CO-ACT

Multispecies Design in Practice

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Introduction

What is this book?

Welcome to *CO-ACT – Multispecies Design in Practice*, a book that explores various sensory approaches comprising visual, auditory, tactile, and kinaesthetic methods, tools, and recipes for encouraging ethical co-actions among multispecies actors engaged in a design process. The book derives from an Artistic Research Project, called the CO-ACT project, that have explored the concept of co-action, stemming from the term "intra-action". *Intra-action,* a notion coined by Feminist theorist Karen Barad (2007), differs from "interaction", which implies that there are established things or people that then act together. Intra-action, conversely, involves mutual constitutions of entanglements, where agency arises through relationships between people, things, and other entities. This means that the capacity to act is not inherent within an individual but emerges within these relationships. This concept offers a novel perspective on relationships with others, material objects, the natural world, and discourses, as these entities' intermingling can result in new abilities, transformations, and changes. Throughout the progression of the CO-ACT project, it became evident that embracing intra-action was essential for examining collaborative action, co-action, among multispecies actors in practice. Furthermore, the CO-ACT project incorporates actor-network theory (ANT), which assigns significant importance to non-human actors like machines, animals, texts, and hybrids. These actors establish relationships within networks, shaping their identities, intentions, and actions (Latour, 2007; Law & Hassard, 1999). ANT, therefore, explores how networks can navigate intra-active challenges, which has guided the CO-ACT project's emphasis on co-action, ultimately leading to the publication of the book: CO-ACT - Multispecies Design in Practice.

As a case, the CO-ACT project examines soil conditions at former and current textile dye sites in Denmark. The purpose of this investigation is to bring attention to the challenges that arise from the intra-action between soils and wastewater generated by textile dye production. Its objective is to advocate for transformative action, particularly in the realm of sensory and multispecies design, to nurture future co-production. Rather than viewing production as a static system, the CO-ACT project embraces the concept of co-production as dynamic and alive, acknowledging the significance of the multispecies actors involved in the design process as noted in the work by Anthropologist Anna Tsing and colleagues (2017), and Design researchers such as Carole Collet (2017) and Svenja Keune (2019). The CO-ACT project delves into the exploration of how design can facilitate the cultivation of imaginative possibilities for multispecies co-action within living future systems. With developed learning materials such as the CO-ACT methods and tools, as well as traveling exhibitions, the CO-ACT project advocates for a re-evaluation of design practices, urging the adoption of holistic approaches that foster caring relationships among multispecies actors involved in the design process.

The CO-ACT project is underpinned by posthuman and regenerative design thinking. These theories have guided the CO-ACT project's explorations, which aim to examine co-action with multispecies actors in practice. I speculate on how this approach can be integrated into future design processes by developing diverse methods and tools. With this book, I encourage you to use and further develop the methods and tools presented here.

By sharing new perspectives, experiences, knowledge, and learnings, I aim to inspire you to physically explore multispecies co-action in your process and stimulate your curiosity about using these insights to evolve your practice.

Who is this book for?

This book is intended for people interested in exploring future co-action with multispecies actors in their personal or professional lives. This includes established designers who create systems, products, or services, and individuals in educational settings looking to evolve their practice. The book may also interest educators and researchers interested in unfolding ways of doing multispecies design in practice or communities seeking to foster awareness of intra-action and co-action among multispecies actors. It offers valuable insights into respectfully presenting these concepts and facilitating their integration within community contexts.

CO-ACT is a pioneering and enduring field of continuous learning and understanding, which in my opinion has a high relevance for being integrated into all educational institutions, workplaces, and communities. While the book serves as a starting point for this learning and knowing, it is just one piece of a larger paradigm shift. I aspire for the book to be a valuable resource that stimulates and encourages the development of future holistic design practices.

Whom is this book made by?

As the writer of this book, I, Louise Permiin Tønder Jensen, am an Artistic design researcher at the Lab for Sustainability and Design, the Design School Kolding, Denmark. I focus on designing for positive change for holistic futures, utilising participatory design and speculative prototyping for multispecies co-action and behavioural change. This book features contributions from a diverse group of multispecies actors who, in their way are passionate about co-action, sharing their perspectives through semi-structured interviews and providing open-source recipes for examining the topic of interest. The book was designed together with Andreas Solhøj Hansen, a Graphic designer who provided the graphical setup to the book: *CO-ACT – Multispecies Design in Practice*.

Fig.1. Image of me, Louise, documenting multispecies co-action in a Woad field at Ulfborg, Denmark, 15.09.22. By Sivertsen, 2022.

How can the book be helpful?

In this book, I present CO-ACT – Multispecies Design in Practice in a format I think can be helpful for practitioners interested in exploring sensory and multispecies design for supporting long-term engagement amongst multispecies actors in a design process.
You will find:

- Recipes_ for accessing open-source materials related to the topic of interest.

- Methods_ for co-action across multispecies actors, emphasising the importance of collaboration and intra-active relationships. These methods can be applied in both professional and personal contexts, allowing you to explore the potential for multispecies co-action in various ways.

- Tools_ for providing hands-on action for exploring intra-actions amongst multispecies. A tool that can function alone or together with the relating method.

- Speculative prototypes _as a feasible method for establishing relationships with multispecies actors inspired by posthuman and speculative design perspectives (Auger, 2013; Dunne & Raby, 2013; Wakkary, 2021).

In this book, I aim to provide resources that facilitate ethical decision-making in future design practices while also inspiring practitioners to consider the impact of their designs on society and the environment. By providing insights into the complex relationships of intra-action and multispecies design, the book aims to encourage a greater sensitivity towards these issues in practice.

Reading guidance

This book draws on many ways of knowing, doing, and thinking, unfolded in four chapters: 1_Project case, 2_The Art of Noticing, 3_The Art of Relating, and 4_The Art of Co-producing. Each chapter can be explored individually or understood as an iterative. The four chapters elaborate on examined theory in posthuman and regenerative design thinking, current design, artistic and eco-scientific practices, and practitioners operating in sensory and multispecies design. Readers can engage with the book at their preferred pace, whether through a comprehensive examination of details or a more concise overview.

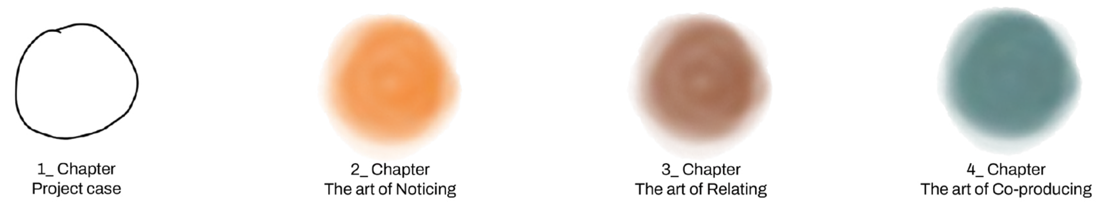

Fig.2. Illustration of the CO-ACT book's four chapters. By Permiin, 2023.

How this book is organised

Chapter 1_ presents an overview of the case of exploration and illustrative theory and methodology that has informed and shaped the CO-ACT project and book. For those eager to begin, a link to download a single PDF containing all the developed CO-ACT Method Cards can be found after this chapter.

Chapter 2_The Art of Noticing, presents a brief introduction to multispecies territories (Despret & Morrison, 2021; Tsing, n.d.) and soils as a multispecies actor (Metcalfe, 2015) through sensory engagements (Pink, 2015; Porteous, 2019), unfolding the first research question: How can sensory design methods and tools facilitate human noticing and understanding of sites as vibrant living entities? The term "noticing" is used in the book with reference to Anthropologist Anna Tsing's writings about the 'art of noticing' in the article On Nonscalability (2012). In the article, Tsing addresses the 'art of noticing' by paying close attention to the particulars of the world around us, including the unique behaviours, relationships, and interactions of different species (Tsing, 2012). This chapter seeks to highlight the use of noticing to gain a deeper appreciation for the complexity and unpredictability of ecological systems and to begin developing more nuanced and context-specific ways of understanding them.

Chapter 3_The Art of Relating, examines eco-somatic poses and sensory communication with multispecies actors in practice. This chapter focuses on examining: what sensory and multispecies design methods and tools might entail if they relate to soils as living? The chapter stresses the importance of a performative aspect to such relations since humans and non-humans are multispecies and derive their identity through intra-action and relationships with other entities. This argument is supported by the works of scholars like Escobar and de la Bellacasa, who have emphasised the role of relationality in shaping identity (de la Bellacasa, 2012; Escobar, 2018). Additionally, this chapter examines how this orientation can create more equitable multispecies worlds if perceived in a design process.

Chapter 4_The Art of Co-producing presents two speculative prototypes that explore possible future co-production involving multispecies actors. Co-production is used to understand the complex intra-actions between actors in their environments. The CO-ACT project leans on Tsing and colleagues' writings in the edited volume *Arts of Living on a Damaged Planet* (Tsing et al. (Eds.), 2017). According to Tsing, "co-production" refers to the process by which humans and their surroundings are mutually constituted. Within this dynamic relationship, humans and their environments continuously influence and shape one another. Therefore, this chapter questions: How might using the sensory and multispecies design methods and tools affect future co-production among multispecies actors? Through this examination, the chapter seeks to expand the CO-ACT project's scope to include other fields and practices beyond the case of textile dye design. This further broadens the exploration of multispecies design and its potential applications. Each chapter results in several proposed sensory and multispecies design methods, tools, and open-source recipes, which are available at the end of the chapters. Finally, the complete list of references is gathered towards the end of the book.

I hope this book will be a helpful and inspiring resource to develop your future holistic design practices.

1

Project case

Background for the case

My understanding of *CO-ACT – Multispecies Design in Practice* has emerged through my teaching in the course "Preferred Futures" designed for students at the master's program Planet, the Design School Kolding, Denmark. Alongside my esteemed colleague, Design researcher Lene Hald, I in 2022 organised and facilitated the course, focusing on fostering a multispecies orientation and promoting co-action in 2052. During this course, it became evident that multispecies design is complex and challenging, thereby highlighting the need for a comprehensive case study that thoroughly investigates and develops practical methods and tools.

We initially explored the plant-radio tool, developed by the *Growing Co-Design project*(1) conducted by the Digital Design Lab at Aarhus University (see fig. 3-6). It, however, failed to generate the desired level of curiosity amongst the students. This might be due to the introduction to multispecies design being too fluffy. Consequently, I sought a case study to exemplify how multispecies communication could be utilised in future co-production and transitional processes. Throughout this book, the term "multispecies" encompasses various actors' such as types of soils, earthworms, the textile dye plant Woad, technologies, textiles, and humans. The intention behind employing the concept of multispecies is to democratise and foster a holistic orientation that includes selected, more-than-human actors involved in the design process.

1 Growing CoDesign is a one-year Research Project funded by NOVA. Led by Lone Koefoed Hansen and Raune Frankjaer, along with Margrete Lodahl Rolighed and Ester Marie Aagaard, the project explores the integration of nature into design practice using creative methods and digital technologies. Please find their project by following the link: https://www.growingcodesign.com/

Fig. 3-4. Images by MA students testing the plant-radios from the Growing CoDesign project, in the Preferred Future course at Geographical Garden in Kolding, Denmark, the 08.02.22.

Fig. 5-6. Images by MA students testing the plant-radios from the Growing CoDesign project, in the Preferred Future course at Geographical Garden in Kolding, Denmark, the 08.02.22.

Framing the case of exploration

The CO-ACT project utilises the case of living textile dye systems to understand how soils and their inhabitants can become actors in future co-production processes. Textile dye production is an example of a worldwide production system that, for many years, has caused depletion in soil fertility due to the treatment of textile products and their wastewater (Burgess & White, 2019, p.6; Fletcher & Tham, 2020, p.44). Here, the textile dye and finishing industry have caused an extensive pollution problem, being one of the most chemically intensive industries on earth (Burgess & White, 2019, p.22; Kant, 2012, p.22-23). As demonstrated by a 2020 study, textile treatment, and dyeing accounted for 20% of industrial wastewater worldwide, providing a tangible example of the issue at hand (Niinimäki et al., 2020, p.189).

Despite new initiatives and technological developments in handling wastewater from textile dyebaths (Burgess & White, 2019, p.6; *CORDIS*, 2015), current textile dye facilities have difficulties in implementing new and environmentally friendly initiatives due to the immense scale of textile dye production driven by the fast fashion system (Burgess & White, 2019, p.9). Consequently, textile dye wastewater continues to be discharged into nearby rivers, resulting in detrimental health effects (Burgess & White, 2019, p.18;

Kant, 2012, p.23) and ecological depletion (Lellis et al., 2019). While most textile dye production has been outsourced from Denmark, I examine current small-scale natural textile dye sites and former textile dye sites known to have caused pollution (Ellemann-Biltoft, 2011; Larsen et al., 2019).

This book seeks to enhance our understanding of the environmental ramifications associated with textile dye production through situational analysis of the present state of soils and their inhabitants at these specific sites. Furthermore, it explores how these insights can facilitate the development of ethical methods and tools that promote future co-production among multispecies actors.

Please find an overview of the examined theoretical and methodological framework of the case below:

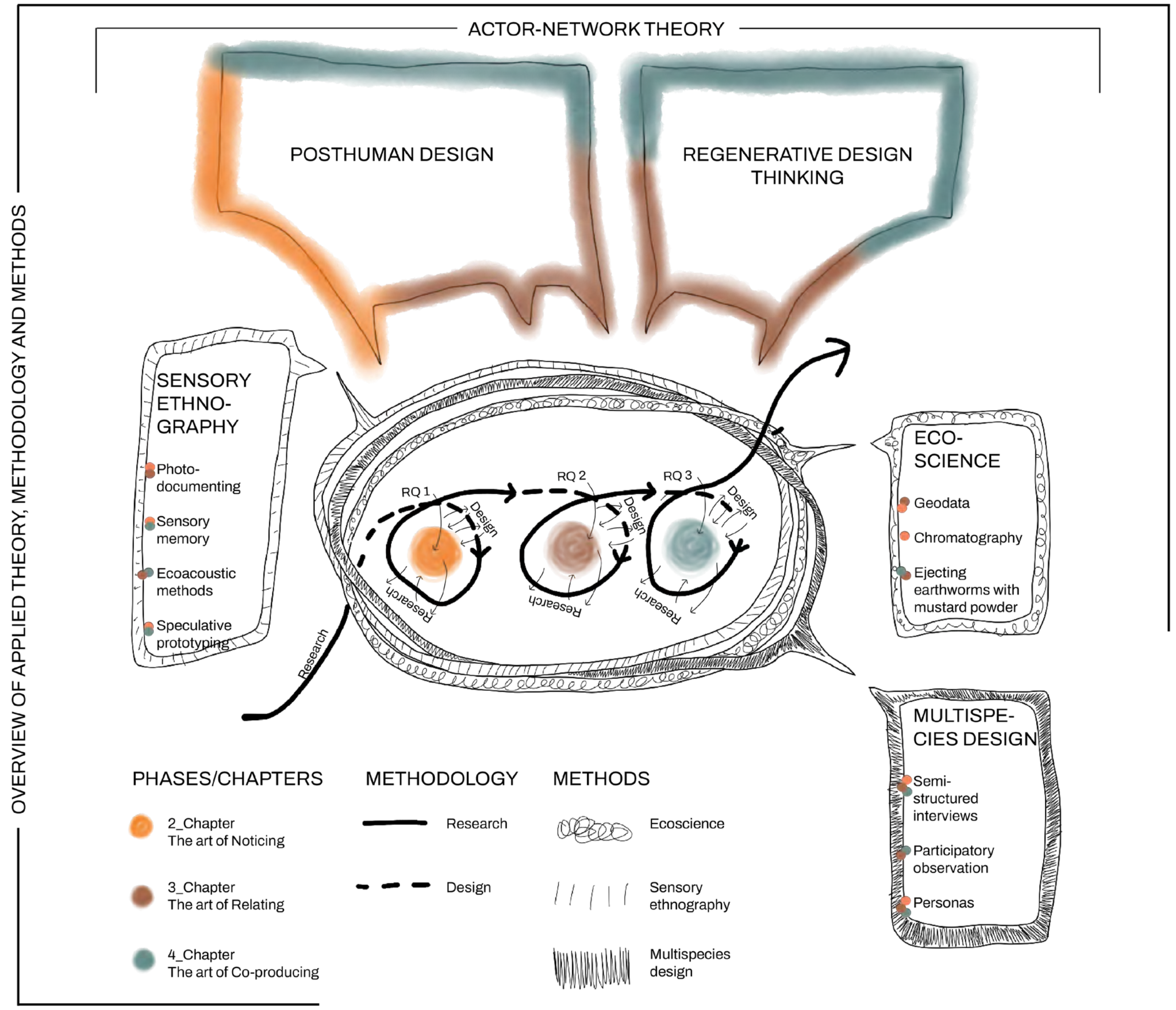

Fig. 7. Illustration of the CO-ACT project's theoretical and methodological framework. By Permiin, 2023.

Short theoretical framework

The inception of the CO-ACT project is rooted in the principles of Actor-network theories (Latour, 2007; Law & Hassard, 1999) and draws inspiration from the realms of posthuman design and regenerative design thinking.

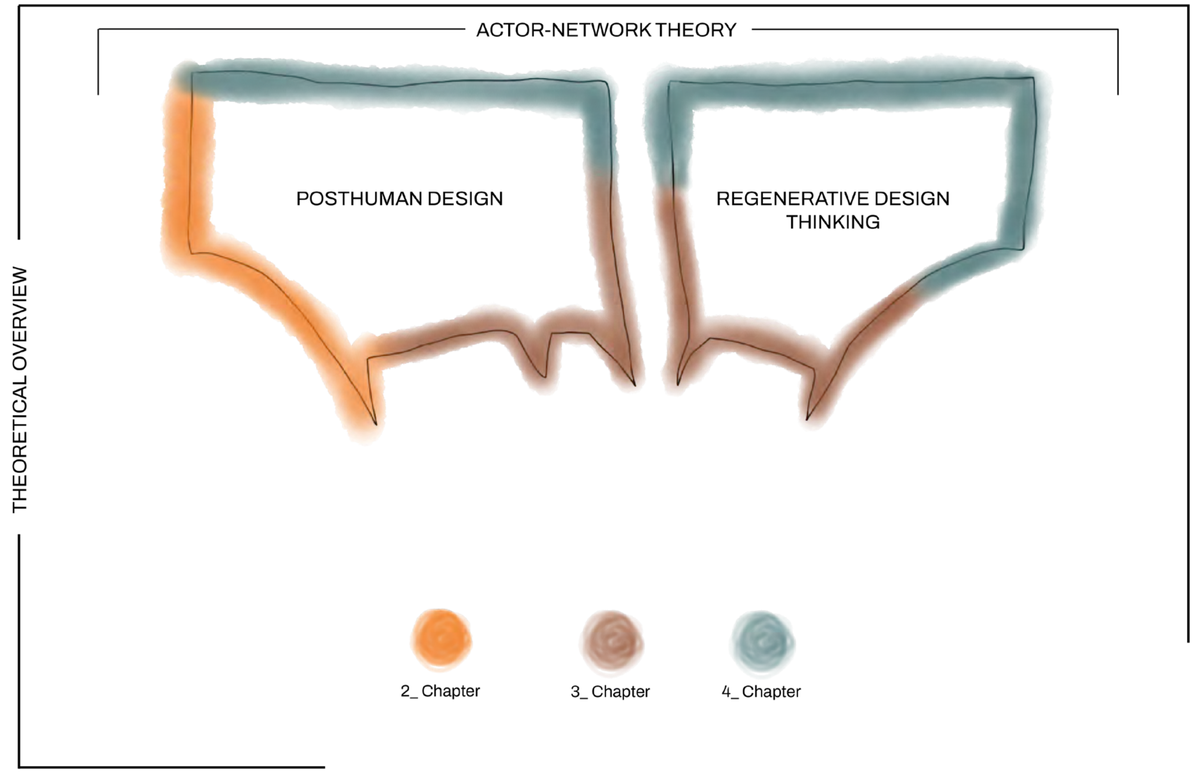

Fig. 8. Illustration of theoretical appearance in the three chapters: The Art of Noticing, the Art of Relating, and the Art of Co-producing. By Permiin, 2023.

Actor-Network Theory (ANT)

ANT emerged in the mid-1980s through the contributions of Sociologist Bruno Latour and John Law. It provides a conceptual framework for examining collective sociotechnical processes, focusing on science and technological activities. ANT challenges traditional views that elevate scientific knowledge or prioritise innovation models by arguing that science is not fundamentally distinct from other social activities (Harrington et al., 2006, p.4-5).

ANT challenges the binary distinction between natural (realism) and cultural (social constructivism) explanations of scientific production. Instead, it suggests that science involves a diverse array of social, technical, conceptual, and textual elements that interact and transform through translation. ANT questions essentialist divisions between science and technology, society and nature, agency and structure, human and non-human, and knowledge and power. It emphasises the relational materiality of entities in relation to others, presenting science as a network of diverse practices (Latour, 2007; Law & Hassard, 1999).

In the CO-ACT project, ANT serves as an inspiring foundation for exploring co-active design with multispecies actors in the design process. By embracing the ideas and insights of ANT, the CO-ACT project aims to foster co-active engagements that transcend traditional boundaries through transformative communication and highlight the intra-connectedness of multispecies actors within the design context.

Posthuman design

The CO-ACT project operates from a relational ontology (Escobar, 2018), applied to the design field to help understand the complex relationships and connections shaped within the design process among multispecies actors (Haldrup et al., 2022). By recognising that objects and systems are not isolated entities but part of a network of relationships, designers can think more holistically about their design's impact on the environment and society.

A recent field of posthuman design has drawn questions to the predominant human-centred focus and suggests that humans should share the stage with non-humans (Wakkary, 2021). This suggestion is elaborated upon by Design researcher Arturo Escobar who argues for a reorientation in design. Escobar states: "*To nourish design's potential for a transition, however, requires a significant reorientation of design from the functionalist, rationalistic, and industrial traditions from which it emerged, and within which it still functions with ease, toward a type of rationality and set of practices attuned to the relational dimension of life*" (Escobar, 2018, p. X).

The concept of posthuman design, which seeks to attune design practices to the relational dimensions of life, is being explored by designers and researchers in various ways. For example, some are examining how multispecies can become co-creators of experience and knowledge (Haldrup et al., 2022, p.14), while others are co-working and designing living systems with living organisms (*ArcInTexETN*, 2019, p.144-157; Collet, 2017, p.26). These practices challenge traditional approaches to design, which have historically focused on non-living systems. By foregrounding the importance of a more relational approach to design, posthuman design offers a pathway to more sustainable futures (ibid).

Considering the urgent need for designers to become more attuned to the relational dimensions of life, the CO-ACT project explores the new practices that arise when designers shift from being sole creators to embracing living systems within a design process among multispecies actors. To achieve this goal, the CO-ACT project will explore the concepts of "territory" and "temporality", drawing inspiration from Philosopher Vincian Despret (Despret & Morrison, 2021) and Anthropologist Anna Tsing's approach to noticing and co-producing (2012; 2017). It will also integrate the perspective of Professor Maria Puig de la Bellacasa, an expert in feminist theories and environmental humanities, who emphasises the significance of relationality (de la Bellacasa, 2012). By incorporating these influential frameworks, the CO-ACT project aims to propose new holistic practices.

The CO-ACT project explores how shared *territories*, multiple *temporalities*, and new practices can be implemented in the design process to support more holistic and responsive methods and tools. The CO-ACT project will draw inspiration from posthuman design and regenerative design thinking to achieve this goal.

Regenerative design thinking

The term "regenerative" derives from the Latin word "regenerationem," meaning "to be reborn," combining "re" (again) and "generate" (bring forward). In the field of biology, regeneration refers to the natural processes by which living organisms replace lost cells, tissues, or body parts. According to a report by FN in 2014, it was projected that if the depletion of soil continues, there will be no fertile soil available for planting food within 60 years (*Status of the World's Soil Resources*, 2015). In response to this crisis, regenerative land use practices have been proposed as a potential solution. These practices actively focus on assessing the humus content and microbiological life in the soil, which help sequester CO2 and enhance the conversion of atmospheric carbon into fertile humus in soils (Ahl, 2023, p.9).

Inspired by the movement of regenerative farming a Textile researcher, Rebecca Burgess, has developed an innovative approach that promotes soil health and ecological balance within a textile process by using regenerative agriculture practices. Drawing on the principles of regenerative design thinking, a comprehensive approach to designing sustainable and regenerative systems, Burgess has incorporated this approach into the organisation Fibershed. Fibershed aims to foster social equality and community well-being by utilising sustainable farming practices that benefit the health of the soil, leading to healthier and more productive crops (Burgess & White, 2019, p.80). This approach aligns with Biologist Daniel Wahl's argument that regenerative systems require us to move beyond the limitations of the current sustainability paradigm, which seeks to reduce harm and minimise negative impacts, and instead adopt a regenerative paradigm that actively contributes to the health and well-being of multispecies actors (Wahl, 2016, p.32).

The CO-ACT project showcases the interest in soil health as an example of combining theoretical backdrop with design processes in practice. By combining the approaches of posthuman design and regenerative design thinking, the CO-ACT project aims to provide designers with a range of CO-ACT methods and tools as learning materials to create more inclusive and adaptive designs that take all actors into account in the design process. By adopting a regenerative paradigm, designers can develop strategies that minimise harm and actively contribute to all actor's well-being. Burgess's work with Fibershed demonstrates the effectiveness of such an approach in promoting soil health and ecological balance, which the CO-ACT project draws inspiration from.

Methodology

The CO-ACT project delves into the exploration of various intra-actions concerning soil health, specifically focusing on Danish textile dye sites with historical and current ties to textile dye production. In pursuit of this goal, the research adopts the framework of Research through Design. The term "Research through Design" was initially coined by Sir Christopher Frayling (1993) to describe different relationships between research and design. Over time, it has been interpreted in various ways and has become associated with a specific research community and conference series (Redström, 2017, p.9). In order to bridge the gap between theory and design experimentation, design research environments have adopted systematic laboratory experiments (e.g., Koskinen et al., 2011). These experiments involve controlled studies focusing on specific design variables. This approach allows for the establishment of connections between theory and experimentation. As the research process iterates, a deeper understanding of how different design variables impact the test situation emerges, leading to the development of stronger relationships between theory and design (Redström, 2017, p.19). By using *Research through Design*, the CO-ACT project seeks to merge theory and experimentations in practice to propose imaginative changes to living textile dye systems that co-produce with soils. This investigation serves as an exemplar for the implementation of multispecies design in practice.

Applied research methods

To ensure a thorough understanding and validation of findings, the CO-ACT project adopts a mixed methods approach, integrating qualitative and quantitative research approaches (Bjørner, 2015, p.21). This approach enhances the comprehension of soil conditions and potential strategies for incorporating this understanding into future textile dye systems involving multispecies actors.

The CO-ACT project adopts a multiphase mixed methods approach (Ibid), wherein the various phases are interdependent. The initial phase (Chapter 2) encompasses qualitative methods such as multispecies design and sensory ethnography, as well as quantitative methods like eco-science, to inform the subsequent phase (Chapter 3) and so forth (Bjørner, 2015, p.21). Each phase (chapter) undergoes a situational analysis to identify pertinent patterns, relationships, and processes that align with the research questions (Clarke, 2003). Please find the illustration of the methods used throughout the CO-ACT project in fig.9.

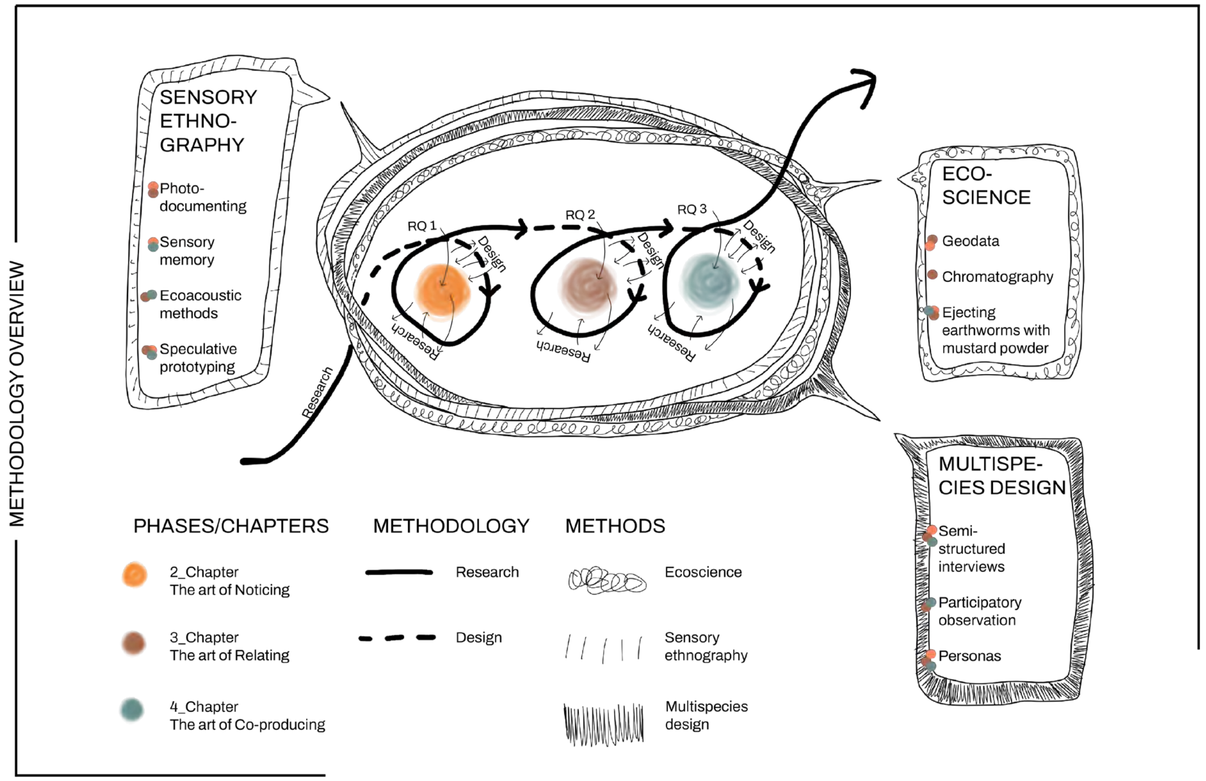

Fig. 9. Illustration of the CO-ACT projects use of Multiphase Mixed Methods. Each phase is informed by both quantitative (Eco scientific data) and qualitative (Sensory ethnography or Multispecies design) methods. The specific methods used in this book is described below and will be further elaborated throughout the different phases (chapters). By Permiin, 2023.

Multispecies design

- *Semi-structured interviews* allow the researcher 'to include additional questions in response to the participant's answers and reaction to the interview situation' (Bjørner, 2015, p.87). This book employs semi-structured interviews with geoscience, information science, and eco-science professionals, and cultural and natural heritage preservation. The CO-ACT project draws inspiration from Multispecies designer Daniel Metcalf's Multispecies design cards that include the method of 'Learning the science' (Metcalfe, 2015). This method highlights the significance of engaging with scientists specialising in studying animals (multispecies) and relevant sites. To facilitate this approach, semi-structured interviews are utilised extensively across the upcoming three chapters of the book. See fig. 10.

- *Participatory observation* is used to deeply understand the participants(actors) needs, values, and behaviours. During the engagement with participants(actors), a comprehensive mapping of their activities, routines, and interactions is conducted (Bjørner, 2015, p.179). This method offers a caring orientation towards the actors' intra-action within the design process and is consequently employed in all three forthcoming chapters of the book.

