



Leveraging shadow networks for procedural justice

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Increasingly, environmental sustainability-governance research investigates procedural justice, which is focused on fairness, discrimination, and inclusion in decision-making. To understand the (re)production of inequity and environmental injustice, we must examine who is included and excluded, what types of knowledge and information are incorporated, and how more inclusive processes may (not) facilitate transformation of environmental governance. A growing empirical literature explores the potential of shadow networks to expand inclusion in governance arenas. Shadow networks work inside and outside the dominant system, facilitate information flows, create nodes of expertise, identify knowledge gaps, engage in social learning, and explore alternatives to the status quo, yet some shadow networks reinforce historic legacies of injustice exacerbating exclusion and centering particular actors or communities.

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Introduction

Environmental injustice is inherently social, generated by human (in)action and redressed by people through transformation of the system. Environmental justice as a theoretical framework continues to evolve and extend beyond its historic focus on distributional justice — inequity in access to resources and unequal burdens among poor and minoritized communities [1]. Increasingly, environmental justice focuses on the inclusion of diverse voices and preferences through procedural justice, which relates to fairness, inclusion, and discrimination in decision-making processes [2,3]. Procedural justice is embraced by many within the

environmental and sustainability policymaking spheres as both a means to deal with environmental inequity and improve governance [4–7]. Increasingly, scholars call for inclusion of diverse perspectives and knowledge from local communities and stakeholders to better understand and manage social–ecological systems [8–10]. But, there is inherent tension between approaches rooted in western, liberal democratic values that embrace the use of procedural justice within formal governance structures (see e.g. [11]) and radical imaginaries that seek to realize ecological and social justice through activism [12] and epistemological pluralism [13,14••]. We explore this tension examining how procedural justice within shadow networks is intertwined with communities' practice and action toward recognitional and socioecological justice.

There are numerous means for diverse perspectives and knowledge systems to influence environmental sustainability decision-making, but use of shadow networks of experts and stakeholders is a common route.¹ Shadow networks are, "informal networks of people who are working both inside and outside of the dominant system, who facilitate information flows, create nodes of expertise, identify knowledge gaps, engage in social learning, and explore alternatives that could replace the dominant system when there is a window of opportunity [16] (page 2)." These shadow networks are seen as a means to improve adaptive governance by the inclusion of diverse voices and knowledge, western scientific expertise, and traditional ecological knowledge [17•–19]. Decades of research on complexity and social learning have illustrated how diverse perspectives (including lived experiences and multigenerational knowledge) may be necessary to understand (and govern) coupled social–ecological systems [20], but power asymmetry and a lack of recognitional justice may thwart these efforts. Shadow networks may increase procedural justice, but we must look beyond simple inclusion on coalitions, appointments, or informal information-sharing to also understand the types of knowledge, information, and perspectives that are welcomed and respected, known as recognitional justice. Recognitional justice relates to power in the creation, makeup, and dynamics of shadow networks vis-a-vis the governance system. Recognitional

¹ Shadow networks are sometimes referred to as policy networks, epistemic communities, and learning communities; we adopt 'shadow network' in this review because of our focus on inclusion and justice, transparency of processes, and intersections with social learning, but recognize that these literatures are closely interlinked (see similar approach adopting shadow networks in Schmidt [15]).

and procedural justice are required to transform environmental governance through the inclusion of and respect for diverse voices and perspectives [13].

There is potential for co-option and the reproduction of injustice through participation in well-established and historically unjust decision-making processes [21], which has led to calls for an intersectional decolonial environmental justice [22] and a move toward radical imaginaries focused on social movements for environmental justice that are relational, connected to place and space, and challenge local-to-global power asymmetries [23•,24]. Thus, there is tension in whether to participate within governance decision-making through shadow networks, to resist it through activist orientations, or to participate in both shadow networks and activism to advance socioecological justice.

Here, we focus on transformation of governance through social learning within more inclusive shadow networks. Instead of narrowing in on specific measures for socioecological justice, or development of a new holistic comprehensive environmental justice framework, we link literature on social learning to environmental justice. The purpose of this paper is to explore how social learning through more inclusive shadow networks leads or fails to lead to transformation of governance [11] by broadening epistemologies [13] and centering socioecological justice [25]. To accomplish this, we must ‘reposition’ our exploration by drawing upon works spanning diverse epistemologies and ontologies [20]; thus, this paper links empirical and theoretical work on environmental governance from both positivist and critical realist perspectives.

Adopting a complex system framing, we explore the potential transformation of governance systems via social learning with more inclusive shadow networks. To frame our review, we begin with exploration of environmental justice and power literatures, including a discussion of socioecological justice. Then, we examine research on shadow networks generally and in environmental policymaking spaces. We focus our attention on both the opportunities and challenges of using shadow networks with their social-learning orientations to redress injustice, as well as draw on the broader social-change literature to consider the role of activism in interlinked spaces of resistance to and transformation of extant environmental governance (Table 1).

Environmental justice

Environmental justice scholarship explores the distribution of environmental benefits and burdens, procedure (inclusion in decision-making), recognition (respect for diverse knowledge and perspectives), and capability (ability for diverse groups and communities to

live safe and healthy lives) [1]. Importantly, inclusion of representatives from diverse communities does not necessarily lead to respect for inclusion of diverse knowledge, world views or values, and recognitional justice [13]. Intersecting justice frameworks consider intergenerational and interspecies justice [26], climate justice [27], ecological justice [28], and social–ecological justice [29] — these frameworks expand the idea of environmental justice to other generations, nonhuman species, and the ecosystem as a whole. We draw on Yaka’s conception of socioecological justice that extends environmental justice to consider the relational ontology between human and nonhuman and the importance of social struggle in realizing justice [25]. Here, we focus on the role of procedural justice as a lever to advance other types of environmental justice, particularly whether inclusion in the shadow networks that typify governance leads to recognition of diverse knowledge systems and perspectives or transformative change.

