Speculative design for envisioning more-than-human futures in desirable counter-cities

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A B S T R A C T

The city has long been regarded as the domain of humans. Residing above the physical constraints of nature, such detached and dualistic anthropocentric perceptions tend to universalize, marginalize and de-politicize the value and possible co-benefits of human/nonhuman nature connections. Recognising a need to re-conceptualise the city as a multispecies space, we analyse outcomes from an interdisciplinary Master's subject that sought to encounter, restore, protect and co-exist with more-than-human species. Students were encouraged to step beyond their disciplinary boundaries to develop innovative strategies that could reconfigure human/nonhuman relationships within the city of Trondheim, Norway. Through their work, visions of alternative, possible futures emerged. Such alternative visions can be powerful: speculation can challenge and transform the linear, dualistic understandings of the city, and shape and redirect innovation practices. This article explores students' visions of multispecies cities to consider their contribution to just and sustainable transitions literature, analysing them with respect to design for sustainability transitions, teaching transdisciplinarity and the concept of the counter city.

1. Introduction

Increasing social, economic and environmental crises in the Anthropocene prompt a need to re-integrate more-than-human natures within cities. Cities, representing key sources of consumption, pollution and proximate human/more-than-human interactions, are excellent sites in which to explore potential pathways to convivial and healthy co-existences (Castree, 2014). Approaches such as nature-based solutions, urban greening and waterway projects are popular examples, often endorsed by international funding bodies, that are being implemented to increase social, environmental and economic co-benefits (Faivre et al., 2017). Sustainability transitions and transformations are, however, highly complex processes associated with power struggles with potential winners and losers. Reviewing the potential of nature-based solutions, Pineda-Pinto et al. (2021), for example, argue that they largely remain human-centered, associated with social but not ecological justice.

The shift to a just and sustainable city requires transformative change – a need upheld by the global policy agenda. For example, assessing the state of biodiversity and ecosystems services more broadly, IPBES (2019: 14) call for system-wide re-organisation across economic, social, political and technological paradigms, goals and values, where:

"Goals for conserving and sustainably using nature and achieving sustainability cannot be met by current trajectories". In research on approaches to the governance of sustainability transitions, consensus around new ways of framing problems and alternative understandings is considered important to help shift the development in new directions (Loorbach et al., 2017).

The 'more-than-human city' is one such concept that recognises the presence, rights and ethics of nonhuman natures in the city while repositioning humans in relational, ecological terms (Plumwood, 2009). More-than-human perspectives can be applied to spaces, tempos, ethics and the rights of non-human others, which extend beyond animals and plants to include soils, water, climate and more (McGregor & Alam, 2022). This perspective builds on a trajectory of work that strives to overcome conceptual divisions between human and nonhuman worlds, such as Hinchliffe and Whatmore's (2006) 'living cities', Haraway's (2008) 'becoming with', Puig de la Bellacasa's (2017) 'living with' and Hyvärinen's (2019) 'multispecies livelihoods'. It is increasingly recognised that post-human narratives are required to break the perception of a singular 'way to do things *for* humans' to instead illustrate the multiple and hybrid possible multispecies 'worldings' of urban coexistence (Escobar, 2018).

Profound ontological reform work is needed to appreciate an interdisciplinary approach that goes beyond engineering or techno-fixes to address the complex problems of urban sustainability. Scholars advancing this goal include Fieuw et al. (2022) and Metzger (2019) who apply a more-than-human perspective towards integrating the rights of nonhuman natures within urban planning and development. Alternatively, Prebble et al. (2021) use a more-than-human lens to critically analyse and explore how digital technologies are being increasingly applied in Australian municipalities to revolutionise urban forest management. As an example of scholars taking such topics into speculative practice, Dolejšová et al. (2023) experiment with co-creation with diverse more-than-human forest stakeholders. This paper joins these efforts to offer an alternative application, audience and reflection within this emerging field.

Such strategies require innovative ways of rethinking human/nonhuman relations and the city. Exploring alternative approaches further require space and time for experimentation, patience for reflection, and creativity to overcome barriers such as an embedded expectation for human control. This latter category can be divided into physical and conceptual risks: the former recognises how greater proximity to nonhuman natures in cities can potentially harm human health and damage property, while the latter acknowledges how – by prioritising certain aspects over others – can lead to this bias, and hence, conflict (Maller, 2018; Soulsbury & White, 2016).

While futures are unpredictable and the ideas about desired states and outcomes can be many, visions are among the tools used in transition governance, to motivate, empower and coordinate action, guide innovation and experimentation (Loorbach et al., 2017). Here, approaches from fields such as design, arts and futures studies are relevant. Work on non-anthropocentric design and futuring is still emergent, but scholars have, for example in the context of design and placemaking, begun to explore what shifts to more-than-human ways of co-creating and designing may entail (for example, Pettersen et al., 2018; Akama et al., 2020; Clarke et al., 2019; Dolejšová et al., 2023; Olsen, 2022; Roudavski, 2020; Sheikh et al., 2023).

Transitions research has developed into an interdisciplinary field, drawing on many different perspectives and approaches. Educating future practitioners for such work, drawing on pedagogical approaches that welcome an interdisciplinary perspective to address the complex problems of the Anthropocene, is thus much needed. The Independent Expert Group on the Universities and the 2030 Agenda (UNESCO, 2022: 3) lists "the need to move towards inter- and transdisciplinary modes of producing and circulating knowledge" as the first of three main themes in their report on the contributions of institutions in higher education to achieving necessary social, economic and environmental transformations and the SDGs, followed by the importance of "engaging in other ways of knowing" (p. 26), and taking a more proactive role in society, partnering with other actors. Such "other ways of knowing" can include concepts of relationality that borrows from Indigenous worldviews (see Graham, 2014; Graham & Maloney, 2019), while considering the politics of how such knowledge is constructed (Latulippe & Klenk, 2020; Vásquez-Fernández & Ahenakew pii tai poo taa, 2020).