- *Personas* are used in the CO-ACT project as multispecies actors. The project draws inspiration from Metcalf's method 'Representing animals in the design process', which seeks to include animal personas as stakeholders(actors) interacting in existing products or services. According to Metcalf the methods should assess the design and prototyping phase from the animal's(multispecies) perspective (Metcalf, 2015), highlighted throughout the book.

Eco-science

- The CO-ACT project utilises geodata about soil conditions measured in Denmark, incorporating the results from the publicly available website, Dingeo.dk. The project takes outset in soils from two former Danish textile dye sites, *Brødrende Mathiasens Klædefabrik* (1865-1970) in Løgstør, and *Sødahl Design* (1974-2005) in Brande. Both sites are predicted by the Danish municipality to be polluted sites due to their former production of textile dyes. These predictions are shown in reports from local municipalities of north and centre Jutland (Ellemann-Biltoft, 2011; Larsen et al., 2019) which makes the sites significantly interesting to explore in the CO-ACT project.

- *Chromatography* is used to analyse and identify the different components in a soil sample. Soils are complex mixtures of organic and inorganic materials, and chromatography can separate and identify components of a soil sample (Kokornaczyk et al., 2017). The CO-ACT project uses chromatography as an exploration for becoming familiar with soil conditions for future co-action.

- *Ejecting earthworms with mustard powder* is an alternative method used in eco-science, and this method facilitates the assessment of soil conditions based on the earthworm count (SEGES, 2020). The CO-ACT project uses this method to familiarise earthworms and their intra-relation to soil health. It examines how an orientation to earthworms and soils can become active actors in future co-production.

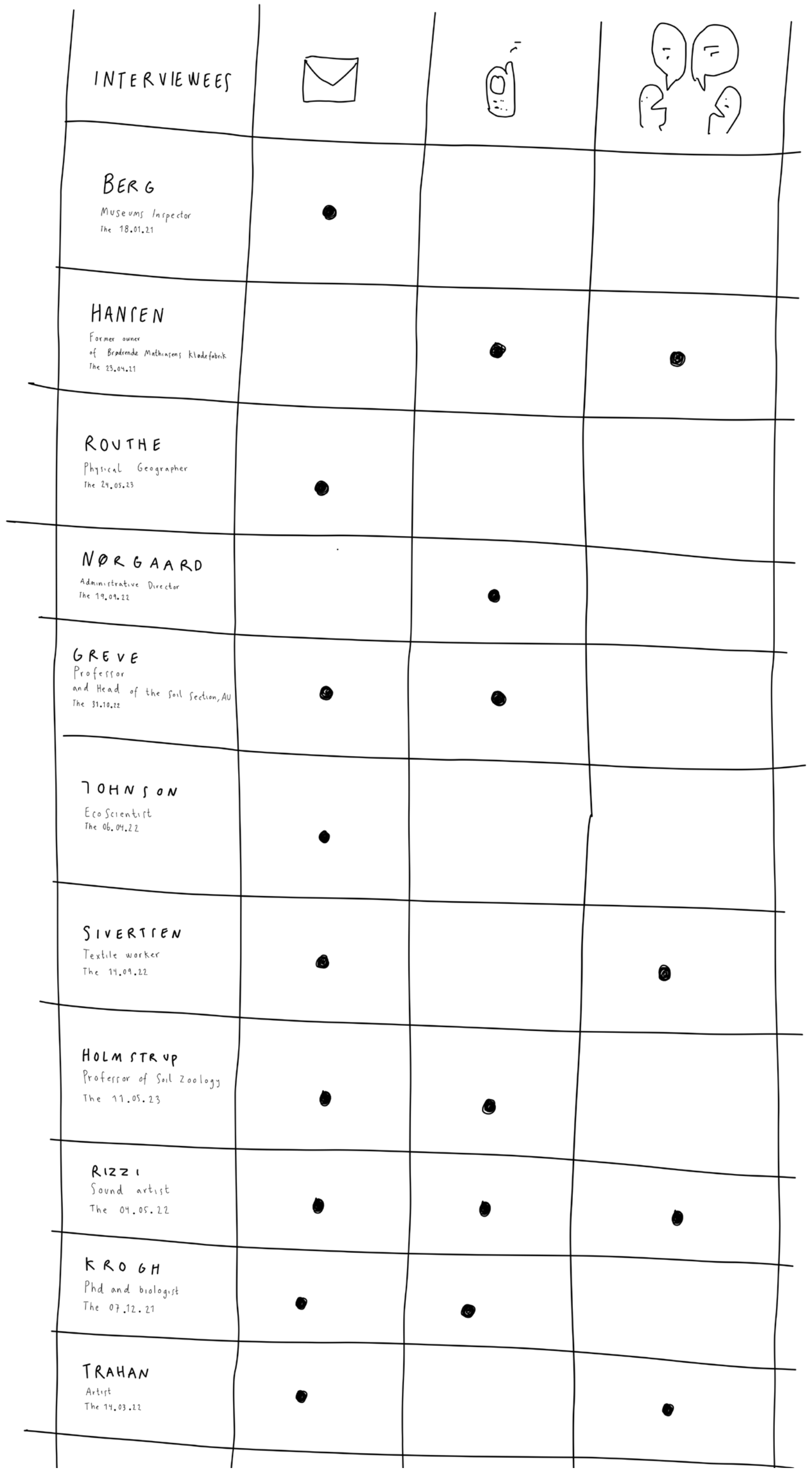

Fig. 10. Overview of Semi-structured interviewed interviewees taking part in the CO-ACT project using personal communication such as phone, mail, and physical meetings. By Permiin, 2023.

Sensory ethnography and design

- *Photo documentation* is a method that can be used to document actors, territories, and temporalities, as well as the relationships and interactions between them. It can confirm changes over time and the subjective experiences of individuals and groups (Pink, 2021, p.83). This method is particularly used in Chapter 2_ .

- *Eco-somatic* is coined by Thomas Hanna (1976) introducing the term “somatics” which shift the focus from the objective perspective of anatomy and biology to the experiential body called the soma. Somatics emphasises personal sensations and experiences, which provide valuable information not easily accessed through scientific methods. This led dancers and somatic practitioners to recognise the continuous interaction between the body and its environment, giving rise to the field of eco-somatics, which combines ecology with somatics (Rufo, 2022, p.3). This method is used throughout the CO-ACT project in various ways to merge sensory and multispecies design orientation in practice.

- *Eco-acoustic* methods are referred to as a set of tools and techniques used to study the sound and acoustic environment of natural ecosystems throughout this CO-ACT project. Using eco-acoustic methods the aim is to analyse and understand the relationships between living organisms and their acoustic surroundings, including the sounds produced by animals, the impact of human activities on the environment, and the impact of climate change on acoustic environments (Maeder et al., 2019).

- Speculative prototypes. Research through Design involves the creation of artifacts to generate new transitional theories and deepen our understanding of design theory itself (Redström, 2017, p. 2). As highlighted by Design professor William Gaver “It is the artifacts we create that are the definite facts of Research through Design” (Gaver, 2012, p.945) which emphasise the importance of tangible outcomes in this research approach. Therefore, the CO-ACT project explores the application of prototypes in speculative design (as discussed by Auger, 2013; Dunne & Raby, 2013; Wakkary, 2021) to establish the posthuman speculative prototype as a practical means of fostering collaboration among multispecies actors involved in a design process.

CO-ACT Method Cards (PDF)

Please scan the QR code for accessing the developed CO-ACT Method Cards.

Fig.11. Image of the interactive PDF containing the CO-ACT Method Cards. By Permiin, 2023.

Please scan QR-code or visit the website by this link: https://www.designforplanet.dk/projects/co-act-multispe-cies-design-in-practice/

2

The Art of Noticing

Introducing the chapter

This chapter focuses on the CO-ACT project's first research question: How can sensory design methods facilitate human perception and understanding of sites as vibrant living entities? A question which is unfolded throughout this chapter as two subchapters: 2.1_Noticing a site and 2.2_Noticing soils.

In general, the chapter builds on eco-scientific data that served as a fundamental framework to identify the textile dye sites under examination, with references to reliable sources such as DinGeo(2) and the regional environment development in the North and Central Denmark Regions(3) . In this chapter, the CO-ACT project focuses on areas where former textile dye production has caused soil pollution. Through this initiative, I advocate for caring design experiments that encourage an embodied understanding of multispecies perspectives and the creation of speculative prototypes, aiming to notice multispecies worlds. The primary objective is to acknowledge and comprehend the presence of multispecies actors within these sites while exploring the diverse territories and temporal dynamics that shape these environments.

Drawing on the writings of the Philosopher of science Vinciane Despret in the co-authored book Living as a Bird (2021) this chapter highlights that establishing a territory is a complex process involving multiple forms of territorialisation, which can be linked to time and space depending on specific circumstances and species (Despret & Morrison, 2021, p. 28). By incorporating these insights, the first subchapter 2.1_Noticing a site, contributes to a comprehensive understanding of noticing multispecies actors' diverse territories and temporalities as a starting point for future co-action.
The territory in focus is the former textile dye site of *Brødrende Mathiasens Klædefabrik* (1865-1970) in Løgstør, which is anticipated to be polluted due to past less restricted regulations such as wastewater management practices (Ellemann-Biltoft, 2011). This subchapter applies semi-structured interviews and photo documentation as methods to observe the various temporal aspects within the site actively. Furthermore, I employ an embodied approach to acquaint myself with the location, broadening my sensory orientation to the site beyond visual interpretation.

2 DinGeo is a platform that collects geodata and presents them in a simple and clear format. Figuratively speaking, DinGeo retrieves geodata from dusty and inaccessible archives intended exclusively for data experts and releases them to the general Danish population. www.Dingeo.dk visited the 10.06.23.

In contrast, the second subchapter, 2.2_Noticing soils, aims to broaden the scope of site exploration beyond a particular location by investigating past and present textile dye sites throughout Denmark. This subchapter uses semi-structured interviews with diverse actors knowledgeable in the field of interest. Additionally, it incorporates a chromatography technique to highlight the art of noticing soil actors as personas in the design process.
Finally, at the end of the chapter, an invitation to actively try out the method and recipe for co-action is proposed, providing a practical approach to engage with the concepts discussed.

2.1_Noticing a site

"*The former textile dye production in Løgstør holds historical significance as one of the earliest industrialised production sites in West Jutland. Certain sections of the former production building in Løgstør are still preserved; however, they are privately owned and in a deteriorating state*" (Berg, personal communication, 18. January. 21, translated).

Fig. 12. Images of Rådhusgade 31-33, Løgstør, highlighting the area of the former textile dye site of *Brødrende Mathiasens Klædefabrik*. Image is taken from Dingeo.dk the 25.05.23.

Fig. 13. Image showcase that the area is indicated as predicted polluted (blue colour), whereas an area with examined pollution is coloured red. Image is taken from Dingeo.dk the 25.05.23.

3 Regional Udvikling at Midtjylland is a department for regional development responsible for mapping and investigating soil and groundwater pollution in the region, as well as cleaning the soil in areas where there is a risk to human health or the environment. https://www.rm.dk/kontakt/regional-udvikling/ visited the 23.06.23.

The concept of noticing draws inspiration from Tsing's investigation of the matsutake mushroom and its intricate entanglements with human and non-human elements within capitalist landscapes. In Tsing's context, a former timber production site in Oregon, America, now in a state of deterioration, serves as one of the sites examined (Tsing, 2015). Here, Tsing emphasises the significance of developing a keen sense of observation, attention to detail, and a willingness to embrace unexpected encounters and connections. Through the practice of noticing, Tsing encourages a deeper comprehension of the intricate networks of life and survival that exist within abandoned capitalist environments (Tsing, 2015). From this outset, the CO-ACT project investigates the former textile dye site in Løgstør to gain a detailed and sensory orientation to the network of life and survival that exist within the abended site of past human activities with textile dyes. The subchapter starts with sensory observations, which involve becoming familiar with multispecies territories, temporal dynamics, and multiple encounters.

Through semi-structured interviews conducted with Environmental worker Pia Bjørn Haven at the North Denmark Region (04.03.22) and Jan Hansen, the previous owner of the textile dye site (23.04.21), it became apparent that polluted sites often are perceived from a human perspective. According to Hansen: "*The extensive damage to the former production building of Brødrende Mathiasens Klædefabrik in Løgstør and the contamination of its ground makes the site unsuitable for human construction*" (Hansen, personal communication, 23 April 2021, translated). In this context, the CO-ACT project aims to explore a broader understanding of construction that goes beyond human perspectives. It seeks to inspire the inclusion of multiple actors' lived experiences at a site, thus acknowledging our intra-actions with diverse territories and temporalities to foreground how to incorporate this orientation into future co-action.

Consequently, the following pages showcase a collection of photographs from my first field trip to the archive in Løgstør as well as the former textile dye site, *Brødrende Mathiasens Klædefabrik*, documenting the territories and temporalities of various actors present at the former textile dye site. By showcasing this collection, I intend to encourage you to delve into multiple ways of being, knowing, and doing, enabling you to observe the distinct ways in which each photograph embodies territorialisation through the interplay of diverse time and space.

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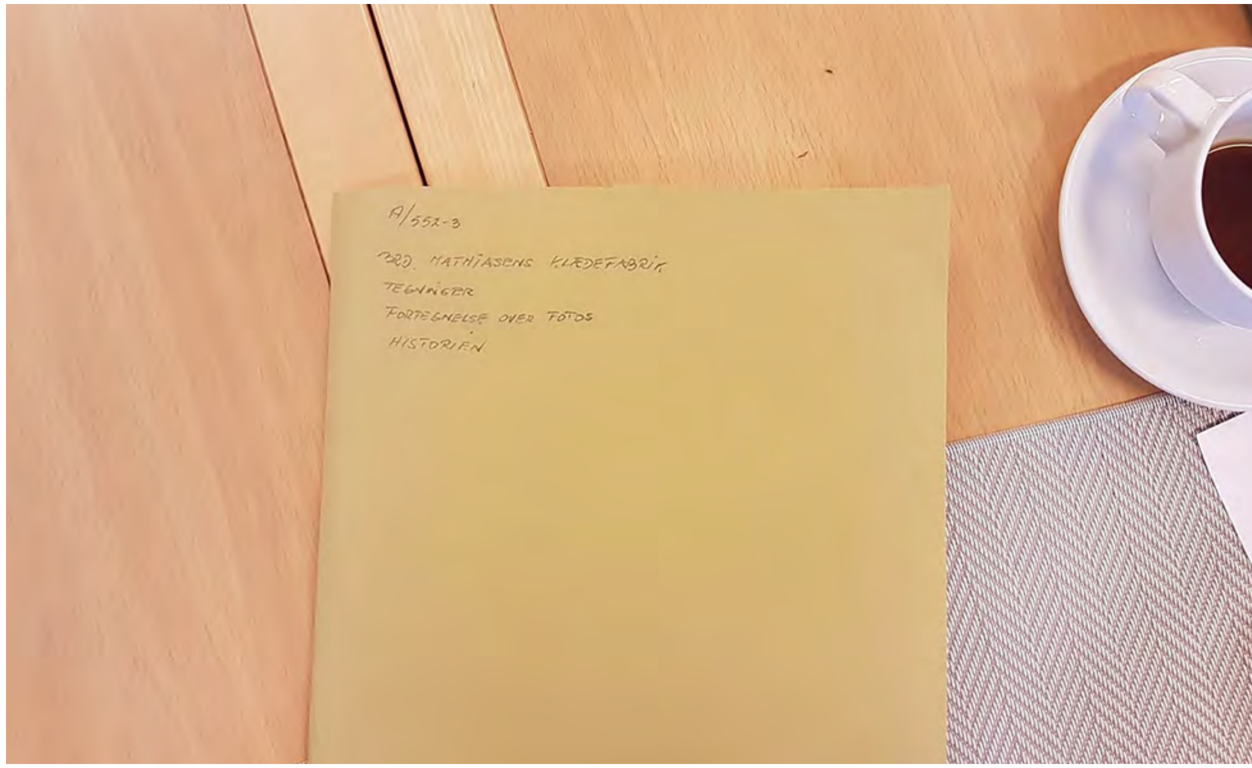

Fig. 14-47. Images from field trip to the archive in Løgstør and the former textile dye site *Brødrende Mathiasens Klædefabrik*, Løgstør, Denmark, 23.04.21.


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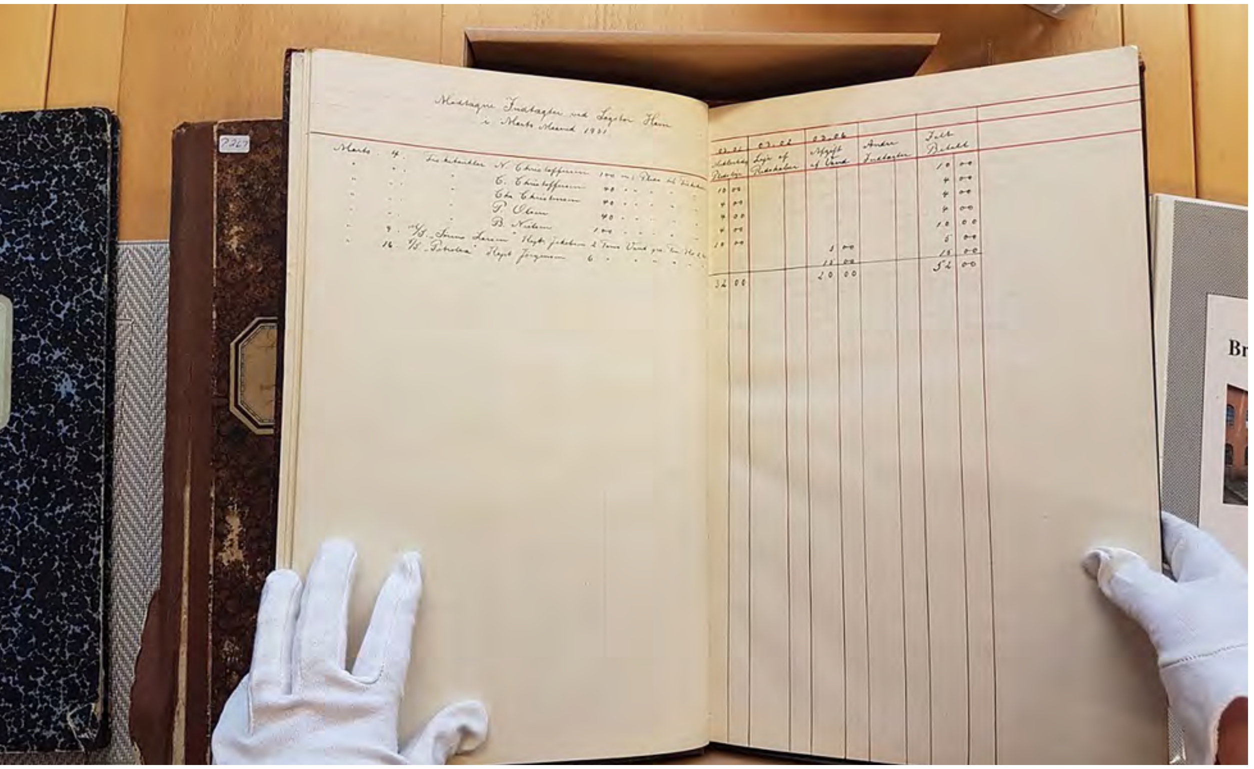
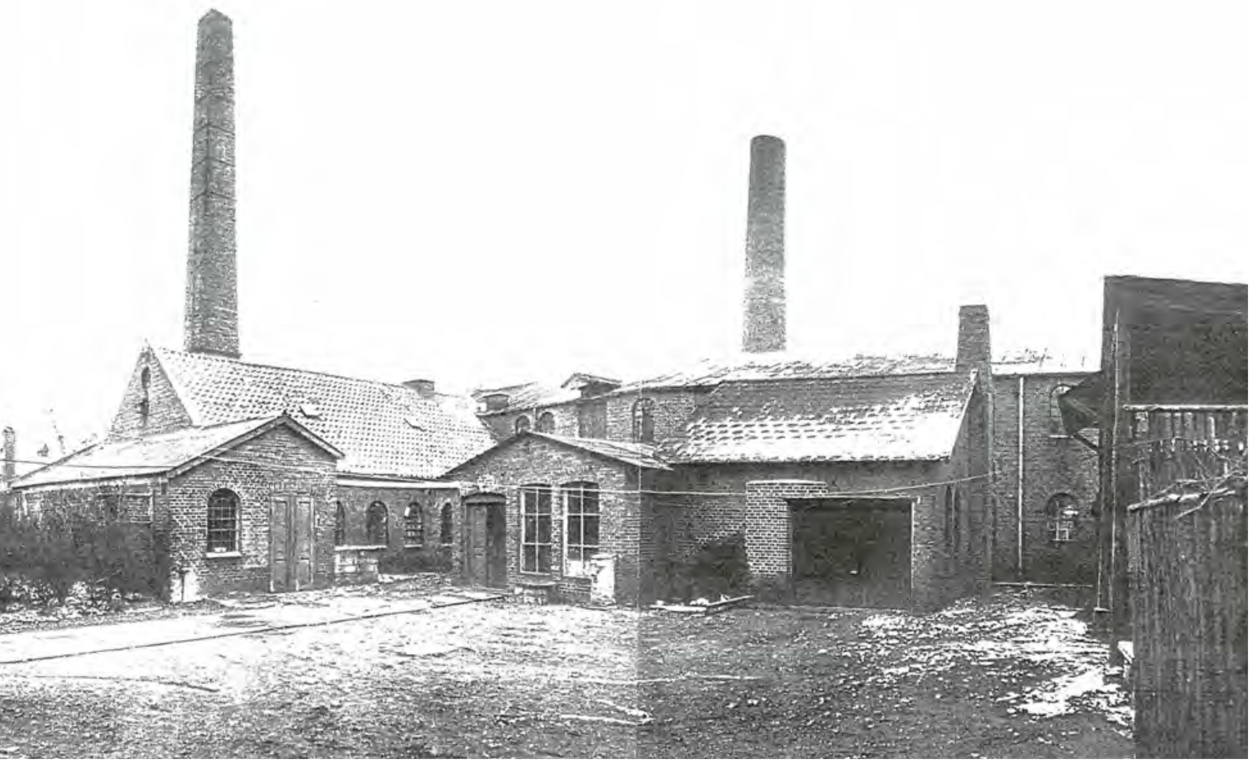




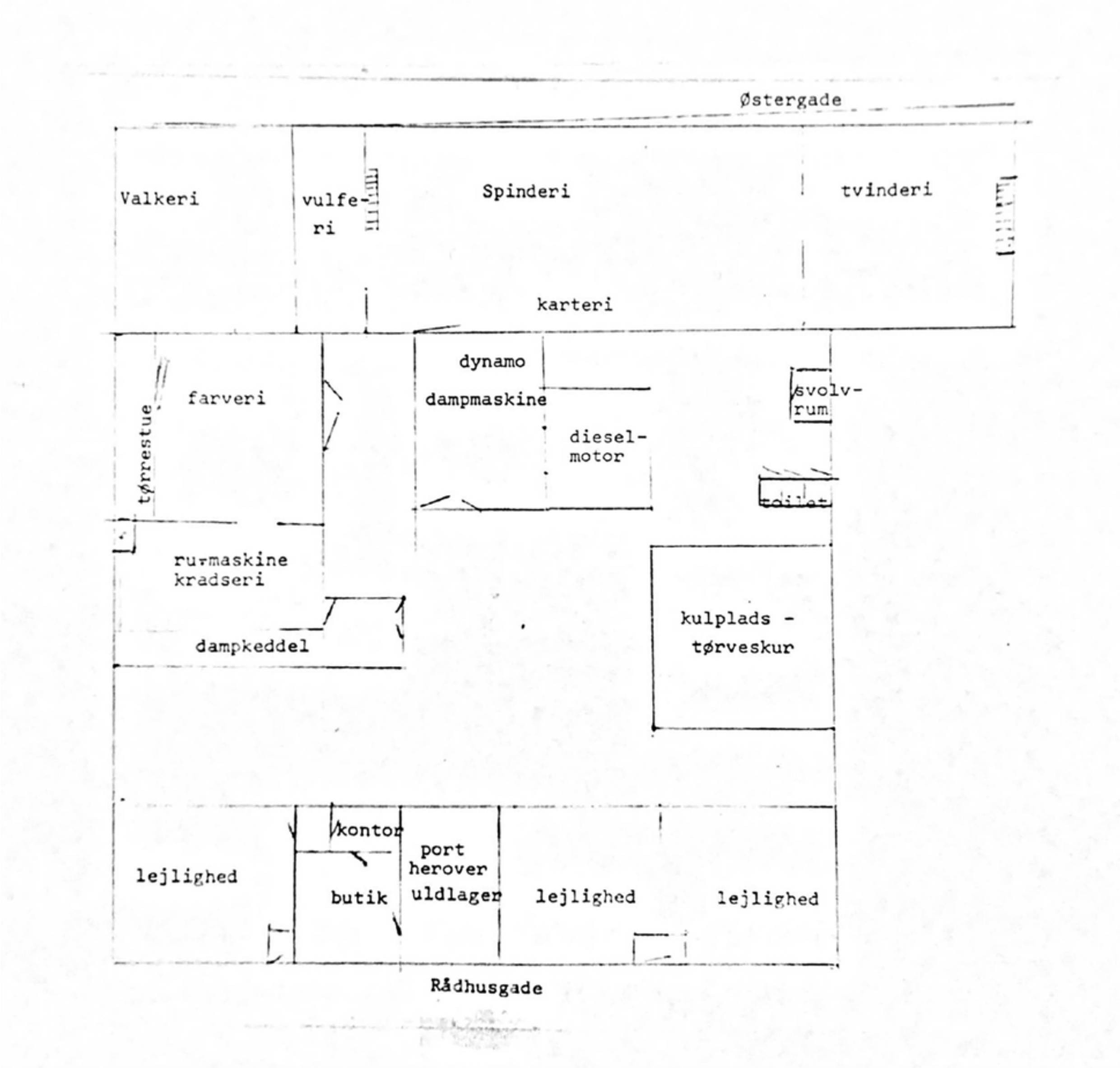
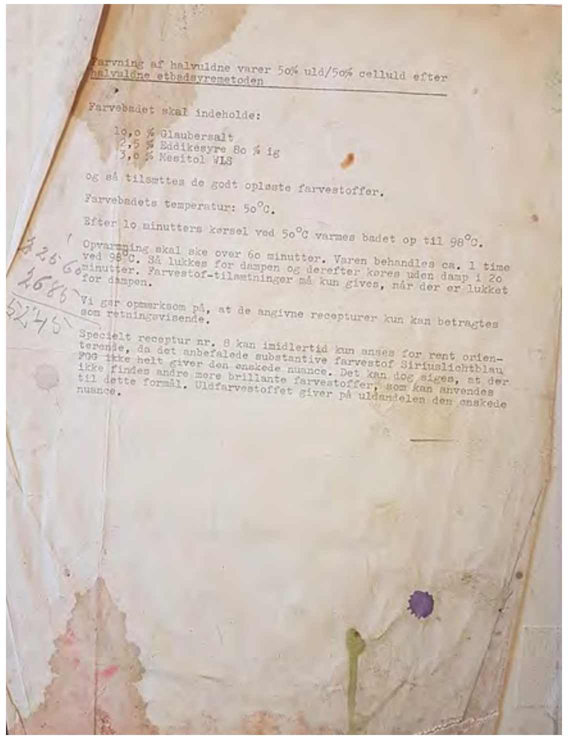


Fig. 22. Image of Brødrende Mathiasens Klædefabriks location and facilities, from Løgstør archive, 2021.



Farvning af halvuldne varer 50% uld/50% celluld efter halvuldne etbadsyremetoden

Farvebadet skal indeholde:

10,0 % Glaubersalt
2,5 % Eddikesyre 80 % ig
3,0 % Mesitol WLS

og så tilsættes de godt opløste farvestoffer.

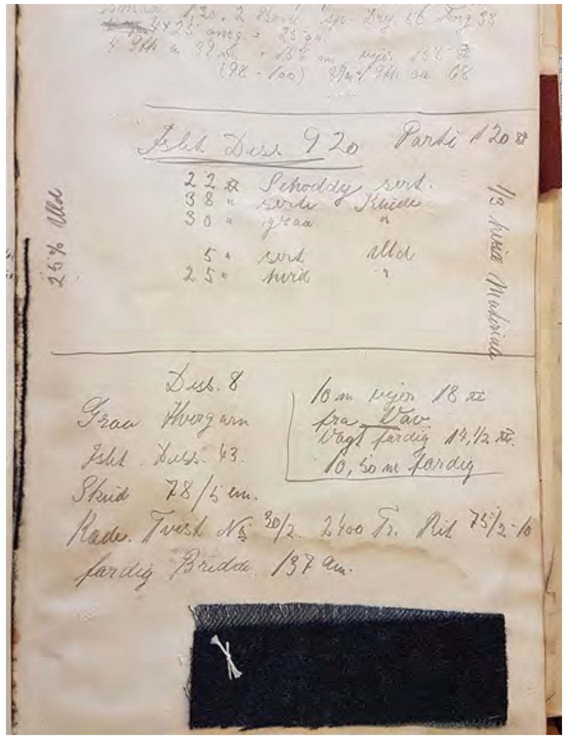
Farvebadets temperatur: 50°C.

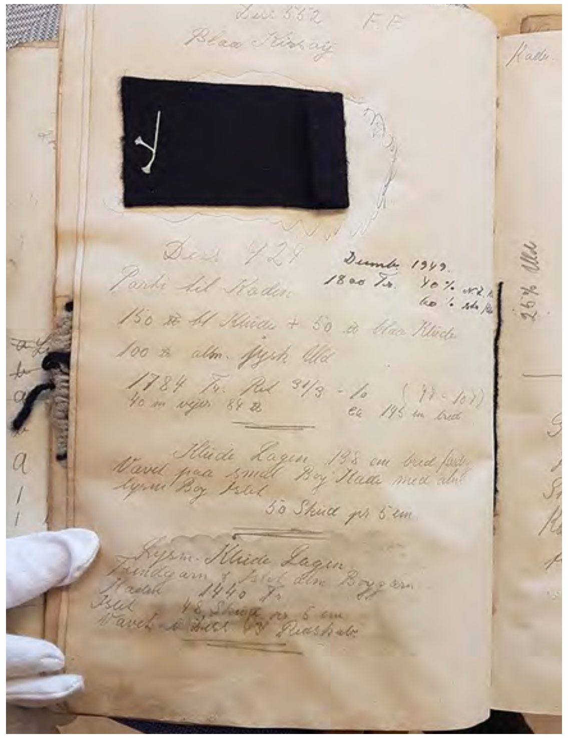
Efter 10 minutters kørsel ved 50°C varmes badet op til 98°C.

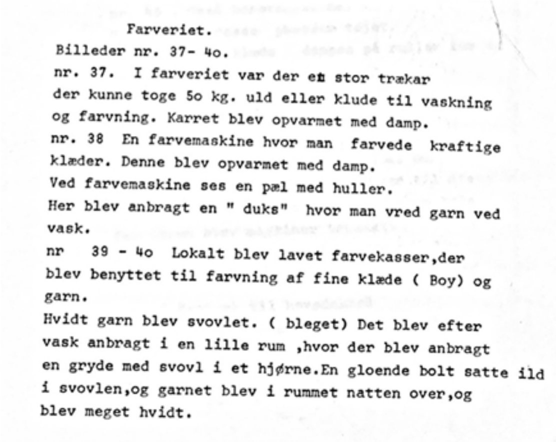
Opvarmning skal ske over 60 minutter. Varen behandles ca. 1 time ved 98°C. Så lukkes for dampen og derefter køres uden damp i 20 minutter. Farvestof-tilsætninger må kun gives, når der er lukket for dampen.

