Designing with Nature for Sustainability

Towards a critical approach for including natural nonhuman stakeholders in collaborative and participatory design when designing for sustainability

Emīlija Veselova
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Abstract

Collaborative and participatory design (C&PD) is an area of design theory and practice in which designers involve project stakeholders as active participants to jointly explore and frame problems and to co-create solutions. In response to increasingly more pressing sustainability challenges, C&PD scholarship has been engaged in rethinking the premises, constructs, and practices of the field. One of the ways in which C&PD is striving to address the sustainability challenges is by including natural nonhuman stakeholders. Such an approach warrants a careful and evaluative investigation.

Therefore, this doctoral dissertation critically explores in what ways including natural nonhuman stakeholders in C&PD can contribute to sustainability. It seeks to answer four research questions. (1) Why should designers include natural nonhuman stakeholders in C&PD when aiming to contribute to sustainability? (2) How to approach the identification of natural nonhuman stakeholders in C&PD when aiming to contribute to sustainability? (3) In what ways can natural nonhuman stakeholders be included in C&PD? (4) How to approach the identification of natural nonhuman needs? This dissertation includes two parts: five peer-reviewed research publications form one part, and a six-chapter introductory essay forms the other part. The essay answers the research questions by integrating and discussing the findings, summarizes the results, and outlines limitations and avenues for further research.

The doctoral research findings indicate that including natural nonhuman stakeholders in C&PD when aiming to contribute to sustainability has merit; however, it requires being critical and careful when identifying the stakeholders, including them in C&PD processes and sourcing their needs. Including natural nonhuman stakeholders can contribute to sustainability in three interrelated ways: by shifting individual and collective worldviews towards being more aligned with sustainability; by challenging the dominant systems and structures that support unsustainability; and by creating practical design solutions that are more aligned with and support sustainability. The dissertation discusses these three reasons and proposes an integrative framework showcasing the interdependencies and interconnections between them. Further, the dissertation proposes a systemic approach and the usefulness of non-anthropocentric environmental ethics to identify natural nonhuman stakeholders. Then the dissertation presents three ways designers can use to include natural nonhuman stakeholders in design time and discusses natural nonhuman stakeholder participation in the use time. Finally, because natural entities are rarely discussed in relation to their needs and research disciplines do not necessarily identify needs of natural nonhuman stakeholders, the dissertation suggests that designers should attentively approach the identification of needs of the natural nonhuman stakeholders in their projects.

Keywords collaborative and participatory design, natural nonhuman stakeholders, design for sustainability

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This dissertation is the culmination of my journey within collaborative and participatory design that started during my bachelor’s exchange at Malmö University in the fall of 2013. I want to thank Mette Agger Eriksen and Pelle Ehn for introducing me to the world of design and participation. Also, my doctoral research would not have been possible without my master’s level studies at the Department of Design, Aalto University. During that time, I was able to lay strong foundations in academic research and reflective thinking. I especially want to thank Tuuli Mattelmäki, Sampsa Hyysalo, and Ramia Mazé for their support and inspiring teaching during that time.

The topic of my dissertation was inspired by a conversation with Leyla Acaroglu at her Creative Optimism Project Farm in Portugal. I am grateful that a dinner conversation during my visit to help renovate the farm has (somehow) resulted in several publications and a dissertation.

My doctoral journey would also not have been possible without me being part of a remarkable research community. I want to thank Sustainable Design Research Groups NODUS and its past and current members for the seminars, discussions, lunches, and their curiosity to co-write a paper while we were restrained by the pandemic. I especially want to thank Elise Hodson for being a skilled co-pilot in that endeavor and for our uplifting conversations over the
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Vantaa, 3 May 2023
Emīlija Veselova
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<td>COVID-19</td>
<td>Coronavirus disease 2019</td>
</tr>
<tr>
<td>CWN</td>
<td>connectedness with nature</td>
</tr>
<tr>
<td>C&amp;PD</td>
<td>collaborative and participatory design</td>
</tr>
<tr>
<td>DfST</td>
<td>design for sustainability transformations</td>
</tr>
<tr>
<td>DSRP</td>
<td>distinctions, systems, relationships, perspective (structures of systems thinking)</td>
</tr>
<tr>
<td>IPBES</td>
<td>Intergovernmental Platform on Biodiversity and Ecosystem Services</td>
</tr>
<tr>
<td>NODUS</td>
<td>Sustainable Design Research Group (at the Department of Design, Aalto University)</td>
</tr>
<tr>
<td>PD</td>
<td>participatory design</td>
</tr>
<tr>
<td>RQ</td>
<td>research question</td>
</tr>
</tbody>
</table>
List of Publications

This doctoral dissertation consists of a summary and of the following publications that are referred to in the text by their numerals:


The Author’s Contribution

**Publication 1:** Bioinclusive collaborative and participatory design: A conceptual framework and a research agenda

I am the first author of this publication. This journal article presents a conceptual framework and a research agenda for non-anthropocentric, bioinclusive collaborative and participatory design based on a two-part, systematic, integrative literature review. I designed the study, conducted the literature review, analyzed and integrated the findings, and developed the conceptual framework and the research agenda. Then, I drafted and finalized the article. Meanwhile, the second author supervised the research process and assisted in editing the paper.

**Publication 2:** Designing for sustainable entangled human–nature systems

I am the sole author of this publication. This short conference paper presents the results of an integrative literature review that defined systemic sustainability and human–nature systems; it also suggests their implications for design.

**Publication 3:** Design for sustainability transformations: A deep leverage points research agenda for the (post-) pandemic context

I am the second author of this publication. This journal article presents a prototype research agenda for research on design for sustainability transitions during and after the COVID-19 pandemic. I initiated the research process and convened the co-authors. I developed the research design and analytical framework with the first and third authors. I was responsible for writing Section 2.2 and reviewing and commenting on the rest of the document.

**Publication 4:** When a tree is also a multispecies collective, a photosynthesis process and a carbon cycle: A systemic typology of natural nonhuman stakeholders when designing for sustainability

I am the first author of this publication. This conference paper presents a systemic typology of natural nonhuman stakeholders and pointers for identifying natural nonhuman stakeholders in the context of sustainability. The typology is based on empirical data collected via a multispecies ethnography study and analyzed through systems thinking. I created the study design; collected and coded the empirical data; presented the research insights, the iterations of the
typology, and the drafts of the paper to the second author for further collaborative development; and I acted as the lead author throughout the writing process.

**Publication 5:** Mediating the needs of human and natural nonhuman stakeholders: Towards a design methodological framework

I am the first author of this publication. This conference paper presents findings from an expert interview study within a consortium research project. I was responsible for the study design, conducting the interviews, data analysis, and writing the paper. The research was conducted in close cooperation with the second and third authors of the article, with whom I discussed the research design, interview questions, and findings. The second author extensively participated in the writing of the paper by contributing to the theoretical and analytical framing.
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Sustainability challenges are pressing, and their impact is already noticeable at global, regional, and local levels. Climate change and the natural disasters linked to it, the hottest years to date, and rapid biodiversity loss are some of the sustainability-related topics that have appeared in the news during the past few years. *The Sixth Assessment Report* by the Intergovernmental Panel on Climate Change (Intergovernmental Panel on Climate Change, 2022) highlighted that climate change already has a significant negative impact on human physical and mental health, and on critical infrastructure. However, climate change is only one of the interrelated environmental challenges that humanity faces today, which include pollution, biodiversity loss, the overuse of resources, and natural disasters. For example, the rate of species extinction has increased in the last 40 years, and currently, scientists estimate that up to 25% of species are facing a risk of extinction (Intergovernmental Platform on Biodiversity and Ecosystem Services [IPBES], 2019). Research strongly supports the idea that various sustainability challenges are caused by humans (Cook et al., 2016); thus, many individuals, disciplines, and practices (including design and designers) have been reflecting on their contributions to the problems and finding solutions.

Since its conception and formalization as a profession in the early twentieth century, design has primarily focused on creating solutions that satisfy human needs. First, designers used a technology-focused approach; later, they explicitly centered design processes around humans and human needs using user-centric, human-centric, and participatory approaches (Ceschin & Gaziulusoy, 2020). The collaborative and participatory design (C&PD) approach was one of the approaches that supported the transition from technology-driven design practice to human-centered design practice. C&PD is an area of design theory and practice that strives to involve stakeholders in design projects. In C&PD, designers and stakeholders jointly explore the problem area, learn about each other’s needs, negotiate values, and collectively envision, conceptualize, and create a future scenario or solution that would satisfy the needs of the stakeholders (Steen, 2013). C&PD processes are typically framed around enabling participants to share their perspectives and needs, building an understanding of others, shifting views about the design context, and co-creating design solutions (Simonsen & Robertson, 2012).

In C&PD, there is a correlation between how a design project defines the problem to be addressed, called the *problem space*, and the created solution, called the *solution space* (Dorst & Cross, 2001). The definition of the problem space is
shaped by the previous experiences of designers, the context, and available resources (Dorst & Cross, 2001). When a designer identifies the stakeholders of a particular process, they shape the problem space. Later, once the stakeholders have been identified and included in the process, the designers and participating stakeholders can further shape the problem space and, in turn, shape what solutions can address this problem (Steen, 2013). Therefore, special attention should be paid to who and what is identified as a stakeholder in C&PD and how and why this is done. Unfortunately, the widely-accepted C&PD theories and practices exclude the participation or consideration of natural entities (Veselova & Gaziulusoy, 2022).

The terms nature and natural carry many meanings (e.g., see Joachim, 2016). In the context of this dissertation, the concepts of nature and natural stem from Western culture. Currently, the dominant worldview in Western societies is that human beings and their creations are not part of nature, and nature is that which is not human or human-made (Chen, 2017). The divide is ingrained in the meanings of the words human and nature. While there are alternative definitions of the terms, I choose to use Western conceptualization of nature, as separate and opposite to nature, because my research is situated within design and sustainability research rooted in Western thought.

Recently, theory and practice for including natural nonhuman stakeholders in C&PD have emerged. Pioneering academic projects have questioned the human-exclusive framing of design, including C&PD (see, e.g., Akama et al., 2020; Fletcher et al., 2019; Forlano, 2016; Jönsson, 2014; Westerlaken, 2020). These projects conceptually and often practically explore why and how C&PD could shift towards including and considering not only human stakeholders but also natural nonhuman stakeholders.¹

Argumentation for including and considering natural nonhuman stakeholders in C&PD varies, yet two reasons seem prominent. First, researchers involve natural nonhuman stakeholders to increase and care for the well-being of animals. Such projects focus on domesticated animals, pets, or zoo-kept animals and strive to enrich the lives of these animals (see, e.g., Frawley & Dyson, 2014; Mancini et al., 2015; Robinson & Torjussen, 2020; Webber et al., 2020, 2022). The researchers aim to, for example, create smoother work conditions for working animals (see, e.g., Mancini et al., 2015) or to facilitate interaction and collaboration between working animals and humans (Zeagler et al., 2016).

Second, researchers include natural nonhuman stakeholders in C&PD to address the sustainability crisis (e.g., Akama & Light, 2018; Bardzell et al., 2021; ¹ Efforts to include natural nonhuman stakeholders can be broadly included under the more-than-human design approach. In more-than-human design, researchers and designers can consider not only natural nonhumans elements but also artificial, human-made, and digital nonhumans elements. However, in my dissertation, I only focus on the natural nonhuman stakeholders, and, to retain clarity, I aim to refrain from using the terms more-than-human design, more-than-human stakeholders, and nonhuman stakeholders. Instead, I use the term natural nonhuman throughout the dissertation.}
Haldrup et al., 2022; Jönsson et al., 2021; Tomitsch et al., 2021). The sustainability-related reason includes differing, sometimes overlapping perspectives. Some researchers seem to accentuate the need to acknowledge and potentially counter the perceived human separation from nature (e.g., Akama et al., 2020; Nijs et al., 2020; Prost et al., 2021; Sandelin, 2019; Tomitsch et al., 2021). Some highlight that humans become who they are through relationships with other (companion) species—based on or inspired by the ideas of Haraway (2003) and Tsing (2012)—which should not be excluded from design (e.g., Fletcher et al., 2019; Jönsson & LenskjOLD, 2014; Rosińska & Szydlowska, 2019). Some focus on challenging anthropocentrism (Sandelin, 2019). Such research may challenge the “human exceptionalism narrative” (Nijs et al., 2020, p. 2) or suggest de-centering humans as the focal point of all human activity (Fletcher et al., 2019; Jönsson & LenskjOLD, 2014). Some explain that both humans and natural nonhumans inhabit this planet (Liu et al., 2019; Tomitsch et al., 2021), and that designers should care for natural nonhuman well-being. Some suggest that natural nonhumans have agency (Bertulis, 2019), are as “capable of action” as humans (Jönsson & LenskjOLD, 2014, p. 7.1), and should be given space to express this agency and act in co-design processes. Some strive “to sensitize and invite humans to experience” aspects that are threatened due to biodiversity loss (Jönsson & LenskjOLD, 2014, p. 7.1), such as pollination. Meanwhile, some aim to build emotional sensitivity towards the nonhuman species who experience the consequences of human activities, such as the species affected by plastic waste in the oceans (e.g., Dimitrijevic, 2019). Some broadly state that design needs to change practices and rethink itself due to environmental degradation (e.g., Foth & Caldwell, 2018; Haldrup et al., 2022; Jon, 2020).

The proposal that considering nature and natural nonhuman entities can contribute to addressing the sustainability crisis is significant and warrants a careful and critical investigation. While many design researchers link the inclusion of natural nonhuman stakeholders and sustainability, it remains unclear how exactly the inclusion of natural nonhuman stakeholders can assist in addressing the causes of the crisis and building solutions that advance sustainability. Moreover, many researchers working with natural nonhuman stakeholders do not describe how they identify natural stakeholders. There seem to be no guidelines for identifying natural nonhuman stakeholders and their needs when aiming to contribute to sustainability.

1.1 Aims and research questions

In my doctoral research, I want to critically explore the emerging practice of including natural nonhuman stakeholders in C&PD. Primarily, I aim to scrutinize the proposition that including natural nonhuman stakeholders in C&PD could contribute to sustainability. Secondarily, I seek to develop approaches for identifying natural nonhuman stakeholders and their needs in C&PD processes that aim to contribute to sustainability, as well as review the existing practices
related to including natural nonhuman stakeholders in C&PD. To achieve these aims, I strive to answer four research questions (RQs):

RQ1: Why should designers include natural nonhuman stakeholders in C&PD when aiming to contribute to sustainability?

RQ2: How to approach the identification of natural nonhuman stakeholders in C&PD when aiming to contribute to sustainability?

RQ3: In what ways can natural nonhuman stakeholders be included in C&PD?

RQ4: How to approach the identification of natural nonhuman needs?

1.2 The structure of the dissertation

This dissertation includes two parts: five peer-reviewed research publications form one part and a six-chapter introductory essay forms the other part. The research publications present the aims, methodology, and findings of five studies conducted during the doctoral research while the introductory essay explains the overall purpose, theoretical framework, methods, and conclusions of the investigation.

Chapter 1 of the introductory essay introduces the context, overall aims, and RQs of the doctoral study.

Chapter 2 introduces two key theoretical concepts: C&PD and sustainability. Section 2.1 defines C&PD as an approach in which designers design with stakeholders and reviews the key variables that impact on how a C&PD process is structured. Section 2.2 presents relevant concepts from sustainability science. It introduces the systemic definitions of sustainability and the concept of human–nature systems. Then, it describes two worldviews identified as the likely root causes of the sustainability crisis: the perception of human separation from nature and humans’ right to dominate nature.

Chapter 3 presents the methodology used to conduct the research. Section 3.1 shows the overall research design. Then, Section 3.2 presents the five studies included in this doctoral research, showcasing the aims and methodological choices.

Chapter 4 presents summaries of the five publications included in this dissertation.

