P/REFERENCES OF DESIGN

MULTISPECIES ENGAGEMENT AND SPECULATIVE ECOLOGIES: TOWARDS MULTISPECIES WAYS OF KNOWING FOR ECO-SOCIAL SPECULATIONS.

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ABSTRACT | This paper introduces the concept of “Multispecies Engagement” as a framework to bridge speculative design practices with emerging multispecies and interspecies approaches that challenge the traditional human-centred focus within the design discipline. It emphasizes the necessity of incorporating non-human stakeholders into speculative design processes to address climate-related challenges, such as biodiversity loss, environmental conservation, and energy transitions, among others, thereby fostering social and ecological innovations. This study underscores the critical role of speculative design in tackling these issues and traces its evolution toward multispecies approaches, drawing from interdisciplinary fields like anthropology, amidst emerging socio-ecological challenges, transcending purely technological implications. The discussion is grounded in a mapping of Multispecies tendencies and potentials within design. This mapping identifies fields of action, roles, skills, and responsibilities of speculative designers, prompting further discourse. The goal is to provide guidance on navigating these diverse approaches and delineating the actions required from speculative and future-making designers concerning the potentials and limitations of embracing a multispecies perspective.

1. Climate Change as a Multispecies Design Challenge

Speculative Design Practices (SDP) play a pivotal role in envisioning alternative futures, and making substantial contributions to transdisciplinary and societal transformation processes. Traditionally, their focus has centred on critically examining the social impact and aesthetics of emerging technologies through fictional "What if" narratives and storytelling objects. However, as the climate crisis intensifies, a new frontier emerges, necessitating a shift beyond the technology- and human-centred roots of Speculative Design Practices. To meet this challenge, it becomes imperative to engage non-human stakeholders, such as plants, microbes, insects, and undiscovered and almost extinct species, in shaping solutions for today's complex socio-ecological issues.

This necessity becomes evident when putting human life in perspective: the estimated total number of species on Earth varies widely, with the vast majority believed to be microbial and still undiscovered. When considering only known and described species, humans represent a minimal percentage, estimated at less than 0.01% of the total. Even though this number is a rough estimate, it underscores the importance of envisioning futures that serve purposes beyond human-centric needs. Against this background, this study aims at sharing observations of an ongoing *multispecies turn* within Speculative Design Practices and questions new roles, responsibilities, and research questions that are emerging for the design discipline. Furthermore, this study invites framing climate related and ecological challenges as a *multispecies design challenge*, that requires modes of engagement and knowledge-production with other-than-human beings.

1.1 Interdisciplinary Playgrounds for Speculative Design Practices

The transformative potentials of Speculative Design Practices extend beyond the confines of design discipline. For instance, within the realm of research agendas, such as Responsible Research and Innovation (RRI) (von Schomburg, 2013) methodological approaches of Speculative Design Practices are valued, to include different perspectives from research, policymaking, economy, and society at an early stage of the innovation process, by extrapolating possible developments of emerging technologies with uncertain impacts, such as biotechnologies (Harles & Heidingsfelder, 2021). By embodying these outcomes through fictional narratives, they open debating grounds to discuss societal needs and to include perspectives of everyday life experts. However, against the backdrop of socio-ecological challenges, such as biodiversity loss, new design challenges emerge, that extend beyond technology-centered agenda settings and human needs. But the challenge lies in articulating those needs which interconnections are not always apparent in everyday life.

Furthermore, the potentials of Speculative Design Practices are increasingly recognized within the realm of public sector innovation, policymaking, and democracy. But here as well, the necessity to include non-human agents becomes evident, as the notion of granting legal rights to non-human beings gains traction at governmental levels, exemplified by initiatives like the "Sumac Kawsay" in Ecuador or the "Te Awa Tupua Act" in New Zealand (Kauffmann & Martin, 2018).

Against this backdrop, this study delves into how Speculative Design Practices can effectively respond to the growing demands for inclusivity on societal, political, and environmental levels that go beyond human-centric perspectives.

In the first section, the study emphasizes the impact of interdisciplinary *Multispecies Studies* and *Multispecies Design approaches* that challenge anthropocentric and Western-centric perceptions within the realm of socio-ecological challenges. This is followed by a short overview of the entanglements between design and nature, ranging from "Nature-inspired Design" to an ontological turn.

The main part of this study scrutinizes the evolution of SDP, tracing their roots from *Radical Design*. It showcases significant influences from interdisciplinary touchpoints and maps an emerging multispecies turn. The study culminates in a reflection on the requirements, challenges, and limits of a Multispecies approach in design, illustrated by a prototypical concept of "Multispecies Engagement."

