but the variety will be greatly reduced, and, we suggest, the most awe-inspiring possibilities will be lost. Simply restoring urban industrial landscapes may benefit weedy species in novel ecosystems, but this in no way approaches equity with large, intact landscapes.

Loss of Wild Places and Wild Experiences

It is not just biodiversity that is being destroyed. Wild places are facing the same extinction crisis as wildlife (Watson et al., 2018) and, like species extinction, this is largely irreversible. Watching glaciers calve off and collapse into the sea is an awe-inspiring sight, however glaciers are disappearing on every continent. For example, the highest mountain in Sweden has changed recently because the glacier at its peak melted, while the shape of iconic Andean mountains have changed dramatically meaning future generations may never see a slow moving river of ice with the power to carve landscapes.

Beyond the loss of biodiversity and spectacular geological features in wild places, wild experiences are being lost too. It is now physically impossible to kayak down Australia's longest river system because over extraction for irrigation upstream has deprived the river of sufficient water for navigation. Light pollution from humanity is widespread rendering opportunities for future generations to experience complete darkness or to see constellations or the brightness of the Milky Way more limited. Likewise, it is increasingly difficult to find places on Earth that are devoid of human noise (Hempton and Grossmann, 2010). Natural soundscapes around the world are vanishing as they are being replaced by the omnipresence of anthropogenic sounds, especially industry and vehicle-related noise. Light

and noise pollution not only deprive future generations from peaceful opportunities to relieve stress, but they also create novel landscapes of human-induced fear that impact biodiversity (Hölker et al., 2010; Laurance, 2015), jeopardising the ecosystem services they provide (Francis et al., 2012).

The loss of wild places also results in many human rights violations involving indigenous peoples who lose their ancestral lands, and the loss of cultural and linguistic diversity that is so closely coupled with biological diversity across the planet's remaining intact ecosystems (Loh and Harmon, 2005; Gorenflo et al., 2012). For instance, the eternal ice (*munch*) in Mongolia was used by pastoralists to cool heat-stressed animals and provide respite from insect harassment. However, climate change is melting the ice such that this cultural practise is rapidly being lost (Taylor et al., 2019). The Mayan people once performed traditional fishing in ephemeral ponds in the Calakmul region of Mexico, but many of these ponds have desiccated due to prolonged droughts. Many of the cultural and spiritual connections between indigenous peoples and species are part of a wealth of knowledge and practises accumulated over generations that often results in sustainable management and coexistence with wildlife. Unsustainable resource extraction in indigenous territories by governments and industry deprives younger generations of indigenous peoples of their ancestral lands, resources, biodiversity, culture, language, and heritage. It also disrupts models of coexistence with biodiversity and sustainability that should inform global development to avert the biodiversity crisis (Gilberthorpe and Hilson, 2014). Extinction of wildlife species also results in a loss of millennia of cultural connection, stories, and coexistence.

Inequality in Access to Wild Places

There are already global and intra-country discrepancies in the access of citizens to nature. In some instances, racial or cultural variance in visitation rates of protected areas is the result of historic prejudice, e.g., in the USA where the National Park Service was created while Jim Crow segregation laws were in full effect. This, combined with other compounding factors, such as historical targeting of park resources to white Americans, socioeconomic resources, and cultural factors results in people of colour not feeling comfortable with visiting protected areas and skewed demographics of visitors to parks (Taylor, 2000; Scott et al., 2018). Moreover, only recently have Indigenous people been involved in park management. Similarly, in Africa, visitation of local citizens to parks is a relatively limited and recent phenomenon, partly inhibited by cost considerations (Melubo, 2020).

The exclusion of citizens from access to nature due to financial, historical and socio-political, cultural, or demographic reasons means fewer and fewer young people will visit parks and natural areas, and be able to have joyful experiences with wildlife and wild places in coming generations. This is worrisome, because it is likely to undermine public and thus political will for conservation (Cheng and Monroe, 2012).

The outcome of these problems is that, already, the depletion of nature affects people at every age. Without these joyous

experiences from a young age, children are less likely to form connections to the natural world, and are therefore less likely to feel a sense of guardianship for the planet as they grow up. Without this connection, future generations will be less likely to prioritise nature, and their behaviours may further exacerbate the destruction of biodiversity and wild places (Soga and Gaston, 2018).

We do not know whether the intergenerational equity of biodiversity engagement is affected by the quality or quantity of nature, but given the health benefits of biodiversity increase with the amount of time spent in biodiversity (Shanahan et al., 2016), more seems likely to be better. Similarly, how different members of the global population experience different degrees of intergenerational inequity in experiencing biodiversity merits additional research.

KEY STEPS NEEDED TO RECTIFY THE INTERGENERATIONAL INEQUITY IN NATURE

While there are currently many mechanisms (frameworks, legislation, incentive schemes) to conserve biodiversity, the increasing number of species on the IUCN Red List and the increasing amount of habitat transformed illustrate they have not been sufficiently effective. Reasons for this are diverse, and include poorly framed legislation and weak regulation mechanisms (Cole, 1992), inadequate engagement with local communities and diverse sectors of society (Andrade and Rhodes, 2012), and particularly, inadequately addressing the world's dominant economic system as a driver of environmental destruction (Tallis et al., 2008). A way in which this system of inequity can be righted is if society creates frameworks that confer true value to biodiversity and wild places (Büscher and Fletcher, 2019). This will rectify one element of intergenerational inequity—the equity of beneficial experiences and positive feelings associated with biodiversity and wild places.

CONCLUSION—PROTECTING INTERGENERATIONAL EQUITY OF NATURE

Society clearly and urgently needs to change its course if it wants to protect intergenerational equity of nature. Scientists, indigenous people, conservationists, and other allies understand what is happening to biodiversity, wildlife and wild places. Inaction is not an option and it is incumbent upon the concerned citizens of the planet to trigger the change necessary in our society. To date, there has been no formal recognition of this form of intergenerational inequity. Entrenching these in policy is a key component of this in the same way that sustainability has been.

Importantly, all is not yet lost. There have been successes in improving intergenerational equity inherent to the experience of wildlife and wild places. For instance, the commercial whaling moratorium has led to increasing great whale numbers such

that future generations will be more likely to see the majesty of huge whales breaching than current generations (**Figure 1**). Improving the water quality of the Potomac River, once described by US President Lyndon Johnson as a “national disgrace,” has meant future generations are likely to see dolphins swimming and breeding within the once polluted river. Following the awareness of the value of its ecosystems, Costa Rica transitioned from one of the highest deforestation rates in Latin America in the 1980s to doubling its forest cover in <30 years thanks to effective policy making. This led to a remarkable recovery of biodiversity, but also gains in social indicators, especially education level and poverty reduction, over the same time frame.

These accomplishments provide evidence that human society has the expertise and ability to achieve conservation outcomes. However, these successes rely on timely action and progressive policies, adequate legislation, substantial financial investment, ecological expertise and commitment from various stakeholders, through effective alliance of governments, scientists, and local communities. Future generations will not forgive us if we fail.

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MH and PL conceived the idea of the paper. All authors contributed to the writing.

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