Chapter 5 presents and discusses the findings of the doctoral research. The chapter is arranged into four sections that answer the RQs. Section 5.1 answers RQ1: Why should designers include natural nonhuman stakeholders in C&PD when aiming to contribute to sustainability? It introduces three interdependent ways—personal, systemic, and practical ways—through which the inclusion of
natural nonhumans can support a shift toward sustainability. Section 5.2 answers RQ2: How to approach the identification of natural nonhuman stakeholders in C&PD when aiming to contribute to sustainability? It presents a systemic approach and a typology for identifying natural nonhuman stakeholders and discusses implications of the systemic approach for C&PD. Then, it discusses the potential for using non-anthropocentric environmental ethics to identify the natural nonhuman stakeholders in a project. Section 5.3 answers RQ3: In what ways can natural nonhuman stakeholders be included in C&PD? It presents and discusses the practical approaches to how designers can include and represent natural nonhuman stakeholders. Section 5.4 answers RQ4: How to approach the identification of natural nonhuman needs? It identifies and discusses the lack of theories on nonhuman needs and inconsistencies in the framing of the concept of needs in design and other disciplines.

Chapter 6 concludes the introductory essay by summarizing the doctoral research findings and outlining both the limitations of the study and the avenues for further study.
2. Theoretical Background

This chapter introduces theoretical considerations from the two key research areas that informed this dissertation. First, the chapter defines C&PD and presents its characteristics and variables. Second, it introduces two areas of sustainability science that are relevant to the thesis: the attributes of sustainability and the worldviews underlying the sustainability crisis. Finally, the chapter concludes by summarizing the key insights that form the theoretical background of this dissertation.

2.1 C&PD

C&PD scholarship commonly views design processes as including two types of participants: designers and “others.” Designers are predominantly expert professionals trained in designing and are responsible for the design process, approaches, tools, and developed solutions (Bødker et al., 2011; Manzini, 2015). The others category is broader, and designers and researchers view, define, and name others differently. The others can be viewed more passively, and they can also be called users, citizens, informants, implicated actors, or more actively, design partners, co-designers, user designers, diffused designers, and non-expert designers (Lee, 2008; Manzini, 2015; Simonsen & Robertson, 2012; Zhang & Dong, 2016). In my research, I use the term stakeholder to refer to the participants of the design processes who are not designers. I define a stakeholder as “an actor without formal design training who can inform, be involved in, or be affected by the design process and its outcomes” (Veselova & Gaziulusoy, 2022, p. 4). A stakeholder can be an individual, a group, or an organization (Simonsen & Robertson, 2012). My review of C&PD literature indicated that strict differentiation between designers and stakeholders is most common (Veselova & Gaziulusoy, 2022, Publication 1). However, emerging perspectives challenge this historically dominant divide and propose that both expert designers and stakeholders can actively contribute to and lead design efforts (Hyysalo et al., 2017; Kohtala et al., 2020). Nevertheless, in this dissertation, I retain the traditional divide between designers and stakeholders because this view is dominant within C&PD research.

The importance of including stakeholders—more precisely, users—in the design processes was first accentuated at the “Design Participation” conference, held in 1971 (Cross, 1972; Kensing & Greenbaum, 2012). Since then, slowly but surely, designers have moved “increasingly closer to future users of what they
Theoretical Background

design” (Sanders & Stappers, 2008, p. 5). Various design areas have incorporated the participation of stakeholders in their processes (Lenskjold et al., 2015). Two routes seem to have been prominent in taking the design community from the early discussions of the need to include users in design processes in the 1970s to this approach being a cornerstone of design practice in the 2010s and 2020s. The two routes were participatory design (PD) and user-centered design (Harder et al., 2013; Hyysalo et al., 2014). PD, prominent in the Scandinavian countries, aspired to include future users and other stakeholders in the design process to ensure that, following democratic principles, those stakeholders could influence the development of technologies that would impact on their lives (Simonsen & Robertson, 2012). Meanwhile, user-centered design strived to involve users and other stakeholders in order to develop better solutions that satisfy needs through their functionality and social and cultural fit (Harder et al., 2013). Over the decades, the approach of including stakeholders has gained a strong prominence in the field, and designers and researchers have developed many sub-approaches, tools, and methods. The ability to design with stakeholders seems to have become one of the critical competencies for designers. Moreover, this approach has expanded outside the design of technology and artifacts. The principles, tools, and methods of C&PD are also extensively used in, for example, the development of policy, the public sector, non-governmental organizations, urban planning, and the development of healthcare (Huybrechts et al., 2017; Simonsen & Robertson, 2012; Teli et al., 2017; Vines et al., 2013).

The diversity of sub-approaches, tools, and methods warrants a clear definition of C&PD. Designers can involve stakeholders to varying degrees. The extent of involvement can be arranged into a seven-level spectrum (see Figure 1 and Table 1), which I developed by integrating four different involvement spectrums and typologies presented by Harder et al. (2013), Hyysalo and Johnson (2015), Lee (2008), and Zhang and Dong (2016). The spectrum levels correlate to the extent to which stakeholders are recognized and involved in the design process.

Figure 1. A seven-level spectrum of stakeholder involvement in the design process and the location of the C&PD approach on the spectrum.
The levels of involvement seem to relate (at least in theory) to the power of the involved stakeholders over the goals, planning, execution, and decisions made during the design process (Harder et al., 2013; Lee, 2008; Zhang & Dong, 2016). The boundaries between the spectrum levels are blurred. The spectrum presents “involvement variations rather than a collection of clear-cut categories” (Veselova & Gaziulusoy, 2022, p. 4). Moreover, a single process could include several levels of involvement: It can include several types of stakeholders to various degrees or use differing approaches in different parts of the project.

Table 1. The seven levels of the stakeholder involvement spectrum (based on Veselova & Gaziulusoy, 2022, Publication 1)

<table>
<thead>
<tr>
<th>Stakeholder involvement and power to affect the process</th>
<th>Stakeholder level</th>
<th>A brief description of the level</th>
<th>Key references</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW</td>
<td>Denigrated</td>
<td>Designers do not recognize the actor as a relevant stakeholder or can intentionally diminish their importance.</td>
<td>Harder et al., 2013</td>
</tr>
<tr>
<td>^</td>
<td>Neglected</td>
<td>Designers recognize the actor as a potentially relevant stakeholder but choose to exclude the actor.</td>
<td>Harder et al., 2013</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Observed for inspiration</td>
<td>Designers recognize the actor as a potentially relevant stakeholder and observe the actor for inspiration; the stakeholder has no direct impact on the process.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Studied for insights</td>
<td>Designers recognize the actor as a relevant stakeholder and learn about the actor through research that guides the design process; the stakeholder is a passive informant and has no direct impact on the design process and outcomes.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Involved as a design partner</td>
<td>Designers recognize the actor as a relevant stakeholder and involve the actor as an active design partner; the stakeholder has an active role in and impact on the whole or parts of the design process. Designers retain the majority of the power.</td>
</tr>
<tr>
<td>^</td>
<td>Supported in creating designs</td>
<td>Designers act as skilled helpers in design processes led by the stakeholders. The stakeholders retain the majority of the power in the process.</td>
<td>Lee, 2008; Zhang &amp; Dong, 2016</td>
</tr>
<tr>
<td></td>
<td>V</td>
<td>Designed by the actor for the process</td>
<td>There is no explicit involvement of designers in the process; the stakeholders design by themselves.</td>
</tr>
</tbody>
</table>

C&PD is typically linked to the “involved as a design partner” level because, in this approach, designers strive to include stakeholders as active participants. Designers contribute their expertise in designing, lead the design process, and initiate and facilitate stakeholder participation (Simonsen & Robertson, 2012). The stakeholders participate in the process when invited and contribute their expertise, perspectives, and knowledge related to or stemming from their per-
sonal or professional lives (Mattelmäki et al., 2011). Designers structure the design process following the needs of a particular context or project. Overall, C&PD projects differ a lot. There is no standard approach to C&PD and no standard terminology (Taffe, 2015). Table 2 presents the key variables and their variations that impact on how a C&PD project is structured and shaped. The variations have resulted in the emergence of many sub-approaches in C&PD. Designers and researchers can use terms such as PD, collaborative design, co-creation, co-design, and stakeholder participation to refer to C&PD efforts. Each of these terms can carry several meanings (Harder et al., 2013; Lenskjold et al., 2015), and some researchers and designers use them interchangeably, while others assign clearly defined meanings to each.

Table 2. The key variables in C&PD and their variations (based on Veselova & Gaziulusoy, 2022, Publication 1)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Variations</th>
<th>Key References</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reason for stakeholder involvement</strong></td>
<td><strong>Political/moral reason</strong>: To enable people to affect design decisions that influence their lives</td>
<td>Carroll &amp; Rosson, 2007; Kujala, 2003; Simonsen &amp; Robertson, 2012</td>
</tr>
<tr>
<td></td>
<td><strong>Pragmatic reason</strong>: To increase the quality, applicability, and usability of solutions</td>
<td>Kristensson &amp; Magnusson, 2010; Lundström et al., 2016; Steen et al., 2011</td>
</tr>
<tr>
<td></td>
<td><strong>Innovativeness-related reason</strong>: To increase the amount and innovativeness of ideas and solutions</td>
<td>Kristensson et al., 2002</td>
</tr>
<tr>
<td></td>
<td><strong>Commercial reason</strong>: To strengthen the brand, build customer loyalty, and increase competitiveness and revenue</td>
<td>Kristensson et al., 2002; Steen et al., 2011; Vargo &amp; Lusch, 2004</td>
</tr>
<tr>
<td><strong>Time of involvement</strong></td>
<td><strong>Design time</strong>: A period when a solution is developed before it is taken into use</td>
<td>Botero &amp; Hyysalo, 2013, 2013; Fischer et al., 2009; Giaccardi &amp; Fischer, 2008</td>
</tr>
<tr>
<td></td>
<td><strong>Use time</strong>: A period when a solution is taken into actual use; the context and needs emerge</td>
<td></td>
</tr>
<tr>
<td><strong>The focus of the process</strong></td>
<td><strong>Research focus</strong>: Understanding the current situation, stakeholder perspectives, needs</td>
<td>Sanders &amp; Stappers, 2008; Steen, 2013</td>
</tr>
<tr>
<td></td>
<td><strong>Design focus</strong>: Ideating, designing and creating a solution</td>
<td></td>
</tr>
<tr>
<td><strong>Actors that set goals</strong></td>
<td>Only designers</td>
<td>Lee, 2008; Sanders &amp; Stappers, 2008; Steen, 2013</td>
</tr>
<tr>
<td></td>
<td>Designers and one type of stakeholder</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Designers and a few types of stakeholder</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Designers and all stakeholders</td>
<td></td>
</tr>
<tr>
<td><strong>Actors that make decisions</strong></td>
<td>Only designers</td>
<td>Harder et al., 2013</td>
</tr>
<tr>
<td></td>
<td>Designers and one type of stakeholder</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Designers and a few types of stakeholder</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Designers and all stakeholders</td>
<td></td>
</tr>
<tr>
<td><strong>The variety of stakeholders</strong></td>
<td>One type of stakeholder</td>
<td>Harder et al., 2013</td>
</tr>
<tr>
<td></td>
<td>A few types of stakeholders</td>
<td></td>
</tr>
</tbody>
</table>
Many or all types of stakeholders

<table>
<thead>
<tr>
<th>The number of stakeholders</th>
<th>One stakeholder</th>
<th>Harder et al., 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>A few stakeholders</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Many stakeholders</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The number of stages of the design process with stakeholder involvement</th>
<th>One stage: For example, research, analysis, ideation, solution design, or testing</th>
<th>Harder et al., 2013; Hoyer et al., 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two or more stages</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All stages</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.2 Sustainability

As a concept, sustainability does not have an exact, universally accepted definition (Barbosa et al., 2014). In this dissertation, I align my conception of sustainability with sustainability science. Sustainability science is an inter- and transdisciplinary research field that focuses on defining sustainability and producing actionable knowledge in order to reach it (Horcea-Milcu, 2019). Sustainability science emerged in the 1980s and unified as a scientific field in the early 2000s (Bettencourt & Kaur, 2011). Sustainability science predominantly studies the complex interactions between humans and nature (Miller, 2013). Sustainability scientists view disciplinary views and approaches to sustainability as leading to fragmented opinions on the causes, dynamics, and possible solutions for achieving sustainability. To transcend disciplinary boundaries and limitations, scientists employ systems thinking and systems analysis (De Vries, 2012; Liu et al., 2015), calling for “integrated, system-oriented approaches to navigating socio-ecological complexity” (Abson et al., 2017, p. 31).

2.2.1 Systemic sustainability and the interconnected human-nature systems

Humans and human-made systems depend on natural entities and systems, and human survival on Earth requires a viable natural environment. Among other things, the human body needs oxygen, clean water, food, and an appropriate temperature to function, and all materials used by humans—regardless of whether that material is perceived as natural or artificial also originate in nature and are extracted from nature (Ives et al., 2018). This dependence is conceptualized and modeled in nested sustainability models, such as the strong sustainability model (Neumayer, 2003) and the multispecies sustainability model (Rupprecht et al., 2020), presented in Figure 2. Multispecies sustainability is a more recent, nuanced conceptualization of strong sustainability. It proposes that strong sustainability oversimplifies nature, for example, by disregarding the differences between living beings and the non-living parts of nature; it also suggests that nature should be viewed in its complexity (Rupprecht et al., 2020).
Humans and human-made systems extensively and inseparably interconnect with natural elements and systems (Ives et al., 2017; Schoon & van der Leeuw, 2015). Flows and exchanges of materials, nutrients, and energy (among other things) link humans, human-made artifacts, and human-made systems with nature and its elements (Hull et al., 2015). The parts of human–nature systems interlink through various types of connections, and they interact with each other and are part of different systemic processes. Through the interconnections, humans and nature form vast and complex systems (Liu et al., 2015). In this dissertation, I use the term human–nature systems to refer to these systems, while some researchers use the terms socio-ecological systems and coupled human–environment systems (Fischer et al., 2015). I schematically model the interconnected human–nature systems as a mesh of four types of entity (see Figure 3): societal, economic, technological, and environmental entities. In this case, I use the term entities to indicate the possible diversity of potential elements and sub-systems that constitute the human–nature systems.

When striving towards sustainability, the concept of human–nature systems is especially relevant because, at its core, sustainability is a systemic property. Sustainability is an emergent property of systems (Clayton et al., 1996). It emerges from the dynamic, activity-based, and behavioral interactions between [environment] [society] [economy]

*a. Strong sustainability model*  
*b. Multispecies sustainability model*

Figure 2. Visual models of (a) strong sustainability (Neumayer, 2003) and (a) multispecies sustainability (Rupprecht et al., 2020).

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2Societal entities include, for example, individual humans and groups as well as human-made elements and systems, such as organizations, societal structures, laws, regulations, political systems, and cultural practices and norms. Economic entities include money; monetary, banking, and payment systems; and the global economic infrastructure. Technological entities encompass both the analogue and digital human creations, including physical infrastructure (such as roads, buildings, and vehicles), digital infrastructure, (such as the Internet and digital systems), and mixed infrastructures (such as a mobile phone, which includes the physical phone and digital apps). Environmental entities include organisms, species, and ecosystems.
sub-systems and their elements if their dynamics are “conducive to the continued operation of the system as a whole within its wider environment” (Hay et al., 2014, p. 241). The sustainability of human–nature systems emerges from elements and sub-systems aligning themselves with activities that support sustainability (Gaziulusoy, 2015). When adopting the human–nature systems perspective, sustainability becomes the property of the joint system, and humans, natural elements, and sub-systems need to align themselves with contributing to sustainability. Overall, the human–nature systems are essential to consider when working towards sustainability (Fischer et al., 2015; Liu et al., 2015; Schoon & van der Leeuw, 2015).

2.2.2 Worldviews underlying the sustainability crisis

Sustainability science increasingly highlights inner worlds, worldviews, mindsets, values, and beliefs as forming one of the critical areas for intervention and transformation required in order to reach sustainability. For example, the leverage points framework, which deals with identifying intervention points for systemic change, proposes that acknowledging and shaping worldviews, mindsets, and values has the potential to create the most profound changes in systems (Abson et al., 2017; Meadows, 1999; Woiwode et al., 2021). The concept of inside-out sustainability suggests that the inner worlds of an individual—including their mental models, beliefs, and emotions—significantly shape that person’s view towards sustainability and their actions toward sustainability (Ives et al., 2020). Meanwhile, the three spheres of transformation for sustainability framework indicates that shifting the personal and collective worldviews
Theoretical Background

and values—which the framework refers to as the personal sphere of transformation—has the most potent potential to create shifts toward sustainability (O’Brien & Sygna, 2013). In this dissertation, I use the term worldviews as an umbrella term that encompasses the inner worlds, mindsets, values, beliefs, and other elements that shape how a person perceives and values the world around them.

