

Bridging senses of place and mobilities scholarships to inform social-ecological systems governance: A research agenda

Sarah Gottwald^{a,*}, Iga Kołodyńska^b, Matthias Buchecker^c, Andrés Di Masso^d, Nora Fagerholm^e, Maciej Frąckowiak^f, Viola Hakkarainen^{g,h}, Katarzyna Kajdanekⁱ, Ursula Lau^j, Lynne C. Manzo^k, Stefan Ortiz-Przychodzka^{a,l}, Jasmine Pearson^{a,m}, Tara Quinn^{n,o}, Łukasz Rogowski^f, Richard Stedman^p, William P. Stewart^q, Agnieszka Trąbka^r, Daniel R. Williams^s, Timo von Wirth^{t,u}, Jakub Zawieska^v, Christopher M. Raymond^{g,h,w}

^a Social-Ecological Systems Institute, School of Sustainability, Leuphana University Lüneburg, Germany

^b Institute of Spatial Management, Wrocław University of Environmental and Life Sciences, Poland

^c Research Unit Economics and Social Sciences, Swiss Federal Research Institute WSL, Switzerland

^d Faculty of Psychology, University of Barcelona, Spain

^e Department of Geography and Geology, University of Turku, Finland

^f Faculty of Sociology, Adam Mickiewicz University in Poznań, Poland

^g Helsinki Institute of Sustainability Science, University of Helsinki, Finland

^h Ecosystems and Environment Research Program, Faculty of Biological and Environmental Sciences, University of Helsinki, Finland

ⁱ Institute of Sociology, University of Wrocław, Poland

^j Department of Psychology, University of Johannesburg, South Africa

^k Dept of Landscape Architecture, College of Built Environments University of Washington, Seattle, USA

^l Grupo Espacio, Tecnología y Participación (ESTEPA), Universidad Nacional de Colombia, Colombia

^m School of Architecture and Built Environment, Queensland University of Technology (QUT), Brisbane, Australia

ⁿ Irish Climate Analysis and Research Units, Maynooth University, Ireland

^o UKHSA, Centre for Climate and Health Security, UK

^p Department of Natural Resources and the Environment, Cornell University, USA

^q Department of Recreation, Sport and Tourism, University of Illinois, Champaign, IL, USA

^r Jagiellonian University in Krakow, Institute of Applied Psychology, Poland

^s USDA Forest Service, Rocky Mountain Research Station, Fort Collins, CO, USA

^t Dutch Research Institute for Transitions (DRIFT), Erasmus School for Social and Behavioral Sciences (ESSB), Erasmus University Rotterdam, the Netherlands

^u Research Lab for Urban Transport (ReLUT), Frankfurt University of Applied Sciences, Germany

^v Institute of Infrastructure, Transport and Mobility, SGH Warsaw School of Economics, Poland

^w Department of Economics and Resource Management, Faculty of Agriculture and Forestry, University of Helsinki, Finland

ARTICLE INFO

Handling Editor: J Peng

Keywords:

Senses of place
Mobilities
Social-ecological systems
Ecological catastrophe
Odra river
Research agenda

ABSTRACT

Uncertainty and change are increasingly commonplace as communities respond to impacts of social-ecological change including climate change, and dangerous levels of pollution. Given the extent of these crises, new approaches are needed to support responses. Here we identify challenges and discuss insights that the nexus of Senses of place (SoP) and mobilities research offers in navigating such uncertainty. We conducted a two-round Delphi, followed by a workshop, and collaborative writing process with a global network of researchers with expertise in either or both SoP and mobilities research. Participants identified five challenges at the place-mobility nexus that emerge when a social-ecological system is disrupted. We use the 2022 Odra River fish die-off to exemplify the identified challenges: 1) accounting for power dynamics, inequalities and motility; 2) doing justice to more-than human actors; 3) integrating multiple and sometimes nested spatial scales; 4) considering temporalities of place and mobilities, and 5) embracing multisensoriality. To address these challenges, we recommend drawing on diverse methods and knowledge co-creation processes that combine more-than-human perspectives, multisensoriality, and engage in the dynamic relations between places to

* Corresponding author.

E-mail address: sarah.gottwald@leuphana.de (S. Gottwald).

<https://doi.org/10.1016/j.apgeog.2024.103286>

Received 25 October 2023; Received in revised form 23 April 2024; Accepted 28 April 2024

Available online 13 May 2024

0143-6228/© 2024 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

understand people-place disruptions in the face of socio-spatial precarity. Addressing such knowledge gaps requires stronger collaboration of mobilities and place researchers.

1. Introduction

Uncertainty and change are increasingly commonplace as communities respond to the impacts of global climate change, ecological regime shifts, and migration (Devine-Wright et al., 2020; C. Raymond et al., 2021a). These changes and uncertainties may create “socio-spatial precarities”, and disrupt people-place relationships (Manzo et al., 2023). The concept of senses of place (SoP), referring to the emotional and cognitive connections between people and places (Stedman, 2008), helps generate new possibilities for thinking and acting in response to disruptions (Manzo et al., 2023). SoP concepts are increasingly recognized within research on social-ecological systems (SES) governance (Gottwald et al., 2021; Knaps et al., 2022; Masterson et al., 2019). They provide conceptual frameworks for understanding and assessing perception of SES and their changes (Stedman, 2016). While research showed that SoP and local knowledge influence place-embedded agency (Hakkarainen et al., 2022), there is a need to better understand how SoP relate to major disturbances and their governance. For instance, Manzo et al. (2023) show how SoP unfold in response to various disruptions within different social, economic and political contexts. They highlight how disruptions herald new beginnings, and raise tensions between uneven landscapes of power, grassroots initiatives and institutionally-led spatial changes that can create new opportunities for emplacement as well as responding to place related trauma and recovery.

Within the research of place change, disruption and relation, we acknowledge that mobilities are a key trait of contemporary societies (Hannam et al., 2006; Schläpfer et al., 2021), involving multiple actors such as people, goods, capital, information, diseases, and harmful environmental flows on local to global scales (Boas et al., 2018; Büscher & Urry, 2009; Hannam et al., 2006). Therefore, we propose to understand social-ecological systems governance through a nexus of SoP and mobilities. Some research has conceptualized the complex interrelationship between senses of place and mobilities specifically (Di Masso et al., 2019; Gustafson, 2009; Massey, 2005b; C. Raymond et al., 2021a), and highlighted the possibilities of multiple modalities of senses of place and mobility reflecting different configurations of fixed and fluid people-place relations (Di Masso et al., 2019). Di Masso et al. (2019) have illustrated the dynamic links between place and people's mobilities, highlighting that, rather than negating place, mobilities respecify the nature of places including openness, relationality and instability as some of their basic ontological sources. Thus, we understand the nexus as a complex and multifaceted two-sided relationship between senses of place and mobilities. On the one hand, human and more-than-human mobilities transform places and shape peoples' SoP (Arp Fallov et al., 2013; Drozdowski, 2007; Hakkarainen et al., 2022). On the other hand, senses of place may trigger (im)mobility, for example when attachment to holiday destinations leads to residential migration (e.g. Tuulentie, 2007), or SoP plays a key role in negotiating decisions to stay or move (e.g. Jansen, 2020; Jansen et al., 2017). These processes are difficult to disentangle as they are often intertwined and reinforce each other. Therefore, our goal in this article is not to systematically distinguish possible relationships between mobilities and SoP, but rather to focus on their nexus as a potentially fruitful research and analysis approach. In this sense, rather than defining the nexus, we provide here a conceptual starting point, which allows place and mobility scholars to engage with the nexus as a boundary object, which is flexible enough to be adopted to the diverse research contexts, and positionalities, yet robust enough to “maintain a common identity”, i.e. provide for a basic common understanding (Star, 2010; Star & Griesemer, 1989, p. 393). For example, while SoP scholars engage with the meaning of places (Stedman, 2008),

mobilities research looks at the meaning of the movement (Cresswell, 2011). Yet, limited research has dealt with the interactions between SoP and mobilities (Verstraete & Cresswell, 2016), mainly in the area of tourism and multiple dwelling (McInyre et al., 2006; Stedman, 2006), and migration (Gustafson, 2009; Hernández et al., 2007; Rishbeth & Powell, 2012; Trajka, 2019). These two scholarships provide insights for understanding SES disruptions and improving SES governance, and for bringing new theorizations on the dynamic nexus between mobilities and SoP amidst rapid social and environmental changes.

Rapid social and environmental changes are often reflected in river landscapes which are worldwide in peril, impacting human lives and biodiversity (Vörösmarty et al., 2010). They are a prime example of a complex SES whose changes underscore the nexus of SoP and mobilities. Rivers provide services such as flood protection, fresh water provision, and recreation (Vermaat et al., 2015, pp. 1–34). Therefore, the exposure of fragile river ecosystems to pollutants and climate change can significantly reshape SoP, as well as people's sense of safety and stability across temporal and spatial scales (Devine-Wright & Quinn, 2020; C. Raymond et al., 2021a). Changes to the physical contexts of places interrupt the very meanings and values of places, resulting in experiences of loss or alienation (Schlosberg et al., 2020). For example, severe flooding can trigger human migration (Dun, 2011), and the mobilization of soil contaminants across landscapes (Crawford et al., 2022). The connections of people with places and the way they move through places will change in response to chronic climate risks and sudden ecological shocks. The impacts of climate change through changes in ecosystems and livelihoods interact with other social-ecological processes to influence mobility patterns and people's relationships with places.

A specific transboundary case of disruption within a riverine SES is the massive fish die-off in the Odra River on the border between Germany and Poland during the summer of 2022. Around 360 tons of fish died, poisoned by a brackish water alga (*Prymnesium parvum*). This alga thrives in a stressed water ecosystem exacerbated by climate change and inappropriate river management. In our case, high salt concentrations occurred due to industrial waste, high nutrient content of anthropogenic origins (mainly agriculture), high water temperatures, and low water levels (Free et al., 2023; IGB, 2023; Slugocki & Czerniawski, 2023). This crisis demonstrated that the Odra River constitutes both a physical border between Poland and Germany and a SES that needs to be jointly managed. The media discourses turned the river into a symbol of broader governance issues concerning Polish-German relationships, daylighting the need for new forms of trans-border SES governance. Such crises may create opportunities for challenging established governance systems and creating new cross-border arrangements (Bellamy et al., 2017). As discussed by Manzo et al. (2023), SoP provides opportunities to navigate these challenges by integrating local place meanings into SES governance strategies. As we will argue, considering mobilities and their nexus with SoP can provide new insights for understanding and reacting to ecological crises.

Mobilities are omnipresent elements: they shaped the fish die-off, its perception and its impacts, and they illustrate the spatial interdependence of the system's elements, such as the river's flowing water, which transported saline inputs and poisonous algae, and afterwards, the dead fish. The perception of Odra disaster is enabled through mobilities and their disruption. The strong smell of dead fish drove people away, riverfront restaurants closed, and people avoided the river as recommended by local governments (BMUV Federal Ministry for the Environment/Nature Conservation N. S. and C. P., 2023; Service of the Republic of Poland, 2022). Thus, there was a disruption of the physical connection of both people and animals belonging to this SES. Yet, simultaneously every day thousands of people continued to cross the

Odra River connecting the two countries (Günzel et al., 2017), witnessing the appearance and the removal of the dead fish. The news of the catastrophe traveled around Europe (The Guardian, 2022), providing an example of virtual mobilities (Büscher & Urry, 2009). In response, people held a “silent funeral march” in Warsaw, which demonstrates both mobilities (physical movement and imaginative mobility of people marching in a city 300 km away from the river), and how the crisis may provide space for critical thinking and problem-solving (Bellamy et al., 2017; Manzo et al., 2023). The impact on people-place connection is mediated by mobilities; for example, when the usual activities or movements taking place drastically change after a crisis (Butler et al., 2019).

