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Power research in adaptive water governance and beyond: a review

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ABSTRACT. Power dynamics are widely recognized as key contributors to poor outcomes of environmental governance broadly and specifically for adaptive water governance. Water governance processes are shifting, with increased emphasis on collaboration and learning. Understanding how power dynamics impact these processes in adaptive governance is hence critical to improve governance outcomes. Power dynamics in the context of adaptive water governance are complex and highly variable and so are power theories that offer potential explanations for poor governance outcomes. This study aimed to build an understanding of the use of power theory in water and environmental governance and establish a foundation for future research by identifying power foci and variables that are used by researchers in this regard. We conducted a systematic literature review using the Web of Science Core Collection and the ProQuest Political Science databases to understand how power is studied (foci, variables of interest, and methods) and which theories are being applied in the water governance field and in the environmental governance field more broadly. The resulting review can serve as a practical reference for (adaptive) water governance inquiries that seek to study power in depth or intend to integrate power considerations into their research. The identified power variables add to a much needed groundwork for research that investigates the role of power dynamics in collaboration and learning processes. Furthermore, they offer a substantive base for empirical research on power dynamics in adaptive water governance.

Key Words: *adaptive water governance; collaboration; learning; power; power theory; systematic review*

INTRODUCTION

Water governance has been shifting from command-and-control approaches to more adaptive and collaborative approaches over recent decades—although the shift in practice has lagged behind the scholarship in this area (Österblom and Folke 2013; Akamani 2016, Baird et al. 2016a, 2016b). Water scarcity, flooding, wastewater management, ageing water infrastructure, and provision of clean and safe drinking water are the face of the present global water crisis (UNESCO WWAP 2020, Vollmer and Harrison 2021). Though water governance approaches have been implemented to address many of these issues, they often remain ineffective, mismatched, or absent, exacerbating the global water crises. To understand why current governance approaches are not as effective as they need to be, we must evaluate the water governance systems and their underlying power dynamics so we can reveal barriers and intervention points for transformation (Pahl-Wostl et al. 2013, Mirumachi and Hurlbert 2022, Shunglu et al. 2022). Our research addresses this power gap in an effort to better equip water scholars for power-related water governance research that can identify root causes and locate suitable intervention points.

Approaches to scholarship on water management and governance include (but are certainly not limited to) integrated water resources management (e.g., Biswas 2008), collaborative governance (e.g., Bodin 2017), adaptive comanagement (Armitage et al. 2007), adaptive water governance (e.g., Pahl-Wostl et al. 2012, Cosens 2018), and water resilience (e.g., Baird and Plummer 2021). Although these approaches vary in their design and focus, shared attributes include advocacy for more diverse participation, strengthened capacity for groups to participate, and increased adaptive capacity (which is the capability to adjust processes and features to better suit present or expected social-ecological changes; Pahl-Wostl 2017, Plummer and Baird 2020). This review focuses on power dynamics that shape deliberative processes in adaptive water governance,

although we also recognize that our inquiry is highly relevant to contemporary water and environmental governance research and practice more broadly.

Adaptive water governance (AWG) aims to include diverse institutional actors and public participation in polycentric governance structures. Polycentricity describes a governance arrangement that consists of multiple decision-making authorities that are decentralized but horizontally and vertically connected (Pahl-Wostl and Knieper 2014, Carlisle and Gruby 2017, Morrison et al. 2017). Following the social-ecological systems (SES) literature, we regard polycentric governance arrangements as a structural feature that better supports deliberative processes and is well suited to address complex environmental issues such as the water crisis. Different authors (e.g., Galaz et al. 2012, Cumming et al. 2017, Lubell et al. 2017) have demonstrated that polycentric governance structures are messy in the real world, meaning “polycentric and monocentric systems almost always coexist, and they are often intertwined in complicated way” (Morrison et al. 2019:6).

A key feature of AWG is the deliberative processes that result in decision-making flexibility through collaboration, continuous learning, and experimentation (Bouwen et al. 2004, Huitema et al. 2009, Akamani et al. 2011, Herrfahrdt-Pähle 2013, Cosens et al. 2017). This flexibility supports adaptive capacity to address the complexity of social-ecological systems, including issues of scale and fit (Folke et al. 2005, Green et al. 2013, Rouillard and Spray 2017). Such a deliberative and flexible approach is therefore considered well suited to deal with the complex challenges of contemporary water governance (Mostert et al. 2007, Pahl-Wostl et al. 2012, Johannessen and Hahn 2013, Craig et al. 2017); however, implementing adaptive governance in practice often falls short of delivering improved outcomes (Williams and Brown 2016, Paauw et al. 2022). The scholarship offers limited evidence of adaptive features being implemented to support the transformative change needed to address the global water crisis

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(Pahl-Wostl 2020). As described in the introduction to this special feature, failures to implement AWG and management are common and indicate a need to understand the complexities associated with their implementation.

Power asymmetries have long been identified as critical barriers to transformative change toward sustainability in the SES literature (Biggs et al. 2012, Folke et al. 2016, Sovacool et al. 2017, Reyers et al. 2018), within which AWG scholarship is nested. We define power here as all visible, hidden, and invisible dynamics that influence the decision-making process in a direct or indirect way. We recognize that theories and definitions of power vary widely, as evidenced by the list of power-theory based definitions that were derived from this review (Table 2). The conceptualization of power within the social dimension of SES thinking has been largely neglected, causing three main weaknesses in SES theory. First, its positivist epistemology (which stems from the natural science historical background of the field) fails to capture the contextual complexity of SES (Olsson et al. 2015). Social scientists have argued that a constructivist paradigm would illuminate the context of governance processes by considering socio-cultural, political, and economic characteristics that shape power dynamics (Davidson 2010, Hayward 2013, Brown 2014, Wilson 2018). Second, core social concepts like power and agency are largely absent from the theoretical discussions of SES and lack theoretical integration (Davidson 2010, Brown 2014, Olsson et al. 2015, Stojanovic et al. 2016, Wilson 2018, Calderón-Contreras and White 2019, Musavengane 2019). The third key weakness that is widely criticized by social scientists is the notion of external pressures (e.g., biophysical stressors like climate change) that reflect a social system only partially. Brown (2014) and others (O'Brien et al. 2009, Cote and Nightingale 2012, Wilson 2018) argue that there are a range of pressures that originate from within the social system (internal pressures), like economic and social inequalities or power imbalances. External and internal pressures likewise hold the potential to disrupt the SES (e.g., civil unrest) and are lagging in analysis in SES research generally (Chaffin 2022) and AWG research specifically. To understand how the characteristics and phenomena of the social dimension shape the governance of water resources, we must work toward theoretical integration of well-established social concepts such as power into AWG, water governance, and the broader environmental governance literatures.

Power is often identified as an influence on deliberative processes including learning and collaboration (Armitage et al. 2008, Huitema et al. 2009, Brisbois et al. 2019). For example, Armitage and colleagues urge “attention ... to learning environments that enable different segments of heterogeneous communities an opportunity to transform traditionally disadvantageous power relations and engage in truly collaborative learning” (2008:94). We chose the focus on deliberative processes, like learning and collaboration, based on the hypothesis that uncertainty of SES “is best addressed with collaborative processes and recognition that multiple sources and types of knowledge are relevant to problem solving” (Armitage et al. 2008:2). Making decisions in the context of uncertainty requires a social environment that facilitates learning and collaboration to reach a common problem understanding and problem definition and to build respect for alternative knowledge frames, values, and problem-solving strategies (Keen and Mahanty 2006, Mostert et al. 2007, Gober

2018, Johannessen et al. 2019). Although acknowledging that participation plays an important role within the concept of adaptive governance, in this work, we use collaboration—rather than the broader term participation—to ensure that the research design goes beyond “equitable participation” (Brisbois and de Loë 2016:776) and integrates the value of power sharing, a critical prerequisite to decision-making for facilitating equity, fairness, and balancing stakeholder interests (Gray 1985, Innes and Booher 2004, 2010, Brisbois and de Loë 2016, Morrison et al. 2019).

Despite a growing body of literature focused on the significance of power conceptualizations to AWG and water governance more broadly, power dynamics remain understudied and poorly understood (Brisbois and de Loë 2016). The lack of attention to power dynamics is of concern given that power sharing is an important feature of collaboration and most forms of modern environmental governance (Innes and Booher 2004, Ansell et al. 2007, Margerum 2008, Emerson et al. 2011, Brisbois and de Loë 2016). The field of AWG works with the concept of power sharing in the context of multiple stakeholders sharing power and responsibilities over a specific water resource (Dietz et al. 2008). Our focus is on power in deliberative processes of AWG, following Morrison and colleagues’ (2019) call to “examin[e] the power-laden conditions that enable different types of actors, with different types of power, to achieve their preferred outcomes” (Morrison et al. 2019:6). Understanding the power dynamics that influence collaboration and learning in AWG settings is therefore crucial when seeking to address implementation failures and improve outcomes of AWG.

The aim of this systematic review is to provide an overview of power theories used in the broader environmental governance literature and consider to what extent these occur in water governance scholarship specifically, i.e., to examine “how power matters” (Morrison et al. 2019:5). We focus on collaboration and learning because these are two deliberative processes that represent hallmarks of AWG (Armitage et al. 2007, Curtin 2014). This research extends the work of Brisbois and de Loë (2016) who identified that hidden and invisible power dynamics have rarely been addressed in studies focused on collaboration in water governance. We concentrate on the use of established social theories of power and emergent environmental or water governance-specific, power-focused research to document and analyze engagement with concepts of power. The results of this review contribute to the AWG scholarship by charting the theoretical body of work used to study power as well as the power-focused works that researchers have drawn on specifically within the field of water governance and within the broader environmental governance literature. Our analysis shows how power and power theories have been applied and operationalized in this context. It provides AWG scholars with a valuable resource to guide their inquiries into power dynamics with awareness of the numerous ways in which power dynamics can impact collaboration and learning in AWG specifically and environmental governance more broadly.

METHODS

Our review analyzed water governance and environmental governance literature that engages with theories of power dynamics in the context of collaboration and learning to understand the status quo of power research in the field. We define theory as the following: “A theory is a big idea that organizes

many other ideas with a high degree of explanatory power” (Collins and Stockton 2018:2). We used the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) to guide this systematic literature review. PRISMA provides the researcher with a set of standard reporting items to build and structure a systematic review. Using a standardized review approach increases the comparability and reporting quality of a review. The PRISMA Checklist for this review can be found in Appendix 1.

Search and study selection

The Web of Science Core Collection and the ProQuest Political Science Database were used because they are popular venues for environmental and water governance research. Searches were conducted on 26 August 2020 and 29 August 2020. The searches gave 321 results from the Web of Science Core Collection and 88 results from the ProQuest Political Science database. The searches were run for abstracts only, targeting research focusing on power theory and learning and/or collaboration in the environmental governance and water governance literature. This was operationalized by using four separate search strings in both databases. Individual search strings and search results are presented in the Appendix 2. Filters were used to limit searches to scholarly articles in the English language. To capture the full extent of power-related research in the field, work from all years and both empirical and conceptual works were included. In total, we retrieved 409 search results (179 with learning focus and 230 with collaboration focus). After eliminating duplications, we reviewed 332 papers (148 with a learning focus and 184 with a collaboration focus). The number of search results retrieved from each database are depicted in Appendix 3.

Study selection

The first phase of the selection process was to screen all search results by reading titles and abstracts. Fig. 1 depicts all phases of screening and the individual number of papers that were excluded at each phase. Articles that were off topic (e.g., a focus on wind power) were eliminated. The second phase involved scanning the full text of the 110 papers (that were identified as relevant in phase one) for their level of engagement with power. If the full text review revealed that the paper was irrelevant for our purpose, it was excluded. For example, some papers mentioned the relevance of power to their case in the abstract but, when scanning the full text, it became clear that the research did not focus on power. If a paper’s relevance was confirmed in this phase, the paper went to phase three. The criteria at phase three were, (1) a clearly stated power theory included; (2) a brief discussion (i.e., longer than 1–2 sentences) of the power theory from which they approached their research (e.g., a statement like, “Many theories on power exist and are highly contested like Foucault, Giddens, Lukes” was insufficient for inclusion); and (3) the power theory needed to be supported by a reference. Phase three split the data into two datasets based on the power theoretical framings. Papers that used a power theory as a framework to guide their inquiry and fulfilled all three criteria were assigned to dataset I. Papers that lacked a power theoretical framework to guide their inquiry but examined power dynamics were assigned to dataset II. The criteria used to make these distinctions are displayed in Table 1. Where a reviewer was unable to clearly decide in which dataset a paper fit, a second reviewer was consulted. The second reviewer was randomly allocated from among the initial research team of three, with

intention of fair workload distribution. The second review (i.e., phase four) consisted of reviewing 48 pertinent papers. Papers could still be discarded at this stage if the thorough analysis of the paper revealed poor quality in the research design and/or poor explanation of methodology/methods (e.g., lack of operationalization of power). In such instances, the paper no longer had relevance to our study. In four cases, the final decision about the papers’ inclusion (dataset I, dataset II, or discarded) had to be made by a third reviewer. The reason(s) for a reviewer’s indecisiveness was not shared with subsequent reviewers in an effort to minimize bias on the next reviewer’s decision-making.

Data collection process

The papers of dataset I (i.e., papers that used power theories) were divided up between the three investigators and those in dataset II (i.e., papers that discussed power dynamics but were not grounded in power theories) were divided up between two of the investigators. A shared online spreadsheet was used to document data. If one of the investigators was not able to identify certain data items, this would be indicated in the spreadsheet and trigger a second team member to investigate. Initially, we worked with a combination of verbatim text from publications and our own paraphrased notes to document data but decided to use only direct quotations to reflect original intent and reduce interpretation bias. We used a shared online folder to store and exchange materials.

Data collection

We collected the following data from each included paper (for both datasets): research focus (where within the governance system was the focus on power), what literature was cited in relation to power, type of approach (empirical study or conceptual), research design (single or multiple case studies), type of data source (i.e., documents, interview transcripts, observations, surveys), how power was operationalized (variables or indicators used to study power), data collection methods, and analytical methods. Based on the differences in the theoretical framing(s) of power between the two datasets, we investigated slightly different data items related to the literature cited in each dataset. Papers that were assigned to dataset I were investigated for their power theoretical framing, whereas dataset II papers were investigated regarding their definition of power, what research they cited in relation to power, and their engagement with power concepts.