Vi gør opmærksom på, at de angivne recepturer kun kan betragtes som retningsvisende.

Specielt receptur nr. 8 kan imidlertid kun anses for rent orienterende, da det anbefalede substantive farvestof Siriuslichtblau FGG ikke helt giver den ønskede nuance. Det kan dog siges, at der ikke findes andre mere brillante farvestoffer, som kan anvendes til dette formål. Uldfarvestoffet giver på uldandelen den ønskede nuance.







Farveriet.
Billeder nr. 37- 4o.
nr. 37. I farveriet var der en stor trækar der kunne toge 5o kg. uld eller klude til vaskning og farvning. Karret blev opvarmet med damp.
nr. 38 En farvemaskine hvor man farvede kraftige klæder. Denne blev opvarmet med damp.
Ved farvemaskine ses en pæl med huller.
Her blev anbragt en " duks" hvor man vred garn ved vask.
nr 39 - 4o Lokalt blev lavet farvekasser,der blev benyttet til farvning af fine klæde (Boy) og garn.
Hvidt garn blev svovlet. (bleget) Det blev efter vask anbragt i en lille rum ,hvor der blev anbragt en gryde med svovl i et hjørne.En gloende bolt satte ild i svovlen,og garnet blev i rummet natten over,og blev meget hvidt.

Fig. 27. Image of material gathered from Jan Hansen, the former owner of the former textile dye site, *Brødrende Mathiasens Klædefabrik*. By Permiin, 2021.

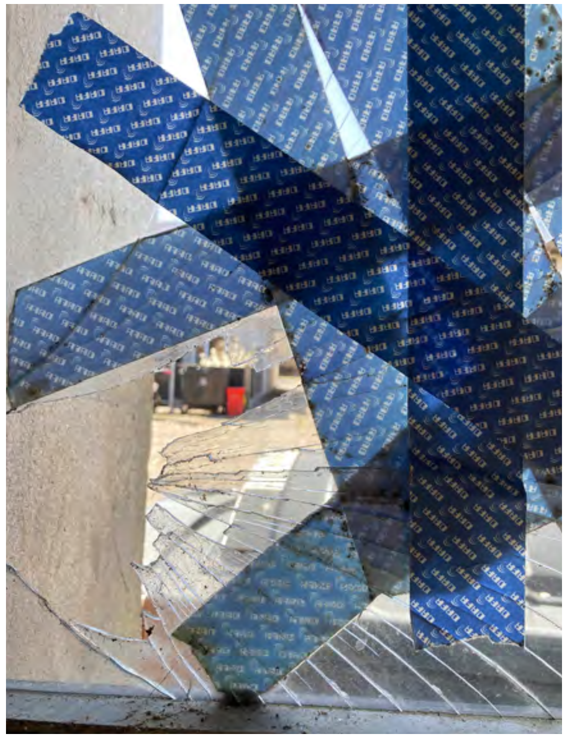
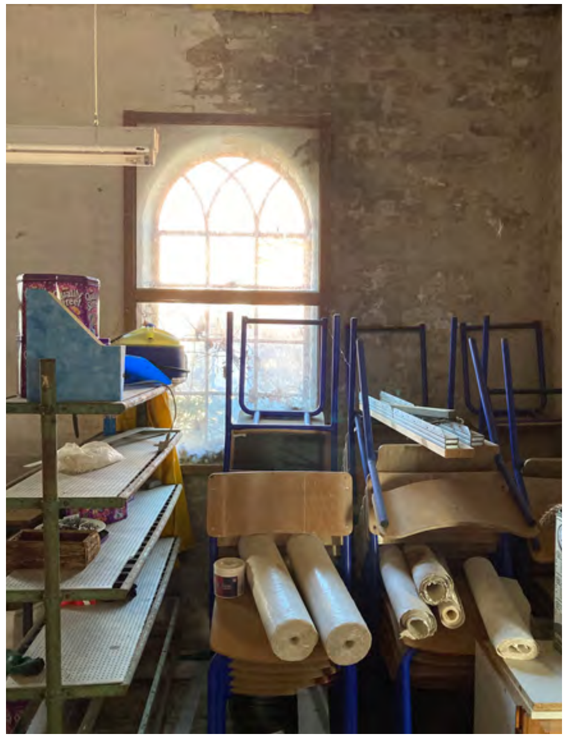


Fig. 28 – 47. Images of the former textile dye site Brødrende Mathiasens Klædefabrik, Løgstør, Denmark, 23.04.21.



Understanding a site through sensory engagements

The initial field trip to the archive and former textile dye site in Løgstør provided valuable insights for the CO-ACT project. Throughout my visit, I gained a deeper understanding of the site's temporal conditions, seasonal work, and the presence of various encounters. This experience revealed the presence of multispecies territorialisation as I documented three simultaneous occurrences: the gradual growth of ivy that enveloped various sections of the site, the construction of spiderwebs amidst the remnants of human activities, and the discovery of bacteria inhabiting windows and concealed areas. Despite being deemed unsuitable for human construction, as noted by Hansen, the site revealed diverse perspectives from the various actors who lived and utilised the space. These observations collectively illustrated the co-existence and intra-actions of diverse species within the site, showcasing the complex nature of a site's territorial dynamics.

By use of photo documentation, I initiated the process of observing the intra-connectedness of multispecies actors inhabiting a particular site. The writings of Professor John Douglas Porteous, a geographer who emphasised the significance of sensory experiences, expressed critique towards the overemphasis on vision, highlighting its dominance over other senses which resulted in Porteous examination of using sound- and smell-scapes (Porteous, 1990, p.23). Taking inspiration from Porteous's work, I embarked on a journey to expand my perception beyond the realm of visual stimuli. My goal was to embrace a more comprehensive understanding of the site and its inhabitants, acknowledging the multisensory nature of their existence. Pink (2015) emphasises that our sensory experiences are deeply intertwined with social relationships that shape our understanding and actions (Pink, 2015, p. 80). Building upon these insights, my next exploration focused on embodied observations, incorporating new sensory practices to actively engage my body's senses in the process of site-sense-making. Through this approach, I intended to employ a co-active method that would enable me to familiarise myself with the site and notice the connections with its diverse inhabitants.

Consequently, the following pages showcase an embodied method, specifically developed to notice co-action through bodily engagement.

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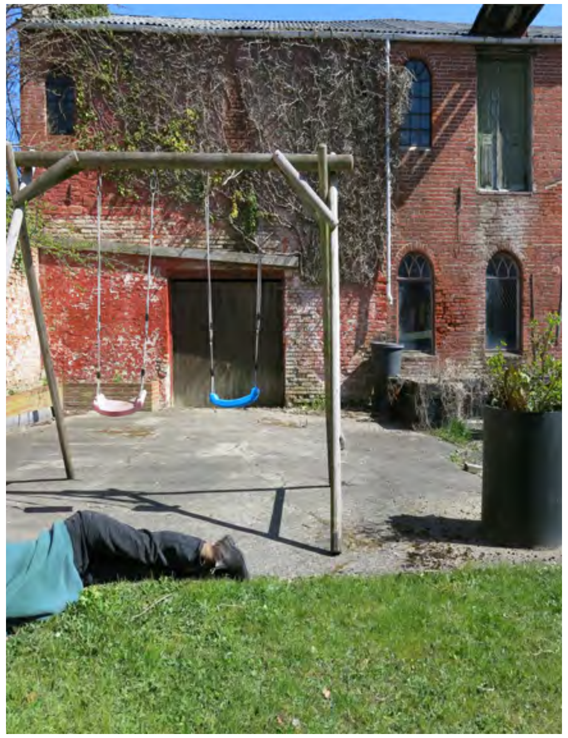
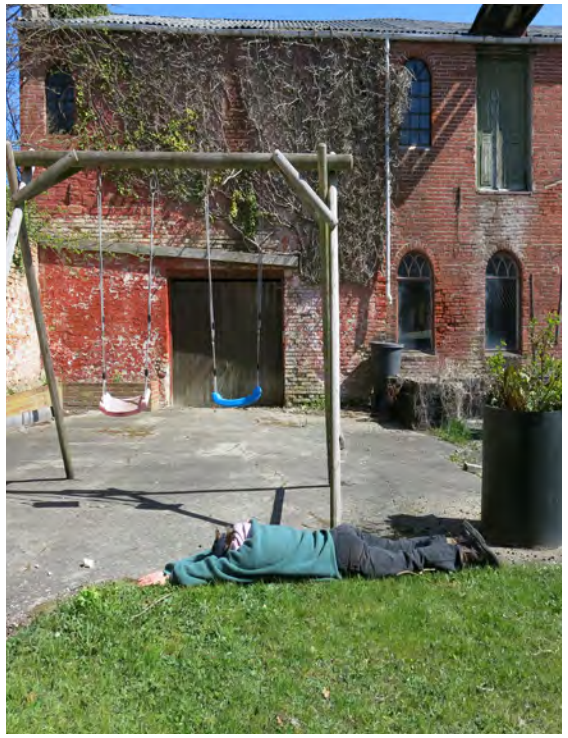
Fig. 48 – 61. Images of my development of the method 2.1_Noting co-action through bodily engagements at the former textile dye site in Løgstør, the 23.04.21. By Permiin, 2021.





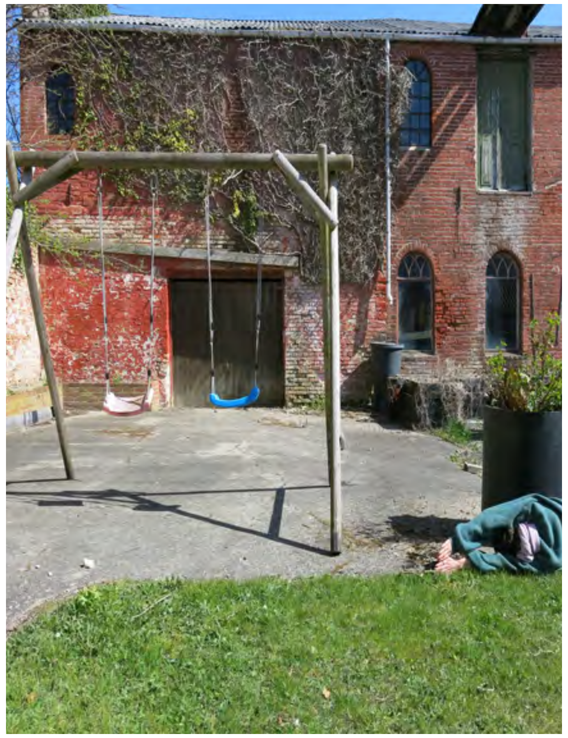


Fig. 61. Image from my participatory observation, bodily encounter soils at the location where the former textile dye room were located, the 23.04.21. By Permiin, 2023.

Findings from the first subchapter

"*As I rested my forehead against the soil, shaping myself into the contours of a gardening platform that lined the facade of the former textile dye building in Løgstør, a gentle steam caressed my skin. In this position I became especially aware of the soil at this site, evoking a newfound consciousness. I couldn't help but ponder who else might have sensed this warmth, and who might have made their home within this pile of soil?*" (personal anecdote from first fieldtrip, 23.04.21.)

Through my interaction with the site, I cultivated a heightened connection, encompassing not only touch, smell, sight, and sound but also emphasising a particular sensory connection with the soil at the site (fig. 61). As a result, my subsequent exploration takes outset in noticing and exploring the unique characteristics of soils.

If you want to try the developed CO-ACT Method Card, 2.1_Noting co-action through bodily engagements, is accessible at the end of this chapter, page 67-68.

2.2_Noticing soils

"Design-with is a way to rethink design in ways that humans and nonhumans are bound together materially, ethically, and existentially" (Wakkary, 2021, p.199)

In recent years, soils have gained attention within the realm of design and arts. In 2020 the Design Museum Lounastauko in Finland launched an exhibition called *Soil Matters*. As part of the Soil Matters exhibition, the Un/Making Studio collaborated with artist-researchers from the Soil Laboratory to explore the local environments affected by glassmaking revealed in an un/making soil community led by Designers Åsa Ståhl and Kristina Lindström(4). Similarly, a collaborative effort between biologists, gardeners, and an artist, Natalie Taylor, at Edinburgh Botanical Garden has resulted in the creation of a project called *Living Soil* made in 2023(5). Moreover, in Denmark, a transdisciplinary organisation called *Jordens hus* (translated as the house of soils) seeks to navigate the intersection between art, science, and agriculture, based on the belief that these disciplines can inspire and unfold each other in fostering care and renewed orientation to soils in an exhibition setting(6).

Through these examples, the CO-ACT project aims to actively participate in the raising movement of transdisciplinary interest and exploration of soils. Therefore, this subchapter examines the importance of understanding soil texture as a materiality bound together within its inhabitants living in and from diverse soils. The subchapter examines soil texture and chromatography through the lens of multispecies design to demonstrate the potential to carefully design-with soil actors in a co-active design process. In the context of multispecies designer Daniel Metcalfe's method in reorientating personas as multispecies actors(7), soil is throughout this subchapter examined as a 'persona'. Furthermore, the subchapter seeks to relate to soils perspective and conditions by use of participatory observation of diverse soils reaction with chromatography papers.

Understanding soil texture

Soil texture displays essential soil properties such as water-holding capacity, nutrient availability, and aeration, which can affect the habitat suitability for different organisms (Nardi, 2003, p.13). Understanding the properties of different soil types, which can vary depending on the climate and geology of a region, is vital for applications such as agriculture and gardening, where soil health is widely recognised as a critical factor (Nardi, 2003). This subchapter investigates soil texture and fertility to explore how soil conditions can be integrated into the design practice and process. This expands the scope of multispecies actors that are actively or passively involved in the co-action of futures.

4 Un/Making soil community, link https://soil-laboratory.aalto.fi/un-making-soil-communities/
5 Living soil, link https://www.rbge.org.uk/whats-on/climate-house-presents/living-soil/

All soils comprise three primary mineral particles: sand, silt, and clay. The combination of these particles determines the soil's texture, ranging from coarse and gritty for sandy soil to smooth and powdery for silt soil or sticky for clay soil due to its smaller particle size. Loam soil is a balanced mixture of all three particles, and there are other mixed soils, like clay loam or sandy loam, which vary based on the percentage of each particle (Nardi, 2003, p.11). Figure 62 illustrates the various soil textures of sand, silt, and clay.

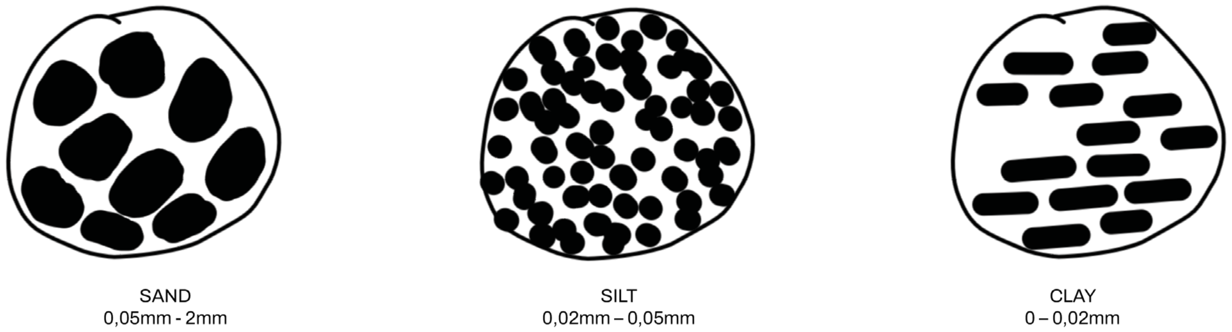


Fig. 62. Illustration that indicates three soil textures arise from different mineral particles mixes. By Permiin 2023.

Gaining a comprehensive understanding of soil texture is essential when identifying the specific actors that thrive within different soil types. It has been observed that various decomposers are attracted to different soil textures, as introduced by Nardi (2003, p.30). These decomposers provide help in the breakdown of organic matter, resulting in the enrichment of soil with nutrients, oxygen, and overall organic activity. Moreover, comprehending the diverse soil actors also involves understanding different soil textures' ability to let substances, like wastewater, permeate through different soil layers, as it can influence the organisms residing within.

6 Jordens hus, link https://www.jordenshus.dk/
7 Multispecies Design Cards by PhD Daniel Metcalfe, 2015.

Fig. 63. Image of Skerrisvej 4, Brande, highlighting the area of the former textile dye site *Södahl Design*. The image to the right indicates predicted pollution showcased from the blue colours. Image taken from Dingeo.dk the 25.05.23.

The former textile dye site at Skerrisvej 4 in Brande, Denmark, *Södahl Design* (1974 - 2005) has been identified as a significant contributor to soil pollution. Their activities, including textile dyeing, printing, impregnation, chemical and waste storage, and heavy fuel oil use, have drawn interest in observing the soil conditions at the site (Storgaard, 2022, p.6, translated). The investigation carried out by The Central Denmark Region in 2022 examined the soil condition at Skerrisvej 4. The findings revealed important information about how the texture of the soil affects its ability to drain wastewater. In an email exchange with Physical Geographer Magnus Greve Routhe from The Central Danmark Region, M.G. Routhe stated: "*Geology plays a role in how pollution spreads in the soil*" (Routhe, personal communication, 24 May 2023, translated). Soil scientists often refer to the "soil profile", which is the layers of soils, when seeking to understand how substances, like wastewater, move at a specific site (Ashman & Puri, 2002, p.22). Therefore, the Central Denmark Region has developed a conceptual model that illustrates how wastewater drains through the soil profile of both clay and sandy soil layers at Skerrisvej 4. This model emphasises the complex relationship between soil textures and the movement of wastewater within the site (see fig. 64).

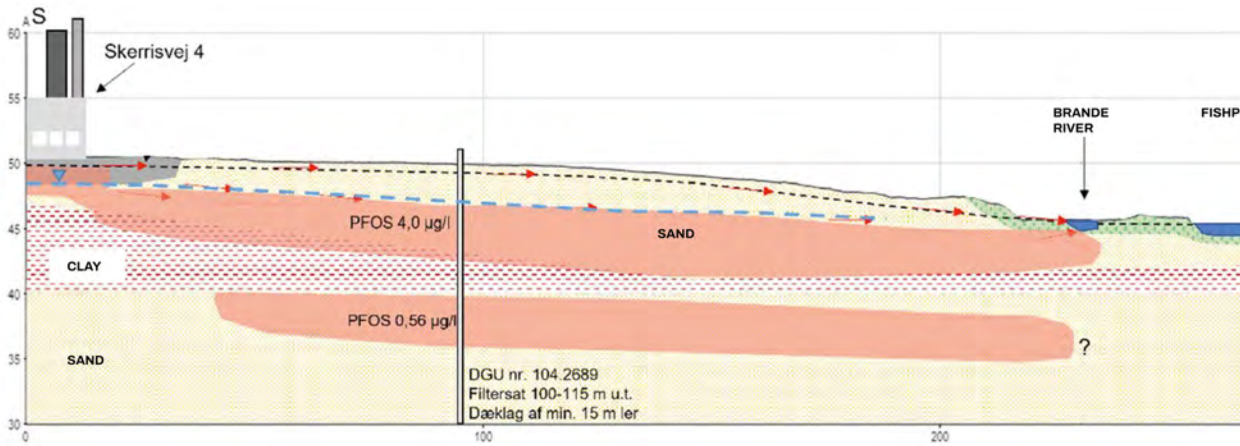


Fig. 64. In their 2022 report (Storgaard, 2022, p. 6, translated), the Central Denmark Region developed a conceptual model depicting the site located at Skerrisvej 4 and its relationship with the nearby Brande River. In this model, the red polygons represent the estimated extent of contamination as determined through an advanced contamination investigation conducted in October 2022. They also illustrate the assessed spreading path of the contamination, originating from the building at Skerrisvej 4 and extending towards Brande River, while also indicating the connection between the watercourse and the fishpond.

Furthermore, the conceptual model provides insight into the soil texture at the site, showcasing the presence of clay and sand as the predominant soil structures. This information enhances our understanding of the site's soil composition and its potential influence on the movement and distribution of contaminants.

The experiment conducted by The Central Denmark Region yields an intriguing question regarding the potential influence of the indicated soil condition on the levels of nutrients, oxygen, and overall organic activity in the examined soil. This is a question which I seek to explore further using a chromatography method.

Framing the sites of exploration

Today the *Danish Bottling Company* operates at the former textile dye site in Skerrisvej 4 and distributes drinking water globally. Therefore, I have encountered restrictions in accessing and collecting soil samples for the chromatography method. The reason provided by Administrative Director Mona Baltzer Fløe Nørgaard is that: "*allowing such access could draw unnecessary attention and raise doubts about the company's reliability*" (Nørgaard, personal communication, 19 September 2022, translated).

Therefore, the CO-ACT project shifted its focus to the former textile dye site at Østre Allé in Brande. This site is connected to *Martensens Fabrik*, which operated from 1855 to 2004 (1855 - 1966/70 at Østre Allé, Brande, and 1930 - 2004 at Hyvildevej, Brande). Here, a soil examination conducted in 1993, after Martensen Fabrik had torn down the factory and chimney at Østre Allé, indicated pollution of oil, metals, lead, nickel, zinc, and copper (*Orienterende Undersøgelse Af 18 Industrigrunde*, 1993, see also screenshots from former work with textile dyes and prints in fig. 65.) The observation of polluted soils at Østre Allé led to excavation of the soil to detoxicate the site as shown in fig. 66.

As a consequence, the sites chosen for investigation using the chromatography method now encompass two former textile dye locations in Denmark: *Brødrende Mathiasens Klædefabrik* in Løgstør, which is expected to be contaminated, and *Martensens Fabrik* in Brande, which is undergoing detoxification processes. I will also examine current textile dye sites in Denmark such as *Midgaards Have* in Ørnhøj and *Lystbækgaard* in Ulfborg, which are currently not reported to be or predicted to be polluted. This exploration aims to compare nutrient levels between the former sites and the current textile dye sites (see elaborated experiment overview in fig. 67). This knowledge can then be utilised to develop speculative prototype designs that enable co-action with soils.

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Fig. 65. Screenshots from Video by Local historian archive Brande, provided by Archivist Jens-Christian Kjær on the 20.09.2022.

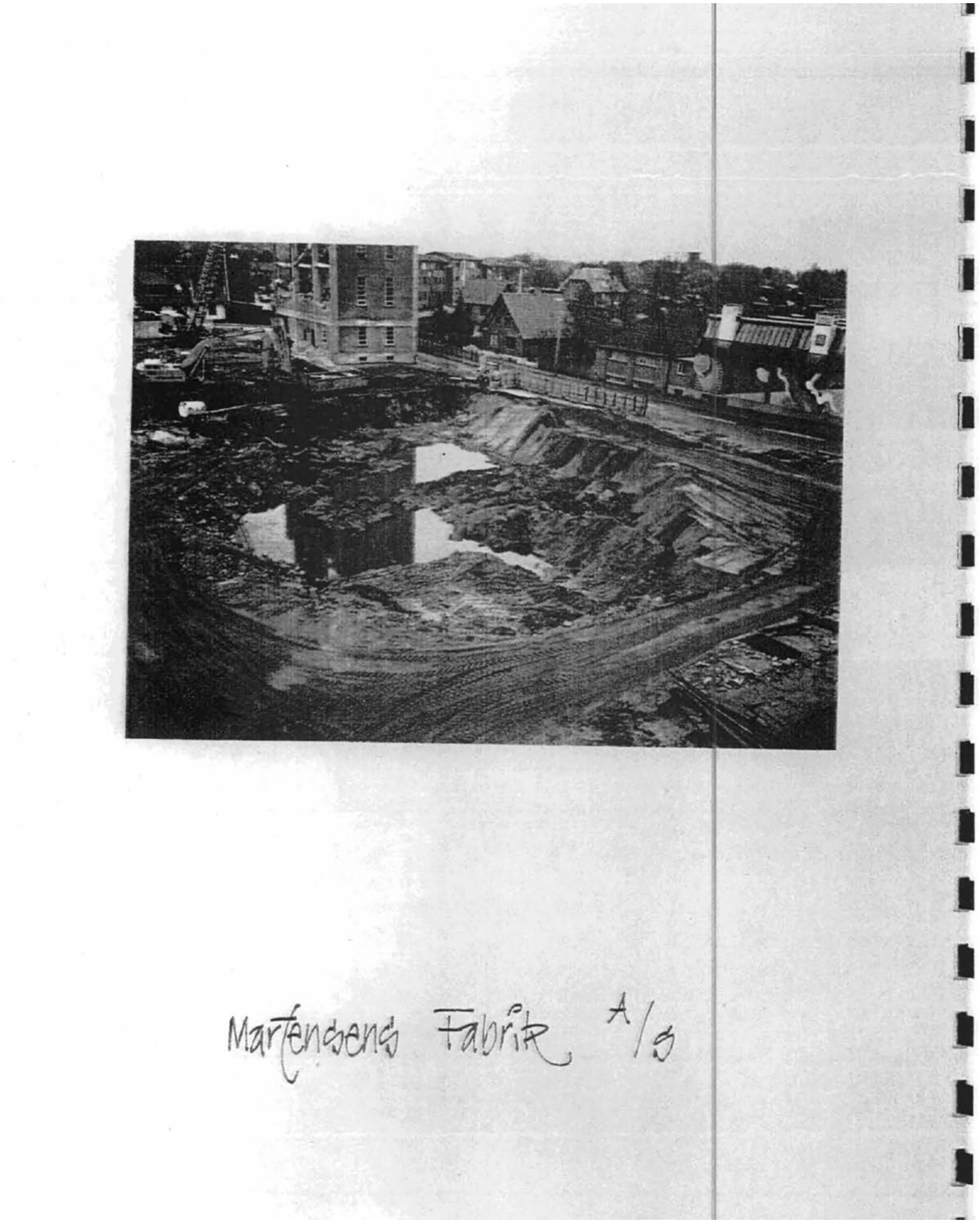

Fig. 66. Image from Local historian archive in Brande, by Birgitte Laasby in 1925.

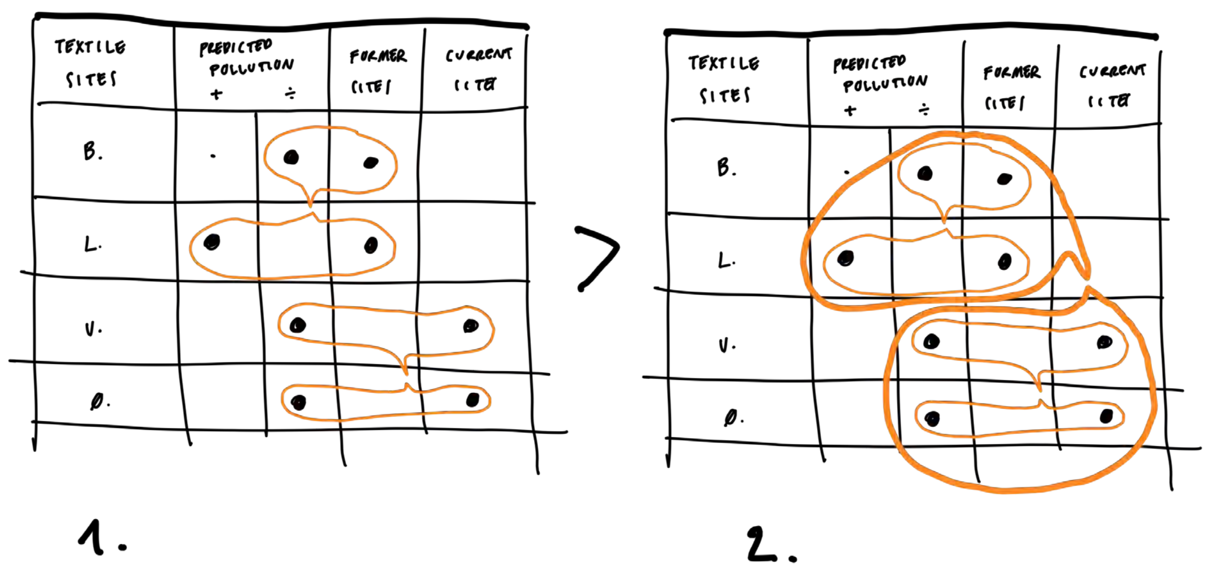

Fig. 67. Experiment overview of parallel analysis of the examined sites. B = Brande, L = Løgstør, U = Ulfborg, Ø = Ørnhøj.

1. Illustrates the former textile dye sites and current textile dye sites brought into examination in parallel to each other. 2.) Illustrates the former and current textile dye sites grouped in each category (former and current) which are then brought in parallel to each other. The objective is to see if there is a difference in nutrients in the soil from the former sites set to be polluted/detoxicated and the current textile dye sites that are not predicted to be polluted. By Permiin 25.05.23.

Experimenting with chromatography

Chromatography is a method used to identify fertile soil by analysing the different organic (living) and inorganic (non-living) components present in a soil sample (Kokornaczyk et al., 2017). This section comprises semi-structured interviews conducted through email correspondences and phone calls with two distinguished experts in the field: Eco Scientist Shem Johnson (2022) from the *Growing Lab at Central Saint Martin*, University of London and Professor and head of the *Soil Section at the Institute* of Agro-Ecology Mogens Humlekrogh Greve. These interviews aimed to gain knowledge about using chromatography in practical experiments. Consequently, the subchapter employs chromatography to facilitate an understanding of soil conditions and demonstrate how this relationship can be effectively applied in future co-active textile dye systems.

The subchapter builds on inspiration and help from Johnson (Johnson, personal communication, 6 April 2022), who introduced the recipe for chromatography as well as two former design students, Cinzia Ferrari and Julia Jueckstock, who had worked with chromatography in their design research project. In their design research project, *Splitting Soil*, Ferrari and Jueckstock utilised chromatography to orient soil health visually. They could predict unhealthy soil samples based on colour, shape, and patterns, with samples lacking nutrients, oxygen, and overall organic activity exhibiting a more substantial difference in colour than healthy soil samples. (See fig. 68).

I conducted chromatography experiments by using the same recipe as Ferrari and Jueckstock, which can be found at the end of this subchapter (2.1_Recipe). Through this experiment, I aimed to gain a deeper understanding of soil conditions, focusing on the former (*Brødrende Mathiasens Klædefabrik* and *Martensens Fabrik*) and current (*Midgaards Have* and *Lystbækgaard*) textile dye sites in Denmark. (See fig. 69).