The “dead fish” incident in the Odra River showed the challenges of SES governance within cross-border contexts, and the need for, and significance of, bridging two apparently disconnected theoretical and conceptual frameworks: SoP and mobilities. Thus, this crisis in the Odra River served as the location for an in-person workshop with an international group of scholars from different academic backgrounds to examine the nexus of SoP and mobilities. The aim of this paper is to identify relevant research challenges at the nexus of SoP and mobilities scholarship, which direct future research towards a deeper understanding of SES and may lead to novel governance implications.

2. Methods

We¹ applied a mixed method design using a structured Delphi survey, an expert workshop, and a collaborative writing process following four main steps: 1) expert selection; 2) a two-round Delphi survey to structure the workshop’s discussions based on the participants’ academic background, research focus, perspective, and interests; 3) expert workshop following a deliberate process; and 4)¹ data analysis and evaluation as well as a reporting process to consolidate the results (Fig. 1).

2.1. Expert selection

We¹ invited 31 experts from around the globe via e-mail for a Delphi Survey and a 3-day workshop in the twin-cities of Frankfurt-Oder (Germany) and Stubice (Poland) on researching at the nexus of SoP and mobilities contacting the key authors of recent books, research papers and members of research teams. The lead authors and key organizers identified an international sample of senses of place scholars, whom they could reach through a range of networks, such as the informal International Place Attachment Network. Furthermore we contacted authors of key publications on the nexus between SoP and mobilities (e.g. Büscher & Urry, 2009), such as contributors to the recently published book on senses of place and global challenges (Raymond et al., 2021b), and authors who had published a much cited framework article on the interface of the static-stable-centered and the dynamic-unstable-decentered aspects of people-place relations (Di Masso et al., 2019). We aimed at recruiting participants diverse in their disciplines, stage of career (see part 3.1. for details on participants’ backgrounds), and geographical variety. Workshop participants were affiliated to institutions from 8 different countries, including Poland (n = 7), Finland, US, Germany (n = 3 each), UK (n = 2), and one each from Switzerland, The Netherlands, and South Africa. Including scholars with research focus on the Polish-German border allowed to gain expert situational knowledge. The first Delphi round resulted in n = 22 valid responses, 16 of whom also participated in the second Delphi round. The expert workshop involved 21 participants, 19 of whom had previously participated in at least one of two Delphi rounds and were joined by two of the lead authors of this article. The lead authors designed and

analyzed the Delphi survey, and thus did not participate in it. The writing process of this article included researchers who participated in the Delphi survey.

2.2. Mixed-method approach

2.2.1. Delphi survey

The Delphi survey was used prior to the workshop to structure group communication (Linstone & Turoff, 2002) and allow participants to reflect on the topic at their own pace, while avoiding direct confrontation with other persuasively expressed opinions (Schmidt, 1997). The first round identified and structured the key debates and ideas around conceptual and methodological approaches for understanding the nexus of SoP and mobilities. It included questions related to research focus, methods, and knowledge gaps. In the second round, we engaged more deeply with specific nexus research contexts and mobility types, and applied a ranking of the most appropriate methods for nexus research that were identified by participants in the first round (Okoli et al., 2004).

2.2.2. Expert workshop

The workshop, as a collective deliberative process, allowed for the identification of a greater range and further development of ideas than individually produced thoughts (Raymond et al., 2014; Spash, 2007). It took place immediately after the dead fish had been removed from the Odra River. The location provided a topical context for the workshop and represents an important case study of the leading authors of this article. The twin-cities are divided by the Polish-German border and the Odra River but it is connected through a multi-modal use bridge. Based on the results from the Delphi surveys, the workshop started with a world-café (Löhr et al., 2020) to explore the plurality of research perspectives, backgrounds, and interests. It focused on central concepts of people-place relations, types of mobilities, how people-place relations and mobilities are connected within the research, and specific methods applied. Delphi survey results were presented for further discussion and group work. The experts gathered then formed subgroups around specific topic areas related to the nexus of SoP and mobilities. The first group task was to identify specific research questions to articulate a research agenda to examine this nexus. Presenting these questions to the larger group led to the identification of cross-cutting challenges. During the second group task, these challenges had to be prioritized and further developed. Presenting results to the larger group led to further refinement. For the final task, the writing-process outside the workshop, researchers assigned themselves to work on at least one specific challenge.

2.2.3. Collaborative writing process

Researchers were organized in small groups to “construct narratives and provide interpretations” (Cresswell, 2018) around the five challenges identified in examining the nexus of SoP and mobilities. Each group identified a leader who was the main point of contact with the lead authors. In each of the small groups the diversity of participants in terms of institutions, research focus, and disciplines were represented. The final text of the manuscript is the result of a sustained interdisciplinary process that engaged differences about theory, methods and research paradigms.

2.2.4. Data and analysis

The workshop discussion, in combination with the artifacts, such as posters and clustered moderation cards, provided the conceptual frame. The qualitative workshop data was enhanced with the previously collected quantitative and qualitative data of the Delphi survey. Delphi data were analyzed using descriptive statistics and representations in Excel, and deductive (e.g. question on metatheoretical moments) and inductive (e.g. questions on research ideas and gaps) coding in MaxQDA.

¹ The pronoun “we” refers to the lead authors of this article who are responsible for organizing the Delphi Survey and Workshop.



Fig. 1. Multi-phased approach to identify challenges and solution ideas around the research on the nexus between SoP and mobilities.

3. Results

3.1. Delphi survey: participants' backgrounds

A large component of the Delphi survey involved the study of participants' backgrounds, the range of which helps to illustrate the complexity of the nexus of SoP and mobilities and how it can be studied with various frameworks. Studying participant's backgrounds enables one to begin to understand how ontological and epistemological backgrounds and biases play into understandings of SoP and mobilities. Most respondents had a disciplinary background in sociology ($n = 10$) followed by psychology ($n = 7$), geography ($n = 7$) and environmental studies ($n = 7$). Eight indicated multiple disciplines. Respondents had worked in academia between three and 50 years, engaging with topics of SoP and/or mobilities for up to 44 years. In current and planned research, SoP is mainly assessed as an outcome of mobilities, for example to changing (urban) landscapes ($n = 4$), or people's mobility ($n = 11$, for more details see appendix). While most participants ($n = 14$)

engaged with the nexus of SoP and mobilities, only three participants did not focus on SoP versus six who did not focus on mobilities. SoP and place attachment were the most commonly used terms. The most studied mobility type was daily movement ($n = 6$, e.g. outdoor recreation, commuting, urban walking), followed by migration ($n = 5$, e.g. residential mobility, situation of migrants, international migration), and tourism ($n = 3$, e.g. second home, flight travel behavior).

Survey participants located their ontological and epistemological perspectives on a spectrum based on Moon and Blackman (2014) (Fig. 2). Generally, participants situated themselves towards a relative, subjective, or inductive perspective (right side of the spectrum), but responses did vary. Many respondents critically highlighted that perspectives depend on the research topic, questions and context. Research may combine different epistemological perspectives linked to disciplinary backgrounds, or dominant theories with which researchers work. Comparing respondents' perspectives not focusing on SoP with those not focusing on mobilities, slight differences can be seen. The three respondents who did not focus on SoP, but on mobilities, scored slightly

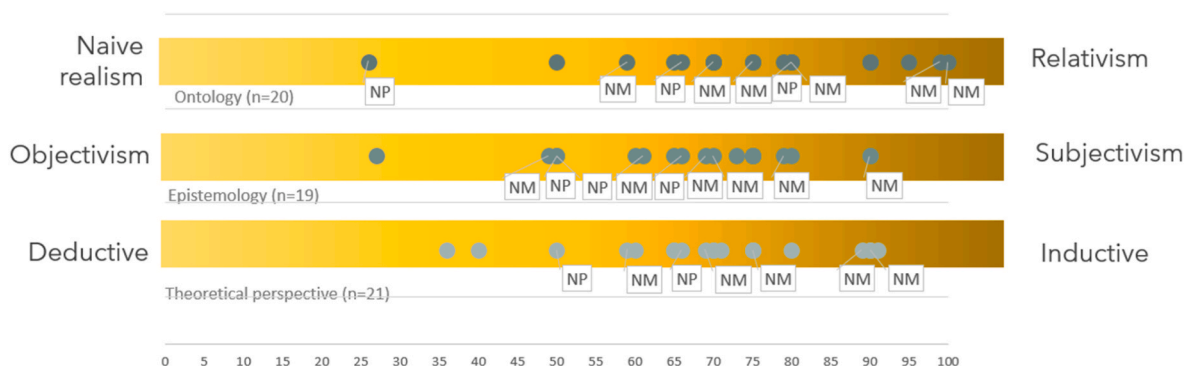


Fig. 2. Perspectives, NP: respondents NOT focusing on SoP, NM: respondents NOT focusing on mobilities; from top to bottom: ontological perspective (mean = 67, StD = 18), epistemic perspective (mean = 67, StD = 16), theoretical perspective (mean = 75, STD = 17).

more towards the center of the spectrum regarding their ontological and epistemological perspectives, yet, all emphasized the difficulty of positioning themselves on that spectrum. In contrast the six researchers focusing only on SoP and not on mobilities located their research more towards subjective perspectives. Regarding the theoretical perspective, these six respondents also scored higher than the average.

Participants held varying methodological perspectives, including 21 qualitative, and 9 quantitative. In terms of data collection techniques, Interviews (n = 20) were the most frequently mentioned method, followed by discourse or thematic analysis (n = 11), surveys (n = 10), use of visual & audio support (n = 8), focus groups (n = 8), and mapping methods (N = 6, including mental maps, participatory mapping, biophysical maps). For research on the nexus of SoP and mobilities, participants recommended methods which account for temporal perspectives, such as life-place trajectories or diary studies (n = 9), using social media data (n = 5), and “mobile methods”, such as GPS tracking, walking-with-video, or walking interviews (n = 4). In the follow up ranking (2nd Delphi survey), qualitative methods dominated over quantitative methods.

In summary, analyses of the positionality of experts suggests a tendency towards research in the fields of sociology, geography, psychology and environmental studies using more relative, subjective or inductive approaches. A plurality of methods has been used to assess SoP, mobilities or the nexus between them, and it was difficult to locate patterns between them. Therefore, the first part of the follow-up workshop needed to establish a common understanding of each other's research focus and conceptualizations around the key topics, and underlying ontological, epistemological and theoretical perspectives.

3.2. Cross-cutting challenges at the nexus of place and mobilities research

Cross-cutting challenges were identified from both the Delphi and workshop process. With respect to the Delphi, major knowledge gaps for assessing the nexus of SoP and mobilities include the consideration of power dynamics (n = 3), temporal and spatial dynamics (n = 2), and new technologies (n = 2), integrating non-human perspectives into research, and combining qualitative and quantitative methods (Table 1). To render power more explicit, respondents suggested community-driven research that might employ techniques like participatory mapping methods. Longitudinal and multi-place approaches could address issues of multi-local and multi-temporal perspectives. Other solutions

included co-creative, transdisciplinary research that contributed to the transformative change, including of visual and audio elements.

Some of these points were further discussed in the workshop around the following topics: New technologies, diverse urban residents, power, values, relation, disruption, and climate change. Participants developed specific research questions related to their topic embracing the nexus of SoP and mobilities. These research questions or objectives ignited discussion of cross-cutting challenges among all themes. For example, how to adjust technology to research needs and participants' needs, and tools for extensive data collection on non-human perspectives. Fourteen challenges were identified during group presentations and discussions and organized into a matrix (Table 1).