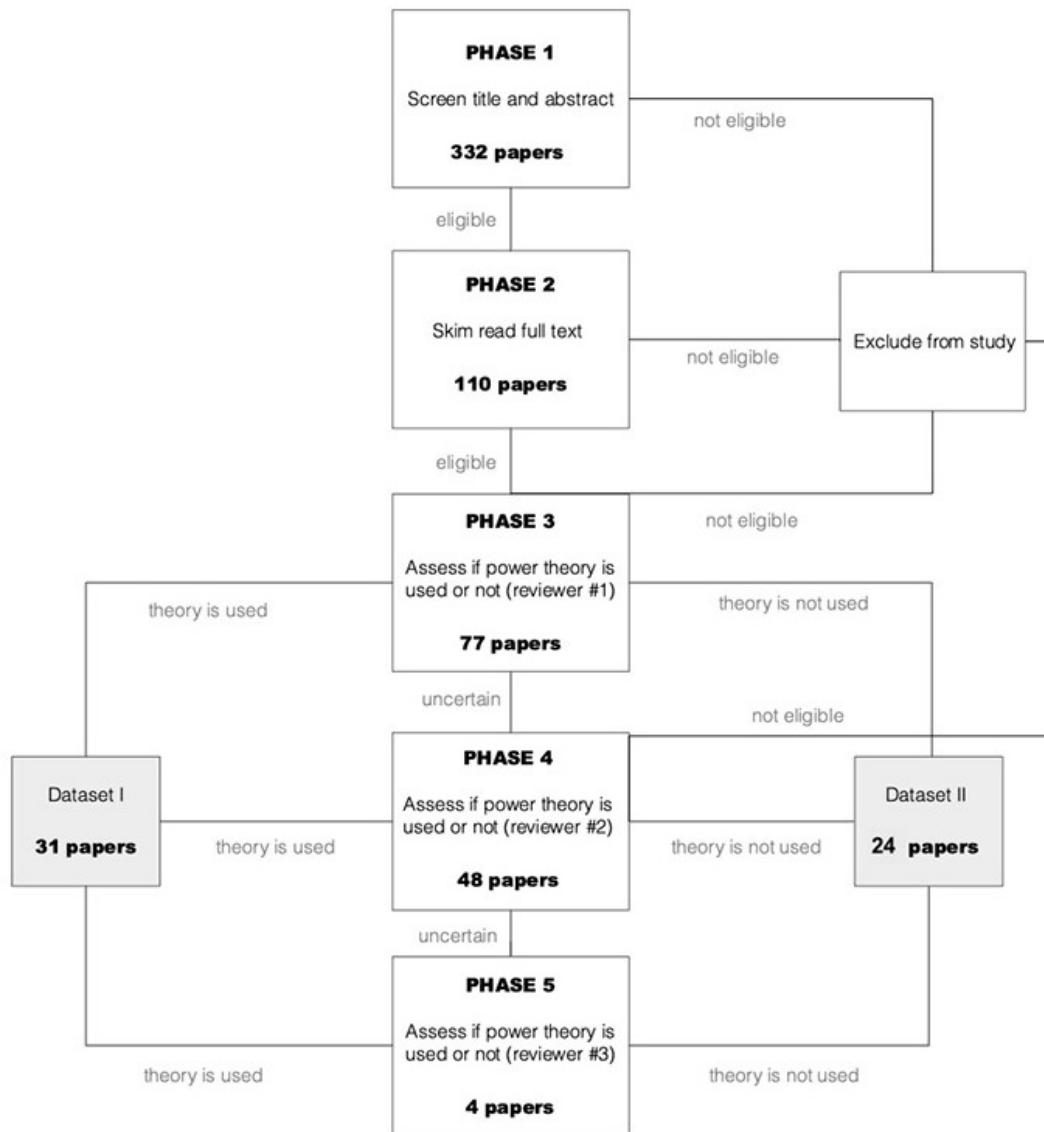
Bias assessment, effect measures, and evidence certainty

The PRISMA systematic review method usually assesses bias, effect measures, and evidence uncertainty as criteria for the inclusion or exclusion of works. Due to the focus of our review (power theory utilization), bias was not relevant, because we were interested in how researchers approach the topic of power from a theoretical perspective. Because we did not analyze or synthesize the results that are presented in the literature, we did not need to assess effect measures or evidence certainty.

Synthesis methods

The first synthesis identified where within governance the authors located power. This was done by examining the individual aims of the papers. If a paper did not specifically state its aim, we interpreted the focus by context. This synthesis used dataset I, as a first step, to establish main focus areas that scholars

Fig. 1. The selection process flow chart.



concentrated on when engaging with power theory in water governance and environmental governance. Here, we used an inductive coding approach (Williams et al. 2019) that produced pilot focus categories. In a second step, we then applied a deductive coding approach to dataset II by using the pilot focus categories. In instances where none of the pilot categories appeared suitable, focus categories were revised so they became representative for all papers in both datasets.

The second synthesis identified specific variables that were used to study power. Given the wide variety of study designs in the dataset, we defined the term “variable” broadly to mean a measure, indicator, or element that researchers used to study power. This broad definition allowed us to compile the operationalization approaches of all studies regardless of their

design differences. We used a slightly different approach than for the focus categories. First, dataset I was coded inductively to generate variable categories that were then applied to dataset II through a deductive coding process. Because the pilot variable categories did not capture the full range of variables in dataset II, we shifted to an inductive coding process for dataset II to allow additional categories to emerge. This additional step was necessary because some differences in variable types used in dataset I and dataset II started to show. Even though reframing of pilot categories was sufficient for the development of variable categories, it proved insufficient for the development of variable categories, which had to be representative of 142 variables across both datasets. These variable categories were then applied to both datasets in a final round of deductive coding. We used verbatim

Table 1. Eligibility criteria.

	Dataset I	Dataset II
Application of theory	The paper uses power theory as a framework to guide the study.	The paper builds theory as a result of data collection, builds theory based on researchers' experience, or builds theory by purely conceptual work.
Type of source	The power theory that is applied is referenced by its primary source; primary source means work that is a model or framework that mentions power in its title, coined a term or distinct perspective on power, or named a type of power or established a categorization of power.	The power theory that is applied is not referenced by its primary source (i.e., secondary sources might be used); and/or papers do not or only marginally engage with established power theory.
Level of theory discussion	Theory is discussed.	Power theory is not or briefly mentioned but not discussed.

(in vivo) codes (Saldaña 2015) as much as possible when listing the variables to reduce interpretation bias. Some variables present in the datasets fit into more than one variable category. In these cases, the three reviewers discussed the options until we agreed on a category that fit best.

RESULTS

The systematic review resulted in 55 papers that suited the criteria for analysis, with 45 items being derived from the environmental governance literature and ten from the water governance literature. Seven papers that were identified through the water governance literature search had also shown in the search that scoped the environmental governance literature. From the 55 results, 34 items were derived from collaboration-specific search strings, 15 from social learning-specific search strings, and six papers were identified both by collaboration and social learning search strings. The search results for individual search strings can be found in Appendix 3.

Application of power theory to water and environmental governance research

How is established power theory used in water governance and the broader environmental governance literature?

Our review found that 31 of all 55 papers engaged with established power theory (dataset I). The remaining 24 papers did not use an explicit theoretical foundation for their research and were grouped into dataset II. Additionally, regarding the lack of engagement with power theory, 16 of 24 papers did not provide a definition of power for the purpose of their work. Only 5 of 24 papers offered a power definition, and another 3 of the 24 made a reference to what the authors understand as power without providing a clear definition.

Comparing the water governance-specific literature with the broader environmental governance literature, we found that 8 of the 10 papers specific to water governance engaged with established power theory. This share was distinctly lower when dealing with the broader environmental governance literature engaging with established power theory, with only 22 papers of 45.

Which theories are used?

These results presented are based on the analysis of dataset I, which comprised 31 papers that engaged with established power theory to study power. The analysis identified 21 different power theories in the 31 papers of dataset I, so we observed a wide variety of theories being used (shown in Table 2). The three most often

used power theories were those by Giddens, Foucault, and Lukes. Eight of 31 papers combined different power theories. In the water governance-specific literature, 4 of 8 papers that engaged with power theory (dataset I) worked with Giddens. Other power theories that were applied to study power in water governance were by Hardy, Callon and Law, Lukes, and Barnett and Duvall.

Where do researchers locate power within governance?

Our analysis sought to understand where and how authors located power within the water governance and environmental governance systems. The coding process resulted in seven main focus categories (Table 3). The majority of papers located power in multiple areas within governance. A comprehensive table that lists all focus categories and indicates which papers (dataset I) and power theories relate to each focus category, is provided in Appendix 4.

Of the 55 papers analyzed, 25 focused on power in Governance structure and features, 16 on Relationship between governance process and outcomes, 14 on Discourses and knowledge (9 papers from dataset II), 10 on Stakeholder relationships and interactions, and 8 papers focused their attention on Instruments and strategies that are used by stakeholders when pursuing their goals. Five of 55 papers concentrated their investigation on the governance context, and only 3 of 55 papers focused on Stakeholder action and inaction (decision and nondecision). In some of the papers we identified multiple foci. Of interest is that 17 of all dataset II papers (24) focused on Governance structure and features. The key differences between dataset I and dataset II were that only one dataset II paper looked at Instruments and strategies and none of the dataset II papers focused their power inquiry on Stakeholder action and inaction (decision and nondecision). The distinct frequencies for all focus categories for datasets I and II are displayed in Fig. 2.

In the water governance-specific literature, the Relationship between governance process and outcomes was the focus of four of 10 papers and the most common focus area. Water governance-specific papers (10) that focused on Governance structure and features and the power dynamics in Stakeholder relationships and interaction were found equally common, with 3 of 10 papers for each category. Least commonly, papers focused on Instruments and strategies or Stakeholder action and inaction (decision and nondecision). None of the water governance papers exclusively directed the focus of their inquiry on Discourse and knowledge, which corresponds to the fact that Foucault's power theory was

Table 2. Power theories used to study power in water governance and environmental governance research.

Theorists	Discipline	Name of theory	Short description	Used by
Dahl 1957	Sociology	The concept of power	Power is relational. Actor A has the capacity to make actor B do something that Actor B would not do otherwise.	York and Schoon 2011
Bachrach and Baratz 1962	Political science	Two faces of power	Power has two faces that are interlinked. The first face is the capacity of a person to influence the behaviour of others (following Dahl 1957). The second face of power restricts the decision-making dynamics by excluding topics and people from the decision-making process.	Cook 2015, York and Schoon 2011
Bakhtin 1984	Language philosophy/ social theory	Bakhtinian dialogism or dialogic/dialogism after Bakhtin	Meaning evolves in dialogue through interaction of author, work, and listener/reader and is influenced by the social and political context it is placed in.	Arnold et al. 2012
Gramsci 1971	Philosophy (Marxist)/ political theory	Hegemony produced through consent and coercion (Marxist)	Power as hegemony of the political establishment. Power is exercised by rules/force and by producing consent to the status quo in the civil society through ideology, values, and culture.	Corson et al. 2014
Lukes 1974/2005	Political and social science	The three-dimensional power model	Power is understood to exist at three different scales that are interlinked and influence one another. These scales are called instrumental, structural, and discursive power dimensions. Instrumental power refers to actions that are undertaken by individuals or groups by deploying certain capacities (e.g., financial, technical, etc.). Structural power refers to (in)action of individuals or groups and (non-)decision-making that shapes, for example, policy agendas or socioeconomic or political structures. Discursive power refers to the ability to shape people's desires and influence their thoughts.	Campbell 2016, Brisbois and de Loë 2017, Brisbois et al. 2019
Foucault 1977-78	Philosophy (government-ality studies)	Governmentality and the technologies of self	Governmentality is the art of government and combines the words government and rationality. Governmentality is the states' conduct of instilling the willingness among its people to behave certain ways/govern themselves.	O'Riordan et al. 2019; Gailing and Röhring 2016
Foucault 1979-78	History/ philosophy	Power-knowledge	Power and knowledge (power-knowledge) are intrinsically linked. Power uses, shapes, legitimises, and reinforces knowledge, and the knowledge at a given time and space legitimises and reinforces power in place. Accordingly, power-knowledge is always reflected in the discourse at a given time and place.	Kenter et al. 2016, May 2013, 2015, 2016, Dewulf and Elbers 2018, Whaley and Weatherhead 2014
Rubinstein 1982	Economy/game theory	Rubinstein's bargaining theory/ Rubinstein bargaining model	Power that is held by one group to survive without coming to an agreement with the other group. The powerful group will be able to secure the bigger share in the negotiation process.	Kasymov and Zikos 2017
Giddens 1984	Sociology	Dualist theory or structuration theory	Socialization into certain structure (e.g., social class, network, institution, family) shapes the agency (free will and choice) of an individual and the agency that is exercised by an individual shapes the structure of their socialization. The nexus of agency and structure is called structuration.	Roldán 2017, Bréthaut et al. 2019, Dengler 2007, Förster et al. 2017, Ran and Qi 2019, Barnaud et al. 2010
Laclau and Mouffe 1985	Political theory	Hegemonic discourse	Production of meaning legitimizes power relations. The hegemonic discourses that are produced become common sense, consensus, and reality and are not questioned.	Dewulf and Elbers 2018
Bourdieu 1986	Sociology	Symbolic power	Power refers to the unconscious and subtle domination that manifests in social/cultural roles and habits.	May 2013, 2015, 2016
Boulding 1989	Economy/ system theory	Three faces of power	Distinguishes three forms of power using a metaphor. The stick as the force, the carrot as enticement, and the hug, as the ability to create relationships like trust, love, or legitimacy (integrative power). Integrative power is viewed as the most influential power type.	Barnaud et al. 2010
Mann 1986/1993	Sociology	Four sources of social power	Distinguishes four power sources: military power, economic power, political power, and ideological power. Military power refers to organized physical force. Political power refers to centralized state power. Economic power is understood as the ability to satisfy subsistence needs. Ideological power refers to values, traditions, and norms of a society.	May 2016
Fiske 1993	Psychology	Power-as-control theory	Power refers to control over resources and outcomes on an individual level. Individuals with little power pay attention to those with power (observation), whereas those with power do not pay attention to the powerless individuals (ignorance).	Wald et al. 2017
Fairclough 1993	Social science	Critical discourse analysis (three dimensions to language)	Power as being implicit in social practices and social practices being implicit in language. Draws on the dialectical relationship between language and social practice. Language/discourse is a space where power is exerted, maintained, and reinforced.	Arnold et al. 2012
Hardy 1996	Organizational management	A model of four dimensions of power (addressing strategic change)	Four dimensional power model: (1) Power of resources: deploying resources to influence decision making (e.g. information, credibility, rewards, money); (2) power of processes: power resides in processes and procedures used in the organizational decision-making (non-decision-making); (3) power of meaning: the power of shaping desire and perception on the community to societal levels to avoid resistance; and (4) power of system: manifests in the organizational values, traditions, cultures, and structures and reaches everyone within the organizational system.	Dare and Daniell 2017

(con'd)

Dryzek 1997/2005	Environmental politics	Approach to discourse analysis that uses Foucault's understanding of discourses and power	Power operates through discourses as they shape the values and perceptions of the individuals who subscribe to them.	Corson et al. 2014
Hardy and Phillips 1998	Organizational management	Simplified framework of three aspects of power	Three aspects of power that are of special interest to inter-organizational dynamics: (1) formal authority, meaning the decision-making right; (2) control of critical resources, meaning that reliance on resource access through another organization creates power imbalance; and (3) discursive legitimacy, meaning legitimacy in relation to certain topics or issues.	Purdy 2012
Arndt 2004	Sociology	The concept of intransitive power (transitive and intransitive power are discussed by Goehler in Goverde et al. 2000; contrasting Weber and Arndt)	Power that arises from actors' shared values motivates collective action to reach shared goals. Power is a capacity/ability.	Barbedo et al. 2015
Latour 2005	Science and technology studies	Actor-network theory (ANT)	The whole world exists as networks connected by relationships. Humans and their natural and material world, as well as processes and ideas and any other element, equally contribute to shaping social situations. Power is situated in the networks and not accumulated at certain points of the network. Every part of the network (human and nonhuman) is regarded as actor and has agency. The agency is relational, derived from the network the actor is situated in. Power resides in the network and is not accumulated at certain points.	Davies et al. 2015
Callon and Law 2005	Science and technology studies	Agency produced by calculation and non-calculation; this resides within the broader frame of actor-network theory	Material arrangements (anything you can touch) shape calculation (rational action) and non-calculation (irrational action) of the actor in the network. This means that material arrangements are constitutive for power that operates in the network influencing human and nonhuman actors.	Valve et al. 2017
Duvall and Barnett 2005	Global governance	Four conceptual types of power	Power relations are direct or diffuse, and power is operating through social interactions or through constitutive relations. (1) Compulsory power operates direct and through social interaction (e.g., coercion). (2) Structural power operates direct and through constitutive relations (capitalist system, wealth creates influence). (3) Institutional power operates diffusely, through constitutive relations (e.g., institutions that are advantageous for same actors but not others). (4) Productive power works diffuse and through constitutive relations (e.g., knowledge and meaning).	Baltutis et al. 2018

not identified as a theory that was applied within the water governance-specific papers.