There are two interrelated types of worldviews that are relevant to the context of this dissertation. The first type is the perception that humans are separate and independent from nature, called the human–nature divide. The second type is the perception that humans have the right to overlook and dominate nature. This section presents these two types in more detail.

The human–nature divide or human–nature dichotomy refers to the worldview that the human realm and nature are two separate realms. This separation and “inability” of humans to see their connection to and dependence on nature are seen as forming one of the root causes of the environmental crisis (e.g., see Abson et al., 2017; Ives et al., 2018; Zylstra et al., 2014). The divide is also ingrained in beliefs, language, structures, and behavior, as well as in research disciplines, research findings, and professions (Abson et al., 2017; Muhar et al., 2018; Raymond et al., 2018). The term human–nature systems that I use in my research also includes the ingrained division between humans and nature while still trying to indicate the interconnections and interdependences between them. Some researchers (e.g., Ives et al., 2017, 2018; Zylstra et al., 2014) conceptualize the human–nature separation as humans being disconnected from nature and call for “reconnecting with nature” to address the sustainability crisis. The call to reconnect with nature urges humans to rediscover that humans and nature are deeply interconnected and that humans depend on nature.

The domination narrative tightly links to the perceived separation of humans and nature. In Western societies, humans tend to consider that they are superior to nature and, thus, have the right to dominate, control, and use nature as they please (Flint et al., 2013; Muhar & Böck, 2018). The right to disregard and overlook nature refers to the perspective that humans are entitled to tame and use nature.

One theoretical perspective used to engage with the domination worldview is the concept of the human–nature relationship. This approach views that domination or being a master of nature is only one of the types of relationship humans can have with nature. With minor variations, researchers seem to present four similar types of relationship: humans as masters of nature, stewards of nature, partners with nature, and participants in nature (see Flint et al., 2013 for an overview). The relationship type differs based on whether humans have the right to use nature, whether humans are part of nature, and whether nature has any value outside of being valuable to humans. The typology of Walker-Springett and colleagues (2016), presented in Table 3, includes the four already mentioned types and two additional types of relationship: an apathetic relationship and humans as a user of nature.
Table 3. Six types of human–nature relationship, according to the role of the human in them (Walker-Springett et al., 2016).

<table>
<thead>
<tr>
<th>Typology</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Master</td>
<td>I think humans can become independent from nature, by developing technology, and should control and change nature. The production of necessary goods, for instance food, can be improved and natural hazards like floods can be averted.</td>
</tr>
<tr>
<td>Apathy</td>
<td>I do not think about nature much in my daily life</td>
</tr>
<tr>
<td>User</td>
<td>I believe humans benefit from functioning ecosystems, for instance from clean water, timber or the beauty of landscapes. Hence functioning ecosystems can also create jobs and profits.</td>
</tr>
<tr>
<td>Steward</td>
<td>I see a moral obligation to conserve and protect nature, because human development and technology can be a threat to nature.</td>
</tr>
<tr>
<td>Partner</td>
<td>I consider humans and nature as equal in value and power. Nature has a value in itself, which cannot be only be measured according to human utilisation.</td>
</tr>
<tr>
<td>Participant</td>
<td>I feel as part of nature. I have an emotional or spiritual bond with it. Being or living in nature is fulfilling for me. Our existence and the well-being of nature are intertwined. We cannot separate humans from nature.</td>
</tr>
</tbody>
</table>

Another theoretical perspective used to engage with the domination worldview is anthropocentrism. Anthropocentrism is a concept coming from environmental ethics, a branch of Western philosophy that explores how humans should relate to and treat nature. Environmental ethics focuses on outlining which actions towards nature are or would be moral: how human societies “ought” to behave towards nature (Allhoff, 2011). The morality of actions is tightly linked to moral standing. When an entity is perceived to have moral standing, moral agents—beings that can act morally, according to the principles of ethics³—ought to consider the entity’s interest when making ethically right decisions (Jaworska & Tannenbaum, 2021). In environmental ethics, the moral standing of an entity typically arises when humans assign intrinsic value to a natural entity. A natural being or system is viewed to have intrinsic value if humans view it as important and valuable, even though it is not useful to humans (Brennan & Lo, 2016). If the natural entity is only valuable because it is useful to humans—for example, it is used to satisfy human needs or reach human goals—it is viewed as having instrumental value.

There is no consensus on which natural entities humans ought to consider when making moral decisions. There are varied, concurrent perspectives on which natural entities have moral standing, which has led to the development of many frameworks in environmental ethics. The frameworks are divided into two primary categories: anthropocentric and non-anthropocentric ethics. Each environmental ethical framework—be it an anthropocentric or non-anthropocentric framework—proposes its particular perspective and criticizes the other frameworks. Table 4 presents the key anthropocentric and non-anthropocentric ethical frameworks.

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³ Only humans are moral agents in Western environmental ethics.
Anthropocentric ethical frameworks consider that nothing in nature has intrinsic value or moral standing and that nature is only valuable for its instrumental contributions to humanity (Boylan, 2013; Sandler, 2018). There are four types of anthropocentric environmental ethics: strong, weak, enlightened, and cynical anthropocentric environmental ethics.

Non-anthropocentric frameworks, in contrast, propose that nature as a whole or some parts of it have moral standing. The individualistic non-anthropocentric frameworks—ratiocentrism, sentientism, and biocentrism—suggest that certain organisms have moral standing (Palmer et al., 2014). Meanwhile, the holistic environmental ethical frameworks—such as ecocentrism, deep ecology, and new animism—propose that natural collectives and systems have moral standing. Some non-anthropocentric ethical frameworks encompass the human–nature divide, while others do not. Ratiocentrism, sentientism, biocentrism, anti-speciesism, and ecocentrism do not necessarily argue that humans are part of nature nor that humans are interconnected with nature (Brennan & Lo, 2016). Meanwhile, the land ethic, deep ecology, ecofeminism, social ecology, and new animism argue for and prioritize the interconnected, interdependent view of humans and nature (Boylan, 2013).

Table 4. The key environmental ethical frameworks (summarized from Boylan, 2013; Brennan & Lo, 2016; Sandler, 2018)

<table>
<thead>
<tr>
<th>Category</th>
<th>Sub-category</th>
<th>Name</th>
<th>Who/what has intrinsic value and/or moral standing (&amp; other relevant arguments)</th>
</tr>
</thead>
<tbody>
<tr>
<td>An anthropocentric framework: only humans have moral standing</td>
<td>Strong anthropocentrism</td>
<td>Only humans</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Weak anthropocentrism</td>
<td>Humans and potentially some natural entities (the intrinsic value of humans is much more important than any intrinsic value of natural entities; creating human well-being at the expense of nonhuman well-being is justifiable)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Enlightened or prudential anthropocentrism</td>
<td>Only humans (humans have moral duties toward nature because they have moral obligations toward humans)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cynical anthropocentrism</td>
<td>Humans and potentially some natural entities (humans ought to employ non-anthropocentrism because it supports a higher-level anthropocentric purpose of human wellbeing)</td>
<td></td>
</tr>
<tr>
<td>A non-anthropocentric framework: elements of nature have moral standing</td>
<td>An individualistic framework</td>
<td>Ratiocentrism</td>
<td>Only rational individuals (organisms), such as humans, individuals from other highly rational species, and highly developed AI</td>
</tr>
<tr>
<td></td>
<td>Sentientism</td>
<td>Individual organisms that have the psychological capability and can feel emotions, such as humans, mammals, birds</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Biocentrism</td>
<td>All living organisms</td>
<td></td>
</tr>
<tr>
<td>A holistic framework: systemic elements and systems of nature can have moral standing</td>
<td>Anti-speciesism</td>
<td>Species (the framework argues for the survival of species, biodiversity, species pluralism, and species richness)</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Ecocentrism</td>
<td>Living systems</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Land ethic</td>
<td>Land and aspects of land, such as waters, solids, plant communities, and animal communities (humans should have a respectful relationship with nature)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Deep ecology</td>
<td>Humans as part of nature (this framework focuses on and values the relations between the living beings—both human and nonhuman—within the interconnected biosphere)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Social ecology</td>
<td>There is no discussion of intrinsic value or moral standing (the framework views humans as part of nature and nature as part of humans and interprets environmental challenges as social challenges)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ecofeminism</td>
<td>Nature and its elements (this framework views that nature, like women, is oppressed by patriarchal systems that need to be dismantled)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>New animism</td>
<td>There is no discussion of intrinsic value or moral standing (nature can be interpreted and valued beyond the Western positivist conceptualizations of reality and rationality; human and other-than-human entities that have consciousness should be respected)</td>
<td></td>
</tr>
</tbody>
</table>

### 2.3 A summary of the key insights

This section summarizes the key insights from the literature review regarding what should be considered when critically exploring the reasons for including natural nonhuman stakeholders in C&PD when aiming to contribute to sustainability and what should be considered when approaching the identification and inclusion of natural nonhuman stakeholders and the identification of their needs.

**Key insights into C&PD:**

- **Stakeholders** are relevant entities who are not the professional designers responsible for the C&PD process but who can contribute valuable information, participate in the C&PD process, or be impacted on by the process or the created outcome. Individuals, groups, and organizations can be stakeholders in a C&PD process.

- C&PD is an area of design theory and practice in which designers involve stakeholders as active participants. Through this involvement, the stakeholders can influence the design process by, for example, impacting on the goals, the perception of the problem and context, influencing the decisions made, and co-shaping ideas and design solutions.
In C&PD, the designers are responsible for the project and facilitating participation: they plan the process; identify and invite relevant stakeholders; and design the approaches, methods, and tools used to enable participation.

The number and variety of the involved stakeholders varies from project to project. A project can include one, a few, or many stakeholders; the involved stakeholders can represent one, a few, or many stakeholder types.

Stakeholders can participate in C&PD processes during design time and use time. Typically, design time refers to the period during which the designers and stakeholders create a design solution before it is taken into use. Use time refers to the period after the solution has been taken into use, but changes and modifications can still be made to it.

C&PD projects differ from one another based on at least eight variables. There is no single standard procedure for a C&PD project; each process is planned according to the context and goals of the project.

Key insights into sustainability:

- Humans and their systems—including the social, economic, and technological systems—depend on natural entities and systems. The dependence of humans on nature is demonstrated by nested sustainability models in which humans, human societies, and their creations are embedded within nature. Multispecies sustainability is the most recent nested sustainability model, accentuating human dependence on nature and the necessity of considering nature, its complexity, and its flourishing when aiming for sustainability.

- Humans and their systems—including the social, economic, and technological entities and systems—are inseparably and extensively interconnected with natural entities and systems. Humans and natural elements and systems jointly form human—nature systems that can be modeled as a mesh of social, economic, technological, and natural entities.

- Sustainability is a property of a system that emerges when elements, entities, and sub-systems align their activities in order to maintain the existence and operation of the system. In the context of the joint human—nature systems, sustainability can emerge when the behavior of humans, human-made systems, natural entities, and natural systems align with supporting and maintaining the existence and operations of the human—nature systems.

- The worldviews of individuals, groups, and societies can either promote or hinder the sustainability of human—nature systems. In the context of this dissertation, the term worldviews encompasses mindsets, values, beliefs, and other elements that shape human perception and valuing of the world.
- Two interlinked worldviews have been identified as the likely root causes of the sustainability crisis: the perceived separation from nature and the perceived human right to dominate and disregard nature.

- The perceived separation from nature refers to the worldview that humans and nature are separate and that humans are independent of nature. The separation-from-nature worldview is ingrained in (Western) languages and words, societal structures, behavior, research, and practice disciplines. To reach sustainability, researchers call for shifting this worldview so that it recognizes the interconnection with nature, dependence on nature and that views humans as part of nature.

- The perceived human right to dominate nature refers to the worldview that humans are superior to nature and have the right to disregard the needs of natural entities and systems. The perceived right to dominate nature can be viewed from two angles: humans’ relationship with nature and anthropocentrism.

- Humans’ relationship with nature is a concept that explores how humans can (and should) relate to nature. The right to dominate nature relates to the master type of human–nature relationship. Being a master of nature correlates with the view that humans are separate and independent from nature and that humans should control and change nature. Besides being the masters of nature, humans can also be apathetic towards nature, users of nature, stewards of nature, partners with nature, or participants in nature.

- Anthropocentrism is a concept coming from environmental ethics, a branch of Western philosophy. Environmental ethics explores how humans “ought” to treat nature by considering which actions towards nature are moral and which natural entities have moral standing. Typically, natural entities that have intrinsic value from the human perspective—entities that are valuable in themselves without having to be beneficial to humans in any way—have moral standing and should be considered in moral considerations.

- Anthropocentrism considers that no natural entity has moral standing; meanwhile, non-anthropocentrism views that some natural entities have moral standing and should be considered by humans in moral considerations. There are four types of anthropocentric environmental ethics: strong, weak, enlightened, and cynical anthropocentric ethics. There are many non-anthropocentric environmental ethical frameworks, including individualistic frameworks that assign moral standing to some organisms and holistic frameworks that give moral standing to groups of organisms or systems.

- Each environmental ethical framework argues for its position and criticizes the other frameworks and their positions. There is no consensus in Western environmental ethics on which natural entities have moral standing and should be considered in moral deliberations.
3. Methodology

This chapter presents the process of this doctoral research and its methodological considerations. First, it introduces the overall research design. Then, it describes the five studies—Studies A to E—conducted during the doctoral research.

3.1 The overall research design

My doctoral research consisted of five complementary and interrelated studies. The aims of the studies—except for Study A—were informed by the findings from the previous studies. I started this research as a student in the Collaborative and Industrial Design master’s program at the Department of Design, Aalto University. I report the process I conducted for the master’s thesis research at the beginning of Study A. Figure 4 presents a chronological view of the studies and their interrelations. The darker blocks indicate the time I actively conducted research for the study or wrote the publication presenting the research. The pale gray blocks indicate the period between the submission of the article and its publication in a journal or conference proceedings. Meanwhile, Table 5 presents information about the studies, including their aims, the RQs the study contributed to, the type of study, and the research methodology and methods.

My research approach was driven by the aims of each study rather than by a single ontological, epistemological, or methodological position. Moreover, I integrated knowledge and findings from disciplines with differing ontological and epistemological perspectives and non-academic expertise in my studies.
### Table 5. An overview of the five studies conducted during the doctoral research.

