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Review

Digital pathways to environmental stewardship

Alba Ortiz[1,2], Mollie Chapman[3,*] and Johannes Langemeyer[1,2,#]

Digitalization is transforming the ways people experience nature and is often blamed for a decline in environmental values and stewardship action. Yet, there is little understanding of how social media content facilitates indirect nature experiences and influences notions of care for nature. This conceptual paper explores how social media can be a space of both opportunity and risk to mobilize values for environmental stewardship. We argue for the potential to rely on three interconnected pathways: affective, cognitive, and enabling pathways. The affective pathway deepens care by fostering emotional connections to nature via storytelling and social validation, yet care is eroded through aestheticization and emotional saturation. The cognitive pathway broadens knowledge by democratizing access to information and facilitating collective sense-making, although knowledge is distorted through algorithmic mediation, the creation of echo chambers, and the reinforcement of pre-existing beliefs. The enabling pathway drives agency through social contagion and grassroots mobilization, linking local actions to global discourses, yet existing unequal power dynamics are also reinforced. Therefore, designing effective communication strategies and network structures in a rapidly changing offline-online environment will be essential for leveraging the potential of social media for sustained environmental stewardship and avoiding the risks.

Addresses
[1] Social-Ecological-Digital Systems Lab, Institute of Environmental Science and Technology, Universitat Autònoma de Barcelona, 08193 Cerdanyola del Vallès, Barcelona, Spain
[2] Department of Computer Science, Universitat Autònoma de Barcelona, 08193 Cerdanyola del Vallès, Barcelona, Spain
[3] TdLab, Department of Environmental Systems Science, ETH Zurich, Switzerland

Corresponding author: Langemeyer, Johannes (Johannes.langemeyer@uab.cat)
[*] https://orcid.org/0000-0003-1399-2144
[#] https://orcid.org/0000-0002-0558-8486

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Introduction

Social media platforms are changing the ways in which people experience, value, and care for nature [1–4]. Although the widespread adoption of these platforms across more than half of the global population [5] has often been blamed for nature disconnection [6,7], indirect interactions through nature-related content can also deepen interest in the natural environment and reinforce environmental values [8–10]. Yet how might these interactions between the digital and physical worlds shape (dis)engagement in environmental stewardship? What role might they have in mobilizing values and fostering actions? The digital age demands novel theory and assessment frameworks to better understand why and how people engage in environmental stewardship within hybrid contexts, where the boundaries between the digital and physical are increasingly fluid. This article explores how social media can serve as a space of both opportunity and risk for environmental stewardship. It considers the pathways that may enable grounded stewardship, as well as those conditions under which such efforts might be undermined. We consider two kinds of stewardship, broadly, as well as the ways that these interact. On the one hand, biocultural stewardship is rooted in the links between cultural diversity and biodiversity and usually involves place-based local action. On the other hand, much literature on stewardship focuses on a broader definition that also includes efforts to address the global environmental crisis, sometimes referred to as earth or planetary stewardship

[11]. Digital environmental stewardship is unique in the way that it can iterate between local biocultural stewardship and planetary stewardship.

Many, if not most, environmental stewardship initiatives use social media, but few have large audiences online, and their effectiveness (despite significant investment of time and resources) remains unclear [12]. Some authors suggest social media engagement to be a purely performative action that fails to translate into meaningful behavioral change [13]. However, dismissing digital engagement overlooks the potential for complementary pathways to stewardship and neglects the deep physical-virtual entanglement, which is a reality for many people, especially younger generations [14,15,16,17].

Put simply, "stewardship is caring about what we value [18]." While research around relational values has advanced our understanding on how nature's values and stewardship emerge and unfold in the biophysical world — highlighting the importance of relationships between people, places and more-than-human life — the concept of *digital relational values (DRVs),* introduced by Langemeyer & Calcagni [19], extends this perspective into the digital space to shed new light on how these relationships are co-constituted in digital and physical spaces. In this way, nature-related content shared online is not merely a digital reflection of offline activities but constitutes a relational expression and ongoing negotiation of nature's values, see also [8,20]. DRVs encompass values related to identity, sociality, agency, and wellbeing, such as, for example, *social relations*, *ecological literacy*, *sense of agency*, and *aesthetics* (Figure 1). DRVs are shaped within online communities that function as complex systems with distinct norms, affordances, and limitations [21,22]. Mirroring societal nature's values in non-digital contexts [23], DRVs are considered foundational to efforts to foster environmental stewardship in hybrid contexts [19].