Fig. 68. Illustration from the design project *Splitting Soil* by Ferrari and Jueckstock. Illustrating healthy and unhealthy soil by the samples indicating the: Terminal nodes, External Zone, Intermediate Zone Edge, Intermediate Zone, and Central Zone. Source found the 17.04.23 https://www.juliajueckstock.com/splittingsoil

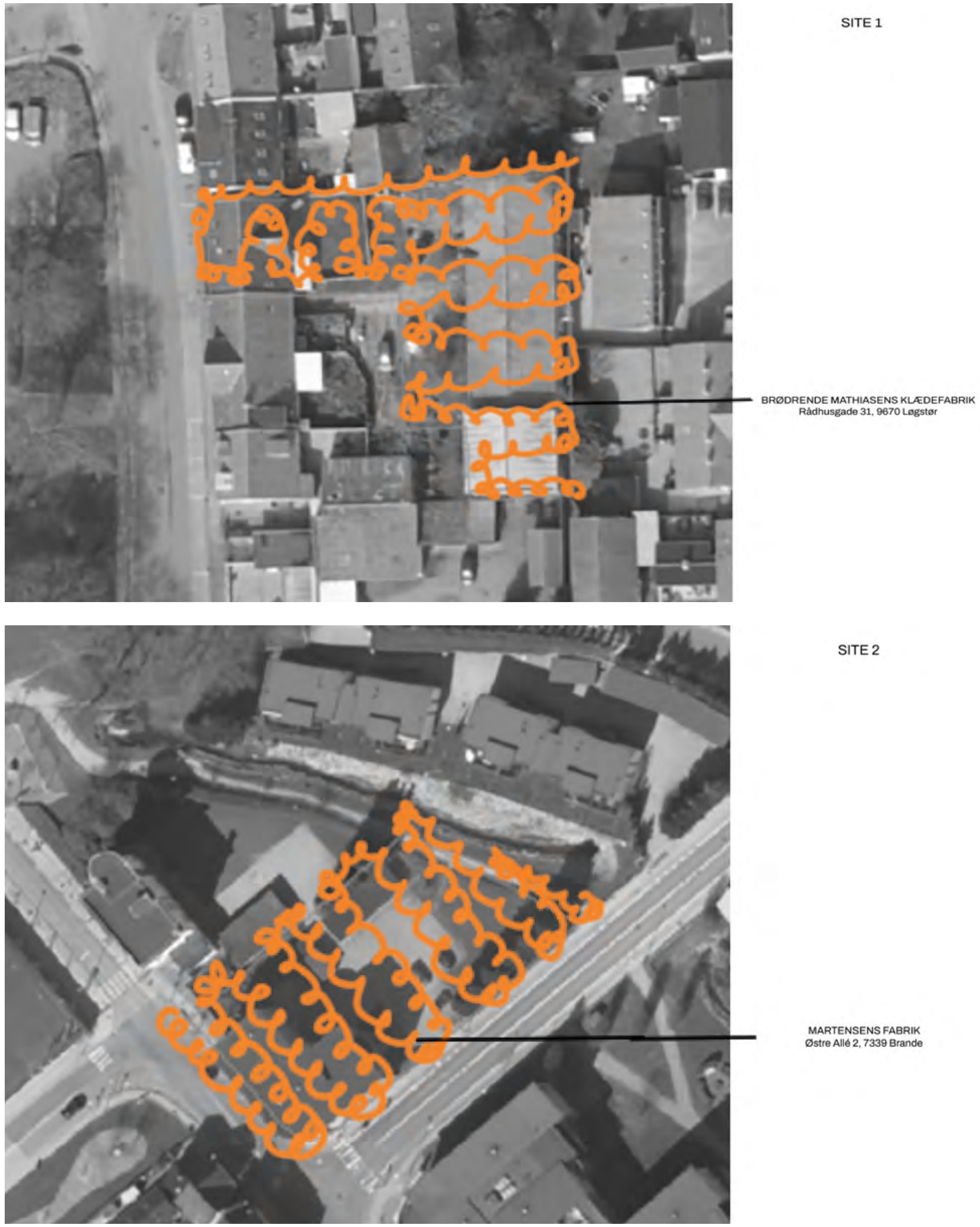

Fig. 69. Images from DinGeo, 25.05.23, and Illustrations of the four investigated sites, Brande, Løgstør, Ulfborg, Ørnhøj, whose soils I aim to test using the chromatography method. Illustration by Permiin, 2023.

SITE 3

MIDGAARDS HAVE
Askovvej 2, 6973 Ørnhøj

SITE 4

LYSTBÆKGAARD
Lystbækvej 1, 6990 Ulfborg

Fig. 69. Images from DinGeo, 25.05.23, and Illustrations of the four investigated sites, Brande, Løgstør, Ulfborg, Ørnhøj, whose soils I aim to test using the chromatography method. Illustration by Permiin, 2023.

In the experiment, I used one soil sample from each site, which resulted in varying shapes, patterns, and colours on the chromatography paper.

The experiment involved pre-prepared chromatography paper and soil liquids, as outlined in the recipe at the end of this chapter (2.1_Recipe). The experiment was conducted twice as the first attempt resulted in slightly lop-sided visualisations due to oval holes through which the filter paper soaked up the soil liquid preparation onto the chromatography paper. In the second attempt, a more circular figure was produced, although the hole was still angled, causing the analysed liquid to flow in angled directions. In hindsight, the circular holes on the paper should be made by a paper-hole machine instead of using a thick needle. (See fig. 70 below).

In the initial attempt, the resulting colours on the chromatography paper were predominantly dark, while in the subsequent attempt, they were predominantly pale, as illustrated in figure 70. While the same soil samples were utilised in both trials, the reliability of the results could have been improved by collecting multiple soil samples from each of the sites investigated. This would have provided a more comprehensive understanding of the soil conditions and their relationship to the observed colours.

SITE 1

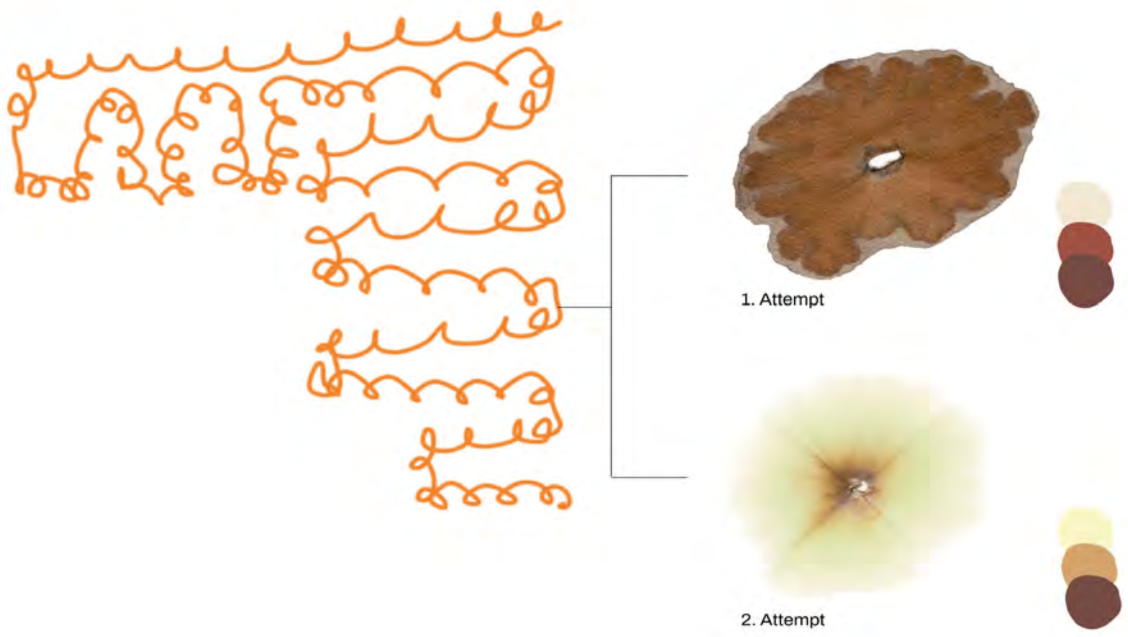

Fig. 70. Images of both 1. and 2. chromatography attempts with soils from Løgstør, collected the 19.09.22. The chromatography test was conducted at Design School Kolding, Ågade 10, the 05.10.2022. Illustration by Permiin, 2023.

Findings from the chromatography method

The aim of examining chromatography was to explore the potential for multispecies relationships within soils and human actors using communication through colour. The chromatography paper's visual representations of colours were intended to enable communication between human actors and the soils, allowing humans to gain insight into the soils' perspective by observing their condition according to the revealed colours and substantial difference on paper. See proposed speculative prototype in fig. 71.

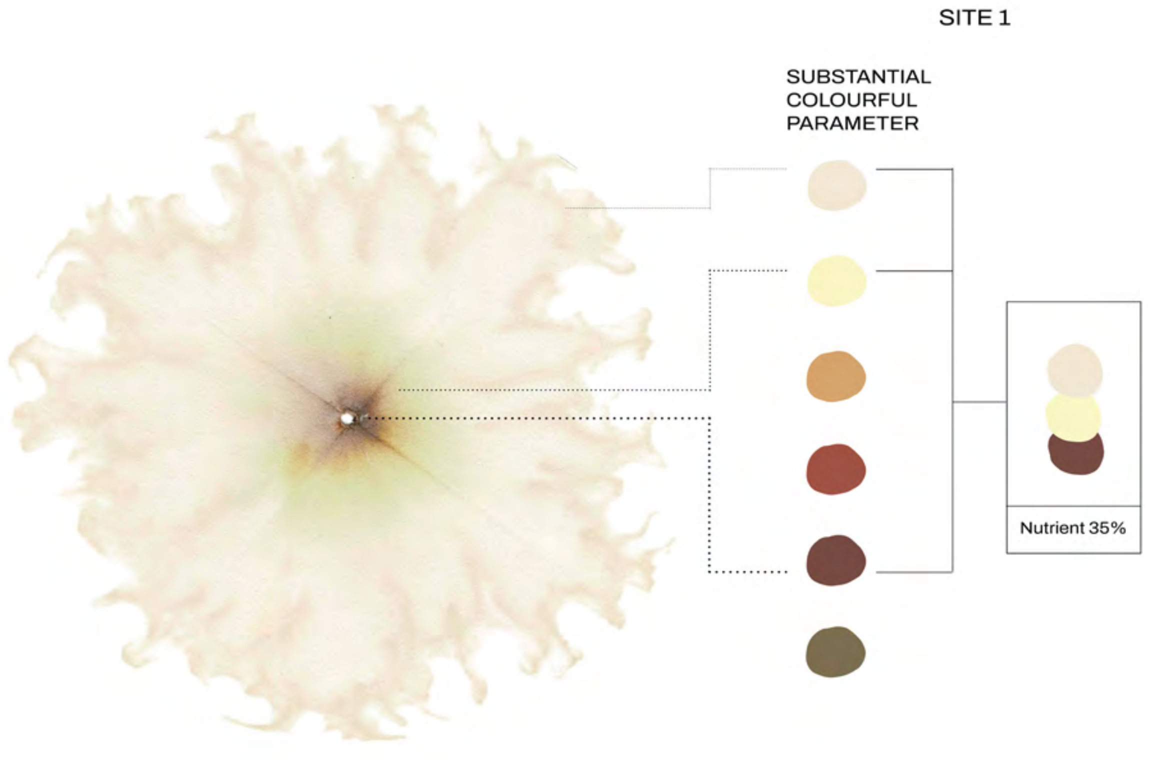

Fig. 71. Illustration of a speculative prototype using chromatography to analyse the nutrient content present in the examined soil. The revealed chromatography pattern is from my experimentation with chromatography with soil from Østre Allé, Brande. Examined the 05.10.2022. Illustration by Permiin, 2023.

However, the two attempts at chromatography revealed conflicting colours and patterns, highlighting the need for further investigation. Despite consulting with experts, little information was available regarding the validity of chromatography. An email response revealed that Greve (2022) did not consider chromatography a reliable method for validating soil conditions in the field of Eco Science, as there is very little evidence for its reliability (Greve, personal communication, 31 October 2022, translated). Therefore, this experiment's attempt to view soils as a persona through speculative prototyping with chromatography has been difficult to verify, even with expert assistance. These challenges highlight the difficulties involved in seeking design-with multispecies actors. Consequently, as illustrated in the subsequent chapter, the second chapter shift its focus towards exploring the connection between soil health and future co-action by examining the textile dye plant Woad and its behaviour in relation with different soils and care as well as earthworms as another actor in soils.

Your turn

I hereby invite you to try the CO-ACT Method Card 2.1_Noticing co-action through bodily engagements as well as the 2.1_Recipe for experimenting with chromatography.

I wish you the best of luck and joy while trying the provided material.

Noticing intra-action through bodily engagements

What?

Noticing intra-action through bodily engagements is a method that examines a situation through bodily engagement. This method allows you to bodily sense the position, shape, materiality, smell, etc of other actors intra-acting in your case or design process.

Why?

Bodily movement and engagement with the surroundings can create a new notion to a situation and the actors involved.

How?

Within the CO-ACT project an example of a recipe is created to exemplify how this method could be approached.

Recipe

You would need a camera with a timer setting and your body.
1. Bring a phone or camera to your investigated site or situation.
2. Orientate yourself to the surroundings and choose the actors whom you want to bodily intra-act with.
3. Set a timer of 10 seconds on your phone or camera. Within these 10 seconds you can run to an actor and try to take shape of it.
4. Reflect on your bodily experience and observations and ask yourself what this physical intra-action made you become aware of and how this awareness can take shape in your design process or practice.

Examples

- *Mineral walks* by designer Petra Lilja, 2021. A performative walk in a limestone quarry allowing speculations to human intra-action with limestone as a material embedded within the human body. https://www.petralilja.com/mineral-meditation-walk
- *HABITAT body scaping* by artist Nana F. Schottlânder, 2021. An explorative journey examining a site and the intra-actions within location, matter, and materiality through bodily engagements. https://www.metropolis.dk/habitat-bodyscaping/
- *Feral Atlas* by Stanford University, 2021. An online platform featuring journeys and essays that explore the multifaceted aspects of the more-than-human Anthropocene. https://feralatlas.supdigital.org/
- *Urban recipe* by Yuxi Liu and Seda Özcetin, 2022. A co-creative project that explores the urban recipes that gives new ways of relating to the more-than-human. https://www.4tu.nl/du/projects/Exploring%20the%20urban%20living%20experience/

2.1_Recipe for experimenting with chromatography

The necessary materials include: Chromatography paper (10diameter), 1 litre of NaOH, AgNO (silver nitrate) powder, sterile petri glasses, jars, different soils and access to an artificial light room.

SETUP IN THE LAB

1_Preparation of soils:
– Mix 6,6 g soil and 66 ml NaOH in a jar.

– To achieve this, stir the mixture for one minute initially, and then again after 15 minutes. Repeat the stirring process after 1 hour and 2 hours. Finally, let the mixture sit undisturbed in the jar for an additional 2 hours to allow the settling of any remaining particles.

– Meanwhile the jaw is settling. Create small paper filters (15mmx15mm) from regular A4 paper to add in the centre of the chromatography paper.

SETUP IN ARTIFICIAL ROOM

2_Preparation for the chromatography papers:
– Make a 0,4ml AgNo fluid. The solution is 1g silver nitrate (powder) pr 100 ml. Demineralised water.

– Place the 0,4ml solution in petri-dishes.
– Carefully place the round 10-diameter chromatography paper on top of the petri dish, ensuring that the filters are centred

– Take the soaked chromatography paper from the dish and let it for dry for min. 3 hours.

Detecting soil condition on chromatography paper:
– Add 0,8ml of the prepared soil from section 01 in another petri dish.
– then place the prepared chromatography paper from section 02 on top of the petri dish. Make it soak for one hour in complete darkness.
– Hereafter the samples should dry for 12 hours in regular daylight.

3

The Art of Relating

Introducing the chapter

In this chapter, I delve deeper into establishing a connection with the inhabitants living in the soil, focusing on the plant woad and earthworms. The chapter addresses the second research question of the CO-ACT project: How can sensory and multispecies design methods and tools facilitate relationships with living soils during the design process? This question is explored in two subchapters titled 3.1_Relating with Woad and 3.2_Relating with Earthworms.

The chapter builds on Professor in feminist science and technology studies María Puig de la Bellacasa's (2012) reinterpretation of Donna Haraway's (2007) concept of "thinking with". This reinterpretation serves as a foundation for understanding how to actively engage and relate with multispecies actors in the design process. Bellacasa argues that "thinking with care" is crucial for collective thinking in interconnected worlds. It requires a deep understanding and commitment to caring, going beyond mere accommodation of differences. Actively living with others and recognising the transformative potential of encounters with otherness is an essential aspect of this approach (de la Bellacasa, 2012, p.11). Embracing multispecies encounters, and the constant process of transformation and engagement with multispecies actors in design and in everyday life, demand ongoing commitment. Professor emeritus of anthropology Arturo Escobar (2018) emphasises that this commitment to active recognition and care for multispecies intra-actions requires the continual renewal of our communal will, fostering a sense of togetherness and a desire for communal existence. Escobar's exploration of indigenous worldviews in the book *Designing for the Pluriverse* (2018) highlights the need for a holistic understanding of territory, where physical and spiritual dimensions intertwine, creating intra-connected relationships for all actors, human and non-human (Escobar, 2018).

How can I recognise, engage, and actively commit to these intra-connected territories and relationships? To establish a relationship with multispecies actors in a design process, the CO-ACT project examines Woad and earthworms using sensory and multispecies design methods. The initial section, 3.1_Relating with Woad, focuses on understanding Woad as a living entity, presenting its historical background, migration patterns, and exploring its perspective by studying its habits, behaviour, and needs. This subchapter incorporates personal gardening experiments in cultivating Woad and employs an eco-somatic approach (Hanna, 1976), allowing individuals to immerse themselves in the life of Woad through shapeshifting experiences. To gain insights, I have used methods such as semi-structured interviews and participatory observation, seeking to uncover valuable lessons from these intra-actions and to establish future co-active relations.

The second subchapter; 3.2_Relating with earthworms, uses eco-acoustics to foster communication with earthworms in different soils. In listening to four site-specific locations connected to Denmark's past and present textile dye production, my goal is to establish a communication channel that enables a sensory connection with the well-being of soil actors and their health. This connection examines in what way this envision can help potential future co-action among multispecies actors in a design process. Various methods and a tool are presented at the end of the chapter for you to experiment with in practice.

3.1_Relating with Woad

Short background for Woad

Woad (Isatis tinctoria) has a long-standing history as a natural dye for textiles, particularly in the production of indigo. The use of Woad can be traced back to the Roman Iron Age, where it was extensively employed for dyeing textiles, including in Denmark (Hartvig, 2015, p.247-248). Indigo has been the sole natural blue dye throughout history. Here, Woad served as its primary source in Europe until the 1600s when indigo began to be imported from India (Edmonds, 1998, p.1). The book *Flora Danica* (2015) attributes the success of Woad in Europe to its ability to thrive in harsh conditions; specifically in windy and cold weather along with its adaptability to thrive in nutrient-poor soils (Hartvig, 2015, p.247-248).

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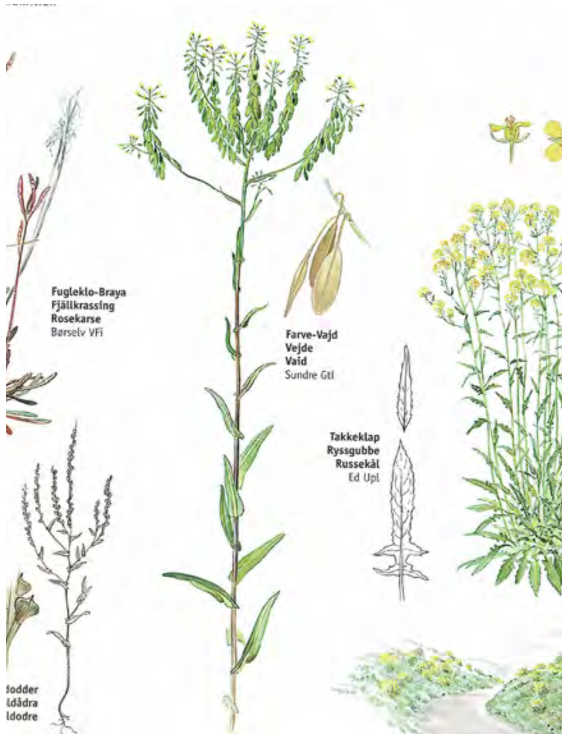

Fig. 72. Woad (Isatis tinctoria) is 40-100 cm tall, live for two-years and thrives in Denmark's peaks during June-July. It commonly grows on Bornholm, an island with stone and sandy soils, and occasionally on Zealand. It is normally found in beach/sandy dunes, roadsides, and quarries. Woad displays an upright stem with many lanceolate leaves, a highly branched inflorescence, and 3-4 mm long yellow glumes. Its flat, single-seeded pod measures 12-18mm and hangs on delicate stalks, exhibiting a yellowish-brown, winged appearance (Stenberg, 2020, p.555).

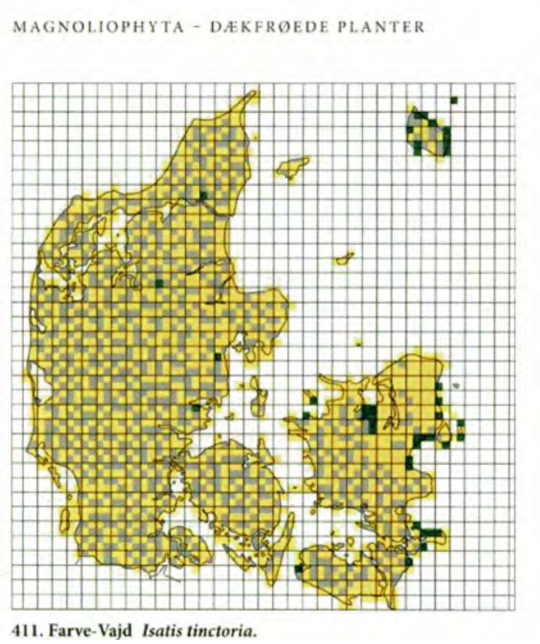

Fig. 73. Field fossil finds from Northern Jutland trace back to the late Roman Iron Age, with origins in Southeast Europe, the Baltic Sea coasts, and Asia. Woad was introduced to Denmark during the Iron Age as a dye plant, possibly unintentionally. In recent times, it is believed to have naturally migrated to Bornholm from Swedish populations, forming an isolated relic occurrence near the southern Baltic Sea. The first discovery on Bornholm was in 1861, followed by findings along the northern coast and the Ertholmene islands from 1920. Woad thrives in open, dry, mostly alkaline, nutrient-poor environments such as rocky beach ridges, sandy beaches, dunes, coastal cliffs, stone piers, and coastal meadows. It is locally common on Bornholm, Zealand, Møn, and the Isefjord region (Hartvig, 2015, p.247-248). .

Woad as a co-actor

The objective of this subchapter is to delve into the fascinating characteristics of wood and its distinctive interactions with the surrounding soil, which enable its remarkable resilience in adverse environmental conditions. As part of the CO-ACT project, my focus has been on merging past and present practices and knowledge related to wood, with a specific emphasis on understanding the needs and habits of wood and its impact on soil fertility and vice versa.

The interview with Astrid Colding Sivertsen, a Molecular biologist and owner of *Midgaards Have* natural textile dye business in Denmark, shed light on the diverse facets of Woad. Sivertsen cultivates her own Woad in her natural textile dye plant garden, where she has observed Woad behaving differently than what is documented in *Flora Danica* (2015). According to Sivertsen, Woad's resilience in challenging environments can be attributed to its ability to find and occupy the limited spaces available for growth, like a "*pocket where it could grow*". (Sivertsen, personal communication, 14. September. 22, translated). However, according to Sivertsen, Woad does not necessarily thrive in nutrient-poor, sandy, and stony soils.

In his book *History of Woad and the Medieval Vat*, John Edmonds (1998), a retired engineer who conducted extensive research and replicated textile dyes employed in Europe from 500 BC to the 19th century, delves into the intriguing topic of Woad's self-protective properties attributed to its indigo content. The level of indigo in Woad leaves, influenced by multiple factors, is believed to primarily serve as an insecticide, safeguarding the plant against pests. Interestingly, the percentage of indigo in terms of dry weight remains relatively consistent regardless of soil fertility. However, the fertility of the soil clearly influences the size and quantity of Woad leaves (Edmonds, 1998, p.10). Therefore, cultivating Woad in fertile soil appears advantageous, as higher quantities of indigo in the leaves enhance its ability to safeguard against unexpected insect invasions and other potential risks.

Sivertsen also provided valuable insights from her readings regarding the historical production of Woad and its impact on soil fertility. According to Sivertsen, she came across information from England "*where there were traveling families who were indigo-growing families. They would rent some fields, and then, after they had grown indigo on them for about 3 years or so, they would move on, because they had completely exhausted the soil. Then, one couldn't grow anything on the land, so they would need to have animals on it or something that could fertilize the area again*." (Sivertsen, personal communication, 14. September. 22, translated).
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This reading challenges prior assumptions by emphasising the substantial dependence of Woad on fertile soil. Not only does fertile soil enhance Woad's ability to protect itself against external threats, but it also facilitates the production of higher levels of indigo, which can be harvested by humans. This prompts the question of whether a new symbiotic relationship can be established and what the dynamics of such a mutual and cooperative exchange of resources might entail.

Sivertsen further adds that "*Woad has a high demand for nitrogen, which is beneficial considering the excessive levels of nitrogen present in our world*" (Sivertsen, personal communication, 14. September. 22, translated). Nitrogen plays a crucial role in agriculture as an essential nutrient for plants. However, its excessive release from agricultural or industrial activities can lead to environmental consequences, such as pollution (Chapin et al., 2011, p.259). Therefore, a reorientation towards Woad and its ability to capture and thrive on nitrogen, through the medium of fertile soil, could provide an opportunity for a co-active give-and-take relationship.

In order to gain insight into the characteristics of such a relationship, I embarked on a personal exploration of Woad's growth patterns, requirements, and behaviours through various gardening experiments conducted in my own private garden.

Co-action and experimentation with Woad

The experiment was conducted in my garden in Herlev, Denmark, from May 10th, 2022, and to May 10th, 2023. The experiment was designed to observe and understand the growth, requirements, and habits of Woad, with the aim of establishing a relationship with the plant. To explore Woad's adaptability to harsh soil conditions, I created two garden beds consisting of sandy loam, with a composition of 70% sand and 30% clay, drawing inspiration from Flora Danica's writings on Woad's potential to thrive in challenging soil environments.

Each bed contained 15kg of sandy loam and 40 earthworms of varying sizes. Initially, both beds were covered with leaves to shield the newly introduced earthworms from direct sunlight and prevent the soil from drying out during the spring heat (refer to fig.74). Two months later, I divided the beds into two sections: one bed received regular care and attention (the left bed), while the other was left to thrive without my intervention, enduring the harsh soil conditions (the right bed).

During my visit to Sivertsen's Woad garden in Ørnhøj, she shared insights on her garden's history, explaining that it had previously been used as a chicken run, where the soil had been enriched by the chickens' natural fertilisation over several years. Before planting Woad, Sivertsen ensured nutrient-rich soil by incorporating horse manure from a neighbouring farmer. Additionally, Sivertsen's colleague, Berit Kiilerich from *Lystbækgaard* (the second textile garden observed during this study), used wool to maintain moisture in the soil throughout the year.

Inspired by these practices, I decided to provide care for the left Woad bed using a combination of wool and regular, nutrient-rich fertiliser, aiming to create favourable conditions for its growth. After a year, the results of the two Woad beds became apparent, please find fig.77.

Fig. 74 - 75. Images from planting Woad in my garden in Herlev, Denmark. By Permiin, the 10.06.22.

Fig. 76. Images from my experimental garden in Herlev, Denmark. Two months after planting the Woad, the bed on the left receives special care, including being covered in wool to retain soil moisture and the application of specially made nettle fermented water as a nutrient-rich fertiliser for the soil.
By Permiin the 17.08.2022.

Fig. 77. Image from my experimental garden after almost a year with weekly attention to the Woad bed to the left.
By Permiin the 10.05.23.

Findings from the Woad Garden experiment

Throughout the experiment, I closely observed the growth and behaviour of Woad. It came as no surprise that the Woad bed that received proper care flourished significantly compared to the unattended bed. While this observation may appear fundamental, it holds significant importance in comprehending the subject. It led me to ponder how I could effectively convey this newfound connection I have forged with Woad, with a desire to provide others with a similar experience. Because of my previous exploration of physically engaging with a place, I became interested in exploring an eco-somatic approach. This approach involves stepping into the perspective of Woad and experiencing its transformation first-hand. I wanted to understand how designers, researchers, and students would engage with this approach as a starting point for future co-action with multispecies in their design process.

Relating with Woad through bodily engagements

Motivated by the work of Botanists Wandersee and Schussler, who introduced the concept of "plant blindness" in 1998, I became aware of how I had tended to neglect and take for granted the plants in my design process. This realisation became even more apparent as I embarked on the CO-ACT project. *Plant blindness* encompasses the failure to recognise the importance of plants in the biosphere and human affairs, as well as an inability to appreciate their unique characteristics and rights equally to other living species (Allen, 2003, p.926). This realisation led me to examine a new approach that considers the participation of a plant in the design process by using bodily engagement.

Drawing inspiration from Hanna's "eco-somatic" concept (1976), my objective was to delve into the dynamic intra-action between the body and its environment, incorporating elements of ecology and somatics (Rufo, 2022, p.3). I aimed to uncover new insights, for a co-active and multispecies oriented design process, by adopting a bodily perspective to 'observe' plants like Woad. To achieve this, I closely studied the growth, behaviour, needs, and habits of Woad, beginning from its seed stage and progressing into a mature plant. Through this exploration, I developed seven-stage positions that embodied the life of Woad, called CO-ACTIVE positions.

The CO-ACTIVE positions serve as a critical tool to bring awareness to everyday behaviours of Woad and unravel the intra-actions and dependencies amongst humans and non-human species. The intention behind the CO-ACTIVE positions was to ignite curiosity and encourage an exploration of the complexity of human relationships with non-human species, highlighting these connections through a tangible embodied experience. I introduced the concept of the CO-ACTIVE positions to two different groups: first, to the Design for Planet students from Design School Kolding (DSKD) in spring 2022, and secondly, to designers and design researchers at the Get-restarted conference at the Royal Design Academy in Denmark in fall 2022. The purpose of this introduction was twofold: to observe their participation and reactions to the concept, and to engage in a discussion about how this perspective could enrich their resource-oriented design processes, fostering a more co-active and multispecies approach to design.

The initial introduction took place with the Design for Planet students from DSKD in the Geografisk Have (Geographical Garden), as part of their Preferred Future course(8). During this session, the aim where to make the students undertake a transformative experience where they transitioned from being humans to embodying the characteristics of a Woad. Some parts of the exercise were shared with the students in advance, while other parts were kept as a surprise, allowing the students to interpret and experience them in their own way. Blindfolded, they walked through the landscape of the Geographical Garden and eventually gathered in the centre of the garden, forming a circle. In this circle, they went through a symbolic transformation of seven steps, starting as seeds and becoming fully grown plants. Following the CO-ACTTIVE positions experience, a discussion was held to reflect on the experiment before the students moved on to another multispecies task for their design course. Please refer to fig. 78 - 84.

Fig. 78. Images of the Design for Planet students' in Geographical Garden. Photo by Lene Hald, Geographical Garden the 08.02.2022.

8 Preferred Future course, 2022. Introducing speculative design methods into the Design for Planet students during their second semester.

Fig. 79 - 84. Image of the Design for Planet students participating in the CO-ACTIVE positions, from a seed becoming Woad. Photo by Lene Hald, Geographical Garden the 08.02.2022.

The second introduction to the stretch occurred at the Get-restarted conference, a conference that discusses new materials, technologies, production techniques and methods for a sustainable future, held in October 2022(9). This introduction took place as part of my CO-ACT project presentation, which later turned into a multispecies and speculative future workshop for co-active co-production, elaborated in chapter 4.3. During this event, I guided the CO-ACTIVE positions with both bodily movements and by using my voice. Here, I carefully described each step, vividly depicting the process of the plant's roots reaching down towards the water flowing in the depths of the soil, while its leaves grew upwards, swaying and dancing in the breeze of the wind creating photosynthesis for others to breathe from. I had added the guides with my voice to keep the participants attuned to the stretch as to foster a curiosity about the transition and imagination of embodying Woad. The CO-ACTIVE positions were performed indoors by 50 participants in a closed room for 7 minutes. The participants received a questionnaire after the conference, asking them to elaborate on their experience in embodying Woad and how they found the orientation to resources as living co-actors relating to their practice. Please refer to figure 85 for an illustration depicting this event.