The workshop process also created new insights into relevant topics not present in the Delphi survey, including: motility, multisensoriality, researchers' connection to the place of study, institutional context (e.g. funding context), entry points to participation, transparency and transdisciplinarity, and application to practice and policy (Table 1). The second group task (selection of specific challenges) resulted in seven challenges, which integrated and synthesized some challenges into larger topics (Table 1, third column). Furthermore, challenges were initially narrowed down to six, and finally five challenges throughout the writing process (Fig. 3).

3.2.1. Challenge I: accounting for power dynamics, (social) inequalities and motility

At the nexus of SoP and mobilities, the position of the researcher and their access to place/s affects how they are perceived and treated by the research partner/s (and vice versa). Given such relational dynamics, as researchers we must critically reflect upon how our position(s) and motility influences what we research and how. While mobility refers to the actual practices of movement, motility refers to the potential for movement, of having the ability to move if one chooses (Kaufmann et al., 2010). This includes access to mobility, competencies to make use of means of mobility, and habits and values associated with mobility. In this view, mobility and motility become elements of social inequalities (Frith, 2012). Inequalities are characterized not only by income and other socio-demographic factors, but also by different degrees of agency, and opportunities and modes of mobility (Torkington, 2012).

Both SoP and mobility exist in an uneven landscape of power. At the nexus of SoP and mobilities, the access that research participants have to place(s) and different forms of mobility vary and are manifestations of

Table 1

Evolution of challenges throughout the process of Delphi-workshop-writing, from left to right.*New topics that came up in the workshops.

Phases	Delphi Survey	Workshop Task 1	Workshop Task 2	Writing process (group phase)	Writing process (synthesis)
Evolution of challenges					
Challenges	Power dynamics	Power and agency Empowerment Researchers 'connection to the place of study' Entry points to participation* Transparency* Transdisciplinarity* Institutional context, e.g. funding context Ethics related to empowerment Motility* Spatial scale	Power and agency	Critical reflexivity	Accounting for power dynamics, (social) inequalities and motility
	Temporal and spatial dynamics	Temporalities	Motility Spatial scale	Motility Spatial scale	Integrating multiple and sometimes nested spatial scales
	New technologies	Tools for extensive data collection How to adjust technology to research needs and participants' needs Application to practice and policy* Multisensoriality*	Temporalities Futurizing senses of place and mobilities	Futurizing senses of place and mobilities	Taking into account temporalities of place and mobilities
	Non-human perspective	More-than human actors	Multisensoriality More-than human actors	Multisensoriality More-than human actors	Embracing Multisensoriality Doing justice to more-than human actors

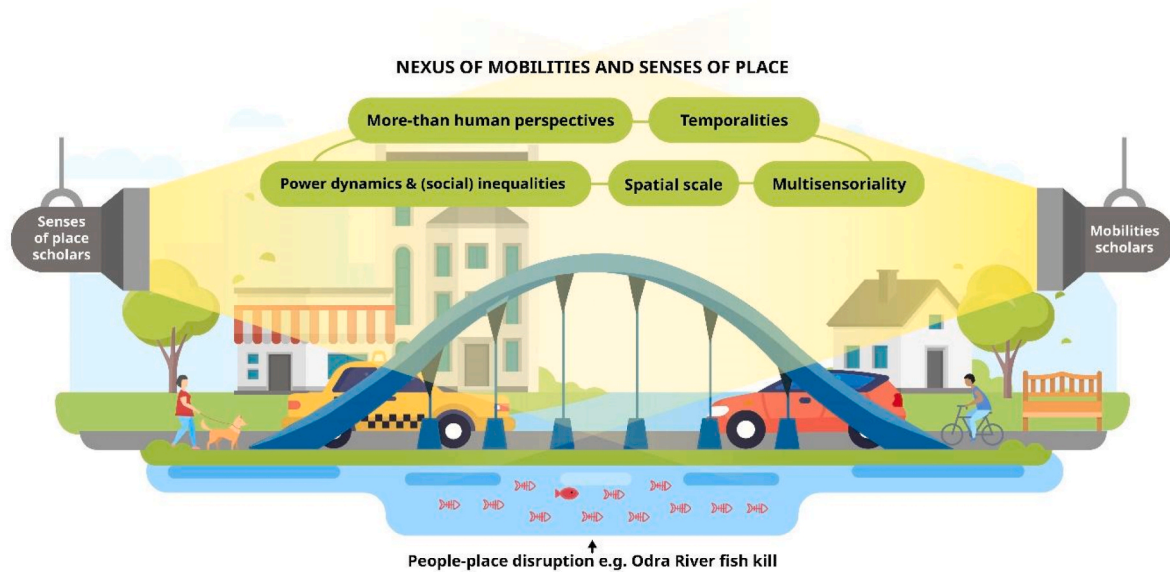


Fig. 3. Bridging mobilities and SoP and cross-cutting challenges.

power. Some are forced to move while others remain confined to place (due to financial restrictions, safety issues etc.), and again others are negatively affected by the mobility of others (traffic noise, CO2 emissions) - all of which can be recognized as a form of displacement and violence (Stepputat, 2008). In contrast, some actors have the freedom to move, and have control over when and how they move, or remain bound (de Jong et al., 2022). As a result, (re-)configuration of place can impact different actors and their SoP in different ways, benefiting certain actors, while causing harm for others. Therefore, it is vital to consciously involve the voices of actors who are: a) negatively impacted by the (re-)configuration of place; b) immobile, particularly when it is not out of choice; and c) negatively impacted by the mobility of others. That is, SoP emerge from the encounters between different actors in space-time (Massey, 2005b) and the terms of such encounters are influenced by power relations.

3.2.2. Challenge II: doing justice to more-than human actors

Multispecies justice extends the accounting for power dynamics, inequalities and motility to more-than-human actors, as it extends the legal understanding of representation in decision-making to include animals, plants, or ecosystems. Breaking through anthropocentric thinking about justice, and referring to moral and ethical categories when concerning non-humans is important because it is not only humans who suffer due to ecological crises but also animals and non-living matter (Tschakert, 2020; Winter & Schlosberg, 2023). Highlighting the role of multispecies interdependence towards a more just and solidary future is thus also a key for sustainable environmental management (D'Evelyn et al., 2022). This means we need to open up to more-than-human actors as well, also to better understand SES, which are inherently dynamic and relational (Ortiz-Przychodzka et al., 2023). Changes in spatio-temporal contexts also involve sensory experiences resulting from the encounters with diverse non-human entities that human actors keep in their memories or integrate into their practices and narratives, and that they actualize in each new place or context (Ortiz-Przychodzka et al., 2023). The consideration of non-human actors in studying SoP and mobilities provides some practical and cognitive benefits (Frąckowiak, 2023), such as recognition of the co-creation of place by animals and vegetation (Eriksson & Bull, 2017; Williams, 2014). There is a growing tradition of spatial studies that considers how local populations depend not only on humans and their practices but also on non-human features and abilities, such as the role of vegetation, microbes (Eriksson & Bull, 2017), or technology (Hjorth & Pink, 2014).

In SoP research, there is evidence on how mobile devices participate in the constitution of space, densify it and intensify the relationships present in it, as well as determine our expectations and how we think about it (Hjorth & Pink, 2014). A more than human perspective emphasizes the acknowledgment of the role of materiality in the creation of SoP (Ingalls et al., 2016), and, in relation to mobilities, in (re-)settlement processes (Biglin, 2020; Drozdowski, 2007). Biophysical characteristics define and shape the possible meanings that can be attributed to a place (Stedman, 2003). The boundaries of (disrupted) places can be drawn not only horizontally but also vertically (Robertson, 2020), by situating ourselves within those transects, rather than outside of them, recognizing our own participation in shaping the places (Arènes et al., 2018).

However, there is still a lack of research that considers how changing the subject of justice to other species in environmental governance in turn changes our understanding of mobility and SoP. This could be addressed by SoP and mobilities scholars by more deeply engaging with the multispecies justice literature, which, as indicated above, shines a spotlight on how humans and other species depend on each other for their wellbeing (Rupprecht et al., 2020), and recognizes how our lives are shaped not only by human infrastructure and capital, but also by other species (Rautio et al., 2022; Welden, 2022).

3.2.3. Challenge III: integrating multiple and sometimes nested spatial scales

Power and justice between human and more-than human actors need to be understood across spatial scales. The extent to which there are ecological, political, cultural and social boundaries across these different scales will affect the lived experiences of the movers and be integral to characterizing associated SoP. From the micro to the macro spatial scale, comparison of SoP within and across scales are contingent on the intentions for travel and power differentials between those who travel and those who stay, or those who are visited. Small scale spatial movement is where distance traveled is minimal, referred to as micro mobilities (Büscher & Urry, 2009). Such mobilities characterize movement from site to adjacent site, or from site to neighborhood (from larger scaled perspectives—e.g., those looking at international migration—they might not even be considered 'movement' as such). As spatial movements become longer in distance, the time and technology invested in mobility grow. The largest spatial scale encompasses travel across long distances at national or international levels, referred to as macro mobilities.

SoP and mobilities should be studied and captured at different and

sometimes nested spatial scales. Although place research already has a history of concern for spatial scale (Cresswell, 2014), its nexus with mobilities underscores the potential for important and distinct insights when integrating spatial scale concerns into research. For example, the movement through space at the Odra River, by the flowing water, blooming algae, daily commuting people, or news of the disruption, highlights place as relational (Di Masso et al., 2019), where borders and other geographic divides as well as interconnections come to consciousness. Interactions between those who move and those who stay influence peoples' perceptions of places; such interactions facilitate comparisons across spatial scales hold potential to affect place-making processes (Williams, 2014). Comparing meanings and attachments across spatial scales connects socio-cultural knowledge with personal experiences, and could do so in ways that acquiesces to socio-cultural knowledge or disrupts the knowledge to resist the discourse.

Technology, also acknowledged as more-than human actor in challenge II, facilitates smooth mobility or virtual representation of places (Relph, 2021). The mode and frequency in which we travel influences the intensity of our physical, emotional, and cognitive connections to place. Walking, bicycling, and driving across spatial scales requires separate mobility systems that engender specific types of interaction and associated meanings with the physical environment. Likewise, virtual and imaginative movement across spatial scales affords a level of knowledge and flexibility in "travel" that engages a multi-layered set of information about places and their connections to other places. A challenge for researching the nexus of SoP and mobilities is that technological devices (e.g., smart phones, watches) facilitate people to be in many places at once, potentially resulting in the hybridization of places, where different people and places exist together at the same time. To further understand the hybridization of places, future research could explore disruptions in SoP across different virtual and imaginative representations of place change, and how they contrast to connections to current places.

3.2.4. Challenge IV: taking into account temporalities of place and mobilities

Temporalities - human perception of time and social organization of time - influence both the place and one's relation with it, as well as mobility practices, which relates closely to issues of inequalities and positionality raised in challenge I. Furthermore, human perception of time and the human life cycle are considerably affected by more-than-human actors with different spatial and temporal trajectories (Massey, 2005a). From a human perspective, the social representations of place can transcend through generations, and thus place meanings and attachments can be shaped by past materialities that no longer exist (Sarrica et al., 2016). Furthermore, patterns of mobility and the factors influencing mobility behaviors change throughout one's life journey, in which decisions to stay or leave are continuously renegotiated (Bailey et al., 2021; Stockdale et al., 2018). Futuring SoP in this context enables us to identify and plan for people-place relations within a context of high (cross-border) mobility.