Environmental justice scholars examining procedural justice analyze decision-making processes and the underlying values, knowledge, and science used to understand and redress environmental injustice [30]. Procedural injustice may occur either through exclusion or within collaborative governance via elite capture [31•]. Vulnerable and marginalized groups included in decision-making processes must have the power, either materialistic (resources, capacity) or ideological (narratives, discourses) power, to participate substantively; in diverse sustainability-issue arenas, such as in energy development [32,33], groundwater [31•], urban development [34], coastal management [35], and community forestry [36], power asymmetry has been a barrier to participation in and transformative change to coalitions, collaborations, and networks.

Procedural justice, therefore, plays an essential role by explicitly including those historically excluded from the decision-making processes, but even when procedural injustice is redressed through inclusion, extant power structures may act as barriers to recognitional or socioecological justice, reproducing power imbalances and inequality [33]. Procedural justice may be comparatively easier to achieve through rules or norms about inclusion, while recognitional justice may be much more difficult. In practice, there may be tension between procedural justice (focused on the rules and positions) and recognitional justice related to respect for diverse stakeholders and knowledge systems [36]. Inclusion of diverse perspectives in environmental and sustainability governance frequently occurs through shadow networks, such as informal communication with those in government or more formally through appointed positions on advisory boards and committees, yet the impact of this inclusion on the governance system is less understood.

Table 1

The assessment of leveraging shadow networks for procedural justice in environmental governance.

Themes	Descriptions	Aggregate dimensions: leveraging shadow networks for procedural justice
Procedural justice	- Examines who is included in decision-making spaces [13,14], but there is dialectic between activism and representation [11,12]. - Decision-making processes are bounded up with recognition, in which the underlying values, knowledge, and science are used both to analyze and redress environmental injustice [13,24]. - Important to identify whether vulnerable groups are included in decision-making processes or excluded via elite capture and formal governance structures [20,21].	- Must look beyond simple inclusion on coalitions, appointments, or informal information-sharing to also understand the types of knowledge, information, and perspectives that are welcomed and respected (recognitional justice). - Although power asymmetry may be produced within governance regimes, less powerful actors may create adjacent spaces or engage in policy issues of less importance to dominant actors.
Shadow networks	- Work inside and outside the dominant system, facilitate information flows, create nodes of expertise, identify knowledge gaps, engage in social learning, and explore alternatives to status quo [15]. - Means to improve decision-making by the inclusion of diverse voices and knowledge through 'backroom dealings', open deliberations in public meetings, leaderships, and lead social learning via informal coordination mechanisms [16–18,38]. - Technocratic and western scientific perspectives may dominant [15,16,45]. - Important to understand to what extent diverse perspectives and knowledge systems within shadow networks reproduce injustice or lead to more equitable outcomes and just futures [16–18].	- Inclusion of diverse communities coupled with recognition of their knowledge, values, and epistemologies may trigger systemic transformation in environmental governance structures through social learning and incremental change. - Opportunity to integrate the knowledge of communities in policymaking and governance at multiple scales, but coupling activism with shadow-network engagement may be necessary to go beyond inclusion. - Socioecological justice may also require coupling participation in shadow networks with activism outside the governance system.
Social learning through governance networks	- Coproduction of knowledge through diverse stakeholders may provide relevant information to decision-makers and facilitate social learning within the governance systems [17,57]. - Shadow networks integrate different kinds of knowledge and may bridge ties between actors and organizations at multiple levels [61,62]. - Important to identify to what extent the generated knowledge through innovation and adaptation inhibits and reinforces the status quo [53,73–75].	

Assessing when various dimensions of environmental justice have been achieved is not a simple question, particularly once we move beyond distributional justice with a somewhat straightforward evaluation of policy outcomes (yet even with distribution, there are competing understandings of equity, e.g. [37]). A recent review of the environmental justice literature emphasized the dearth of empirical work on recognitional justice compared with the relative abundance of procedural and distributional justice studies [38], yet even within the procedural justice literature, there is a gap concerning the underlying mechanisms that may bring about broader social change through inclusion within governance, such as through shadow networks.

Shadow networks

Shadow networks influence decision-making through 'backroom dealings,' open deliberations in public meetings, or alternatively through visible, yet exclusive, appointed boards and advisory roles; shadow networks include some policy networks, epistemic communities,

and learning communities. Shadow networks are created by institutional arrangements existing within the informal, hidden spaces of governance [39]. The shift from government hierarchies to governance networks, including shadow and the formal, calls into question legitimacy and reduced capacity associated with hollowing out of the state. Netelenbos [40] argues that rituals of power, relationships of power, and pathos of power are generated in these governance networks, particularly in the shadow spaces. Yet, for those historically excluded from government, shadow networks provide an opportunity for influence. Importantly, accumulation of so-called 'small wins' through engagement in collaborative processes may lead to more transformative change over time [41].

Yet, erosion of liberal democracy has weakened engagement in some of these participatory or collaborative processes; critical scholarship has exposed the complicity of liberal democratic states in reproducing injustices even with expansion of input from more diverse

communities [12]. While in more centralized states, nonstate actors may struggle to influence policymaking, as state agencies dominate governance networks [42], although actors may strategically find spaces of influence where the government has less interest [43]. Nonstate actors may be sidelined to supportive roles with limited ability to influence policy [44]. Extending our gaze to include coordination within and across government agencies and departments, institutional formalization may be necessary to support the ad hoc working groups and informal coordination mechanisms [45].