2. A Multispecies Turn: Moving Beyond Human-Centered Ways of Knowing

2.1 Multispecies Ways of Knowing: Theoretical Common Grounds

This paragraph provides a brief overview of the theoretical foundations of *Multispecies Studies* at the intersection of interdisciplinary disciplines of humanities, social sciences and natural sciences. These contributions emphasize the interconnectedness of all living beings, including humans, animals, plants, and microorganisms. By moving beyond anthropocentric and western-centred understandings of nature, Multispecies Studies also challenge new modes of academic knowledge production. Therefore, this emerging field develops new methodologies for studying the agency and perspectives of other-than-human entities, contributing to social and environmental justice. As part of this study's investigation on Multispecies Approaches within the Design discipline, an overview of existing theoretical concepts is crucial. This overview proposes three theoretical pillars, each of them defined by influential concepts and pioneers from different backgrounds:

1. **Sociology & Posthumanism**
   Relevant and influential contributions to understanding multispecies are grounded in sociological and post-humanist concepts—primarily represented by Donna Haraway and Bruno Latour. Haraway's concept of "nature cultures," "companion species," or the "Chthulucene" challenges the traditional divide between nature and culture, emphasizing the complex and mutual entanglements between humans, animals, and the environment. Latour's actor-network theory highlights the agency of non-human actors in social networks (Latour, 2007), and his concept of "parliaments of things" proposes a new way of thinking about the relationship between humans and non-humans by emphasizing the need to understand the complex networks of actors and their interactions (Latour, 1993).

2. **Anthropology and Environmental Histories**
   Building on the foundations laid by Haraway and Latour, key concepts have emerged at the intersection of anthropological sciences and environmental history, specifically that of *Multispecies Ethnography* (Kirksey & Helmreich, 2010*), Multispecies* Assemblages (Aisher & Damodaran, 2016)*, Multispecies* histories (Loewenhaupt-Tsing et al., 2019) describing an *ontological and non-human turn (Grusin, 2015)*. These approaches have, in common, that they recognize the interconnectedness and inseparability of humans and other life forms from an anthropological perspective. They are emphasizing the agency of other-than-human species, highlighting the environmental, political and economic dimensions of human-nonhuman relations. The intersection of anthropological and environmental research, a contributing with valuable interdisciplinary methodologies for studying complex human-nonhuman relations.

3. **A Symbiotic View Of Life from a Natural Sciences Perspective**
   Recent findings in natural sciences challenge the perception of life forms as individual, independent entities. Gilbert's work on "A Symbiotic View of Life: We Have Never Been Individuals" advocates for re-evaluating the concept of the "biological individual" (Gilbert et al., 2012). Furthermore, the introduction of the "holobiont" discussed in natural science recognizes the multispecies assemblages comprising the multicellular eukaryote and its

persistent symbionts. This shift, influenced by Lynn Margulis, emphasizes the significance of symbiosis and cooperation in biological systems. Horizontal gene transfer further elucidates symbiotic evolutionary developments. These scientific foundations underpin multispecies ethnography, exploring the interconnectedness of human societies with the non-human world. Incorporating developments in environmental, conservation, and evolutionary biology into multispecies approaches enables interdisciplinary exploration of relationships between humans, non-human beings, and their microbial symbionts. This approach sheds light on how these relationships shape culture, society, and health.

These developments are paving the way towards new ways of knowledge production in academia that can lead to a fundamental culture change in Western-centric research institutions.

3. Human and Non-Human Entanglements Through Design

The entanglements of the human and non-human worlds within design practices are vast, forming a significant part of design history that is shaped by scientific and technological developments. To comprehend the mutual benefits between Multispecies Studies and the design discipline, this paragraph explores the roots of interconnected relationships between humans and their natural world within the design process, by proposing three concepts:

1. **Nature-Inspired Design: Nature as a Source of Inspiration**
   Nature has influenced various design domains, including product design, material design, architecture, and technology. Learning from nature, by adopting principles or mimicking movements, material qualities, and functionalities, has resulted in nature-inspired prototypes and concepts such as Biomimicry Design or Biodesign (Sachs, 2016). By engaging with nature as source of knowledge, other-than-human beings inform the design process. Here, designers are drawing inspiration from nature and seek nature-based knowledge, rather than opposing it. However, caution is essential to ensure that the design outputs benefit both human and non-human entities, considering ecological sustainability and ethical production.

2. **Transition Design, Eco-Social Design & Pluriversal Design: Designing for Eco-Social Transitions**
   Further developments that can be observed within the design discipline are approaches that consider the entanglements of social, political and ecological impacts of design. Its roots can be traced back to influential concepts evolving in the 1970s, such as Viktor Papanek's "Design for the World," or Buckminster Fuller's works on the "Operating Manual for Spaceship Earth." They are emphasizing the need for functional, sustainable, and accessible designs that address the needs of all people, marginalized groups, and the environment. In contrast to nature-inspired design, the role extends beyond generating tangible design outputs. It is elevated to a systemic level that connects societal, political, and ecological perspectives.
   The systemic role of design is negotiated against the backdrop of current socio-ecological challenges and is expanded through approaches such as Transition Design (Irwin, 2015), Eco-Social Design (Krois, 2020) or Pluriversal Design (Escobar, 2017). These approaches distinguish themselves by not aiming to develop final solutions, but by using design to raise ecological, political and socially relevant questions. They are democratizing the design process, enabling co-creative, participative, interdisciplinary design processes that involve pluriversal perspectives from communities, society, politics, science, and economy. This requires common grounds for societal debates and desirable visions of the

convivial futures. The importance of Speculative Design approaches, which often open space for alternative realities and imaginaries of the future, is particularly evident here, as illustrated in the next paragraph.