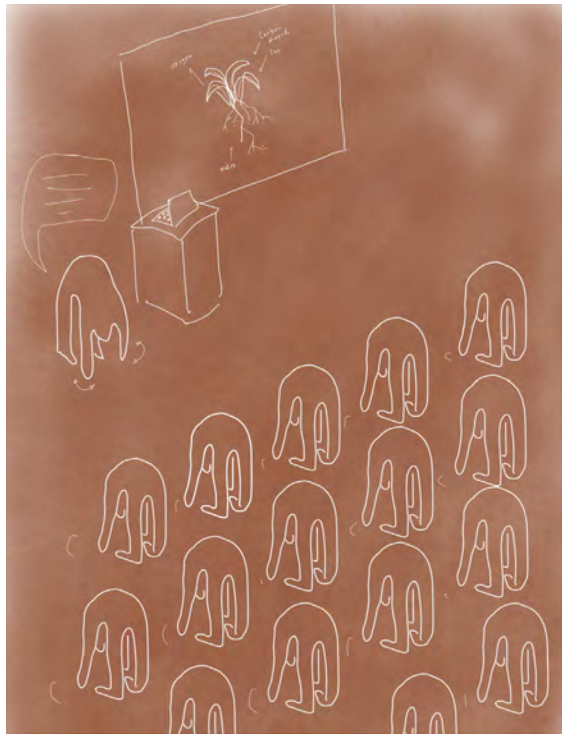


Fig. 85. Illustration from the CO-ACTIVE positions facilitated at the conference Get-restarted the 26.10.2022. By Permiin, 2023.

9 Get restarted conference, KADK, 2022. https://kglakademi.dk/kalender/get-restarted-0

Findings from the two interventions

This reflection uses transcribed recordings after the CO-ACT stretch with the Design for Planet students in the Geographical Garden, 08.02.22, and answers from the questionnaire handed in by participants at the Get-Restarted conference, 26.10.2022.

The first intervention, where the students underwent a transition from being an individual human to a collective chain, walking blindfolded through the park, was met with enthusiasm and curiosity. The concept of the walk had been introduced prior to their blindfolded journey, aiming to expand the student's awareness of their surroundings through senses other than sight, while also fostering trust among the group during the transformation. One participant shared their experience, noting how they contemplated the intra-connectedness of different plant routes, similar to how they were connected during the walk (participant 2, personal communication, 08.02.2022). They also found a moment of almost Zen-like serenity, solely focused on the sensations of walking and the feeling of mud beneath their feet, finding it to be a delightful experience. Another participant reflected on her initial disconnect from nature but acknowledged that the experience prompted her to reflect on the relationship with other species and nature itself (participant 5, personal communication, 08.02.2022).

The participants were kept unaware of the purpose and underlying idea behind the CO-ACTIVE positions exercise, allowing them to have their own unique experiences. One participant felt that the exercise was forced and too abstract, making it difficult to connect with nature (participant 4, personal communication, 08.02.2022). However, another participant understood the metaphorical aspect of the exercise, relating it to the growth of corn and the production of oxygen. Once understanding that discomfort was intentional for reflection, he found it easier to continue (participant 1, personal communication, 08.02.2022). Both participants suggested that more people would appreciate the discomfort if they knew the intended reflection beforehand. Being transparent about the purpose and discomfort could improve acceptance, particularly for participants with health conditions or different body complexities. Another participant highlighted the activity's relevance to societal issues and the role of sustainable designers in driving change (participant 5, personal communication, 08.02.2022). And some students complained to the management about the activity, not understanding its connection to design and sustainability education. Reflecting on the feedback, the importance of openly inviting participants into the activity's aim and providing a more descriptive introduction to encourage trust and comfort became evident. This realisation prompted me to explicitly reveal the activity's relevance and to provide a more descriptive introduction to build trust and comfort in the second intervention.

To ensure the participants felt safe and engaged in the second intervention, I began with a brief presentation about the purpose of the CO-ACT project and introduced what would happen during the exercise. Throughout the exercise, I guided the participants step by step, using imaginary orientation to depict how a plant might behave in the stage they were embodying. The responses

in the questionnaire were provided by three participants from the fields of textile design, industrial design, and furniture design, all of whom actively participated in the CO-ACTIVE position.

Participant 1 found the exercise to be a bit silly and far-fetched. On the other hand, participants 2 and 3 felt more engaged and connected. Participant 2 expressed that the stretch deepened their understanding of the life of Woad (and other plants) in a way that was longer and more profound than before. Participant 3 described the stretch as energizing, particularly because it was a departure from the usual sitting activities throughout the day. It also provided a thought-provoking perspective on the life of a plant, highlighting the in-between stages often overlooked.

Regarding the participants' practice, participant 1 did not find a direct relationship between the stretch and their work. Participant 2 mentioned that the stretch helped them gain empathy for various user typologies in their projects, including living and non-living entities. They saw similarities in using mimicking, bodystorming, acting out, and empathy tools. Participant 3 acknowledged that the stretch somewhat related to their practice, as everything is a process, and they could think about textiles in a similar way.

When asked if they thought about the stretch after the conference, participant 1 reflected on whether it provided any new information but found anthropological methods more relevant for their work. Participant 3 remembered the fun experience and discussed it with someone else, highlighting how it made them think more about plants and their lifespans.

The introduction to an eco-somatic approach to engage with Woad as an active participant in the design process resulted in a range of interpretations and reactions. These diverse responses sparked intriguing discussions regarding a new relation to plants as well as both curiosity and scepticism to the idea of co-acting with plants in future design projects. These insights further stimulated my interest in exploring the potential impact of sound in drawing attention to these multispecies actors. Instead of simply replicating the process of becoming Woad, I became interested in actively listening to the lives of woad and its relationality to the surrounding multispecies actors. Consequently, the second section of this chapter delves into the field of eco-acoustics, exploring the intra-connectedness between Woad, the soil it grows in, and the earthworms present at the site.

3.2_Relating with earthworms

Why earthworms?

In Peter Wohlleben's book *The Hidden Life of Trees* (2015), Wohlleben uncovers the intricate world of trees, highlighting their ability to experience pain, retain memories, and exhibit parental care through root-based communication with their offspring (Wohlleben & Flannery, 2017, p.xiv). Similarly, earthworms communicate with each other through scent cues, adding to the complexity of multispecies behaviour (Holmstrup, personal communication, 11. May. 23, translated).

These observations have led me to question how humans can engage in communication with multispecies actors living in the soil as well as gain insights into their well-being. Can we establish a relationship with earthworms using eco-acoustic methods to capture their movements within the soil? And what can such information reveal about the overall health of the soil and the well-being of its inhabitants?

The primary objective of this subchapter is to delve into the presence and significance of earthworms in assessing soil health. Through the application of eco-acoustics, the CO-ACT project aims to uncover valuable insights into the well-being of multispecies actors within the studied sites. This subchapter explores how designers and design research practitioners can engage with earthworms using sensory applications. Additionally, the findings from this investigation will help identify potential avenues for future co-action among multispecies actors in the design process.

Understanding earthworms

Earthworms have long been recognised as essential bioindicators of soil health, with their significance noted as far back as Aristotle in 322 BC (Goulson, 2021, p.221; Keen et al., 2022, p.2; Krogh et al., 1997, p.50). Even Charles Darwin dedicated his last book in 1881 to the study of earthworms (Darwin, 1881). Research societies in the field of ecology, such as OPAL (Open air laboratories London)(10) and the Society of Britanion Earthworms (11), highlight the critical role of earthworms in addressing ecological challenges and emphasise the need to protect and preserve earthworm populations.

In order to relate with earthworms in a design process, it is important to understand earthworms´ habits and needs. According to Biology professor Dave Goulson earthworms have basic needs, but their habits and contribution to soil health can vary depending on their ecotype (Goulson, p.227). Earthworms can be divided into four ecotypes (Anecic, Endogeic, Epigiec, and Compost earthworms), which have been identified based on their feeding and burrowing behaviours (Brown, 2019, p.9).

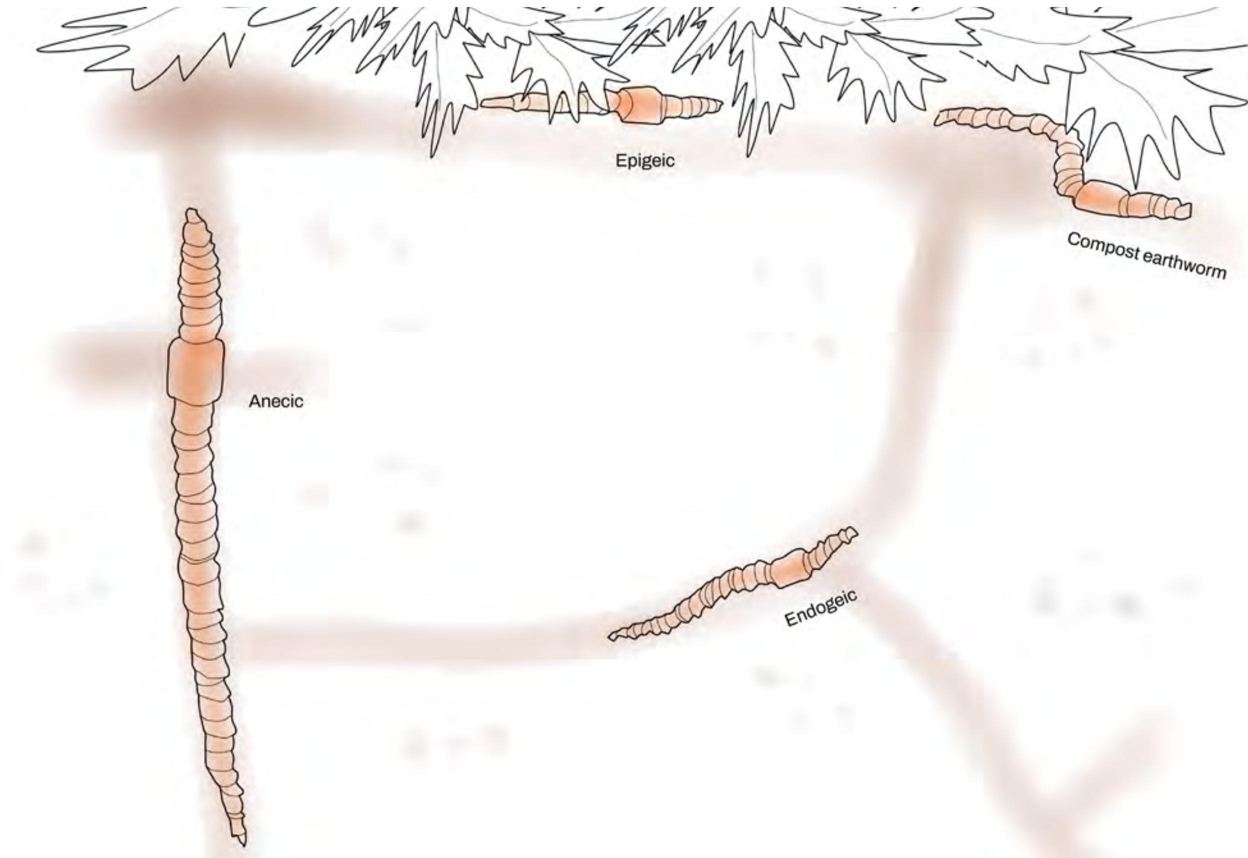


Fig. 86. Illustration of different earthworms in their environment. By Permiin, 2023.
– Anecic earthworms are large in size, feeds on fresh fallen leaves and lives in the soil. They are darkly coloured at the head end (red or brown), have paler tails, and dig deep vertical, unbranching burrows. - Endogeic earthworms live in and feed on soil, has no pigmentation, are small to medium sized and creates a network of horizontal, branching burrows.
– Epigeic earthworms live on the surface in leaf litter, are small in size and do not make burrows.
– Compost earthworms are found in or just beneath litter. They have pigmented skin, moderate in size and rarely borrows deep. (Earthworm Society of Britain, 2019, p.9).

10 OPAL (Open air laboratories London). https://www.imperial.ac.uk/opal/about/
11 Society of Britanion Earthworms. https://www.earthwormsoc.org.uk/

These ecotypes represent functional adaptations to the soil environment, allowing different earthworm species to coexist by exploiting different food resources and habitats. Understanding these ecological strategies is crucial for comprehending the structure and functioning of earthworm communities (Edwards & Arancon, 2022). As an example, Charles Darwin observed that Anecic earthworms orientate themselves from experience behaviours, such as dragging fallen leaves into their burrows to protect themselves from predators or later food source (Nardi, p.64). Despite being blind and relying on touch to navigate, researchers have found that they can communicate with each other using touch and taste (Nardi, p.64; Holmstrup, personal communication, 11. May. 23, translated). This observation is valuable as a starting point for understanding and relating with earthworms as a possible co-actor in the design process.

In addition to earthworms' different functions in soils, they work systematically and carry out tasks that are similar to those performed by agricultural machinery, albeit at different speeds and times (Nardi, p.62). The contribution of a single earthworm may seem insignificant, but the collective effort of millions of earthworms is crucial for maintaining soil health (Goulson, p.220). By burrowing into the soil, they facilitate air and water flow and help to recycle organic matter, making them an essential component of the earth's ecosystem. Moreover, recent studies have revealed that earthworms have the potential to increase greenhouse gas emissions, including carbon dioxide (CO2) and nitrous oxide (N2O), from soils (Keen, 2022, p.2). Given the critical role that earthworms play in maintaining soil health and their potential impact on climate change, it is crucial to establish a relational orientation and communication channel between earthworms, soils, woad, and humans as active actors in a co-active design process. Therefore, this subchapter aims to explore possible communication channels by using eco-acoustics, as a sensory way of fostering a new relationship between humans and earthworms.

Relating to earthworms using eco-acoustics

"We cannot see the manifold organisms and life processes present in soils, but we may hear them if we listen closely." (Maeder et al., 2019, p. 5)

In this section, the use of sound serves as a sensory tool to establish a connection between earthworms and the soil conditions under investigation at a specific site. According to Pink (2015, p. 174), employing sound recordings can create a sense of intimacy between the recorder and the recorded, as well as between the listener and the sounds themselves. This notion of intimacy is explored throughout this subchapter to envision earthworms as active actors in a future co-active design process.

The recording of vibrations from various species has recently gained renewed attention, with the prominent eco-acoustic expert Chris Watson at the forefront. Over the years, Watson has been a pioneer in developing and

refining passion for capturing sounds from animals, meteorological phenomena, and unexpected encounters in nature. One of Watson's podcasts was featured at the Danish BLOOM festival in spring 2023, a public platform for science and nature communication that blossoms every year as a festival in Søndermarken and in Odsherred, Denmark(12). Here, the CO-ACT project's orientation to eco-acoustics have been inspired by recent design research works that uses sound to relate to multispecies and their surroundings.

The CO-ACT project have particularly been inspired by the design research project called *PLURIVERSE* (2020) by the Affective Interactions and Relations Lab (AIR LAB) at ITU, Denmark, who presents a sound installation that establish a connection between the tree, the individual, and the forest(13). Furthermore, the CO-ACT project draws inspiration from the Institute for Interspecies Sound & Society (IISS), which aims to foster an interdisciplinary community of practitioners and expand research impact by use of diverse soundscapes.They seek to grow emphasis on building new research tools and shift the focus away from human-centered perspectives in public culture(14). Finally, the *Sounding Soils* design project by eco-acoustic Designer and researcher Marcus Maeder inspired the CO-ACT project. Maeder recorded the sounds of various soils in Switzerland, creating a collective public event and orientation to the life of soils beneath our feet(15). Please find images from the project below, fig. 87 - 88.

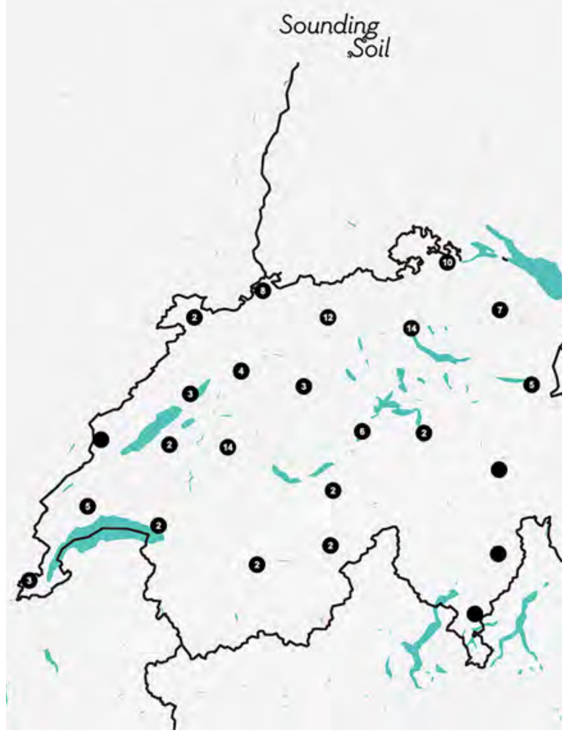


Fig. 87 - 88. Image from the design project Sounding Soils by Marcus Maeder, 2019. Image taken from Maeder's webpage the 13.06.2023.

12 Danish BLOOM festival, 2023. https://www.bloom.ooo/explore/listening-to-nature
13 PLURIVERSE, 2020. https://airlab.itu.dk/plurivers/
14 IISS. https://mlml.io/p/institute-for-interspecies-sound-and-society/
15 Sounding soils. https://www.soundingsoil.ch/en/research/

This next session aims to explore the sounds in soils, with a particular focus on earthworms, by attempting to identify their vibrations when moving in soils and thereby locate their presence. To achieve this, the section begins by testing different eco-acoustic equipment and evaluating their reliability in different soils questioning if it is possible to hear earthworms' movement in soils and differences in number.

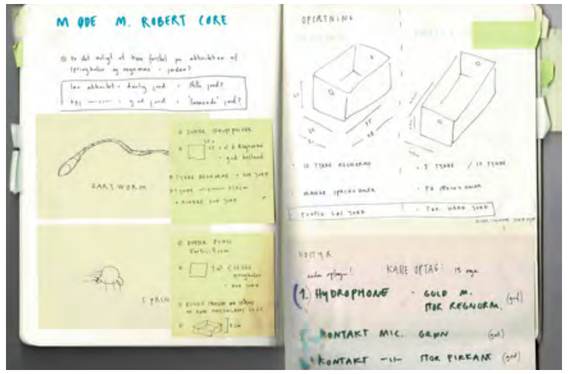
3.2.1_Participatory observation

To test the possibility in hearing earthworms' movements in soils the CO_ ACT project was supervised by Sound artist Robert Cole Rizzi the 04th of May 2022 at Design school Kolding, Ågade 10, 6000 Kolding, in Denmark.

Here Rizzi and I aimed to identify which of Rizzi's wide range of recording equipment was most suitable for capturing earthworms' movements in diverse soils. This experiment focused on sand and clay soils. The first experiment aimed to test the hypothesis that different soil textures produce different sounds when earthworms move through them. This was done in a closed environment with two buckets of soils, each containing a different texture (sand and clay soils), and 30 living Endogeic earthworms.

The earthworms used in this experiment were collected from a park in Kolding, Denmark. The earthworms were placed in each bucket testing the equipment of three diverse hydrophones, three diverse contact mics, and two microphones. Please find the scheadualed settings for the experiment illustrated in the notebook at fig. 90.

The Aquabeat hydrophone(16) produced the best results and was therefore used to conduct the second experiment which involved analysing the variation in sound in relation to the number of earthworms present in the soils. This experiment was set out to test if we could hear the difference between 3 and 30 Endogeic earthworms in sand and clay soils. Here the findings showcased a diversity in sounds from the different recordings, revealing slightly more vibrations in the recordings of 30 earthworms than 3 earthworms illustrated in fig. 92 - 93.



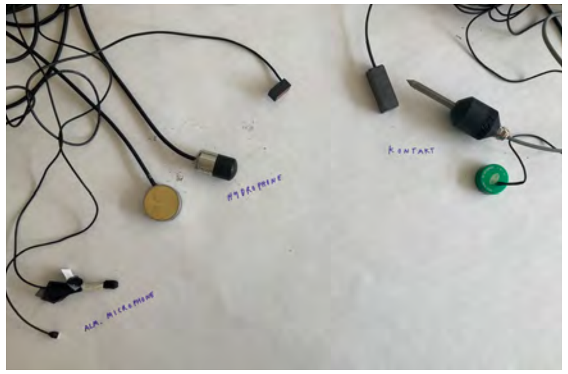


Fig. 89 - 91. Images of the location in the park in Kolding where the participating Endogeic earthworms were collected for the 3.2.1 experiment, CO-ACT vibrant soils. Image of notebook with the scheadualed experments and an overview of the tested equipptment: Hydrophones, Contact microphones, and Geophones. By Permiin, 2022.

16 Aquabeat hydrophone. https://www.indiegogo.com/projects/aquabeat-hydrophone#/

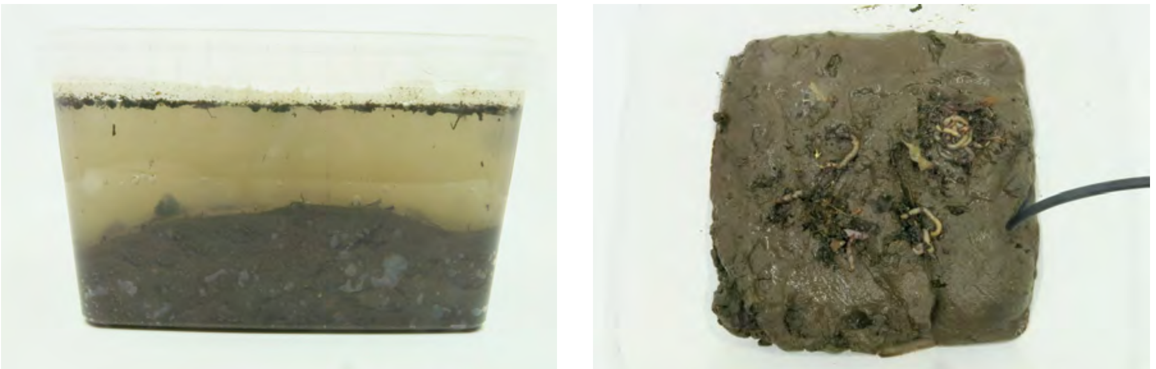
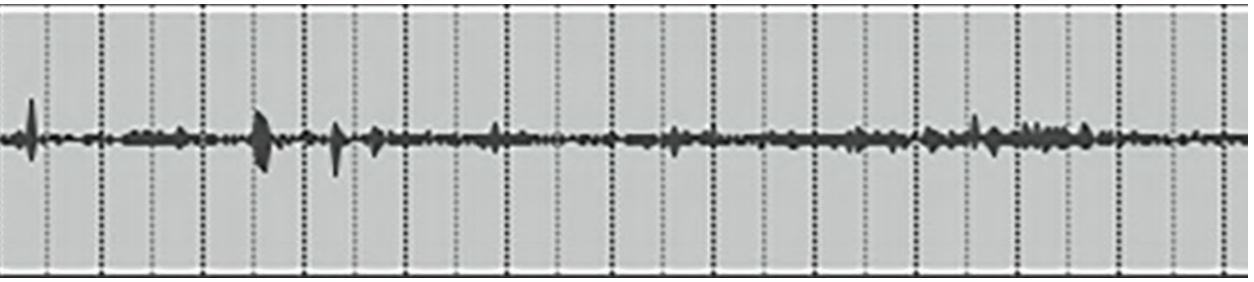


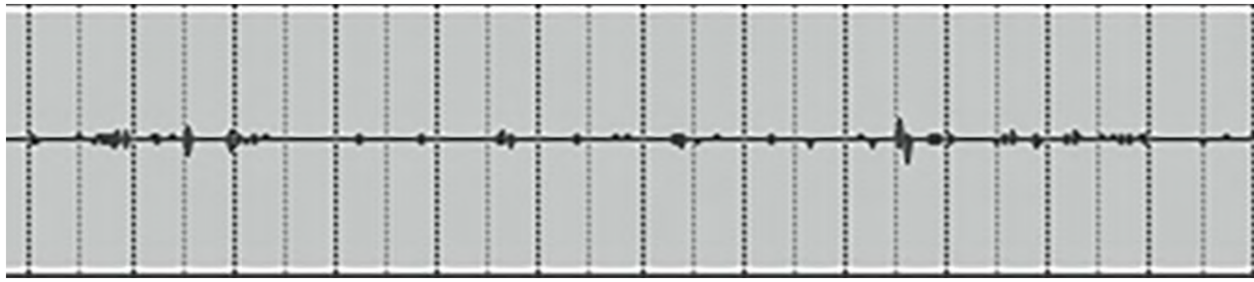
Fig. 92. Images of the 3.2.1 experiment, examining the difference in recorded vibrations from 3 and 30 participating earthworms in closed environments, clay. By Permiin, 2023

3 Earthworms

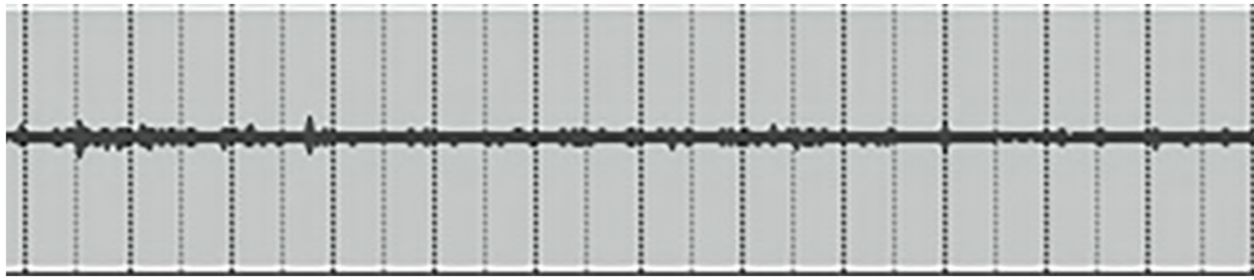


33 Earthworms

Fig. 93. Images of the 3.2.1 experiment, examining the difference in recorded vibrations from 3 and 30 participating earthworms in closed environments, sand. By Permiin, 2023



3 Earthworms



33 Earthworms

From this finding the CO-ACT project sought to explore the Aquabeat hydrophone in outdoor settings to become familiar with the relationality between sound, the number of earthworms, and the environment surrounding the recordings. Thus, before the real outdoor experiment (3.2.3) could be conducted the Aquabeat hydrophone was tested in an observation garden planned in my backyard (3.2.2).

3.2.2_Participatory observations

"*The notion of the interconnectedness of all life is central to ecology where all living, human or not, takes place within a relational matrix*" (Escobar, 2018, p. 24).

Ecology emphasises the interconnectedness of all life, acknowledging that every living entity, regardless of whether it is human or not, is enmeshed within a web of relationships. As Sara C. Keen and colleagues in bioacoustics note, soundscapes can provide a continuous stream of data, enabling researchers to detect ongoing changes within dynamic soil communities that are difficult to discern through traditional surveying methods (Keen et al., 2022, p.2). Soundscapes can therefore facilitate a deeper understanding of the relational matrix and allow us to actively engage with earthworms as key actor in a future design process.

To test the possibilities of listening to earthworms in an outdoor environment it was important to understand when, where, and how the Aquabeat hydrophone could be placed in the soil. Here, PhD and senior researcher and biologist Paul Henning Krogh from AU EcoScience has been providing valuable guidance and supervision for the CO-ACT project. Specifically helping in understanding the relationship between earthworms and soil conditions. According to Krogh, the best time to observe earthworms in Denmark is during spring and fall, considering the weather conditions (Krogh, Personal communication, 07. December. 21, translated). As a result, the first outdoor experiment is scheduled to take place in May 2022, in an observation garden which I arranged in my backyard. The aim of this experiment was to track the activity and number of earthworms through soundscapes, recording their movements in the observed bed.

The chosen Aquabeat hydrophone was tested on the ground, enclosed in a narrow frame to minimise noise from passing cars and wind. As well as completely covered to protect earthworms from birds and sunlight, which can be harmful to the earthworms' sensitive skin. Unfortunately, the resulting recordings were too noisy and did not provide specific relation to the earthworms living in the observed soil. Under the guidance of Krogh, the experiment was expanded to explore the potential of using a liquid mustard powder technique from SEGES Innovation (SEGES, 2020, p.14) to relate to earthworms at specific sites. This technique involves using liquid mustard powder to attract earthworms from underground to the soil surface, enabling researchers to count the number of earthworms in a specific location and thereby be able

Fig. 94 - 96. Images of the first step testing the Aquabeat hydrophone outdoor at the observation garden in Herlev. By Permiin the 06.08.2022.

to estimate the total number of earthworms in the field, which can provide insights into soil conditions.

Therefore, the second outdoor experiment with the hydrophone involved using the liquid mustard powder technique while recording the movement of earthworms. However, to reduce noise from cars and wind, the hydrophone had to be dug into the ground instead of laying on the surface. Prior to conducting the second experiment, new preparations and ethical questions were required, such as which tools should be used when digging into the soil, to avoid harming as many earthworms as possible.

The Anecic and Endogeic earthworms are typically found within the soil at a depth range of 5-50cm(17) but during a mustard powder experiment, only earthworms until 25cm in the soil will appear (SEGES, 2020, p.14). To ensure that the tools used in the second outdoor experiment could penetrate the soil to a minimum depth of 10cm, I visited a gardening center (BAU-HAUS) to familiarise myself with the commonly employed tools for digging into soil. Fig. 97 illustrates an overview of the tools found in the gardening center.

Fig. 97. Image of regularly used tools to dig into soils, observed in the gardening house, BAUHAUS. By Permiin the 20.05.2022.

17 Society of Britanion Earthworms. https://www.earthwormsoc.org.uk/earthworm-ecology

Fig. 98 - 99. Images of tool_1 and tool_2 in the observed bed. The bed is planted with woad plants and covered with wool to protect the soil and give nutrition, lanolin and moister to the soil. By Permiin, 2023.

From the abovementioned exercise, two tools were selected from BAUHAUS. The first tool was a blue digging tool(tool_1) that could dig 10 cm into the soil and grasp the dug soil chunk which could cover the hydrophone again during the recordings. The second tool(tool_2) consisted of two tubes, one 10 cm long and the other 20 cm long, which were used to create more stable recording stations. Tool_2 would only need to be dug into the soil once compared to tool_1 that needs to be dug into the soil for each new recording.

The recorded vibrations provided in the tubes (tool_2) were not very good, as they gave a vacuumed sound in the recordings. The vibrations recorded from the dug hole and covered hydrophone gave a very detailed recording, which gave reason for continuing with tool_1 for the experiment with the liquid mustard powder.