This article emerges from teaching the Master-level subject Experts in Teamwork, which is well positioned to address the themes raised in the UNESCO (2022) report and engage with transformative learning: learning where the goal is to empower students to critique existing beliefs and practices and enable them to take action based on new knowledge and their analyses (Sahakian & Seyfang, 2018). Experts in Teamwork is a compulsory subject for all students across NTNU that aims to develop interdisciplinary teamwork skills through experiential-based learning that addresses real-world issues (Sortland & Section for Experts in Teamwork 2020, 2021). While making use of a rare opportunity for students to engage in substantial collaboration on transformative sustainability-oriented work across disciplines, we thus also join others who experiment with pedagogic approaches that invite students to explore more-than-human relations, challenging the anthropocentrism of the SDGs (e.g., McGregor & Alam, 2022), basing teaching on "deeper exploration and understanding" of the interdependencies between humans and nature (UNESCO, 2022: 58). Divided into thematic 'villages', the subject's 'village' in focus here, 'Designing in Urban Natures', sought "to recognise, frame, encounter, restore, protect and co-exist with more-than-human species" (Edwards & Pettersen, 2020: np). In doing so, it sought to critically acknowledge the social, environmental and economic benefits that nonhuman natures can bring to the city while also reasserting the presence, ethics and rights of diverse nonhuman natures (Albert et al., 2019; Frantzeskaki et al., 2017; Kabisch & Haase, 2013; Kremer et al., 2016).

This article examines the benefits and challenges of designing an interdisciplinary subject to address complex problems of urban sustainability. The subject took as its starting point that nonhuman natures already, and will always, exist in cities where strategies to improve human/nonhuman relations are essential for moving forward. In this article, we explore the degree to which students were able to step outside their disciplinary boundaries to think beyond static and dualistic approaches to produce innovative strategies for human/nonhuman nature coexistence. In doing so, it contributes grounded knowledge for steps towards understanding and enacting the more-than-human city in theory and in practice. Towards these aims, this article next describes the methods and the findings, to close by analysing three visions emerging from the student work with respect to design for more-than-human futures, teaching interdisciplinarity and contributions to the more-than-human city as the counter-city.

2. Methods

In total, thirty students attended the Experts in Teamwork village held over one semester in Spring 2021. As this subject was taught during the Covid-19 pandemic, it partly relied on Blackboard Collaborate and Microsoft Teams for teaching and meetings with the students. While some work was conducted online, all the student projects were based in Trondheim, Norway's third most populous city with 213,000 citizens and a population density of 424 per square kilometer (Statistisk Sentralbyrå, 2023; Trondheim Municipality, 2021). Trondheim is a coastal city and municipality, located by the Trondheim fjord, with considerable annual weather and temperature variations: in 2021 the city had 165 days of precipitation and temperatures ranged from $-20°$ to $+29°$ (yr.no, 2021). Trondheim possesses unique fauna and flora, with more than 6000 species (Petersen et al., 2021).

Working in student groups numbering from four to six students throughout the subject, the aim was for each group to be diverse in their cultural and disciplinary backgrounds and gender. The disciplines of the course coordinators or village leaders – anthropology and design – guided a critical approach; one whose potential is being increasingly explored by others (Escobar, 2018; Smith, 2022). Anthropology provided qualitative, ethnographic research techniques, a holistic perspective and cross-cultural examples of possible applications. Alternatively, design, also concerned with sustainability transitions and transformations (e.g., Irwin, 2015), contributed by reframing problems and supporting the iterative development of visions and interventions that could demonstrate what might be possible and redirect developments towards alternative futures. Both disciplines interpret the more-than-human in their own ways. 'Multispecies ethnography' (Kirksey & Helmreich, 2010) is a method from anthropology, which, in its posthuman turn has sought to "meaningfully integrate the affective and the ecological, the individual and the relational, moving beyond anthropocentrism, speciesism, symbolism and utilitarian thinking" (Lien & Pálsson, 2021: 16; see Edwards et al., 2023). Alternatively, design introduces emerging approaches such as 'multispecies' (Roudavski, 2020), 'inclusive' (Bichard, 2018; Hernandez-Santin et al., 2023), 'bioinclusive collaborative and participatory' (Veselova & Gaziulusoy, 2022) and 'nature inclusive urban' design (Apfelbeck et al., 2020), and perspectives on 'more-than-human' participation and co-creation

([Pettersen et al., 2018](); [Akama et al., 2020](); [Clarke et al., 2019](); [Dolejšová et al., 2023]()) and innovation, such as explored through emerging technologies ([Nijs et al., 2020](); [Tomitsch et al., 2021]()). Recognising urban sustainability as a complex and multifaceted challenge ([Du Plessis, 2009]()), the village leaders invited experts from other disciplines and sectors – biology, conservation biology and local governance – to in line with goals about inter- and transdisciplinarity and engagement with societal actors, share knowledge from science and practice, further demonstrate the diversity of ways that nature could be perceived and to provide student feedback.

The subject was divided into a start-up phase, work phase and completion phase, and the students did self-directed work on self-chosen topics and approaches within the broader theme of the course. First, however, students were asked to *identify* what diverse types of nonhuman natures lived in cities. This itself proved challenging, encountering questions such as, 'how is nature defined?' The goal was to broaden conceptualisations beyond known and 'acceptable' urban creatures, such as domesticated dogs and cats, to consider the ugly, diverse and hidden, such as the nocturnal or seasonal, the untamed or stray, the underground or up above, the cultural and even the mythical nonhuman natures that exist around us. Moving beyond species, the lecturers sought students to acknowledge natural elements in cities, such as the weather (water, ice, snow and hail), sun and so forth.

Next, it was needed to challenge students to *critique and disrupt* their preconceived frames of 'nature': to broaden what this term could include and to illustrate the diversity of ways that nature could be perceived and how such frames conveyed different values, that in turn, affected their power to interact and shape the human world around them. Such frames may be formed from societal values in addition to specific cultural beliefs, values, and generational experiences. [Kerr and Andreotti (2018)]() liken this to decolonial pedagogic practices that strive to desettle "the role of colonial power in structuring the imaginative limits of Western modernity" (p. 53) where "ecocritical scholars draw needed attention to the inter-related injustices for the human and more-than-human that are supported through modernist epistemologies and related metaphors" (p. 55). Decolonial disruption disentangles traditional human-centred relationships – such as 'pest' or 'weed' – to consider new identities in addition to recognising connections between species, and assemblages between species, place and other relevant aspects ([Chao, 2021](); [Power, 2009]()). By highlighting frames to reveal assumed power structures, both a critical thought process and an ethics of design was taught – as the students' work embedded directionality from their own assumptions. Such critical thinking encompasses a delicate iterative process, simultaneously 'tightening' understandings when questioning the politics behind assumptions, while alternatively, innovation necessitates creative, more open, perspectives. By raising issues of conflict and opportunity through discussion and news articles, aspects of more-than-human politics, ethics and justice in the class were highlighted while the students were encouraged to critically identify and question their assumptions of both what current human/nonhuman nature relationships existed and could be. For example, students were asked to take note of discourses used to describe and manage various types of natures, such as the use of 'weed' or 'invasive pest' in the media, or relationships of control that were embedded within public land management practices. Rather than carry these forward, they were asked to consider how new relationships could be formed towards establishing convivial relationships between nonhuman and human natures.

