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Abstract

Regenerative thinking is gaining momentum in HCI, shifting the focus from merely mitigating environmental harm to actively fostering cohabitation within more-than-human ecosystems. This shift challenges HCI researchers to develop new methodologies that engage with both material and cultural regeneration—harnessing the regenerative capacities of ecologies while preserving valuable knowledge systems. It also underscores the need for a fundamental onto-epistemological shift beyond anthropocentric notions of sustainability. To support HCI researchers in adopting regenerative approaches while addressing these challenges, this panel brings together a diverse group of design researchers working hands-on with materials ranging from biological to algorithmic. Through concrete examples and actionable insights, the panelists provide practical guidance on engaging with regenerative material ecologies. By interweaving multiple perspectives through a diffractive approach, the panel also explores the opportunities this emerging perspective offers for HCI, particularly at the intersection of sustainability, posthumanism, and decoloniality.

CCS Concepts

• **Human-centered computing** → Human computer interaction (HCI); HCI theory, concepts and models.

Keywords

regenerative ecologies, sustainability, more-than-human, biodesign, practice-based research, indigenous knowledges, material-driven design

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1 Introduction

The technologies we design have profound social and ecological consequences, consuming valuable resources and often marginalizing diverse perspectives [7, 9, 33]. A recent study estimated that generating a single 100-word email with an AI chatbot using GPT-4 consumes approximately 519 milliliters of water—more than a standard bottle [22]. While accurately measuring the environmental footprint of contemporary technologies is challenging—particularly given their nature as socio-technical systems distributed across multiple locations and timeframes—one thing is clear: the development and use of technology frequently come at the expense of ecological balance [13].

While quantifying the social and environmental harms of technology is crucial, a more pressing question for the CHI community is: *How can HCI research contribute to restoring ecosystems damaged by the production and use of novel technologies?* Addressing this question requires a fundamental rethinking of sustainability in design—one that shifts the focus from harm assessment to active participation in regeneration [10, 23] and from human-centered approaches to post-anthropocentric notions of sustainability.

Within these shifts, designers and scholars from various disciplines are embracing regenerative approaches. Regenerative design seeks to harness ecosystems' inherent vitality and capacity for renewal and self-restoration [8, 11, 24, 31, 34]. It does so by adopting relational perspectives that position humans as integral participants within ecosystems rather than as masters attempting to "control" nature [16, 20, 39]. While regenerative design prioritizes multispecies cohabitation, its broader aim is to cultivate both ecological and cultural regeneration [11, 36].

Despite its growing momentum in HCI [15, 16, 20, 30, 33, 39], implementing regenerative approaches remains complex. Challenges arise on multiple fronts: some are technical, stemming from the novelty and intricacy of material technologies [25, 29], while others are methodological, as many established design frameworks are rooted in humanist principles [27]. More fundamentally, regenerative design requires an epistemological shift—one that involves unlearning entrenched Western and colonial anthropocentric ways of thinking in design and HCI [17, 18, 37].

To address these challenges, it is essential to examine existing regenerative practices both within and beyond HCI. Practice-led researchers in HCI are particularly well-positioned for this task. Their hands-on engagement with diverse materials has fostered a deep understanding of relationality, interdependence, and ecological principles. Moreover, they have explored practices that blur disciplinary boundaries between biology and technology, design and engineering, as well as the conventional divide between theory and practice.

Examples of such work include 3D printing with bio-based materials [4, 14], weaving and textiles with evolving fabrics [1, 21, 29], designing living artifacts [20, 40], and, more recently, creating multispecies interactions with and through living organisms to support regenerative ecologies [38]. Building on this practice-based body of work, the panel explores how HCI research can contribute to the development and maintenance of regenerative material ecologies.

The panelists' work provides concrete examples across various materials, including living/biomaterials (Karana, Bell, Helms), textiles (Devendorf, McQuillan, Withers, Oogjens), morphing and active materials (Yao, Kakehi, Karana), and digital materials (Devendorf, Nicenboim, Helms, Oogjens, Speed). Through these examples, the panel not only articulates key principles for regenerative HCI but also provides practical guidance for researchers interested in adopting this approach.

The panel also addresses tensions in this emergent approach–and potential strategies for navigating them. Beyond the distinct challenges posed by different materials, the panel discusses the trade-offs between technical innovation and sustainability that practitioners face, the interplay between regenerating cultures and materials, and the challenge of determining appropriate scales, from systemic perspectives to localized approaches. Additionally, the panel highlights the need for critical engagement with regenerative design to avoid reproducing the same anthropocentric biases we aim to overcome.