We also looked specifically at the foci of papers that presented a novel concept linked to water or environmental governance and power. Of these 11 conceptual papers, 5 focused on the Relationship between governance process and outcomes, 4 on Governance structure and features, 2 on Discourse and knowledge and another 2 on Context. None of the papers that developed a new conceptual approach (as opposed to empirical research) directed their focus on Instruments and strategies, Stakeholder relationships and interaction, or Stakeholder action and inaction (decision and nondecision). Two of the conceptual papers belonged to the water governance scholarship and both papers directed their focus on the Relationship between governance process and outcomes.

How is power operationalized?

Overall, the analysis revealed a large variety of variables used to study power. We identified four main variable categories, fourteen subcategories and 142 variables in total. All variables and their respective categorization are listed in Appendix 5. A condensed version is displayed in Table 4. Some of the 142 variables are very similar and could potentially be aggregated; however, we decided against aggregation because authors define same or similar variables differently.

Forty out of the 142 variables were derived only from the water literature. Almost half of the variables (49%) were derived from dataset I, and 42% of the variables originated from dataset II.

Twelve out of 142 variables were identified in both datasets; however, this did not include variables that could be considered the same or similar. For example, we consider variables like Aspirations of what should be done, Intent, and Goals and trajectories the same or similar but have listed them as distinct variables. Because these variables were derived from different papers and datasets, we decided to report them (if possible) verbatim to reduce interpretation bias.

Both datasets operationalized power most frequently to study the Governance setting (37%) and least frequently to study Stakeholder interaction (15%; Table 4). Power of Agent(s) and their social domain and Dominance were operationalized in both datasets at very similar frequencies (Fig. 3). Agent(s) and their social domain were depicted by almost 28% of dataset I variables and by 26% of dataset II variables. Dominance was operationalized in both datasets by around 22% of their individual variables. Variables that we identified in both datasets operationalized power of the Agent and its social domain (specifically, Purpose and intent, Agent attributes, Cultural attributes, and Resources and nonmaterialistic resources), Governance setting (specifically, Context and Rules and legitimacy), and Dominance (specifically Positioning and brokerage ability).

Overall, the papers of dataset I operationalized power in all four variable categories rather evenly (Fig. 3). Differences between individual variable categories were more pronounced in dataset II. Only 11% of all variables derived from dataset II

Table 3. Identified key areas that power research focuses on within water and environmental governance systems.

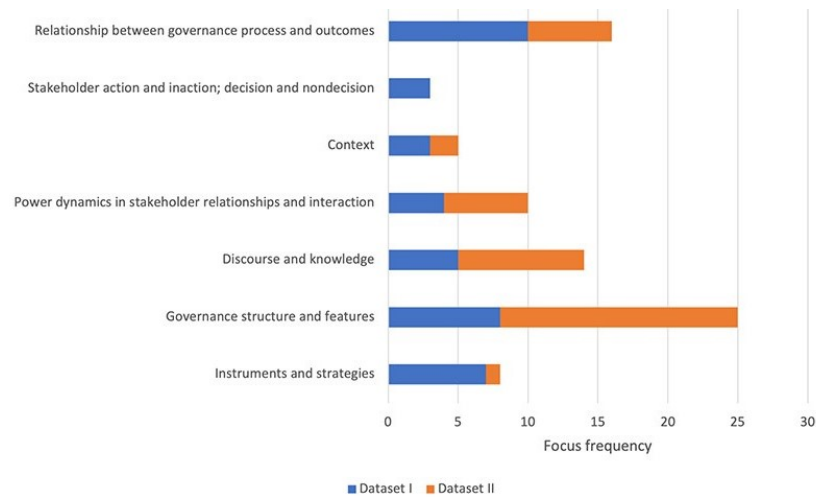
Focus category	Description of category	Example papers from dataset I
Instruments and strategies	Power is located either in sources, resources, instruments, or tools used to exert power or locates power within strategies that are used by actors/stakeholders in pursuit of their interest or in order to influence a decision in their favour.	Gailing and Röhring 2016 Dewulf and Elbers 2018 Purdy 2012 Dare and Daniell 2017 Valve et al. 2017 Cook 2015 May 2015 May 2016
Discourse and knowledge	Power is located in dominant or suppressed discourses, themes, or narratives actors use to frame their agenda as well as the values, worldviews, belief systems, and knowledges that actors/stakeholders hold.	O’Riordan et al. 2019 Whaley and Weatherhead 2014 Corson et al. 2014 Baltutis et al. 2018 York and Schoon 2011 Campbell 2016
Power dynamics in stakeholder relationships and interaction	Power is located in the relationships/relations between different stakeholders or actor groups as well as their interactions with each other, including power asymmetries.	Kenter et al. 2016 Campbell 2016 Brisbois et al. 2017 Brisbois et al. 2019 Barbedo et al. 2015 Brethaut et al. 2019 Ran and Qi 2018 Barnaud et al. 2010
Governance structure and features	Power is located in the structure of the governance system (procedures, arrangements) and in the prerequisites or features of the participatory process and the way it is facilitated.	Purdy 2012 Roldán 2017 Dengler 2007 May 2015 Corson et al. 2014 Arnold et al. 2012 York and Schoon 2011
Context	Power is located in external factors that influence actors’ decisions like the social, political, or economic conditions or situation in which a governance system is embedded.	Whaley and Weatherhead 2014 Corson et al. 2014
Stakeholder action and inaction, decision and nondecision	Power is located in the ability of stakeholders or stakeholder groups to act independently and to make decisions freely. It also encompasses the possibility of purposive inaction and nondecision making.	May 2015 May 2013 Wald et al. 2017 Baltutis et al. 2018 Kasymov and Zikos 2017 Förster 2017
Relationship between governance process and outcomes	This refers to the relationship between governance processes and the effectiveness or outcomes of these processes.	Davies et al. 2015 Ran and Qi 2019 Ran and Qi 2018 Baltutis et al. 2018 Barnaud et al. 2010 Kenter et al. 2016

operationalized Stakeholder interactions. In contrast, 40% of dataset II variables operationalized the Governance setting. This distinguished dataset II from dataset I. A comparison between dataset I papers (those that used established power theory) and dataset II papers (those that refrained from applying established power theory) regarding variables subcategories is displayed in Fig. 4. We found that only 12 of 142 variables were present in both datasets. All papers that used variables that are categorized as Agent attributes, Knowledge, and Stakeholder interaction and networks originate from dataset I. All papers that operationalize Purpose and intent are part of dataset II (Fig. 4).

When comparing the numbers of environmental and water governance papers that used variables from each subcategory (Fig. 5), we found that 14 of 55 papers used variables from subcategory Rules (formal and informal) and legitimacy, followed

by the Organizational form subcategory, which was used by 11 of 55 papers (a single paper could have multiple variables and thus be counted more than once). Nine of 55 papers used variables that operationalized Agent attributes, and 8 of 55 papers operationalized Discourses, language, and dominant themes (Fig. 5). The subcategories of Knowledge, Rights and control, Purpose and intent, and Politics were each counted 3 times or fewer within 55 papers. The results for the most often used variable categories were identical for the water specific literature. Here, 4 of 10 papers used variables from the category Rules (formal and informal), and 3 of 10 papers used variables that depict the Organizational form. Power variables that operationalized Positioning and brokerage ability were also used by 3 of 10 papers from the water-specific literature. Agent attributes were operationalized by 2 of 10 papers, and, equally often, water scholars employed variables that operationalize Resources and nonmaterialistic resources. The

Fig. 2. Frequencies of identified key focus areas of power research within water and environmental governance systems.



subcategories Governance context and Purpose and Intent were not used in water governance papers. Variables from all other subcategories were used evenly by 1 of 10 papers (Fig. 4).

We traced the links between power focus and variable categories for learning and collaboration (Fig. 6). We found that papers that concentrated on collaboration tend to locate power more frequently in Instruments and strategies and Stakeholder (in) action when compared with papers that studied power in relation to learning, as depicted in Fig. 6. Regarding the operationalization of power, we found that collaboration focused and learning focused papers used variables across the four main variable categories relatively evenly. This means that there is no variable category that is frequented more by papers that are learning specific or more likely to be studied in relation to collaboration (Fig. 6).

What methods are used to study power?

Papers included in both datasets tended to be more empirical than conceptual; 23 of 31 dataset I and 21 of 24 dataset II papers used empirical methods, which was similarly reflected in the water governance papers, where 8 of 10 papers were empirical. Of those empirical sources, single case studies were more common than multiple case studies (for the water governance papers, all but one empirical paper was a single case study), and data sources were approximately equally distributed between human and text-based sources (e.g., documents; Fig. 7). Many of the papers (13 of 31 papers in dataset I and 13 of 24 papers in dataset II; 4 of 10 water governance papers) included both people and text sources in their work. Interviews, document analysis, and participant observations were the most commonly used data collection approaches for both datasets. Papers tended to use either qualitative or quantitative approaches, with only one paper in dataset I and two papers in dataset II mixing quantitative and qualitative methods. Despite this predominance of either quantitative or qualitative approaches, multiple data collection methods were used in most empirical studies, with a median of two methods for dataset I and three methods for dataset II, and the total number ranging from one to five methods for data

collection. Water governance papers used fewer methods, with a median of one and a range of one to two. We plotted the co-occurrence of methods within studies to examine which methods were used together most often. Interviews, document analysis and participant observation were most prevalent in general (most often used in datasets I and II and in the water governance papers), and these methods were also used together most often (see figures in Appendix 6, which show the co-occurrence matrices).

In summary, the results of our analysis show that a wide variety of analytical methods were used to study power and the majority were qualitative (69% for dataset I and 88% for dataset II; see Appendix 7, which presents the full list of methods identified with frequency of occurrence by dataset). The most common qualitative methods used, when adding the instances in both datasets, were content analysis (10 instances in 55), thematic analysis (6 instances in 55), and discourse analysis (5 instances in 55), although the details of these methods—especially content analysis—were not always clearly explained. All other qualitative methods were used three or fewer times in total. Quantitative methods varied more than qualitative between the two datasets, with statistical analysis (broadly defined) and social network analysis being the most common, i.e., with three instances each between the two datasets. Water governance papers tended to use content analysis and coding, broadly defined, most often (5 of 10).

DISCUSSION

A general finding from the systematic literature review is that both those papers that explicitly used established power theories and those that did not engage established power theory exhibited a large variety of approaches and strategies to investigate power dynamics in the context of environmental and water governance. Furthermore, there was also diversity regarding how power theories were applied and operationalized. Studies often used experimental and innovative research designs to understand power dynamics in environmental and water governance.

We sought to understand how the reviewed research engaged with established power theory. We found that researchers who worked with established power theory (dataset I) more often focused on

Table 4. Variable categories, subcategories, and variable examples.

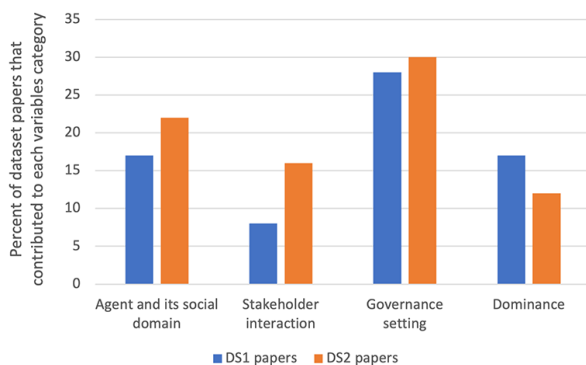
Variable category	Variable subcategory	Variables used to study power in reviewed papers (Appendix 5 lists all identified variables)
Agent and its social domain (28%)	Purpose and intent	Purpose of Indigenous engagement [†] Motivations guiding collective action [†] Goals [†] and trajectories [‡]
	Agent attributes	Charismatic or rhetorically gifted [‡] Political, economic, and social positions [‡] Stakeholders' gender, race, and age [‡]
	Cultural attributes	Norms ^{†‡} Values ^{†‡} World views [‡]
	Knowledge	Privileged access to pertinent knowledge [‡] Inclusive or exclusive use of knowledge [‡] Cognitive knowledge [†]
	Resources and nonmaterialistic resources	Unequal capacities (e.g., technical, social) to participate [‡] Financial resources ^{‡§} (e.g., money) Physical resources ^{‡§} (e.g., IT, transport, land)
		Stakeholder interaction (15%)
Governance setting (37%)	Characteristics of interactions	Face-to-face dialogue [†] Consensus and limits of consensus ^{‡§} Ways stakeholders referenced or responded to claims made by others [‡]
	Rights and control	Property rights [†] Control over information production and use ^{‡§} Authority ^{†‡}
	Context	Political ^{†‡§} (e.g., political economy, political regime [†]) History ^{†‡} Ecosystem conditions [‡]
	Organizational form	Shared responsibility for goal achievement [†] Mediation (encouraging stakeholder interactions and using a mediation technique to navigate interactions and process) [†] Institutional diversity and fragmentation
	Rules (formal and informal) and legitimacy	Sanctions [†] Legislation and policies ^{†‡§} Position rules defining who can act [†]
	Dominance (20%)	Politics
Positioning and brokerage ability		Degree centrality [†] Agenda setting or control ^{††} Ability of a stakeholder to survive without an agreement [‡]
Discourses, language, and dominant themes		Who is, or is not, favoured by the dominant discourse ^{‡§} Hegemonic themes or values related to capitalism ^{‡§} Used representations, and narratives [†]

[†] Variable was derived from dataset II.

[‡] Variable was derived from dataset I.