Third, still following the subject's experiential learning process and goals about drawing on different kinds of knowledge and challenging beliefs and practices ([Sahakian & Seyfang, 2018](); [UNESCO, 2022]()), students were encouraged to *sense* their surroundings to feel where 'nature' could be found in the city (see [Abram, 1996]()). Acknowledging how environments influence human/nonhuman understandings, [Ingold (2013)]() stresses how an 'anthropology of the outside' not just requires an observation of what occurs there, but also a process of 'thinking through'

with the environment. As recognised by others, this process "involves seeing, listening to, and responding to other entities as well (cf. Zylinska, 2012; Driessen et al., 2014)" ([Westerlaken, 2020](): 117), as a result training students in "the arts of noticing" ([McGregor & Alam, 2022](): 178). From this 'making visible' of diverse urban natures – in both intellectual and sensorial ways – the students were encouraged to explore how these found natures *related to* others to help draw out species that are the most hidden. This relational approach repositioned humans as part of that natural system; to consider human/nonhuman relationships and interdependencies ([Maller, 2018]()). Reconceptualising being 'more-than-human' can also extend to the perception of the human body, not as a singular and separate subject but as a host representing its own ecosystem of microbes ([McFall-Ngai, 2017]()).

Finally, the students were encouraged to conceptualise and move towards experimentation and action by proposing a design intervention to reconfigure negative, or to construct new positive, human/nonhuman nature relationships. The goal was to encourage students to develop scenarios that demonstrated how humans and nonhumans could 'live well' together. To achieve this aim, diverse and less privileged stories from nonhuman natures were encouraged using the future-oriented character of design. Positioned within the area of design for sustainability transitions (e.g., [Irwin, 2015]()), students were invited to envision more-than-human urban futures; alternatives that countered the human-centered city. The focus for the subject was to explore what was imaginable, possible and preferable ([Candy, 2010](); [Hancock & Bezold, 1994]()). Alternative urban visions can mobilise powerful forces: shaping innovation activities where speculation can challenge and transform the linearity of the city. With its emphasis on visualisation and materialisation, design can make futures experientially accessible through speculative proposals that in turn allow for discussions about what is desirable and experimentation with alternatives. In doing so, the students were challenged to move beyond the human-centeredness of design and other disciplines to ask questions and speculate about how things *could* be ([Dunne & Raby, 2013]()). This powerful capacity can enable collective explorations of issues of inclusion and radically different 'counter-city' futures.

Group project themes were developed over the entirety of the semester, culminating in the student groups' project reports, an approximately 12,000 words report with graphics, co-written by all team members produced at the end of the semester. These reports were complemented by three presentations by each group held throughout the semester with feedback provided from the lecturers and students also guided the development of these projects, and hence their visions.

This article analyses visions emerging from the student group work. The visions were identified largely through analyses of the project reports. Some visions were completely represented within an individual project report, while other projects shared similar visions with respect to topic, timeline or approach, and were collated. As a result, from the six group projects produced in the class, five group projects were analysed for this article, categorized into three visions. Future 1 represents a composite vision from three groups (groups 1, 3 and 6) who focused on short-term possibilities. Future 1 is expressed by two prominent themes – the projected decline of pollinators and how weeds are perceived in urban areas. Futures 2 and 3 are visions from singular projects (groups 4 and 5 respectively) where future 2 explores the vision of convivial cohabitation, and future 3 investigates the vision of enduring urban nature.

The sources were analysed using content analysis for qualitative coding ([Stemler, 2001]()). Rather than provide a definitive analysis, such as by a word frequency count, discussions and illustrations pertaining to these visions infer points of engagement with a wider body of more-than-human, urban studies and design literature, while revealing the key interests and assumptions held by the students. Analysis was further triangulated by notes taken by the teachers from reference group meetings; meetings held three times over the semester where one student from each group provided feedback on the process and content of

the subject (Neuman, 2005). Hence, these sources represented a record of continual development and reflection of the students' engagement with the themes over the semester. Permission to use these sources for publication was received from all students.

3. Findings: future visions

This section draws out and discusses the three future visions within the students' projects.

3.1. Future 1: (mobilisation for) not-so-distant futures

The first vision is one of (relatively realistic) possible outcomes in the not-too-distant future. These are imagined as results of processes in which citizens are mobilised for action, through information, awareness-raising campaigns and social dynamics, in turn leading to behaviour and community level change. Rather than imagining alternative futures to critique individualisation of action and responsibility, these projects build on and develop such strategies further, showcasing possible desirable outcomes.

In the words of Group 1, "we want to help make the city a friendly and livable environment for [bees]" (Elsheim et al., 2021: 2). To do that, the group designed an app that could engage the community in developing green pollinator paths where they could follow their progress via green dots. Fig. 1 shows an overview of its main functions. The group emphasised citizen engagement as: "these are problems that normal people can contribute to solving if they get the proper motivation and guidance" (ibid.).

Focusing on bumblebees, Group 3 picked the challenge of moving "from public awareness" to "public action that benefit pollinator stocks" (Estevez Fernandez et al., 2021), aiming to "create an awareness campaign for both the decline of pollinator stocks and the seemingly simple endeavors to mitigate this decline" (ibid: 8). The group employed game-like strategies, designing a treasure hunt to get people out into urban nature and engage different groups in mitigating the decline, through online posters accessible through QR codes on tiny gravestones placed around the city (see future 3). The students described how the tiny graveyards served three functions, where, first they would "have an attention grabbing effect, making bypassers stop and have a look, and ideally scan the QR code", second, "as a symbol for the declining pollinator stocks", and third, "not only be a symbol of the pollinators declining stock but also of death itself" (Estevez Fernandez et al., 2021). Information-based strategies targeting different groups of citizens were here thus coupled with symbolic elements to create emotional engagement and highlight relationality and interdependence. This raises questions, including: are dystopic symbols and scenarios conducive to action? If so, for whom and for how long? With the recent finding that almost 50 % of global youth believe the world is doomed due to climate change (Hickman et al., 2021), there is a strong need to assess what types of visions are effective for mobilising change.

For a third group (Group 6) focusing on weeds, the threat of urbanisation was the starting point. The group aimed to increase biomass in urban landscapes, using currently unwanted plants – native weeds – to prompt change (Fjeld et al., 2021). They proposed a five-step strategy to change attitudes towards 'unpopular' weeds and a pilot project to test it. They thus implied that individuals in the public needed to change their attitudes towards weedy plants so they could be accepted and introduced in larger quantities, supporting the health of urban ecosystems and ecosystem services. This project challenged current norms and standards for 'wanted' and 'unwanted' plants, and ideas about controlling nature.