Shadow networks exist in most modern governance contexts, yet their importance varies. In many environmental-governance domains, such as water, there are highly technocratic actors within shadow networks dominating decision-making processes [16,46••]. Agencies and policymakers use shadow networks to generate knowledge, but all too often, technocratic knowledge from western perspectives dominates, while diverse knowledge systems are not represented or given voice [17•]. Shadow networks may be politically influential, but often, these networks seek maintenance of the status quo [47]. Owing to the hidden nature of these spaces and networks, many citizens and communities are excluded because of the lack of transparency, exclusivity of meetings, and limited public communication, which may be a strategic choice of organizers to prevent resistance or to try to build trust and shared understanding among those within the network.

Nonstate actors interface with government decision-makers in many capacities, not simply for information-sharing, but also to influence governance that affects their decisions, notably for industry actors — this interaction is what governance scholars refer to as the ‘shadow of hierarchy’ [48,49]. In environmental and sustainability scholarship, shadow-network research tends to focus on knowledge and information-sharing from communities, but arguably shadow networks also advance industry objectives such as the creation of markets and contracts to address food security [50] or resistance to low-carbon energy policy adoption [51]. There is a duality as shadow networks seek to influence government actors, while the shadow of hierarchy affects nonstate actors who attempt to steer or avoid future regulation or government action. Given this duality in governance regimes, how are justice efforts advanced? Which ones may be thwarted?

As Pelling et al. [39] argue that shadow spaces are those created, yet hidden by their informality, within existing governance regimes and formal institutions. Formal institutions are codified rules and constitutionally defined rights [52] that may constrain, amplify, and reproduce the power of actors at many different levels and scales [53]. Informal institutions, however, are based on socially

shared norms, traditions and routines, values, culture, and networks formed through trust and social capital. Shadow networks, therefore, are part of informal institutions with potential to alter the formal institutional context. Shadow spaces where shadow networks are active create a ‘dialectical relationship’ between nonstate actors and governing bodies [39], but importantly not all governance systems enable these spaces, and as we point out below, activism may push governments to create new and more inclusive shadow spaces. Thus, shadow networks exist alongside and are creatures of the formal institutional regimes, but also have transformative potential. As Westley et al. [54] argued, social learning could be used through shadow networks to innovate and support transformation within governance regimes. Within the resilience and social-ecological system literatures, shadow networks are seen as a means to increase knowledge to transform policy via social learning, see, for example, [47,54,55], yet it is unclear how transformative these networks can be as these coexist within the dominant regime [15]. Herrfahrdt-Pähle et al. [56] argue that shadow networks are especially important in the creation phase of flexible governance regimes with novel ideas when social learning is both possible and critical. Working within a shadow network, versus in open forums, may be necessary to cultivate trust and facilitate social learning between actors with different understandings of the world and different priorities. As shadow networks increase efforts at inclusivity, there is a critical complement required facilitating ‘epistemic shifts’ [13] that provide both respect for diverse knowledge and understandings of the world, but also links to the practice of justice to action [25]. Without this shift, embracing social learning to address socioecological justice is likely to fail.

Social learning through governance networks

Social learning through collaborative processes and co-production of knowledge may provide relevant information to decision-makers [18,57,58] seeking to govern environmental challenges. Inertia makes change difficult in most governance contexts, but governance networks provide opportunities for social learning and adaptation [59]. Governance networks, including both the shadow and the formal, tend to reproduce the status quo, but actors’ strategic behavior may shift management or policy choices [46••] through institutional navigation [60]; likewise, the organizational culture may inhibit or strengthen authentic relationships necessary for procedural justice [61] within and outside the shadow networks. Shadow networks integrate different kinds of information and may bridge different levels, local to national [62,63], while multiple intersecting policy spaces with overlapping ties between actors and organizations generate a multiplicity of spaces for strategic behavior [64]. Perhaps unsurprisingly, the most inclusive governance spaces (in terms of interests

represented) may in fact be the spaces with the most intense conflicts [65].

Innovation and adaptation are viewed as a means to navigate conflict in heated governance systems [65,66], but the processes for social learning and knowledge-brokering also reproduce power asymmetries [14••]. Western scientific biases and scientific colonialism reflect recognitional injustice in knowledge coproduction often used in collaborative spaces, such as shadow networks [67,68•]. Knowledge-generating processes in environmental governance often echo unequal power relations exacerbated by elite actors', large NGOs', or western scientists' participation, while less powerful participants, such as unorganized citizens or less well-known groups, with less financial resources, may be ignored [69,70]. Recognitional justice provides a path for acknowledgment of diverse knowledge systems and preferences through critical knowledge coproduction [71], yet all too often, efforts at inclusion limit the types of knowledge, which may represent diverse communities, and how their perspectives may be shared. Industry and elite nongovernmental organizations may dominate these networks. Analyzing the representation of disadvantaged communities in the new groundwater-governance institutions established in 2014 in California, Dobbin and Lubell [31•] find that the representation of vulnerable and marginalized communities, even in collaborative governance structures, lags behind their more advantaged counterparts, and disparities due to lack of political recognition and procedural inclusion have increased through time. In polycentric multilevel, and especially international governance regimes, shadow networks seek to influence policy change, although may be ineffectual, particularly if lacking substantive funding and resources [72]. Owing to the relational nature of power and decision-making power, the leadership of individuals or organizations are important determinants of change [73].