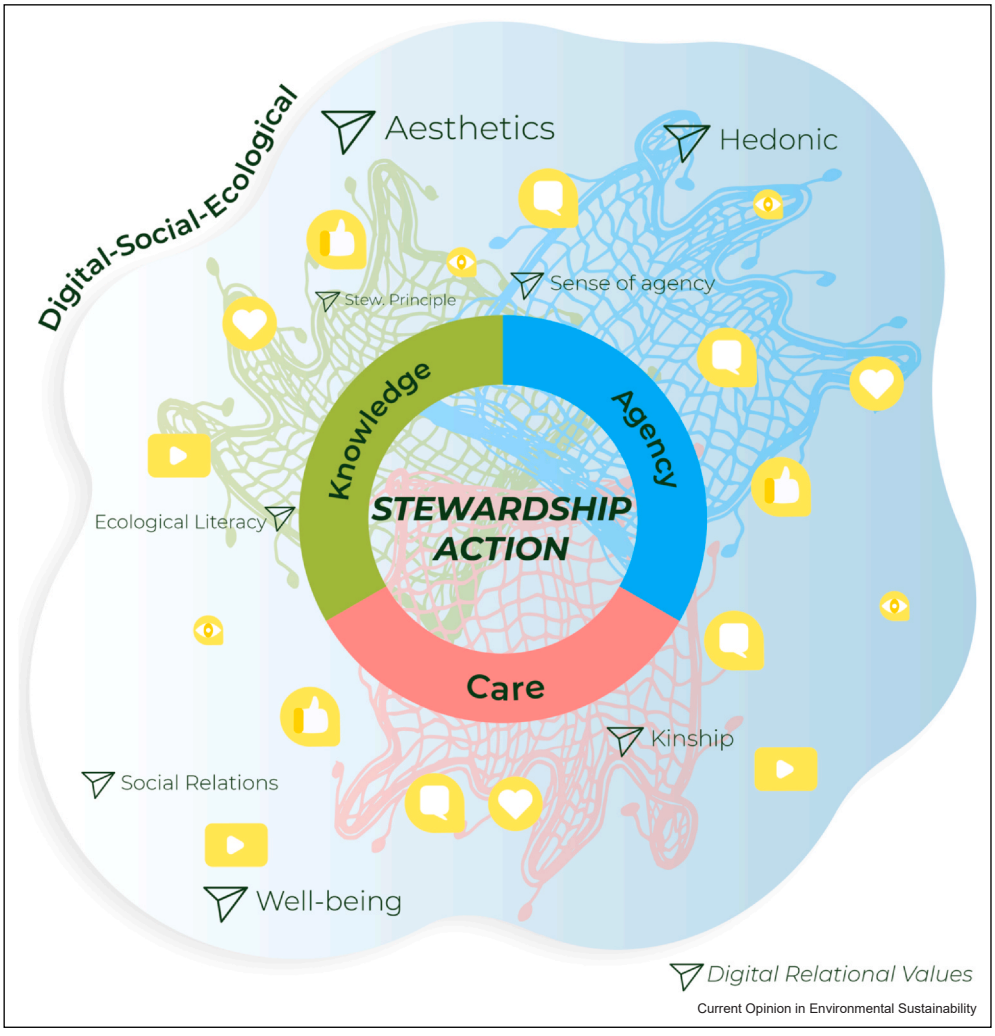
When someone publishes a social media post, they signal that they ascribe some kind of value to the content [8], even though this motivation can be mixed with the instrumental logics of digital platforms that promote self-representation and reward engagement [24]. When nature is represented in social media content, user responses can range from disengagement to varying levels of engagement (from viewing to commenting on or sharing a post). These content interactions by other users function as social signals of alignment or contestation, through which meanings and values can be collaboratively constructed [8]. In this way, a post functions as a site of valuation, where meanings of nature are negotiated. The extent to which such expressions reflect genuine values and not curated forms of self-portrayal remains uncertain. In those networked spaces, the reach of the content —— its 'spreading' [19] —— depends on multiple factors, including, without being exhaustive, framing and emotional expression, the presence of influential voices, algorithmic amplification, platform features, and (platform-specific) social norms and institutions [3,24,25,26,27]. However, while DRVs can be widely 'seeded' and shared on social media, they risk becoming 'dispersed' if not translated into stewardship action. We assume that the 'grounding' of DRVs into stewardship action [19] is not a passive reception of digital content but a relational, interactive, and iterative process among individuals, communities, and their digital-social-ecological contexts. This process is shaped by the societal and technological affordances of social media platforms and by the material realities of the physical environment in which stewardship practices take place. It can lead to more globally focused stewardship or to biocultural stewardship, or perhaps to linkages between the two. These different entanglements of global and biocultural stewardships can be seen in the three examples in Table 1. The first example, Espigoladors, is an organization that takes a global issue — food waste — and implements local forms of stewardship, creating a link to historical practices, but implemented with the current local food system. The second example, #NoDAPL, highlights the ways that global and local biocultural stewardship intersect. The movement focused on stopping the Dakota Access Pipeline on indigenous ancestral land. It brought together both topics of care for the biocultural heritage of the Standing Rock Sioux, the protection of their water resources, alongside support from global stewardship efforts to halt new fossil fuel infrastructure. In the case of Coral Gardeners, example 3, the issue of coral reef bleaching is addressed firstly locally, starting with local, grounded biocultural stewardship in Mo'orea (French Polynesia), but then using social media to generate funding, support, and resources, and scale the program out to other local projects. Table 1 further explains how pathways to grounding and dispersal may manifest across the different initiatives by triggering care, knowledge, and agency.