3.2. Future 2: convivial cohabiting with unlikely companions

The second vision depicted 'unlikely yet desirable futures' that could become possible with additional approaches such as new human/

nonhuman relationships, material structures and/or digital or alternative forms of technology. Underlining this vision was the goal of convivial multispecies cohabitation, a concept that strives to bring nonhuman nature even closer to human homes. It is based primarily on one group's work titled here as 'Living Well with Bats', where the group sought to establish a unique geographical space where people and bats could peacefully co-exist by spending time with 'the other'.[1] Drawing on work by architect Einar Bjarki Malmquist and biologist Jeroen Van Der Kooij (Årdal & Chavez, 2020), they developed the idea of a retreat (referred to as a 'bat house') located in a quiet location above the river beside the cemetery (see Fig. 2). This retreat is designed to first accommodate the needs of bats – as demonstrated by its specialised walls, sensors and barriers – to secondly welcome humans to book a place to sit on the other side of the partition to socialise and watch the sunset (Figs. 3–5). The site is accessible to everyone with a smart phone.

This vision occurs within the foreseeable future where such human/nonhuman interventions could become an ongoing attraction for the town. The intervention primarily draws on engineering solutions and the careful examination of suitable spaces to create urban 'acupunctures' (Casagrande, 2013) of attractive multispecies' spaces.

3.3. Future 3: enduring generational visions

The final vision by Group 5 focused on providing a strategy to sustain human wellbeing through connection with nonhuman natures into the future. It focused on the built heritage of Dora I, shown in Fig. 6. This is a former above ground submarine bunker from the Second World War when Norway was occupied by Nazi Germany. The material structure of Dora made the site particularly alluring as a project as they were built to last with extremely thick concrete walls. Indeed, the presence of the bunker made Trondheim a target for allied bombing operations during the war – a plan that was later aborted (Skjaerseth, 2015). This enduring characteristic also prevented plans for demolition after the war, where "due to its massive size and thick walls, the amount of dynamite needed meant that the subsequent explosion and resulting shockwave would damage or ruin a significant part of the surrounding area" (Myhre et al., 2021: 10). Today, the building is mostly used for offices, storage and as an archive due to its constant temperatures (Dora Eiendom, n.d.; Rosvold, n.d.).

The students decided to transform Dora I into 'Dora the Exploration Centre', drawing from the children's television program of a similar name (Wikipedia, n.d.). This revised version of Dora would house a rainforest, with the purpose to "create a year-round indoor space to increase the human non-human interaction in Trondheim". By providing a living accessible urban forest within the building, the students desired: "to increase the populations' exposure to nature, light and warm weather, as well as physical activity" (Myhre et al., 2021: 5–6) – an unusual form of nature engagement considering Trondheim's Arctic climatic conditions. This sensual approach sought "to create an authentic feeling of being in the middle of a tropical forest", where it would feel "more like an indoor ecosystem than a botanical museum" (ibid.)

Hence, Dora the Exploration Centre expressed the positive side of nonhuman nature in climate that on average experiences weather below zero for four months per year (Weather Spark, c.2016) and is likely to worsen with climate change becoming more erratic, warmer and wetter (Hanssen-Bauer et al., 2017). The students describe how through Dora's constant humidity – while escaping the treacherous weather outside – Dora "will give them a first-hand experience with nature that they might never otherwise encounter", as "a feeling of untouched nature" (Myhre et al., 2021: 7) where: "Natural pathways will form through the forest as people start moving within the ecosystem. Otherwise, no man-made

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[1] See Kaninsky et al. (2018) for a similar example of using technology to overcome peoples' fear of bats.
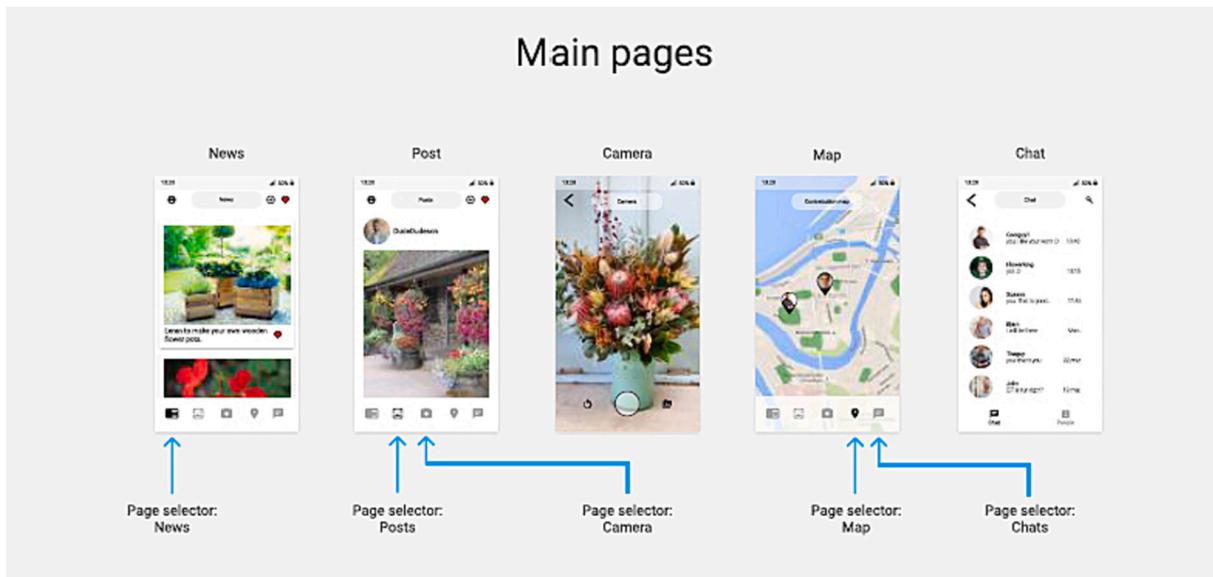
Fig. 1. The pollinator path app (Elsheim et al., 2021). The figure shows the five main pages and functions. From left to right, these are "News", with articles and information posted by experts, "Posts", where users will find pictures from people they follow, showing their contributions to creating a pollinator path, "Camera", which they can use to take pictures and post their own contributions, "Map", which illustrates the development of the path and is updated with green dots when new posts are accepted as contributions to it, and finally, "Chats", where users can stay in touch with friends, share information and discuss initiatives. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

Fig. 2. The bat house (Bremnes et al., 2021: 42).

influence will be present inside the building" (ibid.). The longevity of such nature connections was further stressed by the fact that a full tropical forest may take up to 65 years to reach maturity, and anywhere "up to 4000 years to create a truly natural identity [15, 16]" (Myhre et al., 2021: 8).