3. **More-than-Human Design**
   In response to escalating environmental concerns and ethical considerations of novel technologies, such as Artificial Intelligence, the design discipline undergoes a paradigm shift from a human-centred to more-than-human approaches (Gatto & McCardle, 2019; Hook, 2019; Mancini & Lehtonen, 2018; Metcalfe, 2015). Multispecies and interspecies approaches, often inspired by the three theoretical pillars outlined above, advocate for the active involvement of other-than-human agents as clients of design. These methodologies can be observed at the intersection of urban planning, material design, and human-machine interaction.
   More-than-human Design is not only narrowed to other living species, such as animals or bacteria. Its scope encompasses every entity on this planet, from the technosphere, biosphere or geosphere. These considerations lay the groundwork for exploring the potentials of Multispecies Studies and Speculative Design, establishing a necessary framing for further inquiry.

A retrospective of the entanglements between nature and design within the past decades is relevant to explore the evolution of a Multispecies Turn in Speculative Design Practices outlined in the next paragraph.

4. A Multispecies Turn in Speculative design?

4.1 From Radical Design to Speculative Ecologies

In this exploration, Speculative Design Practices encompass a collective category of design approaches whose origins trace back to the 1960s with movements like *Radical Design* and *Critical Design*. Over the past two decades, a diverse array of SDP methodologies has emerged, including Speculative Design (Dunne & Raby, 2013), Design Fiction (Bleecker, 2009; Bleecker et al., 2022), Adversarial Design (DiSalvo, 2012), Associative Design (Malpass, 2013), Discursive Design (Tharp & Tharp, 2018), Critical Artifact Methodology (Bowen, 2009), and Speculative Enactments (Elsden et al., 2017).

These approaches share a common objective: to detach design from market-oriented utility and the creation of ready-made consumer goods. Instead, they use design to interrogate societal, technological, economic, and ecological developments and their interconnections. Rather than simply describing how things are, these practices generate fictional narratives and storytelling prototypes of alternative futures and sooner-nows to stimulate societal discourse. The designed outputs are considered as research artefacts (Matthews, 2014), “diegetic prototypes” (Kirby, 2010), "provotypes" (Boer & Donovan, 2012), or “boundary objects” (Heidingsfelder et al., 2019) embodying the intricate interweaving of societal and technological developments. Unlike design prototypes for consumer goods, these artefacts do not describe functionality; instead, they aim to pose questions and foster collaborative inquiries on how things could be. In this way, these artefacts break down the complexity of future impacts, translating technological and scientific feasibilities into everyday scenarios, while creating a space for collaborative exploration of how we want to co-exist with new-to-everyday life artefacts.

Speculative Design Practices are increasingly recognized beyond the confines of the discipline, particularly for engaging the public in scientific and technological innovations. This recognition allows for early-stage assessments of acceptance of novel technologies in both the public and private sectors. However, there is a risk of a technocratic misunderstanding of these approaches, which consider potential developments through a solely human-centric lens, seeking to address complex challenges primarily through readily

applicable technological solutions, while overlooking broader societal and political implications. This limited perspective, often rooted in Western, and capitalist world views, frequently disregards environmental consequences and fails to acknowledge the wealth of cultural knowledge and diverse perceptions of the world (Tunstall, 2013). Therefore, it is crucial to consider the ethical responsibilities of SDP in the context of socio-ecological challenges before expanding these approaches towards Multispecies Studies (Harles & Heidingsfelder, 2021). There is a need for an ontological turn, that considers societal developments that call for decolonized, pluriversal and inclusive futures that expand the realm of SDP through new approaches, such as Afro-Futurism or Indigenous Futurism (Harrington et al., 2022).
Against this background, the reconsideration of Multispecies Studies within SDP means to integrate a multiplicity of perspectives and speculative ecologies (Armstrong, 2021), that are considering the complex relationships between humans, cultures, non-humans, and the environment.

4.2 Evolutionary Roots of Speculative Design Practices

The following paragraph provides a brief overview of the development of Speculative Design Practices (SDP) over the past 30 years, highlighting its inherently close connections to human history and technological advancements.