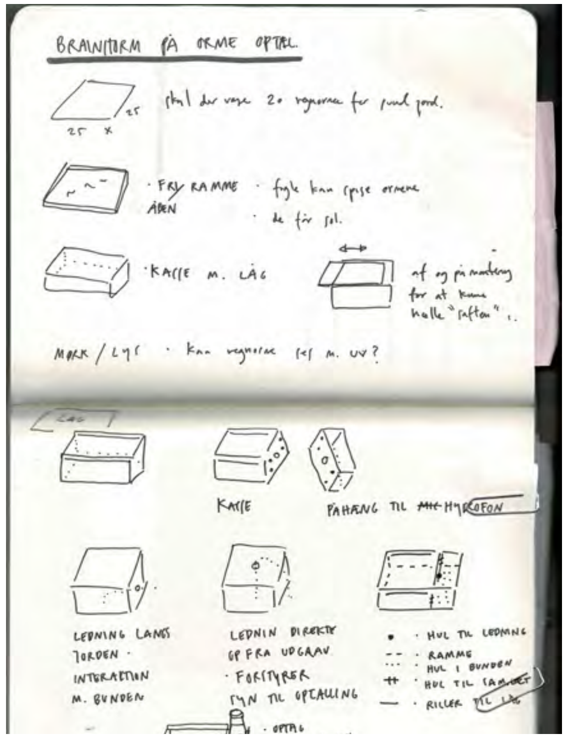
3.2.3_Participatory observations

To effectively conduct the second outdoor experiment involving the use of hydrophone, tool_1, and liquid mustard powder, it was crucial for the soil to have adequate moisture. This is because excessively dry soil can lead to earthworm hibernation, causing Anecic earthworms to seek deeper soil layers and making them difficult to capture during participatory observation (SEGES, 2020, p.14).

The main objective of combining these three approaches and testing them at the four selected sites (Løgstør, Brande, Ulfborg, and Ørnhøj) is to gain a deeper understanding of the relationship between earthworm behaviour, soil conditions, and site ecology.

To streamline the investigation process and use the mustard powder extraction during the second outdoor experiment at each site, a 25x25cm frame was used (SEGES, 2020, p.14). This frame served as a prototype designed to establish a caring relationship with the participatory observed earthworms. Over the years, researchers and practitioners have proposed various prototyping techniques to explore the potential of prototypes in different research fields. In the CO-ACT project, a speculative design perspective (Auger, 2013; Gaver et al., 1999; Wakkary, 2021) was adopted to conceptualise the posthuman speculative prototype as a method for establishing a relationship between humans and earthworms.

The speculative prototype was specifically designed to fit within the frame, accommodate the addition of liquid mustard powder, and ensure that the observed participants, the earthworms, were treated with care. For more detailed information regarding the size and purpose of the speculative prototype, refer to figure 100 - 102. The frame used for extracting mustard powder was evaluated and refined into a speculative prototype that prioritised the care of the observed earthworms, both before, during, and after the observation.



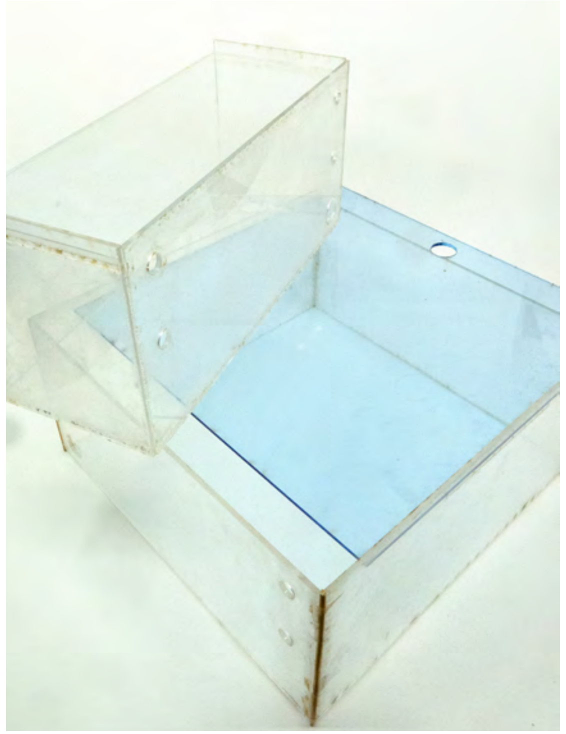


Fig. 100 - 102. Images of the development of the speculative prototype for the second outdoor experiment. The box is 25x25cm and 10cm in hight. It is made of transparent plexiglass and has a lead of in a semi-transparent tone for reject the sunlight on the earthworms' skin, but still providing possibilities for counting the earthworms appearing within the frame of investigation. Besides the main frame-box there is made an extra box for the recorder to lay in, avoiding being wet if it rains during a recording. By Permiin, 2022.

This prototype was designed as an observation box, considering the space required for participation by both the earthworms and human observer. The box was semi-transparent to create a comfortable space for the earthworms and their skin while moving on the soil surface, while also protecting them from potential danger posed by birds during the entire observation period.

Each site was recorded with a camera for a duration of 45 minutes, as the mustard powder takes effect within 10-15 minutes and the earthworms needed their time for entering the soil again. Apart from the soundscapes captured at each observed site, as well as earthworms being counted during each observation. Soil samples were also collected from each site to gain a better understanding of the texture and its impact on the soundscape and recorded movement of the earthworms. Please find observed sites, their number of participating earthworms and the texture of soils in fig. 103 - 107.

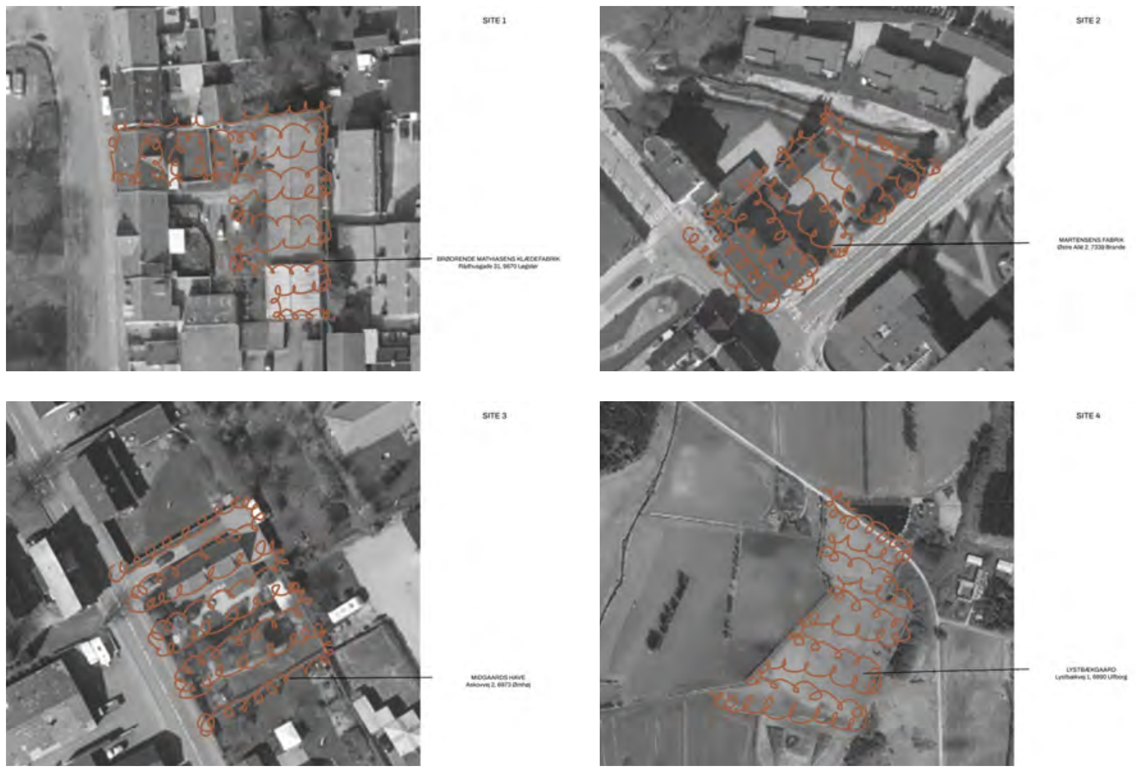


Fig. 103. Illustration of locations where the soil recordings for the CO-ACT project are taken from. By Permiin, 2023.

Fig. 104. Observation at former textile dye site: *Brødrende Mathiasens Klædefabirk*, Løgstør, the 12.09.22. Observed participants through camera recordings: 16 earthworms_14 Anecic earthworms and 2 Endogeic earthworms. Soil: sandy loam soils. The observations were affected by wind and my presence in walking back and forth during the recordings.

Fig. 105. Observation at former textile site: *Martensens Farveri*, Østre allé, Brande, 19.09.22. Observed participants through camera recordings: 3 Endogeic earthworms. Soil: silt soils. The observations were affected by two pedestrians walking by with a dog, as well as a cyclist passing by the recordings as it was just next to the bike lane.

Fig. 106. Observation at current textile dye site: *Midgaards Have*, Ørnhøj, the 14.09.22. Observed participants through camera recordings: 1 Endogeic earthworms. Soil: sandy loam. The observations were affected by passing tractors and cars as the garden are placed next to a road.

Fig. 107. Observation at current textile dye site: *Lystbækgaard*, Ulfborg, the 14.09.22. Observed participants through camara recordings during 45min: 2 Anecic eartworms. Soil: sandy loam. The observations were affected by wind as it is an open field.

Findings from the CO-ACT vibrant soil experiment

The primary objective of the CO-ACT vibrant soil experiment was to assess the use of eco-acoustics as a sensory method and tool to establish a relationship between soil conditions and the presence of earthworms in the observed soil. The aim was to identify the characteristics that a multispecies method and tool should possess in order to facilitate a caring relationship with earthworms and soil conditions in future co-active design processes.

3.2.1 + 3.2.2
The findings from the 3.2.1 experiment conducted in a controlled environment allowed Rizzi and I to have better control over the recorded sounds. This enabled us to distinguish the recorded sounds, particularly because we were aware of what was placed in and around the recorded soil. In contrast, the 3.2.2 experiment conducted in the observation beds captured diverse sounds such as car passing by, bird songs, and wind noises. These new recordings did not exclude any particular vibration but drew awareness to the assemblage of multispecies intra-actions present at the given time and space, highlighting the complexity in navigating in intra-active sounds among multispecies actors.

3.2.3
When using the mustard powder extraction method to count earthworms and therefrom predict the soil health as examined in the 3.2.3 experiment, it is crucial to take into account the current usage of the soil at the observed sites. A soil condition with six earthworms is considered good for a site used for land cultivation, while a grass field is expected to have twice that number for good soil condition (SEGES, 2020, p.15). Hence, during the participatory observation of earthworms at the former textile dye site in Løgstør, where the soil has remained untouched by human intervention for centuries, a substantial number of earthworms were observed compared to the current textile dye sites where fields are cultivated every second year due to the two-year growth cycle of woad. Despite the absence of soil pollution at the current textile dye sites, and the owners' actions in thinking-with care (as noted by de la Bellacasa), including careful fertilisation and the addition of wool for increased moisture, the results of the mustard powder experiment revealed a lower earthworm count compared to the anticipated polluted former textile dye site in Løgstør (fig. 104). It is important to note that the 3.2.3 experiment was conducted only once at each site. According to Krogh (2022), such tests require multiple validity assessments for comparison and prediction. This should be considered in future co-action design processes.

Furthermore, when contemplating the ethical aspect of the mustard powder method, it is important to note that the liquids used in the experiment do not pose a toxic threat to earthworms. However, they may cause itching on the earthworms' skin due to the presence of ammonia, which leads the earthworms to surface in order to avoid the discomfort (Krogh, personal communication, 07.November. 22, translated). Given this, I am intrigued by the possibility of establishing communication with earthworms solely through the use of sound, without the need for mustard liquid. This would require carefully observing the movements of earthworms in various soil textures and their surrounding environment at the communication site, akin to creating alphabets and different languages across diverse continents. Although this exploration is very complex and would take long time, I am interested in delving into how such communication might manifest, which I will examine in Chapter 4, focusing on the Art of Co-producing.

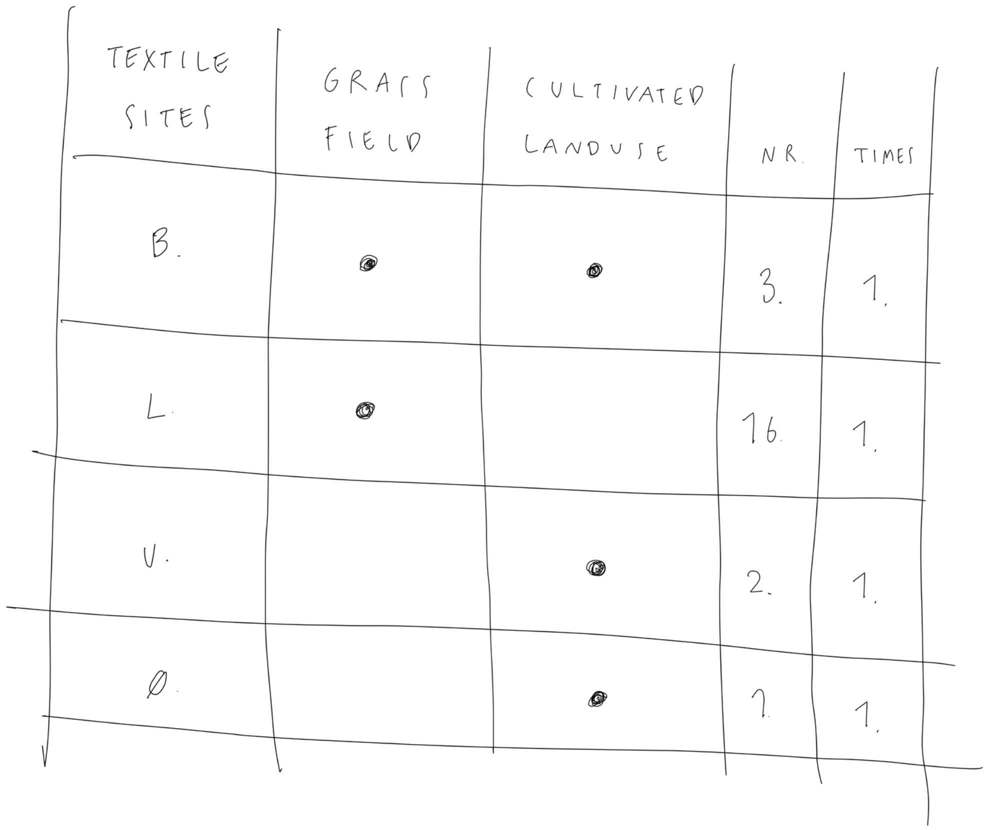


Fig. 108. Observation overview of the examined sites. B = Brande, L = Løgstør, U = Ulfborg, Ø = Ørnhøj. The illustration demonstrates the land use of the observed sites varying from grassfield and cultivated soil and its relation to the observed numbers of earthworms at each site. By Permiin, 2023.

3.2.2
In the 3.2.2 experiment, where a stationary tube was used to capture continuous recordings, the resulting audio had a tunnel-like sound quality, rendering the recordings unusable. Keen (2022) used a layer of sand (≥5 cm) as a barrier between the tubes and the surrounding environment (Keen, 2022, p.3). The sand proved useful in enhancing the sound vibrations, as observed during my experiments with earthworms in sandy and clay soils (3.2.2). This finding is useful for a future co-action with a site, creating stationary recording tubes at the site of interest with added sand around the tubes to highlight

the vibrations in the nearby surroundings. This might create better recordings and avoid disturbing the soils ecosystem when seeking co-relationship with soil conditions. Keen's (2022) observations included experimental beds that had been in use for four years (keen, 2022, p.3). This extended timeframe allowed for closely monitoring the development of a bed. Similar to my one-year experimental bed with woad (see subchapter 3.1), a future co-action experiment should have a long timeframe to actually know the effects of intra-actions, as in the case of the CO-ACT project, between humans, soil, Woad, and earthworms.

The tool employed to dig the hydrophone into the recorded soil also raised ethical concerns due to its disruptive nature, often resulting in unintended harm such as accidentally severing the earthworms in half. While certain parts of an earthworm can survive if cut after their belt, it is still not an ideal outcome. Consequently, throughout the course of the experiments, I developed a nutrition-gift-bag as a means to mitigate these issues and establish a co-active give-and-take dynamic. This solution aims to protect the soil chunk following the initial disturbance, providing a protective environment for the earthworms involved hereafter. Moreover, the nutrition-gift-bag is constructed using nettles, which serves a dual purpose as both nourishment and fertiliser for both the earthworms and the soil itself (see fig. 109). This regenerative design approach and concept of thinking-with care is a significant initiative that I intend to delve further into in the upcoming chapter, exploring the intricacies of the art of co-producing.

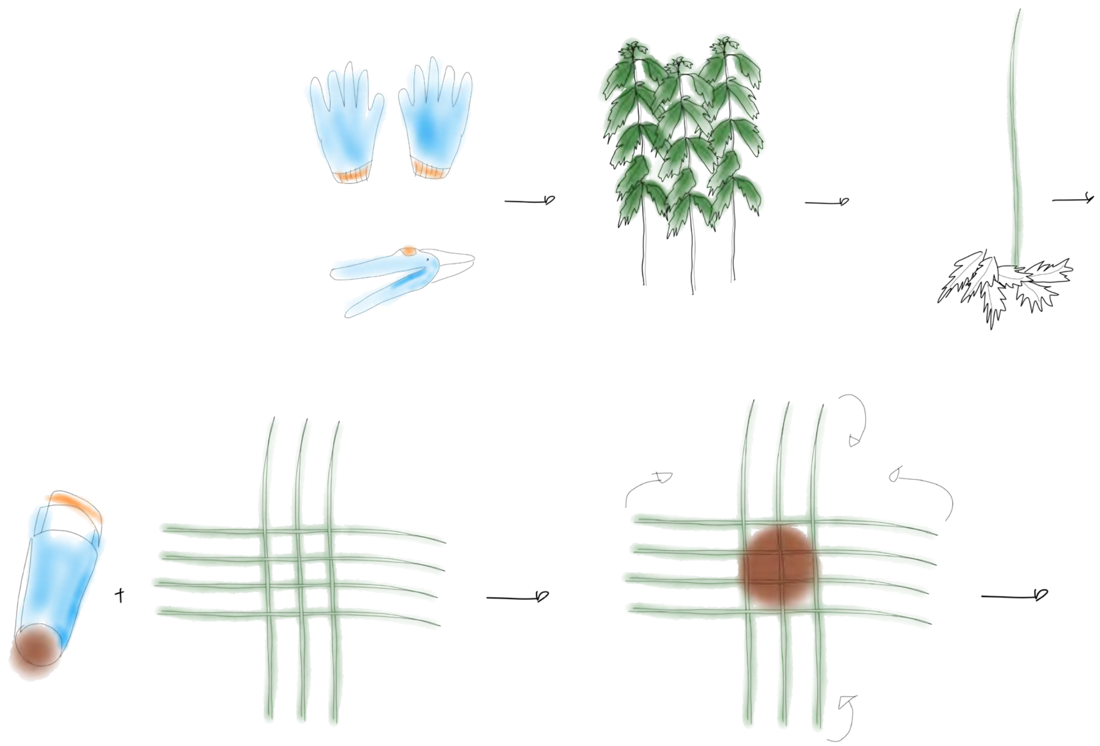


Fig. 109. Illustration of how to make nutrition-gift-bags. By Permiin, 2023.

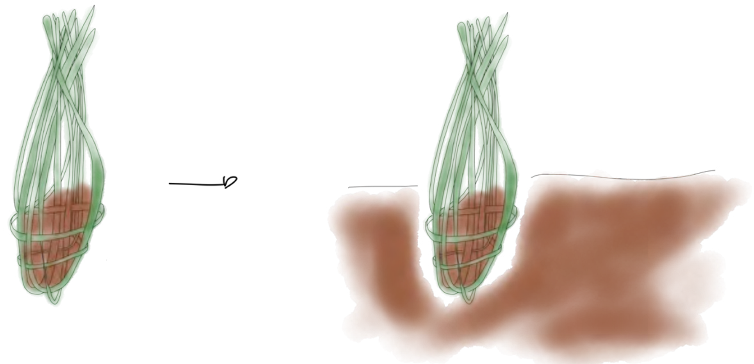
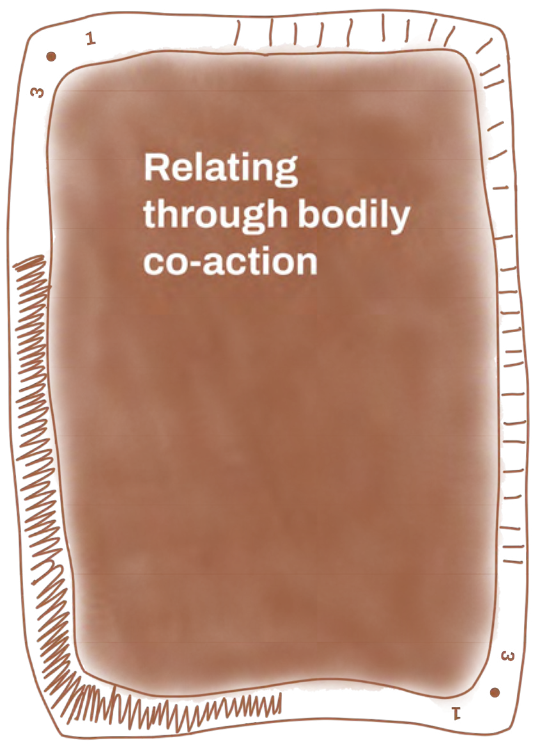


Fig. 109. Illustration of how to make nutrition-gift-bags.
By Permiin, 2023.

Your turn

I hereby invite you to try the CO-ACT Method Cards 3.1_Relating through bodily co-action as well as 3.2_Communicating co-action. The 3.2 CO-ACT Method Card also involves the 3.2 CO-ACT toolbox provided for rent at the DSKD technical support office.

I wish you the best of luck and joy while trying the provided material.



Relating through bodily co-action

What?

Relating through bodily co-action is a method that draws attention to the lives of multispecies by physically embodying their movements and behaviours.

Why?

Embodying the behaviours, movements, and experiences of other species is a method that allows us to envision empathic and intra-connected futures among diverse multispecies actors.

How?

Within the CO-ACT project an example of a recipe is created to exemplify how this method could be approached.

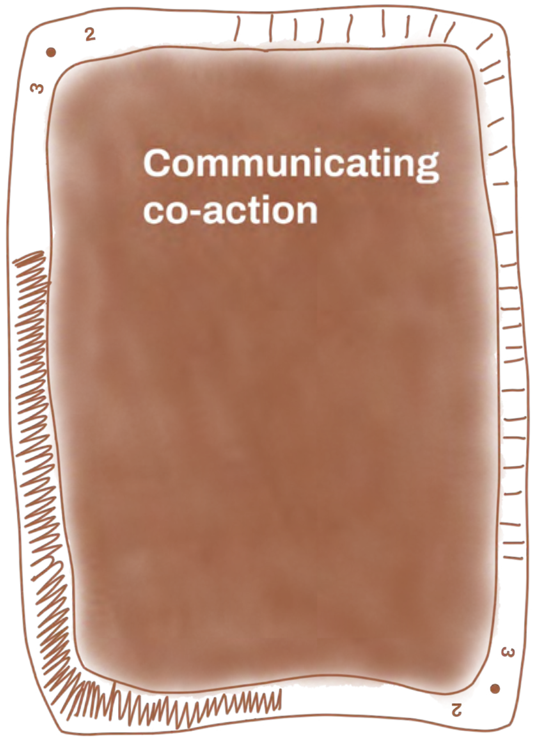
Recipe

You would need a multispecies actor of interest and your body.
1. Choose an actor of interest.
2. Observe the movements, behaviour, and time of the actor.
3. Try to transform your observations into bodily movements.
4. Try to join the created bodily movements into a step-by-step pose.
5. Test it with others.
6. Reflect on your experiences and observations and ask yourself how this method has affected your perspective to your actor of interest.

Examples

- *Animal Superpowers* by designer Chris Woebken, 2007. A sensory design project addressing the perspectives of animals' senses beyond the human experience. https://chriswoebken.com/Animal-Superpowers
- *Goatman* by designer Thomas Thwaites, 2016. A design project exploring how close modern technology can take humans to take on characteristics from other animals. https://www.thomasthwaites.com/a-holiday-from-being-human-goatman/
- *EXERCISE TO UNLEARN THE CANON* by Vivian Tauchmann, 2019. A design research project that envisions a future of empathy, cooperation and plurality through the use of embodied performance. http://www.vivientauchmann.com/exercise-to-unlearn-the-canon
- *Urban Refuge* by designer Hannah Roche, 2022. A design research project that documents views of Glasgow through the eyes of multispecies to challenge the human perception of the city. https://gsashowcase.net/hannah-roche/

Fig. 110. Image of the 3.2 CO-ACT toolbox. By Permiin, 2023.



Communicating co-action

What?

Communicating co-action is a method that brings orientation to the engagement with multispecies actors by using sound.

Why?

Listening is a way to acquire first-hand experience of a situation enabling us to act with greater care in a design process.

How?

Within the CO-ACT project an example of a recipe is created to exemplify how this method could be approached.

Recipe

You would need a recorder and the 2.2 CO-ACT toolbox which you can pick up at the technical support office at DSKD. The 2.2 CO-ACT toolbox is provided with a guidebook, a hydrophone, minijack, digging tool, gloves, and a pruning shears.
1. Follow the description of the guidebook in the 2.2 CO-ACT toolbox in order to make the recordings in a careful way.
2. Chose a site for investigation. Remember to keep track of your recordings by taking notes of each recording.
3. Go record.
4. Compare the recordings while asking yourself what you hear, what is different, and why that might be? These observations can be used to relate to your multispecies actors.

Examples

- *Melbourn mussel choir* by artistic researcher Natalie Jeremijenko, 2015. A research project on water ties intra-action with mussels' movement. http://www.carbonarts.org/projects/melbourne-mussel-choir/
- *Sea synthesis* by Xandra van der Eijk, 2017. A design project that maps the sound of windmills impact on actors living in the ocean. https://www.xandravandereijk.nl/projects/seasynthesis
- *Sounding soil* by designer Marcus Maeder, 2019. A design research project that invites the public to record current sound of soils around Switzerland. https://www.soundingsoil.ch/
- *PLURIVERSE* by associate professor Stine Køijer and the AIR LAB, 2020. a sound installation that establishes a connection between the tree, the individual, and the forest. https://airlab.itu.dk/plurivers/

4

The Art of Co-producing

Introducing the chapter

This chapter investigates the potential of co-acting with earthworms as an illustrative example for examining how co-action with soil health can inspire scenarios for future co-production amongst multispecies actors in practice. The central research question this chapter seeks to examine is: How might the use of sensory and multispecies design methods and tools affect future co-production among multispecies actors? This question is investigated within the framework of three subchapters referred to as 4.1_Exploring co-production, 4.2_Imagining future co-production, and 4.3_Widening multispecies co-production in other fields.

The chapter examines new design practices for future co-production. Here, “co-production” is explored within a frame of multispecies actors who work together in shaping a holistic co-active relationship. According to Anthropologist Anna Tsing (2017) and fellow scholars, co-species survival is dependent on both imaginative creativity and scientific understanding (Tsing et al., 2017, p. 144). Therefore, this chapter seeks to set a scene for sensory co-action with multispecies actors that join speculative future thinking (imaginative creativity) with eco-scientific data (scientific understanding). The chapter takes outset in Sustainable Design Researcher Joanne Boehnert (2018) who focuses on ways through which design can facilitate new modes of noticing and relating in multispecies worlds. In her work, Boehnert practices communication design to “nurture new perceptive and cognitive abilities in support of relational or ecological perception and ways of knowing” (Boehnert, 2018, p.6). Inspired by this approach and with the use of communication design practices, the first subchapter (4.1) seeks to nurture a sensory connection with soil conditions in speculative prototypes that examine multispecies diverse temporalities and agencies in a co-production involving earthworms, clay/local soil, a 3D printer, and researchers/artists.

According to Professor Maria Puig de la Bellacasa (2017), the traditional human approach to soil has been to prioritise its fertility based on production demands. However, public attitudes towards soils are changing, as there are growing concerns that they have been mistreated and neglected due to a focus on production. Soils are now perceived as endangered ecosystems in urgent need of care, and the warnings about their depletion have raised concerns about the future, prompting immediate action (Puig de la Bellacasa, 2017, p. 23). Leaning on Bellacasa (2017), the second subchapter (4.2), therefore focuses on co-active methods using foresight and speculative design to contribute to a sensory co-production with soil ecosystems at textile dye and wastewater sites. This examination builds upon previous studies conducted in the CO-ACT project elaborated on in chapters 3.3 and 4.1.

Furthermore, the chapter aims to unfold how the CO-ACT project explorations of sensory and multispecies design practices can be widened into other fields, as discussed in the third subchapter (4.3). The core aim of subchapter 4.3 is to broaden the horizons and prospects of future co-production among multispecies actors, which will be achieved by practically testing and refining the 4.1 and 4.2 CO-ACT methods with participants from various backgrounds.

I hope this chapter serves as an inspiration and encourages you to actively participate in developing and refining the CO-ACT methods, making them valuable for your future design process and practice.

4.1_ Exploring co-production

A brief introduction to multispecies co-production

The CO-ACT project draws inspiration from various design researchers who have explored diverse methods of communication among multispecies actors to understand ways for possible co-production. Here, Boehnert (2018) proposes communication design as a discipline that navigates the intimately intertwined space between individuals, society, and the environment. *The PigeonBlog /2/ project*(18)(2008), developed by Interdisciplinary artist Beatriz da Costa is an example of a co-production that joins space and multispecies actors by communicating air pollution through the unique collaboration of homing pigeons, artists, engineers, and pigeon enthusiasts. Their goal was to create a grassroots initiative for gathering scientific data on air quality and sharing it with the public (da Casta et al., 2008, p.1).

Another example is the design research project *Melbourne Mussel Choir*(19) (2015) created by Artistic researcher Natalie Jeremijenko. This research project focused on the intra-action between water and mussels through sound communication. By using sound, it shed light on the mussels’ movement patterns, providing insights into their habitat and behaviour. This expanded the sensory scope, enabling the observer not only to visually perceive the ties between water and mussels but also to audibly experience them through a multispecies co-production. Inspired by these projects and approaches, this subchapter aims to combine eco-acoustic sounds with an environmental focus on soil health examined through speculative prototypes.

18 The PigeonBlog /2/ project. https://nideffer.net/shaniweb/pigeonblog.php
19 Melbourne Mussel Choir. http://www.carbonarts.org/projects/melbourne-mussel-choir/

Over the years, researchers and practitioners have proposed numerous of prototyping techniques aimed at exploring diverse avenues for extending the concept and application of prototypes across various research domains. In this subchapter, I will specifically delve into the use of prototypes from a speculative design perspective (Auger, 2013; Gaver et al., 1999; Wakkary, 2021). Here the objective is to introduce a framework to guide the creation of a posthuman speculative prototype, fostering a symbiotic relationship between multispecies actors such as soils, earthworms, technology and humans. Drawing inspiration from Professor Carole Collet's concept of 'Nature as a Co-worker,' which integrates biomimicry principles with biology and husbandry practices to involve living organisms in the creation or production process (Collet, 2017, p.27), this subchapter explores the potential of collaborating directly with living actors to incorporate their agencies into co-produced speculative prototypes.

The main objective of this subchapter is to investigate how eco-acoustic sound recordings of earthworms moving in diverse soils, as explored in chapter 3.2, can serve as a model for living multispecies co-production in communicating soil health.

Shaping eco-acoustics

This section aims to communicate co-action with soils and its inhabitants as well as their wellbeing through sensory and multispecies design using the developed CO-ACT methods and tools. The recordings from the former and current textile dye sites in Løgstør, former site *Brødrende Mathiasens Klædefabrik*, and Ulfborg, current site *Lystbækgaard*, are used to experiment with how recordings of earthworms' movements in soils can bring orientation toward soil conditions and can co-productively be used in the prototype development.