4. Discussion

4.1. Designing for more-than-human futures

In this subject, input from design guided both the process of exploring the diversity of urban natures, identifying human/nature conflicts, and doing research and generative work on how to foster change, and the development of the resulting proposed concept or intervention. At the same time, the subject is a rare opportunity –

especially in the context of more-than-human design – for design students to closely engage with students from other disciplines, over time, as called for by Clarke et al. (2019). The overarching design approach introduced was, in addition to input from other disciplines, coupled with perspectives and approaches for grounded, real-world research from anthropology. Students were encouraged to do background reading, go on walking tours, conduct brief fieldwork and interviews, experiment with auto-ethnography, mapping approaches and storytelling, in addition to using visualisation and materialisation techniques throughout their process.

This was done to help students break away from dominant understandings and develop their ability to imagine otherwise. This matters as current understandings and imagined futures influence what is done and innovated. Visions of alternative, possible futures can form the basis for discussions in the present about what is desirable, risks and
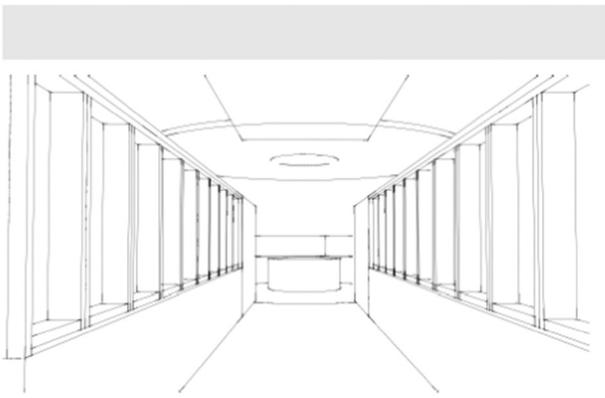
Fig. 3. A side profile of the bat house with bat chambers and the fire pit (Bremnes et al., 2021: 35).
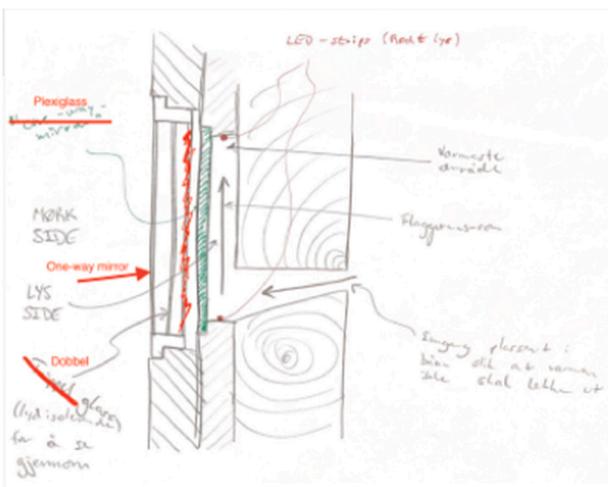

Fig. 4. Within the bat chambers (Bremnes et al., 2021: 43).
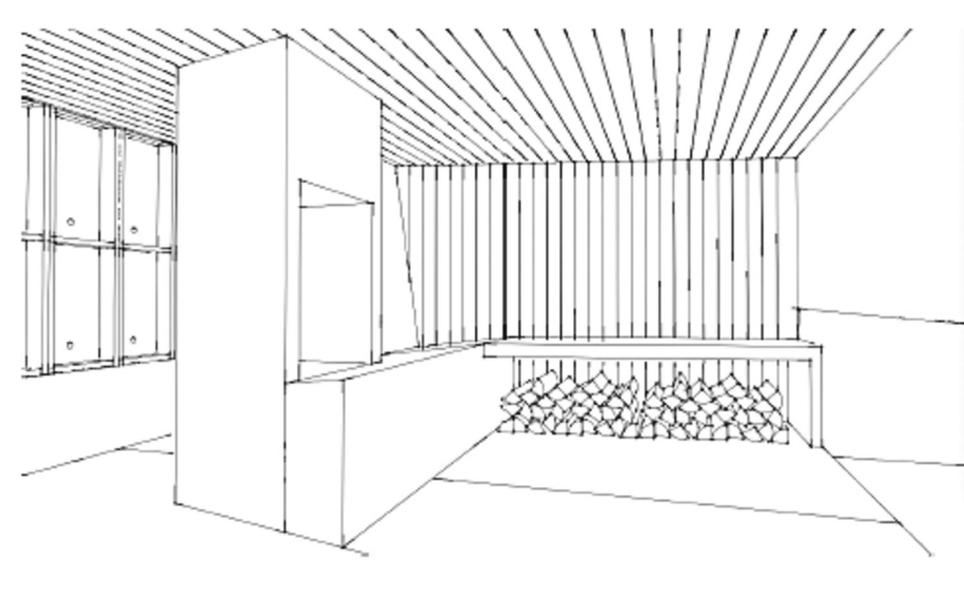
problematic sides of current developments, and "act as a catalyst for collectively redefining our relationship to reality" (Dunne & Raby, 2013: 2). Visualising and materialising can further make futures accessible and connected to the everyday.

The students made use of drawing and visualisations in different ways. For example, Fig. 7 shows how students represented the experience of exploring and sensing their surroundings, discovering an unexpected presence of uncontrolled urban nature. Platforms such as Miro were used to facilitate joint brainstorming and mapping, drawings and images used to explore current situations and generate ideas, digital app prototypes were developed, graphic user interfaces designed, and CAD models built to detail and visualise concepts.

In their work, the students visualised images of humans and non-humans living well together. However, while providing snapshots of possible urban nature futures, they explored to little extent contextual change beyond the specific challenges and relations they were focusing on.

Future 1 depicts the near future as a result of technology-mediated awareness-raising, individual and community level attitude and behaviour change. It engages with probable futures in that it focuses on mitigating current or projected declines in pollinator populations and biodiversity. By doing so it builds on rather than challenges current mitigation strategies and ameliorates the effects of past developments. For citizens, the vision both imagines engagement in new activities and resolves problematic ones, such as extensive removal of 'weeds'. The second vision depicts less probable futures, in that it promotes cohabitation with unlikely companions. Although facilitating unusual conviviality, it occurs within the foreseeable future and depicts a controlled environment with humans and other creatures kept apart. The proposed acupuncture approach challenges this, potentially spreading such unlikely meeting points around the city. Future 3 takes optimisation and control to the extreme, moving 'nature' into a bunker. Although partly a vision of a protected space, opportunity for immersion in nature and connection to other temporalities, it can be read as a dystopian future and critique of ambitions to engineer 'solutions' to global challenges.