The roots of SDP can be traced back to Radical Design, a design movement that emerged primarily in Italy during the 1960s and 1970s. It arose in response to the social, cultural, and political upheavals of the time, forming part of a broader countercultural movement that aimed to challenge established norms and question the role of design in society. Radical Design sought to break away from traditional design conventions, exploring new ideas, materials, and forms.
In the 1990s, Dunne and Raby developed the concept of speculative design to challenge the conventional view of design as a problem-solving activity. They aimed to explore the potential of design as a tool for thinking and speculation about the future, influenced by societal, political and technological developments. This marked a shift from strategic future thinking prevalent during the Cold War, characterized by scenario planning and predictive approaches. In contrast to this strategic understanding, Speculative Design argued for viewing future scenarios not as final goals but as mediums to enable collaborative debates and “social dreaming” of many possible futures.

Simultaneously, the affordability and widespread use of electronic devices, especially computers, began to impact various aspects of our lives. This raised questions about the usability, aesthetics, and future roles of electronic products in society, laying the conceptual foundations for what Dunne and Raby defined as Critical Design. Critical Design proposes the use of design as a tool for questioning and critiquing the role of products and technology in society, encouraging debate and speculation about possible futures. Since the 2000s, SDP has witnessed a rich biodiversity of approaches building upon these conceptual foundations, that go beyond the scope of this paper. However, three fundamental concepts, that lead to relevant evolutionary developments within SDP, will be highlighted in the following.

4.3 The Mundane Turn: Sooner-Nows and Speculative Enactments:

Despite being rooted in future-making methodologies, Speculative Design outputs do not exist in a “futurist vacuum.” The conceptual roots of SDP connect present challenges and developments with potential future outcomes. To ensure public engagement within speculative practices, future scenarios must be understandable to a broad audience. There has been a call from a design anthropological perspective to align Critical and Speculative Design Practices with everyday life situations, creating “mundane” futures rather than opening fictional narratives beyond our expected lifetime (Auger, 2013; Kjærsgaard & Boer, 2015).

By linking speculative scenarios to everyday realities that describe the impact and frictions of emergent technologies in mundane situations, it establishes a direct connection to the audience. Given the societal relevance, there has been a questioning of access to SDP outputs, often presented as passive objects in museum contexts. The focus is not only on situating these scenarios in everyday application contexts but also on the experiential aspect through immersive scenarios or so-called Speculative Enactments (Elsden et al., 2017). Additionally, the role of SDP artefacts has been scrutinized, with designers not only crafting artefacts but also involving the audience and non-designers in the process. This participatory approach allows different personal perspectives to be considered, enabling societal groups to articulate needs and desires for future scenarios (Heidingsfelder et al., 2019).

This shift, termed by the author of this paper as the “Mundane Turn” in Speculative Design Practices, aims to argue for a more profound and responsible understanding of SDP, particularly in addressing urgent environmental challenges that demand immediate action and prevent problems from being deferred into an intangible future.

4.4 The Biotechnological Turn

In addition to a paradigm shift in temporal aspects within SDP, there is also a thematically driven transformation to consider, which will be explained in the following paragraph.

Significant technological developments that have rapidly gained momentum in the past 20 years, turning our understanding of nature upside down and challenging the boundaries between human-made and nature-made, are the field of Modern Biotechnology and Synthetic Biology. Through them, humans have not only learned to decipher the code of life but also to rewrite or redesign it entirely, and at increasingly affordable costs and time investment. This technology brings forth fundamental ethical questions and tremendously complex impacts on society, the economy, politics, and the environment. Its significance is underscored as it is declared as a key technology at political levels within a short period, prompting inquiries into global ethical standards.

This technological development does not go unnoticed in SDP and forms the basis for an expanded line of questioning that not only incorporates humans and technology but actively includes nature as a stakeholder in the speculation, thus re-examining the boundaries of SDP (Dunne & Raby, 2013). The engagement with biotechnological implications on society through interventionist speculative design methods is referred by the author of this paper to as the "Biological Turn." This turn is exemplified by numerous contributions, as illustrated in the following through exemplary use cases.

- Emilia Tikka's work "ÆON" envisions a future where the biological clock can be reversed by genetic reprogramming. The project is embodied as a device for daily use and narrated as a fictional story of a couple who made opposite choices about using the rejuvenating technology 60 years ago and now must face the consequences of their decision. The project aims to question the human desires and dreams driving current biotechnological innovations, and societal dimensions of the idea of prolonged lifespan, raising philosophical questions about human life, death, and the afterlife.

- The Pink Chicken Project by the Nonhuman-Nonsense Collective proposes using a “Gene Drive” to change the colour of the entire species of chickens to pink. This is in response to the impact of human-made materials on marine life, with the bones of 60 billion chickens killed every year leaving a distinct trace in the rock strata. The project aims to change the future fossil record by modifying the genetic makeup of chickens, turning them pink, and using the recently invented Gene Drive technique to spread this gene on a global scale. Raising questions about the impact and power of synthetic biology and gene drives, and invites the public to reflect about the incentives and impacts. However, it highlights the need for an ecological discourse that includes

issues of social justice and the radical restructuring of society needed to break the death grip of the sixth extinction.