In a study of an urban network in Vienna, Leixnering et al. [74•] find that shadow networks, through relationships, culture, and informal institutions, maintain the status quo enabling coordination among those in power, but also limiting innovation and change. When considering innovation that is partially reliant on private actors, such as low-carbon energy transitions, extant shadow networks may likewise inhibit and reinforce the status quo [75]. Yet, there are numerous cases where action within shadow networks led to changes in sustainability policy through knowledge-sharing and social learning. Such as the case of watershed management in Hungary, shadow networks advocated for transformative changes in policy by working with new local and national government decision-makers through educational and informational campaigns [55]. While in Chile, arguably a shadow network, or at least shadow spaces, was used to

influence decision-makers to create a new fishing-governance model that recognized local fishers' needs and demands [76]. Thus, shadow networks' influence on policymaking varies by context, while the transformative potential depends partially on opportunities for social learning related to coproduction of knowledge and respect for diverse knowledge systems through recognitional justice. Reimagining democratic ideals to focus more on grassroots' politics and practice, versus simply representation in governance structures, may enable emergence of new complex systems of governance (see, e.g. use of complex system transformation through 'visionary pragmatism' [77]). Transformation of governance through social learning in more inclusive shadow networks is possible, but due to intransigence, transformation will not occur simply through inclusion, recognition is also required [78].

Embracing shadow networks for socioecological justice

Focusing on the definition of shadow networks as networks that work inside and outside the dominant system, facilitates information flows, creates nodes of expertise, identifies knowledge gaps, engages in social learning, and explores alternatives to the status quo, arguably some socioecological justice advocacy is occurring through these networks. Justice is perceived to occur when people of a community regard their relationships with one another to be equal and fair [6]. However, what is seen as 'fair sharing' is dependent on a number of culturally and contextually entrenched concepts [33]. For instance, in the case of western water and the Colorado River, advocacy on the part of Indigenous communities eventually led to inclusion on government-sanctioned boards [79], but these battles were hard-fought and took decades to achieve and are insufficient to redress socioecological injustice associated with the settler-colonial state [80•,81].

Procedural justice largely examines who is invited into decision-making spaces, but there is a dialectic between activism and representation. Although power asymmetry may be reproduced within governance regimes, less powerful actors may create adjacent spaces through their shadow networks, such as the case of forestry comanagement in Bangladesh where local actors were able to focus on substantive control of areas that were less important to central government actors [44]. Or as Fisher [82] demonstrates in India where nongovernmental organization leaders of the Indian Network on Climate Change and Ethics engaged with community members and leaders to ensure that local perspectives were represented in national and international climate-policy debates, advocated for inclusion of alternative climate-justice perspectives in national policy decision-making processes, and supported local-to-global climate action

and activism. In the case of environmental justice in California, environmental nongovernmental organizations engaging in coalitions that include environmental justice organizations are more likely to advance procedural justice issues than those outside coalitions [37•]. Thus, when considering shadow networks in the context of socioecological justice, we must recognize the agency of communities as they use shadow networks to link local to international spaces, adjacent policy domains, and shape environmental justice action within coalitions. Further, activism and advocacy may fuel change in shadow networks by highlighting injustice.

But, power asymmetry and injustice may be reproduced or amplified when actors form large coalitions with less-cohesive networks, such as coalitions focused on disrupting energy development in the United States, which includes diverse actors, but limit the voice of the least powerful and historically excluded [83••]. Institutional navigation, particularly recognizing when and where to engage [60], given power asymmetry, may be key. Achieving socioecological justice may require stepping outside of traditional procedural efforts and into conflictual and protest modes. In the case of the Great Bear Rainforest, shadow networks catalyzed action within the existing political regime and through adjacent activist efforts [54]. Devolution of actual decision-making may be required and not simply the appearance of shared governance through hollow appointments [84].

Sector-specific sustainability-governance arrangements limit our ability to achieve environmental justice goals, arguably of all types, including distributional, procedural, and recognitional [29]. Moving beyond action within extant governance systems, some argue that we must adopt relational approaches that re-imagine and co-produce climate justice by rejecting governance embedded within a settler-colonial state [85,86]. Activism that resists the dominant sociopolitical systems may be necessary to redress injustices, whereas inclusion of historically excluded communities within shadow networks in the absence of recognitional justice may reproduce environmental injustice. Failure to consider root causes of the dominant system and unwillingness to embrace activist-oriented approaches to transformative justice may reproduce environmental injustices, even when procedural injustice is addressed [87••].

Conclusion

Shadow networks are a critical aspect of environmental governance, but are sometimes highly technocratic and linked to particular interests and industries. Co-option of diverse knowledge and interests through inclusion in decision-making processes is a risk in many shadow networks. Nevertheless, social change through shadow networks might appear incremental at first, but the

accumulation of ‘small wins’ that recognize diverse knowledge and values might lead to systemic transformation [41] of environmental-governance structures. Many historically excluded groups are embracing their agency within (and outside) shadow networks to advance social learning and push for transformation. These changes require both recognitional and procedural justice within shadow networks in order to draw upon diverse knowledge and epistemologies. Additionally, these changes may paradoxically require the ‘shadow,’ or closed nature, of shadow networks to facilitate social learning and trust building across diverse communities with diverse knowledge systems and conflicting priorities. Without recognitional justice, procedural justice in shadow networks will be hollow with limited social learning and lack of substantive change. Savvy institutional navigation by diverse communities and groups [60] may harness social learning through opportunities generated by inclusive governance processes. Or alternatively, these actors may strategically shift their focus to those policy domains that are less important to government actors in order to affect social change.