The relational lens allows us to frame this process as simultaneously social, ecological, political, and technological [30]. We build on Enqvist et al.'s [31] three dimensions of stewardship action —— care, knowledge, and agency —— to theorize how social media can foster and undermine each of these dimensions (Figures 1 and 2). Extending this initial framework and Enqvist et al.'s [32] more recent work on theater as a creative practice in conservation conflicts, we reflect on how social media can likewise be understood as a performative arena in which stewardship is enacted and contested through the reshaping of meanings, relationships, and power.

Digital pathways for environmental stewardship

We expand the concept of 'grounding' [19] as the process through which care is deepened, knowledge is

Figure 1



Stewardship fostered in digital-social-ecological systems: The conceptual framework illustrates how DRVs may become either grounded (i.e. caught in the fishing net) or dispersed (i.e. out of the fishing net) in digital-social-ecological systems. DRVs positioned closer to Care, Knowledge, and Agency, such as *ecological literacy* and *sense of agency,* are more likely to be connected to biocultural stewardship practices than those located further away (e.g. *aesthetics* or *well-being)*. The entanglement of the differently colored fishing nets at the center of the figure illustrates the interaction among the three pathways; when triggered together, their interplay strengthens and grounds stewardship action. The size of the DRVs also speculates on their prominence in the digital sphere.

contextualized, and agency is enabled, such that DRVs can foster environmental stewardship. Conversely, 'dispersal' refers to situations in which DRVs remain ephemeral and fail to translate from online engagement into stewardship in the physical world.

Affective pathway: care

The *Care* dimension involves subjective and normative aspects influencing stewardship action, such as an emotional connection to nature and its meanings and values ascribed to it [30]. It is worth noting that care is not inherently positive, as it can also lead to harmful practices, for example, driving wildlife trade, justifying the captivity of species, or displacing local communities for the establishment of protected areas [33]. Social media can function to link care for global issues to local contexts or vice versa, to link local communities' concerns to a global audience.