- An interdisciplinary example of Speculative Design at the intersection of biotechnology is the work of Dr. Pinar Yoldas, who combines design, synthetic biology, and cultural criticism to coin *Speculative Biology*. This field involves the design of tissues, organs, organisms, biological systems, ecotypes, and ecosystems to catalyse creative critical thinking about the ethical and cultural implications of biotechnology. In her project "Ecosystem of Excess" features a series of speculative organisms that live in an ocean of plastic waste, highlighting the impact of human-made materials on marine life. The project uses synthetic biology to design organisms that can survive in this extreme environment, such as a jellyfish that feeds on plastic particles and a shark that has evolved to swim through plastic waste.

- Another prominent example is the work of Daisy Ginsberg, who uses design to explore the potential implications of synthetic biology. Her project “Synthetic Kingdom” imagines a world where synthetic organisms have been designed to perform various functions, such as cleaning up oil spills or generating energy. The project emphasizes the need to consider the ethical and societal implications of creating new life forms. Furthermore, her project "Designing for the Sixth Extinction," which explores the use of synthetic biology to save endangered species. The project uses SDP to spark a dialogue between the conservation and synthetic biology communities about the ethical implications of using biotechnology to save existing, “natural” organisms.

Figure 1. ÆON by Emilia Tikka| Photograph by Zuzanna Kaluzna.

Figure 2. Pink Chicken Project by Nonhuman-Nonsense.

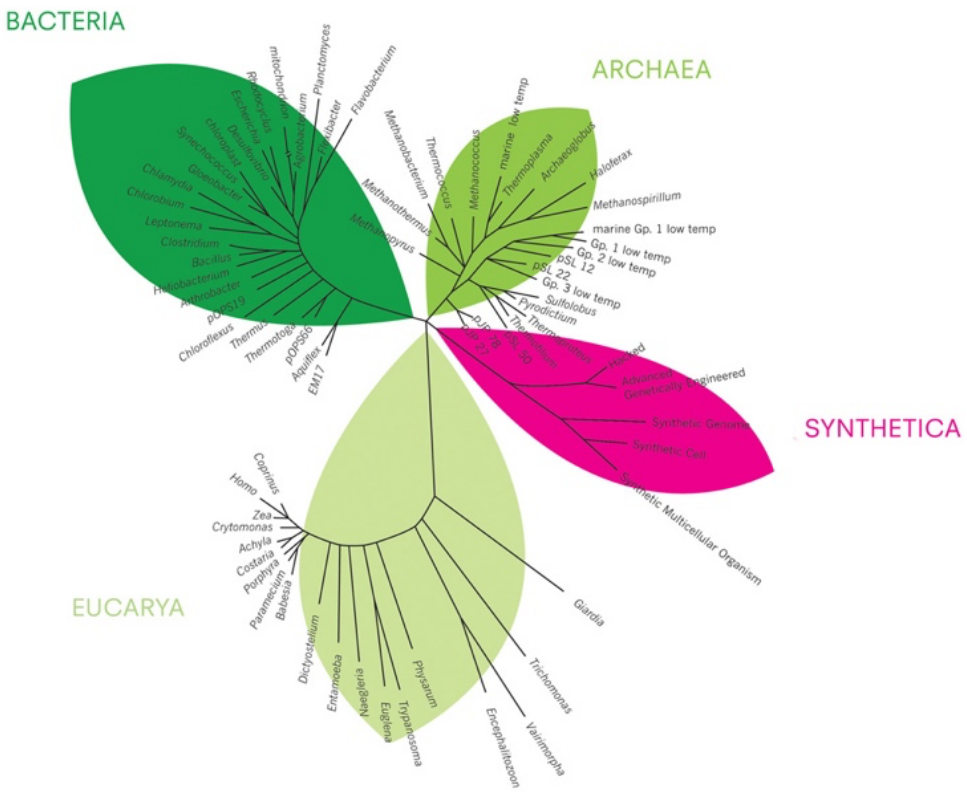

Figure 3. Synthetic Kingdom by Alexandra Daisy Ginsberg.

These use-cases exemplify the application of Speculative Design Practices to explore the boundaries between nature, humanity, and technology, concurrently prompting critical inquiries into the ethical and cultural implications of such advancements. The advent of the Biological Turn significantly contributes to the evolution and potential of SDP, particularly in addressing socio-ecological challenges. This shift places non-human protagonists and speculative living artifacts at the centre of Speculative Design Approaches.

Despite the intended focus of these projects on highlighting current environmental issues and posing essential questions, it is imperative to note that the primary emphasis lies on technological feasibilities and human impacts, rather than intercultural and non-human implications. The biotechnological outcomes, such as genetic modifications to non-human entities or extending human lifespan, are predominantly contemplated from a human-centred perspective, lacking consideration for the perspectives of surrounding ecosystems and non-western cultures.