But efforts within the shadow network may be insufficient on their own within settler-colonial- dominated systems; communities may instead, or in addition, adopt activist orientations to facilitate new radical imaginaries [77]. Activism outside shadow networks and engagement within are not necessarily an either-or proposition, yet this approach will be costly and presents significant coordination challenges that require savvy leadership and strategy. Shadow-network engagement with recognitional justice may lead to incremental change via social learning, which may be further advanced through activism outside the governance system that demands more substantive social change. Thus, complex governance systems may transform because of external pressures through activism and social learning within shadow networks and the feedbacks therein, where external pressure leads to change of shadow networks, such as redressing procedural injustice via inclusion. Simply advancing procedural justice in terms of who has a seat within a shadowy network is not sufficient to redress historic and contemporary environmental injustices; recognitional justice is required to facilitate social learning and transformation, while activism may be necessary to achieve socioecological justice.

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.

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References and recommended reading

Papers of particular interest, published within the period of review, have been highlighted as:

- of special interest
- of outstanding interest

1. Schlosberg D: **Theorising environmental justice: the expanding sphere of a discourse.** *Environ Polit* 2013, **22**:37-55.
 2. Bell D, Carrick J: **Procedural environmental justice.** The Routledge Handbook of Environmental Justice. Routledge; 2017:101-112.
 3. Gellers JC, Jeffords C: **Toward environmental democracy? Procedural environmental rights and environmental justice.** *Glob Environ Polit* 2018, **18**:99-121.
 4. Lindgren AY, Reed MG, Robson JP: **Process makes perfect: perceptions of effectiveness in collaborative environmental governance.** *Environ Manag* 2021, **67**:228-241.
 5. Grillos T, Zarychta A, Nuñez JN: **Water scarcity & procedural justice in Honduras: community-based management meets market-based policy.** *World Dev* 2021, **142**:105451.
 6. Edge S, Brown EL, Ghosh S, Murnaghan AM: **Procedural environmental (in) justice at multiple scales: examining immigrant advocacy for improved living conditions.** *Local Environ* 2020, **25**:666-680.
 7. Zhu L, Lo K: **Non-timber forest products as livelihood restoration in forest conservation: a restorative justice approach.** *Trees For People* 2021, **6**:100130.
 8. Aminpour P, Gray SA, Jetter AJ, Introne JE, Singer A, Arlinghaus R: **Arlinghaus R: Wisdom of stakeholder crowds in complex social-ecological systems.** *Nat Sustain* 2020, **3**:191-199.
 9. Aminpour P, Gray SA, Singer A, Scyphers SB, Jetter AJ, Jordan R, Murphy R, Grabowski JH: **The diversity bonus in pooling local knowledge about complex problems.** *PNAS* 2021, **118**:e2016887118.
 10. Blue G, Davidson D: **Advancing a transformative social contract for the environmental sciences: from public engagement to justice.** *Environ Res Lett* 2020, **15**:115008.
 11. Nootboom S: **Environmental assessment as an institution of liberal democracy.** *Impact Assess Project Apprais* 2020, **38**:109-112.
 12. Eckersley R: **Ecological democracy and the rise and decline of liberal democracy: looking back, looking forward.** *Environ Polit* 2020, **29**:214-234.
 13. San Martín W, Wood N: **Pluralising planetary justice beyond the North-South divide: Recentring procedural, epistemic, and recognition-based justice in earth-systems governance.** *Environ Sci Policy* 2022, **128**:256-263.
 14. Caniglia G, Luederitz C, von Wirth T, Fazey I, Martin-López B, •• Hondrita K, König A, von Wehrden H, Schöpke NA, Laubichler MD: **A pluralistic and integrated approach to action-oriented knowledge for sustainability.** *Nat Sustain* 2021, **4**:93-100.
- The authors outline a pluralistic, integrated action-oriented knowledge and research agenda with the goal of transforming society. They highlight three dimensions of this approach that each require a plurality of knowledge: 1) intentional design that recognize intentions and actions shaped by normative values and goals and requires generative, prescriptive, and strategic knowledge, 2) shared agency, which is deliberate exercise of individual and collective will and requires critical, empowering, and coproduced knowledge, and 3) contextual realization whereby sustainability action occurs in coevolving, complex systems necessitating adaptation orientations and requires emergent, tactical, and situated knowledge.
15. Schmidt J: **Social learning in the Anthropocene: novel challenges, shadow networks, and ethical practices | Elsevier Enhanced Reader.** *J Environ Manag* 2017, **193**:373-380.
 16. Wutich A, DeMyers C, Bausch JC, White DD, Sullivan A: **Stakeholders and social influence in a shadow network: implications for transitions toward urban water sustainability in the Colorado River basin.** *Ecol Soc* 2020, **25**:28.
 17. Gerlak AK, Karambelkar S, Ferguson DB: **Knowledge governance and learning: examining challenges and opportunities in the Colorado River basin.** *Environ Sci Policy* 2021, **125**:219-230.
- With the context of Colorado River basin water governance, the authors examine knowledge governance in five collaborations, specifically questions related to the legitimacy of the organizational structure, credibility of the knowledge produced, salience of the research priorities, and mechanisms that promote learning for adaptation. Power imbalances are reproduced by the current institutional structures resulting in a lack of diverse knowledge and over-reliance on particular stakeholders restricts learning potential; there is an opportunity for greater inclusion in knowledge governance, which may improve water governance.
18. Gerlak AK, Heikkilä T, Newig J: **Learning in environmental governance: opportunities for translating theory to practice.** *J Environ Policy Plan* 2020, **22**:653-666.
 19. Chaffin BC, Gosnell H, Cosens BA: **A decade of adaptive governance scholarship: synthesis and future directions.** *Ecol Soc* 2014, **19**:56.
 20. Gerrits L: **Traveling between worlds: repositioning methods and theory for research into coupled socio-ecological systems.** *Landscape Ecol* 2021, <https://doi.org/10.1007/s10980-021-01363-y>
 21. Álvarez L, Coolsaet B: **Decolonizing environmental justice studies: a Latin American perspective.** *Capital Nat Social* 2020, **31**:50-69.
 22. Menton M, Larrea C, Latorre S, Martínez-Alier J, Peck M, Temper L, Walter M: **Environmental justice and the SDGs: from synergies to gaps and contradictions.** *Sustain Sci* 2020, **15**:1621-1636.
 23. Nagy R: **Transformative justice in a settler colonial transition: implementing the UN Declaration on the Rights of Indigenous Peoples in Canada.** *Int J Hum Rights* 2021, **26**:191-216.
- The paper explores transformative justice and redressing colonial injustice in the Canadian context. Nagy contributes to the theoretical literature by disentangling transitional justice that focuses on short-term formal instruments, such as truth commissions, versus transformational justice that requires grassroots efforts for structural change. The UN Declaration on the Rights of Indigenous Peoples defines a bundle of rights that enable a process for enacting transformative justice by generating space for advocacy and Indigenous self-determination and dismantling colonial structures and the unjust international order.
24. Harnesk D, Isgren E: **Sustainability as a Real Utopia-Heuristics for transformative sustainability research.** *Environ Plan E Nat Space* 2021, **1**-18, <https://doi.org/10.1177/25148486211018570>
 25. Yaka Ö: **Rethinking justice: struggles for environmental commons and the notion of socio-ecological justice.** *Antipode* 2019, **51**:353-372.
 26. Lele S: **Environmentalisms, justices and the limits of ecosystem services frameworks.** The Justices and Injustices of Ecosystem Services. Routledge; 2013:133-153.
 27. Verlie B: **Climate justice in more-than-human worlds.** *Environ Polit* 2021, **31**:297-319.
 28. Washington H, Maloney M: **The need for ecological ethics in a new ecological economics.** *Ecol Econ* 2020, **169**:106478.
 29. Grossmann K, Connolly JJ, Dereniowska M, Mattioli G, Nitschke L, Thomas N, Varo A: **From sustainable development to social-ecological justice: addressing taboos and naturalizations in order to shift perspective.** *Environ Plan E Nat Space* 2021, **1**-23, <https://doi.org/10.1177/25148486211029427>
 30. Davies T, Mah A: **Introduction: tackling environmental injustice in a post-truth age.** Toxic Truths. Manchester University Press; 2020.
 31. Dobbin KB, Lubell M: **Collaborative governance and environmental justice: disadvantaged community representation in California sustainable groundwater management.** *Policy Stud J* 2021, **49**:562-590.
- Studying California's sustainable groundwater management, the author's find that representation of vulnerable and marginalized