There is limited research on futurised SoP and how people-place relationships can develop in multiple possible futures (e.g. Murphy et al., 2017). Theory and empirical evidence of SoP to date have focused on existing relational processes, historical trajectories and contested environmental changes (e.g. Devine-Wright & Howes, 2010; Müller et al., 2020), but current and anticipated processes of significant social and ecological changes are forcing us to think about SoP and mobilities in different ways. Anticipation processes are always acts of political negotiation, in which messy future dynamics are made sense of, and processes of prioritization and inclusion are shaped (Muiderman et al., 2022). Future focused methods can help us anticipate potential social and ecological change, and can inspire and inform planning for transformative futures (Bengston, 2019; Elsawah et al., 2020; Murphy et al., 2023). Understanding possible changes in SoP and mobility processes going forward, and in particular grasping how they may interact to

create new opportunities and vulnerabilities, can help to inform the design of policy and planning interventions that promote alternative pathways for sustainable development.

3.2.5. Challenge V: embracing multisensoriality

Multisensoriality recognizes the human experience in its complex expression, feeling, movement, articulation, enactments, as these are sensed and lived out in social settings (Pink, 2011). This perspective is important for connecting research on senses of place with studies of mobility, shaping our understanding of social-ecological systems governance. Crucially, multisensoriality informs both our role as critically reflexive researchers, considering our own motility and mobility relative to participants, and our role as active participants interacting with the materiality of life alongside non-human actors. Our relationship to a present experience of place, in its material and social aspects, is inevitably influenced by our sensory histories, personal and social. In this respect, sensory experiences are not simply 'contained' in the individual mind-body, but are co-constructed, collectively embodied, affective, spatial and temporal forms of psychosocial practice. They are also performative acts that reference the wider socio-political landscape and its defining person-place narratives informed by collective memory (Mondada, 2019) as referenced in Challenge I. In this vein, multisensoriality can be considered as a combination of situated practice and affective economy, driven by temporality (psychosocial memory) (Ahmed, 2004; Nicolini, 2012), as detailed in the previous challenge (IV).

A *multisensoriality lens* that explores the nexus between (im)mobilities and SoP requires reconciling dominant senses of sight and sound typically with the more subdued, non-verbal forms of embodied knowing. Thus, we co-experience SoP through the commonality of situated and embodied communicative exchange. This translates to a shared experience of place by virtue of synchronized movement, physical proximity, and emotional resonance, as in Maffesoli's neotribalism (Maffesoli, 1995). On this basis, a communicative community is produced, resulting in a commonality of sensory experience and a sense of being in similar "sensory worlds." We propose that these shared sensory worlds as situated social practice are not necessarily confined to temporal-spatial context in which they are co-produced. Affective sense is borrowed, transferred and referenced from psychosocial memory of place, and it is this cohering element that reproduces intransigent social practices.

The situatedness of social practices when conjoined with an affective ontology offers a micro-politics of multisensoriality. Affective economies (Ahmed, 2004), the circulation of emotions, as they *slide* over or *stick* onto bodies, surfaces and things, have a performative function. They do things – they *affect* ideas and meanings to produce space and place. Emotions have a discriminating function; they mis/align individuals with communities, as molded by psychosocial memory. This historical temporality allows the affective economy to circulate through discourse, or stories we tell about place. Places become contact zones, the "space of contact between cultures ... where bodies encounter other bodies" (Ahmed, 2004), of human and more-than human kind. A lack of research in SoP scholarship examines how these landscapes are co-produced, as sensory perceptions or impressions produced temporally in the here-and-now, but also critically, as multi-sensed narrations that are citations of history borne to present sense-making (Lau et al., 2021). Future research would benefit from combining the social construction of places with multi-modes of sensory engagement including site, sounds, smell and touch.

3.2.6. Interconnectedness of the challenges

While described here above separately, the identified challenges are interconnected, as illustrated in the case study section (3.3). The interconnectedness of the challenges reveals the complexity of certain aspects of the nexus between SoP and mobilities nexus. Multisensoriality nuances the sensing of space through the body, more-than-human

perspectives point to the role of non-humans in the process of establishing it, spatial scale and temporalities point to the change in its definition depending on the time and scale of analysis, and power dynamics points to the political (not neutral) dimension of this reflection. All these perspectives have a common denominator - they encourage a relational approach to space and abandon the anthropocentric figure of the researcher (seeing everything at once, outside the world of values, focusing on other people), and only switching between these perspectives allows us to see the process of place and mobility in all its complexity. Motility and power (challenge I) do not just exist between humans, but extend to more-than human actors, leading to discussions on multispecies justice (challenge II). Multisensoriality is a key component of forming senses of place, and specifically understanding its dynamics in the context of mobilities (challenge V). Furthermore, both challenges are embedded within a spatial and temporal context (challenge III, IV). Finally, here we acknowledge that besides the contextualized, more-than-human, multisensory perspective, which unites the challenges, the phenomenon of technology (as a more-than-human actor, enabler of mobility, or perception etc.) appears throughout them. Although not that prominent in the case study below, technology is a key element.

3.3. Spotlighting the challenges in the odra case

In this section we use the case of the Odra River at the border of Germany and Poland to illustrate the above introduced challenges researching the nexus of SoP and mobilities. In August 2022, news traveled across Europe showing pictures of massive amounts of dead fish floating on the Odra River. The Odra River flows over 850 km through Czech Republic, Poland and forms the physical border between Poland and Germany for around 180 km, finally arriving at the Baltic Sea. In summer 2022, gold algae (*Prymnesium parvum*) bloomed in the river for 2 weeks. Yet, this was sufficient to decrease the fish population in mid-stream by around 53–67%. Through mobilities of human and non-human agents, the ecological catastrophe at the Odra River happened at different and sometimes nested spatial scales. Specifically, the sources and impacts of disruption of the SES of the Odra River occurred across spatial scales ranging from global climate change, regional planning decisions to local industrial waste input (Free et al., 2023; IGB, 2023). This had an impact on local citizens by restricting their access to the river for both recreation and fishery, on the regional image of the river (The Guardian, 2022), and on international relations (BMUV Federal Ministry for the Environment, Nature Conservation, 2023), see **challenge III**. On August 10th citizens of the cross-border city of Słubice (Poland), and Frankfurt-Oder (Germany) could witness the sight and smell of thousands of dead fish floating at the surface of the river.

In late August, the previously mentioned workshop took place right after the fish carcasses had been removed. Identifying researchers' own positionality (see workshop world-café exercise) allowed us to reflect critically on power dynamics between researchers from various institutional backgrounds, and on barriers to promote epistemic and socio-spatial justice, see **challenge I**. Bringing together a diverse group of researchers underscored the various means that people had for traveling (including time and financial resources), and the different privileges and connections to place that underlie distance and proximity. Furthermore, none of the researchers were originally from the study region, making them outsiders with education qualifications and income levels above the local community's average. Their presence contrasted with the local micro mobilities, for example of daily commuters across the Odra Bridge who witnessed the entire process of the fish-die off. Movement through space and across scales, by the flowing water, blooming algae, daily commuters, traveling researchers, and news of the disruption, all high-light place as relational. Similarly, looking at the temporalities, the impacts, such as on access to places, on bi-national political debates, were distinct at different temporal scales, yet connected. The dead fish were removed within two weeks and news coverage decreased soon

after, yet research and political debates are ongoing (Free et al., 2023; IGB, 2023), see **challenges II, III, IV**. In the midst of an ecological catastrophe, heightened awareness and critical self-reflection of one's socio-spatial positionality and privilege were crucial for our considerations of SoP and mobility, see challenge I.

Inequalities, and resulting injustices, need to be considered also regarding non-human actors. The dead fish may act as an indicator (for the ecological state of the river) and symbol (for the vulnerability of systems against climate change). They also show how the (mis)use and interpretation of the river by some actors disrupts this place for non-human actors. Acting towards multispecies justice, the initiative OSOBA Odra (<https://osobaodra.pl/en/home/>) aims at legally considering the Odra River as a person - i.e. an entity with rights - see **challenge II**. Furthermore, the floating algae, the flowing water of the Odra, the industries along the river, and the fish are just examples of non-human agents which demonstrate the systems context of the Odra fish-die off, see **challenge II**. The lack of fish, the smell of dead animal corpses, and the symbols and emotions associated with this event and to the Odra River, are also examples of how complex the arrangements (of more-than human actors) are that shape people's SoP. Whilst some may not have had direct sensory encounters with the dying fish, a shared imaginary is produced through personal experience, social discourse and media narratives; these converge in shared understanding, see **challenge V**. For example, the shared stories around foul smells ('stank', 'garbage', dying fish) along Poland-Germany's mutual border, the Odra River, could be interpreted beyond the immediate sensory impressions by the local population. These referenced the larger narrative of environmental pollution and emanating tensions between two countries on attribution of responsibility, see challenges II, III and V. Thus, "poisoned relations" exceed 'fish-issues' to socio-political relations that draw on historical memory of Germany's wartime occupation of Poland (Zimmermann & Kość, 2022).

Temporal dimensions of places and disruptive events influence people-place relationships, the story of places and have been key for understanding and managing the river landscape of the Odra River, see **challenge IV**. The end of the Soviet Union, the entry to the European Union 2004, the Schengen agreement 2007, the flood of 1997, and the Covid 19 pandemic with border closures 2020 had impacts on cross-border mobilities, and how the river has been experienced, used and perceived. This showed for example in the uncertainty of resettled Germans and Polish citizens at the border after 1945, hesitant to build a sense of belonging and uncertain about returning to their origins (Elżbieta Opilowska, 2009), or when citizens of Frankfurt-Oder and Słubice protested against border closure during Covid 19 with slogans such as 'We want to work and live with dignity' (Elżbieta Opilowska, 2021). This patchwork of place and mobility is also reflected in governance systems in place for the region today. For example, on a local scale, where our workshop took place, the cities of Frankfurt-Oder and Słubice collaborate with each other and their citizens to create a common twin-city identity where people move back and forth over the bridge, and to plan for a climate-friendly, integrated, cross-border city center by 2035 (Frankfurt-Słubice Cooperation Centre, 2023).

Future research is needed to empirically investigate the effects of the event on senses of place, and mobilities. For example, the Odra River affords for water-related meanings, such as fishing or recreating at the shore, which were disabled during the disruptive event in August 2022. Furthermore, images of the Odra with dead fishes that were transported through (social) media, besides raising environmental awareness, might also have contributed to building geographical imaginations and affected the perception of this river landscape. Furthermore, we mainly see rather uni-directional SOP - mobility relations, where (a change of) mobility, e.g. of the fish, or a place change through mobility (of the Odra water), or a perception of change through mobility (through physical encounter), potentially impacts senses of place. There is a need to consider mobility influencing senses of place, and vice-versa, and for more empirical research of this case looking at both directions.

4. Discussion

The overarching aim of this paper is to identify relevant research challenges at the nexus of SoP and mobilities scholarship, which direct future research towards a deeper understanding of SES and may lead to novel governance implications. Five challenges were identified as part of the mixed-methods process: power dynamics and (social) inequalities, more-than human actors, spatial scale, temporalities, and multi-sensoriality. In this discussion we focus attention on principles for navigating challenges that may range from specific methods, over methodological approaches, to theoretical lenses, and are all situated at the nexus between SoP and mobilities to generate research-based information for managing such incidents as the Odra fish kill and guiding improved ecosystem governance. In this way, we present a research agenda for studying the nexus between mobilities and senses of place going forward.