With regards to what was designed and how it was presented, the first two futures further connect future possibilities for care and encounters to everyday technologies and environments that are familiar and attractive to humans, such as mobile phone apps and possibilities for watching the sun set by the river. At the same time, in the first and last future new connections are made as physical elements – tombstones and


Fig. 5. Inside the bat house with fire pit and bat chambers to the left (Bremnes et al., 2021: 41).

Fig. 6. Dora I.
(Source: Ferne Edwards).

Fig. 7. "Then we sighted something very interesting: A tree growing from a crack in a vertical concrete wall!" (Fjeld et al., 2021: 5).

a bunker – are introduced as mediators of encounters with nonhuman natures, with the possible effect of surprising or disrupting audiences' expectations.

The extent to which the futures were alternative and disruptive varied, and a question for the future is thus how to further enable students to critically address current developments and imagine beyond current understandings and conditions, also given the complexities of the challenges addressed. Here, opportunities could include to further

introduce and encourage students to draw on approaches from design and futures studies. Some of the groups had design students in the teams, and thus experience with project-based creative work and moving from open assignments to concrete proposals through iterative processes. For design students, the topic and especially the call to challenge the human-centeredness of the field was new, but the way of working familiar. For others, as further discussed in the next section, both topic, project work and working across disciplines was new and seemingly transformative. Students for example reported to have been experiencing synergies but also tensions, gaining insights into their own and others' way of working, for example based on how design students wanted to keep exploring what to design and reframe problems, whereas engineering students focused on progress, efficiency and problem-solving.

4.2. Teaching interdisciplinarity

The subject studied is a relatively unique opportunity for students to meet across disciplines to jointly address complex, multi-faceted sustainability challenges while the village discussed here also emphasises approaches that are inclusive of other beings and knowledges (cf. UNESCO, 2022). Unlike other courses that address multispecies cohabitation starting from and specialising within one discipline, such as 'Designing Multispecies Architecture' (Ezban, 2021), the students in this Experts in Teamwork village had to both overcome interdisciplinary differences while engaging with what was for many a new topic. Furthermore, the students were encouraged to think critically about the application of their projects – to not take the assumed or easiest route. For example, while web-based applications were popular with this demographic, caution was expressed in how such chosen methods could

impact their outcomes (Morozov, 2014; Sadowski, 2020).

Another point of difference was that while many professional situations can choose their working groups (Pennington et al., 2013), the students did not have a choice of who (and which professions) were in their groups. As a result, the case study came to reflect what interests, abilities and opportunities from Trondheim were present, rather than being representative of what strategies were of top priority for resolving urban nature issues. Table 1 illustrates interdisciplinarity involvement as experienced by one group per future. (Please note that while future 1 builds on the work of three groups, we have here thus only included analysis of one (Group 3)).

The table demonstrates considerable crossover of disciplines, where students identified new skills from their backgrounds to interpret and apply to the project work. In their reports, the students expressed both social, process- and content-based interdisciplinary skills in their groups, including skills gained outside of their studies. Experts in Teamwork enabled students to explore new perspectives, knowledges and approaches in a safe, 'slow' and understanding space that they would not normally be encountered in their professional lives. For example, an engineering student mentioned how he took this opportunity to take role that was more socially oriented than task-oriented, while another student focused more on developing their communication skills rather than project management – the latter being their typical work focus.

However, *how* this exchange occurred was not so apparent or predictable. The village leaders were surprised in later discussions to find

Table 1
Interdisciplinary profiles and contributions of students in the groups.

Visions	Disciplines – background and contribution
Future 1: (mobilisation for) not-so-distant futures (Group 3)	*Computer science*: informatics specialist, web development *Planning*: creative process; matters relating to urban planning *Biology*: bumblebee specialist *Ecology*: content for the web-posters *Nanotechnology*: developer and biologist (Estevez Fernandez et al., 2021)
Future 2: convivial cohabitation (Group 4)	*Industrial design*: aesthetics, the human experience, and project facilitation through mind mapping and other collaborative design techniques *Mechanical engineering*: concept development; technical aspects *Civil engineering*: building standards, construction; project management Nano(bio)technology: physics, mathematics, material science, chemistry, molecular/cellular/microbiology; immunology, toxicology; navigating medical and biological research; risk analysis. *Urban planning*: green corridors, principles of universal design, accessibility, current laws; software. (Bremnes et al., 2021)
Future 3: enduring generational visions (Group 5)	*Informatics*: programming, software development, web and graphic design *Material Science & Engineering*: knowledge of materials, media & communication > in charge of the building's properties; structural engineering; use of materials in humid and highly corrosive environments; marketing; design *Electrical engineering*: instrumentation, i.e. Solar panels *Cybernetics and Robotics*: robotics and control in real-world applications; passion for both plants and nature > automation of temperature, light and humidity Physical planning: geography, philosophy, linguistics and psychology; > quantitative and qualitative methodology, social and natural geography; local knowledge and perspective. (Myhre et al., 2021)

out that one group had worked largely independently of each other, dividing the tasks between them and only uniting their efforts in the finished report. This approach – while producing an excellent report – highlighted how rather than produce cross or transdisciplinary approaches, instead maintain multi – and in some cases – intra disciplinary approaches may result.

On reflection, the village took an inter- to transdisciplinary approach, where more disruption was needed to encourage students to consider different methods, theories, scope and spaces to apply to urban natures. This approach pushed students into an uncomfortable, open space to assemble or develop innovative approaches for their projects. This approach is referred to as a 'non-disciplinary' or 'undisciplined' approach in design studies, where "new knowledge is created rather than incremental contributions to a body of existing knowledge" (Marshall and Bleecker, cited by Celaschi et al., 2013: 6), shifting from "disciplinarity, to interdisciplinarity, via trans-disciplinarity, to undisciplinarity" (Celaschi et al., 2013: 6).

4.3. The more-than-human city as the counter-city

To realise the more-than-human city, dominant power relationships between humans and nonhumans need to shift to enable nonhuman natures the right to coexist in the city. To reach this aim, nonhuman natures need to be sensed, valued, normalised and legitimated. Power is illustrated in the future visions through the students' choice of natures and how they are framed, sitting on a spectrum from caring 'about' and 'for', to respect, towards a 'living with'.

In future 1, citizens and communities are aware of the challenges and have taken action to improve the living conditions for less visible species, and their perception of previously 'unwanted' or 'ugly' nature types has changed, making such nature abundant. Future 2 also acknowledges the rights of 'frightening' animals – such as bats– to urban space. Groups from future 1 sought to engage and guide humans into caring and making space for them in cities, thus starting with individual humans and communities to 'counter' or perhaps rather make the human-centered city more inclusive. Here the question arises: how much risk and sacrifice will humans tolerate to share the city with nonhuman others?