communities in collaborative governance structures lags behind their more advantaged counterparts. Disparities due to lack of political recognition and procedural inclusion have increased since 2014.

32. Jalbert K, Shields D, Kelso M, Rubright S: **The power to plan: mineral rights leasing, data justice, and proactive zoning in Allegheny County, Pennsylvania.** *Environ Social* 2019, **5**:164-176.
 33. Ryder SS, Malin SA: **Mechanisms of metapower & procedural injustices in the Colorado Oil and Gas Task Force decision-making process.** *Crit Policy Stud* (4) 2021, **15**:1-24.
 34. Kronenberg J, Haase A, Łaskiewicz E, Antal A, Baravikova A, Biernacka M, Dushkova D, Filčák R, Haase D, Ignatieva M, et al.: **Environmental justice in the context of urban green space availability, accessibility, and attractiveness in postsocialist cities.** *Cities* 2020, **106**:102862.
 35. Lau JD, Gurney GG, Cinner J: **Environmental justice in coastal systems: perspectives from communities confronting change.** *Glob Environ Change* 2021, **66**:102208.
 36. Ruzol CD, Camacho ACD, Sabino LL, Garcia JE, Gevaña DT, Camacho LD: **A materialist-idealist divide? Policy and practice in participatory mangrove rehabilitation in the Philippines.** *Environ Sci Policy* 2020, **112**:394-404.
 37. Rigolon A, Gibson S: **The role of non-governmental organizations in achieving environmental justice for green and blue spaces.** *Landscape Urban Plan* 2021, **205**:103970.
- The authors explore emerging green and blue space coalitions in California and their impact on procedural, interactional, and distributional environmental justice. They find that inclusion of environmental justice organizations in coalitions leads to more environmental justice action by other nongovernmental organizations, more green and blue NGOs focus on procedural or interactional justice, and distributional justice focused NGOs tend to have larger budgets and an urban focus.
38. Blue G, Bronson K, Lajoie-O'Malley A: **Beyond distribution and participation: a scoping review to advance a comprehensive environmental justice framework for impact assessment.** *Environ Impact Assess Rev* 2021, **90**:106607.
 39. Pelling M, High C, Dearing J, Smith D: **Shadow spaces for social learning: a relational understanding of adaptive capacity to climate change within organisations.** *Environ Plan A* 2008, **40**:867-884.
 40. Netelenbos B: **Bringing back Max Weber into network governance research.** *Crit Policy Stud* 2020, **14**:67-85.
 41. Termeer CJ, Dewulf A: **A small wins framework to overcome the evaluation paradox of governing wicked problems.** *Policy Soc* 2019, **38**:298-314.
 42. Zhang W, Zhang X, Wu G: **The network governance of urban renewal: a comparative analysis of two cities in China.** *Land Use Policy* 2021, **106**:105448.
 43. Yazar M, York A: **Urban climate governance under the national government shadow: evidence from Istanbul.** *J Urban Aff* 2021, **1**:1-17, <https://doi.org/10.1080/07352166.2021.1915151>
 44. Subroto S, Davidsen C, Rashid AM, Cuadra M: **Dual governance and the shadow of state authority: co-management realities in Rema-Kalenga protected area of Bangladesh.** *J Sustain For* 2021.
 45. Park AY, Krause RM, Hawkins CV: **Institutional mechanisms for local sustainability collaboration: assessing the duality of formal and informal mechanisms in promoting collaborative processes.** *J Public Admin Res Theory* 2021, **31**:434-450.
 46. Pahl-Wostl C, Knieper C, Lukat E, Meergans F, Schoderer M, Schütze N, Schweigatz D, Dombrowsky I, Lenschow A, Stein U: **Enhancing the capacity of water governance to deal with complex management challenges: a framework of analysis.** *Environ Sci Policy* 2020, **107**:23-35.