<table>
<thead>
<tr>
<th>Study</th>
<th>Research members</th>
<th>Aim(s)</th>
<th>Type of study</th>
<th>Research methodology &amp; method(s)</th>
<th>Informed by …</th>
<th>Which RQs it contributed to answering</th>
<th>Final outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study A</td>
<td>Individual</td>
<td>To investigate how C&amp;PD might need to evolve to accommodate perspectives of the bioinclusive ethic, one of the non-anthropocentric environmental ethical frameworks</td>
<td>Theoretical</td>
<td>A two-part integrative literature review</td>
<td></td>
<td>RQs 1, 2, 3, 4</td>
<td>Journal article (see Publication 1, summarized in Section 4.1)</td>
</tr>
<tr>
<td>Study B</td>
<td>Individual</td>
<td>To build a theoretical understanding of sustainability and human-nature interconnection</td>
<td>Theoretical</td>
<td>An integrative literature review</td>
<td>Study A</td>
<td>RQs 1, 2</td>
<td>Short conference paper (see Publication 2, summarized in Section 4.2)</td>
</tr>
<tr>
<td>Study C</td>
<td>A group of 9 researchers</td>
<td>Group aim: to develop a prototype research agenda for design for sustainability in the COVID-19 pandemic times and in the post-pandemic times Personal aim: to identify changes in views about and attitudes towards nature during the early months of the COVID-19 pandemic</td>
<td>Empirical</td>
<td>Environmental scanning &amp; co-creative analysis (through an expert workshop and co-writing)</td>
<td>Studies A, B</td>
<td>RQ 1</td>
<td>Journal article (see Publication 3, summarized in Section 4.3)</td>
</tr>
<tr>
<td>Study D</td>
<td>Individual</td>
<td>To outline how to approach the identification of natural nonhumans stakeholders in a systemic manner and the complexities that arise from such an approach</td>
<td>Empirical</td>
<td>Multispecies ethnography, systemic analysis (using distinctions, systems, relationships, perspectives theoretical structures for systems thinking)</td>
<td>Studies A, B</td>
<td>RQs 1, 2, 3</td>
<td>Conference paper (see Publication 4, summarized in Section 4.4)</td>
</tr>
<tr>
<td>Study E</td>
<td>A team of 3 researchers (part of a consortium project)</td>
<td>To identify key aspects to be considered when mediating the needs of human and nonhuman stakeholders</td>
<td>Empirical</td>
<td>Boundary concept, semi-structured expert interviews, hybrid coding</td>
<td>Studies A, D</td>
<td>RQ 4</td>
<td>Conference paper (see Publication 5, summarized in Section 4.5)</td>
</tr>
</tbody>
</table>
example, I integrated insights from environmental psychology, physiology, and computer science in Study E and insights from biology with insights from gardeners in Study D. Therefore, I position my research within the broad approach of transdisciplinary research. *Transdisciplinary research* is an approach that strives to integrate knowledge from varied disciplines and non-academic actors around a particular topic or case (Hirsch Hadorn et al., 2008). Transdisciplinary research engages with problems that have social relevance, but the nature of these problems and knowledge about them is uncertain or unclear (Pohl & Hirsch Hadorn, 2007). I predominantly used theoretical concepts and models to integrate the different types of knowledge (Pohl & Hirsch Hadorn, 2008). I retained my position and perspectives as a design researcher throughout my doctoral research. I am a designer specializing in C&PD, and in each of the five studies, I aimed to step outside of the boundaries of C&PD, draw knowledge from other expertise areas, and then integrate that knowledge into C&PD.

### 3.2 The research studies

#### 3.2.1 Study A: Reimagining C&PD as a non-anthropocentric, bioinclusive practice

Study A investigated how C&PD might need to evolve to accommodate the perspectives of the bioinclusive ethic, one of the non-anthropocentric environmental ethical frameworks. I conducted a theoretical study because I needed in-depth knowledge about C&PD and the bioinclusive ethic, anthropocentrism, and non-anthropocentrism. I conducted an integrative literature review (Torraco, 2016) because research on C&PD and the bioinclusive ethic stem from two different disciplines. The integrative literature review is a research method that “reviews, critiques, and synthesizes representative literature on a topic in an integrated way such that new frameworks and perspectives on the topic are generated” (Torraco, 2016, p. 404). In Study A, the topic was bioinclusive, non-anthropocentric C&PD. I also adopted elements of a systematic literature review, which is a research method that strives to identify, appraise, and synthesize all (or as much as possible) of the literature on a topic (Booth et al., 2016; Grant & Booth, 2009). The two-part systematic integrative literature review—first part reviewing C&PD and the second part reviewing the bioinclusive ethic—allowed me to build an in-depth understanding of the two research areas and then, through the integration, identify what needs to change in C&PD if it were to adopt a non-anthropocentric, bioinclusive values base. The review of C&PD also surfaced existing examples of C&PD projects that included natural nonhuman stakeholders.

argued that definitions of designer and stakeholder, the stakeholder involvement spectrum, and the three key types of C&PD could be reimagined by adding natural nonhumans as stakeholders. In the second iteration, the study became part of this doctoral research. At this stage, I revisited and distilled the findings of my master’s thesis and turned them into a conference paper (Veselova & Gaziulusoy, 2019) for the European Academy of Design conference in 2019. In the third and final iteration, I deepened my understanding of the bioinclusive ethic and environmental ethics by taking an environmental ethics course at the University of Helsinki and studying the Stanford Encyclopedia of Philosophy (Brennan & Lo, 2016) and two introductory books (Boylan, 2013; Sandler, 2018). The more profound study of environmental ethics facilitated a significant deepening of my perspective on anthropocentrism, non-anthropocentrism, various environmental ethical frameworks, and the bioinclusive ethic. The deepened understanding surfaced three considerations that I had not discussed in the previous iterations: (i) the necessity to explicitly discuss the impact of dominant worldviews and systems on the goals and aims of the project; (ii) the necessity to differentiate between needs and wants; and (iii) the importance of including natural nonhuman stakeholders in design time, not only in use time. The final findings were published as an article in the Design and Culture journal (Veselova & Gaziulusoy, 2022); this article is included in this dissertation as Publication 1.

3.2.2 Study B: Conceptualizing sustainability and human–nature systems

Study B had a two-fold motivation. First, it was motivated by the findings of the first iteration of Study A, which indicated that humans and nature could be viewed as interconnected and that a shift to a non-anthropocentric, bioinclusive perspective would support reaching sustainability. Second, Study B was also inspired by my struggles to clearly and sufficiently define sustainability and explain the inherent interconnectedness of humans and nature. While the interconnection between humans and nature seemed apparent to me, I struggled to articulate my point of view to colleagues and students. Therefore, in Study B, I aimed to build and present a theoretical understanding of sustainability and the human–nature interconnection.

This need coincided with an opportunity to take a theoretical doctoral-level course, “Intersections of Sustainability and Design,” in the first semester of my doctoral studies. This course introduced some of the key aspects of sustainability and design for sustainability. I conducted an integrative literature review (Torraco, 2016) on human–nature interconnections for the course assignment. The topic of human–nature interconnections has been researched across various disciplines. I reviewed literature from sustainability science, systems thinking, environmental psychology, and transdisciplinary research on the human–nature systems. In this integrative literature review, I aimed to build an initial
overview of the topic. Through this work, I built an integrative understanding of perspectives on human–nature interconnections and systems. Meanwhile, the doctoral-level course also enabled me to understand the key perspectives on and definitions of sustainability. Study B resulted in a short conference paper presented at the 8th Bi-Annual Nordic Design Research Society Conference in the summer of 2019; this paper is included in this dissertation as Publication 2.

3.2.3 Study C: Identifying changes in views about and attitudes toward nature during the early months of the COVID-19 pandemic

Study C was inspired by the happenings of the early months of the COVID-19 pandemic in the spring of 2020. The idea for this study arose during one of the meetings of my research group, the NODUS Sustainable Design Research Group, at the Department of Design, Aalto University. Following this meeting, I— with the help of the head of the research group and my supervisor Prof. İdil Gaziulusoy and colleague Dr. Elise Hodson—initiated a process of environmental scanning (Gordon & Glenn, 2009) and took a co-creative analysis approach through an expert workshop and co-writing. Nine NODUS researchers took part in the process; the work of all the participating researchers broadly relates to sustainability.

Over several weeks, the participating NODUS researchers identified emerging happenings and developments relevant to their research area. As a group, we framed these observations as weak signals: emerging developments that, if amplified, could cause a significant change within society and systems (Ansoff, 1975). I observed the news and happenings in my personal life and society. I focused on identifying the changes in attitudes towards nature and how it is valued and on changes in the perspective that humans are separate from and dominant over nature. After the observation period, I hosted a participatory co-analysis workshop in which participating researchers shared their observations and identified noteworthy changes and their relevance to their research area. The workshop allowed the participants to build a joint image of the changes that might or should impact on the direction of the research in design for sustainability. The workshop was audio-recorded and transcribed using speech-to-text software.

Dr. Elise Hodson and I pasted the relevant parts of the transcripts into a single shared Word document and invited the participating researchers to co-write in it. Primarily, the researchers thematically arranged the insights from the recordings, and elaborated on and included examples of the weak signals related to their research. However, the researchers also engaged with the observations and the weak signals identified by others. The researchers were invited to refer to relevant media publications documenting their observations. The workshop and co-writing focused on identifying emerging themes rather than enforcing a particular analytical framework. Then, once the key themes were identified, we employed the leverage points to intervene in a system framework (Abson et al., 2017; Meadows, 1999) to structure the themes according to their potential to
create systemic change towards sustainability. From this point, the first three authors of the paper (which included me) finalized the journal article that was later published in a special issue of the *Strategic Design Research Journal*. This article is included in the dissertation as Publication 3.

In the context of my doctoral research, Study C contributed insights into how the COVID-19 pandemic challenged the seemingly unquestionable perceptions of human independence from nature and human ability to dominate nature. It also showcased the possibility that the dominant (Western) perceptions of nature can be shifted.

### 3.2.4 Study D: Outlining how to approach the identification of natural nonhuman stakeholders through a systemic lens

Study D was inspired by the research findings from the first and second iterations of Study A and Study B. Study A indicated that, from a non-anthropocentric perspective, there is a need to consider and include natural nonhumans in C&PD processes and to consider the interrelations and interconnections between humans and nature. Meanwhile, Study B proposed the need to approach and frame sustainability-related projects systemically and operate within the interconnected human–nature systems. Neither Study A nor Study B yielded a definitive proposal regarding which natural nonhuman entities C&PD should consider and how to approach their identification. Therefore, in Study D, I decided to investigate the identification of natural nonhuman stakeholders in a real-life context through a systemic approach and the potential implications of such an approach for C&PD theory and practice.

I chose to use the multispecies ethnography approach to gather empirical data. *Multispecies ethnography* is a research methodology that views humans as inherently interconnected with and interdependent on natural beings and systems (Swanson, 2017). Multispecies ethnography studies these interconnections and interdependencies by focusing on the interactions between the natural world and the human world (Kirksey & Helmreich, 2010) in order to identify how they shape one another (Ogden et al., 2013). Multispecies ethnography provided a theoretically grounded approach to determining which natural entities and systems interact with humans, are affected by humans, how they affect humans, human activities, and human-made systems.

I gathered the empirical data in my family’s garden. I chose this location due to four reasons. First, the garden is a context with many human–nature interactions and processes. Second, I have extensive practical, contextual experience in engaging with the garden and the natural entities and systems it encompasses, which, until the point of the study, I had excluded from my design research and practice. Third, I have theoretical knowledge in my native languages—Latvian and Russian—about the species and processes in the garden, which eased the documentation and analysis process. Fourth, this setting was available and safe to access during the COVID-19 pandemic.
I collected the data in the summer of 2020 over five consecutive weeks. I used varied data collection methods, such as participant observation, field notes, ad hoc interviews with humans in the garden, photography, and video and audio recordings of the garden. These are typical methods in multispecies ethnography (Kirksey & Helmreich, 2010; Ogden et al., 2013; Swanson, 2017). The participation of human subjects in the study was based on consent. At the onset of data collection, I informed the three human subjects in written form, in their native language, about the aims of the study, the data collection methods, the personal data that would be collected, and the ability of the participant to withdraw consent.

After data collection, I used the distinctions, systems, relationships, and perspectives (DSRP) theoretical structures of systems thinking (see Cabrera et al., 2008, 2015, 2021; Cabrera & Colosi, 2008) to analyze the data iteratively. The DSRP structures for systems thinking are presented in depth in Publications 4. I used this approach because Study B showcased that a systems perspective is fundamental to sustainability research and understanding human–nature systems. I analyzed the data in several iterations. First, I used the hybrid coding approach (Saldaña, 2015) to code the empirical data, and in applying this approach, I identified the humans, human-made elements, and natural elements, as well as the relationships between them. While coding, I utilized the following resources: the online edition of Encyclopedia Britannica to access up-to-date yet general-enough knowledge from relevant fields (Britannica Knowledge Experts, n.d.); collections of species in Latvia (see, e.g., Čakstīņa et al., n.d.); expert publications on farming and gardening (e.g., Gardener’s Path, n.d.); and information for gardeners published in the Latvian mass media (e.g., Klovāne, 2014). Based on the identified elements and relationships, I iteratively arranged them into systems and created four visual systems models. Each subsequent model included more elements and relationships. Then I developed a systemic nonhuman stakeholder typology and insights into how the systemic approach can impact on natural nonhuman stakeholder identification in C&PD. The findings were presented and published in the Relating Systems Thinking and Design Symposium proceedings in November 2021; the conference paper is included in this dissertation as Publication 4.

### 3.2.5 Study E: Identifying key aspects to consider when mediating the needs of human and nonhuman stakeholders

Study E was conducted within a research project called NorDark. NorDark was a consortium research project that brought together researchers from six areas, based in six institutions across Sweden, Norway, and Finland. NorDark aimed to explore how urban outdoor lighting solutions in the Nordic after-dark environments can consider the needs of not only humans but also natural nonhuman stakeholders. I was part of this project in the proposal writing stage and during the first 11 months of the research. Our three-person team, which in-
cluded two professors and me, added competencies in more-than-human design, design for sustainability, collaborative design, and transdisciplinary research theory and practice to the project. Within the project, our team had two aims: “[1] developing a generic design methodological framework for mediating the needs of humans and nonhumans and [2] facilitating transdisciplinary knowledge integration across the consortium” (Veselova et al., 2022, p. 3).

Study E was the first study our team conducted within the NorDark project. In this study, we focused on exploring the concept of needs as mediating the needs of humans and nonhumans was at the core of the project. Moreover, this focus was informed by one insight from Study A, which indicated that there is a necessity to differentiate between needs and wants when designing in a bioinclusive manner. Therefore, the concept of needs became the focal point of Study E. Study E was also informed by taking a systemic perspective on identifying natural nonhuman stakeholders, which came from Study D. Study E had three key aims: (1) to uncover how each of the involved disciplines frames and views human or nonhuman needs; (2) to uncover how the involved research areas identify human or nonhuman needs; (3) to identify the concrete human and nonhuman needs that are relevant for lighting design for urban Nordic after-dark environments.

In Study E, I conducted nine semi-structured expert interviews (Flick, 2009) with the key researchers involved in the NorDark project, and one of my team-mates interviewed me. Expert interviews enabled our research team to rapidly access disciplinary knowledge and perspectives on needs. Due to the COVID-19 situation, the interviews were conducted via Zoom. Participation was consent based; participants were informed about the aims of the study and the methodology in consortium meetings and the invitation email. Additionally, before the findings were submitted for publication, the study participants were invited to check the validity of the insights related to their discipline. Each of the interviews was audio-recorded and later transcribed using speech-to-text software. The textual data was coded using a hybrid coding approach (Saldaña, 2015). In the analysis, first, the expertise area-specific insights were identified, and then the insights were integrated through comparison, grouping, and mapping. The integrated findings were published in a conference paper presented at the Design Research Society’s conference of 2022 (held in June 2022); the conference paper is included in this dissertation as Publication 5.
4. Summaries of the Included Publications

This chapter summarizes the five publications included in this doctoral dissertation.

4.1 Publication 1: “Bioinclusive collaborative and participatory design: A conceptual framework and a research agenda”

Anthropocentrism has been identified as one of the root causes of the sustainability crisis (Ceballos et al., 2015; Ripple et al., 2017; Zylstra et al., 2014). There is a need to shift towards non-anthropocentric values and cultures in which the needs of natural nonhumans would be considered and supported. Anthropocentric values have also informed design approaches, including C&PD, which have focused on developing solutions that satisfy human wants and needs. In this paper, we identify that one of the ways to shift anthropocentric values in C&PD is by re-assessing its constructs through non-anthropocentric environmental ethics. We chose one environmental ethical framework—the bioinclusive ethic (Mathews, 2006, 2008, 2011)—for the reassessment and developed an integrative conceptual framework for bioinclusive C&PD.

Typically, designers and stakeholders are the two key types of participants in design processes. In this paper, C&PD is defined and used as an umbrella term to refer to a broad set of design approaches (such as participatory design, co-design, and co-creation) in which designers involve stakeholders as active participants in design processes. In this paper, three tables succinctly introduce fundamental notions about C&PD: Tables 1 and 2 have been introduced in Section 2.1 of this dissertation. Table 1 provides an overview of the seven levels of stakeholder involvement, ranging from low to high stakeholder involvement and power to impact on the design process. The stakeholder is denigrated, neglected, observed for inspiration, studied for insights, involved as a design partner, supported in creating design, and designing for the stakeholder, by the stakeholder. C&PD is viewed to correspond with the involved as a design partner level. Table 2 provides an overview of eight variables that shape a C&PD process: reasons for stakeholder involvement, time of involvement, the focus of the process, actors that set goals, actors that make decisions, the variety of
stakeholders, the number of stakeholders, and the number of stages of the design process with stakeholder involvement. The third table introduces three key sub-approach groups found in C&PD, arranged according to the reason for stakeholder involvement and whether or not the stakeholders are involved in design time or use time. The groups are participatory design, collaborative design before use, and collaborative design in use.

