Maritime Studies (2025) 24:45
https://doi.org/10.1007/s40152-025-00439-8

RESEARCH

Towards 'the science *we* need for the ocean *we* want': revealing and addressing power relations in knowledge-action co-production practices

Tatiana Sokolova[1] · **Fred Saunders**[1] · **Michael Gilek**[1] · **Kristin Tietje**[2]

Received: 13 November 2024 / Accepted: 25 June 2025

Abstract
International research programs have endorsed knowledge co-production to enhance the utility and impact of global environmental change research. However, knowledge co-production frequently overlooks the complex interrelations between knowledge and power that permeate transdisciplinary sustainability research (TDSR). We analyse how power relations in transdisciplinary ocean governance projects form research agendas and design of six projects within the Belmont Collaborative Research Action on Ocean Sustainability, representing a broad set of experiences of transdisciplinary marine sustainability research practice spanning a wide set of sustainability issues and geopolitical contexts. We examine how distinctive forms of power shape the ways in which researchers envision socio-environmental change and transdisciplinary work within a spectrum of knowledge-action practices ranging from 'linear' to 'relational'. Our findings highlight the need for a deeper engagement with theories of change throughout the lifespans of transdisciplinary projects. Furthermore, the results point at constraints imposed by existing funding structures and epistemic assumptions on the ability of the projects to adopt relational transdisciplinary co-production research strategies, tailored to specific ocean contexts. We recommend adaptive funding structures which would allow researchers to exercise co-production agility and overcome the tension between the needs for embeddedness and transferability of insights. Finally, we show how the three forms of power interact in the linear and relational models of linking knowledge and action and suggest areas where researchers need to direct their attention when designing and implementing transdisciplinary projects aiming to promote sustainability action in close collaboration with societal actors.

Keywords Sustainability transformations · Science-policy interface · Sustainability science · Participation · Actionable science

Introduction

The UN Decade of Ocean Science for Sustainable Development, launched in 2021, outlines visions for the 'science we need for the ocean we want'. It underlines the importance of transdisciplinary research for creating 'transformative' solutions to fulfil the goals of the 2030 Agenda (Intergovernmental Oceanographic Commission 2021), thereby addressing the social and environmental justice challenges inherent in Sustainable Development Goal (SDG) 14, 'Life Below Water'. The aim of the UN Decade is to enhance the relevance and usability of knowledge production by engaging diverse stakeholders, ensuring equitable participation, and co-creating solutions for marine sustainability (Inbakandan 2023). These institutional demands foreground transdisciplinary sustainability research (TDSR) in the marine context, acknowledging the need to go beyond conventional science-policy interfaces to actively engage a broader range of societal actors (Bennett 2018; Claus et al. 2023; Kiatkoski Kim et al. 2022; Lawrence et al. 2022). This approach

✉ Tatiana Sokolova
tatiana.sokolova@sh.se

[1] Department of Environment, Development and Sustainability Studies, Södertörn University, Alfred Nobels allé 7, Huddinge 141 89, Sweden

[2] Helmholtz Institute for Functional Marine Biodiversity at the University of Oldenburg (HIFMB), Im Technologiepark 5, 26129 Oldenburg, Germany

Published online: 07 July 2025

acknowledges that marine sustainability challenges extend beyond technical solutions, necessitating a comprehensive understanding that encompasses historical, equity, and political dimensions (Crosman et al. 2022; Jentoft and Chuenpagdee 2009; Vierros 2021).

Knowledge co-production, which has become an organising principle of TDSR (Beck 2019), is meant to challenge a linear knowledge-to-action model, where knowledge is decontextualised from the situation in which it was produced to be subsequently applied elsewhere (van Kerkhoff and Lebel 2006). Bergmann et al. (2021) describe this linear model as researcher-initiated and -conducted studies, with little collaboration with societal actors, except as empirical subjects. By contrast, co-production as a principle is supposed to generate what we term a relational model of knowledge-action, in which knowledge and action are iterative and context-dependent. This relational model supports the research processes that involve pluralistic, collaborative, dynamic, open-ended sustainability policy and practice tied to specific contexts (West, van Kerkhoff, and Wagenaar 2019). We take a critical stance towards the linear model, as we argue that it fails to deal with the challenges that the co-production turn has faced when aiming to include a broader range of actors in the research (ibid.) and thus to effectively contribute to the UN Decade. Producing the science 'we need for the ocean we want' necessitates complex processes of constructing the 'we' and the 'want' (see, for example, McKinley 2024). It presupposes a differentiation between various types of knowledge claims, navigating socio-political asymmetries among stakeholders, and defining framings of desirable change towards sustainability (McCabe et al. 2021; Turnhout et al. 2020) – all challenges for which the linear model is likely unfit. If TDSR is called to radically shift norms, values and deep-seated epistemic assumptions of sustainability science, it must necessarily address the issues of social and epistemic justice (Code 2014; Temper and Del Bene 2016) through reconfiguring the relationship between knowledge and power. Unsurprisingly then, exploring power dynamics is a key concern in TDSR (de Geus et al. 2023), where what 'power' means is far from uniform (Schmidt and Neuburger 2017). Previous research states that power dynamics affect the ideations of the processes connecting knowledge and action in TDSR (Brugnach and Özerol 2019; Schneider 2019). And yet, while TDSR aims to generate knowledge to transform an unsustainable status quo, the roles of power have not been adequately understood in sustainability studies generally (Fritz and Meinherz 2020), and marine-focused studies in particular (Strand et al. 2022). This necessitates scrutiny towards the ability of TDSR to implement the relational co-production principles and ideals in practice.

In response to these gaps, we analyse the types of power relations at play in the design and research practices of six transdisciplinary projects within the Belmont Forum Collaborative Research Action Program on Ocean Sustainability. The Belmont Forum is an international institution that garners and amalgamates national funding for international collaborations, and for this call it partnered with Future Earth and JPI Oceans to fund research aimed to 'accelerate sustainable use' (sic.) of the ocean resources, with a focus on equity, integration of various knowledges, and transdisciplinarity. The call aptly illustrates TDSR in the ocean governance, because it presupposes an explicit connection between knowledge and action and calls for their co-production with societal actors. We examine the different projects' views of change/transformation in the context of marine sustainability and how these understandings relate to various types of stakeholder engagement, forms and challenges of co-production processes, and heterogeneous knowledge relationships. We explore what forms of power enable and constrain researchers' understandings of transformative research practices, observing the complex relationship between linear and relational models of connecting knowledge and action.

To sketch the forms of power shaping TDSR, we draw on scholars in transition studies who have produced analytical renderings of power perspectives (Ahlborg 2017; Avelino 2021). This work is relevant for our purpose, as it addresses conceptualisations of power in relation to societal change and sustainability. We used these classifications to develop an analytical framework to examine the decision-making power of research leaders, the institutional structures in which the projects are embedded, and the socio-epistemic power of unquestioned assumptions about knowledge and action. We use this framework to understand how the linear and relational models of knowledge-action interplay with the power dynamics we observe in our empirical material, and to identify wherein lie impediments and potentials for transformative change in TDSR practices.