The authors develop a transdisciplinary diagnostic framework for understanding water governance and specifically water coordination issues from a literature review, participatory workshops, and consultation with domain experts. The framework enables participatory assessment of cases and comparative analysis with a focus on regional and local scale within a multilevel water governance system. The authors develop a set of hypotheses for future research on polycentric governance

around the following topics: coherence of governance functions and policies, governance models, and ecosystem services.

47. Olsson P, Gunderson LH, Carpenter SR, Ryan P, Lebel L, Folke C, Holling CS: **Shooting the rapids: navigating transitions to adaptive governance of social-ecological systems.** *Ecol Soc* 2006, **11**:18.
48. Gjaltema J, Biesbroek R, Termeer K: **From government to governance... to meta-governance: a systematic literature review.** *Public Manag Rev* 2020, **22**:1760-1780.
49. Schneider A, Scherer AG: **State governance beyond the 'shadow of hierarchy': a social mechanisms perspective on governmental CSR policies.** *Organ Stud* 2019, **40**:1147-1168.
50. Rosenthal A, Newman K: **Beyond the shadow state: the public-private food assistance system as networked governance.** *Urban Aff Rev* 2019, **55**:1433-1455.
51. Downie C: **Business actors, political resistance, and strategies for policymakers.** *Energy Policy* 2017, **108**:583-592.
52. Clark GL, Feldman MP, Gertler MS, Wójcik D: **The New Oxford Handbook of Economic Geography.** Oxford University Press; 2018.
53. Rodríguez-Pose A: **Institutions and the fortunes of territories.** *Reg Sci Policy Pract* 2020, **12**:371-386.
54. Westley F, Olsson P, Folke C, Homer-Dixon T, Vredenburg H, Looibach D, Thompson J, Nilsson M, Lambin E, Sendzimir J: **Tipping toward sustainability: emerging pathways of transformation.** *Ambio* 2011, **40**:762-780.
55. Sendzimir J, Magnuszewski P, Flachner Z, Balogh P, Molnar G, Sarvari A, Nagy Z: **Assessing the resilience of a river management regime: informal learning in a shadow network in the Tisza River Basin.** *Ecol Soc* 2008, **13**:11.
56. Herrfahrdt-Pähle E, Schlüter M, Olsson P, Folke C, Gelcich S, Pahl-Wostl C: **Sustainability transformations: socio-political shocks as opportunities for governance transitions.** *Glob Environ Change* 2020, **63**:102097.
57. Gerlak AK, Heikkilä T, Smolinski SL, Armitage D, Huitema D, Moore B: **It's time to learn about learning: where should the environmental and natural resource governance field go next?** *Soc Nat Resour* 2019, **32**:1056-1064.
58. Koebele EA: **Policy learning in collaborative environmental governance processes.** *J Environ Policy Plan* 2019, **21**:242-256.
59. Pahl-Wostl C: **A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes.** *Glob Environ Change* 2009, **19**:354-365.
60. Lubell M, Morrison TH: **Institutional navigation for polycentric sustainability governance.** *Nat Sustain* 2021, **4**:664-671.
61. Yuan M: **How the perception of public official on organizational culture influences procedural justice in environmental policy processes.** *Front Psychol* 2021, **12**:626210.
62. Gonzales-Iwanciw J, Dewulf A, Karlsson-Vinkhuyzen S: **Learning in multi-level governance of adaptation to climate change—a literature review.** *J Environ Plan Manag* 2020, **63**:779-797.
63. Heikkilä T, Gerlak AK: **Working on learning: how the institutional rules of environmental governance matter.** *J Environ Plan Manag* 2019, **62**:106-123.
64. Klasic M, Lubell M: **Collaborative governance: from simple partnerships to complex systems.** Handbook of US Environmental Policy. Edward Elgar Publishing; 2020.
65. Wilder MO, Varady RG, Gerlak AK, Mumme SP, Flessa KW, Zuniga-Teran AA, Scott CA, Pablos NP, Megdal SB: **Hydrodiplomacy and adaptive governance at the US-Mexico border: 75 years of tradition and innovation in transboundary water management.** *Environ Sci Policy* 2020, **112**:189-202.
66. Castro-Arce K, Vancly F: **Transformative social innovation for sustainable rural development: an analytical framework to assist community-based initiatives.** *J Rural Stud* 2020, **74**:45-54.