Environmental ethics is a type of applied ethics—a branch of Western philosophy—that explores whether something in nature has intrinsic value and moral standing (Brennan & Lo, 2016; Sandler, 2018). Anthropocentric environmental ethics consider that only humans have intrinsic value and moral standing; meanwhile, non-anthropocentric environmental ethics also view some natural entities as having intrinsic value and moral standing. There are many non-anthropocentric ethical frameworks, one of which is the bioinclusive ethic. The bioinclusive ethic is an ethical framework rooted in three interdependent pillars. First, the bioinclusive ethic argues that nature should be defined in a non-dualistic manner. It proposes viewing nature as a joint collective in which conative beings—beings that strive to maintain themselves and realize their inherent potential—pursue their goals while allowing other conative beings to fulfill theirs. Humans are one type of conative being who, due to their reflexive ability, need to pay special attention to ensuring that pursuing human goals minimizes its impact on the pursuits of nonhuman conative beings. Second, the ethic argues that (non-dualistically defined) nature and reality in general should be viewed in a post-materialistic, animistic manner. According to post-materialism, non-human conative beings have a particular mentality that differs from human consciousness and should be respected by humans. Third, the ethic argues for shifting from domination towards synergy between humans and natural nonhumans. In synergy, humans would view nature in a non-dualistic manner and allow natural nonhumans to co-shape human goals, desires, and the ways in which humans satisfy their needs and wishes.

In this article, we introduce and discuss five interrelated areas of C&PD that are reconsidered according to the principles of the bioinclusive ethic. First, we identify the goals and aims of C&PD projects as forming one of the key areas to reconsider. The goals and aims of projects are shaped by the dominant Western anthropocentric worldviews and the dominant socio-technical-economic systems. One of the ways in which designers can challenge the anthropocentrism in C&PD is by explicitly discussing and challenging the impact of dominant worldviews and systems.

Second, we establish that the bioinclusive perspectives indicate that C&PD should reflect on the difference between human needs and wants. The bioinclusive ethic defines needs as aspects necessary for human survival, and it defines desires as aspects that humans want that exceed “mere” survival. Meanwhile, C&PD does not seem to differentiate between needs and wants. C&PD should reconsider its approach to needs and integrate relevant discussions about and
frameworks for the differences between needs and wants into its theory and practice.

Third, we urge C&PD to revisit the unwritten criterion that only humans should be considered stakeholders. Traditionally, in C&PD, only humans and groups or institutions comprised of humans have been viewed as stakeholders. The bioinclusive ethic suggests that natural nonhumans should be able to co-shape human desires and solutions built to satisfy those desires (Mathews, 2006). Such framing indicates that natural nonhumans should be viewed as stakeholders in C&PD. From the bioinclusive perspective, conative beings should also be considered stakeholders. The ethic does not present a list of conative beings; moreover, it is not the only framework that can provide perspectives on which natural entities should be considered stakeholders. We argue that a transdisciplinary approach is necessary when identifying which natural entities should be considered stakeholders in C&PD.

Fourth, we advise C&PD to develop varied and flexible approaches for including natural nonhuman stakeholders in co-creative processes, especially in design time. C&PD processes vary greatly, and designers can choose, adopt, and adjust approaches, tools, and methods according to the needs and context of a project. Thus, a single approach would be impossible to outline. Instead, we discuss early considerations for nature-inclusive C&PD processes, such as the necessity of including natural stakeholders in design time, the possibility of having some natural stakeholders as participants, and the possibility of representing natural stakeholders by human proxies. Additionally, we discuss that the participation of natural nonhuman stakeholders might already be happening in use time, and noticing and valuing this participation requires a shift in human perception.

Fifth, we identify that including natural nonhuman stakeholders challenges the definitions and conceptualizations of C&PD, designers, and design. We discuss whether bioinclusive C&PD only refers to designing instances that include designers and involve human and natural nonhuman stakeholders as active participants in the design process. We also discuss whether bioinclusive C&PD and design as a practice overall can also refer to processes in which natural nonhuman stakeholders co-create with a person who is not a professionally trained designer.

We conclude by summarizing the findings and discussion with twelve principles for bioinclusive C&PD and by outlining six areas for further research.

4.2 Publication 2: “Designing for sustainable entangled human–nature systems”

Addressing the sustainability crisis and reaching sustainable futures require significant changes in human-made systems and attitudes towards nature. The visions of sustainable futures and what changes are necessary in order to achieve
those futures can be hazy, yet some characteristics of sustainability, sustainable futures, and the required changes are evident.

Humans and human-made institutions and systems are highly interconnected with nature, its activities, and its systems; humans and their creations depend on natural entities and systems (Neumayer, 2003). Meanwhile, being sustainable is a property of systems as a whole and not of individual system elements (Gaziulusoy, 2015). Sustainability within a system can only emerge when the activity of the elements and within the elements and sub-systems aligns with the sustainability of the system. Thus, humans and human-made systems need to shift towards aligning with the sustainability needs of human–nature systems. Design can play and is playing a role in this shift. I argue that design should be discussed within the context of interconnected human–nature systems.

Human–nature systems include many human and natural elements. There are countless connections among the human elements, among the natural elements, and between the human and natural elements. I review seven types of interconnections that can be identified between humans and nature: psychological, material, experiential, cognitive, emotional, philosophical, and spiritual interconnections. These interconnections can be determined at the individual level, as well as at the community, local, and global levels (Chen, 2017; Ives et al., 2017, 2018; Muhar et al., 2018; Zylstra et al., 2014). The elements and interconnections can be represented in models. Each model is built according to professional or disciplinary perspectives. Thus, each model and interpretation of human–nature systems should be considered partial and biased. The limitations can be mitigated through transdisciplinary approaches that integrate academic and non-academic knowledge into the model (Chen, 2017; Duile, 2017; Muhar et al., 2018). Transdisciplinary views on human–nature systems are critical when aiming for sustainability (Miller, 2011; Schoon & van der Leeuw, 2015).

How an individual interprets human–nature systems depends on various factors, such as her or his view of herself or himself and nature, personal history, and values (Chen, 2017; Ives et al., 2018; Muhar et al., 2018; Raymond et al., 2013). The interpretation also depends on the time, place, and purpose of analyzing the systems and the views of the collective of which the individual is a part (Muhar et al., 2018; Muhar & Böck, 2018). The individual adopts different lenses of interpretation that fit the particular task, context, and goals (Muhar & Böck, 2018). Nevertheless, environmental and conservation psychology uses the concept of connectedness with nature (CWN)—also referred to as a connection to nature or nature relatedness—to holistically incorporate, evaluate, and represent the cognitive, emotional, and experiential attitudes towards the nature of an individual or groups of people (Raymond et al., 2013; Zylstra et al., 2014). CWN is viewed as a spectrum, with a low sense of CWN or feeling disconnected from nature at one end and high CWN at the other. Higher CWN is linked to a rise in pro-environmental behavior. Western individuals and collectives tend to
have low CWN. In individuals, CWN can be increased by learning about and experiencing nature (Zylstra et al., 2014). In collectives, it can be raised through education, collective activities, and engagement with nature. In disciplines, CWN can be increased through systems thinking and transdisciplinary approaches (Schoon & van der Leeuw, 2015). Additionally, CWN is extensively developed in childhood.

Following on from the above, I identify three key insights and discuss the potential impact of these insights on design. First, human–nature systems are entangled: they are highly interlinked and inseparable. Thus, I argue that every design project is part of human–nature systems and can promote or hinder their sustainability. Moreover, the natural entities and sub-systems the project links to can be viewed as natural nonhuman stakeholders and involved in the design project. Second, understanding the entangled human–nature systems requires a transdisciplinary approach. Consequently, I propose that design research and practice should utilize transdisciplinary approaches and be comfortable using and integrating various types of knowledge. Third, individuals, collectives, and disciplines need to increasingly understand the interconnected human–nature systems and build their CWN. Therefore, I suggest that CWN is an important competence for designers that should be cultivated in design training or set as a requirement for entering design schools. Overall, I argue that design should shift its theories and socio-cultural concepts towards operating with the acknowledgement of the entangled human–nature systems.

4.3 Publication 3: “Design for sustainability transformations: A deep leverage points research agenda for the (post-) pandemic context”

The global COVID-19 pandemic is a worldwide event impacting on most, if not all, systems. In its early days, the pandemic illuminated the dysfunctions, challenges, injustices, and inequalities found in the systems that organize and support human societies. The illuminated aspects of the systems and how humans responded to the challenges can provide insights into designing for sustainability because they showcase potential alternative futures.

In this context, we—that is, a group of researchers from the NODUS Sustainable Design Research Group at the Department of Design, Aalto University—gathered in order to analyze the weak signals of potential or ongoing changes in societies and systems that would be relevant for design for sustainability transformations (DfST). DfST is an area of design that studies how design relates to and contributes to the long-term changes in the systems and structures necessary for reaching sustainability (Gaziulusoy & Erdoğan Öztekin, 2019). DfST relates to many areas of design research and practice; it acquires knowledge and borrows models from disciplines and research areas related to sustainability. In this article, we use a model for analyzing system and systemic change: the leverage points to intervening in a system model (Abson et al., 2017; Meadows,
This model outlines 12 leverage points through which a system can be changed. The model arranges these leverage points, so they range from the shallow points, which are less effective for creating system-wide changes, to the deep leverage points, which are more effective. The six deep leverage points are summarized in two categories: the points related to social structures and institutions, and those underpinning values, goals, and worldviews. We used these two categories to analyze the weak signals relevant to DfST that were identified by the researchers in our group in the early months of the COVID-19 pandemic.

We identified six types of weak signal in the social structures and institutions category. First, the first months of the COVID-19 pandemic indicated that the responses of national governments to complex disruptions of systems required the balancing of potentially contradicting aspects (such as democracy, transparency, and rapidly changing scientific knowledge) and contradicting human, economic, local, national, and global needs. Second, responses that were self-organized by the local communities were often more rapid and effective than those of municipalities and national or federal governments. Third, self-organization was seen as a valuable and necessary approach for addressing the challenges triggered by the pandemic. Fourth, the pandemic highlighted several inequalities within the economic and social structures (such as reliance on precarious, underpaid, yet essential workers; the loss of jobs in service industries; and the shift to remote, safer work for the more privileged). It also questioned the importance and status of the professions and sectors of the economy. Fifth, the early months of the pandemic indicated that the global supply chains that the economy relies on lack resilience and can be (easily) disrupted; however, the limitations of the supply chains can be, to a certain extent, mitigated at the local level. Sixth, the pandemic served as an opportune moment for initiating, implementing, or arguing for environmental and sustainability-related policies, such as “green recovery” initiatives (Pantsar & Tynkkynen, 2020), questioning the principles of the growth economy and the dependency of livelihoods on unsustainable business models.

Further, we identified five weak signals in the values, goals, and worldviews category. First, the pandemic supported humans in reidentifying the inherent, yet often forgotten, interconnection of humans and nature. Second, it also urged humans to rethink the belief that humans are independent of and superior to nature and that humans can control nature because a minuscule natural non-human actor—a virus—could disrupt and dictate various practices and systems that support human life. Third, the lockdowns caused by the pandemic highlighted the importance of urban green spaces and urban nature, and increased their perceived value. Fourth, the pandemic highlighted the fact that worldviews and prejudices related to, for example, sexism, racism, ableism, and ageism shape human-made systems and structures and impact on the ability of individuals and groups to respond to global, complex challenges. Fifth, the pandemic highlighted how governments tend to value and promote maintaining the economy, which contributes to unsustainability, over sustainability transformations.
Based on the identified weak signals, we developed a prototype research agenda for DfST for the (post-)pandemic context. We structured our research agenda around a framework of three types of knowledge gained from transdisciplinary research that argues that systems, target, and transformation knowledge are needed when shifting to sustainability (Pohl & Hirsch Hadorn, 2007). Systems knowledge builds an understanding of the past, present, and possible future of a problem or a context. Target knowledge creates an understanding of the desired states of the problem or context. Transformation knowledge builds an understanding of how to shift the problem or context from the present state to the desired state. In our prototype research agenda, we pose 24 sets of questions—ten sets for systems knowledge, seven sets for target knowledge, and seven sets for transformation knowledge—that arise from the pandemic and should be investigated by DfST.

4.4 Publication 4: “When a tree is also a multispecies collective, a photosynthesis process and a carbon cycle: A systemic typology of natural nonhuman stakeholders when designing for sustainability”

Including and considering the needs of nonhumans is one of the ways in which design research and practice strive to address the sustainability crisis. These more-than-human design approaches challenge human-centric design principles by expanding their considerations to include natural nonhuman entities, artificial nonhuman entities, or both. The co-authors of this paper strove to accommodate natural nonhuman entities because sustainability science strongly indicates that humans and nature are inseparably interlinked. Strong sustainability (Neumayer, 2003) and multispecies sustainability (Rupprecht et al., 2020) accentuate that humans and social, technical, and economic systems depend on nature and ecological systems. Humans and human-made systems should not be viewed as independent from natural systems. At the same time, humans, human-made elements, and systems are inseparably interlinked with natural elements and systems. Thus, more-than-human design should consider the interconnections, systemic dynamics, and dependency of humans and nature. However, most more-than-human initiatives in C&PD do not seem to incorporate systemic perspectives. Therefore, in this paper, we aimed to develop a systemic perspective and typology of natural nonhuman stakeholders for C&PD.

The typology was developed based on empirical data collected by the first author through a multispecies ethnography study (Kirksey & Helmreich, 2010) conducted in the author’s family garden. The data was analyzed using the DSRP framework (Cabrera et al., 2021; Cabrera & Colosi, 2008).

The systemic typology, introduced in this paper, includes seven types—or seven distinct key variations—of natural nonhuman stakeholders. These types include single organisms, single-species collectives, multispecies collectives, life
processes, living systems, biogeochemical cycles, and processes of the atmosphere. The types are not universal nor mutually exclusive, and further research might uncover additional types. The boundaries between the types are not clear cut, and the same natural entities are several stakeholder types simultaneously. For example, from the systemic perspective, a cherry tree is simultaneously an organism, part of a multispecies collective with lichens on its branches, a participant in life processes, part of a garden’s living systems, and a participant in biogeochemical cycles. A human can also be interpreted through the natural nonhuman stakeholder typology. A human is a single organism that goes through life processes and is part of the biogeochemical cycles. Furthermore, technological entities can also be indirectly linked to natural nonhuman stakeholders. For example, a mobile app can be linked to biogeochemical cycles through the electrical energy it uses. Therefore, when identifying natural nonhuman stakeholders, various entities—including those that do not immediately appear to be natural nonhuman stakeholders—should be analyzed using the systemic approach and typology.

Viewing natural nonhuman stakeholders in a systemic way indicates two tensions between traditional C&PD and working systemically. First, a systemic approach to natural nonhuman stakeholders requires a paradigm shift away from viewing stakeholders and C&PD projects in isolation from the systems of which they are part. The typology of systemic natural nonhuman stakeholders could be used as a mental model with which to view C&PD projects as processes within systems. Second, the systemic approach to identifying natural nonhuman stakeholders challenges the traditional approach of C&PD, which is to focus on the active, direct participation of stakeholders through verbal or visual means. Most, if not all, systemic stakeholders would not be able to contribute to a process in these ways; therefore, participation in C&PD would need to be rethought.