Alternatively, group 3's project, 'Bee Gentle, Bee Kind', which is represented in the composite future 1, based their awareness-raising campaign on game elements and dystopian symbolism and an understanding of urban natures within the planetary boundaries model, outlining the environmental boundaries for human survival with respect to biodiversity loss and extinctions (Steffen et al., 2015). Hence, the students assume an attitude of 'caring for' based on anxiety and fear that positions humans with the skills and power to resolve the consequences of their actions. Coupled with the emphasis of mobilisation of citizens, this frame downplays the agency of nonhuman natures and ecological change, rather than empowering more-than-human communities (cf. McGregor & Alam, 2022). Alternatively, by anthropomorphising bumblebees, bumblebees become more visible, demanding urban space and human attention, and hence possibly becoming more valued in human worlds. Yet, in doing so, the intervention fails to recognise their intrinsic values as bumblebees. At the same time however, the group's use of symbols – gravestones – was well liked by its audience. No one could however quite express why. Possibilities include this symbol conjuring up images of elephant graveyards where lone elderly elephants wander off to die unnoticed yet remain communal in death nestled in the corpses of similar others. So too could the symbolism evoke images from Mexico's *Dia De Los Muertos* that embraces death to remind us to relish life, while recognising humans as part of natures' lifecycle.

Future 3 of 'Dora the Exploration Centre' introduces a different human/nonhuman relationship again. While the students' claimed no desire to use this site as a tool for biodiversity conservation, this project stirred visions of Soleri's (1973) arcology; self-contained built systems that are designed to reduce human impact on their external

environments by producing their own essential needs, such as food, water and electricity. Similarly, images of the biodomes from science fiction movie, *Silent Running,* jump to mind – an image that embraces the 'Starship Earth' metaphor "which suggests that the earth is a small, vulnerable craft in space" (Young, n.d.), where human and nonhuman natures must work to coexist for both their survival. Hence the students' project prioritises a mutual dependence between human and nonhuman worlds, while sheltering humans from the storm 'outside'. On a spectrum from continued anthropocentric dominance to re-balancing the right to the city to include nonhuman inhabitants, Dora perpetuates conditions for human control as the forest's right to the city remains dependent upon people to establish this space. Alternatively, future 3 could be interpreted to denote power of nonhuman nature through its longevity, where the forest would reign much longer than an individual human life.

Future 2's application of convivial cohabitation as demonstrated by 'Living Well with Bats' further disrupts what is possible to provide an embodied experience of nearing intimacy, generating an affective resonancing with nonhuman natures on natures' terms where humans must adapt their behaviour to *bats' needs*. This vision thus represents a shift away from an anthropocentric city to a more multispecies one to recognise nonhuman natures' right to space alongside humans, who are also recognised as part of – rather than separate to – the cycles of nature.

Escobar (2018) reminds us that design materialises 'a way of being' where the production, consumption and endurance of urban space over time reflects values and possibilities for action. Noting the prominence of the 'smart city' discourse, we recognise that technology too influences the localisation and embeddedness of space, asking: do such technologies bring humans closer or further away from nature? What types of nature are they taking humans towards? Indeed, a shift in structures, technology and their use of space – and the flows that exist between them – can welcome and enable nonhuman species co-occupation. This prompts the question: how can such ontological shifts occur in the city to bring about normative more-than-human coexistences?

The three visions approached space in different ways. With respect to their place in and across the city, future 1 chose primarily places in the city center, many of which travelled across multiple sites within the (same) city. For example, all three groups focused on Trondheim city center, the second group specifying locations as sites for the treasure hunt. Alternatively, futures 2 and 3 chose specific sites, albeit both also close to the city center. The site for future 3 was both invincible and immoveable, where space was opened up within it for nonhuman natures to (co)exist.

Another way of interrogating space is through the increased emotional or symbolic connection across species in the city. From these examples, future 2 focuses primarily on the bats' needs that could also be enjoyed by humans. This site, based near a cemetery, a hospital and a river, lent itself to being a place of reflection, where nature could remind humans as being of one of many species within a wider natural world. Hence, it illustrates opportunities for geographical *and* affective cross-species' closeness.

While these sites show that students demonstrated an understanding of the city as a connected and relational system, of which nature – human and nonhuman – is integrated within a wider environment, it also reveals a propensity for inner city living – perhaps not surprising being where many students live. Furthermore, it reveals that there is less emphasis on the broader context of Trondheim as a future city. Going further in that direction could involve greater engagement with processes of urbanisation and for example how climate change is expected to affect the city and in turn different locations, beings and relations within it.

The temporal aspect of 'space' – noting the interdependence and/or projection of concerns over space into the future – is most apparent in the work of group 3 and in future 3. With little colony collapse disorder reported in contemporary Norway, group 3's (future 1) 'caring for' pollinators across state borders and generations to present a vision of the

world, and more specifically bees in Norway, is doomed if no action by humans is taken. Alternatively, Dora offers a contained vision of the urban future – presenting a fortress-like approach that preserves, yet also separates and upholds and inverts – divisions of 'wild nature' that now exists – expertly controlled by humans – in the city.

Again, perhaps not surprisingly, many of the visions were short term – ranging from most plausible (being future 1) through to futures 2 and 3 as the most distant. This spectrum reveals that the students prefer obtainable visions – those that are realistic and achievable from which the students can grasp – possibly also correlating to their disciplinary foci. However, short term visions tend to uphold current human/nonhuman relations and assumptions, and as such, are often less revolutionary or transformative. Instead, there is a need for visions of different lengths, where backcasting (Quist & Vergragt, 2006) presents an effective approach, first settling on extensive future visions that can be used to define transitional steps to link back to the present.

To also note is that while context is essential for grounding the research, these visions remain within the characteristics of Trondheim, limiting their translation to (largely) Nordic cities. This however is an excellent iteration which needs to be practiced elsewhere, as urban visions predominantly focus on large cities such as London, Chicago and Barcelona, with some notable exceptions that focus on the Global South (Chattopadhyay et al., 2022). So too does Trondheim represent an excellent site for such more-than-human wonderings due to its temperature and rainfall that can demonstrate the impact of extreme seasonal variations on urban life. Indeed, as noted elsewhere (Edwards, 2023), climate takes on a dominant role in Trondheim, where the transformation of spaces – such as Dora – are essential in urban planning and policy to ensure different types of nature can coexist.