In collaboration with Artist Sarah Trahan, I examined how a multispecies co-production could look like when communicating soil conditions involving diverse human and non-human actors such as earthworms, clay/PLA, technology, and researchers/artists. This co-production is presented as exhibited speculative prototypes called CO-ACT Vibrant Soils proposing 3D clay-printed speakers, which sound and shape is co-created with the recorded earthworms presented in the soil at the observed sites. To draw sensory attention to soil conditions, the 3D-printed visual prototypes act as exhibition pieces, hence speakers playing the soundscape of the recorded movements of earthworms in soils. Here, the thin 3D-printed speakers (Fig. 111) are from sides with few earthworms present (Ulfborg), whereas the thick speakers materialize recordings from sites with numerous earthworms present at the site (Løgstør). The transformation from sound to visual outcomes is done through a custom-built WAV to CSV converter. According to Trahan, the transformation works as described in the following illustration (Fig. 112) and can be tested by using the step-by-step 4.1_recipe below.

Fig. 111. Image of the 3D-printed co-created shapes visualising soil conditions. Thin = few earthworms present at observed site, Thick = numerous earthworms present at observed site.
By Trahan, 2023.

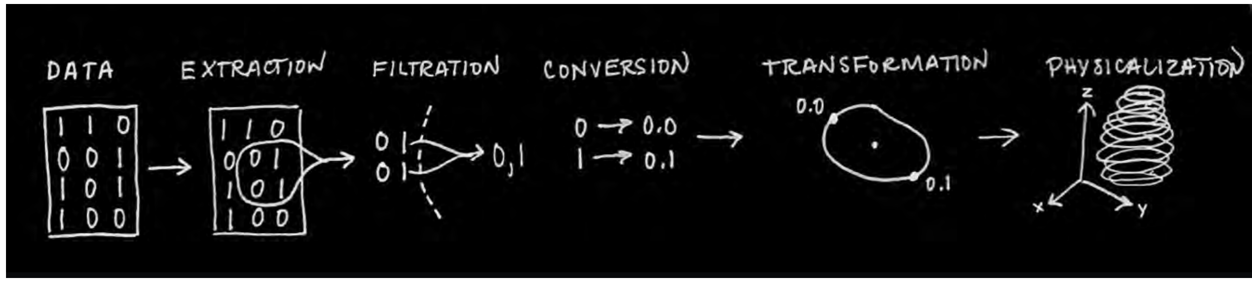


Fig. 112. Illustration by Artist Sarah Trahan, 2022.

4.1_Recipe

1.Step
DATA_The audio file is converted into numerical data using a custom-built .WAV to .CSV converter. The converter takes the sound file and converts it to a .CSV file containing numerical data corresponding to the right and left audio channel output (in stereo).

2.Step
EXTRACTION_From the resulting .CSV file, the artist selects a small part of the data to work with, ideally with a wide range of numeric values (i.e. where the sounds were especially dynamic).

3 + 4. Step
FILTRATION & CONVERSION_The edited .CSV file is fed into a custom-built generative modelling program that converts the numerical data into 3D geometry.

5. Step
TRANSFORMATION_To build this program, Trahan used Grasshopper, a visual programming
environment within Rhinoceros, a type of 3D CAD software.

6. Step
PHYSICALISATION_The 3D models created from the data files are then trimmed, resized and made hollow by the artist. They are then made physically via a 3D printer and prototyped in PLA (plastic biofilament) and a plastic/clay composite.

Testing associations

The speculative prototypes originated from sound files recorded in soils from Løgstør and Ulfborg. Using Trahan's custom-built generative modelling program, four distinct speculative prototypes were created through a multispecies co-productive process.

To gain valuable insights into the perceptions of the shapes and identify which ones were most suitable for human participants to stimulate curiosity to listen more closely to soil conditions, the first diverse speculative prototypes were tested with four non-designers (see fig. 113).

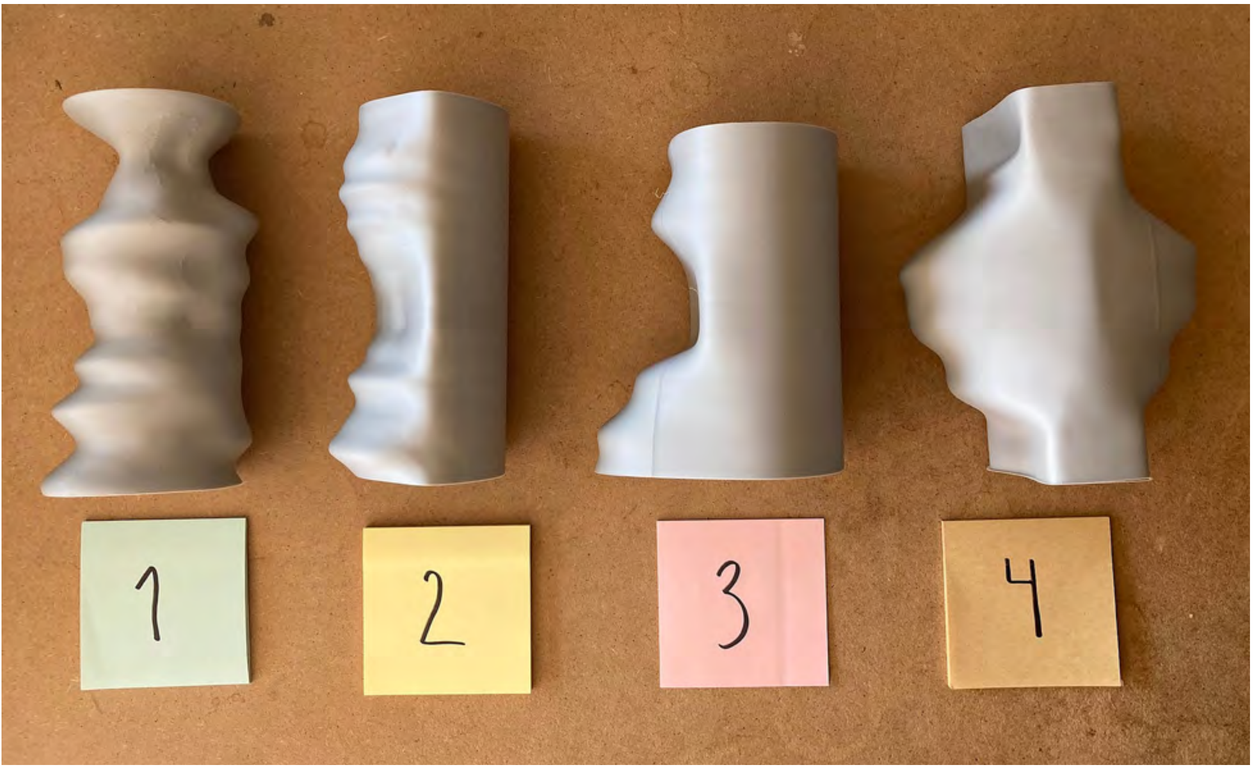


Fig. 113 - 114. Images of the four different speculative prototypes printed in PLA. The first speculative prototypes depend on which of the eight channels were filled out with the converted numerical data. The speculative prototype where numerated and colour-coded in order for the participants to orientate themselves during the semi-structured questionary. Number one with the light blue poster was made with eight filled out channels, number two on the yellow poster was made with two filled out channels (channel 1 and 2), number three on the pink poster was made with one filled out channel (channel 1), and number four on the brown poster was made with two channels but symmetrically filled out (channel 1 and 4). By Permiin, 03.02.23.

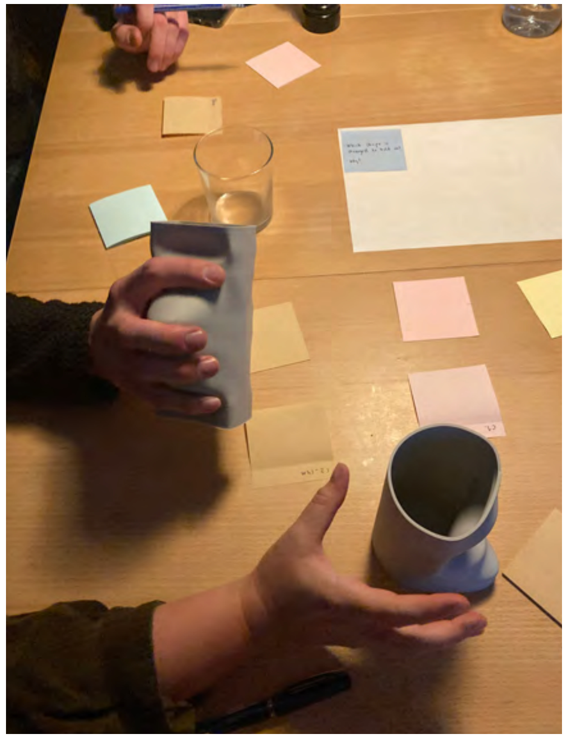


Fig. 115 - 117. Images of semi-structured interview. Participants examining the speculative prototypes to orientate themselves to which of the prototypes are the best to hold on to. Image by Permiin, 2023.

The semi-structured interviews examined the associations the participants had regarding the different speculative prototypes, focusing especially on which prototype reminded them the most of soundwaves and which one they experienced as most comfortable to hold in their hands.

The speculative prototypes brought forward diverse associations such as a hilly landscape, a canoe (number 2), pilled stones, an organ, or a blubbery substance (number 1), monkey faces, or a lion's nose (number 4), a shout and an elephant foot (number 3).

Upon asking the participants which speculative prototype reminded them mostly of sound waves three out of four participant choose number 4, as it "*looks like amplitudes for real bas music*"- (Participant one); "*because soundwaves have wave tops and wave troughs and therefore it looks like a sound recording*" - (Participant two); "*the symmetrical look gives me associations to the soundwaves*"- (Participant three). In contrast, participant four argued that number 1 reminded them mostly of soundwaves as "*the visual outcome is being thrown to all directions*".

Finally, the participants were asked which speculative prototype was best to hold on to, with all participants agreeing on speculative prototype number 1: "*my fingers lie good around this shape and there are several ways to place them there*" - (participant three); "*it is the best to hold on to while the different configurations fit perfectly to my fingers*" - (participant one). Furthermore, the participants were also asked to identify the speculative prototype which was the strangest to hold on to. Here number 4 was referred to as being "*not good enough, as there are no good solutions to hold on to it, which is stressful for the hand to hold on to*" - (participant three), and "*it is too big and uncomfortable*" - (participant four) (see fig. 117.).

As such, the semi-structured interviews revealed that speculative prototype number 4 was mostly associated to soundwaves, but its form was most awkward to hold on to. On the other hand, speculative prototype number 1 was very flexible to hold on to and visually relatable to sound waves. Based on these insights and findings, the next round of prototypes was thereforecreated with eight channels.

Fig. 118-119. Image of me listening to the acoustics in the speculative prototype, at Spinderi hallerne Vejle. By Permiin, 2023.

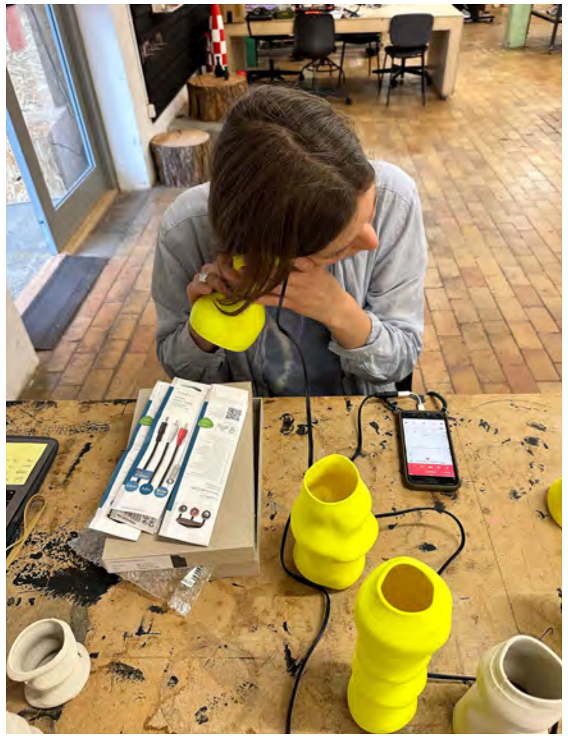


Fig. 120. Images of Trahan and me developing the shapes and cutouts from the eco-acoustic recordings of the two investigated sites, showcasing four speculative prototypes in progress, by Permi in, 2023.

Experimenting with a 3D clay-printer

The concept of "designing-with," as proposed by Professor Ron Wakkary (2021, p. 20), entails designing in a manner that embraces the involvement of multispecies actors in an interconnected and relational way. Wakkary suggests that posthumanism opens new possibilities for design by shifting away from a human-centric perspective and recognizing the intricate material, ethical, and existential connections between humans and nonhumans (Wakkary, 2021, p. 20).

In the experimentation with co-production in the *CO-ACT Vibrant Soils*, Trahan and I strive to de-center our human control over the co-productive process. Instead, we actively involve clay as a multispecies actor with its own agency and agenda. This approach aims to treat clay as an active actor in the 3D printing process, transcending the traditional notion of human dominance, and promoting a co-productive design approach. Here, we employ red Danish pottery clay deliberately to explore the temporal dimension of working with clay, which differs significantly from PLA, the commonly used plastic filament in 3D printing, as observed in our initial examination of 3D-printed prototypes. Each material possesses their unique temporality, influencing the process and resulting in distinct experiences and outcomes.

According to Collet (2017), engaging in co-working with living organisms empowers us to infuse matter with active and dynamic qualities. In this process, matter is no longer passively subjected to shaping activities but becomes an active enabler of the co-productive process (Collet, 2017, p.36). Based on the data co-produced through the movements of present earthworms in the soil from the recorded sites, the experimentation with the 3D clay printer aims to allow the design process to be influenced by the intrinsic nature of clay. This serves as an illustrative example of a de-centered co-production experiment, where clay's agency and involvement play a significant role in co-action. Please find images of the co-producing experiment between clay, technology and researchers/artist in fig. 121 - 122.

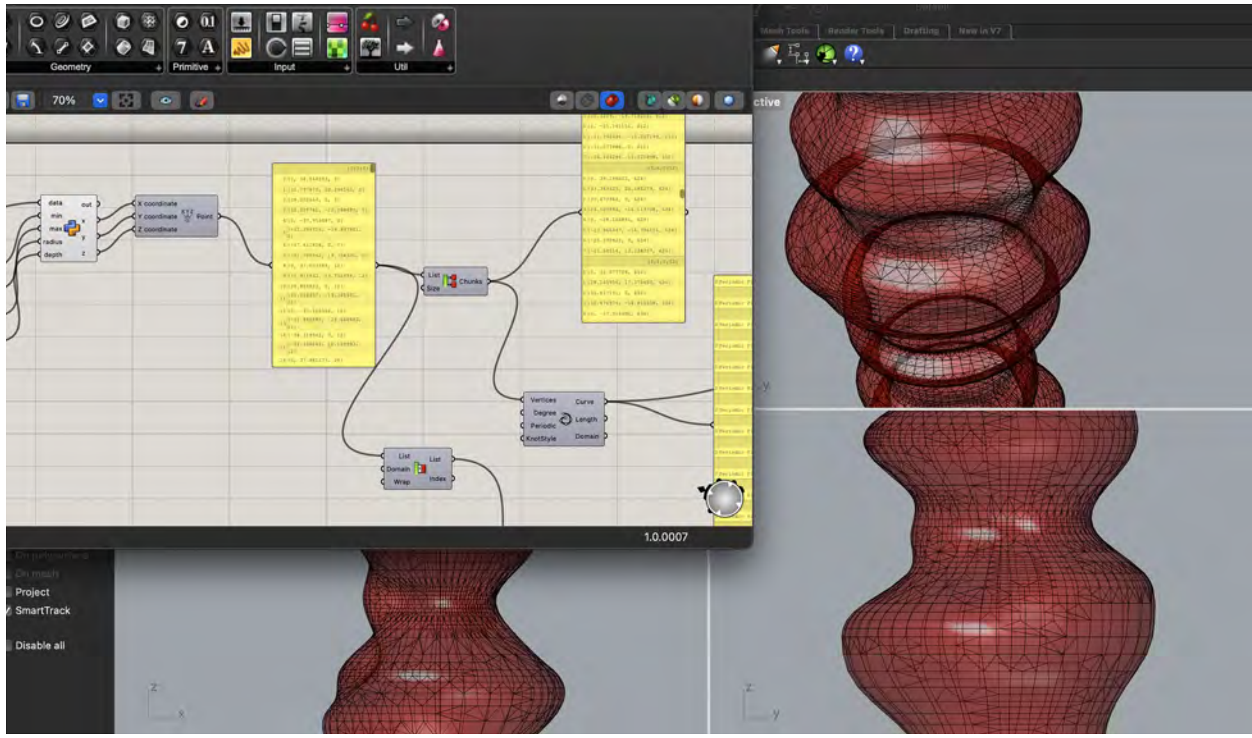
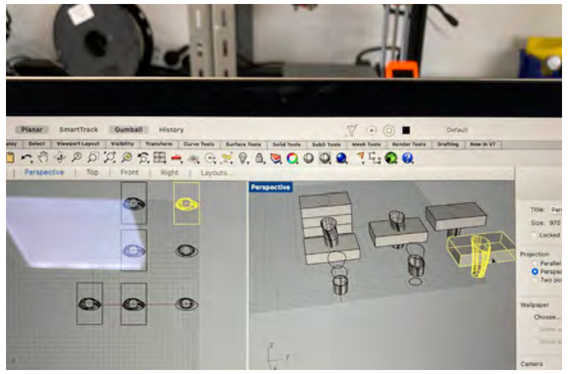
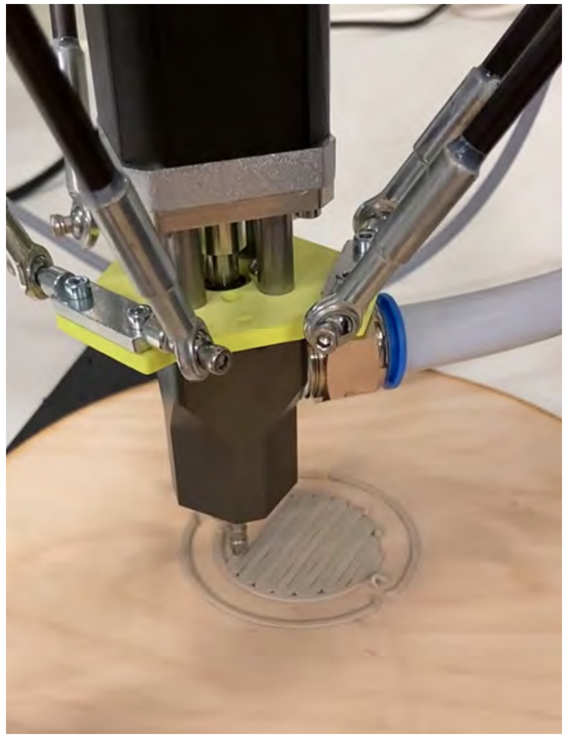
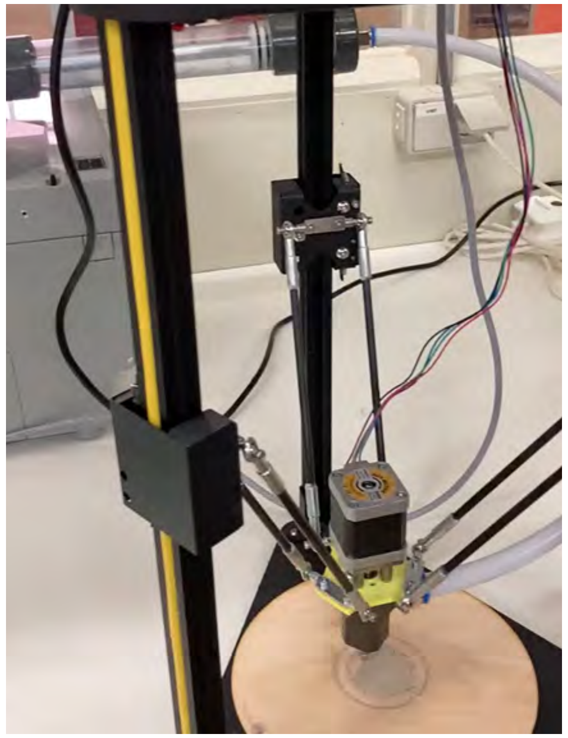
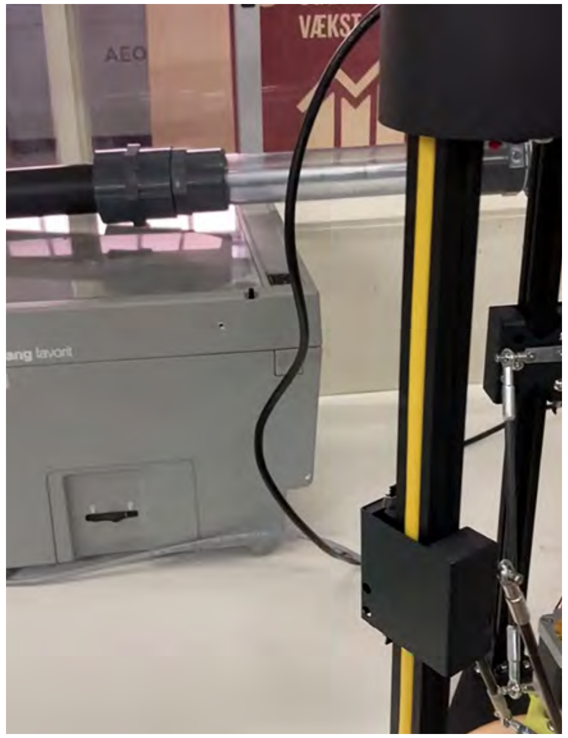


Fig. 121-122. Images of the 3th, 4th and 5th step in the process, transforming the eco-acoustic sound recordings into numbers for 3D visualisation in the program Grasshopper and Rhinoceros for collecting parts of the recordings for 3D printing. Images by Trahan and Permiin, 2023.









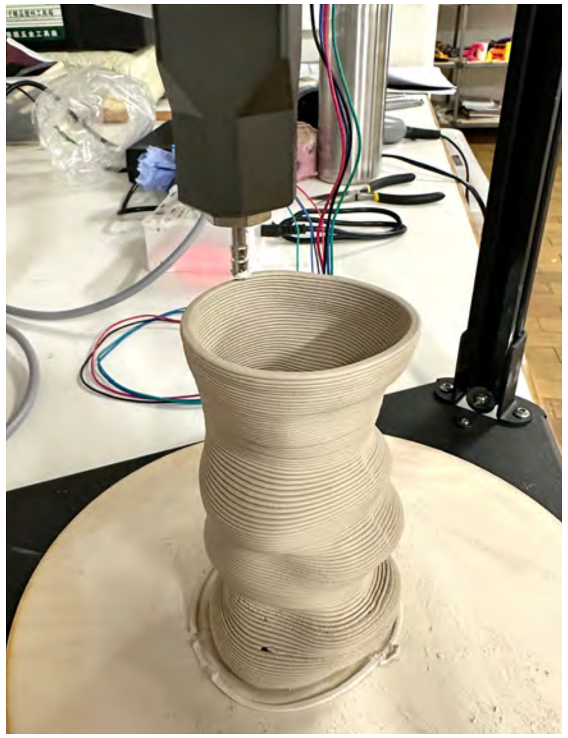


Fig.123-128. Images of the first co-produced speculative prototype 3D printed with clay, by Trahan, 2023

Findings from the co-productive experiment

The focus of this subchapter has been to examine how sensory co-produced communication on soils condition could look like. Throughout this examination the CO-ACT project has involved clay as an actor representative for soils for an exhibition purpose.

Working with clay required care, passion, and time for multispecies negotiation, understanding the agency of clay, and adjusting the extrusion speed for active co-production. This allowed Trahan and I to experiment with de-centering our human participation when printing the co-produced speculative prototype as we could navigate in our control over the shaping process giving clay a co-active ownership.
Throughout the experimentation with the 3D clay printer, we observed a distinct temporality in clay compared to PLA, as clay dried up more slowly during the printing process. Working with clay enabled a new temporality compared to PLA allowing for a reorientated co-production process. This intriguing aspect of co-production with clay allowed for a more equitable participation, while offering possibilities to both the clay, the 3D printer and us to actively co-produce the shape of the speculative prototype, as demonstrated in fig. 129. The experimentation with clay serves a dual purpose: it not only serves as a means to de-center humans from the design process but also sheds light on clay's role as a multispecies actor to interpret new aesthetics and a co-active method.

The main focus of investigating co-production with clay is to understand a practical method of co-acting with soil. As a result, the coming CO-ACT Vibrant Soils exhibition aims to capture sounds from specific soil locations and incorporates them into co-produced 3D clay-printed speakers. These speakers are intended for exhibition purposes to site-specific link and vividly portray soils as living entities in need for reorientated, caring design cultures and practices. In line with Bellacasa's (2017) perspective on soils as endangered ecosystems requiring urgent care, the exhibition seeks to address sensory and multispecies aspects to soil condition. Here, participants will have the opportunity to listen and explore soil ecologies, fostering a sense of care and engagement to prompt future multispecies co-action.

Future work

The coming exhibition, CO-ACT Vibrant Soils at Jordens hus (DK), in October 2023 seeks to use local soils for the 3D clay-printing process promoting action for noticing and relating to site-specific soil ecologies. Here, similar to clay, the use of local soil has potential to be returned to the soil if left unfired. The exhibition seeks to showcase site-specific 3D-printed speculative prototypes made with local soil. These prototypes can be reintegrated into the soil, creating a living exhibition that involves co-action with the observed soil and its inhabitants. This perspective emphasises the symbiotic relationship between the prototypes and the natural environment, while allowing participants to gain a direct intra-action with soils. In the future, endeavours will focus on exploring regenerative co-production, as illustrated in fig. 129.

Fig. 129. Illustration of the CO-ACT Vibrant Soils regenerative co-production concept, by Permiin, 2023.

In the upcoming subchapter (4.2), I will focus my exploration on the process of speculative co-production. During this investigation, I will examine how the developed co-active method can directly contribute to fostering future care and regenerative co-action with soils and textile dye wastewater.

4.2_Imagining future co-production

Emphasising foresight and speculative futures

"*Foresight is the ability, the skill and art of describing, explaining, exploring, predicting and/or interpreting future developments, as well as assessing their consequences for decisions and other actions in the present*" (Berkhout et al., 2007, p. 74).

Foresight can be connected to speculative design, which involves crafting potential future goods and services using contemporary systems and product lineages (Auger, 2013, p.2). By combining tools from different fields, speculative design allows the creation of tangible prototypes and abstract ideas to envision speculative futures (Dunne & Raby, 2013). This approach aligns with the concept of foresight described by Berkhout et al. (2007), where potential futures are imagined based on the present state and available resources. In the realm of speculative futures and foresight, projects often fall under one or more of five categories, initially proposed by Dr. Trevor Hancock (1994) in the "Future Cone" model (See fig. 130). Tese categories are: Potential, Probable, Plausible, Possible, and Preferable futures. In this subchapter, the primary aim of the CO-ACT project is to use foresight and speculative futures to envision more preferable and sensory futures related to soils and textile dye wastewater.

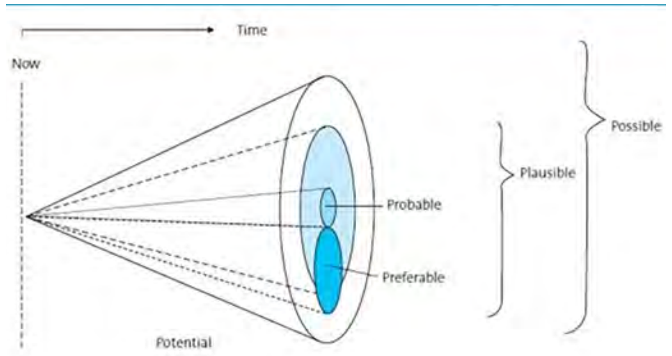


Fig. 130. Illustration of the "Future Cone" five P's: potential futures venture into the realm of uncertainty, while possible futures rely on forthcoming information. Plausible futures align with our existing understanding of the world, while probable futures represent continuations of current trends. Lastly, preferable futures advocate for what we want or hope to happen, based on our values and beliefs (Voros, 2017). Source taken from https://sjef.nu/theory-of-change-and-the-futures-cone/

Speculative co-production with soils

This section seeks to embrace regenerative practices as a “transmission” for a preferable co-active future with soils. According to Anthropologist Sofie Isager Ahl (2023), regenerative practices are the transmission of the conditions for life (Ahl, 2023, p. 27). In recent years, the idea of regenerative design thinking has gained attention, particularly in the context of reimagining local textile and fashion systems (Burgess & White, 2019; Fletcher & Tham, 2020). A notable example is Textile researcher Rebecca Burgess (2019), who founded the California based organisation Fibershed(20). Burgess’s work revolves around exploring ways to establish a circular textile production process that considers every step of the textile production chain to create a good foundation for the transmission of the conditions for future resources. In her book Fibershed (2019), Burgess argues that there has been limited public discourse regarding the environmental, social, and human health implications linked to the production, usage, and disposal of garments.

The book highlights that around 20 percent of global freshwater pollution can be traced back to the dyeing and treatment processes employed in the textile industry (Burgess & White, 2019, p. 17-18). This textile industry uses numerous synthetic compounds, often in various combinations, for softening, processing, and dyeing textiles and clothes. In response to these production structures and processes found in the textile industry, Burgess devises an innovative “Soil to Soil” model that embodies a regenerative approach, prioritising the well-being of both humans and soils. The model revolves around the development of regional textile systems that contribute to soil enrichment. A key aspect of this approach is the ability to return textile products back to the soil, extending their lifecycle to serve as nutrition for the soil and thereby promoting a circular transmission. Fig. 131 showcases a visual representation of Burgess’s Soil-to-Soil model.

Fig. 131. Illustration of the Soil-to-Soil model by Fiber shed, 2010.