In summary, the Biological Turn illustrates how SDP can facilitate holistic storytelling for collaborative inquiry into environmental issues, positioning non-human entities as central protagonists. However, there exists a potential risk of perceiving these non-human agents merely as artificially implemented living technological interfaces in natural habitats, serving human-centric benefits. Consequently, there is a pressing need for a more radical inclusion, which will be expounded upon in the subsequent paragraph.

4.5 The Multispecies Turn

Expanding on the reflections discussed above, it becomes apparent that there is a compelling necessity for the continued evolution of Speculative Design Practices in addressing intricate socio-ecological challenges, such as biodiversity loss, rising temperatures, and sea levels. A spectrum of experimental use-cases and practice-based design research projects has already emerged, positioning themselves at the intersection of these challenges and multispecies studies. These projects can be recognized as pioneers, navigating the boundaries and challenges inherent in adopting multispecies approaches within speculative design practice.

These initiatives traverse various fields of action intimately connected with everyday life, encompassing environmental conservation and multispecies in urban habitats (Roudavski, 2021; Sheikh et al., 2023), prototypes for enhancing coastal regions (Metcalfe, 2015), explorations of human-plant interactions (Gatto, 2019), and efforts focused on fostering empathy for non-human entities through Animal-Computer Interaction (Hook, 2019). Employing speculative and immersive methodologies, these projects ponder how socio-ecological challenges can be envisioned from a more-than-human perspective.
Moreover, these endeavours are generating pertinent research questions that explore methodological frontiers and interdisciplinary playgrounds at the crossroads of multispecies ethnographies, conservation strategies, and biological impact assessments. Going beyond mere speculation, they actively seek collaborations with scientific experts, non-governmental organisations, local communities, and stakeholders. By building bridges and facilitating knowledge transfer, they strive to cultivate meaningful collaborations extending beyond public debates, translating into tangible actions for socio-ecological betterment. In doing so, they contribute to a more nuanced and actionable approach in the evolving landscape of speculative design, integrating theory and practice to address urgent socio-ecological challenges.

5.A Multispecies Engagement Framework

5.1 Engaging Other-Than-Human Agents Through Speculative Design

In light of the preceding discussion, this study introduces the concept of a "Multispecies Engagement Framework," proposing a paradigm shift in speculative design interactions with non-human entities in socio-ecological transitions that aim to take climate action. In this study, the term is inspired by *Public Engagement with Science (PE)* (Schäfer, 2019*)* which delineates a participatory approach to science communication fostering a mutual dialogue between science and society. Public Engagement and participatory practices are evolving as strategic pillars within research institutions, aiming to involve the public in their research agendas to create impactful outcomes aligned with societal needs.

Speculative Design Practices have demonstrated their potential to involve societal stakeholders in Public Engagement formats through design-based methodologies, using speculative future scenarios as a collaborative platform of exchange and inquiry (Heidingsfelder et al., 2019).

In the context of pressing ecological challenges, this study posits the hypothesis that SDP, aiming to engage communities within ecological transitions, needs to take the ontological turn into account. It renegotiates the influential concept of PE, primarily focusing on incorporating human needs into scientific research. There is a risk that PE keeps perpetuating a human-centred (and Western) bias into research agendas, excluding cultural perspectives and ecological impacts, particularly concerning overarching societal issues at the intersection of sustainability and conservation. As communities and environments are impacted by ecological challenges in very different ways, there is a need to expand the modes of engagements. Against this backdrop, the concept of Multispecies Engagement expands the notion of “the public” beyond the human scope. So, what and who constitutes a “Multispecies Public”?

The proposed concept “Multispecies Engagement” advocates for establishing a mode of engagement that includes other-than-human beings within research and innovation processes, aiming to create transformative change within the scope of socio-ecological challenges. This concept serves as a bridge between design, society, nature, science, and pluriversal perspectives and drives ecological, environmental and multispecies justice through a *multispecies way of knowing*.

5.2 Methodological Approach and Use-Cases

The multispecies framework builds upon the developments in Speculative Design Practices (SDP) discussed earlier, focusing on collaborative inquiries for socio-ecological imaginaries of the future by translating complexity into everyday scenarios, and engaging diverse cultures, modes of knowledge, and interdisciplinary expertise.

This framework is constructed through a methodological mapping of practice-based design literature centred around multispecies, interspecies, and more-than-human design interventions, aiming to address socio-ecological challenges in collaboration with or for other-than-human entities. Given that this field is still in its nascent stages, the framework also incorporates use-cases that may not explicitly align with Speculative Design Practices. However, they share the same values and aspirations. Their ambition to engage other-than-human beings within their design process and exploration of interspecies methodological approaches makes them a relevant source of knowledge. Some investigated use-cases are highlighted below to provide an overview of what can be defined as multispecies design practice.

- Daniel Metcalfe's dissertation “Multispecies Design” (2015) introduces a design approach recognizing animals as clients of design, human-animal interactions as designed experiences, and man-made systems as extensions of ecological systems. The research addresses designing for biodiversity in human-dominated habitats, emphasizing the physical and socio-cultural requirements. The developed *Principles and Tools for Multispecies Design* aim to shift practices towards more sustainable and biodiverse human habitats.