Affective resonance

Overall, social media platforms shape the affective landscape of stewardship by enabling the expression and amplification of emotions, which further reinforce or challenge social norms around care. Certain emotions are likely more effective at inspiring stewardship action than others [34]. Emotional storytelling from user-generated content, for instance, might connect more abstract values

Table 1

Case examples of biocultural stewardship initiatives that have used/are using social media for their mission. Digital pathways to grounding and dispersal are explained, detailing how care, knowledge, and agency may be fostered or undermined through social media.

Example of Initiative	Description	Digital pathways to grounding	Digital pathways to dispersal
Fundació Espigoladors	A non-profit organization from Catalonia that fights against food waste, while empowering people at risk of social exclusion from a transformative, participative, inclusive, and sustainable way.	Educational content posted by Espigoladors strengthens knowledge by translating abstract issues of food waste and inequality into tangible narratives. Care and agency are moreover nurtured by appealing to ethical responsibility and everyday practices around food.	Emphasis on awareness-raising risks limiting agency to individual behavioral change, unless online engagement is coupled with pathways to collective action, political advocacy, or participation in on-the-ground food recovery.
#NoDAPL movement	Movement led by the Standing Rock Sioux Tribe against the Dakota Access Pipeline.	Social media played a decisive role in shaping the affective engagement with the pipeline protests. Indigenous knowledge was carried into digital spaces through storytelling, and the Facebook check-in function allowed to show support and solidarity for the people present from far-away, further enabling Indigenous-led resistance [28].	Social media can foster empathy by offering snapshots of live protests, but also risks substituting meaningful allyship through low-effort digital gestures that leave deeper structures of privilege untouched.
Coral Gardeners	Reef restoration initiative that began in Mo'orea (French Polynesia) and has become globally known largely because of their use of digital tools.	Sharing live footage from coral reef restoration on social media has allowed *Coral Gardeners* to show otherwise invisible work in remote places to a global audience and through this foster not only affective advocacy for marine conservation but also securing the necessary funding to sustain their operations [29].	Due to the visual constraints of social media platforms, reefs are sometimes portrayed as objects rather than culturally embedded seascapes, risking a very one-sided public imaginery of what a healthy reef should look like. There is also a risk of dependency on corporate identity for visibility and donor appeal, which may shift priorities away from long-term stewardship.

to personal, lived experiences, which resonate with other individuals and can inspire environmental action.

Rather than being instilled top-down, for instance, through digital environmental campaigns, care likely emerges in dialogue through likes, comments, and community (social) validation and builds over time through repeated exposure. For example, a particular endangered flagship species —— such as the polar bear in the context of climate change —— might become a symbolic focal point, and through emotional storytelling and emergent webs of community validation, turn into a valued natural entity for which even people who never physically encounter it, feel connected to and be motivated to take action to protect.

Affective erosion

In this process, social media are not neutral platforms but environments in which care can be either nurtured or neglected, for instance, through influential voices, moderation policies, and the creation of echo chambers [35].

Public outrage on social media over environmental damage or animal suffering can escalate into hostile online campaigns, intensifying conflict rather than fostering constructive dialogue and solutions.[3]

The strong aesthetic focus of most social media platforms further risks an over-representation of some values and actions of care, which are more tangible and easier to convene aesthetically, such as a polar bear, than others, such as ecosystem complexity, carbon cycles, or political advocacy [36]. Therefore, more transformative forms of care —— crucial for long-term environmental stewardship —— may not perform well in conventional social media engagement metrics and get less visibility.