The systemic typology presented and discussed in this paper is a starting point and should be further developed across various contexts and with the participation of different knowledge areas. We built the typology based on data from one context. Applying the typology in another context can surface other types of systemic natural nonhuman stakeholders, which can lead to an expansion or modification of the typology and the identification of which natural stakeholders are relevant for particular contexts and project types. Furthermore, development of the typology would benefit from transdisciplinary approaches with the involvement of experts from scientific and applied disciplines. Additionally, our research and process of developing the systemic typology indicated that C&PD designers would benefit from knowledge of the natural world, understanding and skills in transdisciplinary research, and systems thinking.
Design approaches that include more than just humans—*more-than-human design*—aim to reconsider having humans and their needs as the single focus of design processes (e.g., see Akama et al., 2020; Fletcher et al., 2019; Forlano, 2016). These considerations are rooted in philosophical and ethical discussions, sustainability science discussions, or both. The prominence of more-than-human discussions and concerns in design is growing. However, there is a limited number of applicable methods and tools for implementing a more-than-human design approach in practice. In this article, a team of design researchers within an interdisciplinary consortium project NorDark presented and discussed initial findings that inform the development of a methodological framework for more-than-human design. NorDark investigates how outdoor lighting design and solutions for the Nordic dark periods can account for the needs of humans and wildlife. The project includes six research areas: lighting design, environmental psychology, human physiology, urban ecology, computer science and engineering, and sustainable and more-than-human design. In this project, our research team has two interdependent goals: developing a generic design methodological framework and facilitating the transdisciplinary integration of knowledge. Our initial findings for developing the methodological framework explore the concept of needs, a prominent concept in design and the consortium project. The findings are based on expert interviews with the consortium researchers, which studied disciplinary framings of needs, approaches for uncovering needs, and concrete lighting-related needs.

The publication summarized the characteristics of the research areas stemming from the interviews in a table. This table presents four characteristics: whether the research area uses theories on needs, whose needs the area considers, what types of needs the area considers, and what approaches the area uses to identify or work with needs. The table differentiates between characteristics relevant to the broader research area and insights specific to the NorDark project.

Based on the characteristics, the paper identified four insights. First, it identified three categories of research areas in the consortium:

1. Conceptual descriptive research areas that do not explicitly discuss needs and focus on the impact of contextual aspects on an entity.
2. Needs-based solution building areas that focus on uncovering stakeholder needs and building solutions to satisfy those needs.
3. Prescriptive research areas that focus on differentiating between needs and wants in order to contribute to sustainable development.

Second, the study showed that some research areas in the consortium have worked with lighting before and are close to the topic while other areas have no proximity to it. Third, the interviews surfaced a wide variety of human stakeholders and natural nonhumans stakeholders whose needs the project should
consider, indicating that human stakeholders and nonhuman stakeholders are not homogeneous categories. Fourth, the interviews revealed no conceptualizations or theories about natural nonhuman needs. Instead, natural nonhumans were more often discussed from the perspective of natural nonhuman rights.

The insights from the interviews indicated five areas for consideration when developing a design methodological framework for mediating human and natural nonhuman needs within the context of the NorDark project. First, the project-specific methodological framework should reflect the three perspectives on needs identified within the consortium and the proximity of research areas to lighting. The generic methodological framework should also anticipate how designers can engage with different conceptualizations of needs and insights from research areas with a differing view of needs.

Second, the project-specific and generic methodological frameworks should avoid generalizing and seeing humans and nonhumans as uniform, homogeneous groups. One of the approaches to identifying natural nonhuman stakeholders is the systemic approach, discussed in Publication 4 and summarized in Section 5.2 of this dissertation. The systemic approach should be applied across the whole life cycle of the projects and their components, as visualized Figure 8, in Sub-section 5.2.1. Thus, the project-specific and generic methodological frameworks should support designers in exploring three aspects: (i) variations of and conflicts among human stakeholders and their needs, (ii) variations and conflicts among natural nonhumans and their needs, and (iii) potential conflicts between humans and nonhumans. The frameworks should illuminate the variations of stakeholders and guide designers while considering and choosing which entities to consider and which to exclude.

Third, the development of the methodological frameworks should include an exploration of the conceptual differences between natural nonhuman needs and rights. No theories of natural nonhuman needs are readily available, and we only identified one instance of attempting to apply a theory of human needs to nonhumans (see Jolibert et al., 2011). Rights seem to be a more prominent concept in relation to natural nonhumans. There is a need to conceptually explore the difference between needs and rights, and identify how the different conceptualizations might impact on design.

Fourth, the analysis process and the findings highlighted that our research team needs to clarify the relationship between developing the methodological framework and supporting transdisciplinary knowledge integration in the NorDark consortium. The two goals are distinct yet interrelated. The transdisciplinary integration within the consortium impacts on and informs the methodological framework and vice versa. Moreover, it can be helpful to include insights and guidance on transdisciplinary knowledge integration in the methodological framework because mediating human and nonhuman needs requires integrating information from various academic and non-academic sources.
Finally, throughout the development of the methodological framework, we need to consider the relationship between NorDark’s case-specific methodological framework and a generic methodological framework. The development of a generic framework would benefit from researchers defining who would use the framework, when, and why and from researchers engaging with practicing designers (who are the target audience for the methodological framework).
5. The Findings and Discussion

This chapter presents and discusses the findings of my doctoral research by answering the four RQs. First, it discusses three reasons for including natural nonhuman stakeholders in C&PD when aiming to contribute to sustainability. Second, it presents and discusses two approaches to identifying natural nonhuman stakeholders. Third, it presents and discusses three practical techniques through which C&PD designers can include natural nonhuman stakeholders. Finally, it presents and discusses one approach for identifying natural nonhuman needs.

5.1 Why should designers include natural nonhuman stakeholders in C&PD when aiming to contribute to sustainability?

My research indicates three interrelated reasons why designers should include natural nonhuman stakeholders in C&PD when aiming to contribute to sustainability. First, including natural nonhuman stakeholders can lead to the development of practical design solutions that satisfy human needs while accounting for the needs, processes, and survival of natural beings and systems. Second, including natural nonhuman stakeholders can shift the worldviews of the designers and human participants towards being more aligned with sustainability. Third, including natural nonhuman stakeholders in C&PD can challenge the validity of the (dominant) socio-economic-technical systems and structures that support and maintain unsustainability. This section presents each of these reasons in more detail. Then, it proposes an integrative framework that incorporates the three reasons.

First, including natural nonhuman stakeholders can contribute to the design of practical solutions aligned with systemic and multispecies sustainability and human–nature systems. By including natural nonhuman stakeholders in C&PD, designers create processes that acknowledge the natural nonhuman stakeholders connected to the project and, in turn, opportunities to design solutions that accommodate and support these natural nonhuman stakeholders (Publication 1). Moreover, including natural nonhuman entities in C&PD also acknowledges the human–nature systems in which design projects are embedded (Publications 2 & 4). Every design project, including a C&PD project, can be seen as a process within human–nature systems, and every outcome of a design project becomes a part of the systems. Viewing the
The Findings and Discussion

A design project and outcome as part of a human–nature system indicates that every project links to and interacts with not only humans and human-made artifacts, systems, and concepts but also with natural entities and systems. A design project also links to and interacts with natural nonhuman stakeholders indirectly because the humans, artifacts, and systems further relate to natural nonhuman entities in the human–nature systems. Figure 5 schematically represents the placement of a project in human–nature systems; it represents the direct connections as solid lines between entities and the indirect connections as dashed lines. The natural nonhuman entities within the human–nature systems that link to, contribute to, or are impacted on by the project could be considered natural nonhuman stakeholders. The inclusion these natural nonhuman stakeholders more accurately represents the reality of the human–nature systems in which a C&PD project is embedded. Discarding these natural nonhuman stakeholders seems contrary to sustainability efforts because human–nature systems can only be sustainable as a joint system. Thus, including natural nonhumans stakeholders in C&PD can support the project in contributing to the sustainability of human–nature systems. Further research should investigate a potential differentiation between relevant natural nonhuman stakeholders and natural nonhuman entities the project might link to and whether the relevancy affects the ability of the project to contribute to systemic sustainability.

Figure 5. A schematic representation of a design project’s position in the human–nature system and the natural nonhuman stakeholders it has; direct connections are shown by solid lines and indirect connections are shown by dashed lines (visualized based on Veselova, 2019, see Publication 2; Veselova & Gaziulusoy, 2021, see Publication 4).
Second, including natural nonhuman stakeholders in C&PD can **challenge and shift the worldviews underlying the sustainability crisis.** When approached from a human–nature systems perspective, the inclusion can contribute to the deconstruction of the separation of humans and nature that the human-exclusive design processes seem to reinforce (Publications 1 & 4). Including natural nonhuman stakeholders also has the potential to challenge and start shifting the worldview that humans are entitled to dominate nature (Publication 1). Suppose that natural entities are included and considered in design processes. In that case, their inclusion may indicate to those human participants who do not yet recognize the importance of natural stakeholders that natural nonhuman entities have moral standing and should be considered. It can also highlight that humans and nature are inseparably interconnected and humans depend on nature. Furthermore, the inclusion can reinforce the significance of natural nonhuman stakeholders and nature overall to designers and human stakeholders who already recognize the interconnections, interdependencies, and value of nature. Additionally, the theory, methods, and tools of C&PD that require and support the inclusion of natural nonhuman stakeholders can help shift the worldviews of designers and design students. In turn, shifting the worldviews of designers can lead to more projects that challenge the worldviews that support unsustainability. Further research should investigate the potential of including natural nonhuman stakeholders in order to shift worldviews related to nature and its role and value. Research is also needed to inquire about how designers can identify their worldviews and which mechanisms they can use to engage with the worldviews of participants.

Third, when including natural nonhuman stakeholders in C&PD, designers can **create opportunities to illuminate and challenge the structures and systems that maintain unsustainability.** The socio-economic-technical systems in which designers, human participants, and projects are situated affect a design project and its outcome (Publication 1). These systems include, but are not limited to, social structures, laws, regulations, technical capabilities, existing technologies, the political-economic paradigm, and formal economic structures and procedures. A project that includes natural nonhuman stakeholders can challenge the systems and structures and highlight the value of nature, interconnection with nature, and dependence on nature. It can also guide reflections on whether systems and structures account for them and, if so, how they do so. For example, a project can explore whether the economic system values nature and, if so, how it does so and, if it does not recognize the intrinsic value of nature, how it should be restructured to do so, or a project can question to what extent technological systems acknowledge their dependence on nature. Including natural nonhuman stakeholders can also challenge the written, explicit definitions and the unwritten, implicit meanings of concepts, such as the concept of a stakeholder (Publications 1 & 2). Once the term *stakeholder* not only covers human individuals, groups, and organizations, the structures that legitimize humans being the only rightful stakeholders can become visible and
The Findings and Discussion

renegotiated. Further research is needed in order to investigate practical ways of including natural nonhuman stakeholders in C&PD and to evaluate how such inclusion can contribute to questioning and potentially restructuring systems, structures, and meanings.

5.1.1 An integrative framework of reasons to include natural nonhuman stakeholders in C&PD when aiming to design for sustainability

The three reasons discussed in this section are interconnected and interdependent. Worldviews inform how designers understand the systems and structures in which a project is embedded. In turn, the mindsets, systems, and structures shape the practical choices, such as the goals and aims, processes, and co-designed solutions. Worldviews shape how design (including C&PD) has been developed, practiced, researched, and taught (see Publication 1). The worldviews have also shaped the dominant socio-technical-economic systems, and various structures impact on what, in practice, is designed in a C&PD project and how this is done. Every design project is embedded within human–nature systems. Personal and professional mindsets, paradigms, and views of connectedness with nature impact on how humans interpret, act, and design within the human–nature systems (see Publication 2). Moreover, how a person understands and models systems around them depends on the perspective they adopt (see Publication 4).

These findings correlated to a framework of three spheres of transformation for sustainability (O’Brien & Sygna, 2013; Sharma, 2007). This framework indicates three nested, interrelated, and interdependent spheres in sustainability transitions: practical, political, and personal spheres. The practical sphere refers to concrete changes in human behavior, technological or social innovations, and reforms of institutions that aim to contribute to sustainability. The political sphere refers to the “social and ecological systems and structures that create the conditions for transformations in the practical sphere” (O’Brien & Sygna, 2013, p. 4). The personal sphere refers to the worldviews of individuals and collectives that shape the systems and structures in the political sphere and dictate what is seen as possible in the practical sphere. The practical sphere is embedded within the structural sphere, and both are embedded within the personal sphere. I have used this framework as a base for structuring the integrative framework of the reasons for including natural nonhuman stakeholders in C&PD processes when aiming to contribute to sustainability (see Figure 6). However, further research should further explore the mechanism through which including natural nonhuman stakeholders contributes to each of the shifts. Further research should also investigate the interrelations and interdependencies between the three contributions to sustainability. Additionally, further research should investigate the potential differentiation between relevant and irrelevant natural nonhuman stakeholders when striving for change in each of the spheres. If natural nonhuman entities can be divided into relevant natural stakeholders and irrelevant
natural nonhuman entities, research should also investigate whether one entity in a project can be irrelevant in terms of impact on one sphere (for example, whether it can it be irrelevant in regard to building practical solutions) while being relevant in another (for example, while being relevant in regard to changing worldviews).

Figure 6. An integrative framework of the reasons to include natural nonhuman stakeholders in C&PD when aiming to design for sustainability (based on O’Brien & Sygna, 2013; Sharma, 2007)

My research indicates that, currently, C&PD researchers who aim to contribute to sustainability predominantly propose that including natural nonhuman stakeholders challenges the personal and collective worldviews that contribute to unsustainability. Researchers indicate that their projects strive to counter the perceived separation from nature (e.g., Akama et al., 2020; Nijs et al., 2020; Prost et al., 2021; Sandelin, 2019; Tomitsch et al., 2021) and perceived human independence from nature (e.g., Fletcher et al., 2019; Jönsson & Lenskjold, 2014; Rosińska & Szydłowska, 2019) or strive to challenge the perception that humans have the right to dominate nature and disregard nature when making decisions (e.g., Bertulis, 2019; Fletcher et al., 2019; Jönsson & Lenskjold, 2014; Nijs et al., 2020; Sandelin, 2019). Some researchers—when interpreted from the perspective of the integrative framework—do not seem to indicate how exactly the inclusion of natural nonhuman stakeholders will contribute to sustainability (e.g., Foth & Caldwell, 2018; Haldrup et al., 2022; Jon, 2020). However, the approaches that design researchers employ when aiming to shift minsets also include commentary on systems and structures (e.g., see Jönsson, 2014; Prost et al., 2021) and the development of practical solutions or artifacts that challenge the structures and the worldviews (e.g., see Liu et al., 2019; Tomitsch et
Further analysis of C&PD literature is necessary in order to identify reasons for including natural nonhuman stakeholders in relation to the proposed integrative framework. It is also necessary to identify a potential division between primary and secondary reasons and the relationship between the reasons before identifying the reasons for including natural nonhuman stakeholders and the approach, methods, and activities of a project. This research likely requires the involvement of design researchers working with natural nonhuman stakeholders in order for them to aid in correctly interpreting the reasons for including natural nonhuman stakeholders and to assess and further develop the integrative framework.

5.2 How to approach the identification of natural nonhuman stakeholders in C&PD when aiming to contribute to sustainability?

I explored this RQ from two perspectives: (1) a systemic view of the human–nature system and sustainability, and (2) a non-anthropocentrism perspective. The following sub-section presents the considerations for both.

5.2.1 A systemic approach to identifying natural nonhuman stakeholders

My research indicates that when viewing C&PD projects as part of human–nature systems and aiming to contribute to sustainability, approaching natural nonhuman stakeholder identification systemically seems the most appropriate approach. There is a need to view design projects and the contexts in which they operate through a systems thinking lens (Publications 2 & 4). Thus, if the stakeholder identification is done with the explicit framing of designing for sustainability, a systemic approach to identifying natural nonhuman stakeholders should be adopted. Therefore, I aimed to develop a strategy for identifying systemic natural nonhuman stakeholders. As part of this study, I developed a systemic typology of natural nonhuman stakeholders (see Publication 4) presented in Table 6. This typology includes seven types, or seven key variations, the borders between which are flexible and which can overlap and include one another. My findings indicate that taking a systemic approach to identifying natural nonhuman stakeholders requires designers to differentiate between elemental and systemic stakeholder types (see Publication 4). This differentiation is needed because, from a systems thinking perspective, it is challenging to draw a single, definitive boundary between the entities (Cabrera et al., 2008). For example, a cherry tree in a garden can be seen as inseparable from the soil it grows in, the bacteria that enable it to absorb elements and nutrients (Montgomery & Biklé, 2015), and the lichens and fungi growing on its branches. The tree can only be separated from the other elements through creating arbitrary, temporary boundaries. These boundaries create or are created by the mental models of what a person interprets about what they see: “[An object] being a desk or a
barricade refers to our mental model of [the object] (our epistemological and cognitive reality)” (Cabrera et al., 2021, p. 14). When identifying natural nonhuman stakeholders in a systemic manner, the temporary boundaries need to co-exist because no single boundary accurately represents the natural entity (see Publication 4). Figure 7 schematically demonstrates the relationship between an observable entity and the systemic stakeholder types. The coexistence of boundaries can create a rich, nuanced perspective on the stakeholders that one observable entity represents. Therefore, systemically identifying natural nonhuman stakeholders requires not only observation (“What do we see?”) but also inference (“What are we experiencing?” “What processes are happening?” “What stakeholders can we infer from what we see, observe, and do here?”).