- Alan Hook's paper on "Exploring Speculative Methods" (2019) proposes using speculative design to understand nonhuman animals and foster interspecies understanding. The Equine Eyes prototypes explore human-horse interactions, challenging anthropomorphizing nonhuman animals. The paper argues for creating experiential artifacts in speculative design and highlights the role of design in suggesting arguments about the world.

- The paper "Reparative futures of smart urban governance: A speculative design approach for multispecies justice" by Hira Sheikh, Peta Mitchell, and Marcus Foth (2021) explores the potential of speculative design to create more just urban environments for both humans and non-human species. The authors suggest a framework considering the needs and perspectives of all urban inhabitants, using speculative design to investigate the potential of urban governance for environmental justice and species equality.

The methodological mapping analyses these and other projects, identifying approaches, similarities, and blind spots to refine the understanding of how multispecies frameworks and speculative design can be effectively employed.

5.3 Aspects of a Multispecies Engagement Framework

The following paragraph highlights seven main principles that build the conceptual foundation of the Multispecies Engagement Framework to engage other-than-human stakeholders within SDP.

1. **Anticipating Otherness**
   Speculative design critically examines anthropocentrism, challenging the prevailing human-centric worldview. It seeks a more profound understanding of the non-human sensorium, encompassing the sensory experiences and perceptions of non-human beings. This raises the question of who has not yet been considered, requiring an initial comprehensive understanding of protagonists, dependencies, and frictions in

ecosystems. To achieve this, we must first overcome our human empathy biases towards significantly different mammals and dissolve classifications between domesticated, wild, and utilitarian animals.
Furthermore, other-than-human beings include not only animals and other species that are visible to human eyes, with which we already have a connection. It is crucial to consider microorganisms, bacteria, fungi, and ecological agents, such as soil, air, and water as well that present different modes of otherness than that of mammals, birds, or fish. Above all, it is essential to understand that all beings are part of an ecosystem, indirectly affected regardless of their dependency relationships. So multispecies world building is a complex entanglement of different modes of otherness, that needs to be anticipated.

2. **Levels of Engagement: From Co-Producers to Clients of Design**
Speculative design approaches, depending on their goals and processes, offer various possibilities for involving non-designers. This results in different roles, such as that of the informant or consultant, providing expertise to the designer. Participants, representing the affected target groups, are engaged through speculative artifacts, ranging from informants shedding light on challenges from their perspective to co-designers actively involved in shaping artifacts. These levels of engagement must also be questioned in multispecies approaches. In addition to considering whom the designer includes, there is the question of how other-than-humans can be involved—ranging from co-production, such as material development, to "clients of design" like the intertidal species in Daniel Metcalfe's project, to "informants" highlighting challenges from their perspective.

3. **Fields of Action and Interdisciplinary Playgrounds**
The application realms of Multispecies Engagement within Speculative Design Practice are as varied as the challenges it addresses. Key themes revolve around participatory processes in urban habitats, converging design, architecture, urban planning, and environmental sciences. These initiatives explore how urban spaces can be designed for both humans and non-humans, recognizing cities as crucial habitats and "urban arks" for various species. This perspective shifts urban structures from "Anthropocene objects" to new to nature ecosystems, optimizing them as protected habitats through strategies like Rewilding, Assisted Migration, or Grey Greening.
These applications extend beyond urban spaces to rural areas. For instance, Metcalfe's exploration of optimizing a Coastal Pipeline as a shared habitat involves approaches from Multispecies Ethnography (Kirksey & Helmreich, 2010), Reconciliation Ecology (Rosenzweig, 2003), Cross-Species Engagement (Hinchliffe et al., 2005), and embodied design interventions (e.g., prototypes of tiles).
Rasa Weber takes it further by introducing concepts of Interspecies Architecture in critical maritime zones like coral reefs, coining the term *Sympoïetic Design* (Weber, 2022). Inspired by Lynn Margulis's theories, this approach combines materials research with behavioural biology and Living Architecture to create artificial reefs tailored for non-human marine environments.
Approaches at the intersection of material research and food production, such as Emma Sicher's work, bridge design, anthropology, and molecular biology. Sicher explores human-plant-microbe interactions, envisioning "Multispecies Matter" as an adaptable open design model promoting regenerative practices and resilience in diverse contexts (Sicher et al., 2023).
Projects like the *Interspecies Designstudio*, led by Jannis Kempken, engage non-human as co-designers to produce colours or decay materials. Other mentionable speculative

endeavours at the intersection of Environmental and Multispecies Justice consider other-than-human beings as eligible actors in democratic processes (Sheikh et al., 2023). Furthermore, projects situated at the intersection in Animal Aided Design and Animal Computer Interaction aim to make species' sensorium accessible to humans, promoting empathy through design (Hook, 2019).
Their focus is on opening negotiation spaces and perspectives through interdisciplinary, research-based practice, rather than developing final market-ready products. Despite lacking a specific timeframe, these projects address various environments, from cities to underwater realms and research laboratories.