Theorising knowledge co-production, power, and change

Transdisciplinary research and action: two models of co-production

Understanding a transdisciplinary research project as a sustainability intervention involves scrutinising assumptions about how desired change is expected to come about and the role of researchers in collaborating with societal actors. Cvitanovic et al. (2021) view predominant understandings of 'impact' in marine knowledge production as instrumental

and reductionist. Questions persist about how transformation is envisioned to be translated from an academic perspective into normative actions in co-production processes, and how this might influence change in various settings (Blythe et al. 2018), generating different ideas about knowledge-action connections. To effect societal change, TDSR often involves marginalised groups, whose sustainability visions may appear idealistic or impractical as seen through a conventional scientific lens. However, this 'impracticality' is what makes these visions essential for sustainability. Bell and Pahl (2018) see co-production as a utopian method which has the potential to transform the dominant configurations of power by offering diverse perspectives and more inclusive and equitable alternatives, thus challenging the status quo. For this potential to be realised, TDSR needs to be attentive to the dangers of co-optation by powerful actors, including researchers themselves (Harnesk and Isgren 2022). Participation, especially in the development practice context, has been critiqued as a form of adverse incorporation: a way to legitimise interventions without benefitting the excluded groups (Kothari 2001). Researchers must therefore be sensitive to the power relations they are potentially maintaining, creating or disrupting, which demands engaging in transgressive learning and politics tied to transformative action (Lotz-Sisitka et al. 2016; Tafon et al. 2021). Such 'transgression' is a tall order for research communities working within the institutional frameworks of conventional scientific approaches which, despite the endorsement of co-production, have built-in assumptions and structures that run counter to the transformational potential of TDSR (Roos 2024; Turnhout 2024; Van der Hel 2018).

Given the above challenges inherent in the relationships between researchers and societal actors, we explore what we see as two models of engagement between knowledge and action, namely, the linear and relational models, with regard to what these models imply for possibility of societal change envisioned by the projects. Recognising that these two models are 'ideal types', we acknowledge that, in the context of actual research practice, they often overlap. The linear model presupposes researchers producing 'objective' knowledge which is then applied by practitioners, thus separating knowledge-action domains (West, van Kerkhoff, and Wagenaar 2019). The relational model envisions knowledge and action produced simultaneously in an entangled way that works to unsettle the hierarchy of scientific and non-scientific kinds of knowledge. Transdisciplinary research, remaining 'captive' to linear assumptions of knowledge-action, has been argued to fail to realise its transformative potential as it fails to deal with deeply contextual, dynamic, plural, interconnected practices of sustainability knowledge-action (ibid.). Although there are many reasons for the failures of TDSR in practice, we argue that the linearity of knowledge-action connections is both a source and an outcome of certain forms of power relationships manifesting in (and we would argue, constituting) the knowledge-action interfaces. These forms of power promote sedimentation of existing institutional and procedural configurations and prevent the kind of transformative and actionable research that the UN Decade of Ocean Science, Belmont Forum Collaborative Research Action, and TDSR initiatives aim to endorse.

Knowledge and power

To interrogate the ways in which the two knowledge-action models laid out above impact the potential of the projects for effecting transformative change, we analyse how these models enact the relationship between power and knowledge. To that end, we draw on the distinction made by Avelino (2021) between two schematic understandings of this relationship: knowledge defining power versus power defining knowledge. The former understanding sees power shaped by the asymmetries of knowledge production and distribution in society, while the latter suggests that power produces knowledge (ibid.). We engage the latter interpretation (power shapes knowledge) to see knowledge production as a social practice shaped by power relationships. In particular, we explore three forms of power (Fig. 1): the agents and their intentions (*agential*); the institutions that the agents are embedded in (*structural*); and the normalisation of certain assumptions about knowledge and social change which the agents are subjected to (*socio-epistemic*).

Agential power refers to the agency of identifiable actors. It has been theorised as actions or dispositional abilities to act (cf. action-theoretical concept of power in Allen (2005). It includes both exercise of power and a potential for such exercise, emanating from possession of 'power resources', like authority (Haugaard 2021). Such power is central to TDSR insofar as it reflects differential capacities of researchers and societal actors to shape research design and development. Modes of transdisciplinary research, such as Participatory Action Research (PAR) explicitly aim to empower or benefit currently marginalised actors by placing value on 'experiential knowledge for tackling problems caused by unequal social systems, and for envisioning and implementing alternatives' (Cornish et al. 2023: 1). Agential power manifests, negatively, as coercion and manipulation, exclusion and nondecision-making (power 'over') – but also positively, as resistance and empowerment (power 'to'), cooperation and learning (power 'with') (Avelino 2021; Partzsch 2015). Although power 'with' can be seen as a manifestation of the orientation towards capacity-building among actors, the ideas of 'empowerment'

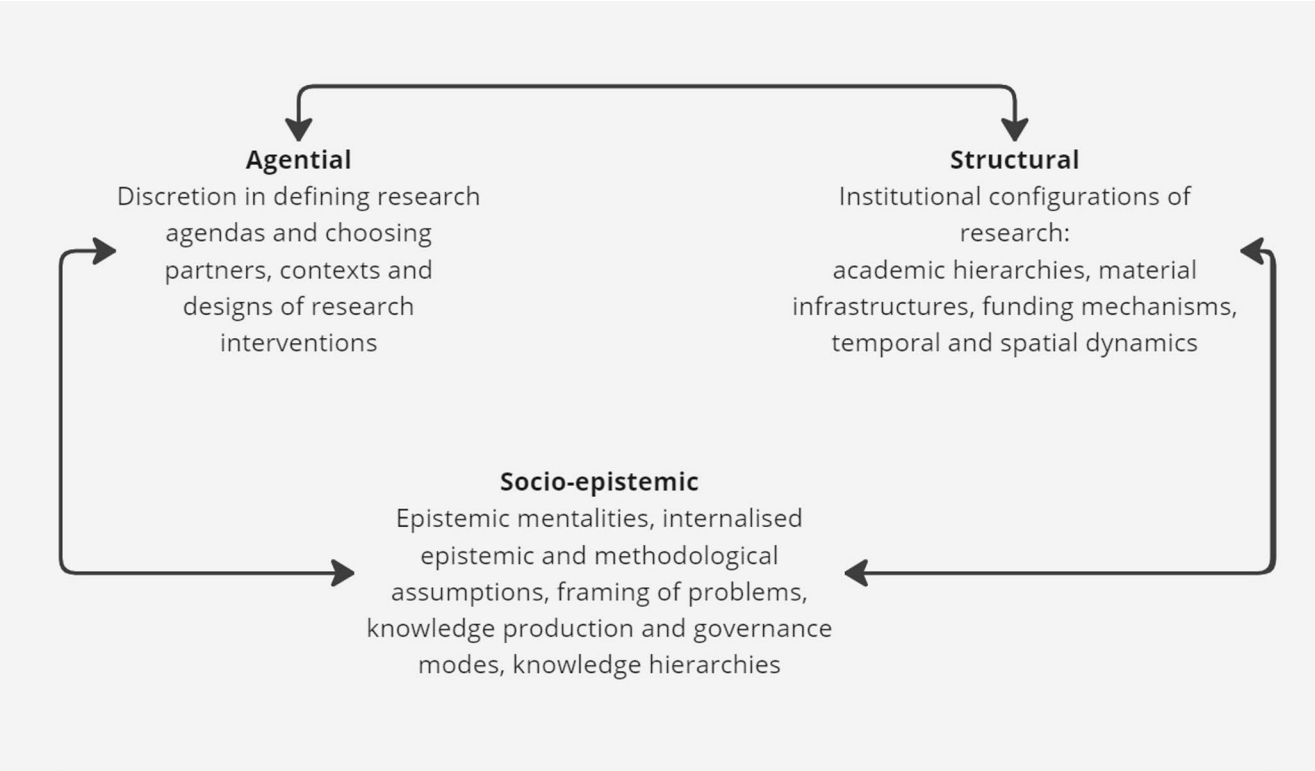

Fig. 1 Power forms conceptualisations. (Source: the authors)