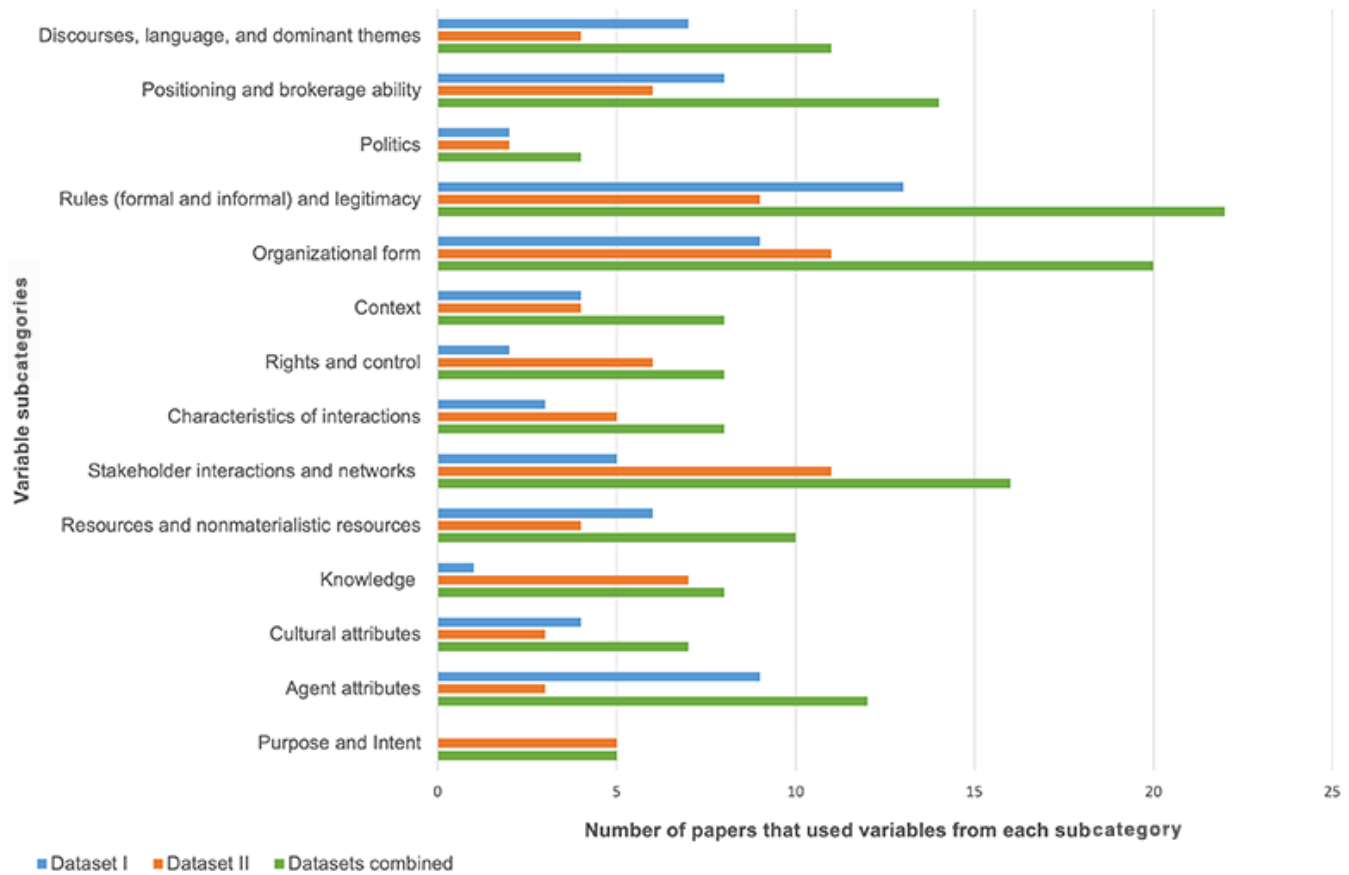
[§] Variable was derived from water literature.

Fig. 3. Dataset comparison of variable origin by category.



power Instruments and strategies whereas power researchers working without using established power theory (dataset II) rarely investigated power in this area. Other focus areas were addressed relatively equally between the two groups, such as Governance structures and features and Discourse and knowledge. In addition, we observed that papers that did not engage with established power theory (dataset II) rarely provided a clear definition of power for the purpose of their study. The absence of power definitions could hint at the difficulty of grappling with the concept of power, given its complexity and the manifold conceptualizations that exist. However, a lack of definition reduces the ability to operationalize power and hence compromises the study of power. We see here great potential for further research that focuses on suitable power definitions for different focus areas within environmental and (adaptive) water governance.

Fig. 4. Comparing dataset I and dataset II papers based on the variable subcategories used.



In the water governance-specific literature, none of the 10 papers used Foucault’s power theories, coinciding with a lack of focus on Discourse and knowledge in the water literature in our search. Although some attention is paid to Discourse and knowledge by Brisbois and de Loë (2017) and Brisbois et al. (2019), the review suggests that we still have only a limited understanding of how discourses shape collaboration and social learning in AWG. This could be due to a history of hesitance to engage with and integrate social theories into social-ecological frameworks generally and AWG specifically (Davidson 2010, Brown 2014, Calderón-Contreras and White 2019). Although we appreciate that this identified gap could also be a result of our specific search terms, which narrowed the scope to literature related to learning and collaboration, it leads us to argue that the field’s future research agenda would benefit from an increased engagement with power theoretical conceptions of discourse and knowledge. Here, Foucault (1991, 1998), Laclau and Mouffe (1985), or Fairclough (1993) are suitable theories that support discourse analysis (Table 2). Foucault (1991, 1998) worked with the concept of power/knowledge, which regards these two as intrinsically linked. Fairclough (1994) developed a critical discourse analysis that regards social practices and language to mutually influence one another. Hence, the language we use and the discourses that emerge form a space where power is exercised. By using Dryzek’s (2012) approach to discourse analysis (based on Foucault’s power

understanding), Hussein (2016) exemplified how different institutions construct dissimilar narratives about water scarcity in Jordan and how this affects management responses. Water related discourses are likely to differ across time and space. Hence, comparative analysis between catchments or regions might offer new insights on the implications that different framings have for decision-making and management choices. Analyzing discourses of shared water concerns (e.g., climate change, water quality, flooding) and how they affect collaboration and learning of groups with divergent narratives might also enlighten barriers to effective AWG.

We identified a lack of attention on power dynamics in Stakeholder relationships and interactions, as well as Stakeholder action and inaction, across the environmental and water governance literature, particularly in conceptual papers. This came as a surprise because collaboration and learning are key concepts of AWG, yet these power dynamics were not sufficiently conceptualized nor studied in the works included in this systematic review. This leads us to reason that the AWG scholarship would benefit from engagement with suitable social theories of power (Davidson 2010, Brown 2014, Calderón-Contreras and White 2019) that are capable of revealing and explaining stakeholder action and inaction as well as stakeholder relationships and interactions.

Fig. 5. Comparing water and environmental governance papers based on the variable subcategories used.

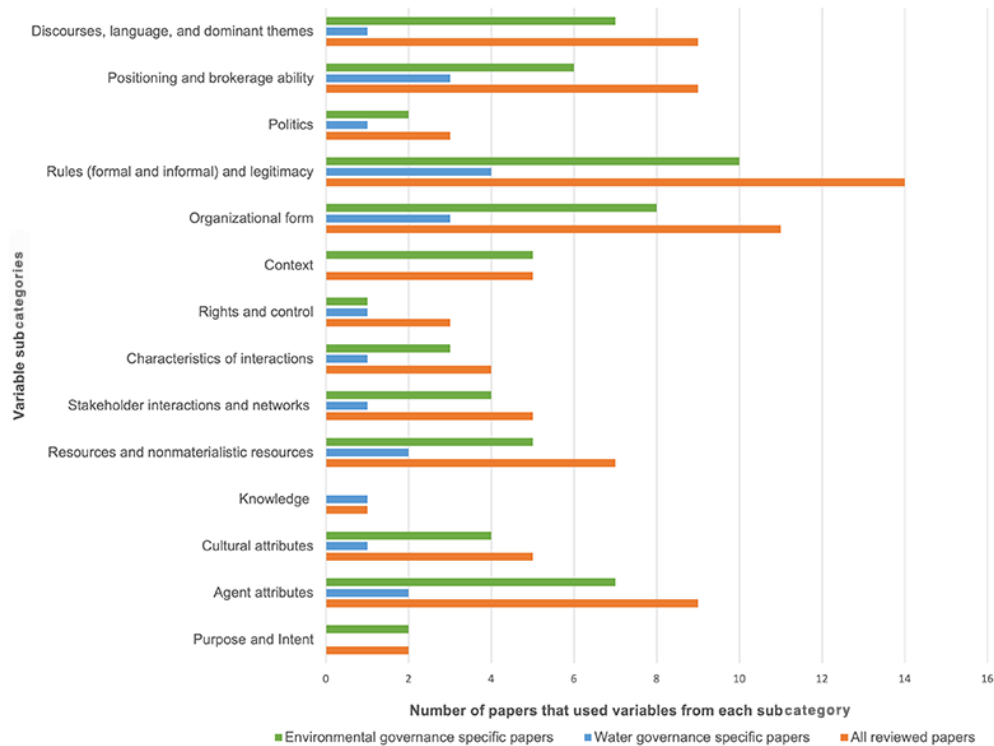
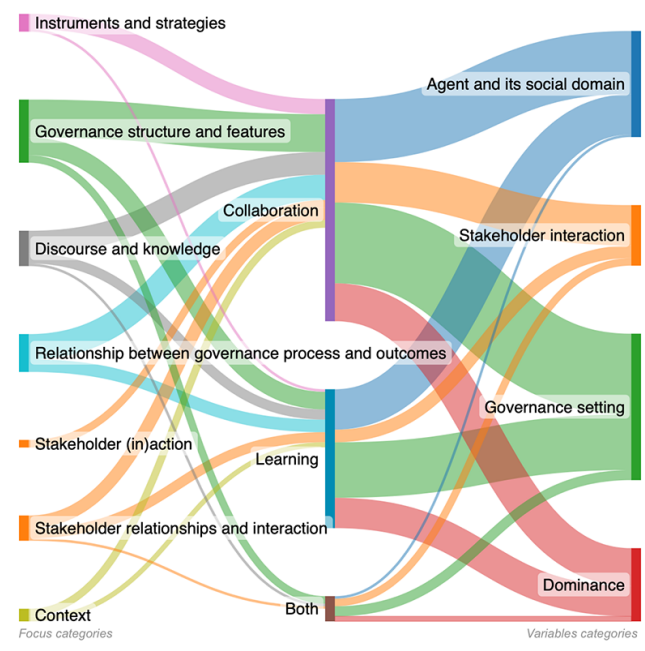


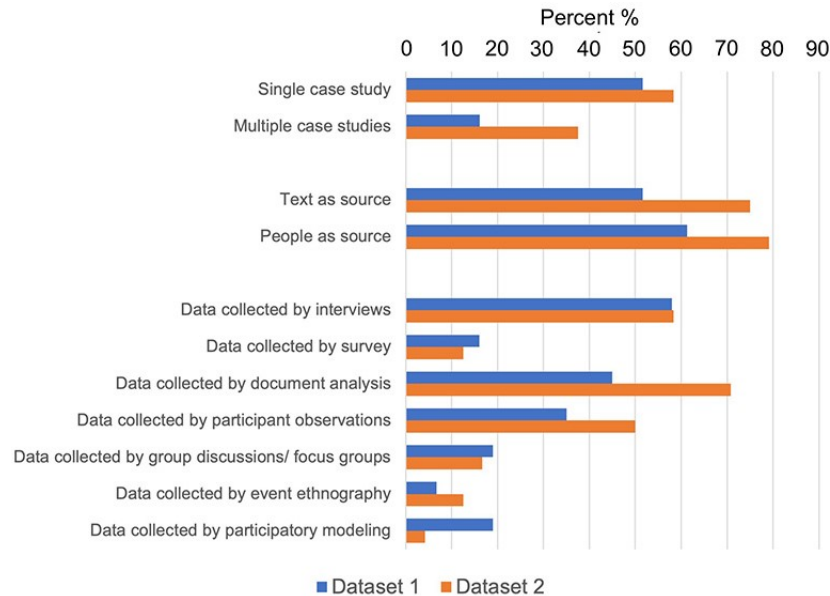
Fig. 6. Sankey diagram showing focus to learning/collaboration to variable flows.



To investigate stakeholder actions and interactions, we suggest agent-based power theories as theoretical framings. Agent-centered power theories that could be used to support such inquiry are the concept of power by Dahl (1957), the theory on the two faces of power by Bachrach and Baratz (1962) or Rubinstein’s (1982) bargaining theory, to name a few. Power theories that are suitable here, while also showing strong explanatory power for Instruments and strategies, are the theory on the three faces of power by Boulding (1989), the four sources of social power by Mann (1993) and Fiske’s (1992) power-as-control theory. For example, Barnaud et al. (2010) employed Boulding’s (1989) theory to shed light on power games in community water management. We also encourage scholars to analyze how governance structures influence stakeholder actions and inactions and stakeholder relationships and interactions. Useful theories could include Giddens’ (1984) structuration theory, Barnett and Duvall’s (2005) four conceptual types of power, Latour’s (2005) actor-network theory, or the structural dimension of Lukes’ (2005) three-dimensional power model. Brisbois and de Loë (2017), for example, used Luke’s (2005) theory to study the influence of the natural resource industry on collaborative processes and outcomes in water governance (see examples in Table 2).

The theoretical framings that we have compiled offer a range of future avenues that field-specific power research could explore. To advance concepts of AWG, we encourage scholars to integrate established power theories more holistically into AWG-specific conceptualizations. AWG itself is a field that brings together diverse disciplinary perspectives and methodologies, and we see

Fig. 7. Comparing datasets I and II regarding case study design, data sources, and data collection approaches.



this as a strength to power inquiries. Our results show that a variety of methods were used to both collect and analyze data related to the study of power. Hence, we consider AWG scholars well equipped to capitalize on the disciplinary diversity in theory and methodology present in power dynamics scholarship. Drawing on the approaches reviewed in our study holds the potential to build a nuanced understanding of the multi-dimensional and interlinked power dynamics that shape critical features of AWG like collaboration and learning (Keen and Mahanty 2006, Pahl-Wostl et al. 2013, Mirumachi and Hurlbert 2022, Shunglu et al. 2022). Next to grasping power dynamics themselves, it will also be essential to understand how different types of power interlink and influence each other across physical scale, space, and time.

This review shows that some approaches to operationalizing power rely on established power theory and others on developing field-specific theory. Although we encourage scholars to take advantage of established power theory, we also urge scholars not to feel limited by them. Instead, we need to acknowledge that there might be context-specific factors that are unique to water governance, which can drive further development of power theory in the field. For example, variables concerning Agent purpose and intent were exclusively identified from papers that did not engage with established power theory. Here we are likely to see such context specifics. AWG scholars are encouraged to continue to build on the novel power theory we document here to provide some continuity and theory maturation over time.

We recognize that there are some limitations to this systematic literature review. First, we focused specifically on learning and collaboration in the review. We acknowledge that these deliberative processes are key characteristics or hallmarks of AWG (although not limited to it). As a result of this focus, power studies that did not have an explicit reference to some form of the terms “collaboration” or “learning” were excluded and are not

accounted for here. Further, our search terms focused on explicit use of the term “power,” which may have excluded sources where power and/or power theory was used in a less explicit way. Additionally, our focus on scholarly literature may have excluded relevant work published outside of academic journals, including books and/or book chapters, both peer-reviewed and not. Finally, although we made a strong effort to define what constitutes an established power theory, our definition may not have aligned exactly with how others might define it. All these scoping decisions for the systematic literature review have implications on the literature that was included. At the same time, we acknowledged that our search filters have led to the exclusion of other relevant works that exist but have not been picked up in our searches. For example, Boonstra (2016), who conceptualized power to study social-ecological interactions, or Morrison and colleagues (2017), who studied the effectiveness of different types of powers (pragmatic, framing, and power by design) in polycentric systems. A broader review of the water and/or environmental governance literature to understand how power is theorized and operationalized would be a valuable contribution to building on this study. A stronger and methodologically better supported focus on power in water governance, and specifically within AWG, would be valuable to advance our understanding around power dynamics and their impact on effective governance outcomes.

Overall, we anticipate that these findings may be a valuable resource in support of AWG research that more strongly engages with power theory. We urge researchers to use these resources to advance AWG research on power, particularly by leveraging power theory resources identified from this review to support specific research foci and to address gaps in power theory development within the field.