Table 6. A systemic typology of natural nonhuman stakeholders when designing for sustainability (adapted from Veselova & Gaziulusoy, 2021, Publication 4 in this dissertation)

<table>
<thead>
<tr>
<th>The types of natural nonhuman stakeholder</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Single organisms</strong></td>
<td></td>
</tr>
<tr>
<td>Organisms that are typically seen as independent living entities</td>
<td>Plants; animals (incl. humans, mammals, birds, reptiles, insects, amphibians, crustaceans, mollusks)</td>
</tr>
<tr>
<td><strong>Single species collectives</strong></td>
<td></td>
</tr>
<tr>
<td>Collectives of organisms of a single species that jointly partake in life processes</td>
<td>Social insect colonies; bryophytes (incl. mosses and hornworts); algae; fungi</td>
</tr>
<tr>
<td><strong>Multispecies collectives</strong></td>
<td></td>
</tr>
<tr>
<td>Collectives of living organisms (such as microorganisms, insects, and worms) that jointly partake in life processes</td>
<td>Bacterial collectives; lichens; soil: compost; animal manure</td>
</tr>
<tr>
<td><strong>Living systems</strong></td>
<td></td>
</tr>
<tr>
<td>The location-tied systems of living organisms, collectives, and the organic and inorganic matter and gasses that jointly partake in life processes</td>
<td>Gardens; lawns; greenhouses; forests; rivers</td>
</tr>
<tr>
<td><strong>Life processes</strong></td>
<td></td>
</tr>
<tr>
<td>Flows of elements between living and nonliving parts of the biosphere</td>
<td>Photosynthesis; the decomposition of organic matter; respiration; nitrogen fixation</td>
</tr>
<tr>
<td><strong>Biogeochemical cycles</strong></td>
<td></td>
</tr>
<tr>
<td>The cyclical flows of elements between the living and nonliving parts of the biosphere</td>
<td>The carbon cycle; the nitrogen cycle; the phosphorus cycle; the water cycle</td>
</tr>
<tr>
<td><strong>Processes of the atmosphere</strong></td>
<td></td>
</tr>
<tr>
<td>A short-, mid-, or long-term process in the atmosphere that determines the presence of elements and energetic resources for life processes</td>
<td>Weather; the season; climate</td>
</tr>
</tbody>
</table>

A human could also be viewed with a systemic perspective and interpreted as a set of systemic natural nonhuman stakeholders (see Publication 4). From a physiological perspective, a human could be considered a single organism. At the same time, the human body includes a large microbiome and is inseparable from it (Gilbert et al., 2018). A microbiome is described as follows:

[A] microbiome is the community of microorganisms that co-live with a host. The human being is the result of the integration of its genome and the coexistence with millions of microorganisms throughout its evolutionary history. Human-microbiome association can be considered a step of integration in evolution, constituting a superorganism. (Salvucci, 2019, p. 781)
Thus, a human and the microorganisms the human hosts form a multispecies collective that goes through life processes with many species of bacteria. Moreover, humans breathe, drink water, and eat food. Through these activities, the human body carries out life processes and, through these processes, participates in the biogeochemical cycles, such as carbon and water cycles. Humans can be systemically mapped as at least five of the systemic types of natural nonhuman stakeholders: single organisms, multispecies collectives, life processes, living systems, and biogeochemical cycles.

![Figure 7. A schematic representation of the relationship between observable entities and the systemic types of natural nonhuman stakeholders (Veselova & Gaziulusoy, 2021, see Publication 4).](image)

Human creations could also be analyzed from the systemic natural nonhuman stakeholder perspective. To explain this, I will use an example of a mobile app. A mobile app is not an organism, a collective, or a life process. However, it could be inferred that it uses electrical energy, produced either by burning fossil fuels and biomass or through wind power, hydropower, or solar power. If the electricity is generated through burning fossil fuels, it directly adds carbon to the carbon cycle. If it is produced through wind power, hydropower, and solar power, it depends on the processes of the atmosphere. Thus, the app can be indirectly linked—via the electrical energy it uses—to two natural nonhuman stakeholder types: biogeochemical cycles and processes of the atmosphere (schematically illustrated in Figure 7).

Furthermore, designers might need to consider natural nonhuman stakeholders across the space and time continuum (see Publication 5), as visualized Figure 8. From the systemic perspective, the problem space and the designed solution not only link to natural nonhuman stakeholders in the immediate surroundings (the site) but also to natural nonhuman stakeholders in close (local), medium (regional), and distant (global) proximity. Moreover, the parts of a physical or digital solution go through an entire life cycle, during which they may interact with and impact on different to those that they impact on during the use phase of the life cycle.
To visualize the distribution of natural nonhuman stakeholders across time and space, I will use an example of an outdoor light pole, taken from Study E. A light pole could be produced, for example, from steel. Steel is mainly composed of iron (Wente et al., 2019). Iron is often made from iron ore, which is predominantly mined through strip mining (Walker, 2017), which removes the soil and rock above the iron ore (Hustrulid, 2011). Such soil removal can affect several types of natural nonhuman stakeholders, including the soil (a multispecies collective), animals, plants, insects, and microorganisms living in or on that soil (single organisms, and single and multispecies collectives). Soil removal affects the whole ecosystem and might disturb life processes and change parts of biogeochemical cycles. Once the iron ore is extracted, it goes through various heating, smelting, and chemical processes in order to become the steel that is used to manufacture the light pole (Walker, 2017; Wente et al., 2019). The production processes most likely use fossil fuels and various other elements that engage with the biogeochemical cycles. The installation of the light pole might require moving or removing soil at the site, thus potentially impacting on the local ecosystem, organisms, and single- and multispecies collectives. During use, the light pole may interact with and affect the natural entities around it. After use, the removal process might involve digging and moving soil. Then, depending on the chosen way of disposal, the light pole might become recycled material, or it may end up in a landfill or another part of a human-made or natural environment. At the disposal site, the light pole might interact with the surrounding organisms, ecosystem, and life processes in this environment.

As demonstrated by the light pole example, a design solution interacts with and impacts on many natural nonhuman stakeholders in every phase of its life cycle. These stakeholders are likely to be dispersed across spatial proximity as the iron ore is unlikely to be located at the same site where the light pole will be installed. Such stakeholder distribution across time and space poses challenges for designers striving to consider natural nonhuman stakeholders. Designers would be unable to identify and accommodate every natural nonhuman stakeholder directly and indirectly related to their project. Tracing them would take
a lot of resources, time, and effort. Further research is needed in order to develop and test clear, actionable approaches, methods, and tools for designers to trace natural nonhuman stakeholders across the time and space continuum while potentially differentiating between the relevant and irrelevant ones. At the same time, designers might be unable to impact on, for example, manufacturing or mining decisions. Theoretically, there might be some cases when designers can influence (design) decisions across the whole life cycle of the solution. Further research could investigate how to approach decision-making across the entire time and space continuum, especially when there might be human stakeholders or, for example, regulations that impact on the life cycle. I anticipate that it might be challenging to draw boundaries regarding which stakeholders the particular project can consider and which must be left out due to the project circumstances. Further research would be required in order to outline how designers could draw boundaries regarding which natural nonhuman stakeholders should be considered and which should be left out.

5.2.2 The potential use of non-anthropocentric environmental ethics in identifying natural nonhuman stakeholders

While the systemic approach seemed the most appropriate when designing for sustainability, I also critically investigated whether non-anthropocentric ethical frameworks can be adopted to identify natural nonhuman stakeholders. The non-anthropocentric ethical frameworks seem to be an important tool in challenging Western worldviews. They could be used to determine the natural nonhuman stakeholders in C&PD by choosing entities to which environmental ethics assign intrinsic value and moral standing. However, there are four limitations when trying to identify natural nonhuman stakeholders through this approach.

First, intrinsic value and moral standing are constructs through which Western societies attribute value to nature, but they do not fully represent all types of value of nature. In environmental ethics, the natural nonhuman entities with intrinsic value should be considered when identifying right or wrong actions and making decisions about them (Sandler, 2018). Thus, if a designer chooses to approach the identification of natural nonhuman stakeholders through environmental ethics, they need to acknowledge the limitations of Western environmental ethics (for example, the limitations resulting from what they assign value to or do not assign value to and why they do this).

Second, in environmental ethics, there is no consensus on which natural entities have intrinsic value and moral standing. As presented in Chapter 2, each non-anthropocentric environmental ethical framework argues for its particular perspective and critiques the other frameworks. A designer would most likely need to adopt a single non-anthropocentric perspective. The types of natural nonhumans to consider and include would change depending on which non-
anthropocentric framework the designer adopts. Adopting one of the individualistic frameworks—ratiocentrism, sentientism, or biocentrism—would lead to some type of individual organisms becoming stakeholders. Meanwhile, adopting one of the holistic frameworks—such as anti-speciesism, ecocentrism, the land ethic, deep ecology, social ecology, ecofeminism, or new animism—would lead to species and ecosystems becoming stakeholders. Further research is necessary in order to identify whether a designer can simultaneously adopt several non-anthropocentric environmental ethical frameworks.

Third, environmental ethical frameworks do not definitively list the beings that are assigned moral standing. Designers need to interpret which natural entities have moral standing and should be considered stakeholders. For example, the bioinclusive ethic—the ethical framework used in Study A of this dissertation—assigns moral standing to conative beings yet does not provide a list of them. It only presents a definition that designers need to interpret. The bioinclusive ethic defines a conative being as a being that strives to “maintain itself and realize its inherent potential” (Veselova & Gaziulusoy, 2022, p. 11; based on Mathews, 2006, 2010). This property is also called autopoiesis, a term that “describes living systems as active, adaptive, self-maintaining and self-individuating, that is, as having the property of self-reproducing through self-regulating strategies” (Wilson & Foglia, 2015, Section 2.2). Based on these definitions, a designer or researcher would need to identify which entities are conative beings in their design context. The identification challenge seems less contested when using individualistic environmental ethics because they assign moral standing to organisms. The identification becomes more complicated when using holistic frameworks because many of them assign moral standing to groups and systems and not to individual organisms. For example, environmental ethical frameworks that assign moral standing to species do not assign moral standing to the individual organisms of a species. Thus, a designer can face challenges when translating environmental ethical frameworks into natural nonhuman stakeholder lists. Further research is needed to identify how a designer could engage with the organisms and potential sub-elements of holistic environmental entities with moral standing. Such research could explore questions such as “Are the single organisms that constitute the holistic entities also stakeholders or not?”

Fourth, while all non-anthropocentric ethics seem to address the anthropocentric worldview, it might be that not all of them align with the systemic framing of sustainability. Individualistic environmental ethics only view some non-human organisms as stakeholders (Brennan & Lo, 2016). The individualistic frameworks do not seem to require a systemic perspective, nor do they challenge the worldviews that see humans as separate from nature. This potential contradiction between individualistic environmental ethics and sustainability should be explored in further research. Meanwhile, the perspectives of some of the holistic environmental ethics—such as the land ethic, deep ecology, social ecology, and new animism—propose reconceptualizing these worldviews in order that
humans are seen as part of nature (Boylan, 2013). The view of humans being part of nature seems to correlate to sustainability and the systemic stakeholder types discussed earlier in this section. It also connects to the need to challenge the worldview of seeing humans as separate from nature. Further research is necessary in order to investigate the relationship between the different types of non-anthropocentric ethical frameworks and their alignment with sustainability and, thus, their usefulness when identifying natural nonhuman stakeholders in C&PD when aiming to contribute to sustainability. Such research would benefit from close collaboration with an expert in environmental ethics.

Overall, my research indicates that designers should be cautious when using non-anthropocentric ethics to identify natural nonhuman stakeholders, especially when aiming to contribute to sustainability. Identifying natural nonhuman stakeholders in C&PD through non-anthropocentric environmental ethics seems less practical and more challenging than the systemic approach.

5.3 In what ways can natural nonhuman stakeholders be included in C&PD?

My research indicates that C&PD processes should include natural nonhuman stakeholders from the onset of the design process (see Publication 1). In design time, natural nonhuman stakeholders can be involved or included in C&PD in three key ways. First, some natural nonhuman stakeholders can be involved as direct, active participants. In design time, some direct communication is partly possible with some mammals, and some design projects have involved nonhuman mammals, such as dogs (e.g., see Mancini et al., 2015; Robinson & Torjussen, 2020; Zeagler et al., 2016) and orangutans (e.g., Webber et al., 2020). Animal participants have, for example, been involved in testing the prototypes of potential design solutions (Piitulainen & Hirskyj-Douglas, 2020). However, some research indicates that directly involving a nonhuman mammal as a co-designer requires considerable reflection on whether the mammal’s participation is genuine, consensual, and correctly interpreted and, if so, to what extent this is the case (e.g., see Grillaert & Camenzind, 2016; Hirskyj-Douglas & Read, 2014). This mode of participation seems possible with some nonhuman mammals and maybe with birds. Other natural entities—for example, insects, a photosynthesis process, a beehive, or a carbon cycle—would be unable to participate in this way. Further research is necessary in order to develop comprehensive and actionable approaches, methods, and tools for directly including natural nonhuman stakeholders in design time.

Second, natural nonhuman stakeholders could be represented by an expert human proxy. An expert representative should have in-depth knowledge of the nonhuman entity and its mentality and processes. The expert can be an academic expert (e.g., see Webber et al., 2022) or a non-academic expert. For example, Haldrup et al. (2022, p. 16) collaborated with an activist expert—the “ambassador for the great newt”—and an angler, neither of whom are scientists
but who both have in-depth knowledge of particular species or natural habitats. The expert proxies could also be people from local indigenous communities. However, working with indigenous communities requires careful consideration of the ethics and differences in cosmologies and ontologies (Parsons et al., 2016). Further research should evaluate this approach and further develop the approaches and tools for facilitating the representation of natural nonhuman stakeholders.

Third, natural nonhuman stakeholders can be included through representative profiles developed in collaboration with experts or based on secondary sources. For example, Tomitsch et al. (2021) proposed using nonhuman personas to represent and showcase the needs of animals and plants in participatory processes based on secondary data about the species. Also, Frawley and Dyson (2014) have used nonhuman personas. Meanwhile, Tomlinson et al. (2021) proposed the use of ecosystems, which they define as “a tailored description of an ecosystem potentially impacted by particular design activities” (Tomlinson et al., 2021, p. 4). In their project, ecology and evolutionary biology students—who could be seen as soon-to-be experts in their fields—co-created the ecosystems with students from computer science (Tomlinson et al., 2021). Overall, Tomlinson et al. (2021) proposed that ecosystems should be collaboratively developed by designers, ecologists, and partners from other relevant expertise areas (such as business, engineering, law, and industry partners) in order to represent the ecosystem as fully as possible. Both examples indicate that existing design methods and tools could be modified to bring the natural nonhuman stakeholders and their needs into the design project. Further research could investigate which tools and techniques could be modified to represent not only nonhuman mammals but also other systemic stakeholder types.

While the representation of natural nonhuman entities—be that through a human proxy or a representative profile—differs from direct participation, which is often associated with C&PD processes, it could help (at least to some extent) to make the perspectives and needs of the natural nonhuman stakeholders visible. This approach has its challenges and limitations. A human proxy can only represent some aspects of the nonhuman stakeholder. Even if a human is very familiar with the natural nonhuman stakeholders, they cannot represent all aspects, perspectives, and needs of the entity. Scientific disciplines, non-academic practice, and indigenous perspectives can only develop partial, biased knowledge and models of natural entities. Thus, the representation of nonhuman stakeholders by human proxies should be viewed as partial and biased. However, limited representation is better than no representation at all. I think it might be important in the early stages of the development of nature-inclusive design processes to start representing natural entities while acknowledging the limitations, biases, and incompleteness of representation.