and 'capacity-building' are problematic. Henkel and Stirrat (2001) suggest that 'empowerment' sometimes masks the very formation of the subjects who are allegedly being empowered. The meaning of empowerment is unstable, as it enacts diverse understandings of what constitutes power; but often the empowerment rhetoric acts as a stand-in for 'management' or 'development' (Cooke and Kothari 2001). Similarly, Maschietto (2016) argues that 'empowerment' and 'capacity-building' have been a prominent part of the development discourse, at best not implying any substantive benefits to the communities, at worst serving the agendas of international donors and local actors with significant economic and political influence. Given this critique, in this paper we approach the ideas of empowerment and capacity-building as our own interpretations of the intentions of the projects which seemed to be concerned with the well-being of the local communities.

Structural power deals with institutional configurations of research. Although 'social structures' can be defined broadly, from language to political systems (Haugaard 2021), we limit our understanding of structural power to effects of TDSR organisation at institutional levels: academic and funding structures. Such understanding is warranted by previous research which has observed structural forms of power relationships between 'social and natural sciences, academic hierarchical layers, researchers and societal actors and between the Global North and South' (Schmidt and Neuburger 2017: 54). Such power typically manifests in the institutional and material setup, including academic hierarchies, physical infrastructures, research funding mechanisms, temporal and spatial configurations of research programmes, as well as post-colonial dynamics. Haugaard (2002) stresses the importance of considering both constraining and enabling aspects of how structural power operates. That is, structural power can have normatively positive effects, for example, through TDSR facilitating partnerships between different societal groups and knowledge systems (scientific and local, Global North and South), or working to build different types of sought-after capacities for knowledge and action. Thus, there are structures constraining and enabling the evolvement of research, and to various extents resisted, bypassed, and negotiated by the projects.

Socio-epistemic power cannot be traced to specific agents or institutions. Allen (2005) refers to it as constitutive power, emphasising the mutual constitution between 'individuals and the social worlds they inhabit' (p. 3). We term it socio-epistemic to emphasise our concern with the embeddedness of the ways in which knowledge is understood and produced in the broader societal contexts of TDSR. It alludes to Foucauldian analysis of power, focused on internalisation of social practices and normalisation of

discourses and political rationales (de Geus et al. 2023). It surfaces through modes of thinking, internalised epistemic and methodological assumptions (including hierarchies of methods and epistemologies), the ways in which research problems are framed, and knowledge is produced and governed. This form of power relies on what Haugaard (2021) describes as the 'natural attitude' of actors to their practical knowledge, encompassing ways of thinking, procedures and techniques which are taken for granted by the actors applying them (Jernnäs and Lövbrand 2022). It naturalises the ways in which phenomena are constructed as objects of governance (Lövbrand, Stripple, and Wiman 2009) through systems of thought created by everyday work of knowledge-makers (Miller 2007).

Methodology

The Belmont Forum Collaborative Research Action (CRA) program on ocean sustainability aims at supporting collaborative research knowledge to action towards sustainability transformation in marine settings. We selected six of the projects funded by the CRA for analysis (Table 1) to reflect a diversity of ocean sustainability topics, researcher-actor configurations, and geopolitical contexts. As we studied projects as they unfolded, we did not analyse the actual impacts of the projects, but their intentions and how they have so far been realised, changed, or adapted in the process. The empirical part of the study was limited to the researchers' voices: the framing of the projects by researchers, their ambitions, understandings of social change and co-production. We complemented these views through sourcing of background insights on projects from project applications and websites. We acknowledge that including a more diverse range of voices could have supported a comparative analysis of different stakeholders' perceptions, potentially leading to a richer understanding of the social impacts and co-production processes. However, the scope of this study was intentionally focused on the researchers' experiences and how they sought to translate the transdisciplinary ambitions into practice.

Semi-structured online interviews were conducted with the principal investigators (PI) of the six projects, who offered their participation between November 2022 and March 2023. Although we recognise that including other researchers in our sample would potentially broaden and deepen our analysis, we focused specifically on the PIs' perspectives, because our intention was to understand the overall framings and ambitions of the projects as seen by those who initiated and designed them. The interview questions were based around: (1) partnerships and collaborative practices with societal partners; (2) assumptions/practices underpinning notions of sustainability (transformations); and (3) what change was being sought and how it was expected to come about. Prior to the interviews a consent form was signed by all interview participants. The interview audio files were recorded, encrypted, stored, and processed in accordance with the EU Data Protection Regulation 2016/679 (GDPR) and supplementary national legislation. Transcribed interviews were analysed by thematic coding reflecting the theoretical framework of this study.

Three forms of power in the linear and relational research models

In this section, we analyse how power is exercised and the ways in which it shapes research project relations and outcomes along the three dimensions of our analytical framework.

Agential power

Agenda-setting and actor engagement

Agential power manifested in the discretion that the researchers used in deciding upon research agendas and inclusion and exclusion of actors. The projects to various extents engaged private actors (e.g. large industrial operators, offshore wind developers); local communities (e.g. users of marine resources, artisanal and subsistence fishers, NGOs, environmental associations); and decision-makers (e.g. marine planners, national park authorities and various agencies). The linear model of knowledge-action production found expression in power 'over' through top-down agenda definitions. Actors were selected based on their expertise, decision-making power, institutional strength, existing connections, or their being part of the perceived 'problem' or 'solution'. The top-down agendas emerged through researchers formulating them on the basis of previous knowledge or 'hunch', sometimes in consultation with other stakeholders:

> *[…] such as increasing fish catch, decreasing malnutrition. While [the communities] didn't actively tell us that was their goal - how could it not be, right?*[1]

[1] All the interview quotes are from the projects' PIs. To ensure sufficient anonymity of interview quotes we mostly choose not to attribute them to specific projects. In other parts of the results section we, however, deem it possible to make links between specific projects and descriptive/analytical results without infringing on respondent confidentiality.