The discussion during the panel is framed as a dialog around a series of questions: *What novel ways of thinking and doing do regenerative approaches propose to HCI? What challenges do regenerative material practices face in HCI, and how do material-specific aspects shape these dynamics? How could a regenerative approach help to (diffractively) align different HCI discourses around sustainability and inclusion?* These questions are addressed through five themes that cut across them: *Temporal and Ecological Scales, (Bio)Diversity and Interdependence, More-than-human Sensibilities, Ecological Literacy and Onto-Epistemological Shift.*

The purpose of the themes is twofold. On the one hand, they help organize the discussion by framing practical questions within each pillar, outlining concrete paths for making HCI research regenerative. On the other hand, the themes interrogate practices, providing access points to the seemingly messy research processes through design (RTD), including its experimental nature and alternative outcomes. In other words, the themes are generative, offering opportunities to reflect on the panelist's practices, including the challenges, opportunities, and epistemological shifts they encounter in this type of work.

The discussion will be guided by a diffractive principle [26], which presents divergent perspectives through one another and attends to interference patterns without attempting reconciliation. This technique is used to facilitate the discussion among panelists but also to encourage active audience participation. The envisioned outcomes are a website, a Special Issue on Regenerative HCI in the TOCHI journal, or an edited volume. These will aim to promote the development of a Regenerative HCI program focusing on ecological and material practices. Together, these efforts aim to support the development of a Design Research Program for Regenerative HCI that encompasses rich theoretical, practical, and epistemological dimensions.

2 Towards Regenerative Material Ecologies

More than two decades ago, Edward Wilson predicted that the 21st century would be defined by efforts to restore ecosystems [41]. However, dominant sustainability approaches have primarily centred immediate human needs and values while neglecting the

interdependence between human and non-human life. Additionally, the motivations behind dominant restoration efforts have failed to account for futures that include the aspirations of Indigenous communities, who continue to resist ongoing patterns of dehumanization exacerbated by globalization.

From these critical discussions, a more relational understanding of ecology has emerged, positioning regeneration as central to sustainability. A regenerative material approach promotes a shift toward designing material systems that nurture the diverse cycles, scales, and temporalities of organisms, materials, and energy forms [20]. Ecologies shaped by this perspective—referred to as Regenerative Ecologies (ibid)—foster biodiversity while encouraging ecological literacy, holistic worldviews, and deep care for the various life forms that sustain the interconnected web of life. In regenerative ecologies, mutualism, coevolution, and cohabitation define the relationship between humans and other species.

The dynamic, emergent nature of regenerative thinking aligns with the principles of the living systems paradigm, which asserts that all systems exist in interaction and interdependence. In this framework, humans and nature are not separate systems but interconnected components of a dynamic, self-organizing whole. Consequently, regardless of scale, everything designed, produced, and transformed is inherently part of these broader ecological systems. Regenerative design also aligns with posthumanism [3, 5, 6, 12, 18, 28, 35, 38] by challenging anthropocentrism and questioning humanist ideals around progress and modernization [19, 27].

Based on this novel approach to sustainability, regenerative design urges HCI researchers to rethink their positionalities and situate the knowledge they produce, moving beyond anthropocentric notions of sustainability that place human needs at the center. These approaches do not propose excluding humans but rather centring relational subjects—humans understood as always existing in relation to other species, diverse human communities, and ecosystems. Similarly, while regeneration might suggest restoration, it should not be conflated with a solutionist approach in which humans assume sole responsibility for "fixing" the planet. Instead, the focus is on understanding how humans are embedded within ecosystems and how they can continue to exist in ways that support all forms of life [36].

Rather than attempting to "fix" or "control" the environment, regenerative approaches invite us to step back and learn from sites where valuable knowledge has already been cultivated. This is particularly important in HCI, as regenerative systems are central to many Indigenous communities, which maintain that humans belong to the ecosystems from which they descend rather than exercising power and ownership over them. However, this knowledge has been systematically displaced. Thus, restoring ecosystems also requires restoring their associated sustainability knowledge systems. This demands processes of reflection, slowing down, unmaking, and unlearning while centering Indigenous practices that have historically been marginalized. Ultimately, regenerative thinking calls for relinquishing control and embracing change. As Daniel Christian Wahl writes in Designing Regenerative Cultures [36], "*If we stop wanting to control change and shift to a responsive dance with change, we will become more effective change agents*" (p. 138).

3 Panel Themes

To guide the discussion, the panel is structured around five themes inspired by the five pillars of regenerative ecologies identified by Karana et al. [20]. While this framework focuses on the potential of living artifacts within regenerative ecologies, the panel takes a broader approach, repositioning these pillars toward material practices in HCI. The themes and their key questions are as follows.