4.1. Draw on diverse methods and knowledge co-creation processes to understand people-place disruptions in the face of socio-spatial precarity

Each challenge discussed in this paper reveals “a state of uncertainty about the stability of our social worlds and the places where we live” (Manzo et al., 2023, p. 37). The dynamic and relational characteristics of the nexus between SoP and mobilities calls for methodological versatility that allows for knowledge co-creation and epistemic agility in the face of high uncertainty and unpredictable social-ecological dynamics (Haider et al., 2018; Norström et al., 2020; Sala & Torchio, 2019). Also, co-creation of the entire research process with research partners is vital for addressing the multiple manifestations of power and contested place meanings. It can also help to break hierarchies in knowledge production, which leads to more inclusive and legitimate knowledge creation processes through co-creation (Ind & Coates, 2013; Leclercq et al., 2016; van Dijk-de Vries et al., 2020). In this process, the researchers’ positionalities are important as highlighted in challenge I. We propose approaching the research process with critical reflexivity to continually interrogate our assumptions about knowledge production and our own role as researchers, being aware of our positionality, and considering alternative frameworks to understand research phenomena. Critical reflexivity also involves recognizing the agency of all people involved in the research, and considering the methodological implications of such reflexivity. This is what Paulo Freire (1970) calls “conscientization”. If combined with critical reflexivity, collaborative research methods that reconcile multiple perspectives (ontological and epistemic pluralism) can reveal power dynamics, empower research participants and even shift the lines of power between all parties involved, leading to transformed science-policy-society relationships (Hakkarainen et al., 2022). Such an approach is needed to study the nexus of SoP and mobilities to articulate multiple experiences and avoid essentialism, romanticization and fixed representations of places (sometimes with colonial overtones). This can also help avoid perpetuating epistemic injustices by including certain knowledges and knowledge holders. Therefore, collaborative research methods that broadly tend to support inclusivity are vital for research on the nexus of SoP and mobilities in addition to more conventional methods. Arts-based methods are one example of how to be more inclusive of people who feel more comfortable expressing themselves through visual content, and people who do not usually dominate the conversations in group-based settings (Franklin, 2022). For example, participatory mapping could be used to reveal SoP and mobilities simultaneously. Therefore, pluralism and participation through knowledge co-creation supported by critical reflexivity are key elements to contribute to SoP and mobilities research.

4.2. Combine more than human and multi-sensoriality to help represent the influence of non-human actors on human SoP and responsibility towards places

The disruptions of the Odra SES involve deep transformations in the basin’s arrangements, transforming how people experience the river and its surroundings, and how they assign meaning to it. Dead fish and water contamination not only have quantifiable economic and ecological impacts (Free et al., 2023; IGB, 2023; Stugocki & Czerniawski, 2023), they also have qualitative political effects reflected in political leaders’ discourses and public interventions (BMUV Federal Ministry for the Environment Nature Conservation N. S. and C. P., 2023). They can also affect the ways in which people encounter the river by moving through it and sensing it on a daily basis. Challenge II (more-than-human actors) and challenge V (multisensoriality) reveal that there are important interrelationships between humans and non-humans in the formation of SoP, even though SoP concepts are commonly represented from the perspective of humans (Robertson, 2018). Also, there is limited engagement with multiple physical senses in both SoP (Pramova et al., 2022) and mobility research (Silva et al., 2021; Zhang et al., 2024), which impedes understanding of the nexus between concepts.

At the same time, as researchers of (multispecies) environmental justice teach us that the question is not only about how the SoP is produced but also about people’s responsibility for a place as a multispecies community (Tschakert, 2020). A more non-anthropocentric approach to place management helps to think in a perspective that exceeds the horizon of one human life time (see also challenge IV), and avoids being guided solely by profit, thus promoting common goods over individual benefits (Heitlinger & Houston, 2021). These goals can be achieved only by simultaneously promoting decentralized and more inclusive management, which enables non-extractive exchange of perspectives. Implementing this holistic and integrated approach that recognizes the value and agency of all life forms will be ambitious, as anthropocentric thinking is deeply rooted among decision-makers (Gesing, 2019). We could observe this struggle during the Odra River crisis when two visions of its management clashed in the Polish media discourse: the traditional one (focusing on finding a human culprit) and the multispecies one (pointing to the crisis as a result of an anthropocentric approach to the river).

Several key concepts are beginning to emerge that integrate approaches of SoP (as perceived by humans) and more-than-human perspectives (challenge II), helping to represent the influence of non-human actors on human SoP. One of them is the “sociology of space” by Martina Löw (2016). The basic assumption of this concept is that space is a process consisting of two dimensions, arrangement and synthesis. The first involves the situatedness of things, bodies and other kinds of matter in space (e.g. the Odra River includes fish, birds, grass, soil, but also bridges, industrial facilities, the sounds and smells of it all). The second dimension, the “synthesis”, involves the attribution of meanings by the individuals acting in these arrangements (which arrangements are associated with normalcy and which with crisis). Furthermore, the notion of atmosphere is a helpful construct to understand the nexus of SoP and mobilities. Defined as “range of collective affects produced through dynamic, relational place encounters” (Buser, 2014, p. 228), this concept shows how ephemeral human emotion resonates with the built environment, and how the mood of a place depends on, for example, weather conditions. Affect is something that can primarily be sensed (Deleuze, 1994). Another promising stream of research is the contemporary anthropology of local communities, such as local traditional fairy tales that, though outdated, still help people establish an emotional connection with nature and promote sustainable practices, encouraging the breaking down of divisions between humans and nature (Magliocco, 2018).

In the area of methods, the practice of sensory ethnography (e.g., go-alongs, video walks, mobile interviews) is particularly important as it stimulates sensory impressions, affect-laden talk and storytelling

accounts of place. These mobile methods are able to deal with the fleeting, multiple and complex phenomena (Büscher & Urry, 2009). Distinct from a multimodal ethnography, which foregrounds data itself as generated in multimedia forms, a sensory ethnography privileges sensory knowledge as co-produced in unfolding interrelationship (Dicks et al., 2006). Researchers are thus co-performative witnesses in the being, doing, feeling and sensing of place (Madison, 2007). Through empathetic engagement with participants, their practices and places, we co-produce meaning through shared participation and place (Pink, 2011). Together, we bring our unique histories of (not) belonging to place, psychosocial memory, and this informs how our SoP may converge or diverge. Such transformations can be further understood with qualitative approaches that facilitate active listening, articulating values (e.g. Gould et al., 2019), and noticing the human entanglements with the river (Saxena et al., 2018), as well as people's perceptions and meanings (Berman-Arévalo & Valdivia, 2022). Considering the climate crisis, an important outcome of qualitative research (perception, participation and embodying, recognizing the political dimension of everyday practices) is also the creation of empathy towards non-human actors (Tschakert, 2020).

4.3. Engage in the assessment of the dynamic relations between places

Challenge III (spatial scale) reveals that different spatial scales of SoP and mobility need to be compared, contrasted and, where possible, integrated to inform a deeper understanding of the nexus of SoP and mobility. Challenge IV (temporal scale) highlights that such interrelationships cannot be considered in isolation of our relationship to future places, including the dynamic forces of mobility and environmental change. Addressing both challenges requires a commitment to the assessment of the relationality between places including our lived experience of mobility, concomitant with assessments of differences, nestedness and fluidity of people-place relationships across spatial scales. In other words, place narratives change depending on spatial scale contexts (Devine-Wright & Batel, 2017), but also temporal scale, considering for example place change (Butler et al., 2019), or renegotiation of desire to stay at or leave a place (Stockdale et al., 2018).

Relationality implies engaging with different temporal trajectories. Our lived experiences of place are generally focused on one site at one time (Lewicka et al., 2019), yet our memories and situational signs inform and enrich the moment in various ways – to draw-out differences, to recognize similarity, to see conformity, to appreciate plurality, and so forth. As we move across places, our lived experiences constitute a series of current moments that unfold in our journey, and inform the senses of the place we imagine. Simply put, our encounter with a particular place is always affected by our previous encounters with other places, and imagined encounters with yet others. Research approaches that engage and query the lived experience would be a productive direction and one already initiated across many of the social sciences in forms of ethnography, experience sampling methods, and go-along interviews (Barron et al., 2022; Rhee et al., 2020). For example, photo-voice methods are generally characterized by participants empowered by the expertise of their lived experience, and analyzed to explain the relational dynamic across places. Although a lived experience approach to methodologies will engage with such signage, there are needs to assess way-finding, confusing junctures, and general patterns of behavior that connect two or more places. Crucially, these patterns, and the research lenses to examine them, will vary across scales. Various methods of observation, PPGIS-mapping, GPS tracking and overlap with the go-along interview and survey approaches that describe behavior, explore behavioral motivations and intra-personal and inter-personal outcomes of movement. All these methods can be understood as mobile methods (Büscher & Urry, 2009).

4.4. Strengthen collaboration of mobilities and place researchers

This article is not just a call for stronger collaboration of mobilities and place researchers, it demonstrates one way how this collaboration could actually be realized. This has been an interdisciplinary collaborative process, which showcases the transparency in the dialogue to adequately capture the complexity of the phenomenon. Collaboration of many authors may imply a synthesis that needs building rather than an analysis that needs precision and focus. Furthermore, we need inclusive frameworks that are approachable by different research communities. This requires the interdisciplinary collaboration which led to this article. As a result, we provide a conceptual starting point for researching the nexus, as well as the identification of respective research challenges. Finally, future research projects need to integrate expertise from both fields.

5. Conclusions

This paper identified overlooked research challenges at the nexus between SoP and mobilities scholarship. We have illustrated the implications of our findings in a case of SES disruption. Through a multi-step approach, we identify five key challenges for future research, considered as relevant for better understanding SES: 1) accounting for power dynamics, (social) inequalities and motility; 2) doing justice to more-than human actors; 3) integrating multiple and sometimes nested spatial scales; 4) taking into account temporalities of place and mobilities; and 5) embracing multisensoriality. A key component of this paper was the process which aimed to bring together researchers focusing either on SoP or mobilities research who share the motivation of bringing the two areas together. Despite the impression from the Delphi survey, that most researchers engaged with both SoP and mobilities, the workshop discussions revealed that the majority had a very clear focus on either SoP OR mobilities, coming from more relative, subjective and inductive research approaches, and only few engaged with the nexus. This became even more visible during the writing process when researchers expressed their uncertainty about what “the nexus” may be. The workshop has shown how new perspectives and concepts (such as motility from the mobilities research) enabled the discussion and finally development of the presented challenges. Therefore, we argue that existing (conceptual) frameworks, such as the distinction between routes and roots (Gustafson, 2001) or fixity and flow (Di Masso et al., 2019) may serve as an entry point for interdisciplinary research between researchers from both fields. Yet, there is a need for researchers working in the field of either (senses of) place or mobilities research to come together addressing jointly issues of place disruption and SES governance. Luckily, the ecological catastrophe of 2022 did not repeat itself in 2023. However, politicians are still negotiating the future of the Odra River with all its human and more-than human actors living from, in, with, and as part of it.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

CRediT authorship contribution statement

Sarah Gottwald: Writing – review & editing, Writing – original draft, Visualization, Methodology, Funding acquisition, Formal analysis, Conceptualization. **Iga Kołodnyńska:** Writing – review & editing, Writing – original draft, Methodology, Funding acquisition, Conceptualization. **Matthias Buchecker:** Writing – review & editing, Writing – original draft, Conceptualization. **Andrés Di Masso:** Writing – review & editing, Writing – original draft, Conceptualization. **Nora Fagerholm:** Writing – review & editing, Writing – original draft, Conceptualization.