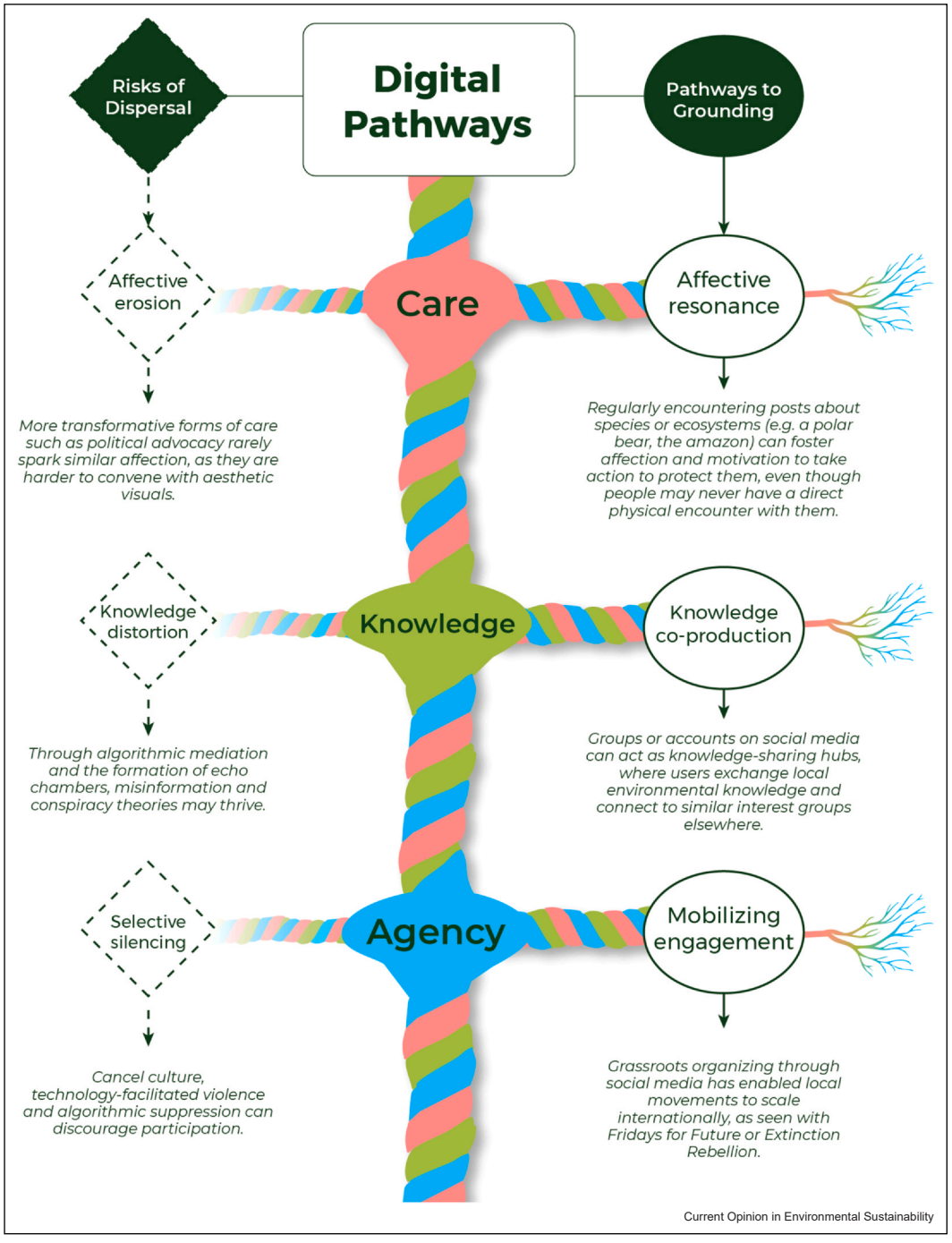
However, constant exposure to emotionally laden content can also lead to emotional numbing and social media fatigue [37]. In a medium of information overload and fragmented attention, caring is also an act of resisting distraction, to remain involved and responsive over time.

Cognitive pathway: knowledge

The *Knowledge* dimension refers to the understanding of

[3] We thank an anonymous reviewer for pointing us to this relevant example.

Figure 2



Building on West et al. [30], here we illustrate the digital pathways to environmental stewardship, showing how DRVs are grounded in environmental stewardship action or dispersed through three distinct pathways: 1) affective resonance vs affective erosion, 2) knowledge co-production vs knowledge distortion, and 3) mobilizing engagement vs selective silencing.

what needs to be stewarded and how, including different epistemologies, from scientific literacy to traditional knowledge and social learning, among others [31]. It helps direct the desire to act on care in an informed manner. In this context, knowledge might flow from local biocultural stewardship to global movements or vice versa, as well as across local biocultural initiatives, in terms of sharing strategies of resistance or fundraising, for example. While social media often facilitates these connections, knowledge exchange itself is not confined to the digital spaces and often occurs elsewhere.