We further suggest that a critical analysis of the established and emerging power theories identified in this review would be a constructive next step to further support power research in AWG

and environmental governance more broadly. For example, applying different power theories to the same case study in a comparative format could lead to a better understanding of the suitability of different theories to a range of AWG settings. Simultaneously, we also encourage future research to apply the same theory and methods to multiple case studies to provide a better understanding of the influence of specific variables on outcomes.

CONCLUSION

This literature review demonstrates that power research related to collaboration and learning in the field of environmental governance and its water governance subfield is still an inchoate area of scholarship that is characterized by a great diversity of explorative and innovative study designs. We have shown where researchers locate power within the fields of environmental and water governance and how scholars operationalize power in their studies. Our review has produced two key resources. First, we provide a table that compiles a broad range of power theories (Table 2) that have been used as a theoretical foundation for the inquiry of power in environmental and water research. Second, we provide a comprehensive table that lists 142 variables (Appendix 5) that have been employed by scholars in the field to operationalize power across various aspects of governance in relation to collaboration and learning. Together, these two documents can aid scholars to study the power dynamics that are “difficult to observe, tough to define, slippery to measure, [and] tricky to generalize about” (Morrison et al. 2019:2). We understand our contribution as a basic guide that may advance the establishment of strong foundations for further power research in the field of AWG and the broader environmental governance literature.

Analyzing power-specific literature in these fields enabled us to understand how power research is practiced and to identify insights about how power research is conducted in the subfield of AWG and beyond. The AWG scholarship can learn the following lessons from the broader power-specific environmental governance literature: (1) established power theory can benefit study design; (2) there are spaces like discourse and knowledge that remain largely untouched by power research in AWG; and (3) power research in environmental governance offers great inspiration for innovative research designs and suitable analytical tools that can deepen our insight into the power dynamics that shape today’s water governance outcomes and limit the effectiveness of AWG.

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Data Availability:

The dataset generated during the current study is available in the Figshare repository and the link is available from the corresponding author on reasonable request.

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Appendix 1 PRISMA Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Power research in adaptive water governance and beyond: A review	p. 1
ABSTRACT			
Abstract	2	Power dynamics are widely recognised as a key contributor to poor outcomes of environmental governance broadly, and specifically for adaptive water governance as a critical consideration to the emergence of adaptive water governance. Water governance processes are shifting with increased emphasis on collaboration and social learning. Understanding how power dynamics impact these processes in adaptive governance is hence critical to improve governance outcomes. Power dynamics in the context of adaptive water governance are complex and highly variable and so are power theories that offer potential explanations for poor governance outcomes. This study aimed to build an understanding of the use of power theory in water and environmental governance and establish a foundation for future research by identifying power foci and variables that are used by researchers in this regard. We conducted a systematic literature review using the Web of Science Core Collection and the ProQuest Political Science databases to understand how power is studied (foci, variables of interest, methods) and which theories are being applied in the water governance field and the environmental governance field more broadly. The resulting review identified that the explicit use of established, general power theories are not commonly used in adaptive water governance. Further, we identified several emerging theories of power specifically within environmental and water governance. In both cases, the variables of interest in the review sources varied substantively, captured in seven main categories: instruments and strategies; discourse and knowledge, power dynamics in stakeholder relationships and interaction; governance structure and features; context; stakeholder action and in-action, decision and non-decision; and relationship between governance process and outcomes. This research can serve as a practical reference for adaptive water governance inquiries that seek to study power in-depth or intend to integrate power considerations into their research, including a focus on the emergence of adaptive water governance. The identified power variables add to a much-needed groundwork for research that investigates the role of power dynamics in collaboration and social learning processes. Furthermore, they offer a substantive base for empirical research on power dynamics in adaptive water governance.	p. 1
INTRODUCTION			
Rationale	3	Despite a growing body of literature focused on Adaptive Water Governance (AWG) and the significance of the power concept to AWG and water governance more broadly, power dynamics remain understudied and poorly understood (Brisbois et al. 2016). The lack of attention to power dynamics is especially surprising considering that power-sharing is as an important feature of collaboration (Innes and Booher 2004; Ansell and Gash 2007; Margerum 2008; Emerson et al. 2011; Brisbois and de Loë 2016). The field of adaptive governance works with the concept of power-sharing in the context of multiple stakeholders sharing power and responsibilities over a specific water resource (Dietz et al. 2003). Our focus on power in deliberative processes of AWG also follows Morrison and colleagues' (2019) call to divert the focus from 'the structural dimensions of polycentric governance to examining the power-laden conditions that enable different types of actors, with different types of power, to achieve their preferred outcomes.' (Morrison et al., 2019, p. 6). Understanding the power dynamics that influence collaboration and learning in AWG settings is therefore crucial when seeking to address implementation failures and improve governance outcomes of AWG.	p. 2f.

Section and Topic	Item #	Checklist item	Location where item is reported
		<p>Understanding the power dynamics that influence collaboration and learning in AWG settings is therefore crucial when seeking to address implementation failures and improve governance outcomes of AWG.</p> <p><i>References</i></p> <p>Ansell, C., & Gash, A. (2007). Collaborative Governance in Theory and Practice. <i>Journal of Public Administration Research and Theory</i>, 18(4), 543-571. doi:10.1093/jopart/mum032</p> <p>Brisbois, M. C., & de Loë, R. C. (2016). Power in Collaborative Approaches to Governance for Water: A Systematic Review. <i>Society & Natural Resources</i>, 29(7), 775-790. doi:10.1080/08941920.2015.1080339</p> <p>Dietz, T., Ostrom, E., & Stern, P. C. (2008). The Struggle to Govern the Commons. In J. M. Marzluff, E. Shulenberger, W. Endlicher, M. Alberti, G. Bradley, C. Ryan, U. Simon, & C. ZumBrunnen (Eds.), <i>Urban Ecology: An International Perspective on the Interaction Between Humans and Nature</i>. Boston, MA: Springer.</p> <p>Emerson, K., Nabatchi, T., & Balogh, S. (2011). An Integrative Framework for Collaborative Governance. <i>Journal of Public Administration Research and Theory</i>, 22(1), 1-29. doi:10.1093/jopart/mur011</p> <p>Innes, J., & Booher, D. (2004). Reframing Public Participation: Strategies for the 21st Century. <i>Planning Theory & Practice</i>, 5(4), 419-436. doi:10.1080/1464935042000293170</p> <p>Margerum, R. D. (2008). A typology of collaboration efforts in environmental management. <i>Environ Manage</i>, 41(4), 487-500. doi:10.1007/s00267-008-9067-9</p> <p>Morrison, T. H., Adger, W. N., Brown, K., Lemos, M. C., Huitema, D., Phelps, J., . . . & Hughes, T. P. (2019). The black box of power in polycentric environmental governance. <i>Global Environmental Change</i>, 57. doi:10.1016/j.gloenvcha.2019.101934</p>	
Objectives	4	<p>Our aim is to provide an overview of power theories used in the broader environmental governance literature and consider to what extent these occur in water governance scholarship specifically, i.e., to examine 'how power matters (Morrison et al., 2019, p. 5). We focus on collaboration and learning as these are two deliberative processes that represent hallmarks of adaptive water governance.</p> <p><i>References</i></p> <p>Morrison, T. H., Adger, W. N., Brown, K., Lemos, M. C., Huitema, D., Phelps, J., . . . Hughes, T. P. (2019). The black box of power in polycentric environmental governance. <i>Global Environmental Change</i>, 57. doi:10.1016/j.gloenvcha.2019.101934</p>	p. 3

Section and Topic	Item #	Checklist item	Location where item is reported		
METHODS					
Eligibility criteria	5		Dataset 1	Dataset 2	p. 5
		Application of theory	The paper uses power theory as a framework to guide the study	The paper builds theory as a result of data collection; or builds theory based on researchers' experience; or builds theory by purely conceptual work	
		Type of source	The power theory that is applied is referenced by its primary source; primary source means work that is a model or framework which mentions power in its title; work that coined a term or distinct perspective on power; or named a type of power or established a categorisation of power	The power theory that is applied is not referenced by its primary source / instead secondary sources might be used; and/ or Papers do not or only marginally engage with established power theory	
		Level of theory discussion	Theory is discussed	A brief mention of power theory without discussion; or no mention of power theory	
Information sources	6	The Web of Science Core Collection and the ProQuest Political Science Database were used since they are popular venues for environmental and water governance research. Searches were conducted on August 26, 2020, and August 29, 2020.		p. 4	
Search strategy	7	The search was run for abstracts only, targeting research focusing on power theory and learning and/ or collaboration in the environmental governance and water governance literature. This was operationalised by using four separate search strings in both databases. Individual search strings and search results are presented in the Supplementary material. Filters were used to limit searches to scholarly articles in the English language. To capture the full extent of power-related research in the field, work from all years and both empirical and conceptual works were included. In total, we retrieved 409 search results (179 with learning focus; 230 with collaboration focus). After eliminating duplications, 332 papers were reviewed.		p. 4	
Selection process	8	The first phase of the selection process was to screen all search results by reading titles and abstracts. Figure 1 depicts all phases and the individual number of papers that were excluded at each phase. Articles that were off-topic (e.g., a focus on wind power) were eliminated from the results list. The second phase involved scanning the full text of the 110 papers (that were identified as relevant in phase one) for their level of engagement with power. If the full text review revealed that the paper was irrelevant for our purpose, it was excluded. For example, some papers mentioned the relevance of power to their case in the abstract, but when scanning the full text, it became clear that the research did not focus on power. If a paper's relevance was confirmed in this phase, the paper went to phase three. The criteria at phase three were: 1) a clearly stated power theory included; 2) a brief discussion of the power theory from which they approached their research (e.g., a statement like 'Many theories on power exist and are highly contested like Foucault, Giddens, Lukes' was insufficient for inclusion); and, 3) the power theory needs to be supported by a reference. Phase three split the data into two datasets based on the power theoretical framings. Papers that used power theory as a framework to guide their inquiry and fulfilled all three criteria, were assigned to dataset I. Papers that lacked a power theoretical framework to guide their inquiry but examined power dynamics were assigned to dataset II. The criteria used to make these distinctions are displayed in Table 1. Where a reviewer was unable to clearly decide in which dataset a paper fit, a second reviewer was consulted. The second reviewer was randomly allocated between the research team of three with intention of fair workload distribution. The second review (i.e., phase		p. 4	

Section and Topic	Item #	Checklist item	Location where item is reported
		four) consisted of reviewing 48 pertinent papers. Papers could still be discarded at this stage, if the thorough analysis of the paper revealed a poor quality of the research design and/ or poor explanation of methodology/ methods (e.g., lack of operationalisation of power). In such instances, papers did no longer have relevance to our study. In four cases, the final decision about the papers' inclusion (dataset I, dataset II or discarded) had to be made by a third reviewer. The reason(s) for a reviewer's indecisiveness was not shared with subsequent reviewers in an effort to minimize bias on the next reviewer's decision-making.	
Data collection process	9	The papers of dataset I (i.e., papers that used power theories) were divided up between all three investigators and dataset II (i.e., papers that discussed power dynamics but were not grounded in power theories) was divided up between two of the investigators. A shared online spreadsheet was used to document data. If one of the investigators was not able to identify certain data items, this would be indicated in the spreadsheet and trigger a second team member to investigate. We discussed concerns and documented our justification for decisions in the spreadsheet, via email or in team meetings. Initially, we worked with a combination of verbatim text from publications and key notes to document data, but decided to use only direct quotations to reflect original intent and reduce interpretation bias. We used a shared online folder to store and exchange materials.	p. 5
Data items	10a	The searches gave 321 results from the Web of Science Core Collection and 88 results from the ProQuest Political Science database. In total, we retrieved 409 search results (179 with learning focus; 230 with collaboration focus). After eliminating duplications, 332 papers were reviewed.	p. 4
	10b	N/A	
Study risk of bias assessment	11	The PRISMA systematic review method identified bias assessment, effect measures and evidence uncertainty as criteria for the inclusion or exclusion of works. Due to the focus of our review (power theory utilization) we believe that bias is not relevant to the review, as we do not analyse the results. Rather, we were interested in how researchers approach the topic of power from a theoretical perspective and bias does not factor into this focus. The same applies for effect measures and evidence uncertainty. Since we did not analyse or synthesise the results that are presented in the literature, we refrained from addressing effect measures and evidence certainty.	p. 5
Effect measures	12	See item #11	
Synthesis methods	13a	The first synthesis tended to each paper's focus area, identifying where within governance the authors located power. This was done by examining the individual aims of the papers. If a paper did not specifically state its aim, we interpreted the focus by context. This synthesis used dataset I, as a first step, to establish main focus areas that scholars concentrated on when studying power in water governance and environmental governance by engaging with power theory. Here, we used an inductive coding approach (Williams et al. 2019) that produced pilot focus categories. In a second step, we then applied a deductive coding approach to dataset II by using the pilot focus categories. In instances where none of the pilot categories appeared suitable, focus categories (italicized in text) were revised and extended so they became representative for all papers in both datasets.	p. 5f.

Section and Topic	Item #	Checklist item	Location where item is reported
		<p>The second synthesis identified specific variables that were used to study power. Given the wide variety of study designs in the dataset, we defined the term 'variable' broadly to mean a measure, indicator or element that researchers used to study power. This broad definition allowed us to gather the operational toolkits of all studies regardless of their design differences. We used a slightly different approach as we had for the focus categories. First, dataset I was coded inductively to generate variable categories (italicized in text) that were then applied to dataset II through a deductive coding process. Since the pilot variable categories did not capture the full range of variables in dataset II, we shifted to an inductive coding process for dataset II to allow additional categories to emerge. This additional step was necessary as some differences in variable types used in dataset I and dataset II started to show (see findings and discussion). Even though reframing of pilot categories was sufficient for the development of focus categories, it had proven insufficient for the development of variable categories which had to be representative for 142 variables across both datasets. These variable categories were then applied to both datasets in a final round of deductive coding. We used verbatim ('in vivo') codes (Saldaña 2015) as much as possible when listing the variables to reduce interpretation bias. Some variables present in the datasets fit into more than one variable category. In these cases, the three reviewers discussed the options until we agreed on a category that fit best.</p> <p><i>References</i></p> <p>Saldaña, J. (2015). The coding manual for qualitative researchers (3rd Ed.). SAGE Publications, London, England.</p>	
	13b	N/A	
	13c	N/A	
	13d	Refer to 13a.	
	13e	N/A	
	13f	N/A	
Reporting bias assessment	14	Papers were discarded, if the thorough analysis of the paper revealed a poor quality of the research design and/ or poor explanation of methodology/ methods (e.g., lack of operationalisation of power). In such instances, papers did no longer have relevance to our study. In four cases, the final decision about the papers' inclusion (dataset I, dataset II or discarded) had to be made by a third reviewer. The reason(s) for a reviewer's indecisiveness was not shared with subsequent reviewers to minimize bias on the next reviewer's decision-making.	p. 4
Certainty assessment	15	See item #11	
RESULTS			