Table 1 Research projects analysed in this study

Project	Aims	Involved countries (team)	Active core groups[2]	Study sites
ARMSRestore (AR) *ARMS to reefs: A new tool to restore coral reef biodiversity, fisheries yields, and human health in Madagascar*	A reef restoration project aiming to employ a novel tool to build reef ecosystems (artificial reefs) and grow fisheries to improve human health and well-being.	US, Madagascar, Sweden	Reef Doctor (NGO), local community, local small-scale fisheries	Madagascar
EXEBUS (EX) *Ecological and Economic impacts of the intensification of extreme events in the Benguela Upwelling System*	Understanding the drivers of change and extreme events in the atmosphere-marine climate in the Benguela Upwelling System and its impact on residents of the coastline and those who derive their livelihoods and resources from the Benguela Upwelling System.	South Africa, US, Norway, Canada, Japan, Namibia	practitioners, representatives of the private sector and civil society	South Africa, Namibia, Angola
MARISCO (MA) *Marine Research and Innovation for a Sustainable management of Coasts and Oceans*	Addressing the multi-layered interactions between biodiversity change, its impact on society and Nature's Contributions to People by defining targets and developing strategies in sustainable marine ecosystem management.	Germany, US, South Africa	National Park Authority Wadden Sea, Lower Saxony Agency for Water Management and the Protection of Coasts and the Environment, South African National Parks, South African Institute for Aquatic Biodiversity, South African Environmental Observation Network, Wildlife and Environment Society of South Africa, Northeast Regional Ocean Council, The Nature Conservancy	South Africa, Germany
MULTI-FRAME (MF) *Assessment Framework for successful development of viable ocean multi-use systems*	Aiming to increase the knowledge base and capacity of public and private actors for sustainable ocean multi-use, by providing concrete open-source tools, assessment results and best practice examples.	Germany, Brazil, Sweden, US, Norway, France	public, private, research and community actors	Sweden, Mozambique, Norway, France, United States, Brazil
NO CRISES (NC) *Negotiating Ocean Conflicts among Rivals for Sustainable and Equitable Solutions*	A mixed method approach and cross-case study comparison to assess the origin, drivers, and mitigation strategies of ocean conflicts to promote transitions to achieve sustainable ocean management.	Australia, South Africa, Sweden, Germany, US	local communities	Fiji, Bangladesh, Hawai'i, North Atlantic, Seychelles, Spain, Brazil
PolyCone (PC) *Integrated and sustainable regulation of cones in Eastern Polynesia*	Development of a sustainable use plan for toxins of cone snails as an important source of pharmaceuticals for treating human health.	France, French Polynesia, Australia, US	local communities	French Polynesia

I have to say that the first definition came from the scientists. Then […] the agencies […] commented on this and that has shifted some of the focus, but it […] didn't really change the complete focus. They were quite in agreement with how we define the challenge. It didn't kind of raise a red flag with them. So it's actually a research-driven sustainability question which came up.

The 'bottom-up' processes of agenda definition implied community meetings, 'co-generating issues', and scoping workshops. Most projects employed a mix of top-down or bottom-up approaches in defining research agendas. Sometimes different strategies were activated at different stages of the projects, for example, starting with input from 'broker' organisations, and then co-evolving research agendas directly with communities in the process of research – in projects which were designed to allow such co-evolution.

Correspondingly, the actors defining the agendas ranged from 'the people' to the researchers in the driving seat, sometimes involving brokers, local organisations, impacted groups or feedback from authorities and agencies. Two somewhat contradictory quotes from the same PI:

> *So the people defined it. We didn't.*

Later:

> *We didn't start from zero. We all work in the region and know the issues.*

These quotes demonstrate an ambivalence regarding the bottom-up and top-down distinction, highlight the iterative nature of the processes, and suggest that understandings of the relationships between power dynamics and research agenda setting could be more reflective.

Impact: Community- (power 'to') and policy-oriented (power 'over')

The perceptions of what constitutes sustainability improvements varied among the projects, from the establishment of tangible structures, such as artificial reefs designed to expand/improve local fisheries and boost fishery-related income and health outcomes for coastal communities (AR), to the development of institutional structures to strengthen and secure customary management and rights to locally valued environmental values linked to local economic benefits (PC). The relational model aimed to nurture local capacity and reduce vulnerabilities related to multi-dimensional ideas of sustainability (examples of projects engaged in this kind of TDSR are NC, AR, PC, EX). When the relational model was being employed, researchers often explicitly attempted to 'elevate marginalised agendas' (Chambers et al. 2022). The relational model was also present where researchers built alliances with local actors, as well as solicited local organisations to provide access to and knowledge about the communities. This strategy also included longer-term capacity-building, such as enhancing scientific capacity of the region. Some of the engagement directly affected the communities, such as intentions to enable conflict resolution (NC), use resources (AR), training community members with specific skills, paying for certain forms of participation (e.g. in the AR project, building artificial reefs or buying their fish catch). Attendant to this were also ambitions to secure beneficial changes or legacies beyond the life of the project. Other examples included collective textile weaving (NC) and involvement of scientific fisheries data gathering (AR). In AR, improving material well-being connected sustainable resource use to the improvement of community health concerns, such as nutritional and mental health. The PC project collaborated closely with a variety of governance, community, and business (pharmaceutical) actors to understand the diversity of values and relationships that different stakeholders currently have and potentially could have with cone snails.

The knowledge and impact generated through this model were contextual, although in some instances intending to upscale project insights for application (and impact) elsewhere. At times this involved implementing structural reforms, where explicit actions were underway to formally institutionalise positive changes for indigenous actors. For example, the PC project was working towards securing rights for indigenous custodians, regarding the exploitation of this species and determining who would receive financial benefits from it. The project design and practices clearly showed an ambition to enhance local actors power 'to' - to manage, control and benefit from resource access and use through a variety of institutional changes and actor-oriented strategies.

At other times, researchers placed more emphasis on the need to improve ways of planning and governance about specific environmental values and uses. Such emphasis was not aimed at disrupting existing power relations but rather at improving the efficiency and effectiveness of governance practices at wider scales on issues such as changing environmental conditions and optimising societal use of marine space or resources by developing transferable decision support tools (such as, for example, in MF, MA). In these examples, emphasis was placed on collaborating with governance actors and (larger scale) stakeholders affected by the projects and the focussed sustainability issues. When projects worked towards this aim, they used varying forms of joint problem framing and co-produced knowledge generation approaches with government agencies, experts and stakeholders, but were not directly aimed at benefiting marginalised communities or social actors, nor was the practical application of the knowledge or approach part of the research project. This approach, aligned with the linear model, aimed at upscaling for impact through science communication strategies, such as policy briefs and reflection on the research practice with higher level governance actors and/stakeholders. Thus, the approach can be seen in these particular instances as contributing to the power 'over' of the existing institutional authorities. That said, the extent of social change from all these approaches in terms of building capacity among actors to better redress sustainability problems is difficult to gauge.