3.1 Temporal and Ecological Scales

This theme encourages a critical examination of how materials—whether non-living or living—are sourced, used, archived, and disposed of within HCI studies and artifacts. Key questions within this theme include:

How can the scales and temporalities of living and non-living entities in HCI research be attuned to establish cyclical material and energy systems?

How can HCI effectively engage with regenerative material ecologies across diverse scales, temporalities, and geopolitics?

How can regeneration challenge the traditional view of time as a linear trajectory toward infinite human progress and instead attune us to alternative perceptions of time by engaging with non-humans, materials, and living beings?

3.2 (Bio)Diversity and Interdependence

This theme focuses on the interdependence of materials, living organisms, and their environments, highlighting the intricate networks of relationships that include intra-actions, adaptations, resource flows, and co-evolutionary dynamics. It looks at how diversity at various levels is essential for resilience and regeneration. This theme raises critical questions such as:

How can HCI research foster multi-species ecosystems, cultivating collaborative and creative dynamics?

What is the appropriate role for humans to assume within these ecosystems? When and to what degree could/should humans intervene?

How can HCI research embrace the emergence and unpredictability of living aesthetics arising from the intricate dynamics among multiple species?

3.3 More-than-human Sensibilities

This theme underscores the importance for designers and researchers in HCI to develop sensitivities to design-with, i.e., increasing the participation of nonhumans in the design process and considering the perspectives of both humans and nonhumans marginalized by anthropocentric design approaches. The theme invites reflections on the following:

How can HCI researchers get sensitized and attuned to non-human species' needs, temporalities, scales, and aesthetics?

How can HCI research foster a comprehensive understanding of (and design for) mutualistic care practices that extend beyond the human realm to encompass more-than-human entities?

What is the culture of participation with Indigenous and diasporic (displaced) communities and HCI, and how can that inform politics of participation in HCI?

3.4 Ecological Literacy

This theme highlights the need for regenerative HCI research to cultivate ecological literacy and facilitate knowledge-building among individuals, communities and society about ecological principles. This awareness has the potential to inspire and connect sustainable social practices towards developing a profound appreciation for the complexities of living aesthetics. The theme considers:

How can material-driven research help communicate and express the principles and activities of living organisms?

What role can care practices play in enhancing the capacity to facilitate knowledge-building within ecological contexts?

To restore connections with their knowledge systems, what must HCI researchers understand about (and with) Indigenous communities and their needs and values?

3.5 Onto-Epistemological Shift

This theme explores how regenerative HCI can address the long-standing (Western/colonial) separation of humans from nature. About this potential, the theme raises several critical questions:

How can HCI research challenge prevalent societal stigmatizations associated with other-than-humans and foster accountability, appreciation, and transformative shifts in perspectives?

To what extent can living aesthetics' dynamic, unpredictable, and emergent nature effectively operate as a conduit for these shifts?

How can HCI aid in displacing dominant bias towards enhancing relational capacities with localized ecological communities towards regenerative shifts?

4 Format and Outcomes

To facilitate discussion among the panelists and encourage active audience participation, the panel adopts a novel and creative approach called diffractive dialogues [2, 26, 32]. This approach focuses on generating new insights by weaving diverse perspectives through one another, emphasizing the creation of novel pathways and connections rather than merely reflecting on existing knowledge or seeking reconciliation.

A panel transcript and video will remain available on the website after the event, ensuring that the diffraction process continues beyond the conference. The website will remain live, allowing for ongoing engagement and further contributions. Our aim is to compile the panel's insights, along with audience interactions during and after the event, into a position paper to be submitted to an ACM publication venue. This paper will summarise the key discussions and propose a roadmap for integrating regenerative design principles into HCI research and practice. Building on this, we will propose a special issue to TOCHI, focusing on Regenerative HCI and practice-based research.

5 Conclusion

This panel promises to be an exciting and engaging event that sparks lively discussions and attracts strong interest from diverse sub-communities within the CHI conference, including researchers working on sustainability, more-than-human design, biodesign, digital fabrication, textiles, critical AI, decolonial design, and material-driven design. The panel will foster dynamic and thought-provoking dialogue by bringing together novel perspectives to explore the intersections of various lines of research and practice. This timely and relevant conversation aims to catalyze the development of a Regenerative HCI program and inspire new directions in HCI research that can address the pressing environmental and social challenges in meaningful ways while actively contributing to the regeneration of all life forms on Earth and the revitalization of Indigenous knowledges.

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