Section and Topic	Item #	Checklist item	Location where item is reported
Study selection	16a	<pre> graph TD P1["PHASE 1 Screen title and abstract 332 papers"] -- eligible --> P2["PHASE 2 Skim read full text 110 papers"] P1 -- not eligible --> E["Exclude from study"] P2 -- eligible --> P3["PHASE 3 Assess if power theory is used or not (1st reviewer) 77 papers"] P2 -- not eligible --> E P3 -- eligible --> D1["Dataset I 31 papers"] P3 -- theory is not used --> D2["Dataset II 24 papers"] P3 -- uncertain --> P4["PHASE 4 Assess if power theory is used or not (2nd reviewer) 48 papers"] P4 -- theory is used --> D1 P4 -- theory is not used --> D2 P4 -- uncertain --> P5["PHASE 5 Assess if power theory is used or not (3rd reviewer) 4 papers"] P5 -- theory is used --> D1 P5 -- theory is not used --> D2 </pre> <p>The flowchart illustrates the study selection process. It begins with Phase 1 (332 papers) where titles and abstracts are screened. Papers not eligible are excluded. Eligible papers (110) move to Phase 2 (skim read full text). Papers not eligible are excluded. Eligible papers (77) move to Phase 3 (assess if power theory is used by the 1st reviewer). Papers where theory is used go to Dataset I (31 papers). Papers where theory is not used go to Dataset II (24 papers). Uncertain papers (48) move to Phase 4 (assess if power theory is used by the 2nd reviewer). Papers where theory is used go to Dataset I (31 papers). Papers where theory is not used go to Dataset II (24 papers). Uncertain papers (4) move to Phase 5 (assess if power theory is used by the 3rd reviewer). Papers where theory is used go to Dataset I (31 papers). Papers where theory is not used go to Dataset II (24 papers).</p>	p. 5
16b		References of papers that were discarded and reason:	

Section and Topic	Item #	Checklist item	Location where item is reported
		<p>Pirsoul, N., & Armoudian, M. (2019). Deliberative Democracy and Water Management in New Zealand: a Critical Approach to Collaborative Governance and Co-Management Initiatives. <i>Water Resources Management</i>, 33. doi:10.1007/s11269-019-02400-x Reason: Indirect focus on power</p> <p>Raisiene, A., & Skulskis, V. (2018). Collaboration Turn: towards understanding stakeholder empowerment for agrarian policy making. <i>Public Policy Administration</i>, 17, 177-191. doi:10.13165/vpa-18-17-2-02 Reason: Minimal engagement with power</p> <p>Sullivan, A., White, D. D., & Hanemann, M. (2019). Designing collaborative governance: Insights from the drought contingency planning process for the lower Colorado River basin. <i>Environmental Science & Policy</i>, 91, 39-49. doi:https://doi.org/10.1016/j.envsci.2018.10.011 Reason: Operationalisation of selected criteria unclear</p>	
Study characteristics	17	<p>References of papers that were included in dataset I</p> <p>Arnold, J. S., Koro-Ljungberg, M., & Bartels, W.-L. (2012). Power and Conflict in Adaptive Management: Analyzing the Discourse of Riparian Management on Public Lands. <i>Ecology and Society</i>, 17(1), 19. doi:10.5751/ES-04636-170119</p> <p>Baltutis, W. J., Moore, M.-L., & Tyler, S. (2018). Getting to ecosystem-based function: Exploring the power to influence Columbia River Treaty modernization towards ecosystem considerations.</p> <p>Barbedo, J., Miguez, M., van der Horst, D., Carneiro, P., Amis, P., & Ioris, A. (2015). Policy dimensions of land-use change in peri-urban floodplains: the case of Paraty. <i>Ecology and Society</i>, 20(1), 5. doi:10.5751/ES-07126-200105</p> <p>Barnaud, C., van Paassen, A., Trébuil, G., Promburom, T., & Bousquet, F. (2010). Dealing with Power Games in a Companion Modelling Process: Lessons from Community Water Management in Thailand Highlands. <i>The journal of agricultural education and extension</i>, 16(1), 55-74. doi:10.1080/13892240903533152</p> <p>Bréthaut, C., Gallagher, L., Dalton, J., & Allouche, J. (2019). Power dynamics and integration in the water-energy-food nexus: Learning lessons for transdisciplinary research in Cambodia. <i>Environmental science & policy</i>, 94, 153-162. doi:10.1016/j.envsci.2019.01.010</p> <p>Brisbois, M. C., & de Loë, R. C. (2017). Natural resource industry involvement in collaboration for water governance: influence on processes and outcomes in Canada. <i>Journal of Environmental Planning and Management</i>, 60(5), 883-900. doi:10.1080/09640568.2016.1182899</p> <p>Brisbois, M. C., Morris, M., & de Loë, R. (2019). Augmenting the IAD framework to reveal power in collaborative governance – An illustrative application to resource industry dominated processes. <i>World development</i>, 120, 159-168. doi:10.1016/j.worlddev.2018.02.017</p> <p>Campbell, L. K. (2016). Getting farming on the agenda: Planning, policymaking, and governance practices of urban agriculture in New York City. <i>Urban forestry & urban greening</i>, 19, 295-305. doi:10.1016/j.ufug.2016.03.011</p>	

Section and Topic	Item #	Checklist item	Location where item is reported
		<p>Cook, J. J. (2015). Who's Pulling the Fracking Strings? Power, collaboration and Colorado fracking policy. <i>Environmental Policy and Governance</i>, 25(6), 373-385. doi:10.1002/eet.1680</p> <p>Corson, C., Campbell, L. M., & MacDonald, K. I. (2014). Capturing the Personal in Politics: Ethnographies of Global Environmental Governance. <i>Global Environmental Politics</i>, 14(3), 21-40. doi:10.1162/GLEP_a_00237</p> <p>Corson, C., Gruby, R., Witter, R., Hagerman, S., Suarez, D., Greenberg, S., . . . Campbell, L. (2014). Everyone's Solution? Defining and Redefining Protected Areas at the Convention on Biological Diversity. <i>Conservation and society</i>, 12(2), 190-202. doi:10.4103/0972-4923.138421</p> <p>Dare, M., & Daniell, K. A. (2017). Australian water governance in the global context: understanding the benefits of localism. <i>Policy studies</i>, 38(5), 462-481. doi:10.1080/01442872.2016.1188908</p> <p>Davies, K. K., Fisher, K. T., Dickson, M. E., Thrush, S. F., & Le Heron, R. (2015). Improving ecosystem service frameworks to address wicked problems. <i>Ecology and Society</i>, 20(2), 37. doi:10.5751/ES-07581-200237</p> <p>Dengler, M. (2007). Spaces of power for action: Governance of the Everglades Restudy process (1992–2000). <i>Political geography</i>, 26(4), 423-454. doi:10.1016/j.polgeo.2006.12.004</p> <p>Dewulf, A. R. P. J., & Elbers, W. (2018). Power in and over Cross-Sector Partnerships: Actor Strategies for Shaping Collective Decisions. <i>Administrative sciences</i>, 8(3), 43. doi:10.3390/admsci8030043</p> <p>Förster, J. J., Downsborough, L., & Chomba, M. J. (2017). When Policy Hits Practice: Structure, Agency, and Power in South African Water Governance. <i>Society & Natural Resources</i>, 30(4), 521-536. doi:10.1080/08941920.2016.1268658</p> <p>Gailing, L., & Röhring, A. (2016). Is it all about collaborative governance? Alternative ways of understanding the success of energy regions. <i>Utilities policy</i>, 41, 237-245. doi:10.1016/j.jup.2016.02.009</p> <p>Kasymov, U., & Zikos, D. (2017). Understanding Human Actions and Institutional Change: What Are the Impacts of Power Asymmetries on Efficiency in Pasture Use? <i>Resources (Basel)</i>, 6(4), 71. doi:10.3390/resources6040071</p> <p>Kenter, J. O., Reed, M. S., & Fazey, I. (2016). The Deliberative Value Formation model. <i>Ecosystem services</i>, 21, 194-207. doi:10.1016/j.ecoser.2016.09.015</p> <p>May, C. K. (2013). Power across scales and levels of fisheries governance: Explaining the active non-participation of fishers in Two Rivers, North Carolina. <i>Journal of rural studies</i>, 32, 26-37. doi:10.1016/j.jrurstud.2013.04.002</p> <p>May, C. K. (2015). Politics of visibility: competing for legitimacy in North Carolina fisheries governance. <i>Environment and planning. C, Government & policy</i>, 33(6), 1484-1500. doi:10.1177/0263774X15614180</p> <p>May, C. K. (2016). Visibility and Invisibility: Structural, Differential, and Embedded Power in Collaborative Governance of Fisheries. <i>Society & Natural Resources</i>, 29(7), 759-774. doi:10.1080/08941920.2015.1072257</p>	

Section and Topic	Item #	Checklist item	Location where item is reported
		<p>O'Riordan, M., McDonagh, J., & Mahon, M. (2019). Unlikely alliances? Knowledge, power and the collaborative governance of Irish peatlands. <i>Geoforum</i>, 100, 188-198. doi:10.1016/j.geoforum.2019.01.010</p> <p>Purdy, J. M. (2012). A Framework for Assessing Power in Collaborative Governance Processes. <i>Public administration review</i>, 72(3), 409-417. doi:10.1111/j.1540-6210.2011.02525.x</p> <p>Ran, B., & Qi, H. (2018). Contingencies of Power Sharing in Collaborative Governance. <i>American review of public administration</i>, 48(8), 836-851. doi:10.1177/0275074017745355</p> <p>Ran, B., & Qi, H. (2019). The Entangled Twins: Power and Trust in Collaborative Governance. <i>Administration & society</i>, 51(4), 607-636. doi:10.1177/0095399718801000</p> <p>Roldán, A. M. (2017). Political Regime and Learning Outcomes of Stakeholder Participation: Cross-National Study of 81 Biosphere Reserves. <i>Sustainability</i>, 9(4). doi:10.3390/su9040553</p> <p>Valve, H., Kaljonen, M., Kauppila, P., & Kauppila, J. (2017). Power and the material arrangements of a river basin management plan: the case of the Archipelago Sea. <i>European planning studies</i>, 25(9), 1615-1632. doi:10.1080/09654313.2017.1308470</p> <p>Wald, D. M., Segal, E. A., Johnston, E. W., & Vinze, A. (2017). Understanding the influence of power and empathic perspective-taking on collaborative natural resource management. <i>Journal of environmental management</i>, 199, 201-210. doi:10.1016/j.jenvman.2017.05.030</p> <p>Whaley, L., & Weatherhead, E. K. (2014). An Integrated Approach to Analyzing (Adaptive) Comanagement Using the "Politicized" IAD Framework. <i>Ecology and Society</i>, 19(1), 10. doi:10.5751/ES-06177-190110</p> <p>York, A. M., & Schoon, M. L. (2011). Collaboration in the shadow of the wall: shifting power in the borderlands. <i>Policy sciences</i>, 44(4), 345-365. doi:10.1007/s11077-011-9138-2</p> <p>References of papers that were included in dataset II</p> <p>Allan, C. (2012). Rethinking the 'Project': Bridging the Polarized Discourses in IWRM. <i>Journal of Environmental Policy & Planning</i>, 14(3), 231-241. doi:10.1080/1523908X.2012.702012</p>	

Section and Topic	Item #	Checklist item	Location where item is reported
		Andonova, L. B. (2013). Boomerangs to Partnerships? Explaining State Participation in Transnational Partnerships for Sustainability. <i>Comparative Political Studies</i> , 47(3), 481-515. doi:10.1177/0010414013509579	
		Ansell, C., & Gash, A. (2008). Collaborative Governance in Theory and Practice. <i>Journal of Public Administration Research and Theory</i> , 18(4), 543-561. doi:10.1093/jopart/mum032	
		Bakker, K., & Morinville, C. (2013). The governance dimensions of water security: a review. <i>Philosophical Transactions of the Royal Society a-Mathematical Physical and Engineering Sciences</i> , 371(2002). doi:10.1098/rsta.2013.0116	
		Canfield, M. C. (2018). Disputing the Global Land Grab: Claiming Rights and Making Markets Through Collaborative Governance. <i>Law & Society Review</i> , 52(4), 994-1025. doi:https://doi.org/10.1111/lasr.12367	
		Cetinkaya Ciftcioglu, G. (2019). Evaluating resilience for the management of social–ecological production landscapes and seascapes in Lefke Region, North Cyprus through adaptive comanagement. <i>Sustainability Science</i> , 14. doi:10.1007/s11625-018-0608-8	
		Hadjimichael, M., & Delaney, A. E. (2017). Forming perceptions and the limits to public participation on ocean commons: evidence from a citizens' workshop. <i>International Journal of the Commons</i> , 11(1), 200–219. https://www.jstor.org/stable/26522913	
		Hill, R., Davies, J., Bohnet, I. C., Robinson, C. J., Maclean, K., & Pert, P. L. (2015). Collaboration mobilises institutions with scale-dependent comparative advantage in landscape-scale biodiversity conservation. <i>Environmental Science & Policy</i> , 51, 267-277. doi:https://doi.org/10.1016/j.envsci.2015.04.014	
		Hill, R., Grant, C., George, M., Robinson, C. J., Jackson, S., & Abel, N. (2012). A Typology of Indigenous Engagement in Australian Environmental Management: Implications for Knowledge Integration and Social-ecological System Sustainability. <i>Ecology and Society</i> , 17(1). doi:10.5755/04587-170123	
		Horcea-Milcu, A.-I., Leventon, J., Hanspach, J., & Fischer, J. (2016). Disaggregated contributions of ecosystem services to human well-being: a case study from Eastern Europe. <i>Regional Environmental Change</i> , 16(6), 1779-1791. doi:10.1007/s10113-016-0926-2	
		Levesque, V. R., Calhoun, A. J. K., Bell, K. P., & Johnson, T. R. (2017). Turning Contention into Collaboration: Engaging Power, Trust, and Learning in Collaborative Networks. <i>Society & Natural Resources</i> , 30(2), 245-260. doi:10.1080/08941920.2016.1180726	
		McDougall, C., Leeuwis, C., Bhattarai, T., Maharjan, M., & Jiggins, J. (2013). Engaging women and the poor: adaptive collaborative governance of community forests in Nepal. <i>Agriculture and Human Values</i> , Springer. The Agriculture, Food, & Human Values Society (AFHVS), 30(4), 511-524.	
		McNeill, J. (2016). Scale Implications of Integrated Water Resource Management Politics: Lessons from New Zealand. <i>Environmental Policy and Governance</i> , 26(4), 306-319. doi:https://doi.org/10.1002/eet.1719	
		Morrison, T. H., Adger, W. N., Brown, K., Lemos, M. C., Huitema, D., Phelps, J., . . . Hughes, T. P. (2019). The black box of power in polycentric environmental governance. <i>Global Environmental Change</i> , 57, 101934. doi:https://doi.org/10.1016/j.gloenvcha.2019.101934	