Knowledge co-creation

Social media is a rich source of informal environmental education [38,39]. Through the participatory features of social media platforms, users can exchange resources and ask questions. The global scales at which these platforms operate can facilitate cross-cultural exchange and peer-to-peer learning, which may enable users to move beyond content consumption and awareness raising toward knowledge co-production. For instance, the Facebook group *Home Gardening Ghana* [40] acts as a knowledge-sharing hub, where participants exchange gardening tips and local ecological knowledge and connect to similar groups elsewhere.

Social media also mediates the uptake of environmental knowledge, as it influences what we think is worth noticing and responding to. As such, how human-nature interactions are framed in social media discourses may shape how we understand what needs to be stewarded and how [41].

Knowledge distortion

Even though social media has partly democratized access to information, the creation of content is driven by a small fraction of users, raising concerns about the true diversity of perspectives represented on these platforms [42]. The proliferation of AI-generated content will further overrepresent certain worldviews, as AI is still very limited in terms of knowledge pluralism and especially dominated by written English content.

Platform affordances play a direct role in shaping the dominant narrative, moderating what and who is included or excluded, making this environment a contested space for visibility, where different understandings of environmental stewardship can be negotiated. Moreover, content moderation practices such as shadow banning (suppressing a user's content without notifying them) invisibly privilege certain voices while silencing others, reinforcing unequal power dynamics [43].

Misinformation and conspiracy theories can also thrive and lead to undesired outcomes (e.g. climate change denialism, greenwashing) [44,45]. Algorithmic mediation tends to feed content aligned to the user's pre-existing beliefs, reinforcing the same perspectives, and limiting the reach of environmental knowledge to new audiences. At the same time, knowledge uptake can be mediated by the level of care – the more someone cares about an issue, the less inclined they may be to seek out alternative perspectives.[4]

Furthermore, the saturation of information and a constant offer of entertainment make it increasingly difficult for meaningful content to 'break through the noise' [46]. Consequently, environmental issues may often emerge as social media trends, risking short-lived participation before fading from public attention. This volatility is reinforced by content guidelines and specific platform formats, which limit the construction of a post and its message, further challenging the balance between accessible and engaging content and scientific accuracy and nuance.

Enabling pathway: agency

The *agency* dimension refers to the perceived and actual capacity to take action, which can also be cultivated online. Here we cast a wide net in terms of stewardship actions — from likes to activism to on-ground practices — while inviting to reflect on: which forms of stewardship action have transformative potential, and which remain merely performative?

Mobilizing engagement

Seeing others engage in stewardship activities or receiving feedback for one's own actions can normalize stewardship behavior and provide inspiration and encouragement to participate, leading to social contagion and expanding the perceived range of what is possible [47]. When expressions of value are paired with concrete calls to action (e.g. joining community events, protests, citizen science initiatives), we hypothesize that digital engagement can mobilize stewardship efficiently and effectively. As seen in movements such as Fridays For Future, engagement on social media can lead to sustained offline mobilization, shaping national discourse and policy agendas.

Moreover, social media promotes a culture of accountability, exposing environmental issues and injustices publicly and in almost real time. This creates potential to strengthen social connections over a cause within a society that is experiencing individualization [48] and a decline in civic engagement [21,49,50]. This provides fertile grounds for grassroots organizing and public debate. The rapid formation of virtual networks around shared concerns can lower barriers to engagement and allow marginalized and under-represented voices to gain more visibility, fostering dialogue and collective identity [51].

[4] We thank an anonymous reviewer for this point.

The interconnectedness of social media can help link local to global scales, the individual to the systemic and vice versa [52]. Diverse local biocultural stewardship initiatives can scale to global awareness by building alliances, with the potential to influence policy agendas [53].