Structural power

Structural power manifested most clearly in the challenges that the projects faced with regard to funding, academic and transdisciplinary practices, and Global North-South configurations. For example, there were discrepancies between exercising scientific caution and producing specific metrics for various authorities; using knowledge produced through publicly funded research for commercial purposes; high mobility of researchers; over-researched and over-collaborated countries and groups of actors; questioning of researchers as intruders; and mistrust due to the Global North/South dynamics, geographic and cultural diversity. One project expressed the issue of relating to communities:

> *We like to think we're co-producing, but the co-production process usually ends up being, we would really like to do this. What do you think? Can you send us a letter of support?… I feel like the way that these funding streams work, often we go from place to place and we're never able to maintain these community relationships very well, so we don't co-produce new work very well either.*

Eschewing the linear models of knowledge and action in favour of more inclusive and iterative was fraught with numerous challenges and constraints. Governance structures restricted modes of engagement of local actors, created resistance and discrepancies in demands on the speed of knowledge production and its usability. Furthermore, the projects struggled with power structures they encountered on the ground, which generated taboos on certain discussions and silenced certain groups' voices:

> *We were told that people could not express their opinions in the forum that we were doing this in. […] We thought we were culturally quite aware, we weren't. And in a lot of cases, you can't hold these roundtable discussions or workshops.*

These restrictive structures, including the limited project time, have 'linearised' the models of knowledge co-production, as they hindered deeper and more relational engagement with local actors in the projects predisposed towards this type of research. The researchers tried to circumvent this through adaptive approaches to selecting actors. The projects employed a diversity of tactics to understand the socio-political dynamics of their fields ('knowing the actors'): systematic approaches to stakeholder mapping, comprehensive preparatory fieldwork, network modelling, scoping exercises. At other times they relied on gate-opening either through local knowledge 'brokers', or on existing relationships. These 'brokers' seemed to be one of the 'make-or-break' factors in the projects:

> *I think it was really fortunate that [local NGO] is so integrated in the community and has been for so long that I think they were able to speak to […] community needs.*

> *That list was going to be generated by one of the major regional organizations who have access to these kinds of lists […] But various […] difficulties with this organisation ultimately resulted in us not having access to that list of stakeholders….*

However, the structures of international funding made the research possible in the first place, opening multiple opportunities for local researchers and actors. Some of the researchers were intentional in developing research capacity in the Global South, especially through engaging early-career researchers (AR).

Socio-epistemic power

The projects produced and built on a diversity of academic and non-academic forms of knowledge. The academic forms included drivers of change and variability in natural systems, sequestration properties, pharmaceutical and cosmetic uses, migration of species, impacts of biodiversity on people, and mental health. Methods of obtaining and using these kinds of knowledge spanned biodiversity sampling, GPS, surveys, genetic barcoding, peptide extraction, ecosystem services approach, scenario modelling. The non-academic forms of knowledge included such examples as traditional knowledge about ritual and medicinal properties of species, mythology, local knowledge about marine reserves, people's experiences of 'extreme events' and 'sea-state', livelihood disruptions, artistic perceptions and legal frameworks. In some projects, the explicit focus on local experiences, socio-cultural practices and material wellbeing was signalled through the interviewed PI actors explicitly seeing this as an integral part of doing ethical research (PC, AR, EX, NC). Researchers described diverging understandings of objects and phenomena as living and non-living; discrepancies between marine and terrestrial understandings and approaches; incongruences in data collection, boundary objects (like 'sea-state', 'extreme event', 'multi-use'), species names and contrasts between artistic and scientific knowledge.

The linear model manifested in the employment of the norms of Western science in knowledge relationships, displaying at times an ambivalent interplay with local knowledges. When the procedures of Western science came to the

forefront, the local knowledges had a tendency to become backdrops or sources of data extraction:

> *It's very much a Western approach to doing science. We think of the ideas, we sell them to the communities who we ask to work with us and then we move on to the next community.*

Some researchers expressed unease about employing science as a verification referent when trying to reconcile or integrate contradictory sources of knowledge:

> *I think verification would be the wrong way to put it. […] We just want to […] see whether their lived experiences match something that we can measure objectively. […] But I do want to stress that we don't want to verify people's experiences. […] that's a little bit condescending to think that scientists have all of the answers and if their experiences do not match what we can measure, that they are wrong.*

The relational model, in practice, emphasised fostering anthropological and ethnographic knowledge (PC), 'holding up a mirror', relating through art (NC) – to more direct, such as providing evidence for assessments (MF), 'selling ideas' (NC), guiding the actors' thinking (EX), training (AR), making knowledge usable/dynamic, 'mainstreaming' biodiversity, making conservation 'more marine' (MA), managing information ownership and intellectual property, and pushing for recognition of the ability to govern (a resource) (PC). Some projects strived to overcome linear tendencies by adopting artistic knowledge-making practices – only to arrive at a frustrating junction where such practices have become difficult to make sense of or integrate in the overall project goals and ambitions:

> *I'm so excited about the creative component because […] it's bigger than just the engagement around the creation of an artistic output because you get people to connect over something and you get them to communicate, and that is probably not very scientific, but it's very powerful at a community level, and it's almost like the two sort of work against each other, right, because you do arts and then you don't do science.*

These difficulties reaffirm the challenging interplay between the linear and relational models of knowledge-action. And yet, sometimes projects effectively transcended the line between the two models. For instance, different sources of data on resource use and human health were integrated to inform local decision-making and assess the impact of installing an artificial reef more holistically. In this case, this meant triangulating different types of data collected through methods such as conventional surveys and resource user-generated data, including exploring local fish name nomenclature and working with fishers to collect fisheries catch data to determine the impact of the project on fisheries (AR).

In projects such as MA and MF, the development of guidelines is aimed at being able to apply research results (and management or policy advice) beyond the study site. Arguably this approach assumes that decontextualised knowledge-action is able to be effectively transposed to other settings which have their own unique interplay of various factors. While this was acknowledged by some researchers interviewed, the extent to which this was problematised could potentially be enhanced. The MF project set up and interacted with a global reference group comprised of experts and practitioners to co-produce a set of guidelines, based on multi-case research insights on multi-use marine spatial planning. Other projects such as EX aimed to develop improved conceptual understandings and modelling capability around forecasting environmental changes and their implications in large ocean systems with and for differentiated vulnerable communities and other stakeholders. MA worked towards a better modelling of biodiversity change to inform formal planning and decision-making. MF, AR, MA sought to root their findings and insights in comparative case research design and then develop cross-case insights to inform transferable knowledge to address sustainability challenges. How the work could be effectively translated to other contexts and sites in a productive way to enhance sustainability was often seen to be beyond the life of the current project. This was seen as a point of frustration by some (MA).

Knowledge and action in the relational model, in contrast, were seen as closely interwoven and embedded in the contexts where they are generated. Commonly, this involved participatory action research where knowledge-action was seen as an integral component of the research process itself, rather than something to be generated for subsequent application.

Discussion

A brief summary of the two knowledge-action models and the three power forms constituting them is presented in Table 2. These models are seen as ideal types. As such, they are naturally oversimplified compared to how they play out empirically – but they still hint at certain tendencies of power dynamics.