Maciej Frąckowiak: Writing – review & editing, Writing – original draft, Conceptualization. **Viola Hakkarainen:** Writing – review & editing, Writing – original draft, Conceptualization. **Katarzyna Kajdane:** Writing – review & editing, Writing – original draft, Conceptualization. **Ursula Lau:** Writing – review & editing, Writing – original draft, Conceptualization. **Lynne C. Manzo:** Writing – review & editing, Writing – original draft, Conceptualization. **Stefan Ortiz-Przychodzka:** Writing – review & editing, Writing – original draft, Conceptualization. **Jasmine Pearson:** Writing – review & editing, Writing – original draft, Conceptualization. **Tara Quinn:** Writing – review & editing, Writing – original draft, Conceptualization. **Łukasz Rogowski:** Writing – review & editing, Writing – original draft, Conceptualization. **Richard Stedman:** Writing – review & editing, Writing – original draft, Conceptualization. **William P. Stewart:** Writing – review & editing, Writing – original draft, Conceptualization. **Agnieszka Trąbka:** Writing – review & editing, Writing – original draft, Conceptualization. **Daniel R. Williams:** Writing – review & editing, Writing – original draft, Conceptualization. **Timo von Wirth:** Writing – review & editing, Writing – original draft, Conceptualization. **Jakub Zawieska:** Writing – review & editing, Writing – original draft, Conceptualization. **Christopher M. Raymond:** Writing – review & editing, Writing – original draft, Conceptualization.

Acknowledgements

We are grateful for the three anonymous reviewers who provided constructive feedback. Furthermore, we would like to thank the Centre of Borders in Motion of the Viadrina University Frankfurt-Oder for hosting the workshop, and Sören Bollmann of the Frankfurt-Stubice Cooperation Service for providing local insights during the workshop. Figure 3 has been illustrated by Pensoft illustrators. This research was funded by the German Science Foundation DFG (grant number 465127621), and the National Science Centre, Poland, (grant number 2020/39/G/HS4/03062). During the preparation of this paper, Stefan Ortiz-Przychodzka was funded by the German Ministry of Education and Research (BMBF, GrantNumber 01UU1903).

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.apgeog.2024.103286>.

References

- Ahmed, S. (2004). Affective economies. *Social Text*, 22(2), 117–139. <https://doi.org/10.1215/01642472-22-2.79-117>
- Arènes, A., Latour, B., & Gaillardet, J. (2018). Giving depth to the surface: An exercise in the Gaia-graphy of critical zones. *Anthropocene Review*, 5(2), 120–135. <https://doi.org/10.1177/2053019618782257/FORMAT/EPUB>
- Arp Fallov, M., Jørgensen, A., & Knudsen, L. B. (2013). Mobile forms of belonging. *Mobilities*, 8(4), 467–486. <https://doi.org/10.1080/17450101.2013.769722>
- Bailey, E., Devine-Wright, P., & Batel, S. (2021). Emplacing linked lives: A qualitative approach to understanding the co-evolution of residential mobility and place attachment formation over time. <https://doi.org/10.1002/casp.2533>
- Barron, A., Browne, A. L., Ehgartner, U., Hall, S. M., Pottinger, L., & Ritson, J. (2022). *Methods for Change: Impactful social science methodologies for 21st century problems*, 2021 p. 299.
- Bellamy, J., Head, B. W., & Ross, H. (2017). Crises and institutional change: Emergence of cross-border water governance in lake eyre basin, Australia. *Society & Natural Resources*, 30(4), 404–420. <https://doi.org/10.1080/08941920.2016.1272729>
- Bengston, D. N. (2019). Futures research methods and applications in natural resources. *Society & Natural Resources*, 32(10), 1099–1113. <https://doi.org/10.1080/08941920.2018.1547852>
- Berman-Arévalo, E., & Valdivia, G. (2022). The rhythms of “acostumbrarse”: Noticing quiet hydro-politics in Colombia’s Caribbean coast. *Environment and Planning D: Society and Space*, 40(5), 843–861. <https://doi.org/10.1177/02637758221118571>
- Biglin, J. (2020). Embodied and sensory experiences of therapeutic space: Refugee place-making within an urban allotment. *Health & Place*, 62(July 2019), Article 102309. <https://doi.org/10.1016/j.healthplace.2020.102309>
- BMUV Federal Ministry for the Environment, Nature Conservation, N. S. and C. P. (2023). FAQ zum Fischsterben in der Oder. <https://www.bmu.de/presse/fragen-und-antworten-faq/faq-zum-fischsterben-in-der-oder>.
- Boas, I., Kloppenburg, S., van Leeuwen, J., & Lamers, M. (2018). Environmental mobilities: An alternative lens to global environmental governance. *Global Environmental Politics*, 18(4), 107–126. https://doi.org/10.1162/glep_a_00482
- Büscher, M., & Urry, J. (2009). Mobile methods and the empirical. *European Journal of Social Theory*, 12(1), 99–116. <https://doi.org/10.1177/1368431008099642>
- Buser, M. (2014). Thinking through non-representational and affective atmospheres in planning theory and practice. *Planning Theory*, 13(3), 227–243. <https://doi.org/10.1177/1473095213491744>
- Butler, A., Knez, I., Åkerskog, A., Sarlöv Herlin, I., Ode Sang, Å., & Ångman, E. (2019). Foraging for identity: The relationships between landscape activities and landscape identity after catastrophic landscape change. *Landscape Research*, 44(3), 303–319. <https://doi.org/10.1080/01426397.2019.1580352>
- Crawford, S. E., Brinkmann, M., Ouellet, J. D., Lehmkuhl, F., Reicherter, K., Schwarzbauer, J., Bellanova, P., Letmathe, P., Blank, L. M., Weber, R., Brack, W., van Dongen, J. T., Menzel, L., Hecker, M., Schütttrumpf, H., & Hollert, H. (2022). Remobilization of pollutants during extreme flood events poses severe risks to human and environmental health. *Journal of Hazardous Materials*, 421(March 2021), Article 126691. <https://doi.org/10.1016/j.jhazmat.2021.126691>
- Cresswell, T. (2011). Mobilities I: Catching up. *Progress in Human Geography*, 35(4), 550–558. <https://doi.org/10.1177/0309132510383348>
- Cresswell, T. (2014). *Place: An introduction* (2nd ed.). Wiley-Blackwell.
- Cresswell, T. (2018). Maxwell street. *Maxwell Street*. <https://doi.org/10.7208/chicago/9780226604398.001.0001>
- de Jong, P., Rouwendal, J., & Brouwer, A. (2022). Staying put out of choice or constraint? The residential choice behaviour of Dutch older adults. *Population, Space and Place*, 28(4). <https://doi.org/10.1002/psp.2553>
- Deleuze, G. (1994). *Difference and repetition*, 1968). trans. P. Patton.
- D’Evelyn, S. M., Jung, J., Alvarado, E., Baumgartner, J., Caligiuri, P., Hagmann, R. K., Henderson, S. B., Hessburg, P. F., Hopkins, S., Kasner, E. J., Krawchuk, M. A., Krenz, J. E., Lydersen, J. M., Marlier, M. E., Masuda, Y. J., Metlen, K., Mittelstaedt, G., Prichard, S. J., Schollaert, C. L., ... Spector, J. T. (2022). Wildfire, smoke exposure, human health, and environmental justice need to be integrated into forest restoration and management. *Current Environmental Health Reports*, 9(3), 366–385. <https://doi.org/10.1007/s40572-022-00355-7>
- Devine-Wright, P., & Batel, S. (2017). My neighbourhood, my country or my planet? The influence of multiple place attachments and climate change concern on social acceptance of energy infrastructure. *Global Environmental Change*, 47, 110–120. <https://doi.org/10.1016/j.gloenvcha.2017.08.003>
- Devine-Wright, P., & Howes, Y. (2010). Disruption to place attachment and the protection of restorative environments: A wind energy case study. *Journal of Environmental Psychology*, 30(3), 271–280. <https://doi.org/10.1016/j.jenvp.2010.01.008>
- Devine-Wright, P., Pinto de Carvalho, L., Di Masso, A., Lewicka, M., Manzo, L., & Williams, D. R. (2020). “Re-placed” – reconsidering relationships with place and lessons from a pandemic. *Journal of Environmental Psychology*, 72, Article 101514. <https://doi.org/10.1016/j.jenvp.2020.101514>
- Devine-Wright, P., & Quinn, T. (2020). Dynamics of place attachment in a climate changed world. *Place Attachment*, 226–242. <https://doi.org/10.4324/9780429274442-14>
- Di Masso, A., Williams, D. R., Raymond, C. M., Buchecker, M., Degenhardt, B., Devine-Wright, P., Hertzog, A., Lewicka, M., Manzo, L., Shahrada, A., Stedman, R., Verbrugge, L., & von Wirth, T. (2019). Between fixities and flows: Navigating place attachments in an increasingly mobile world. *Journal of Environmental Psychology*, 61, 125–133. <https://doi.org/10.1016/j.jenvp.2019.01.006>
- Dicks, B., Soyinka, B., & Coffey, A. (2006). Multimodal ethnography. *Qualitative Research*, 6(1), 77–96. <https://doi.org/10.1177/1468794106058876>
- Drozdowski, D. (2007). A place called ‘bielany’: Negotiating a diasporic polish place in sydney. *Social & Cultural Geography*, 8(6), 853–869. <https://doi.org/10.1080/14649360701712594>
- Dun, O. (2011). Migration and displacement triggered by floods in the mekong delta. *International Migration*, 49(s1), 2011. <https://doi.org/10.1111/j.1468-2435.2010.00646.x>
- Elsawah, S., Hamilton, S. H., Jakeman, A. J., Rothman, D., Schweizer, V., Trutnevte, E., Carlsen, H., Drakes, C., Frame, B., Fu, B., Guivarch, C., Haasnoot, M., Kemp-Benedict, E., Kok, K., Kosow, H., Ryan, M., & van Delden, H. (2020). Scenario processes for socio-environmental systems analysis of futures: A review of recent efforts and a salient research agenda for supporting decision making. *Science of the Total Environment*, 729, Article 138393. <https://doi.org/10.1016/j.scitotenv.2020.138393>
- Eriksson, C., & Bull, J. (2017). Place-making with goats and microbes: The more-than-human geographies of local cheese in Jämtland, Sweden. *Journal of Rural Studies*, 50, 209–217. <https://doi.org/10.1016/j.jrurstud.2017.01.010>
- Frąckowiak, M. (2023). Place-making as an attentive urban presence. *Society Register*, 7(2), 21–32. <https://doi.org/10.14746/sr.2023.7.2.02>
- Frankfurt-Stubice Cooperation Centre. (2023) (n.d.). Retrieved October 4 <https://www.frankfurt-oder.de/Verwaltung-Politik/Verwaltung/Frankfurt-S-322-ubicer-Kooperationszentrum/Über-uns/>.
- Franklin, A. (2022). Introduction: Sustainability science as Co-creative research praxis. In *Co-creativity and engaged scholarship* (pp. 43–73). Springer International Publishing. https://doi.org/10.1007/978-3-030-84248-2_2
- Free, G., Van de Bund, W., Gawlik, B., Van Wijk, L., Wood, M., Guagnini, E., Koutelos, K., Annunziato, A., Grizzetti, B., Vigiak, O., Gnechi, M., Poikane, S., Christiansen, T., Whalley, C., Antognazza, F., Zerger, B., Hoeve, R. J., Stielstra, H., & European Commission. Joint Research Centre. (2023). An EU analysis of the ecological disaster in the oder river of 2022 : Lessons learned and research-based recommendations to