Section and Topic	Item #	Checklist item	Location where item is reported
		<p>Muñoz-Erickson, T. A., Cutts, B. B., Larson, E. K., Darby, K. J., Neff, M., Wutich, A., & Bolin, B. (2010). Spanning Boundaries in an Arizona Waters Partnership: Information Networks as Tools for Entrenchment or Ties for Collaboration? <i>Ecology and Society</i>, 15(3). Retrieved from http://www.jstor.org/stable/26268166</p> <p>Pfisterer, S., & Van Tulder, R. (2021). Governing partnerships for development in post-conflict settings: Evidence from a longitudinal case study in Colombia. <i>Business Ethics, the Environment & Responsibility</i>, 30(S1), 44-60. doi:https://doi.org/10.1111/beer.12278</p> <p>Quaghebeur, K., Masschelein, J., & Nguyen, H. H. (2004). Paradox of participation: Giving or taking part? <i>Journal of Community & Applied Social Psychology</i>, 14, 154-165. doi:10.1002/casp.776</p> <p>Sovacool, B. K., Tan-Mullins, M., Ockwell, D., & Newell, P. (2017). Political economy, poverty, and polycentrism in the Global Environment Facility/Developed Countries Fund (LDCF) for Climate Change Adaptation. <i>Third world quarterly</i>, 38(6), 1249-1271. doi:10.1080/01436597.2017.1282816</p> <p>Suiseeya, K. R. M., & Zanotti, L. (2019). Making influence visible: Innovating ethnography at the paris climate summit. <i>Global Environmental Politics</i>, 19(2), 38-60. doi: https://doi.org/10.1162/glep_a_00507</p> <p>Viana, C., Coudel, E., Barlow, J., Ferreira, J., Gardner, T., & Parry, L. (2016). How Does Hybrid Governance Emerge? Role of the elite in building a Green Municipality in the Eastern Brazilian Amazon. <i>Environmental Policy and Governance</i>, 26(5), 337-350. doi:https://doi.org/10.1002/epe.1978</p> <p>Voß, J., & Bornemann, B. (2011). The politics of reflexive governance: challenges for designing adaptive management and transition management. <i>Ecology and Society</i>, 16(9). Retrieved from http://www.ecologyandsociety.org/vol16/iss2/art9/</p> <p>Waalewijn, P., Wester, P., & Straaten, K. (2005). Transforming River Basin Management in South Africa – Lessons From the Lower Komati River. <i>Water International</i>, 30, 184-196. doi:10.1080/02508060508691859</p> <p>Watson, A. (2013). Misunderstanding the “nature” of co-management: a geography of regulatory science and indigenous knowledges (IK). <i>Environment and Planning A</i>, 45(5), 1085-1102. doi:10.1007/s00267-013-0111-z</p> <p>Westskog, H., Amundsen, H., Christiansen, P., & Tønnesen, A. (2020). Urban contractual agreements as an adaptive governance strategy: under what conditions do they work in multi-level cooperation? <i>Journal of Environmental Policy & Planning</i>, 22(4), 554-567. doi:10.1080/1523908X.2020.1784115</p> <p>Wyborn, C. (2014). Co-productive governance: A relational framework for adaptive governance. <i>Global Environmental Change</i>, 30, 1-12. doi:10.1016/j.gloenvcha.2014.10.009</p>	
Risk of bias in studies	18	See item #11	
Results of	19	N/A	

Section and Topic	Item #	Checklist item	Location where item is reported
individual studies			
Results of syntheses	20a	<ol style="list-style-type: none"> 1) Our review found that 31 of all 55 papers engaged with established power theory (dataset I). The remaining 24 papers did not use an explicit theoretical foundation for their research and were grouped into dataset II. Additionally, to the lack of engagement with power theory, 16 of n=24 papers did not provide a definition of power for the purpose of their work. Only five of n=24 papers offered a power definition, and another three of n=24 made a reference to what the authors understand as power without providing a clear definition. 2) We found that 25 of all papers (n=55) focused on power in Governance structure and features which is even more pronounced in dataset II in which 17 of n=24 papers directed their attention to Governance structure and features. Almost 16 of n=55 papers analysed power by studying the Relationship between governance process and outcomes, making this the second most common focus across both datasets. The third most common focus was on power in Discourses and knowledge with 14 of n=55 papers tending to this area which includes 9 papers from dataset II (n=24). 3) In the water governance-specific literature, the Relationship between governance process and outcomes was the focus of four of n=10 papers and the most common focus area. Water governance-specific papers (n=10) that focused on Governance structure and features and the power dynamics in Stakeholder relationships and interaction were found equally common with three of n=10 papers for each category. None of the water governance papers exclusively directed the focus of their inquiry on Discourse and knowledge, which corresponds to the fact that Foucault's power theory was not identified as an applied theory among the water governance-specific papers. 	p. 6f.
	20b	N/A	
	20c	N/A	
	20d	N/A	
Reporting biases	21	See item #14	
Certainty of evidence	22	See item #11	
DISCUSSION			
Discussion	23a	<p>Our findings based on our research questions are grouped into four areas for the purpose of clarity. First, we sought to understand how the reviewed research engaged with established power theory. What we found is that researchers that worked with established power theory (dataset I) more often focused on power Instruments and strategies and Stakeholder action and inaction (decision or non-decision), whereas power researchers that worked without using established power theory (dataset II) rarely investigated power in these areas. Other focus areas were addressed relatively equally between the two groups, such as Governance structures and features and Discourse and knowledge.</p> <p>Second, this review shows that some approaches to operationalising power rely on established power theory and others on developing field-specific theory. As described in the method section, to develop the variable categories (see Supplementary Table 3) we inductively coded both datasets, since using pilot categories from dataset I to deductively code dataset II, proved insufficient. This, in addition to the fact that we only identified 12 out of 142 variables to be present in both datasets, suggests some degree of dissimilarity regarding operationalisation between</p>	p. 10f.

Section and Topic	Item #	Checklist item	Location where item is reported
		<p>dataset I and dataset II as displayed in Figure 6. Noteworthy is that variables which were categorised as Agent attributes, Knowledge, Resources and non-materialistic resources as well as Discourses, language, and dominant themes were only present in dataset I. Conversely, variables which were grouped Agent purpose and intent as well as Rules and legitimacy were identified nearly entirely from dataset II. However, it should be noted here that some variables listed could be considered the same or similar (e.g., 'aspiration', 'goal', 'motivation') but were kept separately to preserve the authors' original intent. The fact that similar variables were kept separately could amplify the effect that both datasets appear dissimilar. There were no obvious advantages to either approach, and we therefore consider both approaches — of using broader, established, power theory and of drawing upon developing, topic-specific power theory — to have relative strengths. Despite some differences in conceptualizing research, there was more similarity between the datasets in relation to methodology – variation existed but was less substantive.</p> <p>Third, we identified a lack of attention on power dynamics in Stakeholder relationships and interactions, as well as Stakeholder action and inaction, across the power-related literature on environmental and water governance, particularly in conceptual papers. Although collaboration and learning defined our literature review and these are key concepts of AWG, the conceptual development of theories did not focus on power dynamics in Stakeholder relationships and interactions, nor on Stakeholder action and in-action (decision and non-decision). We recognise that power can influence collaboration and learning in manifold ways. At the same time, we argue that power considerations around Stakeholder relationships and interactions as well as Stakeholder action and inaction (decision and non-decision) should serve as a foundation for understanding collaboration and learning in water or environmental governance (Keen et al. 2006, Mostert et al. 2007, Brisbois and de Loë 2016). We consider it important to integrate these power dynamics into governance considerations in AWG to more authentically reflect ways in which power impacts collaboration and learning.</p> <p>Fourth, we found that power dynamics in Discourses and knowledge are still a potential blind spot in water governance. Although some attention is paid to Discourse and knowledge (Brisbois et al. 2017, Brisbois et al. 2019), the review suggests that we still have only a limited understanding on how discourses shape collaboration and social learning in AWG. The environmental literature offers here examples for theoretical approaches and study designs. Additionally, the scholarship on power in environmental governance provides a great selection of power variables and options to operationalise power which are highly suitable to advance power research in AWG.</p> <p><i>References</i></p> <p>Brisbois, M. C., & de Loë, R. C. (2016). Power in Collaborative Approaches to Governance for Water: A Systematic Review. <i>Society & Natural Resources</i>, 29(7), 775-790. doi:10.1080/08941920.2015.1080339</p> <p>Brisbois, M. C., & de Loë, R. C. (2017). Natural resource industry involvement in collaboration for water governance: influence on processes and outcomes in Canada. <i>Journal of Environmental Planning and Management</i>, 60(5), 883-900. doi:10.1080/09640568.2016.1182899</p> <p>Brisbois, M. C., Morris, M., & de Loë, R. (2019). Augmenting the IAD framework to reveal power in collaborative governance – An illustrative application to resource industry dominated processes. <i>World development</i>, 120, 159-168. doi:10.1016/j.worlddev.2018.02.017</p> <p>Keen, M., & Mahanty, S. (2006). Learning in Sustainable Natural Resource Management: Challenges and Opportunities in the Pacific. <i>Society & Natural Resources</i>, 19(6), 497-513. doi:10.1080/08941920600663896</p>	

Section and Topic	Item #	Checklist item	Location where item is reported
		Mostert, E., Pahl-wostl, C., Rees, Y., Searle, B., Tàbara, D., & Tippett, J. (2007). Social Learning in European River-Basin Management : Barriers and Fostering Mechanisms from 10 River Basins. <i>Ecology and Society</i> , 12(1).	
	23b	<p>We observed that papers that did not engage with established power theory (dataset II) also rarely provided a clear definition of power for the purpose of their study. The absence of power definitions could hint at the difficulty to grapple with the concept of power, given its complexity and the manifold conceptualisations that exist. However, a lack of definition reduces the ability to operationalise power and hence, compromises the study of power. We see here great potential for further research that focusses on suitable power definitions for different focus areas within environmental and (adaptive) water governance.</p> <p>In the water governance specific literature, none of the ten papers used Foucault's power theories which coincides with a lack of focus on Discourse on knowledge in the water literature. Although this leads us to argue that there is more potential to engage with Foucault as one of the most influential power theorists in the 20th century, we also appreciate that this identified gap could also be a result of our specific search terms which narrowed the scope to literature related to learning and collaboration.</p>	p. 11
	23c	<p>First, we focused specifically on learning and collaboration in the review. We identified these deliberative processes as key characteristics, or hallmarks, of AWG (but not specific to it). As a result of this focus, power studies that did not have an explicit reference to some form of the terms 'collaboration' or 'learning' were excluded and are not accounted for here. Further, our search terms focused on explicit use of the term 'power' and this may have excluded sources where power and/or power theory was used but more implicitly described. Another search decision made was to strictly follow the search strings to distinguish between water governance and broader environmental governance papers. Although this strategy proved helpful to analyse whether these fields were actually distinct in how they used power theory, there were cases in which papers that could have been attributed to the water governance literature were not picked up in the water-related search but were instead part of the environmental search results. Additionally, our focus on scholarly literature may have excluded relevant work published outside of academic journals. Finally, while we made a strong effort to define what constitutes an 'established power theory', our definition may not have aligned exactly with how others might define it. All of these scoping decisions for the systematic literature review have implications on the literature that was included. At the same time, we acknowledge that this has led to the potential exclusion of other relevant works in the power field, like Boonstra (2016) who conceptualized power to study social-ecological interactions or Morrison and colleagues (2017) who studied the effectiveness of different types of powers (pragmatic, framing and power by design) in polycentric systems.</p>	p. 11
	23d	<p>Future research related to topics like governance instruments and strategies would also be well-served to draw on the established power theories. Finally, there is room – and need – for water governance researchers to develop field-specific power theory for other topics identified by this study. To aid scholars in applying established power theories, we have compiled a list of established power theories being employed in environmental and water governance in relation to collaboration and learning (Table 2). Overall, we anticipate that these findings may be a valuable resource in support of AWG research that more strongly engages in power theory. We urge researchers to use these resources to advance AWG research on power, particularly by leveraging power theory resources identified from this review to support specific research foci and to address gaps in field-specific power theory. We further suggest that a critical analysis of the established and emerging power theories identified in this review would be a constructive next step to further support power research in AWG and environmental governance more broadly.</p>	p. 12f.

Section and Topic	Item #	Checklist item	Location where item is reported
OTHER INFORMATION			
Registration and protocol	24a	N/A	
	24b	Protocol was not prepared	
	24c	N/A	
Support	25	LM's work is jointly funded by The University of the Sunshine Coast, Australia and the Brock University, Canada. JB's participation is supported in part by the Canada Research Chairs program. We acknowledge the support of the Natural Sciences and Engineering Research Council of Canada (NSERC), [funding reference number NSERC NETGP 523374-18], which supported JH's participation in the project. Cette recherche a été financée par le Conseil de recherches en sciences naturelles et en génie du Canada (CRSNG), [numéro de référence NSERC NETGP 523374-18].	
Competing interests	26	No conflicts of interest to declare.	
Availability of data, code and other materials	27	All data and protocols are available herein.	

The Template was prepared from: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372:n71. doi: 10.1136/bmj.n71

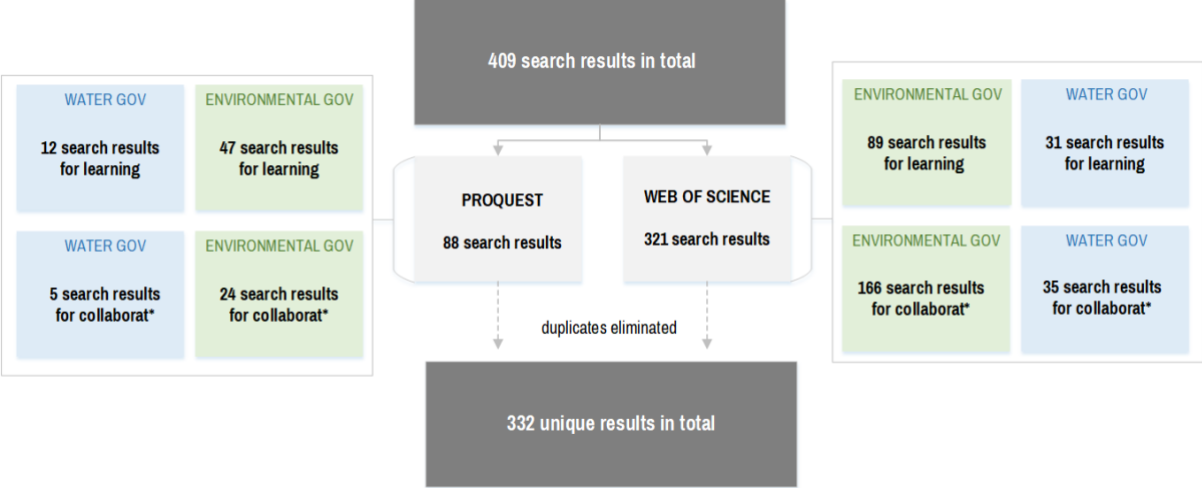
For more information, visit: <http://www.prisma-statement.org/>

Appendix 2 Search strings employed for Web of Science Core Collection and ProQuest Political Database

Topical focus	Scholarly field targeted	Search strings
Learning	Water governance	Line 1: power NOT "power generation" AND Line 2: "water governance" OR "water management" OR "integrated catchment management" OR ICM OR "integrated water resource management" OR IWRM AND Line 3: learning
	Environmental governance	Line 1: power NOT "power generation" AND Line 2: "environmental governance" OR "environmental management" OR "natural resource governance" OR "natural resource management" OR "adaptive management" OR "adaptive governance" OR "adaptive co-management" OR "adaptive collaborative management" OR "integrated management" OR "transformative governance" OR "collaborative governance" OR "resilient management" OR "ecological governance" OR "ecological management" OR "ecosystem services" OR "ecosystem management" OR "ecosystem-based management" OR "landscape management" or "landscape ecology" AND Line 3: learning
Collaboration	Water governance	Line 1: power NOT "power generation" AND Line 2: "water governance" OR "water management" OR "integrated catchment management" OR ICM OR "integrated water resource management" OR IWRM AND Line 3: collaborat*
	Environmental governance	Line 1: power NOT "power generation" AND Line 2: "environmental governance" OR "environmental management" OR "natural resource governance" OR "natural resource management" OR "adaptive management" OR "adaptive governance" OR "adaptive co-management" OR "adaptive collaborative management" OR "integrated management" OR "transformative governance" OR "collaborative governance" OR "resilient management" OR "ecological governance" OR "ecological management" OR "ecosystem services" OR "ecosystem

		management" OR "ecosystem-based management" OR "landscape management" or "landscape ecology" AND Line 3: collaborat*
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Appendix 3 Search results for individual search strings