Dealing with the three forms of power outlined above implies three different sets of implications for co-producing knowledge and action. When dealing with agential power,

Table 2 Three forms of power in relation to knowledge-action models

Power forms	Linear model	Relational model
Agential	Power 'over': enhancing current large-scale governance regimes by generating knowledge-action transferrable to other contexts; top-down agenda definitions	Power 'to': benefitting in situ marginalised social groups, mitigating situated vulnerabilities; bottom-up agenda definitions
Structural	Working within existing institutional structures	Working against constraining institutional structures on the ground; navigating international research structures not conducive to deep engagement
Socio-epistemic	Focus on cognitive aspects of knowledge guided by Western epistemic norms; producing decontextualised knowledge	Focus on knowledge as relationships; co-producing contextual knowledge-action

researchers might need to be aware of the specific power imbalances which are present, be it the relative weight in formulating research agendas and approaches between researchers from the Global North and South, or between actors with higher and lower political, economic, and symbolic capital. Researchers in our cases have shown a high degree of agency when deciding how to engage with actors and when it is possible and appropriate to aim for empowerment of the marginalised perspectives and interests. In case of structural power, researchers have a lot less agency to address the issues which hinder the transformative ambitions of the projects. The focus thus becomes the identification of the structures which both constrain and enable such ambitions and finding ways to create synergies or workarounds. It is also imperative to observe the constraining, sometimes oppressive structures on the ground in the research contexts, and how these structures might be exacerbated or disturbed by the projects. Finally, the socio-epistemic form of power requires a high level of reflexivity from researchers, as it implies, in the formulation of Haugaard (2021), a suspension of the 'natural attitude' of the researchers with regard to their research practices and an acute awareness of how their taken for granted epistemic commitments shape possibilities of social and environmental change.

While the relational practices were concerned with variously recognising socio-cultural values, enhancing a range of local capacities and improving livelihoods of local actors, the linear practices were less context-focused and more concerned with generating multi-scale science-policy impact. That said, the linear practices did not seem to rely on well-developed strategies to transfer knowledge to practice, neither in the empirical contexts in which they were situated, nor in their potential transference to other governance or policy domains. Rather, this work seemed to fall beyond the remit of the current projects. However, the approaches of the relational model also lacked a comprehensive theory of transformation. Despite the intentions to start from the local communities' perspectives, they tended to not go beyond a somewhat patchy diagnostics of the current situation. Most projects identified unsustainabilities but did not deliberatively (or deliberately) develop desirable alternatives in response. The apparent tendency across the projects for non-problematisation of the socio-environmental reproduction of sustainability problems may reflect the commonly unstated limitations of the actionable science paradigm and related research practice. As such, it is unlikely to generate significant structural change (or disruption) through challenging oppressive or dysfunctional political systems or exploitative global capitalist markets (Saunders et al. 2020).

Although the various kinds of desired change described here hardly constitute a shift towards systematic or enduring sustainability transformations, they may be important for sustainability practice in different ways. The 'endurance' of social change triggered by the projects may depend on the way researchers and other powerholders continue their collaborative engagement with the project communities beyond the life of the projects.

The main contradiction emerging from these results has to do with the simultaneous ambition in TDSR to co-produce knowledge in a relational, deeply contextual way – and to be able to generate 'usable' knowledge of a broader applicability. This is because, in reality, few projects adhere to either linear or relational model – they often combine them in their practice. The danger of the linear model is that it exercises power 'over' in two instances: when extracting data from the lived experiences on the ground, and when imposing the generated knowledge on other contexts. To avoid such extraction and imposition, the relational model offers guidance on how to situate knowledge-action co-production in the contexts in which it occurs through exercising power 'to' with the involved actors. However, the researchers' ability to practice the relational model, as is evident from our interviews, continues to be severely constrained by the structural power of the on-the-ground contexts and scientific institutional setups, as well as by the socio-epistemic power of epistemic and methodological rationales and assumptions. Our interviewees expressed frustration with the structural impediments. They also exhibited unease and partial, intermittent yet undeniable awareness of their own linear assumptions. In these frustrations, unease, and awareness lies the potential of TDSR to create spaces for unsettling the predominance of the linear model and strengthening the transformative potential of co-production.

Concluding remarks

In this paper, we have interrogated the expectation imposed on transdisciplinary ocean research to generate transformative ocean sustainability change. We analysed researchers' perspectives on the design and initial phases of six transdisciplinary research projects dealing with various ocean sustainability issues. Through this analysis, we reflected on the potential implications of the nexus between different forms of power and knowledge-action models for socio-environmental change. While our analysis focuses on a small sample of projects and is based solely on researchers' perspectives, we believe that it provides insights towards advancing the vision of the UN Decade of Ocean Science for Sustainable Development, 'science we need for the ocean we want' (Intergovernmental Oceanographic Commission 2021). First, we observe that the vital step of developing a theory of transformation (Harnesk and Isgren 2022) is missing in the analysed projects. To the extent that this observation might be applicable to a wider suite of research projects associated with the UN Decade of Ocean Science, we see a significant need to promote this step in ocean sustainability science. This could be done by requiring a theory of change formulated in research project applications, cultivating a focus on such theory during projects, and having a more focused reflection on change at the end of projects.

Second, the complexity of ocean sustainability issues and the associated multiscale landscape of diverse actors, institutions, worldviews, and visions does not lend itself to investigation, let alone transformation, through linear approaches to knowledge-action co-production. Beyond the conclusion that co-production requires relational, reciprocal, and reflexive practices, insights from this study point to the need to mainstream broader conceptions of what co-production can and should be – beyond the two models. These considerations align with Chambers et al.'s (2022) idea of agility in research, which emphasises the need for flexibility, adaptability, and responsiveness to the specific context and needs of the research area. Such agility seems to be constrained by research funding structures and deep-seated naturalistic assumptions of TDSR. It can be enhanced through adaptive funding structures adjusted to the evolving needs and contexts of different projects and by supporting longer-term collaborative research arrangements that allow relationship-building as well as iterative learning and adaptation in context. Such an approach will allow researchers to transcend the tension between the extractive and decontextualising tendencies of the linear model, on the one hand, and the need to cultivate an exchange of relevant and insightful learning between different contexts, on the other.

Third and finally, this study shows that the ability of TDSR to challenge the norms and epistemologies of the linear knowledge-action model depends on the interplay between different forms of power in research ideations and practices. Given that all three forms of power examined above are likely to play out in any research project involving non-academic actors, the researchers might find themselves in situations where they will need to consciously exercise their agency with regard to how agendas are formed, what actors are included and how, and be aware of the power configurations on the ground. They might need to work with or against institutional structures enabling and constraining transformative ambitions of the projects, with a special dynamic playing out in the postcolonial settings with research funding and implementation capacity asymmetries between Global North and South. Finally, they might want to develop an astute awareness of their own deeply ingrained assumptions about what constitutes valid knowledge and what implications such assumptions may have for the design and implementation of actionable research, given the traditional domination of the marine governance field by natural sciences. However, with some exceptions, there appears to be a general lack of awareness and readiness to explicitly address power dynamics in the studied TDSR projects. While the reasons for this were not examined closely in this study, this shortfall could be attributed to a range of interdependent factors such as the disciplinary composition of project teams, short project time frames, and mandates/expectations of the funding agencies. Indeed, the complexity of multi-dimensional and multi-scale power relations can pose significant challenges for TDSR. While this article offers insights into how to theorise and analyse power in TDSR, addressing different forms of power effects will no doubt continue to provide a tough challenge for the design, co-production, and enactment of sustainability transformation in practice, not least linked to the challenges of ocean sustainability.