In accordance with the Soil-to-Soil model and regenerative design thinking, the main purpose of this subchapter is to speculate on preferrable co-production enhancing sensory and multispecies caring relationships amongst soil conditions and management of textile dye wastewater. Through the application of speculative design, the CO-AT project raises the following questions: *What if all wastewater from future textile dyes would take part in an active multispecies co-production, making sure that the wastewater was to both provide colour for a textile but also enrich the soil ecology at the respective dye sites?* And: *what if a sensory communication of the soil condition at these textile dye sites could provide caring relations between the user of the dyed textile and the soil ecology at the site? What would the appearance of this multispecies co-production be like, and at what point should it be situated within the context of the “Future Cone”?*

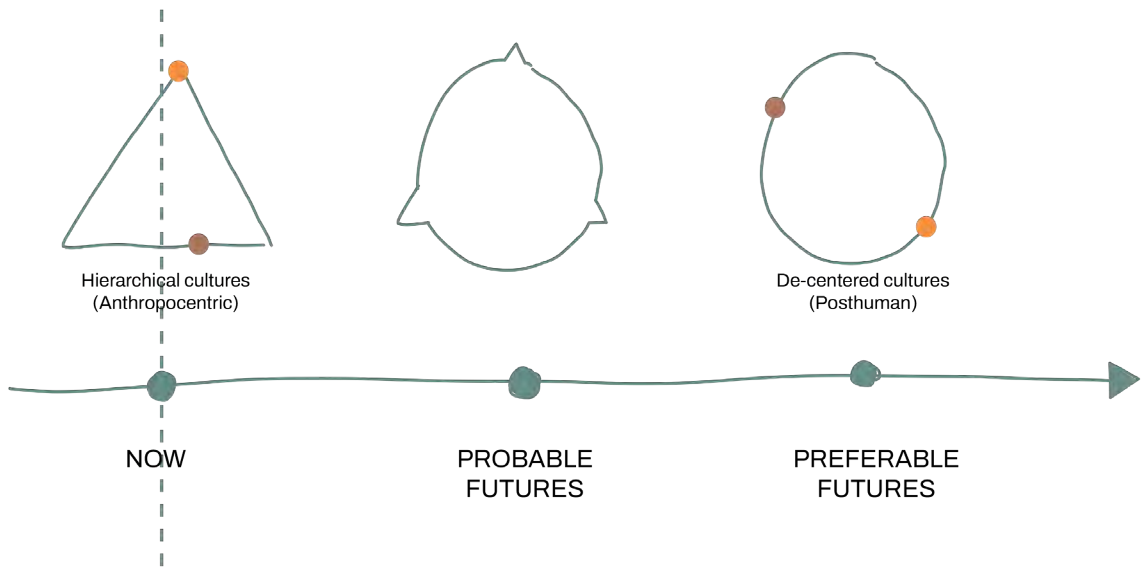
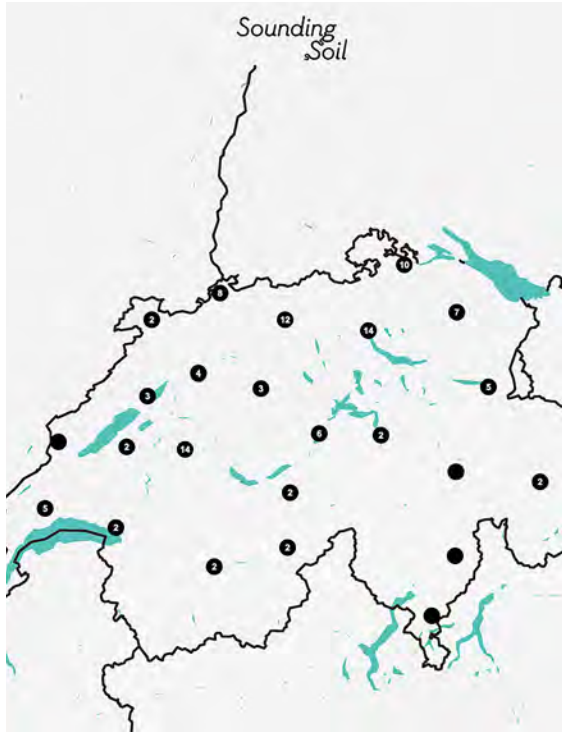


Fig. 132. Illustration of the ”Future Cone”(1994) placed in a timeline of a paradigm shift from a hierarchical human dominant culture towards a circular de-centered new posthuman culture. Orange dot = humans, Brown dot = multispecies. By Permiin, 2023.

By drawing inspiration from the transparent concept of the Fairphone(21), which raises awareness about the origin of resources used in their production (see fig. 133), and the *Sounding Soil* project in Switzerland, where soil sounds are mapped by Design researcher Marcus Maeder and fellow scholars (see fig. 134), a CO-ACT map of recorded soils at textile dye sites could be conducted. This CO-ACT map could potentially establish a sensory connection to the soil at these sites.

20 Fibershed. https://fibershed.org
21 Fairphone. https://www.fairphone.com/en/impact/source-map-transparency/



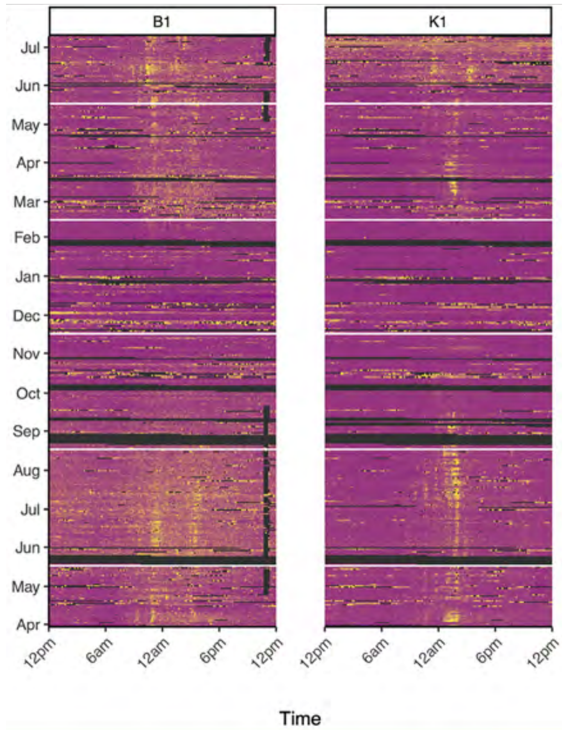


Fig. 133-134. Images from the map of the Fairphone supply chain of their Fariphone 4 and the map of recorded sounds by the project Sounding Soil by Design Researcher Mar cus Maeder, taken from their websites the 23.07.23.

Fig. 135. Visual representation of soil recordings by Keen and fellow scholars (Keen et al., 2022).

Building on the CO-ACT projects previously conducted eco-acoustic method and earthworm counts from chapter 3.3, the CO-ACT map could advance the co-active communication method discussed in chapter 4.1. This approach includes co-actively conveying soil conditions through soil recordings and visual language. As stated before, I draw inspiration from an approach that highlights that "*co-species survival depends on imaginative creativity and scientific understanding*" (Tsing et al, 2017). Therefore, an orientation towards a new posthuman culture for multispecies co-production should take inspiration in scientific data merged with speculative design thinking.

A visual interpretation of the recordings together with the sound could pave the way for a new posthuman culture that actively involves care for soil actors' conditions and ecosystem in future co-production (see fig. 135 - 136). However, it is essential to question whether this attempt to bring transparency is merely another layer of complexity, or if it genuinely serves the examination of a new posthuman culture and design practice involving sensory co-action with multispecies actors.

The following subchapter seeks to widen the scope of future co-production and caring relations with multispecies actors in other fields.

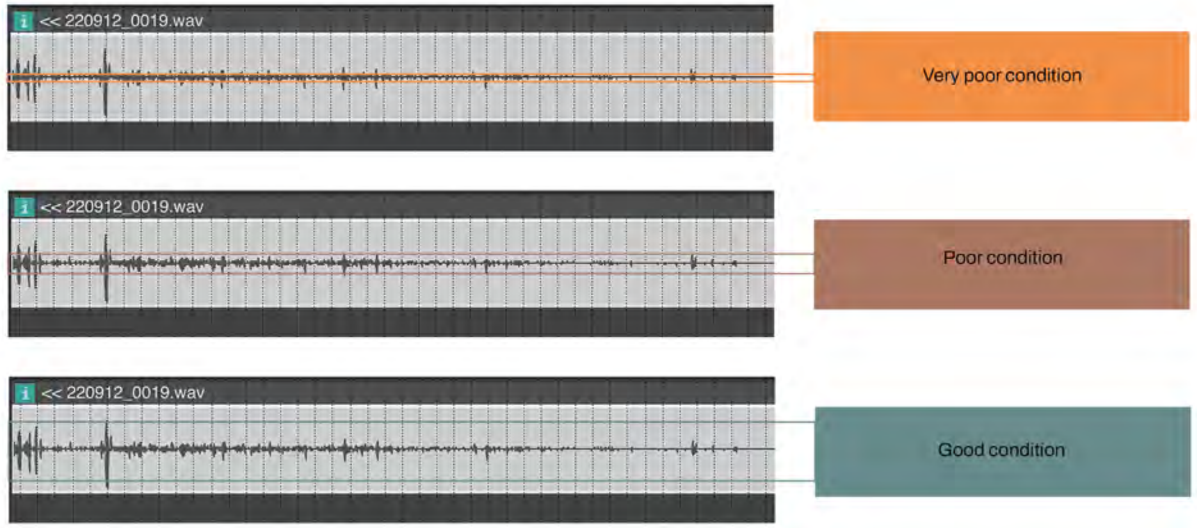


Fig. 136. Proposed illustration to relate with soil condition. According to the SEGES Report (2020) well-being of earthworms and soils can be observed due to earthworms present in a soil sample. The numbers of earthworms observed at a 25x25cm soil sample can vary between low numbers of earthworms (<2) = very poor condition (orange frame), medium numbers of earthworms (>2) = poor condition (brown frame), and high numbers of earthworms (>6) = good condition (blue frame). By Permiin, 2023.

4.3_ Widening multispecies co-production in other fields

Future thinking in Danish Design Studios

In recent years Danish Design Studios have employed foresight and speculative futures to envision plausible scenarios for the coming next decade. A notable Design Studio to name here is Bespoke(22), which merges principles from design and strategic foresight to develop future facing organisations. Another example is the Danish Design Center(23), DDC, which uses design speculations, combining narrated stories from the future with practical tools and guides for present application. According to Speculative design researcher Anthony Dunne, "design speculations" serve as a catalyst for collectively redefining our relationship to reality by stimulating imagination through what-if scenarios, envisioning alternative ways of being (Dunne & Raby, 2013).

This subchapter therefore explores how a speculative workshop organised by the CO-ACT project, which builds on using practical tools, can foreground visons for preferrable co-active futures. Here, the CO-ACT workshop asked what if the participants would engage with processes in regenerative co-production with multispecies actors in their current practice. It did so by inviting the participants (design practitioners, students and researchers) to map their current practices and therefrom create speculative prototypes to envision future co-action possibilities with outset in the CO-ACT MANIFEST.

Working towards multispecies co-action

"How can we repurpose the tools of modernity against the terrors of Progress to make visible the other worlds it has ignored and damaged? Living in a time of planetary catastrophe thus begins with a practice at once humble and difficult: noticing the worlds around us." (Tsing et al., 2017, p. 143)

This quote marked the beginning of the CO-ACT workshop conducted during the Get-Restarted conference at the Royal Danish Academy in Denmark in 2022. The workshop lasted for 1.5 hours and accommodated 25 participants. Alongside two other workshops, attendees had the opportunity to shift between them during the 1.5-hour session.

22 Bespoke. https://bespokecph.com/
23 Danish Design Center. https://ddc.dk/tools/living-futures-scenario-kit/

Fig. 137. Image of the CO-AT manifest, by Permiin, 2022.

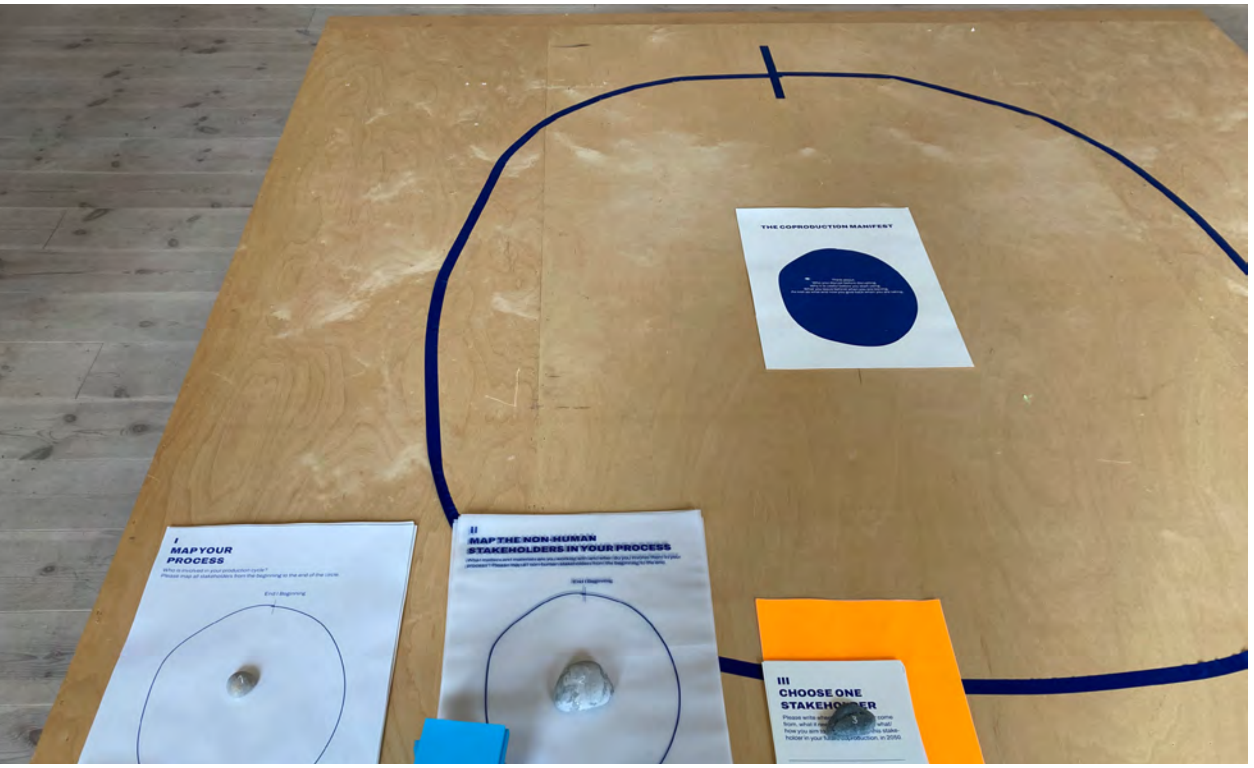


Fig. 138 - 139. Images from the CO-ACT workshop. By Permiin, 2023.

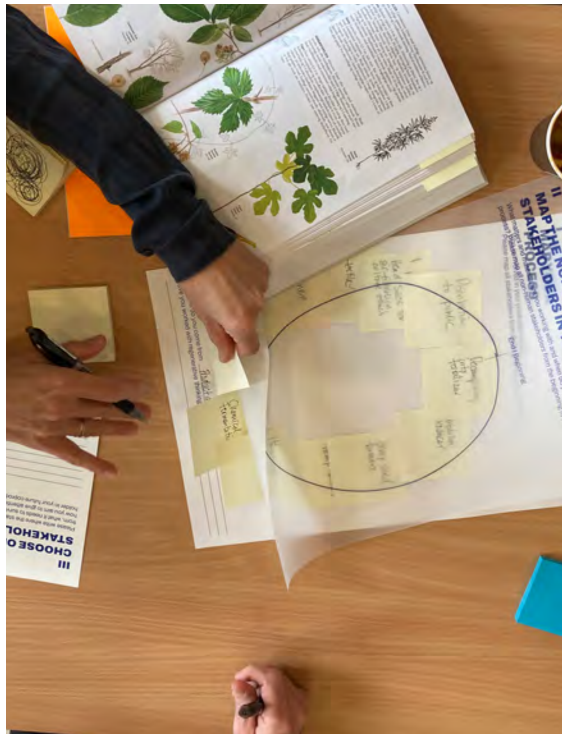
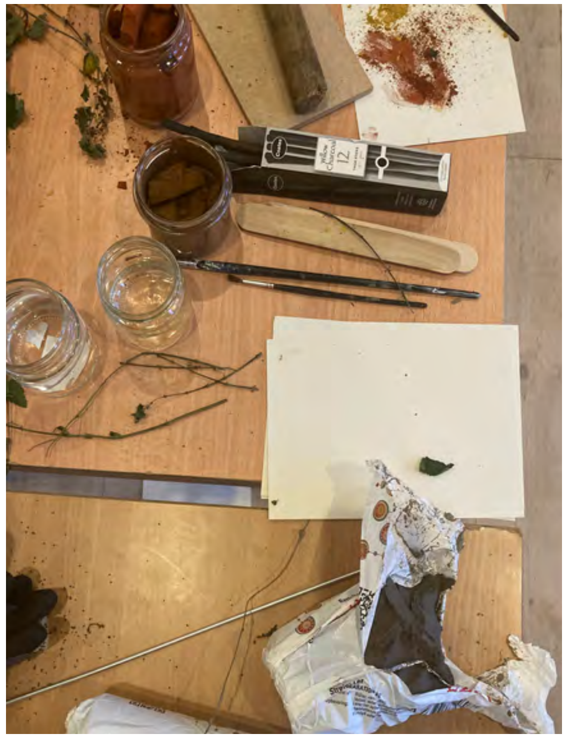
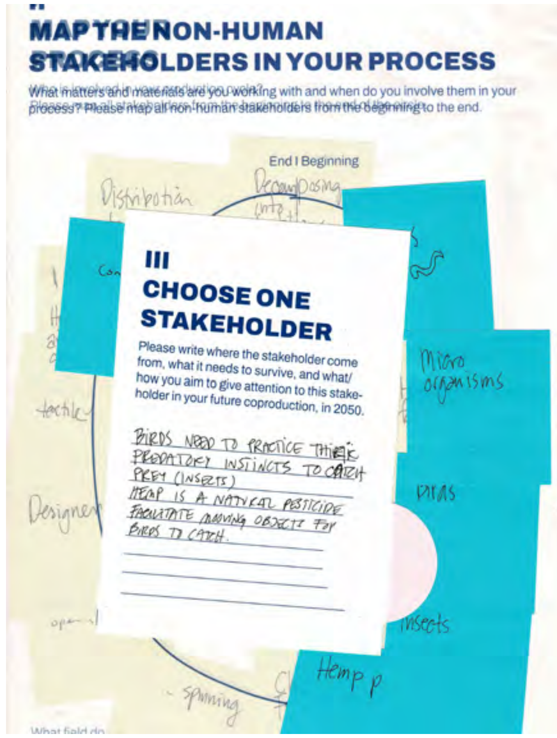


Fig. 140 - 141. Images from the CO-ACT workshop. By Permiin, 2023.

The participants started by gathering around tables to begin mapping the actors involved in their current design process. They carefully traced the participation of these actors from the beginning to the end of the process (see fig. 140 - 141). Subsequently, they were prompted to expand the initial map by including all non-human actors involved throughout the process. This resulted in multiple discussions about the definition of an actor and the level of detail required for the map as the participants started to realise the complexity of involved actors in a single process. The participants' enthusiasm determined the time spent on mapping all actors, ranging from 10 to 30 minutes. The descriptions of the maps also varied from broad overviews to highly detailed representations. After completing their maps, participants were instructed to select one non-human actor from their mapped process for which they would create a regenerative co-productive orientation. This process involved the use of speculative prototyping, drawing inspiration from the CO-ACT MANIFEST. The room was equipped with diverse cutting tools, string, clay, and plants, which the participants used to craft their co-productive prototype with their chosen non-human co-actor (see fig. 138 - 139). This exercise yielded various speculative prototypes, sparking lively debates among the participants. Some individuals formed teams, while others collaborated to help one another envision potential paths for future co-production. Finally, the speculative prototypes were exhibited in the workshop room to spark discussions throughout the remaining conference event. Please find the participants' speculative prototypes in fig. 144 - 147.





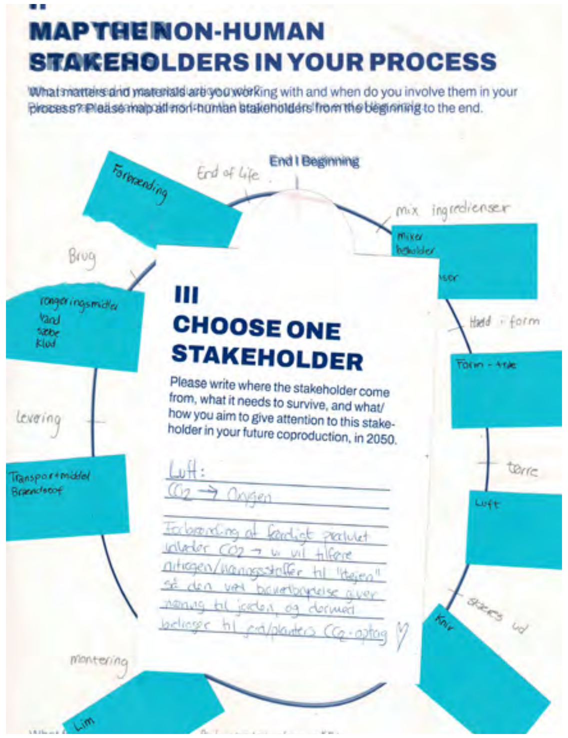
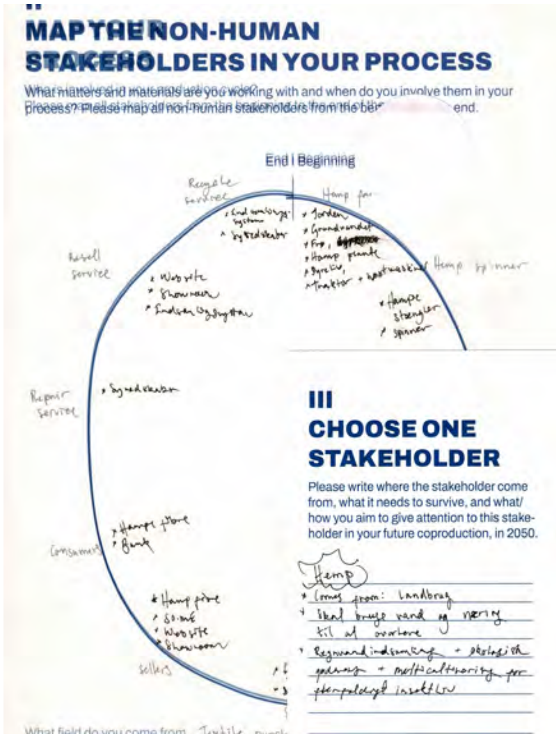
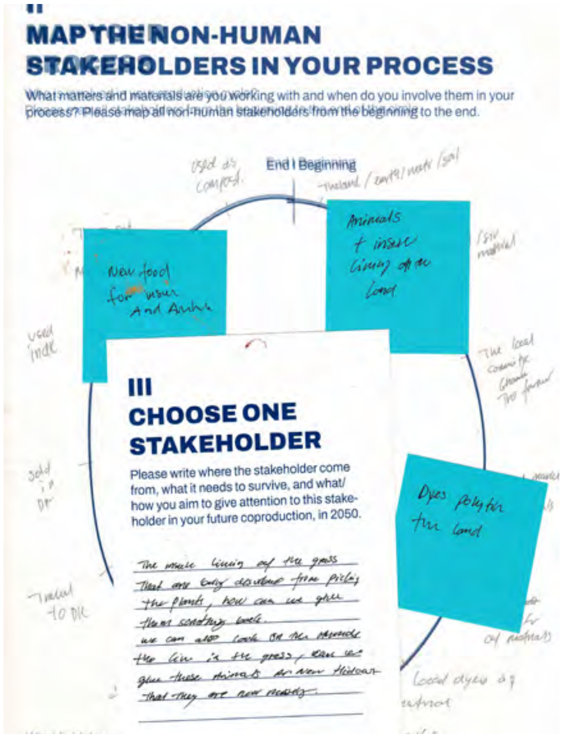


Fig. 142-147. Images of some of the participants' speculative proto types. Documented by Permiin, 2023.





Following the workshop, I discovered that the CO-ACT mapping tool was not only useful in a regenerative co-production explorative setting but also adaptable to other practices and disciplines. Interaction designer Johanne Aarup Hansen, co-founder of Flexworker(24), a cooperative agency focused on inclusive and explorative approaches to foster collective action, expanded the CO-ACT map with design students from DSKD. They focused on three levels: the human level, the “non-human” level, and the structural level. Hansen employed the CO-ACT mapping tool in a manner where participants first mapped a general or specific production cycle relevant to their practice and discipline. Next, they identified issues that personally intrigued them to work on during the course. Finally, they rephrased these identified issues, such as the funding application process or mass production of clothing, into “What if...” questions, allowing exploration of alternative futures (Hansen, personal communication, 15. Marts. 23, translated)(see fig.148)

Consider Hansens example as an open invitation to explore and use the materials provided throughout the CO-ACT project. They are designed to inspire and empower you in your future design processes and practices towards sensory and multispecies co-action.

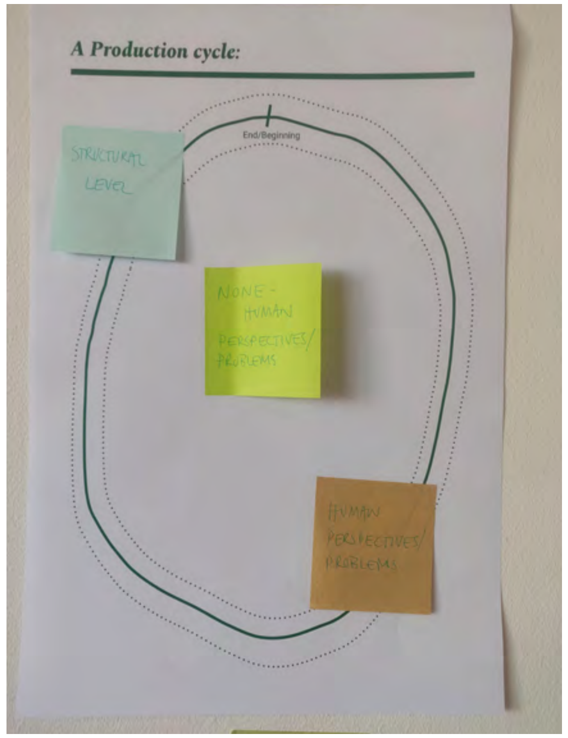
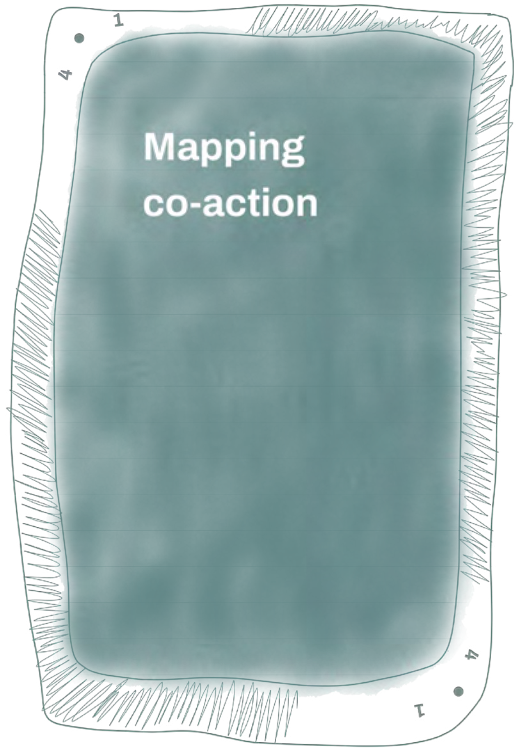


Fig. 148. Image by Hansens developed interpretation of the CO-ACT 4.1 method. By Hansen, 2023.

Your turn

I hereby invite you to try the CO-ACT Method Cards *4.1_Mapping co-action* and *4.2_Co-active co-production*.

I wish you the best of luck as you delve into the provided material, and hope you find the diverse inputs inspiring and use them to explore and develop further.



24 Flexworker. https://flexwerker.dk/

Mapping co-action

What?

Mapping co-action is a method that provide orientation to all the multispecies actors involved in your design process, irrespective of their level of participation.

Why?

By mapping all the actors involved in a design process, you can identify gaps and specific areas that require additional attention and care.

How?

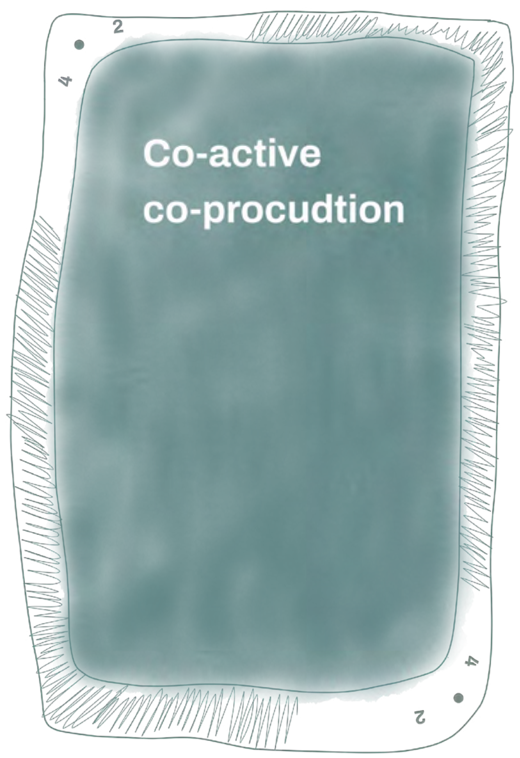
The CO-ACT project has developed an illustrative recipe as an example, demonstrating an approach to implementing this method.

Recipe

You would need A3 paper, a pen, and some Posters.
1. Draw a circle on the paper, marking the starting point of where you began and the closing point of where you completed the circle: Label these points as "Beginning" and "End" respectively.
2. Begin by documenting all the actors, both humans and non-humans, involved in your design process. Write the name of each actor on a poster and arrange them chronologically on the drawn circle.
3. Examine the specific area within the process where you can integrate care for all the actors involved. Seek inspiration from Chapter 3.2 of the book "CO-ACT: Multispecies Design in Practice."
4. Write your ideas down.
5. Reflect on your experience and engage in meaningful discussions with colleagues, business partners, or friends to share your insights and perspectives.

Examples

- *Multispecies Design* by PhD Daniel Metcalf, 2015. A thesis that addresses questions of human-animal interaction. https://ualresearchonline.arts.ac.uk/id/eprint/13351/
- *On textile farming: Living indoors* by designer Svenja Keune, 2019. A project that considers plants and environmental factors in textile design for interior spaces. http://svenja-keune.de/en/projects/enon-textile-farming-seeds-as-a-material-for-textile-design/
- *Interspecies play* by artists Takuma Kikuchi, Lucy Li, Florian Sapp, and Alan Schiegl, 2021. A playful art project proposing a co-active play between urban animals and humans. https://designinvestigations.at/projects/interspecies-play/



Co-active co-production

What?

Co-active co-production is a method to create speculative prototyping using regenerative design thinking to address more holistic design processes.

Why?

The concept of regenerative design thinking has the potential to offer caring orientation to the multispecies actors involved in your design process.

How?

The CO-ACT project has developed an illustrative recipe as a practical demonstration of the approach to implementing this method.

Recipe

It is recommended to prioritise Method 3.1 while considering Method 3.2 as a subsequent step in the process. Additionally, it is advisable to gather bits and scraps beforehand to prepare for the creation of your forthcoming speculative prototypes.

1. Select one multispecies actor in your current or former design process.
2. Deliberate on how to engage in a thoughtful co-action with your selected actor by considering its specific needs. Pose questions such as: What are its requirements, and how can you establish a co-active system that attends to these needs throughout your design process?
3. Find bits and scraps around you and try creating speculative prototypes of what such a co-active system might look like. This exercise can be short 5min or longer as you prefer.
4. Reflect on your experience and bring your speculative prototype into a discussion with colleagues, business partners, or friends.

Examples

- *Fibershed* by researcher Rabecca Burgess, 2018. A regional fiber systems that build soil & protect the health of our biosphere. https://fibershed.org/
- *Fashion Fictions* by Dr. Amy Trigger Holroyd, 2020. Fashion Fictions brings people together to generate, experience and reflect on engaging fictional visions of alternative fashion cultures and systems. https://fashionfictions.org/about/
- *Living futures – Scenario Kit* by Danish Design Center, 2020. An exciting combination of narrated stories from the future and concrete tools and guides for using them in the present. https://livingfutures.org/
- *Organism Democracy* by the Organisms Democracy NGO 2020. Organisms Democracy is a political system in which fight for equality for all living beings who inhabit/use a state territory. https://organismendemokratie.org/en/factions/

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