- avoid future ecological damage in EU rivers, a joint analysis from DG ENV, JRC and the EEA. <https://doi.org/10.2760/067386>.
- Freire, P. (1970). *Cultural action and conscientization*. http://meridian.allenpress.com/h/article-pdf/40/3/452/2107927/haer_40_3_h76250x720j43175.pdf.
- Frith, J. (2012). Splintered space: Hybrid spaces and differential mobility. *Mobilities*, 7 (1), 131–149. <https://doi.org/10.1080/17450101.2012.631815>
- Gesing, F. (2019). Towards a more-than-human political ecology of coastal protection: Coast Care practices in Aotearoa New Zealand. 10.1177/2514848619860751, 4(2), 208–229 <https://doi.org/10.1177/2514848619860751>.
- Gottwald, S., Brenner, J., Albert, C., & Janssen, R. (2021). Integrating sense of place into participatory landscape planning: Merging mapping surveys and geodesign workshops. *Landscape Research*. <https://doi.org/10.1080/01426397.2021.1939288>
- Gould, R. K., Pai, M., Muraca, B., Kai, & Chan, M. A. (2019). He 'ike 'ana ia i ka pono (it is a recognizing of the right thing): How one indigenous worldview informs relational values and social values. *Sustainability Science*, 14, 1213–1232. <https://doi.org/10.1007/s11625-019-00721-9>
- Günzel, R., Boboryk, P., & Friedrich, S. (2017). *Vergleichende Analyse der Pendlerverflechtungen und der Arbeitsplatzverteilung in Deutschland und Polen- Grenzüberschreitende Pendleranalyse der Euregion PRO EUROPA VIADRINA*.
- Gustafson, P. (2001). Roots and routes. *Environment and Behavior*, 33(5), 667–686. <https://doi.org/10.1177/00139160121973188>
- Gustafson, P. (2009). Mobility and territorial belonging. *Environment and Behavior*, 41(4), 490–508. <https://doi.org/10.1177/0013916508314478>
- Haider, L. J., Hentati-Sundberg, J., Giusti, M., Goodness, J., Hamann, M., Masterson, V. A., Meacham, M., Merrie, A., Ospina, D., Schill, C., & Sinare, H. (2018). The undisciplined journey: Early-career perspectives in sustainability science. *Sustainability Science*, 13(1), 191–204. <https://doi.org/10.1007/s11625-017-0445-1>
- Hakkarainen, V., Soini, K., Dessein, J., Christopher, J., & Raymond, M. (2022). Place-embedded agency: Exploring knowledge-place connections for enabling plurality in governance of social-ecological systems. *People and Nature*, 4, 1141–1158. <https://doi.org/10.1002/pan3.10365>
- Hannam, K., Sheller, M., & Urry, J. (2006). Editorial: Mobilities, immobilities and moorings. *Mobilities*, 1(1), 1–22. <https://doi.org/10.1080/17450100500489189>
- Heitlinger, S., & Houston, L. (2021). Algorithmic food justice: Co-Designing more-than-human blockchain futures for the food commons. *Conference on Human Factors in Computing Systems - Proceedings*. <https://doi.org/10.1145/3411764.3445655>
- Hernández, B., Carmen Hidalgo, M., Salazar-Laplace, M. E., & Hess, S. (2007). Place attachment and place identity in natives and non-natives. *Journal of Environmental Psychology*, 27(4), 310–319. <https://doi.org/10.1016/j.jenvp.2007.06.003>
- Hjorth, L., & Pink, S. (2014). New visualities and the digital wayfarer: Reconceptualizing camera phone photography and locative media. *Mobile Media and Communication*, 2 (1), 40–57. <https://doi.org/10.1177/2050157913505257/FORMAT/EPUB>
- IGB. (2023). *Zentrale Zwischenergebnisse zum Zustand der Oder nach der Umweltkatastrophe*.
- Ind, N., & Coates, N. (2013). The meanings of co-creation. *European Business Review*, 25 (1), 86–95. <https://doi.org/10.1108/09555341311287754>
- Ingalls, M., Stedman, R., Society for Human Ecology, M., & Stedman, R. (2016). Engaging with human identity in social-ecological systems: A dialectical approach. *Human Ecology Review*, 1–19. <https://openresearch-repository.anu.edu.au/handle/1885/110881>.
- Jansen, S. J. T. (2020). Place attachment, distress, risk perception and coping in a case of earthquakes in The Netherlands. *Journal of Housing and the Built Environment*, 35, 407–427. <https://doi.org/10.1007/s10901-019-09706-7>
- Jansen, S. J. T., Hoekstra, J. S. C. M., & Boumeester, H. J. F. M. (2017). The impact of earthquakes on the intention to move: Fight or flight? *Journal of Environmental Psychology*, 54, 38–49. <https://doi.org/10.1016/j.jenvp.2017.09.006>
- Kaufmann, V., Viry, G., & Widmer, E. (2010). *Motility*. In N. F. Schneider, & B. Collet (Eds.), *Mobile living across Europe II: Causes and consequences of job-related spatial mobility in cross-national comparison* (pp. 95–111). Barbara Budrich Publishers.
- Knaps, F., Gottwald, S., Albert, C., & Herrmann, S. (2022). Using meaningful places as an indicator for sense of place in the management of social-ecological systems. *Ecology and Society*, 27(4), Article art9. <https://doi.org/10.5751/ES-13340-270409>. Published Online: 2022-11-26 | Doi:10.5751/ES-13340-270409.
- Lau, U., Durrheim, K., & Young, L. S. (2021). Place detachment and the psychology of nonbelonging. In *Changing senses of place* (pp. 103–115). Cambridge University Press. <https://doi.org/10.1017/9781108769471.011>.
- Leclercq, T., Hammedi, W., & Poncin, I. (2016). Ten years of value cocreation: An integrative review. *Recherche et Applications en Marketing*, 31(3), 26–60. <https://doi.org/10.1177/2051570716650172/FORMAT/EPUB>
- Lewicka, M., Rowiński, K., Iwańczak, B., Bałaj, B., Kula, A. M., Oleksy, T., Prusik, M., Toruńczyk-Ruiz, S., & Wnuk, A. (2019). On the essentialism of places: Between conservative and progressive meanings. *Journal of Environmental Psychology*, 65 (April), Article 101318. <https://doi.org/10.1016/j.jenvp.2019.101318>
- Linstone, H. A., & Turoff, M. (2002). *The Delphi method: An efficient procedure to generate knowledge*.
- Löhr, K., Weinhardt, M., & Sieber, S. (2020). The “world café” as a participatory method for collecting qualitative data. *International Journal of Qualitative Methods*, 19, 1–15. <https://doi.org/10.1177/1609406920916976>
- Löw, M. (2016). *The sociology of space*. Palgrave Macmillan US. <https://doi.org/10.1057/978-1-349-69568-3>
- Madison, D. S. (2007). Co-performative witnessing. *Cultural Studies*, 21(6), 826–831. <https://doi.org/10.1080/09502380701478174/ASSET/CMASSET/1AE461DC-1EFC-4469-B8C0-59C64AE32DC7/09502380701478174.FP.PNG>
- Maffesoli, M. (1995). *The time of the tribes: The decline of individualism in mass society*. SAGE Publications Ltd.
- Magliocco, S. (2018). “Reconnecting to everything”: Fairies in contemporary paganism. In M. Ostling (Ed.), *Fairies, demons, and nature spirits 'small gods' at the margins of christianism* (pp. 1–53). Palgrave Macmillan UK. https://doi.org/10.1057/978-1-137-58520-2_1.
- Manzo, L. C., Williams, D. R., Masso, A. Di, Christopher, M., Gulsrud, N., Manzo, L. C., Williams, D. R., Masso, A. Di, Raymond, C. M., & Gulsrud, N. (2023). Using senses of place to help communities navigate place disruption and uncertainty using senses of place to help communities navigate place disruption and uncertainty. 42(1), 37–52.
- Massey, D. B. (2005a). *For space*. Sage. <http://digital.casalini.it/9781446259474>.
- Massey, D. B. (2005b). On space and the city. In *City worlds*.
- Masterson, V. A., Enqvist, J. P., Stedman, R. C., & Tengö, M. (2019). Sense of place in social-ecological systems: From theory to empirics. *Sustainability Science*, 14(3), 555–564. <https://doi.org/10.1007/s11625-019-00695-8>
- McIntyre, N., Williams, D. R., & McHugh, K. E. (2006). In N. McIntyre, D. R. Williams, & K. E. McHugh (Eds.), *Multiple dwelling and tourism - negotiating place, home and identity*. CAB International.
- Mondada, L. (2019). Contemporary issues in conversation analysis: Embodiment and materiality, multimodality and multisensoriality in social interaction. *Journal of Pragmatics*, 145, 47–62. <https://doi.org/10.1016/j.pragma.2019.01.016>
- Moon, K., & Blackman, D. (2014). A guide to understanding social science research for natural scientists. *Conservation Biology*, 28(5), 1167–1177. <https://doi.org/10.1111/cobi.12326>
- Muiderman, K., Zurek, M., Vervoort, J., Gupta, A., Hasnain, S., & Driessen, P. (2022). The anticipatory governance of sustainability transformations: Hybrid approaches and dominant perspectives. *Global Environmental Change*, 73(January 2021), Article 102452. <https://doi.org/10.1016/j.gloenvcha.2021.102452>
- Müller, S., Backhaus, N., & Buchecker, M. (2020). Mapping meaningful places: A tool for participatory siting of wind turbines in Switzerland? *Energy Research & Social Science*, 69, Article 101573. <https://doi.org/10.1016/j.ERSS.2020.101573>
- Murphy, D. J., Yung, L., Schultz, C., Miller, B. A., Wyborn, C., & Williams, D. R. (2023). Understanding perceptions of climate change scenario planning in United States public land management agencies. *Society & Natural Resources*, 0(0), 1–20. <https://doi.org/10.1080/08941920.2023.2172240>
- Murphy, D. J., Yung, L., Wyborn, C., & Williams, D. R. (2017). Rethinking climate change adaptation and place through a situated pathways framework: A case study from the big hole valley, USA. *Landscape and Urban Planning*, 167(July), 441–450. <https://doi.org/10.1016/j.landurbplan.2017.07.016>
- Nicolini, D. (2012). *Practice theory, work, and organization: An introduction*. Oxford University Press.
- Norström, A. V., Cvitanovic, C., Löf, M. F., West, S., Wyborn, C., Balvanera, P., Bednarek, A. T., Bennett, E. M., Biggs, R., de Bremond, A., Campbell, B. M., Canadell, J. G., Carpenter, S. R., Folke, C., Fulton, E. A., Gaffney, O., Gelcich, S., Jouffray, J.-B., Leach, M., ... Österblom, H. (2020). Principles for knowledge co-production in sustainability research. *Nature Sustainability*, 3(3), 182–190. <https://doi.org/10.1038/s41893-019-0448-2>
- Okoli, C., Pawlowski, S. D., & Molson, J. (2004). The Delphi method as a research tool: An example, design considerations and applications. <https://doi.org/10.1016/j.im.2003.11.002>.
- Oplowska, E. (2009). *Kontinuitäten und Brüche deutsch-polnischer Erinnerungskulturen . Görlitz/Zgorzelec 1945-2006 Kontinuitäten und Brüche ... Görlitz/Zgorzelec 1945 – 2006*. Europa-Universität Viadrina.
- Oplowska, E. (2021). Determinants of cross-border cooperation in the Polish-German borderland. *Poland and Germany in the European Union: The Multidimensional Dynamics of Bilateral Relations*, 208–226. <https://doi.org/10.4324/9781003046622-14>. March.
- Ortiz-Przychodzka, S., Benavides-Frías, C., Raymond, C. M., Díaz-Reviriego, I., & Hanspach, J. (2023). Rethinking economic practices and values as assemblages of more-than-human relations. *Ecological Economics*, 211(April), Article 107866. <https://doi.org/10.1016/j.ecolecon.2023.107866>
- Pink, S. (2011). Multimodality, multisensoriality and ethnographic knowing: Social semiotics and the phenomenology of perception. *Qualitative Research*, 11(3), 261–276. <https://doi.org/10.1177/1468794111399835>
- Pramova, E., Locatelli, B., Valdivia-Díaz, M., Vallet, A., Quispe Conde, Y., Djoudi, H., Colloff, M. J., Bousquet, F., Tassin, J., & Munera Roldan, C. (2022). Sensing, feeling, thinking: Relating to nature with the body, heart and mind. *People and Nature*, 4(2), 351–364. <https://doi.org/10.1002/pan3.10286>
- Rautio, P., Tammi, T., Aivelo, T., Hohti, R., Kervinen, A., & Saari, M. (2022). “For whom? By whom?”: Critical perspectives of participation in ecological citizen science. *Cultural Studies of Science Education*, 17, 765–793. <https://doi.org/10.1007/s11422-021-10099-9>
- Raymond, C. M., Kenter, J. O., Plieninger, T., Turner, N. J., & Alexander, K. A. (2014). Comparing instrumental and deliberative paradigms underpinning the assessment of social values for cultural ecosystem services. *Ecological Economics*, 107, 145–156. <https://doi.org/10.1016/j.ecolecon.2014.07.033>
- Raymond, C., Williams, D., Di Masso, A., Manzo, L., & von Wirth, T. (2021a). Introduction: Senses of place in the face of global challenges. *Changing Senses of Place: Navigating Global Challenges*, 1–18.
- Raymond, C., Williams, D., Di Masso, A., Manzo, L., & von Wirth, T. (2021b). Changing senses of place. In C. M. Raymond, L. C. Manzo, D. R. Williams, A. Di Masso, & T. von Wirth (Eds.), *Changing senses of place*. Cambridge University Press. <https://doi.org/10.1017/9781108769471>.
- Relph, E. (2021). Digital disorientation and place. *Memory Studies*, 14(3), 572–577. <https://doi.org/10.1177/17506980211010694>
- Rhee, L., Bayer, J. B., & Hedstrom, A. (2020). Experience sampling method. In *The international encyclopedia of media psychology*. John Wiley & Sons.