Acknowledgements Tatiana Sokolova and Michael Gilek received financial support from the Foundation for Baltic and East European Studies (Östersjöstiftelsen). Fred Saunders and Michael Gilek received financial support from the FORMAS International Coordination of CRA Ocean Sustainability Program, grant no. 2020–02234_3. Kristin Tietje declares that the project on which this article is based was funded by the German Federal Ministry of Education and Research under grant number 03F0856A. The authors are responsible for the content of this publication. We thank two anonymous reviewers for their comments on an earlier draft.

Author contributions Tatiana Sokolova: conceptualisation, methodology, investigation, writing (original draft), writing (review and editing), visualisation. Fred Saunders: conceptualisation, methodology, investigation, writing (original draft), writing (review and editing), supervision. Michael Gilek: methodology, investigation, writing (review and editing). Kristin Tietje: methodology, investigation, writing (review and editing), visualisation.

Funding Open access funding provided by Södertörn University.

Declarations

Conflict of interest The authors have no competing interests to declare.

References

Ahlborg, Helene. 2017. Towards a conceptualization of power in energy transitions. *Environmental Innovation and Societal Transitions* 25:122–141. https://doi.org/10.1016/j.eist.2017.01.004

Allen, Amy. 2005. Feminist Perspectives on Power. In *Stanford Encyclopedia of Philosophy*, ed. Edward N. Zalta and Uri Nodelman. Metaphysics Research Lab, Stanford University.

Avelino, Flor. 2021. Theories of power and social change. power contestations and their implications for research on social change.and innovation. *Journal of Political Power* 14(3):425–448. https://doi.org/10.1080/2158379X.2021.1875307

Beck, Silke. 2019. Coproducing Knowledge and Politics of the Anthropocene: The Case of the Future Earth Program. In *Anthropocene Encounters: New Directions in Green Political Thinking*, ed. Frank Biermann and Eva Lövbrand, 191–211. Earth System Governance. Cambridge University Press. https://doi.org/10.1017/9781108646673

Bell, David M., and Kate Pahl. 2018. co-production: Towards a utopian approach. *International Journal of Social Research Methodology* 21(1):105–117. https://doi.org/10.1080/13645579.2017.1348581

Bennett, Nathan J. 2018. Navigating a just and inclusive path towards sustainable oceans. *Marine Policy* 97:139–146. https://doi.org/10.1016/j.marpol.2018.06.001

Bergmann, Matthias, Niko Schäpke, and Oscar Marg et al. 2021. Transdisciplinary sustainability research in real-world labs: Success factors and methods for change. *Sustainability Science* 16:541–564. https://doi.org/10.1007/s11625-020-00886-8

Blythe, Jessica, Jennifer Silver, Louisa Evans, Derek Armitage, Nathan J. Bennett, Michele-Lee Moore, Tiffany H. Morrison, and Katrina Brown. 2018. The dark side of transformation: Latent risks in contemporary sustainability discourse. *Antipode* 50(5):1206–1223. https://doi.org/10.1111/anti.12405

Brugnach, Marcela, and Özerol Gül. 2019. Knowledge co-production and transdisciplinarity: Opening pandora's box. *Water* 11(10). https://doi.org/10.3390/w11101997

Chambers, Josephine M., Carina Wyborn, Nicole L. Klenk, Melanie Ryan, Anca Serban, and Nathan J. Bennett, Ruth Brennan, et al. 2022. Co-Productive agility and four collaborative pathways to sustainability transformations. *Global Environmental Change* 72(January):102422. https://doi.org/10.1016/j.gloenvcha.2021.102422

Claus, Rachel, Rachel Davel, Cheryl Heykoop, Daniela Pinto, M. Brian, and Belcher. 2023. How to build theories of change for transdisciplinary research: Guidance and considerations. *GAIA* 32(1):186–119. https://doi.org/10.14512/gaia.32.1.18

Code, Lorraine. 2014. Ignorance, injustice and the politics of knowledge: Feminist epistemology now. *Australian Feminist Studies* 29(80):148–160. https://doi.org/10.1080/08164649.2014.928186

Cooke, Bill and Uma Kothari. 2001. The Case for Participation as Tyranny. In *Participation: The New Tyranny?* ed. Bill Cooke and Uma Kothari, 1–15. London; New York: Zed Books.

Cornish, Flora, Nancy Breton, Ulises Moreno-Tabarez, Jenna Delgado, Mohi Rua, Ama de-Graft Aikins, and Darrin Hodgetts. 2023. 'Participatory Action Research'. *Nature Reviews Methods Primers* 3 (1):34. https://doi.org/10.1038/s43586-023-00214-1

Crosman, Katherine M., H. Edward, Yoshitaka Allison, Andrés M. Ota, Gerald G. Cisneros-Montemayor, Wilf Singh, and Megan Swartz Bailey, et al. 2022. Social equity is key to sustainable ocean governance. *Npj Ocean Sustainability* 1(1):4. https://doi.org/10.1038/s44183-022-00001-7

Cvitanovic, C., M. Mackay, Rj Shellock, Ei Van Putten, Db Karcher, and M. Dickey-Collas. 2021. Understanding and evidencing a broader range of successes that can occur at the interface of marine science and policy. *Marine Policy* 134(December):104802. https://doi.org/10.1016/j.marpol.2021.104802

De Geus, Tessa, Flor Avelino, Marta Strumińska-Kutra, Magdalena Pitzer, Julia M. Wittmayer, Lara Hendrikx, and Vaishali Joshi et al. 2023. Making sense of power through transdisciplinary sustainability research: Insights from a transformative power lab. *Sustainability Science* 18(3):1311–1327. https://doi.org/10.1007/s11625-023-01294-4

Fritz, Livia, and Franziska Meinherz. 2020. Tracing power in transdisciplinary sustainability research: An exploration. *GAIA - Ecological Perspectives for Science and Society* 29(1):41–51. https://doi.org/10.14512/gaia.29.1.9

Harnesk, David, and Ellinor Isgren. 2022. Sustainability as a real Utopia– Heuristics for transformative sustainability research. *Environment and Planning E: Nature and Space* 5(3):1678–1695. https://doi.org/10.1177/25148486211018570

Haugaard, Mark, ed. 2002. Power: A Reader. Manchester, UK; New York: New York, NY: Manchester University Press; Distributed exclusively in the USA by Palgrave.

Haugaard, Mark. 2021. The four dimensions of power: Conflict and democracy. *Journal of Political Power* 14(1):153–175. https://doi.org/10.1080/2158379X.2021.1878411

Henkel, Heiko, and Roderick Stirrat. 2001. Participation as Spiritual Duty; Empowerment as Secular Subjection'. In *Participation: The New Tyranny?* ed. Bill Cooke and Uma Kothari, 168–84. London; New York: Zed Books.