Appendix 4 Focus categories, their description and associated examples, power theories and papers from the review

Where in governance is power located?	Description of category	Examples	Theories associated with the category	Papers from dataset 1 associated with the category
Instruments and strategies	This category locates power in sources, resources, instruments or tools used to exert power; and also, strategies that are used by actors/ stakeholders in pursuit of their interest/ in order to influence the decision in their favour	<ul style="list-style-type: none"> • Instruments of power, e.g., financial resources, energy infrastructure, and availability • Sources of power • Material arrangements as constitutive power • Agenda control to shape the outcome of rule-making process (strategies used by various groups) • Legitimacy through invisibility of the problem • Power shapes invisibility and visibility of problems 	Foucault Laclau, Mouffe Hardy Hardy & Phillips Callon & Law Bachrach & Baratz Mann, Bourdieu, Foucault	Foucault [Gailing & Rohring 2016] Foucault, Laclau; Mouffe [Dewulf & Elbers 2018] Hardy & Phillips [Purdy 2012] Hardy [Dare & Daniell 2017] Callon & Law [Valve et al. 2017] Bachrach & Baratz [Cook 2015] Foucault, Bourdieu; Mann [May 2015] Bourdieu, Foucault [May 2016]
Discourse and knowledge	This category locates power in dominant or suppressed discourses or themes, narratives actors use to frame their agenda; as well as the values, worldviews, belief systems and knowledges that actors/ stakeholders hold	<ul style="list-style-type: none"> • Discursive context • Discursive construction of past and the institutionalisation of associated narratives and practices • Roll-out of visions and plans reveals the way in which narrative concepts and specific proposals were reiterated and legitimized • Social values • How power affects the discourse and the institutional arrangements • Enactment of power/knowledge relations between stakeholders [actors' deep values can manifest as power-knowledge regimes] 	Foucault Gramsci Barnett & Duvall Dahl Bachrach & Baratz Lukes	Foucault [O'Riordan et al. 2019] Foucault [Whaley & Weatherhead 2014] Gramsci [Corson et al. 2014] Barnett & Duvall [Baltutis et al. 2018] Dahl, Bachrach & Baratz [York & Schoon 2011] Lukes [Campbell 2016]

		<ul style="list-style-type: none"> Regulatory institutions contribute (or not) to the legitimization of trends 		
Power dynamics in stakeholder relationships and interaction	This category locates power in the relationship/ relations between different stakeholders or actor groups as well as their interactions with each other, this includes power asymmetries.	<ul style="list-style-type: none"> Enactment of power/knowledge relations between stakeholders Collaboration with powerful industry stakeholders Institutions & relationships between the actors; focus on power effects on discourse & the institutional arrangements Power dynamics Power games in this learning and negotiation process (e.g., inclusion/exclusion of information) Conflict 	Foucault Lukes Arndt Giddens Hardy & Phillips; Giddens Giddens; Boulding	Foucault [Kenter et al. 2016] Lukes [Campbell 2016] Lukes [Brisbois et al. 2017, 2019] Arndt [Barbedo et al. 2015] Giddens [Brethaut et al. 2019] Hardy & Phillips, Giddens [Ran & Qi 2018] Giddens, Boulding [Barnaud et al. 2010]
Governance structure and features	This category locates power in the structure of the governance system; and in the conditions or features of the participatory process or the way they are facilitated.	<ul style="list-style-type: none"> Arenas of power Institutional integration Relationship between sets of conditions and the outcomes of interactions Relationship between power distribution and multi-directional learning (twice) 	Hardy & Phillips Giddens Foucault & Bourdieu Dryzek, Gramsci Fairclough Dahl, Bachrach & Baratz	Hardy & Phillips [Purdy 2012] Giddens [Roldan 2017] Giddens [Dengler 2007] Foucault & Bourdieu [May 2015] Dryzek, Gramsci [Corson et al. 2014] Fairclough [Arnold et al. 2012] Dahl, Bachrach & Baratz [York & Schoon 2011]
Context	This category locates power in external factors that influence actors' decisions like the social, political, and economic context a	<ul style="list-style-type: none"> Political-economic context Use of political space and timing 	Foucault Dryzek; Gramsci	Foucault [Whaley & Weatherhead 2014] [Corson et al. 2014]

	governance system is embedded in.			
Stakeholder action and in-action; decision and non-decision	This category locates power in the ability of stakeholders or stakeholder groups to act independently and to make decisions freely. It also encompasses the ability for purposive in-action and non-decision making	<ul style="list-style-type: none"> • Structural and especially agential factors of power • Power of facilitators, who guided participant interactions • Mobilisation of institutional and productive forms of power • Perspective-taking abilities and collaborative behaviour • Structural and agentic power • Regulatory institutions contribute (or not) to the legitimization of trends (twice) 	Foucault, Bourdieu Giddens, Mann, Bourdieu; Foucault Fiske Barnett & Duvall Rubinstein Giddens	Foucault, Bourdieu [May 2015] Giddens, Mann, Bourdieu [May 2013] Foucault [Wald et al. 2017] Barnett & Duvall [Baltutis et al. 2018] Rubinstein [Kasymov & Zikos 2017] Giddens [Forster 2017]
Relationship between governance process and outcomes	Relationship between governance processes and effectiveness or outcomes of these processes.	<ul style="list-style-type: none"> • Relationship between power and trust • Governance effectiveness and power sharing • Role of deliberative processes and social learning • Relationship between power distribution and multi-directional learning 	Latour Giddens Hardy & Phillips, Giddens Dahl, Bachrach & Baratz Barnett & Duvall Giddens, Boulding Foucault	Davies et al. 2015 Giddens [Ran & Qi 2019] Hardy & Phillips, Giddens [Ran & Qi 2018] Barnett & Duvall [Baltutis et al. 2018] Giddens; Boulding [Barnaud et al. 2010] Foucault [Kenter et al. 2016]

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Appendix 5 All variables identified from dataset I and dataset II combined and synthesised into categories

Variable category	Variable sub-category	Variables (‡ Variable was derived from dataset 1; †Variable was derived from dataset 2; § Variable was derived from water literature)
Agent and its social domain	Purpose and Intent	<ul style="list-style-type: none"> • Intercultural purpose incorporating purposes of environmental management project or program[†] • Purpose of Indigenous engagement[†] • Purpose of Indigenous development[†] • Purpose of capacity building[†] • Expectations[†] • Vision[†] • Motivations guiding collective action[†] • Aspirations of what should be done[†] • Intent[‡] • Goals[†] and trajectories[‡]
	Agent attributes	<ul style="list-style-type: none"> • Perspectives and perceptions^{†, ‡, §} (Perception of problem; perception of other stakeholders and perception on problem solutions)^{‡, §} • Being regarded as an expert in the issue to hand[‡] • Charismatic, or rhetorically gifted[‡] • Political, economic, and social positions[‡] • Preferences[‡] • Stakeholders' gender, race, and age[‡] • Power-sharing experience of participating stakeholder groups[‡] • Political and economic influence[‡]

	Cultural attributes	<ul style="list-style-type: none"> • Resource cultural values[†] • Norms^{†; ‡} • Values^{†; ‡} • Beliefs^{†; ‡§} • World views[‡]
	Knowledge	<ul style="list-style-type: none"> • Privileged access to pertinent knowledge[‡] • Inclusive or exclusive use of knowledge^{‡§} • Forms of knowledge[‡] • Cognitive knowledge[†] • Knowledge frameworks considered legitimate to shape problem definition/solutions[†] • Knowledge asymmetries[†] • Knowledge spaces of the decision-making arena^{‡§}
	Resources and non-materialistic resources	<ul style="list-style-type: none"> • Actors' symbolic and material resources[†] • Resource imbalance^{‡; †§} • Unequal capacities (technical, social, institutional, etc.) to participate^{‡§} • Financial resources^{‡§} (e.g., money) • Physical resources^{‡§} (computer; transport, land) • Social connectedness (degree of organization around issues of water amongst a group of actors)^{‡†§}
Stakeholder interaction	Stakeholder interactions and networks	<ul style="list-style-type: none"> • Stakeholder interactions and ties^{†§} • Stakeholder diversity[†] • Degree of cross-scale social networks[†] • Degree of local social networks[†] • Who instigated collaboration^{†§} • Inclusion or exclusion of important actor groups^{‡§} • Lobbying external to the collaborative process^{‡§} • Existence of elite-level relationships^{‡§} • Coercion^{‡§} • Co-optation^{‡§} • Diversion^{‡§}

		<ul style="list-style-type: none"> • Manipulation^{‡§} • Misinformation^{‡§} • Perceived challenges and opportunities[‡] • Different missions accomplished by collaborative network[‡] • Number of participants with whom an actor has co-attended meetings[†] • Stakeholder and issue correspondence[†] • Information access and exchange^{†§}
	Characteristics of interactions	<ul style="list-style-type: none"> • Face-to-face dialogue[†] • Trust building[†] • Consensus and limits of consensus^{‡§} • Multi-directional learning[‡] • Trust-based power and power-based trust^{‡§} • Certainty with which stakeholders made their claims (relative openness to other perspectives)[‡] • Ways stakeholders referenced or responded to claims made by others[‡]
Governance setting	Rights and control	<ul style="list-style-type: none"> • Formal authority; Authority[‡] • Autonomy to adapt policies and measures to the local context[†] • Property rights[†] • Incorporating decision making level and control[†] • Control over information production and use^{‡§} • Decision-making power residing with, or being retained by which stakeholder group^{‡§}
	Context	<ul style="list-style-type: none"> • Political^{†; ‡§} (e.g., overall political economy of the system[‡]; political regime in place[‡]) • Economic^{†; ‡} • Social[†] • Ecological[†] • Institutional[†] • History^{†; ‡} • Temporality of the disputing process[†] • Local incentive structure (including social, economic, political, and ecological factors) that encourage local action[†] • Ecosystem conditions[†]

		<ul style="list-style-type: none"> • Resource attributes[†] • Forms of technology[‡]
	Organisational form	<ul style="list-style-type: none"> • Organizations engaged[†] • Coordination[†] • Institutional arrangements within a policy domain[†] • Shared responsibility for goal achievement[†] • Incorporating participatory processes and functions[†] • Capacity to implement change and to interact with other governance arenas[†] • Number of participants[‡] • Facilitation or bridging actors who mediate power^{‡§} • Polity[‡] • Mediation (encouraging stakeholder interactions and using a mediation technique to navigate interactions and process)[‡] • Institutional diversity and fragmentation[‡]
	Rules (formal and informal) and legitimacy	<ul style="list-style-type: none"> • Legitimacy^{‡§} • Sanctions[†] • Legislation and policies^{†; ‡§} • Policy salience and effectiveness[‡] • Rules of procedure for a specific governance process[†] • Constitutional rules[†] • Forms and arena of dispute management[†] • Rules definition[†] • Formal and informal rules that shape collective action^{†; ‡} • Boundary rules determining membership[†] • Aggregation rules defining the decision-making process[†] • Position rules defining who can act[†] • Information rules determining how information is shared[†] • Obligatory passage points and factual closures^{‡§}

		<ul style="list-style-type: none"> • Payoff rules[‡] • Societal structures^{‡§} • Regulative rules for establishing a water user association^{‡§} • Court rulings^{‡§} • Institutional environment[‡]
Dominance	Politics	<ul style="list-style-type: none"> • Struggle for dominance among broad social groups, sectors, classes, or regions[†] • Struggle for dominance among participants of a governance process[†] • Struggle of organized political actors for dominant positions within a policy domain[†] • Political culture[†] • Politics of translation, scale, performance, and performativity[†] • The structural bias of capitalism or implications there of^{‡§} • Governments favouring specific interests^{‡§}
	Positioning and brokerage ability	<ul style="list-style-type: none"> • Degree centrality[†] • Network centralization measure[†] • Brokerage scores for each organization[†] • Hegemony of appointing participants[†] • Problem definition or framing^{‡; †§} • Agenda setting or control^{‡; †} • Blocking strategies[‡] • Ability of a stakeholder to survive without an agreement (Bargaining power)[‡] • Cost–benefit calculation of stakeholder groups[‡] • Diffusion of power sources among stakeholder groups[‡]
	Discourses, language, and dominant themes	<ul style="list-style-type: none"> • Policy approaches that are dominant within a policy domain[†] • Discourse of fundamental political values and beliefs[†] • Actors’ strategy of frame transformation[†] • Environmental and social ideologies[†] • Hegemony of problems and commonality[†] • Discourse that gives meaning to the physical and social world[‡]

		<ul style="list-style-type: none"> • Content that is discussed[‡] • Topics that are discussed[‡] • Ideological contours[‡] • Who is, or is not, favoured by the dominant discourse^{‡§} • Efforts to control discourse^{‡§} • Prescription of a ‘language’ of collaboration^{‡§} • Groups self-censoring to participate^{‡§} • Dominant, hegemonic themes or values related to capitalism^{‡§} • Claims stakeholders made about the social-ecological system and their justification[‡] • Used representations, and narratives[‡] • Transformation in discourse[‡]
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Appendix 6

Co-occurrence matrix of methods for data collection from Dataset I.

	Interviews	Surveys	Document analysis	Participant observations	Group discussions/ focus groups	Event ethnography	Participatory modeling
Interviews		1	9	9	4	0	3
Surveys			2	0	0	1	3
Document analysis				7	4	0	2
Participant observations					3	0	2
Group discussions/ focus groups						0	2
Event ethnography							0
Participatory modeling							

Co-occurrence matrix of methods for data collection from Dataset II.

	Interviews	Surveys	Document analysis	Participant observations	Group discussions/ focus groups	Event ethnography	Participatory modeling
Interviews		3	15	16	5	2	4
Surveys			2	1	0	1	3
Document analysis				12	4	2	3
Participant observations					5	3	3
Group discussions/ focus groups						0	3
Event ethnography							0
Participatory modeling							

Appendix 7 List of all qualitative and quantitative approaches used in each dataset, and number of papers that used each

Qualitative approaches	Dataset II	Dataset I
Discourse analysis	2	3
Content analysis	3	6
Thematic analysis	2	4
Pattern analysis	1	0
Text analysis	0	2
Deductive coding	1	0
Coding (not otherwise specified)	0	1
Research team experience analysis	1	0
Interpretative approach	0	1
Collaborative ethnography	1	1
Comparative analysis	1	0
Policy analysis	0	1
Institutional analysis	1	2
Institutional ethnography	0	1
Literature synthesis	1	1
Development / use of framework or model	0	2
Process mapping	1	0
Narrative analysis / history	3	0
Mind mapping	0	1
Q methodology	0	1
Conceptual cluster analysis	2	0
Successive approximation	1	0
Discourse based valuation	0	1
Participatory system modelling	0	1
No information provided	1	0

Quantitative approaches	Dataset II	Dataset I
Consensus scores	1	0
Statistical analysis	2	1
Descriptive statistics	2	0
Social network analyses	3	0
Matrix ranking	2	0
Valuation	0	1
Modeling	0	2