67. Turnhout E, Metze T, Wyborn C, Klenk N, Louder E: **The politics of co-production: participation, power, and transformation.** *Curr Opin Environ Sustain* 2020, **42**:15-21.
 68. Reid RS, Fernández-Giménez ME, Wilmer H, Pickering T, Kassam K-AS, Yasin A, Porensky LM, Derner JD, Nkedianye T, Jamsranjav C: **Using research to support transformative impacts on complex, “wicked problems” with Pastoral peoples in Rangelands.** *Front Sustain Food Syst* 2021, **4**:600689.
- The authors explore six pastoral rangeland collaborative ‘science with society’ partnerships. Knowledge integration and social learning are highlighted as critical processes in successful transformations with positive social and ecological outcomes. The authors outline needed changes in transformative science including linking action and science, decolonizing western science and a focus on power.
69. Frantzeskaki N, Rok A: **Co-producing urban sustainability transitions knowledge with community, policy and science.** *Environ Innov Soc Trans* 2018, **29**:47-51.
 70. Goldman MJ, Turner MD, Daly M: **A critical political ecology of human dimensions of climate change: epistemology, ontology, and ethics.** *Wiley Interdiscip Rev Clim Change* 2018, **9**:e526.
 71. Svarstad H, Benjaminsen TA: **Reading radical environmental justice through a political ecology lens.** *Geoforum* 2020, **108**:1-11.
 72. Galaz V, Crona B, Österblom H, Olsson P, Folke C: **Polycentric systems and interacting planetary boundaries—emerging governance of climate change—ocean acidification—marine biodiversity.** *Ecol Econ* 2012, **81**:21-32.
 73. Hoppe T, Miedema M: **A governance approach to regional energy transition: meaning, conceptualization and practice.** *Sustainability* 2020, **12**:915.
 74. Leixnering S, Meyer RE, Polzer T: **Hybrid coordination of city organisations: the rule of people and culture in the shadow of structures.** *Urban Stud* 2021, **58**:2933-2951.
- Using interviews and analysis of policy and organizational documents, the authors explore governance coordination including hierarchy, markets, and networks within Vienna, Austria. The authors find that cultural mechanisms based upon individuals actions dominate the coordination space, while structural mechanisms are latent, but these are mutually dependent and reinforcing with structures providing a shadow for cultural mechanisms to thrive and cultural mechanisms supplant structural coordination because central control is elusive.
75. Nocht T, Skelcher C: **Network governance in low-carbon energy transitions in European cities: a comparative analysis.** *Energy Policy* 2020, **138**:111298.
 76. Gelcich S, Hughes TP, Olsson P, Folke C, Defeo O, Fernández M, Foale S, Gunderson LH, Rodríguez-Sickert C, Scheffer M: **Navigating transformations in governance of Chilean marine coastal resources.** *Proc Natl Acad Sci* 2010, **107**:16794-16799.
 77. Coles R: *Visionary Pragmatism.* Duke University Press; 2016.
 78. Palmer CG, Fry A, Libala N, Ralekhetla M, Mtati N, Weaver M, Mtintsilana Z, Scherman P-A: **Engaging society and building participatory governance in a rural landscape restoration context.** *Anthropocene* 2022, **37**:100320.
 79. Sullivan A, White DD, Hanemann M: **Designing collaborative governance: insights from the drought contingency planning process for the lower Colorado River basin.** *Environ Sci Policy* 2019, **91**:39-49.
 80. Curley A: **Unsettling Indian water settlements: the little colorado river, the San Juan River, and colonial enclosures.** *Antipode* 2021, **53**:705-723.
- Uses a critical legal geography approach to explore two recent Indian water settlements, Navajo-Hopi Little Colorado River Settlement and San Juan River Settlement. Develops idea of colonial enclosures, which change the nature of human and ecological relationships within western water law. Colonial enclosures through water settlements are partially created through the use of quantified logics. Colonial enclosures and the lineage of western water law perpetuates settler-colonial dispossession.
81. Curley A: **Infrastructures as colonial beachheads: the Central Arizona Project and the taking of Navajo resources.** *Environ Plan D Soc Space* (3) 2021, **39**:387-404.
 82. Fisher S: **The emerging geographies of climate justice.** *Geogr J* 2015, **181**:73-82.
 83. Hess DJ, McKane RG, Pietzryk C: **End of the line: environmental justice, energy justice, and opposition to power lines.** *Environ Polit* 2021, 1-21, <https://doi.org/10.1080/09644016.2021.1952799>.
- Systemic and comprehensive review of 70 North American cases on electricity power line development. Authors assess the frames used by opposition groups and find that eight frames are associated with justice. The use of justice framing is associated with the types of opposition actors, their actions, and the outcomes. Critically, subnational governments are important, and sometimes overlooked, actors in outcomes observed. The study also explores coalition breadth in terms of actor types and inclusion of marginalized groups.
84. Berkes F: **Devolution of environment and resources governance: trends and future.** *Environ Conserv* 2010, **37**:489-500.
 85. Potter E, Miller F, Löfbrand E, Houston D, McLean J, O’Gorman E, Evers C, Ziervogel G: **A manifesto for shadow places: re-imagining and co-producing connections for justice in an era of climate change.** *Environ Plan E Nat Space* (1) 2020, **5**:272-292.
 86. Wilson NJ, Montoya T, Arseneault R, Curley A: **Governing water insecurity: navigating indigenous water rights and regulatory politics in settler colonial states.** *Water Int* 2021, **46**:783-801.
 87. Newell P, Srivastava S, Naess LO, Torres Contreras GA, Price R: **Toward transformative climate justice: an emerging research agenda.** *Wiley Interdiscip Rev Clim Change* 2021, **12**:e733.
- Authors examine the extant literature on climate justice with a focus on the disconnect between activist orientations and academic scholarship. Articulates the dominant silos in scholarly climate justice discourses related to the scale or level of study (local to global), mitigation and adaptation, and climate justice versus broader justice inquiries. Advances a new transformative climate-justice agenda that centers power and bridges diverse approaches to understanding the causes of climate change and adaptation to climate change. The agenda focuses on three strands of research and action: inclusive climate justice, deepening climate justice, and governance for climate justice.