The Fridays For Future movement (FFF) demonstrates how agency can be enabled best when it builds on care and knowledge. Through accessible formats of communication, FFF has cultivated knowledge and affective concern about climate change, especially among youth, and as such, enabled agency, translating online mobilization into mass demonstrations and political pressure [54].

Selective silencing

Critical voices argue that social media may contribute to the perpetuation of existing power relations, highlighting how platform monopolies, influencer capitalism, and digital surveillance concentrate control over information flows [55].

At the same time, 'cancel culture' can lead to the public ostracism of individuals, creating a climate where users feel hesitant to express their opinions freely, particularly about polarized topics. Therefore, environmental stewards risk getting exposed to doxxing/(online) harassment, persecution, and violence when being vocal about environmental conflicts.

The operation of social media within the neoliberal economy risks redirecting environmental concern and expression of nature's values toward market value rather than transformative change.

Conclusion

Focusing on the grounding potential and risks of dispersal of DRVs, our perspective aligns with the growing interest in how relational values foster environmental stewardship [30]. We conclude that social media offers complementary pathways to mobilize relational values for environmental stewardship by fostering care, knowledge, and agency. Yet, the potential is determined by the social, environmental, political, and technological affordances that shape how digital nature interactions are portrayed and made meaningful. These structural constraints shape who can participate, whose voices are amplified, and how stewardship narratives are framed and monetized. Major risks associated with the use of social media include privacy data violations, surveillance of individual stewards and communities, technology-facilitated violence, and the reduction of complex human–nature relationships to commodified and consumable content. Addressing those challenges will require further investment in digital literacy and low-bandwidth platforms that better accommodate marginalized communities, but more importantly, policy and regulatory oversight on platform monopolies to ensure the protection of users.

Broadly, we expect to find a rather homogenous digital value landscape, shaped by platform affordances and community cultures, which could privilege certain value expressions over others. Hedonic values such as *aesthetics* and *well-being* may be over-represented as they are very aligned with the esthetic focus and prominence of narratives of 'living your best life' on social media platforms. However, we speculate in Figure 1 that these values will likely be more dispersed around the digital space rather than anchored in concrete stewardship action. By contrast, we hypothesize that moral and action-oriented values, such as a sense of agency or literacy, will be more likely to be used to communicate stewardship online and will have a higher grounding to be particularly effective when they can be paired with clear calls to participate in on-the-ground practices. Empirical research across multiple platforms, languages, and virtual communities will be key to disentangling how these different factors interact and to assessing their relative influence in shaping value formation and practices of care for the environment.

Thus, future research, which critically depends on platforms' commitment to provide data to researchers [56], should identify the key leverage points and barriers through which social media mobilizes relational values for environmental stewardship, considering the contextual factors, such as demographic and biocultural settings, governance structures, and platform affordances.

While research is important, practitioners are needed to translate those findings into impactful engagement. Understanding and designing effective communication strategies and network structures in a landscape that is changing so rapidly will be essential for leveraging the potential of social media to sustain environmental stewardship in the long run. While there will be no universal recipe for a successful communication strategy, a focus on stewardship grounding, rather than just information sharing, is key. We assume that by activating the three interconnected pathways (affective, cognitive and enabling) digital communication can move audiences beyond awareness toward such grounded engagement. Grounding, in this sense, involves situating information within shared values and lived experiences, thereby enabling users not only to understand socio-ecological issues but also to locate themselves within them and to act in response, thus shifting the narrative from 'living your best life' to living a 'good, meaningful life'. This includes proposing concrete actions to take and placing a focus on relationality to foster meaningful relationships with place and within and across communities. Relationality in the digital space should lead to forms of engagement that are not merely performative

but embedded in networks of influence and reciprocity, creating deeper connections that can serve as the foundation for sustained stewardship over the long term. We assume that social media platforms have the greatest potential at catalyzing these connections, given their capacity to connect people at unprecedented spatio-temporal rates.

By challenging the widespread notion that social media leads only to nature disconnection and a decline in environmental stewardship, we hope that our framework inspires discussions and new questions on the role of social media platforms in influencing the socio-ecological transition.

Data Availability

No data were used for the research described in the article.

Declaration of Competing Interest

None.

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