- Rishbeth, C., & Powell, M. (2012). Landscape research place attachment and memory: Landscapes of belonging as experienced post-migration place attachment and memory: Landscapes of belonging as experienced post-migration. <https://doi.org/10.1080/01426397.2011.642344>.
- Robertson, S. A. (2018). Rethinking relational ideas of place in more-than-human cities. <https://doi.org/10.1111/gec3.12367>.
- Robertson, S. A. (2020). Re-placing soil and its mattering in more-than-human cities. *Australian Geographer*, 307–324. <https://doi.org/10.1080/00049182.2020.1785135>
- Rupprecht, C. D. D., Vervoort, J., Berthelsen, C., Mangnus, A., Osborne, N., Thompson, K., Urushima, A. Y. F., Kóvkaya, M., Spiegelberg, M., Cristiano, S., Springett, J., Marschütz, B., Flies, E. J., McGreevy, S. R., Droz, L., Breed, M. F., Gan, J., Shinkai, R., & Kawai, A. (2020). Multispecies sustainability. *Global Sustainability*, 3, e34. <https://doi.org/10.1017/sus.2020.28>
- Sala, J. E., & Torchio, G. (2019). Moving towards public policy-ready science: Philosophical insights on the social-ecological systems perspective for conservation science. <https://doi.org/10.1080/26395916.2019.1657502>.
- Sarrica, M., Roseti, A., Brondi, S., Cervelli, P., & Leone, G. (2016). Flooded by a wall of water: Parent-child reminiscing about local environment and unwanted changes. *Qualitative Research in Psychology*, 13(3), 209–230. <https://doi.org/10.1080/14780887.2016.1169340>
- Saxena, A. K., Chatti, D., Overstreet, K., & Dove, M. R. (2018). From moral ecology to diverse ontologies: Relational values in human ecological research, past and present. *Current Opinion in Environmental Sustainability*, 35, 54–60. <https://doi.org/10.1016/j.cosust.2018.10.021>
- Schläpfer, M., Dong, L., O'keefe, K., Santi, P., Szell, M., Salat, H., Anklesaria, S., Vazifeh, M., Ratti, C., & West, G. B. (2021). The universal visitation law of human mobility. *Nature*, 593. <https://doi.org/10.1038/s41586-021-03480-9>
- Schlossberg, D., Della Bosca, H., & Craven, L. (2020). Disaster, place, and justice: Experiencing the disruption of shock events. *Natural Hazards and Disaster Justice: Challenges for Australia and Its Neighbours*, 239–259. https://doi.org/10.1007/978-981-15-0466-2_13
- Schmidt, R. C. (1997). Managing Delphi surveys using nonparametric statistical techniques. *Decision Sciences*, 28(3), 763–774. <https://doi.org/10.1111/j.1540-5915.1997.tb01330.x>
- Service of the republic of Poland, pub. L. No. 1/2022. <https://www.gov.pl/web/psse-walcz/zakaz-korzystania-z-wod-odry-do-18-sierpnia-wojewoda-zachodniopomorski-wydal-rozporzadzenie-porzadkowe>, (2022).
- Silva, J., Sá, E. S., Escadas, M., & Carvalho, J. (2021). The influence of ambient scent on the passengers' experience, emotions and behavioral intentions: An experimental study in a Public Bus service. *Transport Policy*, 106(December 2020), 88–98. <https://doi.org/10.1016/j.tranpol.2021.03.022>
- Slugocki, Ł., & Czerniawski, R. (2023). Water quality of the Odra (oder) river before and during the ecological disaster in 2022: A warning to water management. *Sustainability*, 15(11), 8594. <https://doi.org/10.3390/su15118594>
- Spash, C. L. (2007). Deliberative monetary valuation (DMV): Issues in combining economic and political processes to value environmental change. *Ecological Economics*, 63(4), 690–699. <https://doi.org/10.1016/j.ecolecon.2007.02.014>
- Star, S. L. (2010). This is not a boundary object: Reflections on the origin of a concept. *Science, Technology & Human Values*, 35(5), 601–617. <https://doi.org/10.1177/0162243910377624>
- Star, S. L., & Griesemer, J. R. (1989). Institutional ecology, 'Translations' and boundary objects: Amateurs and professionals in Berkeley's museum of vertebrate zoology, 1907–39. *Social Studies of Science*, 19(3), 387–420. <https://doi.org/10.1177/030631289019003001>
- Stedman, R. C. (2003). Is it really just a social construction?: The contribution of the physical environment to sense of place. *Society & Natural Resources*, 16(8), 671–685. <https://doi.org/10.1080/08941920309189>
- Stedman, R. C. (2006). Understanding place attachment among second home owners. *American Behavioral Scientist*, 50(2), 187–205. <https://doi.org/10.1177/0002764206290633>
- Stedman, R. C. (2008). What do we "mean" by place meanings? Implications of place meanings for managers and practitioners. In L. E. Kruger, H. E. Troy, & M. C. Stiefel (Eds.), *Understanding concepts of place in recreation research. Gen. Tech. Rep. PNW-GTR-744* pp. 61–82). U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.
- Stedman, R. C. (2016). Subjectivity and social-ecological systems: A rigidity trap (and sense of place as a way out). *Sustainability Science*, 11(6), 891–901. <https://doi.org/10.1007/s11625-016-0388-y>
- Stepputat, F. (2008). Forced migration, land and sovereignty. *Government and Opposition*, 43(2), 337–357. <https://doi.org/10.1111/j.1477-7053.2008.00256.x>
- Stockdale, A., Theunissen, N., & Haartsen, T. (2018). Staying in a state of flux: A life course perspective on the diverse staying processes of rural young adults. *Population, Space and Place*, 24(8), Article e2139. <https://doi.org/10.1002/psp.2139>
- The Guardian. (2022). Oder river: Mystery of mass die-off of fish lingers as no toxic substances found. <https://www.theguardian.com/environment/2022/aug/15/oder-river-mystery-of-mass-die-off-of-fish-lingers-as-toxic-substances-ruled-out>
- Torkington, K. (2012). Place and lifestyle migration: The discursive construction of "glocal" place-identity. *Mobilities*, 7(1), 71–92. <https://doi.org/10.1080/17450101.2012.631812>
- Trąbka, A. (2019). From functional bonds to place identity: Place attachment of Polish migrants living in London and Oslo. *Journal of Environmental Psychology*, 62, 67–73. <https://doi.org/10.1016/j.jenvp.2019.02.010>
- Tschakert, P. (2020). *More-than-human solidarity and multispecies justice in the climate crisis*. <https://doi.org/10.1080/09644016.2020.1853448>
- Tuulentie, S. (2007). Settled tourists: Second homes as a part of tourist life stories. *Scandinavian Journal of Hospitality and Tourism*, 7(3), 281–300. <https://doi.org/10.1080/15022250701300249>
- van Dijk-de Vries, A., Stevens, A., van der Weijden, T., & Beurskens, A. J. H. M. (2020). How to support a co-creative research approach in order to foster impact. The development of a Co-creation Impact Compass for healthcare researchers. *PLoS One*, 15(10), Article e0240543. <https://doi.org/10.1371/journal.pone.0240543>
- Vermaat, J. E., Wagtenonk, A. J., Brouwer, R., Sheremet, O., Ansink, E., Brockhoff, T., Plug, M., Hellsten, S., Tylec, L., Okruszko, T., Brabek, K., Haverkamp, J., Poppe, M., Coerssen, M., Segersten, J., & Hering, D. (2015). *Restoring rivers for effective catchment management ecosystem services approach*.
- Verstraete, G., & Cresswell, T. (2016). Mobilizing place, placing mobility: The politics of representation in a globalized world. In *Mobilizing place, placing mobility*. Brill. <https://doi.org/10.1163/9789004333451>
- Vörösmarty, C. J., McIntyre, P. B., Gessner, M. O., Dudgeon, D., Prusevich, A., Green, P., Glidden, S., Bunn, S. E., Sullivan, C. A., Liermann, C. R., & Davies, P. M. (2010). Global threats to human water security and river biodiversity. *Nature*, 467(7315), 555–561. <https://doi.org/10.1038/nature09440>
- Welden, E. A. (2022). Conceptualising multispecies collaboration: Work, animal labour, and Nature-based Solutions. <https://doi.org/10.1111/tran.12593>
- Williams, D. R. (2014). Making sense of 'place': Reflections on pluralism and positionality in place research. *Landscape and Urban Planning*, 131, 74–82. <https://doi.org/10.1016/j.landurbplan.2014.08.002>
- Winter, C. J., & Schlossberg, D. (2023). What matter matters as a matter of justice? *Environmental Politics*, 00(00), 1–20. <https://doi.org/10.1080/09644016.2023.2220640>
- Zhang, R., Te Brömmelstroet, M., Nikolaeva, A., & Liu, G. (2024). Cycling subjective experience: A conceptual framework and methods review. *Transportation Research Part F: Traffic Psychology and Behaviour*, 101(June 2023), 142–159. <https://doi.org/10.1016/j.trf.2023.12.021>
- Zimmermann, A., & Kość, W. (2022). *Poland and Germany's poisoned relations over Oder River fish die-off*. Politico. <https://www.politico.eu/article/poland-germany-relati-on-oder-river-fish/>