In C&PD projects, in use time, the direct participation of natural nonhuman entities is already possible, at least with certain natural nonhuman stakeholder types. For example, some outdoor solutions might be adjusted or modified by
the organisms living there or by the weather and climate. Pets and other animals can move, chew, and destroy things humans have given them. In these instances, depending on the human mindset, these actions may be perceived as damage or as modifications of designs during use time. Suppose humans only view that participation happened through the adjustments that the humans have been permitted or instructed a natural nonhuman entity to make in use time. In that case, it might be challenging or impossible for natural nonhuman entities to participate in the way designers intended. At the same time, if humans instruct natural nonhuman entities regarding what to do and evaluate what is permissible, this may not align with non-anthropocentrism and the non-domination of nature. Humans, both as individuals and communities, need to cultivate an open, welcoming mindset towards creations, modifications by natural nonhumans and to reflect on why they might view certain acts by natural nonhuman entities as right or wrong, appropriate, or inappropriate. Further research should investigate what type of adjustments by natural nonhumans constitutes participation in use time, to what extent a natural nonhuman entity is “allowed” to modify a design, whether damage can be considered a modification of a design, and who is set to evaluate what is and is not nonhuman stakeholder participation in use time.

5.4 How to approach the identification of natural nonhuman needs?

My research indicates that the concept of needs warrants careful consideration when applying it to natural nonhumans and sourcing their needs. I have not found theories of natural nonhuman needs in my research, and the ecologists in Study E corroborated this finding. Natural nonhumans seem to be discussed more in terms of their rights. I came across one example of attempting to view natural nonhuman needs from the perspective of a theory of needs. Jolibert et al. (2011) extended Max-Neef’s theory of needs to otters and retained the axiological and existential categories of needs. Then, researchers and other experts—including fish farmers and municipality representatives—collaboratively outlined the satisfiers that might satisfy the otter needs. This exercise supported researchers and other project stakeholders in spotting the differences between the satisfiers of human and otter needs in the particular context (Jolibert et al., 2011). Such an approach might also be helpful in C&PD projects; however, future research needs to investigate this potential and the opportunities and challenges it brings.

The concept of rights seems to be more prominent in discussions of supporting the existence and well-being of natural nonhuman entities. The concept of rights is rooted in discussions of interspecies justice (e.g., Healey & Pepper, 2021) and ongoing research on, for example, animal welfare (e.g., Fraser, 2008) and law (e.g., Cano Pecharroman, 2018). The conceptual difference between
needs and rights seems significant. Further research could investigate the potential role of natural nonhuman rights in design, differences between rights and various concepts of needs, and possible differences between using natural nonhuman rights versus natural nonhuman needs in design projects.

Study E also indicated that ecologists do not frame RQs and findings around needs. The needs of species or systems are not explicitly researched. The ecologists involved in Study E explained that, instead, they take a set of basic needs for any living organism—a safe place to live, food, water, and ability to reproduce—as a base and then focus on identifying the correlations between how well the organisms of a species can satisfy those basic needs and the presence or absence of various factors in habitats. The ecologists stated that they can identify patterns and, potentially, the causal mechanisms of why a certain species occurs in a certain context and why the species can better satisfy its survival needs in one context and do so worse, or not at all, in another. Nevertheless, they stated that it is hard to impossible for ecologists to arrive at definite causal mechanisms and conclude with absolute certainty that one factor or a set of factors definitely supports a species in satisfying its basic needs. These comments suggest that ecologists cannot and do not claim that a certain species “needs” something beyond the basic needs of a living organism. Further research is needed to develop strategies for engaging with and including findings from ecology in design processes and the potential of framing these findings as needs. Additionally, from the systemic perspective, organisms and species are not the only natural stakeholder types; there are also other systemic stakeholders, such as life processes and biogeochemical cycles. At this stage, further research is needed in order to identify whether systemic stakeholders can have needs and, if so, how such needs could be conceptualized and identified.

Study E also indicated that designers should critically approach findings and insights from other disciplines when sourcing natural nonhuman needs. First, different fields relate to the concept of needs differently. In Study E, my colleagues and I identified the following four categories of research based on how the research related to the concept of needs: needs-based, solution-building research; contextual descriptive research; perspective research; and normative research (see Publication 5). C&PD is a needs-based, solution-building discipline that focuses on identifying stakeholder needs and building a solution to satisfy those needs. Meanwhile, contextual descriptive research disciplines do not frame their research nor findings around “needs.” Prescriptive research argues for differentiation between needs and wants based on discussions in normative research, and it develops approaches and methods to help decision-makers (such as designers) to differentiate needs from wants in their work. Finally, normative research deliberates about and conceptualizes needs, wants, and rights in order to outline how things ought to be. Further research should explore how C&PD designers and researchers conceptualize needs. Research could also further explore how the different research disciplines that C&PD collaborates with or sources information from relate to the concept of needs. Such research would
be useful in order to identify whether there is a need to critically translate between research findings that have not been framed around needs and the “needs” that designers strive to address with their solution, and if there is such a need for translation, to identify how such translation could be done.

Second, disciplines can directly or indirectly relate to the topic or natural entity that designers investigate. For example, in Study E, the focal issue was lighting; however, the ecologists involved in the project had not done much research into light and its impact on natural nonhumans and seemingly the same can be said for ecology as a field overall. It can be hard or impossible for ecologists to provide a list of considerations that designers could later translate into needs in order for the needs to be addressed by design. Additionally, this creates challenges in using secondary information, such as encyclopedias and research publications, to source natural nonhuman needs. Further research is needed in order to identify the extent of these challenges and potential ways to remedy them.

Third, the designer’s knowledge of and familiarity with the research topic and the natural world may impact on the identification of needs and the ability of the designer to engage with different perspectives on the matter. Familiarity might support the designer in effectively and critically engaging with researchers or research findings from other research areas. This notion was also corroborated in my research in Study D, in which my previous knowledge of biology and ecology, and my years of gardening supported my ability to engage with the environment and to find and understand academic and non-academic expert knowledge.

Finally, my overall research approach and findings from all five studies indicate that each research discipline, practice area, and stakeholder in a project has a partial perspective on needs in that context. Transdisciplinary research is an approach that strives to integrate various disciplinary and non-academic insights into a topic in order to understand it beyond disciplinary and academic limitations (Hirsch Hadorn et al., 2008). Transdisciplinary integration and the use of transdisciplinary research findings are needed when identifying the needs of natural nonhumans stakeholders because using only one discipline as a source of information might provide a narrow, limited view. Further research is needed in order to explore the potential differences between sourced needs when using transdisciplinary approaches versus disciplinary approaches. Research should also identify practical strategies for sourcing transdisciplinary insights or integrating insights from varied academic and non-academic sources.
6. Conclusion: Towards a critical approach for including natural nonhuman stakeholders when designing for sustainability

The interest in including natural nonhuman stakeholders in C&PD is growing. One of the main reasons why C&PD researchers and designers strive to include natural nonhuman stakeholders is to address the sustainability crisis. My doctoral research indicates that, overall, the reasoning for including natural nonhuman stakeholders in C&PD in order to contribute to sustainability has merit. At the same time, including natural nonhuman stakeholders requires designers to be critical about how they approach the identification and inclusion of the stakeholders.

My research suggests that including natural nonhuman stakeholders can contribute to sustainability in three interrelated, interdependent ways. First, it can shift individual and collective worldviews towards being more aligned with sustainability. For example, including natural nonhuman stakeholders can assist in shifting the worldview that humans are separate and independent from nature towards a view that humans are inseparably interconnected with and dependent on nature. It can also assist in shifting the worldview that humans have the right to overlook and dominate nature towards a view that nature has intrinsic value and that humans need to consider nature, natural entities, and systems when making decisions. Second, including natural nonhuman stakeholders in C&PD can challenge the socio-technical-economic systems and structures that support unsustainability, such as the neoliberal political-economic system, which typically only accounts for the instrumental value of nature, or the concept of a stakeholder, which typically only applies to humans. Third, including natural nonhuman stakeholders in C&PD can lead to the development of practical design solutions more aligned with sustainability. By including natural nonhuman stakeholders, C&PD projects can incorporate the interconnections between humans and human-made systems and nature, natural elements, and systems. Such inclusion can also lead to the acknowledgment and consideration of natural nonhuman stakeholder needs while developing solutions that satisfy human needs. These three reasons are interdependent because changes in one of the areas—in worldviews, systems and structures, or practical solutions—can cause changes in the other two areas.
In my research, I explored two approaches through which designers can approach the identification of natural nonhuman stakeholders. First, I empirically developed the systemic approach to identifying natural nonhuman stakeholders based on the fundamental principles of sustainability and human–nature systems. The systemic approach not only views organisms as natural nonhuman stakeholders, it also views collectives, processes, and cycles as natural nonhuman stakeholders. It also suggests that observable entities are not only one systemic stakeholder type but multiple systemic stakeholder types. Second, I theoretically explored the potential use of nonanthropocentric environmental ethics when identifying relevant natural nonhuman stakeholders. In this approach, designers could identify natural nonhuman stakeholders based on which natural entities have moral standing. The ethics approach has limitations because of the variety of often contradicting perspectives and frameworks found in environmental ethics and the need to decode which natural entities fit the ethical concepts and definitions. The ethics approach also seems less practice-relevant than the systemic approach.

The identified natural nonhuman stakeholders can be included in C&PD processes, both in design time and in use time. In design time, designers can include natural nonhuman stakeholders in three key ways. Natural nonhuman stakeholders can be included as direct, active participants when possible. They can also be represented by a human proxy and included through representative profiles. These representative profiles and representation through human proxies differ from the traditional approaches of C&PD, which aims to include natural nonhuman stakeholders as direct participants. The representation is also partial and biased. Nevertheless, representation can be a useful approach when direct participation is impossible. Natural nonhuman entities can directly participate in co-shaping the solutions in use time. My research, however, indicates that when designing for sustainability, including natural nonhuman stakeholders should not be left to use time alone and already needs to happen during design time.

Designers also need to pay special attention to how they approach the identification of the needs of the natural nonhuman stakeholders in their projects. My research indicates that C&PD and design overall rely on identifying stakeholder needs because they aim to design solutions that satisfy those needs. Meanwhile, natural entities are rarely discussed in relation to their needs; more often, they are discussed with regard to their rights. Furthermore, sourcing natural nonhuman needs from other disciplines warrants a critical approach to the disciplines, an approach that considers how the disciplines view needs and the proximity of the disciplines to the topic of design or a particular natural nonhuman entity. Research about natural nonhuman entities—such as the research conducted in ecology—typically does not frame the research around needs or present the findings as needs. Moreover, the discipline or the researcher that designers are
working with might not be familiar with the topic, the entity, or the project context. Thus, designers should approach identifying natural nonhuman stakeholder needs with awareness of what they are looking for and of the limitations of what other disciplines and their findings might provide.

### 6.1 A summary of contributions

This doctoral research contributes to C&PD research in the following ways:

1. It builds integrative links between the literature on collaborative and participatory design, sustainability science, socio-ecological systems, systems thinking, and environmental ethics. Through these links, it brings relevant interdisciplinary knowledge and insights to C&PD.
2. It proposes that every C&PD project is a process within the human—nature systems interconnected with and interdependent from social, technological, economic, and natural entities and systems.
3. It outlines the connection between including natural nonhuman stakeholders in C&PD and the aim of addressing the sustainability crisis. It also presents an integrative framework of three interconnected, interdependent reasons.
4. It develops and discusses a novel systemic approach for identifying natural nonhuman stakeholders and introduced a systemic typology with seven systemic stakeholder types.
5. It discusses the challenges of utilizing non-anthropocentric ethics to identify natural nonhuman stakeholders if a project explicitly focuses on sustainability.
6. It discusses the importance of including natural stakeholders in design time and gives an overview of three key approaches—direct involvement, human proxies, and representative profiles—that can be used at that design project stage.
7. It identifies and discusses challenges related to identifying natural nonhuman needs.

### 6.2 Limitations and avenues for further research

In this dissertation, I aimed to critically examine some of the existing links between sustainability and the inclusion of natural nonhuman stakeholders in C&PD. My research focus, the limited scope of a doctoral research project, the theoretical framing, and the methodological choices shaped my research findings. By focusing on addressing sustainability challenges as the drivers for including natural nonhuman stakeholders, I consequently excluded the C&PD research and practice that includes natural nonhuman stakeholders in order to support and increase the well-being of animals. This exclusion allowed me to conduct a deeper study of the links between sustainability, C&PD, and natural nonhuman stakeholders. Nevertheless, it precluded potential inquiry into the
relationship between sustainability and animal welfare being a driver for including natural nonhuman stakeholders and precluded a comparison of their impact on C&PD. Further research should explore this area.

Focusing on sustainability as the reason for including natural nonhuman stakeholders extensively shaped the theoretical framing and, thus, my research findings. This impact can mainly be seen in two ways. First, the focus on sustainability prompted an inquiry into the likely root causes of the sustainability crisis. This resulted in the addition of research and insights into worldviews that highlighted the complexities behind the reason for including natural nonhuman stakeholders (as discussed in Section 5.1). Second, the focus on sustainability science formed my framing and understanding of sustainability as a systemic property and the concept of human–nature systems, which resulted in the prominence of systemic thinking, analysis, and findings in my research studies and this dissertation overall. Sustainability research, however, also includes other formulations, principles, and sustainability models, which, if adopted, might lead to different conclusions. Further research should explore whether the choice of sustainability models and principles can offer additional insights and argumentation for including natural nonhuman stakeholders in C&PD when designing for sustainability.

My research findings indicate that one of the critical directions for further research relates to the relevancy of natural nonhuman stakeholders for a particular design project. While my results indicate that including natural nonhuman stakeholders in C&PD can contribute to sustainability, they raise further questions about whether all natural entities should be considered stakeholders or if only relevant natural entities should be considered stakeholders; this in turn raises the question of how relevancy can be evaluated when identifying and including natural nonhuman stakeholders. Further research is necessary in order to theoretically and empirically explore these questions.

Despite my clear focus on the inclusion of natural nonhuman stakeholders when aiming for sustainability, the format of a doctoral research project in design provided a constrained scope for researching this emergent topic. The format determined the length of the research, set the focus on design, and emphasized the individual nature of a doctoral research project. The limited time and focus on individual research curbed the depth of the investigation into research areas falling outside of design—such as sustainability science, socio-ecological systems, inner worlds, and environmental ethics—which have extensive research traditions and continuously produce new knowledge. Nevertheless, the format established a fruitful ground for generating new knowledge for design by introducing and integrating knowledge generated outside of design (so outside of C&PD). Due to the constraints of the doctoral research format and the focus on sustainability, I chose to align with the transdisciplinary research methodology, which advocates for integrating insights from academic disciplines and non-academic actors when addressing sustainability challenges. In three out of
my five studies—and while integrating the overarching findings of my doctoral research—I conducted the transdisciplinary inquiry individually. In one of my studies, I partook in a transdisciplinary consortium project and collaborated with two other design researchers during the integration of insights. Further investigation of this topic would benefit from the participation of other design researchers and researchers from other disciplines, design practitioners, and other non-academic experts. Expansion of the transdisciplinary approach can support the development of robust, applicable knowledge and strategies for including, identifying, and accommodating natural nonhuman stakeholders in C&PD when aiming to design for sustainability.


References


References


References


References


As the environmental challenges have become increasingly pressing, collaborative and participatory design has sought ways to reinvent itself. Researchers and practitioners have started including natural nonhumans – such as animals, plants, insects, and ecosystems – in design processes to find solutions for the sustainability crisis.

This doctoral dissertation critically examines this emerging practice of designing with natural nonhuman actors. Primarily, it scrutinizes the proposition that including natural nonhuman stakeholders in collaborative and participatory design could contribute to sustainability. Secondly, it develops approaches for identifying natural nonhuman stakeholders and their needs in collaborative and participatory design processes. It also reviews the practical strategies for including and representing natural nonhuman stakeholders in collaborative and participatory design processes.

The dissertation integrates insights from design research, sustainability science, and empirical studies and presents the findings in five research publications and an introductory essay.