5. Future possibilities for 'designing in urban natures'

The Experts in Teamwork village 'Designing in Urban Natures' only just begins to entertain multiple visions that can address growing population density, environmental disasters and future resource needs (Dixon & Twedwr-Jones, 2021), where more-than-human cities serve as one pathway to deliver numerous co-benefits. As recognised by Westerlaken (2020: 136), such possibilities are limitless where "when we start to take world-making practices seriously, we start to discover multiple times, multiple spaces, multiple relations, multiple origins, and multiple modes of causality or noncausality: worlds start to multiply, and the singular universe starts to dissolve (Law 2018: 361)" (ibid: 314). To assert the more-than-human city as a normality, more visions that amplify both utopian and dystopian possibilities are needed – both in number and extreme – to provide strategies that can entertain possible risk and negotiate convivial multispecies relationships. For the future, this could have been included as an explicit assignment. Here, the overarching assignment was to address a societal challenge – reconfigure negative or construct positive relationships, develop an intervention and demonstrate possibilities for living well together. The visions analysed here thus emerged from work for which coexistence was a goal. Hence, many remained quite 'tame' where power was not handed over completely to nonhuman natures nor were any urban spaces left completely wild. For example, bats remained housed in human-directed form to co-benefit humans, while future 3 was still monitored and controlled (both by technology). By reconceptualising more-than-human relations at an urban scale, new visions can propel new possibilities, as explored by Mathur and da Cunha (2009) who re-envision Mumbai as an estuary: water and fluidity become key components of urban form, softening spatial and temporal lines while nurturing cultural memories of place.

In addition to encouraging more radically different futures, greater emphasis could be placed on broadening and breaking down artificial separations between human and nonhuman worlds, in line with calls for further engagement with diverse cultures and knowledge systems (Clarke et al., 2019; UNESCO, 2022). For example, students could be

encouraged to explore more-than-human ethics, spaces and politics of diverse natures in Trondheim. Indigenous perspectives of nature could be considered within an urban context, such as 'becoming kin' (Rose, 2021). Alternatively, students could explore individual versus collective action in the city, where urban space and infrastructure could enable possibilities for multispecies commoning (Edwards et al., 2022; Grupposo et al., 2022). Recognising how this village is one of many in Experts in Teamwork, the sharing across of pedagogical approaches used in subjects of a similar theme and approach could help to further build on the approaches used here (see Gutierrez Gonzalez et al., under review). So too could aspects raised briefly in this paper – such as care, risk and technology – be explored in greater depth.

Co-creation approaches are relevant to further exploring transdisciplinarity and inclusion. While usually limited to those who can voice their opinion, possibilities exist for pedagogic and methodological innovation. As suggested by Clarke et al. (2019) in the context of design pedagogy and more-than-human participation, alliance-building mediated by design could in particular be a skill to nurture. To deepen transdisciplinary engagement, students could role play more-than-human experiences in the city from different stakeholder perspectives, such as from council (Balsiger, 2015), Indigenous communities (Escobar, 2018) or different generations (Jonsson et al., 2012). New co-design methods can help invite non-human 'participants' in and enable multi-actor explorations of interdependencies and possibilities for coexistence (Pettersen et al., 2018). Olsen (2022) shows how theatre-based approaches and a Latourian 'Parliament of Species' can be used to stage multispecies participation and co-creation. Approaches from other disciplines could also be used to convey such possibilities. For example, 'thick description' from anthropology and visualisation techniques from geography and the arts could enhance communication of more-than-human stories (Rupprecht et al., 2021). Within geography, Kirksey et al. (2018) introduce possibilities for more-than-human co-creation involving new technologies, spaces and participants, using wingtagging and a Facebook page to help trace the conflictual and convivial relationships between people and wild cockatoos in Sydney, Australia. Alternatively, by positioning themselves at different places within the city, for example, taking a 'birds eye' view (Mikkola, 2020), new assemblages of stakeholders could be formed. In her 'Life Overlooked' project, Adamson (2016: 114) argues that such 'constellations of practice' can "help us see deep time, scale and intricately entangled relationships between human and nonhumans that may be relatively invisible to most humans".

So too could the translatability of these visions be considered for other cities and spaces. Future 2 recognised possibilities for extending sites of convivial cohabitation to other creatures, such as humans and bees, where a:

> bee house would allow for experimentation with an organic design and inspiration from honeycomb … humans [could] get honey from the bees to have in their tea; subsequently users fertilize the surrounding flower beds with the tea leaves … an otter habitat was also discussed … we investigated ideas that were related to creating artificial caves in which otters could live … brings humans closer to the water, and maybe include a sauna to make it appealing in the winter.
>
> (Bremnes et al., 2021: 57-8).

Finally, reflections on writing this paper demonstrate that there are multiple ways in which to translate the students' visions – where this plurality may produce more questions than answers in what is possible in a more-than-human world. So too could evaluation tools be introduced during the subject to assess transdisciplinarity. For example, through demonstrating critical thinking skills beyond their disciplines.

6. Conclusion

This article has responded to the call to transition to a more-than-human city that can provide mutual benefits for human and nonhuman natures. This urban shift engages with the concept of the counter-city by arguing against Cartesian dualisms between people and nonhuman nature and the 'wild' and 'civilised', to recognise actual and potential coexistence of human and nonhuman natures in the city. Reflecting on the Experts in Teamwork village 'Designing in Urban Natures', students from different study programs were challenged to reconfigure human/nonhuman relationships in the urban environment. This article explores the student visions that emerged from this subject using an interdisciplinary – towards a transdisciplinary – approach. The three futures provided a range of possibilities for more-than-human coexistence, raising important questions of care, power, responsibility, use of space and approach. Furthermore, it highlights interstices for supporting students to engage beyond their disciplines towards addressing complex problems of urban sustainability. This paper illustrates how by challenging assumptions and practices within and between disciplines, new methods and approaches that encompass a more-than-human perspective can be sparked, questioned and actualised in the classroom.

CRediT authorship contribution statement

Ferne Edwards and Ida Nilstad Pettersen: conceptualisation; methodology; validation; formal analysis; investigation; data curation; writing—original draft preparation; writing—review and editing; supervision; project administration. All authors have contributed equally to the finalisation of the paper. All authors have read and agreed to the published version of the manuscript.

Declaration of competing interest

Ferne Edwards is a current employee of the University of Surrey and a previous employee of the Department of Design, NTNU – Norwegian University of Science and Technology. Ida Nilstad Pettersen is an employee of the Department of Design, NTNU – Norwegian University of Science and Technology. This article is not under consideration for publication elsewhere. The work of group 4 (Bremnes et al., 2021) was previously also described in a conference paper presented at DRS2022 (Edwards et al., 2022).

Data availability

Data will be made available on request.

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