4. **Engaging Multiplicity Modes of Knowledge-Production**
Engaging communities within speculative design processes requires empathy with communities and an understanding about everyday life realities. Expanding these requirements to a non-human perspective, traditional human-centred design approaches, such as interviews and cultural probes, reach their limits.
Here it becomes crucial to engage with scientists, communities, and local knowledge holders, that have a certain knowledge about other-than-human beings through research, observation or co-existence, while incorporating their perspectives into the design process. Therefore, Multispecies Engagement in SDP necessitates interdisciplinary knowledge development, including scientific, local, or indigenous knowledge. It is important to be aware and embrace various forms of knowledge production beyond academia. Overcoming interspecies barriers may also engage spokespersons for certain species, primarily with scientists, local communities, environmentalists (Metcalfe, 2015). Another crucial step is that designers need to immerse themselves in the environment, spending time observing or embodying movements through somatic practices or technological enhancements to adopt non-human perspectives. This approach entails assessing specific knowledge about how other-than-humans might be affected by socio-ecological challenges. Additionally, designers need skills to navigate through environments that may not be natural habitats for humans (ocean), spanning activities from diving and snorkelling to working in biolabs. Multispecies Engagement challenges designers to step out of their comfort zones within design studios.

5. **Mundane Futures and Non-Human Time Scales**
This principle involves considering time, a central aspect in Speculative Design Practices. Whether exploring alternative presents, mundane futures, or distant scenarios, time frames the speculative design process, providing perspective and orientation for reflection.
Understanding the timescales in which other-than-human entities can adapt to ecological challenges, such as forest dieback or migrating insect species, is crucial. Non-human beings operate on different timescales than humans, influencing their interactions with the designed environment. This understanding, incorporating short lifespans of flies (a few days) or the long lifespan of trees (up to more than 1000 years), should inform the design process. Respecting non-human time scales is essential in creating sustainable, resilient, and just designs with long-term impacts on diverse species and ecosystems.
This principle signifies a shift from anthropocentric to eco-centric design practices, prioritizing the diverse needs and perspectives of non-human beings. By integrating an understanding of non-human time scales into the design process, designers can foster coexistence, collaboration, and mutual flourishing between humans and non-humans.

6. **Non-Human Sensory Toolkit**
   This principle highlights the necessity to think outside our human sensory realms and language-based communication. Humans are not able to grasp the manifold ways in which natures communicates, such as sounds, colours or molecular messages that cannot be perceived by our bodies and nervous systems. This multisensory biodiversity opens new question for practice-based research on how designers can include non-human communication channels within SDP.
   Furthermore, we need to anticipate this kind of otherness, without anthropomorphizing or romanticizing other-than-human beings, as this can risk to misleading the debate.

7. **Measuring Impact and Transfer**
   To ensure the practical application and sustained impact of speculative design beyond debates, a transfer within and outside the design discipline is necessary. Alternative methods of impact measurement, such as ecological indicators, should be employed to assess the effects of design interventions on non-human beings and ecosystems, highlighting the socio-cultural, ecological, and ethical dimensions of speculative design.

6. Conclusion

Over the past decades, Speculative Design Practices responded to social and technological developments with transformative potentials and challenges. Against the backdrop of pressing ecological issues, SDP are confronted with new challenges and developments, such as the multispecies turn. This calls for a shift from human-centred to multispecies ways of knowing, that engages other-than-human beings in the co-creative and discursive approaches of SDP. Thus, it will become crucial to push the disciplinary boundaries of the design field once more and draw together a multiplicity of knowledge, that extends beyond human, western and scientific understandings of nature.

Despite the promising potentials that SDP has to offer to create new ways of multispecies ways of knowing, it is important to critically reflect boundaries and expectations of interspecies collaborations, as every multispecies intervention is ultimately initiated by humans. This initiation always follows the motivation that our efforts serve the purpose of ensuring our survival. Humans are likely the only species aware that they will die and that are aware that they are currently depriving the basis for life themselves. Human bias cannot be avoided, but this is not a reason to not pursue further investigations into the possibilities of Multispecies approaches through design.

The real potential lies not in fostering interspecies collaborations but, above all, in breaking through thought patterns of thought that have shaped our society and academic research for centuries. It is a shift away from unlimited technological progress, especially a shift in the Western-centric and repressive understanding of nature, influenced by Western concepts and views through the spread of natural history museums.

Multispecies Engagement is a path to multispecies ways of knowing or “tentacular thinking” as Donna Haraway aptly puts it, breaking with the human-centred tradition of design. It frees design from the shackles of one-dimensional perspectives and the economic benefits that have tried to domesticate it through terms like Design Thinking. To summarize, Multispecies Engagement is an invitation to raise awareness, switch perspectives and to building bridges between design, politics, science, and society and non-human realities. What is known is worth protecting.

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