Inbakandan, Dhinakarasamy. 2023. Understanding and adapting ocean decade action. *Anthropocene Science* 2(2):159–171. https://doi.org/10.1007/s44177-023-00059-z

Intergovernmental Oceanographic Commission. 2021. *The united nations decade of ocean science for sustainable development (2021–2030)*. Implementation Plan.

Jentoft, Svein, Ratana Chuenpagdee. 2009. Fisheries and coastal governance as a wicked problem. *Marine Policy* 33(4):553–560. https://doi.org/10.1016/j.marpol.2008.12.002

Jernnäs, Maria, and Eva Lövbrand. 2022. Accelerating climate action: The politics of nonstate actor engagement in the Paris regime. *Global Environmental Politics* 22(3):38–58. https://doi.org/10.1162/glep_a_00660

Kiatkoski Kim, Milena, Michael M. Douglas, David Pannell, Samantha A. Setterfield, Rosemary Hill, Sarah Laborde, Laura Perrott, et al. 2022. When to use transdisciplinary approaches for environmental research. Frontiers in Environmental Science 10(May):840569. https://doi.org/10.3389/fenvs.2022.840569

Kothari, Uma. 2001. Power, Knowledge and Social Control in Participatory Development. In *Participation: The New Tyranny?* ed.

Bill Cooke and Uma Kothari, 139–52. London; New York: Zed Books.

Lawrence, Mark G., Stephen Williams, Patrizia Nanz, and Ortwin Renn. 2022. Characteristics, potentials, and challenges of transdisciplinary research. *One Earth* 5(1):44–61. https://doi.org/10.1016/j.oneear.2021.12.010

Lotz-Sisitka, Heila, Million Belay Ali, Gibson Mphepo, Martha Chaves, Thomas Macintyre, Tichaona Pesanayi, and Arjen Wals et al. 2016. Co-Designing research on transgressive learning in times of climate change. *Current Opinion in Environmental Sustainability* 20(June):50–55. https://doi.org/10.1016/j.cosust.2016.04.004

Lövbrand, Eva, and Johannes Stripple, Bo Wiman. 2009. Earth system governmentality. *Global Environmental Change* 19(1):7–13. https://doi.org/10.1016/j.gloenvcha.2008.10.002

Maschietto, Roberta Holanda. 2016. Discourses of Empowerment. In *Beyond Peacebuilding*, ed. Roberta Holanda Maschietto, 21–43. London: Palgrave Macmillan UK. https://doi.org/10.1057/978-1-349-94951-9_2

McCabe, Angela, Tom Osegowitsch, Rachel Parker, and Stephen Cox. 2021. Knowledge co-production in Academic-Practitioner research collaboration: An expanded perspective on power. *Management Learning* 52(5):604–629. https://doi.org/10.1177/1350507620988431

McKinley, Emma. 2024. Ocean literacy for an ocean constitution. *Global Constitutionalism* 13(1):25–28. https://doi.org/10.1017/S204538172300014X

Miller, Clark A. 2007. Democratization, international knowledge institutions, and global governance. *Governance* 20(2):325–357. https://doi.org/10.1111/j.1468-0491.2007.00359.x

Partzsch, Lena. 2015. Kein Wandel Ohne Macht - Nachhaltigkeitsforschung Braucht Ein mehrdimensionales Machtverständnis. *GAIA - Ecological Perspectives for Science and Society* 24(1):48–56. https://doi.org/10.14512/gaia.24.1.10

Roos, Roxana. 2024. Maybe you need to do something about it: Challenges in global environmental change research with and within local communities. *Humanities and Social Sciences Communications* 11(1):429. https://doi.org/10.1057/s41599-024-02942-5

Saunders, Fred, Michael Gilek, Anda Ikauniece, Ralph Voma Tafon, Kira Gee, Jacek Zaucha. 2020. Theorizing social sustainability and justice in marine Spatial planning: Democracy, diversity, and equity. *Sustainability* 12(6):2560. https://doi.org/10.3390/su12062560

Schmidt, Laura, and Martina Neuburger. 2017. Trapped between privileges and precariousness: Tracing transdisciplinary research in a postcolonial setting. *Futures* 93(October):54–67. https://doi.org/10.1016/j.futures.2017.07.005

Schneider, Flurina, Markus Giger, Nicole Harari, Stephanie Moser, Christoph Oberlack, Isabelle Providoli, Leonie Schmid, Theresa Tribaldos, Anne Zimmermann. 2019. Transdisciplinary co-production of knowledge and sustainability transformations: Three generic mechanisms of impact generation. *Environmental Science & Policy* 102(December):26–35. https://doi.org/10.1016/j.envsci.2019.08.017

Strand, Mia, Kelly Ortega-Cisneros, Holly J Niner, Michel Wahome, James Bell, Jock C Currie, Hashali Hamukuaya, et al. 2022. 'Transdisciplinarity in Transformative Ocean Governance Research—Reflections of Early Career Researchers'. ed. Yinji Li. *ICES Journal of Marine Science* 79 (8): 2163–77. https://doi.org/10.1093/icesjms/fsac165

Tafon, Ralph Vuoma, Bruce Glavovic, Fred Saunders, and Michael Gilek. 2021. Oceans of conflict: Pathways to an ocean sustainability PACT. *Planning Practice & Research* 37(2):213–230. https://doi.org/10.1080/02697459.2021.1918880

Temper, Leah, and Daniela Del Bene. 2016. Transforming knowledge creation for environmental and epistemic justice. *Current Opinion in Environmental Sustainability* 20(June):41–49. https://doi.org/10.1016/j.cosust.2016.05.004

Turnhout, Esther. 2024. A better knowledge is possible: Transforming environmental science for justice and pluralism. *Environmental Science & Policy* 155:103729. https://doi.org/10.1016/j.envsci.2024.103729

Turnhout, Esther, Tamara Metze, Carina Wyborn, Nicole Klenk, and Elena Louder. 2020. The politics of co-production: Participation, power, and transformation. *Current Opinion in Environmental Sustainability* 42(February):15–21. https://doi.org/10.1016/j.cosust.2019.11.009

Hel, Van Der, Sandra. 2018. Science for change: A survey on the normative and political dimensions of global sustainability research. *Global Environmental Change* 52(September):248–258. https://doi.org/10.1016/j.gloenvcha.2018.07.005

Van Kerkhoff, Lorrae, and Louis Lebel. 2006. Linking knowledge and action for sustainable development. *Annual Review of Environment and Resources* 31(1):445–477. https://doi.org/10.1146/annurev.energy.31.102405.170850

Vierros, Marjo Kristina. 2021. Promotion and Strengthening of Sustainable Ocean-based Economies–Sustainable Development Goal 14. New York, NY, United States: DESA. https://sdgs.un.org/sites/default/files/2022-01/2014248-DESA-Oceans_Sustainable_final-WEB.pdf

West, Simon, Lorrae van Kerkhoff, and Hendrik Wagenaar. 2019. Beyond linking knowledge and action: Towards a Practice-Based approach to transdisciplinary sustainability interventions. *Policy Studies* 40(5):534–555. https://doi.org/10.1080/01442872.2019.1618810